



Australian Government



## COMMUNITY HEALTH AND SAFETY HANDBOOK

*Leading Practice Sustainable Development Program for the Mining Industry*

September 2016



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Leading Practice Sustainable Development Program for the Mining Industry.

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# Contents

ACKNOWLEDGEMENTS	v
FOREWORD	vi
1.0 INTRODUCTION	1
2.0 HEALTH AND SAFETY WITHIN THE MINING LEASE	4
2.1 WHS law for mines in Australia	4
2.1.1 Duty of care	5
2.1.2 Acceptable level of risk	6
2.2 Health and safety for mine workers	7
2.2.1 Chronic and acute health and safety risks	7
2.2.2 Health of workers	10
3.0 HEALTH AND SAFETY IMPACTS OF MINING BEYOND THE MINING LEASE	12
3.1 Legislative framework	12
3.2 Safety	16
3.2.1 Road safety	16
3.2.2 Mine site access	17
3.2.3 Tailings dams	20
3.2.4 Blasting safety	21
3.2.5 Transport of explosives and other hazardous materials	21
3.3 Health	22
3.3.1 Airborne contaminants	22
3.3.2 Waterborne contaminants	24
3.3.3 Noise	30
3.3.4 Light	30
3.3.5 Contamination by hazardous materials	31
3.3.6 The psychosocial hazards of mining on communities	32
<i>Stress and ill-health</i>	35
<i>Place identity</i>	36
<i>A technique for managing community distress</i>	36
<i>Long-distance commute work arrangements</i>	39
<i>Substance abuse</i>	40
3.3.7 Communicable diseases	41
3.3.8 High-risk groups	43
3.3.9 Potential health benefits from mining to the community	43
3.4 Community health and safety impact assessment	43
3.4.1 Community health and safety impact assessment	44
3.5 Management of health and safety impacts	47
3.5.1 Controls and interventions	47
3.5.2 Monitoring	48
4.0 CORPORATE SOCIAL RESPONSIBILITY	49
4.1 Community development in a health and safety context	50
5.0 REFERENCES	52

CASE STUDIES:	
Case Study: The impact of WHS legislation on coal mining safety in Australia	9
Case Study: NSW Health Management Plan	11
Case Study: Hazelwood mine fire	15
Case Study: The Light Vehicle Project—a community road safety initiative	17
Case Study: Porgera Joint Venture (PJV)—illegal ‘mining’	19
Case Study: Mount Polley mine tailings dam, British Columbia, Canada	20
Case Study: An example of airborne contaminants as a result of a mine fire—the Hazelwood mine fire	23
Case Study: Fitzroy Partnership for River Health	25
Case Study: Water issues associated with mining in developing countries	26
Case Study: Alcoa and noise mitigation	28
Case Study: Rosemont Copper Project—Monrad Study	30
Case Study: Kidston gold mine	31
Case Study: Esperance Port lead issues	32
Case Study: Workplace program for HIV/Aids and malaria, Newmont Ghana Gold	42

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# FOREWORD

The *Leading Practice Sustainable Development Program for the Mining Industry* series of handbooks has been produced to share Australia's world-leading experience and expertise in mine management and planning. The handbooks provide practical guidance on environmental, economic and social aspects through all phases of mineral extraction, from exploration to mine construction, operation and closure.

Australia is a world leader in mining, and our national expertise has been used to ensure that these handbooks provide contemporary and useful guidance on leading practice.

Australia's Department of Industry, Innovation and Science has provided technical management and coordination for the handbooks in cooperation with private industry and state government partners. Australia's overseas aid program, managed by the Department of Foreign Affairs and Trade, has co-funded the updating of the handbooks in recognition of the central role of the mining sector in driving economic growth and reducing poverty.

Mining is a global industry, and Australian companies are active investors and explorers in nearly all mining provinces around the world. The Australian Government recognises that a better mining industry means more growth, jobs, investment and trade, and that these benefits should flow through to higher living standards for all.

A strong commitment to leading practice in sustainable development is critical for mining excellence. Applying leading practice enables companies to deliver enduring value, maintain their reputation for quality in a competitive investment climate, and ensure the strong support of host communities and governments. Understanding leading practice is also essential to manage risks and ensure that the mining industry delivers its full potential.

These handbooks are designed to provide mine operators, communities and regulators with essential information. They contain case studies to assist all sectors of the mining industry, within and beyond the requirements set by legislation.

We recommend these *leading practice* handbooks to you and hope that you will find them of practical use.



**Senator the Hon Matt Canavan**

Minister for Resources and Northern  
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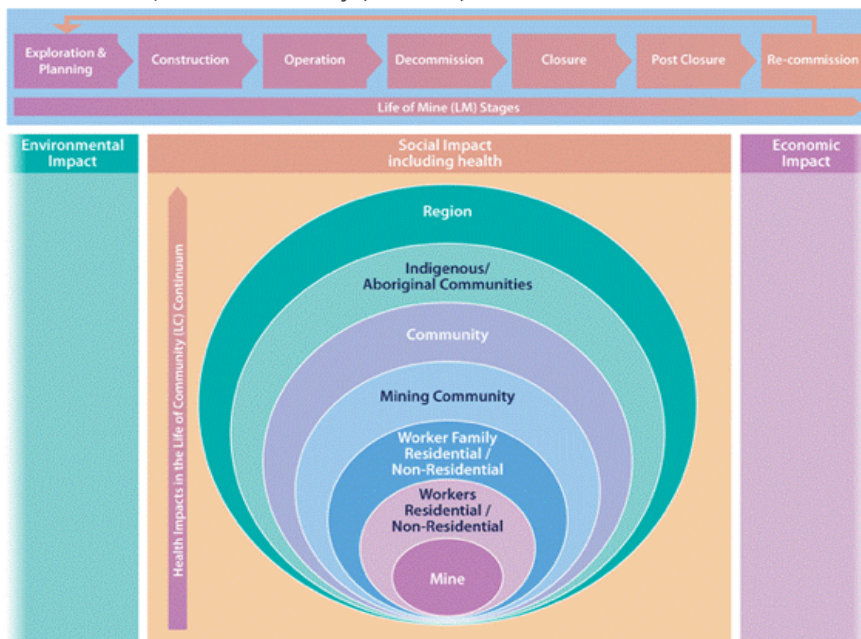
# 1.0 INTRODUCTION

Large and/or multiple mining operations generate opportunities for and challenges to the communities in which they operate—influencing the lives of workers, workers’ families, mining communities, rural communities, Indigenous communities and the wider region. Change can occur on many levels—economic, social, environmental, individual and so on. Mining activity commonly boosts the economic growth of regions, builds the capacity of local communities through vocational training and employment, and adds much-needed infrastructure to underserved towns in remote areas. Conversely, mining workforce

‘in-migrations’ can alter the social identity of local towns, cause housing shortages, particularly for low-income and Indigenous groups, and place pressure on often already under-resourced local services.

Features of the mine, the community and the external environment contribute to how a community might be affected by mining activity. Mining operations have a life cycle: at each stage, factors such as workforce numbers, work tasks, the locality of tasks and the use of equipment differ. Figure 1.1 highlights the confluence of the life-of-mine and life-of-community to prompt further insight into how the different mining stages might differentially affect the various social groups of neighbouring communities and regions. A mining company that has not taken constructive action to close a mine can potentially leave a negative environmental legacy that affects the health and safety of the continuum of groups in the life of the community. As the model suggests, exposure can occur through environmental, social and economic channels. Spills from abandoned mine pits can result in the discharge of acid and heavy metals into river catchments, seas and oceans—damaging the livelihood and health of local farmers as well as fishermen in coastal regions.

Figure 1.1: Life-of-mine/life-of-community (LOMLOC) matrix



Source: Kirsch et al. (2012).



This handbook considers one aspect of the influence that mining operations can have on local communities—that of health and safety. This includes the traumatic injury risks and diseases that people may incur due to mining activity. Traumatic injury risks include trips, slips and falls and being hit by moving objects. Examples of occupation-related diseases include mental disorders, noise-induced hearing loss, infectious and parasitic diseases and respiratory disease. Mining operations can also generate positive health and safety behaviours in local communities. They can provide education and support to community members and groups to promote important social issues, such as mental health issues, provide sporting and medical equipment and facilities, and bring more general health benefits associated with long-term employment.

Mining is a high-risk industry with operating hazards that can have serious health and safety consequences. Those primarily at risk are mine workers, but some mining hazards can also present health and safety risks to people living in the vicinity of the mining lease. A list of mine operational hazards is shown in Table 1.1 and over half of them could affect people living in the vicinity of the mine. A mine fire, for instance, could put at risk the health and safety of both workers and people living near to the mine. In contrast, an underground inrush event causing a sudden inflow of water into mine workings would generally only affect the safety of mine workers. Mining workplace health and safety (WHS) legislation requires that all foreseeable hazards be identified and controlled to an acceptable level of risk (see Section 2.1.2).

Table 1.1: Examples of mine-generated risk to mine worker and community

MINING HAZARD	MINE WORKER	COMMUNITY
Mine fire	✓	✓
Fall of ground—surface or underground	✓	
Tyre explosion/fire/loss	✓	
Loss of control of vehicles	✓	✓
Loss of control of explosives	✓	✓
Underground explosion	✓	
Manual tasks, slips, trips or falls	✓	
Inrush event	✓	
Outburst event	✓	
Loss of control of tailings dams	✓	✓
Health issues		
• Dust in atmosphere	✓	✓
• Diesel exhaust emissions	✓	
• Hazardous substances—gases, vapours, solids or liquids	✓	✓
• Noise	✓	✓
• Thermal environment	✓	
• Ionising & non-ionising radiation	✓	

MINING HAZARD	MINE WORKER	COMMUNITY
• Vibration	✓	✓
• Asbestos and synthetic mineral fibre	✓	
• Waterborne contaminants	✓	✓
• Fatigue	✓	✓
• Misuse of alcohol and drugs	✓	✓
• Physical illness, disease or condition	✓	✓
• Mental ill-health	✓	✓



While the direction of the risk is largely from the mine to the community, the lives of workers outside the mine site have the capacity to influence the health and safety of workers on the mining lease. A worker presenting for work under the influence of or impaired by alcohol, for example, can potentially compromise workplace safety.

Integration of organisational policies, programs and practices, including those relevant to the control of hazards and exposures, the organisation of work, compensation and benefits, built environment supports, leadership, changing workforce demographics, policy issues, and community supports, will contribute to worker safety, health and wellbeing.

Workplace policies, procedures and interventions that focus on advancing the safety, health and wellbeing of the workforce are helpful for individuals, and the benefits spread to their families, communities and employers and to the economy as a whole.

## 2.0 HEALTH AND SAFETY WITHIN THE MINING LEASE

The health and safety of all people on the mining lease is covered by the occupational or workplace health and safety laws of each state of Australia. The primary legislation governing the health of people in the broader community is environmental legislation, and other legislation can also have an impact.

### 2.1 WHS law for mines in Australia

Each state and territory in Australia is responsible for the management of WHS, and WHS in mining is covered by a range of legislation. Except for Queensland and Western Australia, the general WHS legislation applies to mining and is supplemented by special mining legislation or additional regulations. For example, the *Work Health and Safety (Mines) Act 2013* and Regulations 2014 in New South Wales are subordinate to the mainstream WHS Act. In Queensland and Western Australia, the mining WHS legislation applies to mine sites. This does not mean that other legislation may not apply (such as that covering equipment design and supply). Table 2.1 summarises the legislative coverage in Australia.

Table 2.1: WHS legislation in Australia

LEGISLATION	NSW	Qld	Vic.	SA	NT	TAS.	WA
WHS	✓		✓	✓	✓	✓	
Mining	✓	✓					✓
Dangerous goods	✓		✓	✓	✓	✓	✓
Other	Electrical	Equipment	Health		Radiation	Radiation	Radiation

The legislation is not uniform between the states, although there is considerable similarity in the more prescriptive regulations. For example, the New South Wales legislation is similar to the Queensland legislation in terms of major (principal) hazard management. Principal hazards are those that have the potential to cause multiple fatalities.

The Queensland mining legislation is overtly focused on WHS management with an emphasis on safety management systems and risk management. In the mainstream WHS legislation, safety management systems are usually only required for major hazardous facilities or mines. Even in those situations, the focus of the management system is on the prevention of catastrophic events.

In Western Australia, where there is only one mining safety act and associated regulations covering both metalliferous and coal mining.

There have been significant moves towards the harmonisation of WHS laws in Australia in recent years. In 2008, the Council of Australian Governments (COAG) formally committed to harmonising WHS legislation through the Inter-Governmental Agreement for Regulatory and Operational Reform in Occupational Health and Safety. Following an extensive national review into the structure and content of model WHS laws, Safe Work Australia took carriage of the development of a national model Act, Regulation and codes of practice.

The model WHS Bill and Regulations came into operation in five jurisdictions on 1 January 2012. Those jurisdictions are the Commonwealth, NSW, Queensland (not mining), the ACT and the Northern Territory. Legislation in South Australia and Tasmania took effect on 1 January 2013. In the remaining jurisdictions, Victoria and Western Australia, there has been no further progress towards adopting the national model legislation.

A similar process was introduced for mining health and safety legislation through the National Mine Safety Framework (NMSF). The NMSF was an initiative of the Ministerial Council on Mineral and Petroleum Resources and aimed for a nationally consistent occupational health and safety regime in the mining industry. The goal of the NMSF was to achieve both consistency and improved safety outcomes through appropriate regulatory frameworks. In November 2005, the ministerial council established a tripartite steering group (comprising state, Northern Territory and Australian Government officials, five industry associations, two trade unions and the Australian Council of Trade Unions) to guide the development of the framework. The steering group finalised its development of seven strategies in an updated report produced in 2009:

Strategy 1—A nationally consistent legislative framework

Strategy 2—Competency support

Strategy 3—Compliance support

Strategy 4—A nationally coordinated protocol on enforcement

Strategy 5—Consistent and reliable data collection and analysis

Strategy 6—Effective consultation mechanisms

Strategy 7—A collaborative approach to research.

A number of these strategies were subsumed by the development of the national model WHS Act, Regulations and Codes of Practice; while others are at various stages of implementation by state and territory governments for a range of reasons.

## 2.1.1 Duty of care

Under the transition to modern WHS legislation, regulators have largely removed explicit or prescriptive regulation and require companies and workers to exercise a 'Duty of Care', which means that:

- Employers are required to provide and maintain a working environment where, as far as is practicable, employees are not exposed to hazards.
- All employees have a general duty of care to ensure their own safety and health at work. They also have a general duty of care towards others, to ensure that their actions or inaction do not put others' safety or health at risk.
- Self-employed people must ensure, so far as is practicable, that no-one will be adversely affected by any of the work done at the mine, or hazards that may arise from it (DMP 2011)

Duty-of-care provisions of Acts and Regulations are built up under common law, which has developed over time as a result of decisions taken in courts of law. Prescriptive regulations are built up under statute law.

The duty of care is shared between employer and employee. However, primary responsibility rests with the employer, as they largely have control over the working conditions. The duty owed by the employer may be higher to an employee who is inexperienced than to one who has experience, reflecting this level of control. Similarly, a high duty of care exists in hazardous environments.

The employer has a duty of care to employees and others to provide:

- reasonably competent staff
- sufficient workers to carry out work safely
- safe places of work
- proper equipment
- safe systems of work.

Duty of care encourages the management of WHS rather than compliance with regulations. The differences between common law and statute law are as follows:

- Under statute law, each element of noncompliance must be proven beyond reasonable doubt.
- Under common law, each element of failing the duty of care is assessed on the balance of probabilities.
- Under statute law, the burden of proof lies with the prosecution.
- Under common law, the burden of innocence lies with the plaintiff.

## 2.1.2 Risk Management

The second key principle is the management of WHS risks, expressed in legislation as either “as low as reasonable practicable” or “to an acceptable level of risk”. The Queensland *Coal Mining Safety and Health Act 1999* (section 30) states:

How is an acceptable level of risk achieved

- (1) To achieve an acceptable level of risk, this Act requires that management and operating systems must be put in place for each coal mine.
- (2) This Act provides that the systems must incorporate risk management elements and practices appropriate for each coal mine to—
  - a) identify, analyse, and assess risk; and
  - b) avoid or remove unacceptable risk; and
  - c) monitor levels of risk and the adverse consequences of retained residual risk; and
  - d) investigate and analyse the causes of serious accidents and high potential incidents with a view to preventing their recurrence; and
  - e) review the effectiveness of risk control measures, and take appropriate corrective and preventive action; and
  - f) mitigate the potential adverse effects arising from residual risk.

(3) Also, the way an acceptable level of risk of injury or illness may be achieved may be prescribed under a regulation.

Similar definitions are used in legislation covering other jurisdictions. There is no absolute definition of ‘acceptable’ risk. It is something that must be decided for each site and activity.

## 2.2 Health and safety for mine workers

These changes in the focus of WHS have led to the development of the systems model of health and safety management. Both health and safety for workers in the mining and minerals industry are managed by a risk-based process as outlined by legislation, which leads to the development of safety and health management systems (SHMSs).

This is characterised by the recognition of the following:

- Health and safety are affected by all aspects of the design and workings of an organisation.
- The design and management of health and safety systems must integrate environment, people and systems in proportions that reflect an organisation’s unique characteristics. No one system is universally effective.
- Health and safety are also management functions, not just the responsibility of individuals; that means there must be management commitment and involvement.
- Unifying elements produce a set of defined responsibilities and accountabilities for activities at all levels of the organisation.
- Incidents, injuries and illnesses are an indication of a problem in the system, not simply human error.
- Human error can occur at all levels in an organisation and not just by those who are injured or killed.
- Performance goals must reflect management objectives.

### 2.2.1 Chronic and acute health and safety risks

When assessing risks affecting health and safety it is important not to focus only on those relating to a specific incident (acute hazards) but also to allow for those that are generated as a result of repeated exposure to a hazard (chronic hazards). The characteristics of acute and chronic hazards are shown in Table 2.2.

Table 2.2: Characteristics of acute and chronic hazards

ACUTE HAZARDS	CHRONIC HAZARDS
Single exposure	Cumulative over time
Outcome: <ul style="list-style-type: none"> <li>• Death</li> <li>• Injury</li> </ul>	Outcome: <ul style="list-style-type: none"> <li>• Long-term or short-term disability</li> <li>• Death</li> </ul>
Opportunity for harm may exist for a short period of time	Opportunity for harm exists for long periods of time
Often close link between cause and effect	Outcome may appear long after exposure to harm

Acute hazards (often allied to the principal hazards shown in Table 1.1) tend to be managed via specific management plans. Chronic hazards tend to be covered under the requirement to provide a safe working environment and manage exposure to contaminants and other hazards to acceptable levels.

The management of occupational health is more complex, in that it can involve factors beyond the control of the mine operator, some of which may exist off the mine site. For example, it is very common under the WHS Acts to require the mine to manage the fitness for work of a mine worker, including fitness for work as influenced by:

- alcohol
- drugs (prescribed, over the counter or illicit)
- personal fatigue
- physical impairment
- psychological impairment.

In essence, the management of the potential for harm from these elements is controlled through the same process as safety—the development and implementation of an SHMS that includes fitness-for-work considerations. Fitness for duty can be affected by the actions of the mine worker when they are not on the mine site.

For alcohol and drugs, many sites use all or some of the following assessments to decide a person's fitness for work:

- voluntary self-testing
- random testing before starting work
- testing the person if someone else reasonably suspects that the person is under the influence of alcohol or drugs.

However, the system should not just be about testing for the presence of alcohol or drugs but should be an integrated process that includes education and awareness programs and an employee assistance program.

Management of fatigue needs to include:

- management of hours of work
- maximum number of hours for a working shift
- number and length of rest breaks in a shift
- maximum number of hours to be worked in a roster cycle
- work tasks and work environment affecting fatigue.

Non-work-related issues also need consideration (for example, family commitments or community impacts).

The system must also provide for protocols for other physical and psychological impairment for people at the mine.

Occasionally, the WHS Acts can express responsibility beyond the mining lease. For example, under the Victorian *Occupational Health and Safety Act 2004*, section 23 (Duties of employers to other persons) states:

- (1) An employer must ensure, so far as is reasonably practicable, that persons other than employees of the employer are not exposed to risks to their health or safety arising from the conduct of the undertaking of the employer.

This section was the subject of much debate during the Hazelwood Mine Fire Inquiry. Subsequently, to remove any possible ambiguity, the Victorian Government introduced the requirement to develop and implement an approved work plan, which is a legal requirement for mining industry projects licensed under the *Mineral Resources (Sustainable Development) Act 1990*, unless specifically exempted. From 1 January 2016, all required work plans must be risk-based; that is, a work plan must:

- identify the risks that the activities may pose to the environment, to any member of the public, or to land or property in the vicinity of the activities
- specify what the person who proposes to undertake the activity will do to eliminate or minimise those risks as far as is reasonably practicable.

### **CASE STUDY: The impact of WHS legislation on coal mining safety in Australia**

Between 1991 and 2010, and despite a rapid expansion in Australian resources industries, there was a dramatic reduction in the numbers of coal mining fatalities in Australia. In all, 85 workers died over that period—65 in the first decade (1991 to 2000) and 20 in the next (2001 to 2010). Also, all six mine incidents causing multiple deaths across the 20-year period occurred in the earlier decade (mostly in underground mines), the worst being an explosion in the Moura no. 2 mine in central Queensland in 1994 that killed 11 men. In New South Wales, the incident causing the highest number of deaths was in 1996 in Gretley, where four men drowned following an inrush of water from old mine workings.

One factor implicated as driving this improvement in coal mining safety was the introduction in the late 1990s and 2000s of new WHS legislation governing coal mines in Queensland and New South Wales. This change represented a move from a compliance-based approach to a risk management approach to safety (Cliff 2012ab) and was triggered by the death of 36 men in three underground mining explosions in Moura (in 1975, 1986 and 1994). A subsequent inquiry into the last of those disasters, Moura no. 2 (Windridge 1996) generated a wide-ranging set of recommendations for Queensland coal mines that became the basis of Queensland's *Coal Mining Safety and Health Act 1999* (and subsequent Regulations introduced in 2001). One of the main elements of this Act was the implementation of risk assessment based mine safety management plans for principal hazards. At about the same time, a competency framework was introduced in Queensland to ensure that senior mine employees holding safety-critical (i.e. statutory) positions (including mine managers, electrical and mechanical engineering managers, and ventilation officers) had specified qualifications and competencies. New South Wales followed this legislative path, implementing the *Coal Mine Health and Safety Act 2002*, prompted by the Gretley disaster. In response to these changes, it is perhaps significant that all major mining incidents in Australia since 1996 have been in metalliferous mines (North Parkes, 1999; Bronzewing, 2000; Beaconsfield, 2006).



## 2.2.2 Health of workers

In order to effectively manage occupational illness and disease, it is important to monitor and control exposure to hazards that may cause illness and disease and also to monitor the outcomes of exposure. These are very different processes. In the mining industry, monitoring is undertaken as:

- medical monitoring (outcome monitoring):
  - legislative requirement
  - company requirement
  - based on risk and/or job/task
- workplace monitoring (exposure monitoring):
  - hazardous work areas
  - personal monitoring.

Medical monitoring through health surveillance is the ongoing systematic collection, analysis and interpretation of data for the purposes of improving health and safety. Surveillance refers to the compilation of data to track issues over a period of time for a group of workers. However, there is no comprehensive or central system of surveillance for occupational disease or illnesses, even though there are important sources of health data for workers in the minerals industry, including:

- pre-employment medicals
- ongoing health assessments
- surveillance schemes.

In all Australian states, there are requirements for the health monitoring of workers exposed to occupational hazards. The extent of the requirements varies from state to state. In New South Wales and Queensland, there is currently provision for a centralised health surveillance program only for the coal mining industry.

The Western Australian MineHealth system that commenced in 1996 ceased in January 2013. Two comprehensive epidemiological studies of the MineHealth database conducted in 2010 and 2012 showed that these assessments neither prevented nor detected ill-health at an early stage. The cessation of the MineHealth system allows the WA industry to apply a more risk-based approach to health surveillance. Employers are responsible for identifying the hazards in their workplaces, assessing the risks to workers' health and wellbeing, and eliminating or mitigating those risks.

The use of workplace monitoring to determine the exposure to the potential health hazards in the minerals industry can be an effective management technique where there are well-established cause-and-effect and dose-response relationships. For many of these hazards, exposure standards exist as defined in Safe Work Australia's *Workplace exposure standards for airborne contaminants* (2011). Exposure monitoring and the implementation of controls to manage the exposure of workers is a proactive approach to health management for these hazards.

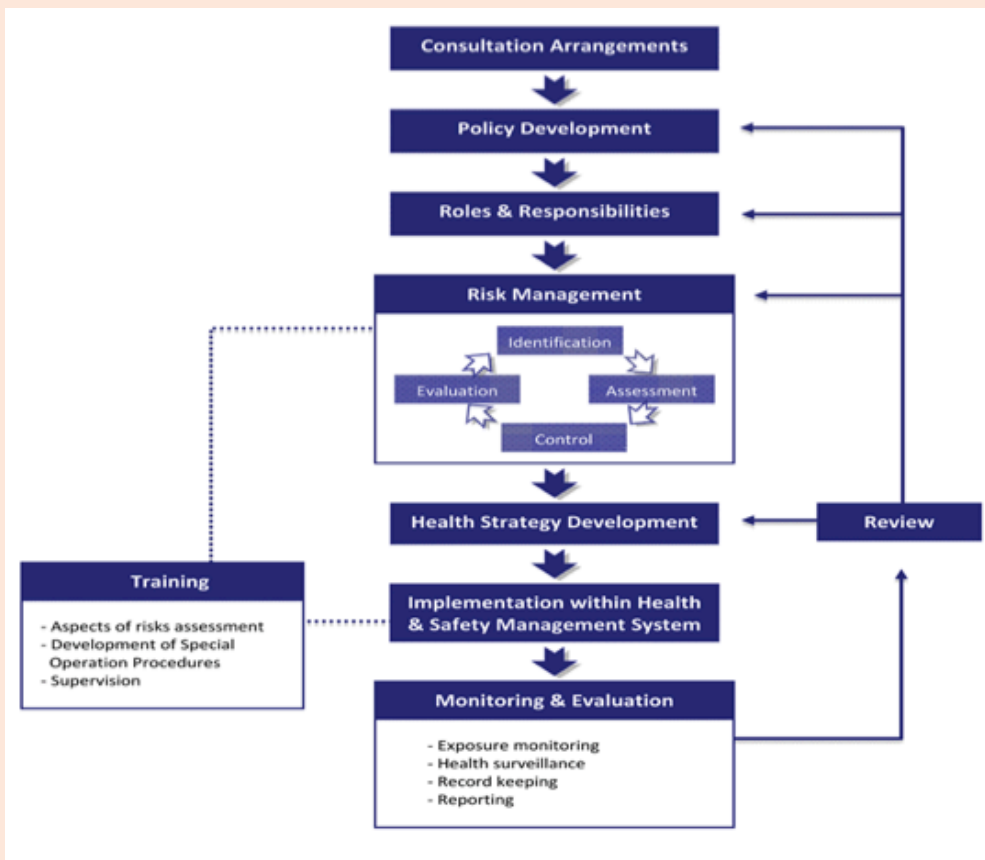
## CASE STUDY: NSW Health Management Plan

The NSW Health Working Party of the Mine Safety Advisory Council has developed a guide (DII 2009) to assist in the development of health management plans. The guide was developed to assist mine sites in understanding their obligations regarding occupational health management and to assist industry in raising its capacity to manage occupational health risks in the same systematic manner as it manages safety risks.

The model proposed includes:

- communicating contemporary health issues to help industry identify health risks
- embodying health requirements into a site health management plan that is integrated with the SHMS
- establishing a system for reporting major health incidents and occurrences
- clarifying and agreeing on role of the regulators, such as NSW DPI and Coal Services.

The overall approach is summarised in the figure below, which has been extracted from the guide (DII 2009:6).



## 3.0 HEALTH AND SAFETY IMPACTS OF MINING BEYOND THE MINING LEASE

The management of the health and safety impacts of mining that extend to the communities beyond the mine lease are potentially covered by a range of legislation covering environmental, social and health and safety aspects. The following description of the various states' mining-related environmental legislation is a general overview. It is not a comprehensive review of environmental legislation in Australia and it should not be used as a guide to jurisdictional requirements.

### 3.1 Legislative framework

In Australia, state-based approvals of mining, oil and gas projects deemed to be environmentally significant involve a two-step process in which the project proponent first gains a tenure, mining title or licence, generally from a resource-related government department, that gives access to the land. Then, before operations begin, the project undergoes a rigorous assessment by an environmental authority, usually from an environment-related government department.

The states have various criteria for identifying 'environmentally significant' projects. Typically, they include those that:

- have a number of environmental issues
- have a greater magnitude, duration, frequency and extent of impacts
- are affected by international, national or state/territory legislation or treaties for the protection of natural habitats, flora and fauna
- pose significant risk or hazard to public safety
- have potential for significant pollution to occur.

(Source: DME 2011)

In the past, the states' environmental regulations were highly prescriptive, but, as with WHS regulations, the onus is now on the proponent to demonstrate that their project's environmental impacts can be managed in a manner that complies with statutory obligations and meets community expectations. As in all risk management processes, risks and their causes and potential consequences must be identified, and measures proposed to avoid or minimise any associated adverse impacts.

In all states, the environmental approval process (for environmentally significant projects) requires the project proponent to:

- develop an environmental impact statement (EIS) on the effect of their mining operations on the immediate mine area as well as adjacent areas
- develop an environmental management plan (EMP) that outlines how they will monitor and audit their operations throughout the life of the project, including how they will rehabilitate the environment after mining (EMPs are subject to regular reporting to and inspection by regulatory agencies).

Together, the EIS and EMP processes typically require the proponent to:

- engage with communities, local government and state government agencies
- identify the environmental (including biophysical, social and economic) costs and benefits of the proposal
- collect qualitative and quantitative data that enables the existing (or baseline) conditions to be measured and provides a basis for measuring future impacts
- develop impact management strategies, often in consultation with affected communities and government agencies
- implement, monitor, review and report on their impact management strategies.

Another feature of this process is that the public are given the opportunity to object to proposals.

In developing an EIS, proponents must address mining-related effects according to particular categories of the environment both within and outside the mining lease. The environment is commonly defined in states' legislation as including:

- land, air, water (including surface and underground water and seawater), organisms, ecosystems, native fauna and other features or elements of the natural environment
- buildings, structures and other forms of infrastructure and cultural artefacts
- existing or permissible land use
- public health, safety and amenity
- the geological heritage values of an area
- the aesthetic or cultural values of the area.

(Source: PIR 2011)

The specific environmental issues that are nominated in NSW EIS guidelines as potentially important in the assessment of impacts in relation to coal mines, for example, are:

- transportation issues (including road safety issues)
- soils and geological issues
- water issues
- air quality issues
- noise, vibration and blasting issues
- flora and fauna issues
- Aboriginal heritage issues (this includes impacts caused by subsidence, vibration and changes to hydrological patterns)
- other heritage issues
- visual impacts
- coastal issues
- hazards issues
- social and health issues
- economic issues
- cumulative issues.

(Source: DUAP 2000)

The NSW social impact assessment further outlines the risks that should be considered in relation to the health of the community and those that could result from any potential changes in air quality, noise and vibration, safety on the roads, and the flooding regime.

All states' legislation requires that mining companies risk-assess their social impacts on local communities and people. As can be seen in Table 3.1, mining company activities have the potential to affect local councils; neighbouring residents, landowners and lease holders; the wider community; special interest groups; government agencies; and the wider mining industry.

In Queensland, the EIS process includes a separate social impact assessment that requires proponents to address community and stakeholder engagement; workforce management; housing and accommodation; local business and industry content; and health and community wellbeing. The process by which mining companies are required to do this is by engaging with local stakeholders and government agencies to measure existing or baseline social conditions, and then by developing, implementing, monitoring, reviewing and reporting impact management strategies (DSDIP 2013). Table 3.1 summarises the issues that need consideration due to different legislative requirements.

Table 3.1: Issues needing consideration due to different legislative requirements

Environmental component that may be affected	Local council	Residents/landowners/lease holders	Wider community	Special interest groups and government agencies	Resources management
Local community	✓	✓	✓	✓	
Land use	✓	✓		✓	
Housing and infrastructure	✓	✓			
Amenity and landscape	✓	✓	✓	✓	
Noise, dust and air quality		✓	✓	✓	
Hydrology	✓	✓	✓	✓	✓
Groundwater		✓	✓		✓
Vegetation, weeds and plant pathogens		✓	✓	✓	✓
Fauna			✓	✓	✓
Topsoil and subsoil		✓		✓	✓
Heritage		✓	✓	✓	

Source: PIR (2011).

## CASE STUDY: Hazelwood mine fire

The complexity of the legislation covering mines, particularly when it relates to off-lease effects, was demonstrated by the inquiry into the Hazelwood mine fire in Victoria in 2014.

### **REGULATION OF VICTORIAN COAL MINES**

*Regulation of Victorian coal mines is complex and has evolved considerably over time.*

*The principal regulatory mechanisms that govern the risk and prevention of fire at the Hazelwood mine are mine licensing laws, which are administered and enforced by the Earth Resources Regulation Branch of the Department of State Development, Business and Innovation (the Mining Regulator) and occupational health and safety (OHS) laws, which are administered and enforced by the Earth Resources Unit of the Victorian WorkCover Authority (VWA).*

*From 1 January 2008, responsibility for oversight of OHS matters in Victorian mines transferred from the Mining Regulator to VWA. From this date, the Mining Regulator no longer considered itself to have any role in regulating fire risk at the Hazelwood mine.*

*The Mining Regulator and VWA each adopted a narrow reading of the statutory regime underlying their respective areas of responsibility. Contrary to arrangements between the Mining Regulator and VWA, which contemplated collaboration and consultation on areas of overlapping responsibility, such as public safety risks, the agencies operated in silos. The Board was concerned that the manner in which the transition for OHS responsibility to VWA was effected meant that expertise and knowledge relevant to assessing fire risk at the Hazelwood mine was potentially lost.*

*The combination of these factors resulted in a gap in regulation of the Hazelwood mine in respect of fire risks with the potential to impact on Morwell and surrounding communities, such as that which manifested in 2014. The Hazelwood mine fire was a foreseeable risk that slipped through the cracks between regulatory agencies. This reality must be confronted if similar incidents are to be avoided in the future.*

*The Mining Regulator doubted whether it had the necessary legislative power to regulate fire risk in Victorian mines, notwithstanding that the Regulator's statutory objectives include ensuring that the health and safety of the public is protected in relation to work being done under a mining licence. The position adopted by the Mining Regulator is not, in the view of the Board, the only interpretation open of the Mining Regulator's regulatory power. This uncertainty is likely to be resolved when legislative amendments enacted in February 2014 come into effect.*

Source: Hazelwood Mine Inquiry (2014).

## 3.2 Safety

As identified in previous sections, many of the safety issues that are present on a mine site do not affect the community directly. However, it is recognised that the consequences for the families or communities of injured or ill workers may be significant.

The following are considered to be the most significant issues for community safety related to mining operations:

- road safety
- mine site access
- tailings dam safety
- blasting safety
- the transport of explosives and other hazardous materials

### **Coal seam gas**

Unlike other mining ventures (e.g. coal) in which operations are largely confined within a single site's boundaries, coal seam gas (CSG) is usually extracted on widely distributed patches of land leased from landowners. When multiple CSG companies operate in one region, the traffic that they (and their contractors) generate aggregates (over time and space) to have a cumulative impact, with the most serious potential consequence being the endangering of drivers and pedestrians (workforce and community members). The level of imposition (whether that be positive or negative) may differ according to a range of factors, including the nature of the community, its geographical characteristics, pre-existing industries (such as agriculture and tourism) and nuances of the CSG operations.

### 3.2.1 Road safety

The minerals industry presents road safety challenges to rural communities in which it operates. These challenges can be greatest when the industry first enters or grows rapidly in a region. Local residents may not be used to heavy vehicle traffic, increased light vehicle traffic that corresponds to shift work, an increase in population generally, changing conditions of roads (improvements and degradation), and shifts in patterns of traffic (for example, more vehicles on what were less travelled roads). Changes occur in the quality, timing and volume of traffic in town centres as well as in outlying areas. In addition, there may be new residents in the community, brought by a resource boom, who are unfamiliar with local roads and local driving practices (such as yielding to farm equipment on the roads). Such factors can be contributors to an increase in the number of vehicle accidents in the local region.

Mining companies' road safety interventions may need to extend beyond their fleets of company vehicles and their workers' commutes and include consideration of the driving, walking and riding practices of community members in the locality.

## CASE STUDY: The Light Vehicle Project—a community road safety initiative

This intervention in 2011 was developed by Energy Resources Australia to promote driver safety on the remote Arnhem Highway, a 260-kilometre road that links the company's Jabiru uranium oxide mine to Darwin in the Northern Territory. While the intervention is primarily directed at ensuring the safety of the workforce and contractors, it is also aimed at the broader community of travellers, including local commuters, tourists and drivers of heavy vehicles.

The intervention was triggered by an internal audit that revealed road travel on this highway to be one of the biggest safety risks for ERA employees. As a result, a risk-based management program was developed to identify key causes of accidents on the Arnhem Highway, to develop controls to prevent and mitigate risks and to monitor the effectiveness of these controls.

The Light Vehicle Project targeted known causes of local crashes: changing road conditions, overtaking of heavy vehicles, fatigue on long stretches of road, the unpredictability of tourist vehicles (including sudden stops to view sites of interest), wandering stock and animals, setting and rising sun and heavy rain. Control measures focused on vehicle safety, roads, roadsides, vehicle speed and road-user behaviour (including seatbelts, alcohol and fatigue). A stringent set of ERA safe driving rules specific to driving on this highway were developed and are now embedded into the company's procedures. A DVD giving safety advice about driving on the highway was developed and made freely available to the general public. ERA has also run awareness sessions in the community in Jabiru and Darwin at local events, road safety forums and schools. For example, one local event focused on vehicle pre-start checks, and an ERA light vehicle mechanic gave advice on improving the effectiveness of checks.

This intervention has been nationally recognised, winning two 2012 Australian Road Safety Awards.

### 3.2.2 Mine site access

Controlling access to mine sites, whether active or abandoned, is another area where the safety of the community must be considered. This is potentially a serious problem where informal small-scale mining is undertaken or where trespassing could result in accidents, leading to injuries and even fatalities.

A number of potential hazards are associated with uncontrolled access, including the following:

- **Surface shafts and other vertical openings:** Falling is a particular risk in abandoned workings. Vertical or inclined shafts can be hidden by undergrowth, darkness, water or loose debris.
- **Interaction with heavy mobile equipment or plant:** On operating sites, the potential for interaction with heavy mobile equipment on haul roads or entanglement in conveyors is a safety issue.
- **Landslip:** During the mine life cycle, there is the potential for geotechnical failure resulting in landslip. During construction, the key risks are associated with cuttings and large excavations. In the operations phase, there is potential for the localised failure of pit walls, waste emplacements and haul road earthworks. Following closure of the mine, there continues to be a risk of failure of the final pit walls and mineral waste emplacements, resulting in risks to anyone who may be in the area after the closure.



- **Water:** Water in mines can be deep. If it fills an area with steep sides, it might not be easy for a person to climb out.
- **Bad air:** Abandoned mine workings may be hazardous due to pockets of low oxygen levels or high concentrations of dangerous gases, such as carbon monoxide. Coal mines are especially prone to containing such gases.
- **Hazardous materials:** Mines can contain various types of heavy metals. Bacterial action can create acids and other compounds that are hazardous to humans. Acid mine drainage is of great concern in some areas. Mills and other processing areas may contain traces of cyanide and mercury compounds that were once used to separate precious metals from the ore.

***Drowning*** is the no. 1 cause of death in abandoned mines in the USA. Most people involved in this type of accident went to a quarry to swim, but quarries are extremely dangerous places to do so. Steep drop-offs, deep water, sharp rocks, flooded equipment, submerged wire and industrial waste can make swimming risky.

Source: Geology.com, [www.geology.com/articles/abandoned-mines.shtml](http://www.geology.com/articles/abandoned-mines.shtml)

## **CASE STUDY: Porgera Joint Venture (PJV)—illegal ‘mining’**

Illegal mining is a complex and difficult issue to manage and one of the principal challenges of mining at Porgera, Papua New Guinea—a country where a relatively low standard of living is evident.

Illegal miners are people who evade the PJV’s perimeter security and enter the mine property or the special mining lease without permission with the intention of stealing gold-bearing ore. Those involved in illegal mining are trespassers and are breaking the law.

This differs from artisanal and small-scale miners, who generate income from labour-intensive mining activities based on either formal legal or informal mining rights. Barrick Gold Corporation and the PJV have an interest in a mutually respectful and peaceful coexistence with lawful artisanal and small-scale miners.

Safe work practices are non-negotiable at Porgera. There are strict safety rules and procedures in place that minimise risk and ensure the safety of employees. The issue of illegal miners at Porgera relates directly to safety. Illegal miners are frequently unfamiliar with the significant risks associated with mining operations and the geological structures of the pit wall. By entering unsafe areas of the mine and active mining areas, they put their own lives and the lives of employees at risk.

The design of the open pit at the operation and the unstable nature of some of its geological structures make the pit walls an extremely dangerous place for people who are untrained and unfamiliar with these surroundings. Despite this, some illegal miners still attempt to access the pit and the old underground mine workings via the sheer face of the pit wall. The risk of serious injury or death due to falling is extreme in this situation.

Effective communication within the wider community is essential to building greater awareness and understanding of mining operations and the risks and dangers associated with trespass and illegal mining. The PJV engages in community-based public education campaigns on the unlawful nature of and risks associated with illegal mining and trespassing. Community awareness programs are also aimed specifically at illegal miners to ensure that people trespassing on the mine site are aware that it is unlawful and dangerous to do so, and that they could be injured or killed by rock falls, dangerous ground or heavy machinery.

Source: Barrick Gold Corporation, <http://s1.q4cdn.com/808035602/files/porgera/Illegal-Mining-at-PJV.pdf>

### 3.2.3 Tailings dams

Two dominant safety issues are associated with tailings dams:

- the physical safety of the dam
- safe containment of any toxic substance.

Any tailings dam must ensure physical, radioactive and chemical safety for both the environment and the community during mine operation and after closure, taking into consideration long-term stability, extreme events and slow deterioration. Further detailed information on tailings dams can be obtained from the leading practice *Tailings management* handbook (DITR 2007).

#### **CASE STUDY: Mount Polley mine tailings dam, British Columbia, Canada**

A tailings dam failure at the Mount Polley open pit copper and gold mine occurred on 4 August 2014. It resulted in the loss of about 17 million cubic metres of water and 8 million cubic metres of tailings and other material into Polley Lake, Hazeltine Creek and Quesnel Lake. An emergency response was undertaken by the province involving various agencies throughout August and into September 2014. A pollution abatement order under the Environmental Management Act was issued on 5 August 2014 and amended on 27 May 2015 to abate the discharge, undertake an environmental impact assessment of the breach and implement remediation activities. A letter of understanding between the province and the Soda Creek Williams Lake Indian Bands outlines a collaborative approach to jointly address all aspects of the tailings breach. The Ministry of Environment led the response for the environmental monitoring, impact assessment, mitigation and remediation of the affected area and worked closely with First Nations, local governments, provincial and federal agencies, and public representatives.

Source: Government of British Columbia, <http://www.env.gov.bc.ca/eemp/incidents/2014/mount-polley/>

The images below show a NASA satellite view of the earthen dam at Mount Polley Mine in British Columbia, which breached on 4 August 2014, sending contaminated water into nearby lakes.



*Before dam breach*



*After dam breach*

### 3.2.4 Blasting safety

Blasting at mine sites, particularly when close to site boundaries, can have impacts on the surrounding community, infrastructure and environment due to vibration through the air (overpressure) and earth (ground vibration), and the generation of dust, fumes, noise, odours and flyrock. Flyrock is the undesirable throw of debris from a blast and can cause severe injury and property damage.

Blast impacts can directly or indirectly affect the health and safety of surrounding communities. Fumes and dust can directly affect health (see Section 3.3.1), and flyrock can directly compromise safety. In contrast, other impacts, such as vibration, may be more likely to exacerbate stress reactions in nearby residents, which may be an indirect pathway to ill-health. Vibration may cause residents to feel anxiety about potential damage to their homes, property, commercial interests and ecological sites of significance (see Section 3.3.6).

Blast mitigation and management measures should manage any potential risk to the public, communities, mine personnel, livestock and fauna on surrounding lands, to transport networks and infrastructure and their users and to heritage sites through controls such as:

- complying with shotfiring safe work designs, equipment and procedures
- monitoring air blast overpressure and ground vibration for each blast (to demonstrate compliance)
- setting up blast exclusion zones
- limiting blasting activity (for example, to weekdays between 9 am and 3 pm, not on public holidays, with a maximum number of blasts averaged over a 12-month period)
- considering meteorological conditions to avoid adverse weather (for example, noise-enhancing conditions or winds that would blow dust or fumes towards neighbouring residential areas)
- notifying landholders of the blasting schedule, with up-to-date, widely accessible information)
- carrying out property inspections and investigations
- maintaining road closure management plans to ensure the safety and protection of road users and to minimise potential impacts on road users, local residents and businesses
- having an appropriate system to respond to local residents' complaints and issues
- coordinating blast schedules with neighbouring mines to minimise the cumulative impacts of blasting.

### 3.2.5 Transport of explosives and other hazardous materials

Mining and processing operations transport, store and use a range of hazardous materials, including fuels, process reagents, lubricants, solvents and explosives. These can present safety risks to the community if not appropriately controlled. The transport of explosives is covered by licensing requirements, the Australian Code for the Transport of Explosives by Road and Rail and the Australian Dangerous Goods Code.

## 3.3 Health

### 3.3.1 Airborne contaminants

Airborne particulates and gaseous emissions have the potential to cause personal health problems in the community, and dust and odour can cause annoyance and complaints.

Dust derived from the mechanical breakdown of rock and soil is the most widespread and abundant emission from mines and occurs across a range of particle sizes. Of direct relevance to health are the finer fractions—particles less than 10 microns in diameter (PM10) and especially those less than 2.5 microns in diameter (PM2.5). Finer particles are more readily transported into the lungs, where they can cause irritation and disease. In general, smaller particles are carried further by the wind than larger particles and so can affect nearby communities.

Amenity impacts from dust are usually associated with coarse particles and particles larger than PM10. The impact of dust from a nearby mine on local amenity depends on the distance from the mine site and climatic conditions, such as wind speed and direction. Concerns about amenity from mine-site dust often relate to the 'visibility' of dust plumes and dust sources. Visible dust is usually due to short-term episodes of high emissions, such as from blasting. Other amenity impacts include dust depositing on fabrics (such as washing) or on house roofs, and the transport of dust from roofs to water tanks during rain.

Gaseous emissions from mines include pollutants such as sulphur dioxide and nitrogen dioxide, which have well-defined human health effects. Blasting at mine sites in Australia generally uses a mixture of ammonium nitrate and fuel oil, or ANFO. The blasting of ANFO explosives can cause orange blast clouds of nitrogen dioxide that can travel across the mine's boundaries into the surrounding area. They usually disperse rapidly and pose no acute health risk, but under certain conditions the gas plume may persist and can affect nearby people or residents who are downwind of the blast site. Symptoms from high-level exposure can include:

- eye, nose and throat irritation and coughing
- dizziness and headache
- shortness of breath
- wheezing or the exacerbation of asthma.

Serious lung inflammation (pulmonary oedema) has been known to develop several hours after exposure to very high levels of nitrogen dioxide (NSW Government, n.d.).

Fugitive methane gas emissions from open cut and underground coal mines are another form of airborne contaminant. Coal industry fugitive emissions currently account for around 5% of Australia's total annual greenhouse gas emissions (MCA, n.d.), which is a relatively small proportion. Nonetheless, the coal industry is working to reduce fugitive emissions from mining. An earlier handbook, *Stewardship*, included an example of a greenhouse gas emissions abatement strategy implemented by Anglo Coal Australia (pp. 24–25) that has three major activities: to improve methane capture, pipeline development and mine site utilisation (DITR 2006a:24–25).

Further detailed information on airborne contaminants at mine sites that affect mine workers and communities is in the leading practice *Airborne contaminants, noise and vibration* handbook (DITR 2009a; note that handbook has not been updated).

## **CASE STUDY: An example of airborne contaminants as a result of a mine fire—the Hazelwood mine fire**

The Hazelwood mine fire began on 9 February 2014 during one of Victoria's hottest and driest summers on record. Situated in the Latrobe Valley, the open cut brown coal mine operated in one of the most bushfire prone areas in the world. The fire was caused by embers spotting into the Hazelwood mine from bushfires burning close to the mine. The mine fire burned for 45 days, sending smoke and ash over the town of Morwell and surrounding areas for much of that time.

On 11 March 2014, a day after the fire was declared under control, the Premier of Victoria, Dr Denis Naphthine MP, announced an independent inquiry into the fire. As described in the inquiry's report (Hazelwood Mine Inquiry 2014), the fire constituted two emergencies: a major complex fire emergency and a serious public health emergency. The report described the public health emergency in the following terms:

*Smoke and ash produced by the Hazelwood mine fire resulted in a number of distressing adverse health effects for Morwell residents, including sore and stinging eyes, headaches and blood noses. The majority of these health effects resolved when the fire was controlled, but some have persisted. Other community members have reported the development of new health conditions as a result of exposure to smoke and ash.*

*A number of vulnerable groups in the community were particularly susceptible to the adverse health effects of the smoke and ash, namely those with pre-existing cardiovascular and respiratory conditions, pregnant women and unborn children, children and the elderly. The Latrobe Valley has an ageing population with a higher incidence of cardiovascular and respiratory disease. The area also has a high percentage of low-income households and a higher percentage of residents who have a disability.*

*There were serious concerns in the community about the potential long-term health impacts of exposure to smoke and ash from the Hazelwood mine fire. Understanding and managing the health and environmental impacts of the Hazelwood mine fire is challenging, as the health effects of medium-term exposure to smoke and ash from a fire in a coal mine are not known.*

*A primary concern, from a long-term health perspective, is the duration for which residents were living with ashy, smoky conditions. The Board heard expert evidence that people with pre-existing cardiovascular and respiratory conditions are particularly susceptible to potential adverse long-term health effects when exposed to ozone, PM2.5 and larger particulates. In particular they are susceptible to an aggravation or progression of their underlying condition, an increased risk of lung cancer and potential effects on coagulation, which could result in an increased risk of arrhythmias, morbidity, hospital admissions and death. There was also a risk that the general population could develop medium to long-term effects from the exposure to PM2.5 and ozone, including but not limited to the development of respiratory conditions, effects on cardiac conduction, increased risk of heart attack, stroke and lung cancer, long-term cognitive decline and psychosocial effects.*

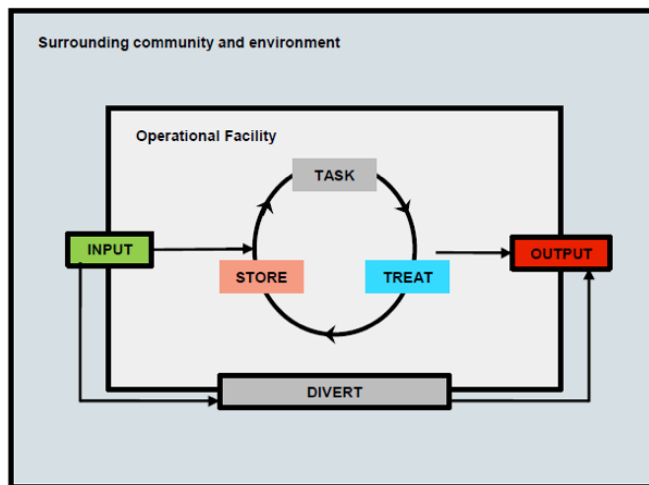
### 3.3.2 Waterborne contaminants

Water is vital to mining operations. The Minerals Council of Australia Water Accounting Framework (MCA 2012) illustrates the water flows between the environment and mining facilities (see Figure 3.1). Inputs include water received by a mine and surface and ground water. The output is water that is removed from the facility after it has been through a task, treated or stored for use. Water is classified as a diversion when it flows from an input to an output without being used by the facility. The flow is not stored with the intention using it in a task or treating it.

Mining tasks that require water include:

- dust suppression
- underground mining
- haul road dust suppression
- ore processing
- coal handling and processing plant
- tailings storage facility
- co-disposal
- amenities use.

Figure 3.1: MCA's input-output model of mining/environment water flows



The use of water in mining has the potential to affect the quality of surrounding surface water and groundwater. Water contaminated with high concentrations of metals, sulphide minerals, dissolved solids or salts can negatively affect surface water quality and groundwater quality. Impacts on human health can occur where the quality of water supplies used for irrigation, drinking or industrial applications is affected.

In water basins where multiple industries co-exist, it is important that cumulative impacts on water be managed. It is critical for mining proponents to work with government, other industries and communities to ensure sustainable water use and the protection of water supplies used by nearby communities and for ecosystem protection. An example of an Australian community, mining, industry and government partnership in water management is described in the case study of the Fitzroy Partnership for River Health.

Australia's extreme climate variability—ranging from drought to flood—adds to the complexity of managing water for mines. For example, the potential for water contamination from process chemicals is minimal following the closure of a mine, but if the mine workings were to be subjected to natural flooding, minerals could dissolve and mix with the surrounding groundwater. This can be the case with active or abandoned mines during extreme weather.

There are four main types of mining impacts on water quality:

- **Acid mine drainage**—Acid mine drainage severely degrades water quality and can make water virtually unusable.
- **Heavy metal contamination and leaching**—Heavy metals (such as arsenic, cadmium, lead and zinc) are leached out and carried in the water. This is accelerated in low pH conditions, such as are generated by acid mine drainage. It can also occur due to discharges of contaminated water when tailings dams overtop, or seepage through dam or pit walls.
- **Processing chemicals pollution**—Chemicals used to separate the mineral can spill, leak or leach into water bodies. These chemicals can be toxic to humans (for example, cyanide) and also present an environmental risk.
- **Erosion and sedimentation**—Excessive sediment can clog rivers and waterways.

The release of water from a mine site is governed by licensing arrangements in many countries, including Australia. The exposure of humans to noncompliant released waters may result in increased health risks, in addition to legal action and damage to reputation. During extreme weather, unplanned releases can cause significant environmental damage and pose major health risks.

How mine water affects communities and the environment has been identified as a high priority issue in developing countries (see case study). Because of past abuses, communities are concerned that mining could damage the environment, with flow-on effects on livelihoods and health. Contamination of water by artisanal scale mining has also been identified as an issue, due to its impact on the environment and the miners' own health (Danoucaras et al. 2012)

Further detailed information on water management that affects mining operations and communities is in the leading practice *Water management* handbook (DITR 2008).

## **CASE STUDY: Fitzroy Partnership for River Health**

The Fitzroy River Basin in central Queensland encompasses six major river systems running through an area of just over 140,000 square kilometres. The catchment stretches from the Carnarvon Ranges in the west to the river mouth in Keppel Bay, near Rockhampton. The basin has significant agricultural and mining industries, as well as being the largest river basin flowing into the iconic Great Barrier Reef.

Around 230,000 people live and work in the communities of the Fitzroy Basin. Agriculture is the major land use, and up to 90% of the landscape is used to produce food and fibre. The region also includes 40 of Queensland's 55 coal mines.



The Fitzroy Partnership for River Health was established following the flooding of Ensham mine during the 2008–09 wet season. The partnership is a collective of government, agriculture, resources, industry, research and community interests that have a common goal of providing a more complete picture on river health. It supports that goal by providing funding and resources and contributing water-quality and ecosystem health monitoring data through data-sharing arrangements. Annual report cards are produced to inform considerations of whether current management strategies are proving successful in maintaining the health of aquatic ecosystems.

The community benefits through access to accurate water-quality and ecosystem health information, presented in a way that is understandable by all. In November 2014, the first Drinking water reports were released for Rockhampton and the Central Highlands, to complement the report card results grading the health of the rivers in the basin. 'A' grades were received for all townships tested.

Source: Fitzroy Partnership for River Health, <http://riverhealth.org.au>.

## **CASE STUDY: Water issues associated with mining in developing countries**

A project funded through the International Mining for Development Centre (IM4DC) aimed to:

- identify and analyse the main mining-related water issues currently experienced in developing countries
- identify priorities for capacity building
- outline solutions and possible barriers to solving the issues.

The project studied eight countries: Mozambique, Zambia, Ghana, Peru, Mongolia, the Philippines, Papua New Guinea and Indonesia. It examined a range of literature to ensure that the perspectives of scientists, academics, mining companies and communities were all included.

The project found that the dominant and highest priority issues identified by all sectors were those involving the community and the environment. Because of past abuses, communities were concerned that mining could damage the environment, with flow-on effects on livelihoods and health. Communities reported that they were not getting the information they needed to understand the impacts of mine-water-related issues. Although there is unbiased information available in the form of the scientific literature, it is not in a format that is accessible to them. Some of the solutions suggested were that academia and government do more to provide understandable, unbiased information to the community; that mining companies could involve the community in their environmental monitoring; and that governments require greater resources for enforcement and implementation of regulations.

Artisanal-scale mining was identified as a medium-level issue due to its impact on the environment and the miners' own health. The issue was brought up not by the community, but in the scientific literature and company reports. Solutions already exist: governments must enforce regulations and close down illegal mines. In at least one example, a mine provided artisanal-scale miners with access to its land after the miners underwent training.

Of importance mainly to the companies was water access for future developments, which was assigned a medium-level priority. It is the government's responsibility to ensure that there is enough water for all users and it is suggested that governments adopt integrated water resource management principles.

Standardised water reporting was assigned a low priority. It had previously been brought up as an issue in an International Council on Mining and Metals study that looked mainly at developed countries, but there are other more pressing issues for developing countries.

Source: Danoucaras, Vink & Bansuan, 2012.

### 3.3.3 Noise

Noise is one of the most significant issues for communities located near mining projects, particularly due to 24-hour, 7-day operations. Mining activities such as blasting, drilling, digging and coal loading and the operations of excavators, trucks, conveyor belts and other machinery all contribute to elevated levels of environmental noise. This can be particularly disruptive for local rural communities accustomed to quiet surroundings. In some regions, there may be multiple mine sites that affect the same community, causing cumulative impacts. Cumulative noise impacts are now commonly raised as a key issue of concern for communities neighbouring mining regions. This includes communities in remote regions (such as the Bowen Basin) as well as those in more concentrated regional areas (such as the Hunter Valley) (see Franks et al. 2010). Noise can also occur throughout all stages of the logistics chain, including rail and truck haulage and port activities.

Blasting can cause noise and vibration, which can have an impact on neighbouring premises. Airborne vibration from blasting (known as airblast) can cause objects to rattle and make noise. At the levels experienced from blasting associated with mining, structural damage to adjoining properties is unlikely to occur. In addition, the noise levels from blasting at a mine site are unlikely to cause any hearing damage to anyone outside the site.

Noise levels experienced from mining operations, including blasting, in communities surrounding mines are generally not high enough to have direct health effects, such as hearing loss. However, the indirect effects of noise include sleep disturbance and interference with communication or concentration. This can lead to irritability and fatigue. Annoyance and discomfort from blasting can occur when noise startles people or when airblast or ground vibration causes the vibration of windows or other items.

Concerned with the potential impact of noise from their heavy vehicles, blasting and fixed plant infrastructure on local communities neighbouring their mining operations in Western Australia, Alcoa developed a noise management plan that includes monitoring systems, procedures, training and audits. Described in the following case study, it is an example of leading practice in noise management (Alcoa, n.d.).

Further information on noise generation, monitoring and effects can be obtained from the leading practice *Airborne contaminants, noise and vibration* handbook '(DITR 2009a).'

## CASE STUDY: Alcoa and noise mitigation



australia's aluminium

# Noise Management

Noise from Alcoa's mining operations is recognised as a potential impact on neighbours living close to the mines and is therefore a priority area of environmental management.

Primary sources of noise from the mines include:

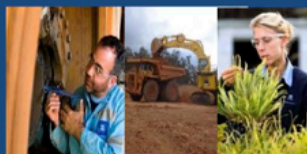
- Blasting of the hard caprock ore layer;
- Mobile equipment such as dozers, scrapers, trucks and excavators; and
- Fixed plant equipment such as conveyor belts, transfer stations and crushers.

Noise is regulated by the Department of Environment and Conservation (DEC). The Environmental Protection (Noise) Regulations 1997 were implemented in 1999 and apply to the Huntly and Willowdale Mines. The noise regulations for operational noise set limits for day time, evening and night time periods. For example, the set noise limits for Day, Evening and Night are 45dB(A), 40dB(A) and 35dB(A) respectively. For blast noise, no blasts are to exceed 125 dB(Pk Lin) and 9 out of 10 blasts are not to exceed 120 dB(Pk Lin).

WA Mining has noise management plans in place to ensure compliance with the Environmental Protection (Noise) Regulations 1997 and minimise noise impacts on neighbours.



*A weather balloon is flown prior to each blast to provide current local weather and atmospheric conditions. This information is then used to predict the noise impact on neighbours.*



**WANT TO KNOW MORE?**  
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Visit the Website [www.alcoa.com.au/nauxitemining](http://www.alcoa.com.au/nauxitemining)  
Call Willowdale Neighbour Relations 9733 8942  
Call Huntly Neighbour Relations 95302527





australia's aluminium

# Noise Management

## Mobile Equipment Noise

At Alcoa's mines, predictive computer modelling and monitoring have assessed the potential noise impacts of mobile equipment. Accordingly, Alcoa has developed and implemented a comprehensive noise management program which includes monitoring systems, procedures, training and audits to ensure effective day to day management of equipment and response to community concerns.

The extensive noise modelling and monitoring undertaken has verified that Huntly and Willowdale Mines are compliant with the Environmental Protection (Noise) Regulations 1997. Similar modelling is also conducted when developing a noise management strategy for new mining regions.

Management of noise at Willowdale Mine is of particular importance due to close proximity of neighbours, predominantly along the western boundary. Mining activities at Willowdale are restricted to specific areas at night to avoid nuisance to neighbours and a continuous noise monitoring network has been established on neighbours' properties. Alcoa also has an automated weather station that provides real-time wind speed and direction information.

The data from the noise monitors and weather station are used to proactively manage operations to minimise noise impacts on neighbours.

*Noise monitoring ensures Alcoa complies with Environmental Protection (Noise) Regulations 1997.*



## Blast Noise

In preparation for a blast, a predictive computer model is run to assess if conditions will ensure the blast meets the required noise limits. This model incorporates the mine pit location, current weather and atmospheric conditions and the location of neighbours in the direction of the predicted impacts.

Alcoa applies internal blast noise limits, which are stricter than the Government regulatory standards. Each blast is monitored at neighbouring properties, predicted to be most impacted by the blast noise, to check levels from a 'pilot shot' and to confirm compliance during the main blast.



*Improving the design of the bauxite conveyor belt and enclosing parts of the system has reduced noise significantly.*

## Fixed Plant Noise

A series of controls has been implemented to reduce noise from conveyors and associated infrastructure. For example, at Willowdale barrier fencing has been installed along side sections of the conveyor, the conveyor belt has been enclosed, quieter conveyor rollers have been installed and cooling fans have been replaced with heat exchangers. In addition, a program for conveyor belt washing has been implemented to reduce dirt build up and reduce noise.

Ongoing maintenance and noise monitoring ensure noise levels remain at acceptable levels.

A Mining Noise Lead Team was established in 2001 and meets on a regular basis to progress noise reduction strategies. Some of the improvements and trials undertaken to date include:

- Installation of alternative reversing beepers on mobile equipment;
- Fitting acoustic enclosures to the new truck fleet;
- Trialling excavator bucket modifications to reduce scraping noise;
- Trialling noise cancellation technology developed by universities;
- Appointment of Mine Neighbour Relations Officers to establish, develop and maintain close communications with all neighbours who may be impacted on by our operations.
- Blast noise reduction trials including investigation of alternative rock breaking methods.
- Benchmarking noise management and monitoring systems (including weather monitoring systems) used by other mining companies in the New South Wales Hunter Valley.

### 3.3.4 Light

Excessive or obtrusive artificial light from mining operations or steps in the logistics chain, such as transport, can affect nearby communities. Light sources include fixed lighting around infrastructure, mobile lighting plants and mobile plant and equipment lights. When artificial outdoor lighting is annoying and unnecessary, it is known as light pollution. Light pollution can be divided into two main types:

- annoying light that intrudes on an otherwise natural or low-light setting
- excessive light that leads to discomfort and adverse health effects.

There is a growing body of scientific research suggesting that light pollution can have lasting adverse effects on human health, including sleep disorders and disruption of the melatonin mechanism (Chepesiuk 2009).

It is important to consider any lighting to ensure that it does not adversely affect communities or accommodation camps and villages.

#### **CASE STUDY: Rosemont Copper Project—Monrad Study**

The Rosemont Copper Project site in southern Arizona lies within an area of concern about the effects of light pollution. Because the project will operate around the clock, additional light pollution is a concern for astronomers and environmentalists. Several of the world's most important observatories are nearby and rely on low levels of light pollution to do their work. Decades of concern by the astronomy community have resulted in the development and implementation of a stringent and continuously evolving outdoor lighting ordinance in Pima County.

As part of its commitment to the best possible environmental practices, Rosemont Copper Company will voluntarily employ an advanced light pollution mitigation plan. The plan will include the use of state-of-the-art lighting equipment and controls to minimise environmental impacts. Importantly, the plan must also comply with the project's operational safety requirements prescribed by the Mine Safety and Health Administration. The plan will include the use of:

- full cut-off solid-state light emitting diode (LED) lighting systems
- high fitted target efficacy lighting systems and optics
- specific-purpose lighting systems with optics that match task requirements
- adaptive lighting controls to dim or extinguish lighting when it is not needed, and to provide immediate 'instant on' emergency or operational lighting
- where colour rendering is needed, colour-tuned solid-state light sources for superior energy efficiency and optical control, with attenuated short wavelengths to minimise Rayleigh scattering
- when colour rendering is not needed, narrow band solid-state lighting to emulate low-pressure sodium light, but with superior optical and electrical control
- colour-adaptive lighting, to shift from narrow band amber emissions to higher colour-rendering light when colour rendering is needed.

(Source: Monrad et al. 2012)

### 3.3.5 Contamination by hazardous materials

A range of hazardous materials could be present at a mining operation. Some specific metals, such as uranium and lead, are inherently risky to extract. There is also variability in how the minerals are processed. Particular aspects of operations that might cause health threats include the following:

- **Smelting**, where the ore is processed at high temperatures—Toxic gases can be released through air emissions and heavy metals can be discharged into groundwater and surface waters.
- **In situ leach mining**, where the ore is processed in place in the ground—Hazardous pollutants can be released into streams, lakes or drinking water wells.
- **Heap leaching and other leaching methods**, where chemicals such as cyanide or sulphuric acid are employed—Leaks of toxic solutions are common and can contaminate ground or surface water.
- **Tailings dams**, where the waste products from a mineral-processing plant are retained.

The broader geographical possibilities for contamination resulting from processing and transport should also be considered. Pollutants from smelters, for example, such as lead and mercury, can be carried long distances by wind and water. Mining pollution can be distributed far from the mine site and can create public health impacts along the transport route.

Further detailed information on hazardous materials management that affects mining operations and communities is in the leading practice *Hazardous materials management* handbook (DITR 2009b).

#### CASE STUDY: Kidston Gold Mine

The grazing trial at Kidston Gold Mine, North Queensland, aimed to assess the take-up of metals from tailings and the potential for unacceptable contamination of saleable meat. Further aims included estimating metal dose rates and identifying potential exposure pathways, including plant uptake of heavy metals, tailings adhering to plants and the direct ingestion of tailings.

It was found that of the 11 metals analysed (As, Zn, Co, Cd, Cr, Sn, Pb, Sb, Hg, Se and Ni) in the animals' liver, muscle and blood during the 8-month trial period, only arsenic and zinc accumulated. A risk assessment including those two metals was conducted to determine the potential for chronic metal toxicity and long-term contamination, using the estimates of metal dose rate.

It was concluded that no toxicity or long-term contamination in cattle was likely at this site. Management procedures were therefore not required at this site; however, the results highlight the percentage of groundcover and standing dry matter as important factors in decreasing metal exposure from direct ingestion of tailings and dust adhering to plants.

Source: Bruce et al., 2003.

## CASE STUDY: Esperance Port lead issues

Magellan Metals, an offshoot of Canadian company Ivernia, started exporting bulk lead carbonate concentrate through Esperance Port in July 2006. The product was transported some 800 kilometres from the mine site near Wiluna in the Northern Goldfields in eight-tonne kibbles covered by tarpaulins, first by road to the railhead at Leonora and then by rail to Esperance. At the port, the contents of the kibbles were tipped into a hopper and transported via conveyor to a storage shed, where the product could sit for up to two months before shipment. In 2006–07, 86,262 tonnes of product was exported, and in 2007–08, 79,588 tonnes.

Exports were halted in March 2008 following the deaths of birds of a number of species in the vicinity of the port, first in December 2007 and then again in March 2008. Tests showed levels of lead in the birds' organs. Investigations indicated that the cause of the deaths was the lead dust escaping from the port boundary during inloading and outloading operations. The low level of moisture in the product when it left the mine site was identified as the problem.

In December 2008, a project team was set up by the Western Australian Department of Transport to clean the Esperance town site of lead carbonate and nickel sulphide dust. The port had handled nickel sulphide concentrates as a bulk product for many years. The project team developed clean-up guidelines, sampling methodologies, cleaning procedures, and validation and monitoring procedures. Isotopic testing identified 2,502 premises within the town (about half) as being contaminated, and after further analysis found that 1,847 homes and other buildings needed some form of cleaning.

The project involved cleaning the roof spaces in 433 premises; cleaning roof surfaces, gutters and rainwater tanks at 1,144 premises; and cleaning internal and external surfaces of 1,648 premises. The physical clean-up was completed in 2011, but a monitoring program continued to ensure that no recontamination occurred. More than 300 people (mainly contractors) were employed on the project, which took more than three years and 220,000 hours to complete. At a cost of \$25.7 million, the project was the biggest environmental clean-up ever undertaken in Western Australia.

Stringent environmental conditions were imposed on the port, including an extensive monitoring regime and a clean-up that included replacing soil and railway ballast along the internal rail network. A \$22 million upgrade of the port's heavy metals concentrate circuit fully enclosed the conveyor system and turning points. A lead removal plan had to be prepared and approved by the environmental authorities for the 9,000 tonnes of lead that remained at the port after exports were stopped. The lead was bagged under controlled conditions, and the last of the product left the port in May 2009. The port continues to handle nickel concentrates, but they come into the port and are shipped in containers.

Source: Esperance Port Authority annual reports 2005, 2006, 2007 and 2008, <http://www.esperanceport.com.au/reports-annual.asp>.

### 3.3.6 The psychosocial hazards of mining on communities

Large-scale mining operations can affect the people living in their vicinity in a variety of ways, some of which are positive, some negative (tables 3.2 and 4.1).

Potential benefits include increased employment and business opportunities, improved infrastructure and services, and social investments made by companies aimed at improving wellbeing and liveability in communities (such as building a swimming pool or funding youth workers). Potential negatives include landscape disturbance, the contamination of rivers and other water sources, the destruction of traditional livelihoods, reduced amenity (noise, dust etc), increased conflict within communities, local price inflation, housing shortages, rapid population influx and loss of cultural heritage.

The nature and scale of impacts can vary markedly from mine to mine, depending on a host of different factors, including:

- the mine's location (is it a settled area, or remote and sparsely populated?)
- whether the mine is on or near Indigenous lands
- the method of mining used (such as open cut or underground)
- the local economy (is it largely dependent on mining and industry, or mainly agricultural?)
- local people's experience and knowledge of mining
- the community's adaptability and resilience
- how well the mine managers understand and manage impacts.

Impacts also vary across the project life cycle (from construction to operation to closure), and through the commodity price cycle (booms present different issues from downturns).

Governments often now require developers of mines and other large projects to undertake a social impact assessment as part of the 'front end' project approval process. The assessments are intended to enhance understanding of how communities might be affected by a development and to identify how unwanted impacts can be avoided or mitigated. Once projects are approved, there is usually little subsequent regulatory oversight of the social impact management process.

However, several leading mining companies have now voluntarily implemented social management systems that include a greater investment in baseline studies, ongoing monitoring of social impacts and risks, and regular updating of management plans to prevent and reduce unwanted impacts and manage risks. Responsible mining companies understand that a failure to address community concerns can threaten a project's 'social licence to operate', making it harder to get regulatory approval for new projects, reducing workforce productivity, causing reputational damage to the company and, in some cases, exposing it to legal action. For the same reasons, it is in the long-term interests of mining companies to better understand and manage the psychosocial hazards associated with unwanted social impacts. See Table 3.2 for some of the changes induced by mining that can lead to social impacts.



Table 3.2: Common changes induced by mining that can lead to social impacts

Social and cultural change	
Population and demographics	In-migration, out-migration, workers' camps, social inclusion, growth or decline of towns, conflict and tensions between social groups
Social infrastructure and services	Demands on and investment in housing skills (shortages and staff retention), childcare, health, education and training
Crime and social order	Corruption, domestic violence, sexual violence, substance abuse and trafficking, prostitution, change in social norms, pace of change for vulnerable communities
Culture and customs	Changes in traditional family roles, changing production and employment base, effect of cash on community, reduced participation in civil society, community cohesion, sense of place, community leadership, cultural heritage
Community health and safety	Disease, vehicle accidents, spills, alcohol and substance abuse, pollution, interruption to traditional food supply, awareness and treatment programs
Labour	Health and safety, working conditions, remuneration, right to assemble, representation in unions, labour force participation for women
Gender and vulnerable groups	Disproportionate experiences of impact and marginalisation of vulnerable groups (women, disabled, aged, ethnic minorities, Indigenous and youth), equity in participation and employment
Human rights and security	Abuses by security personnel (government, contractor, company), social disorder in camps, suppression of demonstrations, targeting of activists, rights awareness programs
Economic change	
Distribution of benefits	Employment, flow of profits, royalties and taxes, training, local business spending, community development and social programs, compensation, managing expectations, equitable distribution across state/regional/local/ethnic/family groups, cash economy
Inflation/deflation	Housing (ownership and rents), food, access to social services
Infrastructure	Demands on and investment in roads, rail, ports, sewerage, telecommunications, power and water supplies
Social and socioeconomic change	
Pollution and amenity	Air (e.g. dust), water (e.g. acid and metalliferous drainage, cyanide, riverine and submarine waste disposal), noise, scenic amenity, vibration, radiation, traffic, government capacity to monitor and regulate
Resources (access/competition)	Land, mobility, water (groundwater, river, ocean), mineral resources (artisanal and small-scale mining), cultural heritage, forest resources, human resources, post-mining land use
Resettlement	Consent and consultation for resettlement, compensation, ties to land, adequacy of resettlement housing and facilities, equity, post-settlement conditions, livelihoods
Disturbance	Disruption to economic and social activities (including by exploration), consultation for land access, frequency and timing, compensation

Source: Franks (2011).

## *Stress and ill-health*

When mining-induced changes are viewed by a community or individual as detrimental and unable to be suitably managed or controlled, stress may result. A large body of literature now suggests that chronic stress is a potential pathway to physical and psychological ill-health, particularly for depression and cardiovascular disease (Cohen et al. 2007); however, demonstrating that link is particularly difficult because it involves the complex interaction of biological, psychological, social and societal factors across the lifespan.

As discussed in earlier sections of this handbook, mining activity has the potential when not suitably controlled to expose workers and nearby communities to airborne and waterborne contaminants, noise, light and hazardous materials that can compromise their physical health. The causes of occupational disease as a result of chemical or biological factors are largely known. For example, contaminants are absorbed by the skin, ingested or inhaled and act as irritants or systemic poisons. In comparison, the trajectory from stress to ill-health (physical or psychosocial) is less clear-cut.

While chronic stress is known to alter our sympathetic, neuroendocrine and immune systems, less is known about the next step that links these alterations with ill-health. Confounding the issue are stress-induced changes in behaviour, such as risky alcohol or drug use or isolating oneself from family and friends, which in themselves can adversely affect health. Pre-existing vulnerabilities related to individual factors such as genetics, lifespan stage, life story and levels of support also add complexity by perhaps causing some people to be more vulnerable to stress than others. It is also now thought that stress does not exist in a negative event, but rather results from the way an individual evaluates or interprets the event and their coping resources. Therefore, stress reactions are more likely to occur when:

- the change event is perceived as being harmful, threatening or challenging
- the community or person perceives that they do not have the resources, coping strategies and/or support available to manage or influence the disruptions caused by the event (Lazarus & Folkman 1984).

Despite this complexity, chronic stress does appear to contribute to ill-health (directly or indirectly). On that basis, mining proponents should suitably control operations that are known to trigger acute stress responses, particularly those that persist across long periods of time. The most obvious are physical aspects that arise as a function of mining operations, such as mining-induced disturbances of visual amenity, noise, light, odour, traffic and vibration, all of which can occur 'too often' and persist 'too long' and potentially produce a sustained stress response in communities.

These problems are largely addressed in mining and environmental legislation. Best practice management of them includes the implementation of controls throughout the lifespan of the mine, initial assessments of impacts, community engagement (including community issue and complaint systems), careful mine design and practice, fit-for-purpose equipment, the training of personnel, and ongoing and final rehabilitation of the site. An example of a method to develop suitable controls for mining-induced impacts is suggested below under 'Substance abuse'. Best practice controls of noise, light and traffic are also described in the relevant sections of this handbook. Other mining-induced effects that could elevate local communities' stress responses are landscape changes, workforce roster arrangements and social changes brought about by the influx of mining personnel.

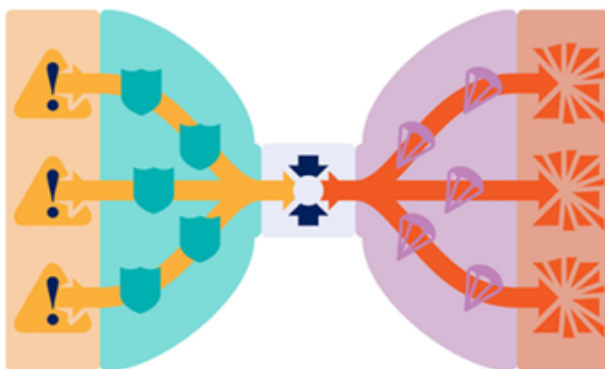
Where multiple mining projects are operating in the same general area, nuisance and amenity factors may have a cumulative effect, exacerbating community distress. Cumulative impacts result from the aggregation and interaction of impacts and may be the product of past, present or future activities (Franks et al. 2010:300). In such cases, a more strategic management approach that includes multi-stakeholder, cross-government, single-company, multiple-company and cross-industry approaches is needed. Franks et al. (2010) suggest the following best practices in such circumstances:

- strategic and regional planning
- information exchange, networking and forums
- pooling of resources to support initiatives and programs
- multi-stakeholder and regional monitoring.

### *Place identity*

One explanation for the association between environmental disruption and stress is an individual's sense of 'place attachment' or 'place identity' whereby the environment becomes part of their personal identity and they develop a strong attachment to the place (Connor et al. 2004). This view supports Albrecht's (2005) concept of 'solastalgia', which describes a feeling of 'homesickness at home' that might be experienced when the home environment is significantly changed. It is distinct from nostalgia because it describes feelings of loss due to separation from home, despite the sufferer being at home.

A growing body of research has documented the impact of ecological disturbance on psychosocial health and wellbeing. People living in communities near to hazardous waste sites, chemical spills, industrial areas and mining regions (Baum & Fleming 1993; Connor et al. 2004) have been found to have elevated physical symptoms of stress (blood pressure, sympathetic arousal, cortisol levels) and/or emotional, cognitive and behavioural distress (worry, anger, feelings of loss, anxiety, depression, perceived loss of control, poorer task performance). In Australia, Connor et al. (2004) investigated people living in mining-affected communities in the Hunter Valley region and found that they experienced considerable emotional distress about the loss of or damage to homes, farming properties, the landscape and community heritage. A sense of loss was particularly felt for objects and places that had special significance for their personal history and way of life. In a later study, Higginbotham et al. (2006), using a measure of 'the bio-psycho-social cost of development activities', found significantly elevated 'environmental distress' scores in a group of people living near coal mines in the region compared to a group living in a nearby farming area.



### *A technique for managing community distress*

Bow-tie methodology is used to manage unwanted events from a risk management perspective. In this form of analysis, the unwanted event is the centre (or knot) of the bow-tie. On the left and right side of the knot are listed the causes and consequences of that event, respectively. Each of the causes and consequences is linked to a series of controls that have the potential to either prevent the event

occurring (preventive controls) or reduce the extent of the consequences (mitigating controls) (Kirsch et al. 2013). This method is commonly used by mining companies in Australia to help them implement safer operations. It is presented here to illustrate how it could be used to guide practice in building a body of

controls for managing community distress as a result of mining activity. This could potentially be a means of sharing knowledge across the industry, as has been the case in the coal industry's funding of the RISKGATE online tool for the management of key coal mining hazards (see [www.RISKGATE.org](http://www.RISKGATE.org), Kirsch et al. 2013).

Ideally, a bow-tie is developed using small groups of experts. For a particular unwanted event, the group could include key personnel from mining companies and community health-oriented organisations (GPs, government and private service providers).



In the following example, the unwanted event (the knot in the middle of the bow-tie) is community distress. The particular cause that is addressed is *reduced visual amenity*. Because this handbook is focused on community health, consequences could be factors such as increases in incidences of reporting of psychological distress, unhealthy behaviours (such as increased alcohol use) and symptoms of illness. However, at earlier stages it is more likely to result in community anger, loss of trust in the mining company and so on. Potential preventive controls are shown in Table 3.3; mitigating controls are shown in Table 3.4.

Table 3.3. Preventive controls

<b>Undertake a visual impact assessment</b>
<ul style="list-style-type: none"> <li>• Undertake baseline landscape characterisation.</li> </ul>
<ul style="list-style-type: none"> <li>• Assess the impacts (determine the visibility of the mine from many vantage points, including the person or group that would experience an impact, the duration of impacts etc).</li> </ul>
<ul style="list-style-type: none"> <li>• Develop preventive and mitigating controls.</li> </ul>
<b>Undertake community engagement</b>
<ul style="list-style-type: none"> <li>• Determine community values in terms of visual sensitivity to changes in particular landscapes, particularly in relation to residential dwellings, locations of public and private importance, heritage sites, tourist destinations, major and secondary roads.</li> </ul>
<ul style="list-style-type: none"> <li>• Manage community complaints early to prevent escalation, including receipt of complaints, investigation, appropriate remedial action, feedback to the complainant, communication to site management or personnel and notification to external bodies where necessary.</li> </ul>
<ul style="list-style-type: none"> <li>• Maintain and publicise a 24-hour, 7-day community and employee information phone line and email address.</li> </ul>
<ul style="list-style-type: none"> <li>• Include in the mine's annual review report a summary of any visual or landscape management issues and actions arising throughout the year.</li> </ul>

<b>Mine design</b>
<ul style="list-style-type: none"> <li>• Buildings and structures designed, located and constructed so as to blend as far as possible with the surrounding landscape (coloured in suitable natural tones etc).</li> </ul>
<b>Mining operations</b>
<ul style="list-style-type: none"> <li>• Keep out-of-pit dumping to a practical minimum.</li> </ul>
<ul style="list-style-type: none"> <li>• Limit vegetation clearance to required areas only.</li> </ul>
<ul style="list-style-type: none"> <li>• Respread any pre-stripped topsoil, fallen timber and leaf litter.</li> </ul>
<b>Undertake progressive rehabilitation</b>
<ul style="list-style-type: none"> <li>• Aim to rehabilitate land as soon as possible after disturbances.</li> </ul>
<ul style="list-style-type: none"> <li>• Carry out temporary rehabilitation (of overburden spoils etc).</li> </ul>
<ul style="list-style-type: none"> <li>• Progressively excavate, backfill and rehabilitate pit areas over the life of the mine.</li> </ul>
<ul style="list-style-type: none"> <li>• Remove infrastructure areas such as access tracks or roads and drill sites that are no longer needed to alleviate compaction and increase infiltration.</li> </ul>
<ul style="list-style-type: none"> <li>• Construct earthworks to control drainage and provide sediment and erosion control.</li> </ul>
<b>Screening to minimise visual impacts</b>
<ul style="list-style-type: none"> <li>• Retain existing roadside and fenceline vegetation.</li> </ul>
<ul style="list-style-type: none"> <li>• Use vegetation screening around individual residential premises.</li> </ul>
<ul style="list-style-type: none"> <li>• Use vegetation screening and elevated bunds around mine infrastructure and activities (accommodation, offices etc).</li> </ul>
<b>Rehabilitation</b>
<ul style="list-style-type: none"> <li>• Recontour and rehabilitate out-of-pit spoil dumps to elevated landforms following mining operations to reduce visible impacts and support sustainable grazing.</li> </ul>
<ul style="list-style-type: none"> <li>• On the closure of the mine, decommission and remove all structures.</li> </ul>
<b>Develop and implement a maintenance and monitoring plan for revegetated areas</b>
<ul style="list-style-type: none"> <li>• Manage replanted areas through a landscape maintenance program that responds to site and environmental conditions and includes ongoing monitoring of planting success and weed management.</li> </ul>
<ul style="list-style-type: none"> <li>• Employ an environmental/community officer (or delegate) to inspect and ensure compliance with the visual amenity plan.</li> </ul>

Table 3.4. Mitigating controls

<b>Ongoing community engagement</b>
<ul style="list-style-type: none"> <li>• Community complaints management, including receipt of complaints, feedback to the complainant, communication to site management or personnel and notification to external bodies where necessary.</li> </ul>
<ul style="list-style-type: none"> <li>• Maintain and publicise a 24-hour, 7-day community and employee information phone line and email address.</li> </ul>
<ul style="list-style-type: none"> <li>• Include in the mine’s annual review report a summary of any visual or landscape management issues and actions arising throughout the year.</li> </ul>
<ul style="list-style-type: none"> <li>• Run community forums, information evenings and workshops.</li> </ul>
<b>System to investigate community issues and complaints</b>
<b>Implementation of remedial action</b>

### *Long-distance commute work arrangements*

In the past 10 years, long-distance commute work arrangements have become commonplace in the Australian mining industry. Employees are transported (by plane, car, bus or any combination of them) to distant worksites, where they are accommodated either on site or in local communities. When workers travel between home and work by plane, such arrangements are known as fly-in/fly-out (FIFO) arrangements. In Australia, the resources boom of the 1990s and early 2000s led to an explosion in long-distance commute worker numbers, particularly in Western Australia and Queensland—Australia’s resource-richest states. In 2012–13, there were an estimated 70,000 such workers in those two states (SCRA 2013).

Long-distance commute work schedules generally consist of a series of extended rosters of consecutive 12-hour shifts in a block (or ‘swing’) that maximise workers’ days at the work site and lengthen their breaks at home. While the characteristics of FIFO accommodation facilities vary considerably from camp to camp, depending on such factors as the nature and location of the operation, the age of the camp, and the requirements of the company or operator involved, there is evidence of a move to more sophisticated design elements in modern FIFO accommodation. Earlier temporary accommodation was basic and was typically located on the mining lease or construction site. These camps were sometimes ‘closed’ facilities that were both physically and socially isolated from the nearest residential community. While such camps still operate, more recently there have been significant changes in the design and location of FIFO worker accommodation, with a greater range of facilities on offer and in some cases efforts to incorporate modern FIFO villages into existing residential communities. Increasing attention is being paid to understanding the experience of the FIFO lifestyle and the expectations of FIFO workers (Barclay et al. 2013).

FIFO has generated considerable public debate in the Australian community, prompting three recent government inquiries into the effects of FIFO practices on workers’, families’ and communities’ wellbeing (SCRA 2013; EHSC 2014; IPNRC 2015). Concerns have focused on whether extended periods away from family and friends have adverse effects on workers’ (and families’) psychosocial health and wellbeing—an issue that might be heightened in under-represented groups, such as women.



The advantages of FIFO work arrangements are that workers have a block of time off that is relatively free from work commitments. They do not have to live permanently in very remote regions, where some experience considerable social isolation, boredom and lack of services. Also, workers' families living in in urban areas have better medical and emergency services, services for children with special needs, childcare services, a range of educational options for children and employment options that they would not have if they lived in remote areas.

FIFO has also been reported as causing a range of social and economic stresses in local or host communities. Some are associated with the loss of local benefits through 'fly-over' effects, including the failure of mining companies to provide employment or training opportunities to local people. Others are associated with the in-migration of the FIFO workforce, such as reductions in housing affordability, greater pressure on local services (medical and police), and increases in crime, drug use and prostitution.

Despite the potential problems associated with FIFO arrangements, they are likely to persist due to the continued economic importance of mining, the remote location of mining in Australia, the preference of some workers to live with their families in urban areas and labour shortages in rural areas.

Recommendations from the recent government inquiries have included minimising the length of rosters and setting limits on the proportion of a company's workforce that is involved in FIFO arrangements. Further industry–research collaborations are needed to identify evidence-based information about the conditions that exacerbate FIFO impacts and about interventions to better support workers, families and communities.

### *Substance abuse*

Australian mines are obligated under WHS legislation to effectively manage risks associated with workers whose behaviour is impaired by alcohol and illicit drugs. They do so using SHMSs comprising education programs, Employee Assistance Programs and assessments to decide a person's fitness for work. However, companies cannot control their employees' behaviour outside of work. Increased drug and alcohol use in society, particularly among men, is well documented and has been linked to an increasing incidence of mental health problems in the population as a whole.

One particular concern in the workplace is the difficulty of detecting and managing users of newer

synthetic drugs. Another issue reported by the National Centre for Education and Training on Addiction is that 'drug testing cannot detect psychological factors associated with regular use, such as anxiety, depression, paranoia, and aggressive behaviour that can impact workplace productivity, safety and worker wellbeing' (Pidd & Roche 2015).

While the overall use of methamphetamines has remained stable in the past decade (around 2% of people are users), the use of one form of it—'ice' (or crystal methamphetamine)—has doubled. It is more commonly used by 18–30-year-old men, particularly those living in remote and very remote areas who are technicians or tradespeople (AIHW 2014). As the mining workforce's demographic is similar to that of those most at risk for illicit drug use, mining companies have the potential to participate in workforce and community programs that build awareness of the effects of drugs and alcohol on health, wellbeing and medical and psychological conditions, particularly for at-risk groups (such as young men).

### **3.3.7 Communicable diseases**

The health needs of communities dependent on or living around mining sites can be significant, particularly in developing countries but sometimes also in remote regions of developed countries. There is the risk of communicable diseases (including respiratory, gastrointestinal or sexually transmitted diseases) arising from interactions among the workforce and local communities.

Programs to address the risk of communicable disease require appropriate management and education of the workforce to be put in place. These programs originate at the mine site and target employees at risk of a range of communicable diseases. Once developed and tested at the site, programs often extend to include local employees' family members, in addition to the associated communities. One such example is of Newmont's program to mitigate the risk of HIV/AIDS and malaria among its employees (see case study).



## **CASE STUDY: Workplace program for HIV/AIDS and malaria, Newmont Ghana Gold**

### **Program rationale**

Following a Newmont-initiated health survey conducted in the area around the Ahafo mine concession in 2005, Newmont Ghana Gold studied the gaps in healthcare provision and the burden of disease in the area. The company focused on malaria and HIV/AIDS awareness, prevention and treatment, given that the prevalence of malaria among employees was 8% in 2006 and HIV prevalence in the Brong Ahafo region, where the Ahafo mine is located, was 3.3%. Recognising that both of these communicable illnesses could have an unacceptable impact on the wellbeing and productivity of the company's employees, the leadership of Newmont Ghana decided to begin with workplace vertical programs before expanding the tested model into the wider project-affected communities.

### **Design**

In consultation with the Ghana Health Service and district authorities, the HIV/AIDS workplace program began in 2005 and the malaria workplace program began in 2007. The HIV/AIDS program is centred on Newmont's corporate HIV/AIDS policy of prevention, non-discrimination and support. The program comprises a voluntary counselling and testing service and a peer education initiative. It has trained a selection of educators from among Newmont's employees and contractors, delivering awareness campaigns on HIV/AIDS and malaria to more than 10,000 people each year. The voluntary counselling and testing service also includes blood sugar and blood pressure tests for non-communicable diseases such as diabetes and heart disease. Other major components of the HIV program include:

- prevention messages through routine workplace update meetings and peer education
- condom promotion and distribution
- sexually transmitted infection counselling and management
- treatment and support for workers with HIV
- counselling and testing.

### **Outcomes and impact**

Malaria prevalence dropped from 8% per year for employees at the outset of the program to 1.1% in 2012, and testing for Newmont Ghana employees in Ahafo rose from 172 employees being tested to 1,011 in 2012.

In 2010, the Global Business Coalition on HIV/AIDS, Tuberculosis and Malaria voted Newmont Ghana's as the leading HIV/AIDS and malaria workplace program.

These results are likely to be sustained as long as the program continues. Sustaining results, particularly once the mine exits and the Newmont Ahafo Development Foundation (NADF) is overseeing the vast majority of the communities' development projects, will be a challenge for district health directorates.

Source: ICMM (2013).

### 3.3.8 High-risk groups

When considering the safety and health of a community, it is important to recognise that a number of high-risk groups in the community may have particular needs or require additional protection. They may view mining activities as being more harmful to their lifestyle or way of life, or they may see themselves as having fewer available resources (or power) to manage or confront change. Such groups may include:

- **Indigenous groups**, who might experience high levels of poverty and employment disadvantage
- **women and girls**, who might experience employment or education discrimination
- **children**, who might be at greater risk for certain health problems due to the effect of pollutants, such as lead, on development
- **poorer households**, who might not have the resources necessary to identify or address health issues
- **elderly or disabled people**, who might not be able to or wish to leave an area of health risk
- **those without access to or the ability to own land**, whose need for income might push them to illegal operations.

These high-risk groups can have more severe health problems from exposure to mining health risks. For example, extended rosters of 12-hour shifts, which are typical in the mining industry, can differentially affect families. While resilient families might have the resources to better adapt to the demands of an often absent (and sometimes fatigued) parent, vulnerable families could experience extra stress. For instance, the symptoms of a family member with a chronic physical or mental illness might be exacerbated when they are unable to receive the extra support given by a regularly absent parent.

### 3.3.9 Potential health benefits from mining to the community

A mining operation also has the potential to significantly benefit the local population by creating direct and indirect employment, transferring skills, enhancing the capacity of health and education services, improving infrastructure, and creating business opportunities for small and medium-sized enterprises. This needs to be considered in a sustainability framework, as the inevitable closure of a mine can also cause significant adverse effects for the local population.

Resources available locally for health services typically increase markedly with mine development as companies develop facilities for employees and their families. This may translate into overall improvements in community health if the facilities are made available to the broader community. Employment and higher living standards can bring important nutritional and psychological benefits, and better health standards.

## 3.4 Community health and safety impact assessment

The assessment and management of community health and safety are part of the risk management and social responsibility of owners and operators in the minerals industry. Community health and safety are usually considered as an integrated part of the broader environmental and social impact assessment (ESIA) process or may be completed as a stand-alone health and safety impact assessment (HSIA) if the impacts warrant it. Whichever method is used, it is important to ensure that the assessment systematically addresses the potential negative and positive effects of policies, plans, programs and projects on community health and safety by identifying, preventing and/or mitigating the impacts and risks.

The issues to be considered from a community health and safety perspective are broad, as mining affects a range of determinants, including direct effects on health and safety and indirect effects on health (such as social, cultural, environmental and economic factors), as summarised in Table 3.5. Additional consideration may be needed for high-risk groups in the community.

**Table 3.5 Effects on the community from mining**

DIRECT EFFECTS	INDIRECT EFFECTS
<ul style="list-style-type: none"> <li>• Physical injury</li> <li>• Mental health and wellbeing</li> <li>• Infectious disease</li> <li>• Chronic disease</li> <li>• Emergency situations</li> </ul>	<ul style="list-style-type: none"> <li>• Housing</li> <li>• Water supply and sanitation</li> <li>• Transport</li> <li>• Learning and education</li> <li>• Crime and security</li> <li>• Social care and public services</li> <li>• Commercial goods and services</li> <li>• Social capital and community cohesion</li> <li>• Leisure and recreation</li> <li>• Energy</li> <li>• Waste</li> <li>• Land and space</li> </ul>

The cumulative impact of mining operations in a region needs to be included in the impact assessment. Impacts may be synergistic or additive, and short-, medium- and long-term effects need consideration.

A proactive approach to preventing negative impacts and maximising positive benefits can improve the financial performance of a project or company, in addition to bringing environmental and social benefits. Key benefits include:

- speedier achievement of a project’s licence to operate
- lower planning and associated legal and consultancy costs
- lower risk of disruptive protest or sabotage
- lower risk of damage to a project and company’s reputation
- lower risk of future community-led liability and litigation
- reduced absenteeism and healthcare costs for employees from local communities
- improved employee morale. (International Council on Mining and Metals (ICMM 2010).

### **3.4.1 The health and safety impact assessment process**

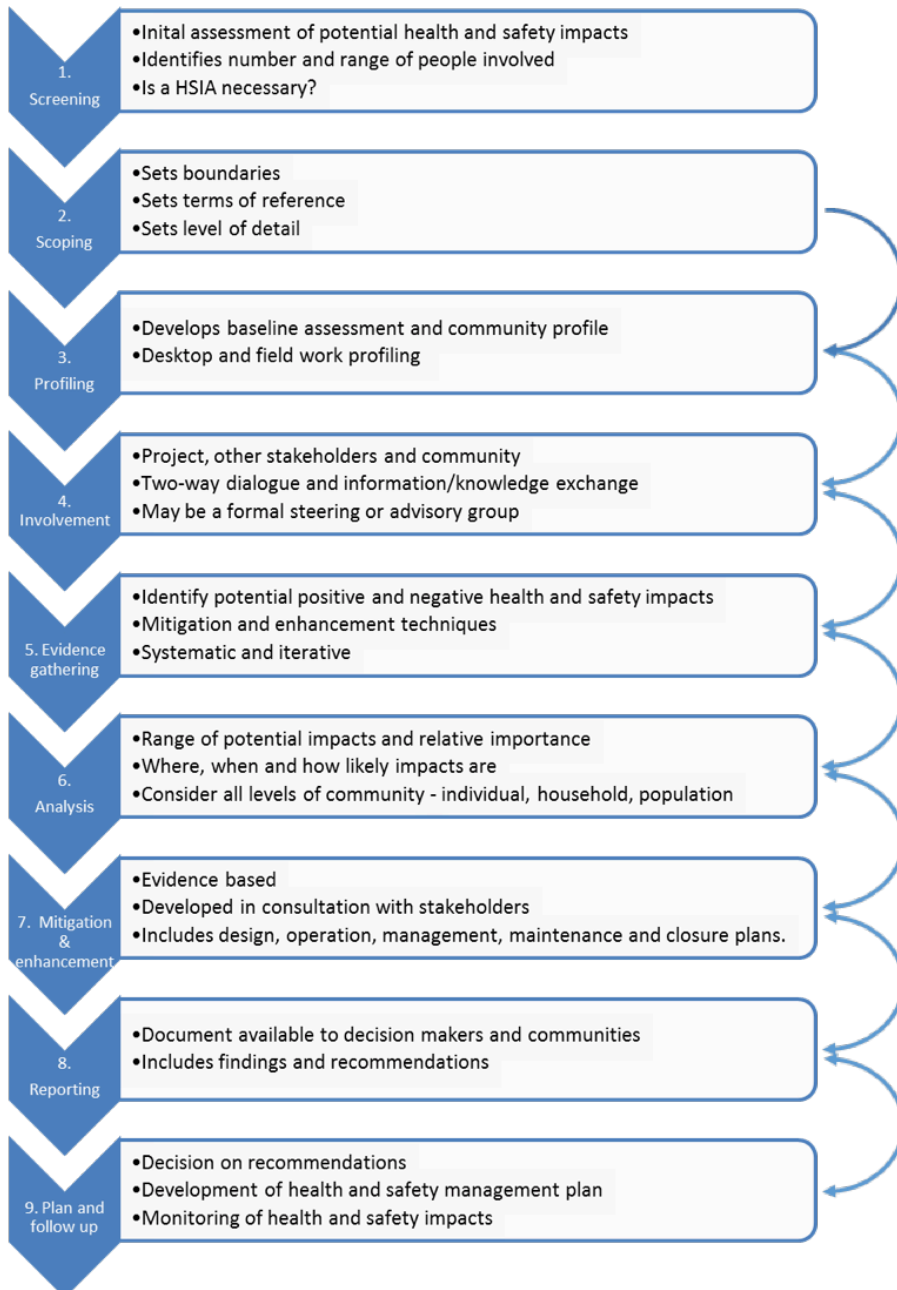
An HSIA systematically analyses potential health and safety impacts and aids the development of options to maximise the positive impacts and minimise the negative impacts. A WHS risk assessment can be combined with the community HSIA to inform strategic health and safety planning.

The model shown in Figure 3.2 is modified from ICMM (2009, 2010). It outlines the steps required for an effective and thorough HSIA. Although the model is presented as a linear process, in practice it is iterative and steps may need to be revisited if new or additional information becomes available. Each step needs to be managed to ensure that appropriate and relevant information is sourced and used.

The following ICMC documents provide detailed information on how to complete a health impact assessment:

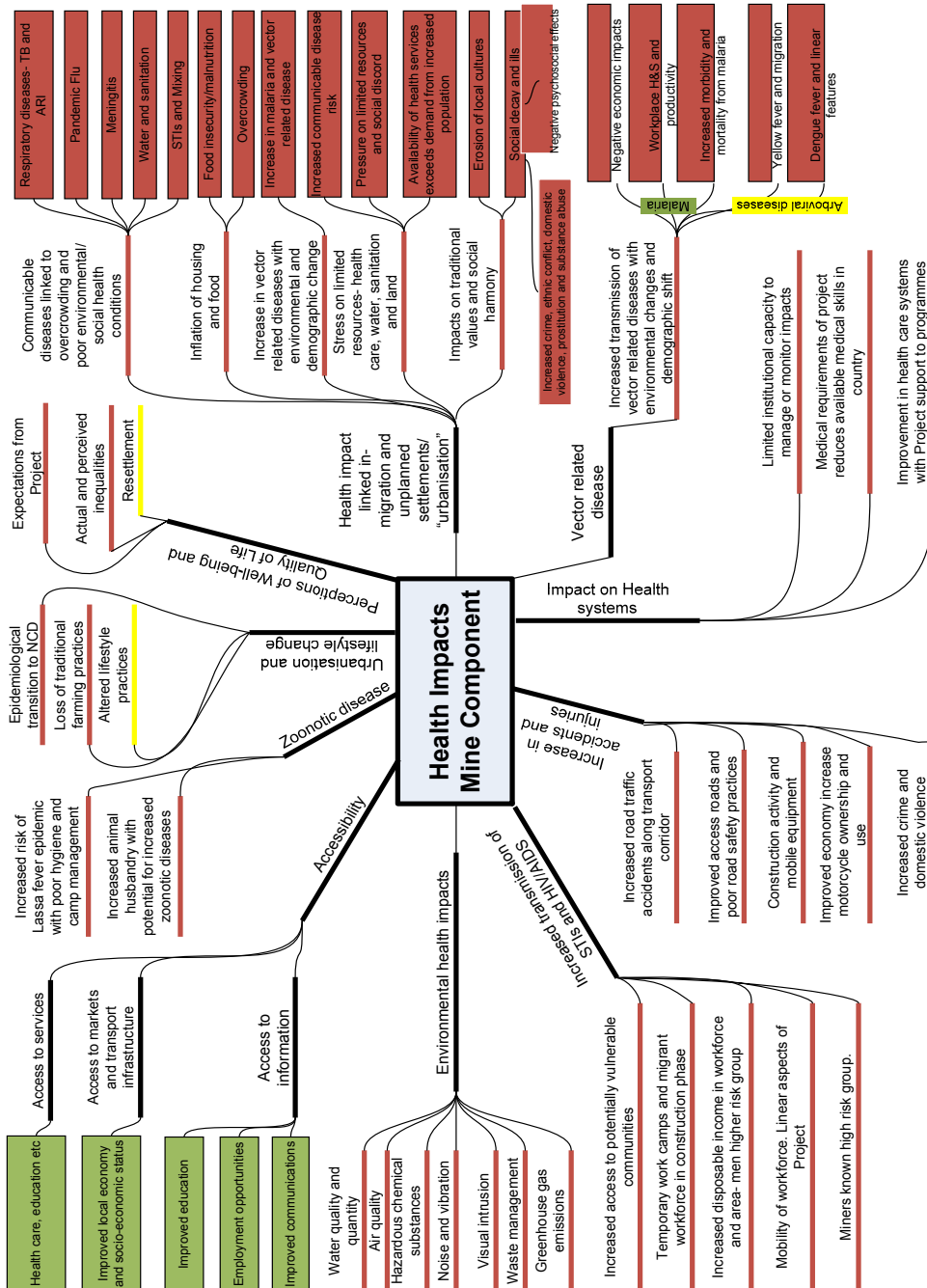
- *Good practice guidance on health impact assessment (2010)*
- *Good practice guidance on occupational health risk assessment (2009).*

Figure 3.2: Model health impact assessment process



Simandou is a Rio Tinto iron ore mine in Guinea. Figure 3.3, a summary of the health impacts from the mine component of the Simandou Social and Environmental Impact Assessment, demonstrates the range and complexity of the information gathered during the assessment and the perceptions and outcomes that could be included.

Figure 3.3: Health impacts of the Simandou iron ore mine, Guinea



Source: Rio Tinto (2012). Simandou Social and Environmental Impact Assessments (SEIA) [http://www.riotinto.com/documents/M\\_An21A\\_CHSSBase\\_EN.pdf](http://www.riotinto.com/documents/M_An21A_CHSSBase_EN.pdf).

## 3.5 Management of health and safety impacts

The HSIA identifies the potential impacts and recommends measures that will minimise negative impacts or enhance positive impacts through the development and implementation of a health and safety management plan. The recommendations need to be reviewed, and that is most effective if the review is completed in partnership with other stakeholders, including the communities affected. The actions identified in the plan should be:

- implementable
- proven to work
- socially and culturally acceptable to the community
- cost-effective.

### 3.5.1 Controls and interventions

It is always more effective to prevent harm occurring than to simply react to it. Therefore, the hierarchy of measures to be considered is similar to the hierarchy of control used in WHS. Table 3.6 outlines a hierarchy of controls or interventions for community health and safety issues and some examples. The type of control or intervention used differs according to:

- the nature of the hazard
- the location of the community (developed versus developing country)
- the level of involvement (passive versus active)
- whether the intervention is sole or partnered
- workforce planning
- families and relationships
- the nature of the community (Indigenous or otherwise).

Table 3.6: Hierarchy of interventions for community health and safety

<b>AVOID</b>	Design the project so that a feature that may cause a potential negative health impact is designed out. For example, reroute a road and provide a footpath for pedestrians and safe places to cross, or prevent stagnant pools of water in which mosquitoes can breed forming on the site.
<b>REDUCE</b>	<b>At project site (source):</b> This involves adding something to the basic design to abate the impact. Pollution controls fall into this category (for example, reduce emissions from chimney stacks by using air filters).  <b>In community (receptor):</b> Some impacts cannot be avoided or reduced at the project site. In this case, measures can be implemented offsite in the community (for example, provide safe crossing points on busy roads and reduce traffic speeds near settlements).
<b>REMEDY</b>	Some impacts involve unavoidable damage to a resource, which then needs repair or remedial treatment (for example, provide medical treatment for a chemical spillage, replace a water well lost during construction or remediate contaminated land).
<b>COMPENSATE</b>	Where other mitigation approaches are not possible or fully effective, compensation for loss, damage and general intrusion might be appropriate. This could be 'in kind', such as by planting new food crops elsewhere to replace what has been lost, by making financial payments for losses of productive farming land, or by providing community facilities to compensate for the loss of recreation and amenity space.

Source: ICMM (2010).

### **3.5.2 Monitoring**

Monitoring health outcomes and health determinants is a critical part of a successful health and safety management plan for stakeholders and communities. Having baseline health information as part of the HSIA provides an effective reference to identify positive and negative impacts and key indicators. There may be stakeholders and other service providers who are collecting relevant information, and data sharing may be possible. Where this is not possible, information relevant to the key indicators will need to be collected. The key indicators need to relate to the direct and indirect health effects identified in Table 3.5.

## 4.0 CORPORATE SOCIAL RESPONSIBILITY

Corporate social responsibility is 'the continuing commitment by business to behave ethically and contribute to economic development while improving the quality of life of the workforce and their families as well as of the local community and society at large' (WBCSD 1999:3). It embraces ideals of community development and engagement, which are addressed in an earlier handbook in the Leading Practice in Sustainable Development Program for the Mining Industry series (DITR 2006b). This section briefly presents some key concepts in that handbook and then provides some illustrations from a community health and safety perspective.

### Terminology

*Community development* is fundamentally about contributing to communities so that they are better able to meet their needs and aspirations, both now and in the future. At its broadest, it is as much about improving quality of life as it is about increasing standards of living in purely economic terms.

Community development includes helping people to link up and support each other through organisations and networks. It can also involve industry working with or influencing governments, other institutions and agencies to contribute to such areas as:

- improving public health and other services
- enhancing the local environment
- building community pride
- strengthening local institutions
- working with marginalised groups to help them participate more fully in the development of their community.

*Community engagement* may involve no more than a basic level of interaction with the local community, such as providing information about the operation. This is often facilitated through information booths, media releases, newsletters, brochures, mailout programs, websites and hotlines. The use of these techniques is often perceived as a way to present basic information to the widest range of stakeholders. As the engagement process moves towards a more directed method of stakeholder interaction, consultation may be used to ascertain specific areas of risk and opportunity. This interaction can involve public meetings, discussion groups, polls, surveys and focus groups.

(Source: DITR (2006b) Community Engagement and Development)



## 4.1 Community development in a health and safety context

The ICMM's *Good practice guidance on health impact assessment* (ICCM 2010) highlights the important and positive contribution that mining companies can make to the health and wellbeing of mine workers and the communities in which they operate. It also encourages the careful selection of health and safety interventions that match the needs of the local community and take advantage of the organisation's resources and expertise.

Based on a 2013 review of its member companies' health programs, the ICMM has identified five common community health strategies used by mining companies:

- **global and regional health initiatives**, usually characterised by investment in an existing program
- **communicable disease control initiatives** in Africa and Asia, addressing diseases such as HIV/AIDS, tuberculosis and malaria among employees, their families and local communities
- **primary healthcare programs** implemented by third parties in settings where government health systems are relatively weak
- **support for health programs** implemented by local government where district health authorities have enough capacity to directly manage the project
- **specialised health interventions**, often targeting marginalised communities, usually in remote areas of developed countries.

In developing countries where people live a higher proportion of their life in poor health and about 36% of deaths continue to be attributable to communicable diseases, maternal and perinatal conditions and nutritional deficiencies (Lopez et al. 2006), broad health initiatives provided by mining companies (such as vaccination programs) can significantly contribute to improvements in community wellbeing.

In developed countries, and also now in many developing countries (such as in Latin America), there has been an increase in the prevalence of chronic non-communicable diseases. Controlling those diseases requires interventions that manage a different set of risk factors, more associated with individuals' lifestyles, that can be less amenable to change. For example, the common risk factors underpinning the four major non-communicable disease groups (cardiovascular diseases, chronic respiratory diseases, cancers and diabetes) are tobacco use, unhealthy diets, physical inactivity and harmful use of alcohol.

Table 4.1 shows some health-related community programs supported by mining companies operating in Australia. A range of activities is supported: some focus on the broader population, while others focus on specific groups (children, young people). Initiatives could be grouped according to whether they address the prevention (education, activity/sport facilities), early detection and treatment (special needs in schools), or long-term management of health-related issues (recovery services, mental health strategies)—termed primary, secondary or tertiary care, respectively. Most have been focused on addressing health issues relevant to remote communities, including Indigenous communities and including by providing better access to medical and support services.

Table 4.1: Example of recent community development activities in Australia

<p><b>Anglo American</b>, financial contributions:</p> <ul style="list-style-type: none"> <li>• Moranbah 2020 community investment program</li> <li>• Used to deliver key community infrastructure projects, including an aquatic centre in Moranbah, upgrades to local infrastructure, assistance with special needs in schools, new housing infrastructure and an alliance with the RACQ rescue helicopter</li> </ul>
<p><b>BHP Billiton</b>, financial contributions:</p> <ul style="list-style-type: none"> <li>• Swim and Survive program (Royal Life Saving Society Western Australia)—through this 10-year partnership, BHP Billiton has supported targeted community programs such as Swim and Survive, Keep Watch, Watch Around Water, Remote Aboriginal Swimming Pools, Infant Aquatics and Indigenous Traineeships</li> </ul>
<p><b>Centennial Coal</b>, financial contributions:</p> <ul style="list-style-type: none"> <li>• Upgrading information technology system (Lithgow Community Private Hospital)</li> </ul>
<p><b>Glencore Qld</b>, financial contributions:</p> <ul style="list-style-type: none"> <li>• Family crisis accommodation (Townsville's Ronald McDonald House)</li> <li>• Recovery services (Salvation Army, Eastern Territory)</li> <li>• Homeless kitchen (Mount Isa Jangawala drop-in centre)</li> <li>• Youth and Community Engagement Co-ordinator (Cloncurry PCYC)</li> <li>• Sport for life program, aimed at young people (Stride Foundation, Mt Isa—uses high-profile sporting role models to deliver health education and life skills workshops to young people living in remote communities)</li> <li>• Child safe services (Act for Kids)</li> <li>• Children's retreat (Townsville Hospital Foundation)</li> <li>• Provision of an emergency helicopter (North Queensland Helicopter Rescue Service)</li> </ul>
<p><b>Rio Tinto</b>, financial contributions:</p> <ul style="list-style-type: none"> <li>• Building the capacity of FIFO communities (Ngala, Western Australia)—aims to build the capacity of local service providers and provide them with strategies to better address the needs of a FIFO population; includes an array of workshops in Busselton, Geraldton, Bunbury, Albany, Broome, Perth and Carnarvon</li> <li>• Mental health (Disability in the Arts, Disadvantage in the Arts)—addresses mental health issues through a variety of artistic and cultural projects that promote social connection, self-expression and community resilience in five Western Australian regional communities: Busselton, Paraburdoo, Geraldton, Derby and Esperance</li> </ul>

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