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A new framework for evaluating beneficial end-uses for mine voids

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Abstract

The rehabilitation and closure of mining voids (which are the large holes remaining upon the cessation of mining) and other mine types in Australia is an issue that involves mining companies meeting legislative requirements for rehabilitation that are enforced by states. Until July 2011, there were no government policy guidelines regulating mine closure or specific legislation regulating mine closure, with mining acts mostly dealing with the environmental aspects surrounding mine site rehabilitation. While there has been research conducted into these legislative requirements and environmental responsibilities, little research has been conducted into examining the economic and social objectives once mining has ceased, nor the requirement for the development of national legislation for mine closure. The lack of mine closure legislation and the need or otherwise for it, is the focus of this research, which investigates 'If there is currently no specific mine closure legislation in Australia, what then represents best closure practice?' Its aim is to develop and explore a framework for mine closure that can be implemented by government, the mining industry and mining communities to provide best practice outcomes for mine void closures. It seeks to answer the following research question: 'What is an appropriate legislative, analytical and stakeholder participation framework for the end-use of mining voids in Australia?'

The thesis is a deliberately wide-ranging research project, which is a scoping study designed to highlight any gaps in the mine closure process in Australia, identify what these gaps are and recommend areas for further research. It has adopted the pragmatism approach to the research process, the central principle being the understanding that adopting a mixed methodology approach using both qualitative and quantitative methods is appropriate within a single study. The philosophical positions adopted in this thesis do not belong to one particular ontological, epistemological, or axiological stance, but instead use a variety of these throughout the work.

The qualitative research methods used include an extensive literature review that examined literature on: sustainable mine closure to determine what constitutes sustainability from the perspective of mine closure; mine closure planning processes; community engagement processes; and mining legislation from countries across the developed world to compare and contrast the legislative requirements of mine closure.

The review of the literature then led to the development of a series of case studies on mine closures around the world using both poor and best practice examples of mine closures to understand if there are similarities in the mine closure process. This information was used in the development of a series of open-ended interviews given to a variety of people involved with the mining industry including mining company personnel, local governments,

community members and state regulators from four Australian case studies, as a means of delving further into the issues surrounding mine closures. The quantitative technique involved a benefit-cost analysis of the developments proposed for the Lake Kepwari site in Collie, Western Australia.

In the literature review common factors were found that influenced mine closures and that were essentially gaps in mine rehabilitation and closures that need to be addressed if mine closures are to avoid the mistakes that have occurred in the past. They include the location of the mine, how the mine closure was planned and conducted, the legislation under which the closure was conducted and engagement with stakeholders.

The desktop case studies were chosen for their unique perspectives on inferior and best practice mine closure. The process was designed to show in detail how each case study met or did not meet the closure criteria that were identified in the literature review, to highlight what is currently missing from mine closure in this country and what constitutes best practice. The case studies on inferior mine closure provided salient lessons on how not to close mine sites. They have all occurred due to a lack of any comprehensive closure plan that may have prevented many of the problems that arose as a result of poor planning. These case studies illustrate why it is so important that planning for mine closure by governments, local governments and communities and mining companies begins during the initial mine planning phase and covers not just the rehabilitation plan, but also the socio-economic impacts of a mine closure.

Across all of the interviewees there was a broad consensus on the need for a more holistic approach to mine closure with all parties working together to achieve sustainable outcomes for local communities. There was a majority belief that governments at all levels should assist communities to deal with mine closure and that planning for this should occur from the outset of the mine planning stage. Mining companies, working with their government counterparts, should incorporate socio-economic problems that can arise after a mine closure into mine closure planning.

The benefit-cost analysis provides a useful tool for both mining companies and governments to determine end-use options for a mine site. However, such an analysis should be undertaken early in the mine planning process as part of an overall mine closure plan that develops a number of post closure options for communities to consider.

A key conclusion of the thesis is that there is a need for a policy framework for mine closure, not just for mine voids. This involves the development of specific legislation for mine closure, or at the very least a set of regulatory guidelines to direct the closure process. Factors that will need to be considered as part of this legislated mine closure guidelines and that are currently missing from mining legislation include: nationally-based mine closure legislation; one regulatory body to oversee the closure process; examine the social and economic conditions of the community in which a mine is situated; monitor the financial viability of a mine site and the company that mines them; early planning for mine closure; and engage stakeholders in the closure process.

Some areas for future research that could be undertaken in this field include: Investigating how to implement a nationally-based legislative framework for mine closure; The best ways to value alternative uses for a mine site post closure, including whether or not benefit-cost analyses are the best way to achieve this; and investigating the elements of a community engagement strategy in mine closure legislative guidelines and how this process should be undertaken.

Acknowledgements

It is often believed that writing is a lonely exercise, one that is carried out in isolation with little interaction with the world outside and while to some extent this is true, in reality the research and writing of a thesis involves a cast of many, each of whom play an invaluable role in the final piece. In the case of this dissertation there are many people that I would like to acknowledge and thank for their contribution, for without you the finished work would be all the poorer.

Thanks must firstly be provided to my main supervisor Associate Professor Roy Murray-Prior who has stood by me through the many trials and tribulations that have been associated with writing this body of work. I once read that the relationship between research supervisor and doctoral student is different to that of student-teacher and in my case this has been absolutely true. You have been a hard task master, however you have stuck by me throughout and I consider you and Robyn to be family friends and to our children's surrogate grandparents. The thesis would not be half as good as it is without your invaluable input and advice and for that I will be forever in you debt. I wish you and Robyn all the best in your future life, enjoy, you deserve it my friend!

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I leave the best for last however. My darling wife Nicole, you know what you have contributed to the finished product, it has been a long process I know, but we are finally at the end and your constant support, encouragement and love has got me through this and for that I will never be able to repay you. You always saw the light at the end what often appeared a dark tunnel. You also provided me with four wonderful children, Indiana-Rose, Levi, Arabella and Sebastian and as great as the experience of writing a PhD has been it pales into insignificance compared to them and you. Thank you and yes, I am awarding you with an honorary doctorate!

Finally, this thesis has been a long time in the making and it has been the support and encouragement of family, friends and colleagues that enabled me to get through it in the end. For those of you just starting out on a dissertation, or halfway through one, the only sage advice I can provide (for what it is worth) is persevere, in the end it is finally worth it.

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Glossary of terms

Below is a glossary of terms commonly used throughout this thesis that can be used as a reference source (DITR, 2006: ICMM, 2008; Zhao et al. 2010).

Care and maintenance

A time following the ending of operations when the mine infrastructure remains intact and the site is managed by the mining company.

Closure

The process at which the mine operations cease, mine infrastructure is removed and the site management consists of a period of monitoring.

Decommissioning

The removal of all unwanted infrastructure and equipment and usually begins when mine operations have ceased.

Mine Void

Mine voids are pits that are formed as a method of extracting ore reserves near the surface. They are usually left due to the fact that it is either uneconomical or not feasible to backfill the pit after ore extraction is complete.

Rehabilitation/reclamation

Rehabilitation or reclamation refers to the return of mined land to a secure and productive condition. These two terms are used interchangeably in this thesis.

Relinquishment

The approval by a regulatory authority stating that a mine's completion criteria have been met.

Chapter 1. Beneficial end use: World's best practice closure outcomes

1.1 Background to mine closure in Australia

Mining in Australia has a long history dating back to the 1840's with the discovery of silver and copper in South Australia. Nearly a decade later the discovery of gold in both New South Wales and Victoria sparked a gold mining boom generating substantial wealth and export income for the colonies (Perkins and Morgan, 1993). During the latter half of the 19th century, five regional centres were established as a direct result of the mining industry; they were Ballarat (Victoria), Bendigo (Victoria), Broken Hill (New South Wales), Kalgoorlie (Western Australia) and Charters Towers (Queensland). The 20th century saw the development of towns such as Mt Isa (Queensland), Mt Tom Price (Western Australia), and Roxby Downs (South Australia) also as a direct result of the mining industry (Hogan and Berry, 2000).

The last four decades has witnessed a growth in fly-in fly-out mining operations and the towns that have developed to service them, and the growth of mining near urban areas, such as the Hunter Valley in New South Wales and the La Trobe Valley in Victoria (Geoscience Australia, 2007). Over the period since the development of the first mines in Australia, thousands of mines have been developed and closed; however, many have not closed in a manner beneficial to either the environment or the community in which the mine was situated. In Western Australia alone, it was estimated in 2003 (Johnson and Wright, 2003) that there were 1,800 mine voids with the potential to develop into pit lakes. There are no estimates for Australia as a whole as there is no national database of the number of mine voids at either a state or federal level (Zhao et al., 2010).

Mining as an industry continues to be of importance to the Australian economy, with the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) estimating that in April 2011 there were 94 minerals and energy projects in Australia at an advanced stage of development (ABARES, 2011). The capital spending on these projects represented $173.5 billion, up by 31% over the six-month period from October 2010 (ABARES, 2011). It is estimated by ABARES (2011) that in 2010-2011 Australia will record its third highest annual mineral exploration expenditure on record. Whilst not all of these projects represent investment in mines per se (as some are investments in energy projects such as the Gladstone LNG project), the Bureau says a number of new mine projects are underway from BHP-Billiton, Rio Tinto and Fortescue Metals (ABARES, 2011).

Minerals and mining represent 8% of the Australian economy and 40% of the exports. The earnings from minerals resources exports were $111 billion in 2007/08, with the bulk of the exports going to China and the rest of Asia. This represents two thirds of Australia's total exports to China (Australian Trade Commission, 2011). The sector employs about 200,000 people directly and 600,000 indirectly in support industries (Minerals Council of Australia, 2011).

Despite these figures there are some dissenting voices regarding the longevity of the sector, who point to previous boom and bust periods throughout Australia's history to support their theory that the country is too dependent on mining and minerals as a source of export income (Roth, 2011). There is some concern that Australia is too reliant on China and is not diversifying its trade and investment portfolio enough to counter any potential downturn that may occur in the Chinese economy (Wesley, 2011). As well, there is a belief that resources stocks may be overvalued and that the best chances for growth have passed (Roth, 2011). Of course, those that disagree with the pessimistic outlook point to the figures provided above and the continued GDP growth of China, which was still 8.9% for the 2011/2012 financial year, and that China's demand for resources is unprecedented and growth for the next five years is still forecasted at 7% (Minerals Council of Australia, 2011).

Regardless of the growth figures for China, or the size of the minerals sector as a percentage of exports, one thing is certain – all of the mines have reserves that are finite and all of the mines at some stage will close due to the depletion of reserves, or some other factor such as falls in commodity prices and mining company bankruptcies. The closure of a mine has the potential to affect not only the mine owners; it can also have serious consequences for the community in which the mine operates, the landscape of the mining operation, and the employees of the mine. The impacts of closure if not mitigated in a sustainable long-term manner can last for many years and can be costly environmentally, economically and socially.

At the end of a mine's life, the unavoidable conclusion to a mining operation is the closure of the mine. There are examples of good mine rehabilitation and closure outcomes that have left positive environmental, social and economic footprints, but they tend to be overshadowed by closure outcomes that have been far from perfect. Unfortunately for the mining industry, their record in this area has been mixed, with many examples of poor closures that attract a lot of attention from the media, environmental and social groups and local communities. Closures that can be considered successful are those that have produced beneficial outcomes, whilst those that are deemed unsuccessful are those that have produced outcomes that are harmful to the communities and the ecosystems in which they operate.

The rehabilitation and closure of mining voids (which are the large holes in the ground that are left behind upon the cessation of mining) and other types of mine sites in Australia is an issue that involves mining companies meeting certain legislative requirements that are enforced at state levels (Khanna, 1999). Until July 2011, in Australia there were no government policy guidelines for the regulation of mine closure or specific legislation for the regulation of mine closure, with the mining acts themselves covering mine closure, mostly from an environmental perspective dealing with issues surrounding mine site rehabilitation (Trezise, 2004). Whilst there has been research conducted into these legislative requirements, and environmental responsibilities, little research has examined the economic and social objectives once mining has ceased, nor the requirement for the development of dedicated mine closure legislation that preferably operates on a national basis (Jackson, 2000; ANZMEC/MCA, 2000).

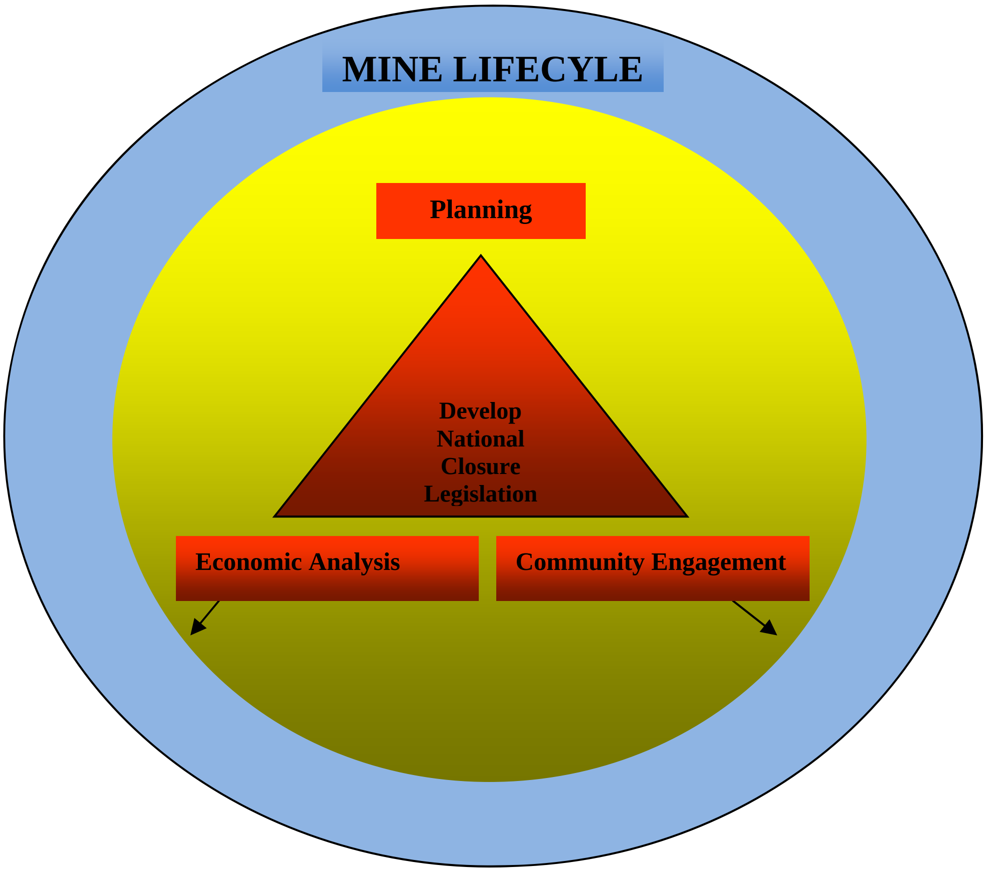
The economic and social objectives of closure need to consider the best possible end-uses from the point of view of all stakeholders in the local community, from shire councils through to local indigenous groups, landholders, business owners and even the mining company employees. This raises the question of how these people are engaged in the mining process. Historically, this is an area that mining companies have not been very good at for a variety of reasons, some of which include: poor planning for mine closures, a lack of legislative requirements in this area, lack of expertise from employees in the field of community engagement, indifference about mine closure and a belief that it was of no benefit to the organisation (Warhurst and Mitchell, 2000). However, there has been a growing recognition from within the mining industry that if mine closure is to produce sustainable outcomes for a community, then the community needs to own the mine closure and develop a sense of empowerment regarding their place in the process.

There is no specific legislation for mine closure in Australia, or indeed throughout most of the world. Instead, throughout Australia mine closure is regulated through various regulatory bodies under diverse Mining Acts (Jackson, 2000). There have been some changes in this area, with the Western Australian Department of Mines and Petroleum in June 2011 releasing a document 'Guidelines for Mine Closure' that although not mine closure legislation, represents a change in direction in terms of Government policy on mine closure in Australia.

The focus of this research is the lack of legislation on mine closure and the need or otherwise for it. The hope is to identify and investigate the following: If there is currently no legislation in Australia specifically for mine closure, what then represents best closure practice?

Figure 1.1 provides a diagrammatical representation of the current best practice mine closure process. It is envisaged that this diagram will be revisited in Chapter 10, where it will be expanded upon based on the research findings incorporated throughout the following chapters.

Figure 1.1: Mine closure process



1.2 Research objectives

The aim of this research is to develop and explore a framework for mine closure that can be implemented by government, the mining industry and mining communities to provide best-practice outcomes for mine closure. The specific objectives of the research are to:

- Examine the different options for mine void closure.
- Investigate a process that determines what level of stakeholder participation is needed in the closure of mine voids and who are the stakeholders that should participate.
- Establish a framework for economic modelling that will assist in determining the use/non-use values of these mining voids at closure.

- Determine world's best practice for mine void closure.
- Suggest a policy framework for the closure of mine voids.

1.3 Research process

This thesis is a deliberately wide-ranging research project whose aim is to develop a framework for mine (void) closure in Australia. The thesis is essentially a scoping study designed to highlight any gaps in the mine closure process in Australia, identify what these gaps are and recommend areas for further research. It is an original contribution to knowledge and research through the provision of an overview on a number of issues that affect mine (void) closure with the aim of establishing areas for further research.

Consequently, a pragmatist approach to the research process was adopted. The central principal to pragmatism is the understanding that adopting a mixed methodology approach using both qualitative and quantitative methods is appropriate within a single study (Tashakkorri and Teddlie, 1998). This style of research can often yield the best results as the research method can be altered to suit the changing needs and nature of the research (Saunders et al. 2009). In addition, the philosophical positions adopted in this thesis, do not prescribe to one particular ontological, epistemological or axiological stance, but instead use a variety of these throughout the work (Saunders et al., 2009).

The following methods were used as part of the research process: literature review, multiple case studies, semi-structured interviews and cost-benefit analysis. Adopting both qualitative research methods through the literature review, desktop case studies and field research interviews and quantitative research techniques via the benefit-cost financial analysis, gives weight to the argument that a pragmatist philosophical position has been used (Saunders et al., 2009). Both qualitative and quantitative research methods were used to collect and analyse data in the development of the thesis outcomes, adopting a stance whereby the results bring about positive outcomes (Tashakkori and Teddlie, 1998).

A multiple methods approach using a combination of quantitative and qualitative data techniques and analysis measures (Bryman, 2006; Saunders et al., 2007) has gained increased acceptance as a method of research in the social sciences (Saunders et al., 2007) and is increasingly being used for its ability to generate unanticipated outcomes (Bryman, 2007). It can be a useful method as it allows different methods to be used for different purposes of the research (Tashakkori and Teddlie, 2003) which is important in this thesis which is trying to develop a framework for mine closure, based on quite wide ranging research objectives.

In relation to the objectives of the research, the qualitative data techniques were used to develop findings for examining the different options for mine void closure, determining the level of stakeholder engagement in mine closure and who these stakeholders should be. A quantitative research method was used to establish a framework for economic modelling to evaluate outcomes from the end uses for mine voids.

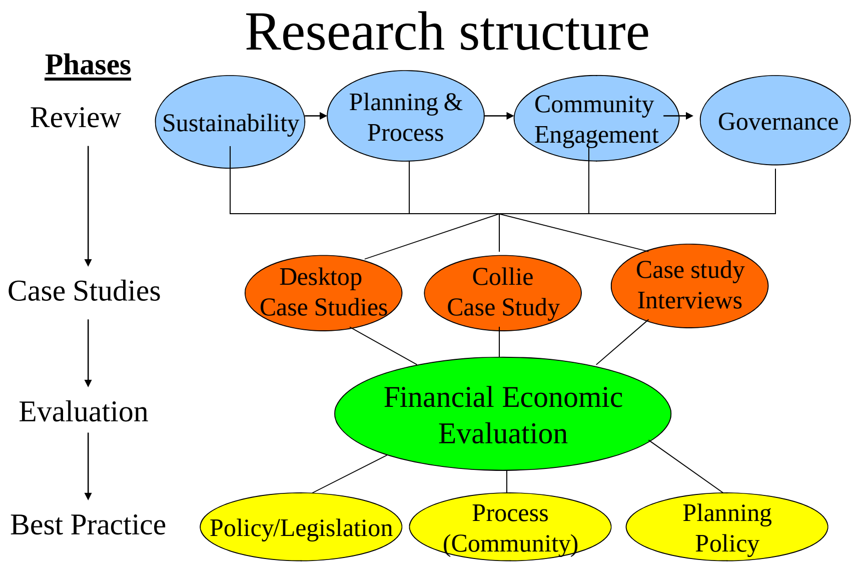
The approach adopted from an epistemology point of view for example lends weight to the pragmatist stance by using a mixed method research process in the thesis. The analysis of the literature review and desktop case study data incorporate an approach to epistemology based on positivism, in that the researcher was removed from the data collection, as the data obtained for these sections was from secondary sources but based on using law like generalisations (Remenyi et al., 1998).

The positivist epistemological approach to gathering and analysing the desktop research contrasts with the subjectivism ontology method used in this thesis, particularly in the gathering and analysing of data used as part of the field research interviews. The subjectivism approach as an example requires that the researcher interprets the results gathered in personal interviews (Saunders et al., 2009), a process that was critical in this research in providing further insights into the data collected in the desktop case studies and literature review.

Figure 1.2 represents the systems approach used in the development of the research process. It provides a diagrammatical overview of the investigative methods highlighting the key features of the thesis as outlined above.

The background to this thesis was to examine the process of mine void closure and determine what options are available for the closure of mine voids through research of the literature on the issue. This included examining the literature on sustainable mine closure and determining what constitutes sustainability from the perspective of mine closure. In addition, since there is no specific mine closure legislation in Australia, or indeed overseas a review of the literature on mining legislation from a number of countries across the developed world was undertaken to compare and contrast the legislative requirements of mine closure (Khanna, 1999; ANZMEC, 2000).

Figure 1.2: Diagrammatical overview of research



The review of the literature then led to the development of a series of case studies on mine closures around the world. These included both poor and best practice examples of mine closures to understand if there are similarities in the mine closure process that can be used to draw further conclusions about what constitutes best-practice closure. This information was used in the development of a series of open-ended interviews to be given to mining company personnel, local governments, community members and state regulators from a number of the case study examples, as a means of delving further into the issues surrounding mine closures.

Finally, an analysis of a coalmine void closure that is currently underway in Collie in Western Australia that the site owners are hoping to turn into a recreational lake was undertaken as a way of examining the closure process and identifying gaps. The site is proposed to be turned into a recreational lake with a feasibility study identifying a number of possible recreational facilities that could be developed at the lake. This research project then conducted a benefit-cost analysis, a method recommended by the Minerals Council of Australia (1996) in their report on developing a framework for mine closure. The benefit-cost analysis could be a useful tool as a means of determining the viability of the proposed options for the Collie site post closure and the likelihood of their success.

By using the information from the literature, the case study analysis, the interviews and the Collie analysis it would then be possible to answer the following research question:

> What is an appropriate legislative, analytical and stakeholder participation framework for the end-use of mining voids in Australia?

1.3.1 Literature review

A critical literature review was conducted using an inductive approach, whereby the most relevant and significant examples from the literature on the topic of mine void closure were reviewed. The aim was to develop a framework for mine void closure that develops a new approach that can be used in a legislative and policy framework. This approach to inductive analysis is one recommended by Strauss and Corbin (1998) to develop findings that are new to the field.

The literature review takes into account the theoretical grounding that has been developed by others in this field (Saunders et al., 2009) as a means of providing an understanding of the changes that have occurred in the last decade on mine void closure. Additionally, the literature review highlights research possibilities into the mine void closure process that have been overlooked, particularly from a regulatory perspective. This leads to recommendations for further research into the field of mine void closure (Gall et al., 2006).

The literature was sourced from primary, secondary and tertiary literature, including industry reports, conference proceedings, company reports, journal articles, newspaper articles, books, government legislation, dictionaries, catalogues and abstracts. The internet was used as a research tool; particularly for the location of secondary sources due to the ready availability of many of these sources on the internet. It also provided useful access to current literature on the topic. In addition, libraries were used as a source for the literature, particularly during the early part of the literature search, which was conducted before so much of the literature became accessible via the internet.

Chapters 2 through to 5 of the thesis contain reviews of the literature and set the foundation for the remainder of the research, notably the case study reviews. The case study examinations were undertaken to determine whether the problems identified with mine void closure and mine closure as a whole in the literature have occurred in the mining industry using examples to clarify this.

1.3.2 Multiple case studies of mine void closures based on secondary data

The reason for conducting case study research was to develop a better understanding of what the literature was identifying as the issues surrounding mine closure and from this, identify what features were common to mine closures and what features were unique. This is what Morris and Wood (1991) referred to as developing an understanding of the background of the research and processes enacted by it. The research in this case study approach is both explanatory and exploratory and hence is using a variety of data collection techniques, including documentary analysis as a means of gathering further information and data for the research. Chapter 6 is a synopsis of the desktop case studies highlighting the best practice and inferior case studies that are provided in full in Appendix A.

The decision was made to use examples from across the world and within Australia in order to generate a number of different closure strategies and from this and the issues identified in the literature, begin to use the information to commence the development of a framework for end-uses following mine void closure that would be best practice. The decision was also influenced by the need to challenge the existing strategy for mine void closures and develop a new series of research questions to expand on this (Saunders et al., 2009).

The case study method used was the multiple cases approach (George, 1979) as it is believed that the findings from the case studies need to determine whether they are replicated across the various case studies. This then provided the basis for developing a generalised framework for mine closure highlighting the aspects of mine closure that require further analysis and research. This is an approach recommended by Yin (2003) stating that multiple case studies are useful methods for determining if the findings from the first case study are repeated in the other case studies and what generalisations can be made from this. The research data for the case studies involved triangulation of data from the case studies an approach recommended by Yin (2003). Confirmatory case studies of selected mine closures in Australia

1.3.3 In-depth case studies of mine void closures based on primary and secondary data

Additional investigations and in-depth interviews were undertaken for four Australian mine sites identified from the previous multiple case study phase. The findings are discussed in Chapter 7. Two of the mine sites were in Western Australia and two were in New South Wales. All were chosen for their approach to mine closure, each representing best practice as it currently stands in Australia based on the criteria determined from this research. The interviewees were chosen from four case studies of best-practice closure in Australia, two of which were closed mines and chosen for their approaches to mine closure and two of which were operational mines that were due to close, one in 2012 and the other by 2015. The mines were in the process of rehabilitation and closure (although the latter was granted a mine lease expansion whilst the case study process was underway).

The stakeholders were chosen based on the findings from the literature reviews about identifying stakeholders in the mine closure process (ANZMEC, 2000, ICMM, 2008). The stakeholders identified for this process consist of mining company representatives, local government representatives, regulatory representatives and community members. Their answers were designed to gain on overview of the mine closure process from a cross section of parties involved in the progression of a mine closure as a way of identifying common themes and any new insights that can be used as data in developing a policy framework for best-practice closure of mines.

Stakeholder views of the mine closure process for these cases were elicited with semi-structured interviews designed to gain an understanding about the mine closure process. They were designed as qualitative research interviews (King, 2004) with the questions drawn up based on the criteria derived from the literature review and used in the case study analysis. The information from the respondents were used to assist in gathering further data from the case studies to determine whether the case study findings from the literature on the issues affecting mine closure are also identified by the respondents.

Time and cost limitations meant that it was only possible to undertake four case study interviews. This is a limitation to this process and an area that will require further analysis by future researchers (Yin, 2003).

The interviews were conducted as face-to-face interviews, with each respondent being asked a series of questions specific to their case study. The interviews were designed to last for between 45 and 60 minutes and hence, a digital voice-recording device was used to record the interviews to enable transcription of responses that were as accurate as possible (Yin, 2003). In addition to this, note taking was also undertaken to supplement the recording process.

1.3.4 Benefit cost analysis

Benefit-cost analysis was chosen for the economic analysis of end-use options and closure alternatives as it provides a monetary evaluation of proposed end-use options. The use of benefit-cost analysis in determining risk assessments for mine closure is a method recommended by the Australia New Zealand Minerals and Energy Council (2000) in their document the *Strategic Framework for Mine Closure.* Although it does not mention post closure end uses, the use of benefit-cost analysis provides an appraisal of the advantages and disadvantages of mine closure end-uses placing a monetary value on both use and non-use options for post closure (Elliot, 2003).

One of the case study sites, the former mine void known as Lake Kepwari in Collie, Western Australia which is being considered for development (Pearce, 1983) was chosen because it is in the process of being developed into a recreational lake and was easily accessible to the researcher. In 2003 a consultancy group (APP, 2003) conducted a study of various development options for the then proposed recreational lake on behalf of the South West Development Commission, a government administered development body. There have been no other updated options studies for this site and no benefit-cost analysis was undertaken examining these options, hence the options developed for the proposed lake in the 2003 report formed the basis for the development of the benefit-cost analysis that is presented in Chapter 8.

The objective was to demonstrate how a benefit-cost analysis could be used to measure a range of possible end-uses for a mine site as it provides a range of options in the allocation of resources to aid in making informed decisions about what is economically feasible (Thyer, 2010).

1.3.5 Discussion

Chapter 9 brings together the various discussions that have arisen at the end of each chapter with the aim of determining what gaps were found during the research and using these gaps to develop a framework for mine closure that encompasses industry, government and community needs and that can be used as the basis for further legislative and policy discussion and research.

1.3.6 Conclusion and recommendations

Chapter 10 outlines how the original research aim and objectives were met during the research and whether or not there were some discrepancies between these aims and objectives and the findings from the research and possible reasons why this occurred. The chapter also outlines the recommendations from the research that can be used as the basis for further research into the mine closure process. As well, the limitations of the research are outlined in order to demonstrate why there are areas where the research did not discuss the minutiae of certain topics and recommends where further research is required, particularly in regards to recommended changes to legislative and policy development in Australia.

1.4 Summary

The decision to use a multiple methods approach was based on the need to use both quantitative and qualitative data in the analysis of this research topic. The aims and objectives of this research are quite broad and there was a need to use data collection techniques that reflected this, yet would still be able to answer the aims and objectives. The techniques chosen are methods of research that have been tested by many others prior to the commencement of this thesis. The innovation of this thesis is the way these techniques have been combined to address a real-world problem.

In the next chapter, Chapter 2, a literature review on mine closures is undertaken, with a focus on beneficial end-uses and closure strategies for mine voids, as it is mine voids that leave the most marked affect on the landscape after closure and they are also the most cost effective means of mining (Fourie and Tibbett, 2006). The chapter will examine the types of mine void closure options available to mining companies, looking at those options that are most beneficial, providing long-term sustainable end-uses environmentally, socially and economically.

Chapter 2. Beneficial end-uses and closure strategies for mining voids

2.1 Introduction

This aim of this chapter is to provide an analysis of the options for closing mine voids upon the cessation of mining. The information for the chapter has come from a review of the literature on mine closures, focussing specifically on mine voids. They are often the most problematic of mine closures due to the large scars they leave behind on the landscape and the often deep, open pits that have the potential to become environmental and safety hazards for many years after mining has ceased. This does not mean that underground mines do not leave physical impacts behind, however, the very nature of an underground mine is that it is less visible and the mine shaft leading to it can be capped (covered) and closed leaving behind less of a physical scar than an open pit. Underground mines can still leave tailings dumps and these will still require rehabilitation, as is the case for open pit mines.

Mine voids are the holes in the ground that are sometimes referred to as open cut mines (or open cast mines in the UK). They can range in size and depth from as little as a few metres deep and wide to depths such as the deepest open cut mine in the world, the Bingham Canyon mine in the United States, which is over 4 kilometres wide and 1.2 kilometres deep. This thesis is concentrating on mine void closures, rather than underground mining operations, as it is open cut mining that leaves the most visible impact on a landscape. Open cut mines can be the most costly to rehabilitate and close (which the latter case study chapter will demonstrate) especially when not undertaken in a best practice manner.

Closing a mine void is not necessarily a straightforward process as this chapter will demonstrate and it can be a costly exercise, regardless of what option is undertaken.

2.2 Beneficial end-uses for mining voids

There are a number of factors that will determine the final cost, end use, shape and size of a mine void at closure. The factors that will influence this outcome include the type of resource mined, the amount of the resource available to be mined, the method used for mining, site constraints (e.g. roads, railways, urban development), the economic benefits of the mine (i.e. can it be viably backfilled) and regulations put in place by governments. These will all contribute to the outcome at closure, and vary from mine to mine, depending on the material extracted. As an example, in most coal and gold mining operations a sizeable void is left at the end of operations, whereas in some mineral sands and bauxite operations there may be no void left at the end of the mine’s life (Department of Environment and Heritage, 1998).

The difficulty that ensues from attempting to determine the end use for a mine void is that there are many factors during the life of a mine that will influence the final options. A mine void will be affected over time by changes in technology, resource prices, new mining methods, and the economic health of the mine operator (Ashton and Evans, 2006). In other words, it is difficult from the initial phases of a mining operation to determine what the final void will look like. Mining companies are forced to speculate and or estimate the appearance and state of the mined site. However, the issue that has occurred both in Australia and overseas jurisdictions is that a lack of mine closure planning at the commencement of mining has led to forced, costly (and often hastily designed) rehabilitation and closure outcomes that have included negative socio-economic effects on the communities where these mines are situated (Sydney Morning Herald, 2004).

Appendix A of this thesis provides some examples of such policy failures from both Australia and overseas. A number of researchers on this issue (e.g. Biggs, 2000; Jackson, 2000; Fourie and Tibbett, 2006) are recommending a progressive approach to mine rehabilitation in Australia. They believe this will assist in developing a more balanced approach to mine closure. Such a process involves continuous monitoring and review of the mine void and according to its proponents will be more cost effective for mining companies, governments and ultimately the community. The Department of Environment and Heritage (1998) highlighted a number of issues to be addressed in the initial stages of rehabilitation and closure planning.

The issues highlighted by the Department included finding that it may be possible to eliminate the need for a mine void at the end of the operational phase of mining, if the mine can be developed in a circular manner to locate the final void near the spoil heap (overburden removed during the mining process). The soil heap can be used to backfill the void, thus avoiding the need for a hole in the ground (Wright, 2001). This can be an expensive option for mining companies and is often not the preferred option, particularly if there is not enough overburden remaining from the extraction process. In addition, it may not be the preferred option for communities, who may want a void turned into a recreational lake after mining has ceased (Department of Environment and Heritage, 1998).

One of the other possibilities to consider when determining beneficial end-uses is the possibility for continued underground mining once the reserves of the open cut mine have been exhausted (Wright, 2001). This will affect end-use options for the site and needs to be factored into any mine closure plans at the commencement of mine planning. While, it is difficult to determine in the initial stages of mining, if it is factored in at the commencement of mining it will influence the options for post closure and will also allow communities to voice any concerns about such a possibility early in the planning process (Biggs, 2000). On the other hand, mining voids need to factor post closure health and safety considerations for the void and any possible hazards that will affect the site and its surrounds once mining has ceased (Department of Environment and Heritage, 1998).

Research by the Department of Environment and Heritage fails to highlight the need for these factors to be considered during the mine planning phase, despite the difficulties associated with forecasting how a site will look post mining. Research conducted by The World Bank and International Finance Corporation (2002) has found that planning early for mine closure is the most cost effective way to ultimately close a mine and can save a company on the final rehabilitation and closure costs. The World Bank (World Bank and International Finance Corporation (2002) states that planning before mining starts can affect the technology chosen and determine how waste is disposed. It can guarantee rehabilitation costs are built in to the operational phases of mining ensuring that capital is available for the project.

Not all mine closures occur in urbanised environments, or near major population centres, there are mining areas in Australia in which the end-use of the void is of little significance due to remoteness of the mine site. This will change the requirements for rehabilitation of such a site, with the end-use requirements more likely to focus on rehabilitation that is safe for human and animal access. The Department of the Environment and Heritage (1998) claimed that there are several factors to consider when planning the closure of mining voids in remote sites. Firstly, there is a need to ensure the wall stability of the final voids in order to prevent movement of the walls. This may mean reshaping the void walls (an often costly undertaking) to make the void more stable and avoid possible collapse. This action will be necessary in order to avoid liability issues if a void is to be open to the public and used recreationally. Secondly, where mining has taken place with flammable minerals such as coal, inert material needs to be placed over exposed areas to prevent combustion. Any metals that are exposed should also be sealed and covered to prevent leakage into the surrounding ecosystem. Safety of a former mine void should also be a priority with the erection of barriers to prevent unwanted access to the void. This can be achieved temporarily by fencing, however over the long term the most cost-effective options are either a deep ditch surrounding the void, or a high bund wall, both designed to prevent vehicular access. Water seepage and runoff from a void into the surrounding ecosystem should be controlled in addition to controlling flooding of a void in order to prevent water entry into the ecosystem. Finally, the area surrounding the void needs to be as aesthetically pleasing as possible using vegetation and trees native to the surrounding ecosystem, which also prevent an ecosystem failure at the site, as these are more likely to adapt to local conditions.

The last few years have seen a change in attitudes in relation to mine void closure and a number of documents published in relation to the issue. Some of the more well known documents include the International Council on Mining and Metals *Planning for Closure (2008),* the Australian New Zealand Minerals and Energy Council/Minerals Council of Australia *Strategic Framework for mine closure (2002),* The World Bank and International Finance Corporation *It's not over when it's over: Mine closure around the world (2002)*. There are also now more regular mining industry conferences devoted to mine closure, notably an Australian instigated conference the *International Seminar on Mine Closure* which held its inaugural conference in 2006.

This change in attitudes demonstrates an increased awareness of the importance of mine closure, notably within the mining industry, particularly amongst the major mining companies, however there is still no specific mine closure legislation either in Australia or overseas. There is no legislated closure requirement for mining companies to follow, with the current mining legislation focussing on the rehabilitation of the site and not necessarily the social and economic impacts. Since Western Australia alone has an estimated 1,800 mine voids that have been abandoned (Wright 2001) without any form of rehabilitation or closure being undertaken, it is important that mine closure becomes more prominent in the strategic thinking of both mining companies and government authorities.

Increasingly there is acknowledgement from those in the corporate sector of society's expectation of good corporate citizenship and the need for a social licence to operate (Garcia, 2008). The need for an effective management strategy applies not only to mine void closures, but also to all mine closures and to those mines still in operation. In terms of mine voids, there are three basic, but broad closure strategies (Wright 2001):

1. Waste Storage
2. Water Storage
3. Open Void

2.3 Waste storage

Waste storage is often considered the best option from the point of view of the environment and community expectations. This option is generally used only when the amount of ore extracted is less than the volume of material or when the costs of adhering to environmental standards are outweighed by the benefits. Johnson and Wright (2003) provide examples of where this has occurred in mines in the Pilbara that were linked to groundwater resources and the costs of filling outweighed the costs of adhering to strict environmental regulations if the mines were left as open voids.

This closure strategy has two possible processes (Johnson and Wright, 2003):

1. Waste Rock storage – The backfilling of mine voids can save companies the cost of disposal of waste material and rehabilitation. However, once this process is started, the mine cannot be used again. This process is also used to create on-surface waste dumps at mine sites.
2. Tailings Storage – The tailings storage method of waste storage is useful when handling sulphide and slurry waste materials. Sulphide heavy materials are best left saturated under water to prevent the potential for acid mine drainage (Johnson and Wright 2003).

In order for tailings storage to be successful, large amounts of dewatering of waste material is required (dewatering is the removal of water from solid material) (Mallet and Mark, 1995). The surface of the tailings storage area needs to be strong and stable to withstand the weight of heavy equipment and be resistant to wind erosion. The tailings also need to be continually monitored to ensure that the quality and the level of water are strictly maintained. Water in the void must also be prevented from leaking into local groundwater and causing potential contamination.

Some of the problems associated with tailings storage include (Johnson and Wright 2003): reduction in the material strength of the void wall, integrity and strength of the tailings material, possible contamination of groundwater, and rehabilitation difficulties as a result of the influx of hyper saline groundwater.

The Eneabba West mine in Western Australia is a good example of where mine water from in-tailings storage has leaked into local groundwater supplies, causing potentially serious problems with water used for stock and irrigation purposes. The cost of fixing this problem can often be greater than the company may have budgeted for. In fixing the groundwater problem, Johnson and Wright (2003) suggest that part of the rehabilitation strategy involves the strategic placement of phreatophytic vegetation to prevent the drawdown of groundwater and to assist in preventing the development of saline areas.

Waste Storage may also include using these voids for the disposal of domestic waste. This approach may at times be seen as a preferred option, due to what would at first appear to be an easy closure outcome and may also be a popular option due to the sheer volume of waste that could be stored in a void. There are, however, issues that to be considered including what type of waste would be placed in the void and any contamination it may cause of surrounding hydrological and geological features. As an example of the possibility for using mine voids for domestic waste disposal, the Department of the Environment and Heritage (1998) have provided an estimate that in the Hunter Valley in New South Wales, the current volume of voids would be able to hold domestic waste for both the Hunter and Sydney regions for the next 180 years.

The Department of the Environment and Heritage (1998) note that the option of waste disposal needs to be very careful consideration before being chosen as the preferred alternative, particularly given both State and Federal laws surrounding environmental and health issues, which have become increasingly detailed, requiring harsher penalties for non-adherence. The Department stated with regard to waste storage that it is necessary to consider the potential impacts waste materials can have in terms of leaching and their potential to contaminate groundwater.

Waste storage at former mine sites is therefore an issue that needs to take into account various impacts on the surrounding ecology and hydrology and needs to consider what geological factors exist at the mine site and the possible affect from waste storage. In many cases, waste storage will not be an option for a former mine site, despite the fact that this option may be considered by some mining companies and even governments as an easy end use for the site. This option may also be seen as a low cost option (in terms of the overall rehabilitation requirements). However, it could also become a lengthy exercise in terms of the final rehabilitation of the site, as a waste disposal option could see the final void take many years to fill and it will then need to be rehabilitated when its use as a waste disposal facility is finalised (Wright, 2001).

With the increasing trend towards more sustainable development practices in both the mining industry and from both state and federal governments, using former mine sites as waste storage will be less likely over time, as more environmentally sound options, such as passive recreational uses for example, will need to be considered. It is also increasingly likely that local communities will demand that companies and governmental authorities ensure that the end-use requirements for a former mine site meet world’s best closure practice and that the closure will be sustainable. In order to meet these requirements both mining companies and governments will be required to be more inclusive when developing mine sites and they will need to consider the closure options for the site during the planning process (Johnson and Wright, 2003).

2.4 Water storage as an additional water source

Water storage as an additional water source for a mine and for use in future mining activities is the redirection of surface water runoff into a mine void. The aim of this method is to reduce reliance on groundwater (which can be saline), hence saving costs in pumping and extraction. The main advantage of water storage is that should further mining be considered feasible then the mine needs only to be dewatered. Two processes can be used in this method of mine void closure, storage of dewatering discharge and diversion and capture of surface water (Johnson and Wright (2003)

2.4.1 Storage of dewatering discharge

Companies are generally forced to discharge water into nearby abandoned mine voids to avoid the environmental constraints imposed against sending water discharges into rivers or lakes. However, the void cannot store water that is more saline than the groundwater, due to the potential for groundwater contamination if it seeps into the groundwater supply from the void. The mine operators need to demonstrate that the void is not linked to any significant groundwater course (Wright, 2001). They will also need to ensure that the void is stable and not liable to faulting that would allow pit water to permeate the groundwater aquifers and cause problems with natural water supplies (Johnson and Wright, 2003).

2.4.2 Diversion and capture of surface water

Diversion and capture of surface water involves capturing surface water runoff from rainfall, particularly heavy rainfall. It allows companies to save on pumping and treatment costs as it can help reduce use of groundwater. In areas of high evaporation and low rainfall, this type of process for filling voids can be unreliable as it depends on extreme rainfall events.

The other option is to divert rivers, creeks and streams into the mine void, along with surface water runoff. This process can save mining companies considerable amounts of money on water and can have a minimal impact on groundwater supplies

Johnson and Wright (2003) provide an example of the Windich pit at the Granny Smith mine in Western Australia, which uses diverted creek water. This use of diverted creek water represents less than 1% of total flow of the creek into nearby Lake Carey, and gives the mine three years supply of process water.

The largest concern for storing water in voids is the quality of the water being stored and possible salinity issues, particularly during periods of drought. The use of diverted water from rivers, creeks, streams into voids can help reduce the possibility of water in these voids becoming saline or highly acidic as the water from these bodies flushes the mine voids. The other major issue to consider is whether any water from the void will leak into surrounding natural water inflows causing possible contamination.

The Federal Department of the Environment and Heritage (1998) suggest two main issues to consider when selecting a site for possible water storage. The first is, does a catchment exist close by that is of a size that it can be used to fill a void rapidly and is the water of adequate quality? In this respect, studies of runoff volumes from the catchment under average, drought and flood conditions are needed, together with calculations of seepage and evaporation losses, to determine whether the water balance will be acceptable. Computer modelling will evaluate the filling time for the void, fluctuations of water level under a range of rainfall years and the quality of the stored water. However, diverting a nearby creek into the void will increase the catchment area, any such diversions will, of course, need to comply with laws relating to water diversion and will need the agreement of neighbouring landowners and the local community.

Second, does the water quality measure up to its beneficial use? If modelling shows the water will be of low salinity and the void is reasonably close to productive farmland, irrigation uses are an option. Good quality water may also be suitable as supply for nearby townships, provided the catchment is adequate and quality will not deteriorate in times of drought. The storage may also provide process water for local mining operations and other industry, in which case high quality may be a lesser consideration. Using a void as a retention basin for major flood flows may considerably benefit a community, while at the same time providing useful water storage for use at other times. There may also be opportunities to create amenity uses, such as for water sports and fishing, though these are likely to be secondary to some other, more economically beneficial uses.

The option of using mines for water storage is one that has considerable appeal for mining companies and regulatory authorities alike, as it can be both cost-effective and contribute towards sustainable mining (Biggs, 2000). If the issues with high salinity and low pH levels can be overcome, then in the long run a mine site may be used for recreational or commercial purposes once mining has ceased. Again, as with the option of waste storage, the issues to be considered are the need for long-term planning for the site, with the end use of the site being considered during the initial planning stages of the mine. Many of the major mining companies are increasingly doing this (e.g. Placer Dome and Rio-Tinto), as community expectations increasingly demand sustainable development of mine sites that takes into account options once the mine has closed (Elliot, 2003).

2.5 Open cut mine void

The use of an open cut mine void involves allowing a mine void to fill with water, with the aim of using the void in the future for some form of recreational or commercial use. This differs slightly from the use of the void for water storage, as the primary aim of water storage is to use the void as an additional water source for the mine, to store dewatering discharge and in the diversion and capture of surface water. In an open void, the primary aim is to develop the site for some recreational or commercial use once mining has ceased, this is what has occurred in Collie at the former Premier site, now known as Lake Kepwari. The major issue regarding this method of closure is the issue of pit wall stability and safety

(Kruger et al. 2002). The closure criteria in this option are quite strict if the void is to be used for aquatic purposes, but is less strict if it is to be used for irrigation and livestock such as cattle and sheep.

This open void process was used in Collie, Western Australia at Western 5B mine void (now known as Lake Kepwari). The process involved capturing streamflow to prevent acidic and saline water from entering local water resources. The local river was diverted into the mine void (after closure) during the rainy season (May to September) to assist in the rapid filling of the lake and it also assisted in recharging depleted deep aquifers at the site (Johnson and Wright 2003).

The major concern for open cut mine sites, is that of salinity and low pH levels, that will require more research in order to find solutions to the problems they cause, but they may also necessitate a different approach at the regulatory level, particularly in cases where the former mine site is to be used for recreational purposes. As an example, regulatory authorities in Western Australia require a pH of 5.0 or above is before they deem water in a mine void safe for recreational use and allow the site to be opened for public use (World Health Organisation, 2003). There is the possibility that this requirement is too inflexible and that a case-by-case approach is needed when considering issues such as pH and salinity levels at former mine sites. This requirement would not necessarily have to mean a reduction in safety standards. It would allow for greater flexibility in the closure process and may also assist in providing more reassurance for mining communities with regards to mine closure and the end use of a mine void, as currently there is not a base metal mine void in Australia that has been closed and legally used for recreational purposes.

There are examples of other developed countries throughout the world, such as Germany, that have allowed mine lakes to be used for recreational purposes, despite having pH levels of less than 4.0 and these can possibly be used as benchmarks when it comes to the issue of mine closure in Australia (Lund 2001). However, there are health issues associated with pH levels less than 5.0, notably skin, eye, nose and throat irritations, particularly after prolonged exposure (World Health Organisation 2003). The point to be emphasised is to examine each site on a case-by-case basis. Each site is different, as is each community and their needs, but certainly for many mining communities a mine closure can have a devastating impact and unless alternative industries are encouraged and developed the social and economic implications of closure could be costly and long term. This is also one of the reasons that the closure process needs to be considered during the initial planning phase of a mine – it has a long-term impact – this is part of world’s best closure practice

2.5.1 Benefits of open void closure

As Johnson and Wright (2003) note, the open void option is the best use for the very large voids e.g. the ‘Super Pit’ in Kalgoorlie in Western Australia. Leaving these mines as open voids is also preferable if they are not near aquifers, local streams, rivers or other water sources. These mine voids are often too large to backfilled and would be an expensive option. Open voids can also have benefits for the communities in which these mines operate. Some of the uses being considered for voids after mining has ceased include nature conservation, tree farms, aquaculture, and recreational tourism including fishing, canoeing, skiing and diving.

2.5.2 Potential problems with open void closure

Wright (2001) believes that in Western Australia the main emphasis on mine void closure should focus around hydrogeological linkages and the potential impact on groundwater, particularly given the finite nature of groundwater supplies in this state. Wright’s concern in Western Australia is the potential for mine void lakes to become sources of hypersaline water. Low rainfall and high evaporation in much of the state is the reason many of these water bodies become groundwater sinks (a groundwater sink is the hydrological term for when a mine becomes a hydrologic capture zone for groundwater and does not discharge the water back into the environment). Wright (2001) goes on to say that this is not as large a problem in the southwest of the state, with its higher rainfall, however, acid mine drainage is of major concern in this region, particularly in the Collie coal region. According to Mallet and Mark (2001), Wright places too much emphasis on the hydrogeological and groundwater issues concerning open void closure, as this is just one of the factors that affect mine closures. Other factors include the localised climate of an area which will affect mine closure options, particularly in areas of low rainfall and high evaporation; the location of the mine which will affect the type of closure options; and social factors such as the population of the region in which a mine is located and its proximity to major urban centres (Mallet and Mark, 1995)

2.5.3 Factors in choosing most suitable options for open void closure

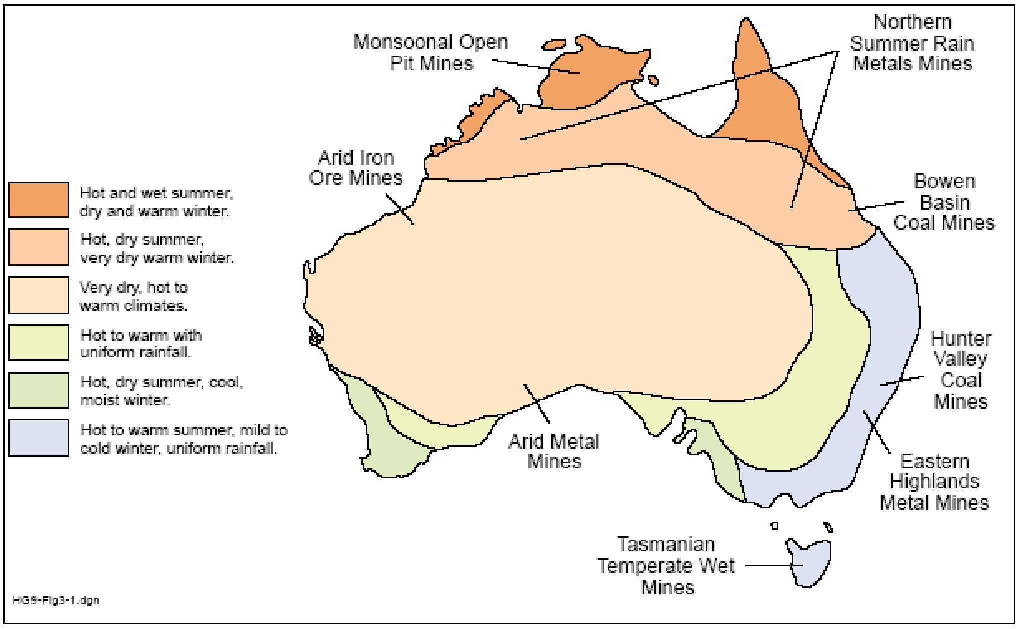
Mallet and Mark (2001) developed a set of decision pathways to determine the steps and data necessary to choose the most suitable option. This involves three factors, climate, site geology and social settings.

Climate

Figure 2.1 is taken from Mallet and Mark (1998) dividing Australia into eight major climactic zones. Every mine region in Australia exists in a different climactic zone and this will influence both the mine site features and rehabilitation options. The map can be used to assist in determining closure options, given that the rainfall and evaporation patterns in a particular region will influence the end-use of a particular mine site.

As an example, in Western Australia much of the state has low rainfall and high rates of evaporation creating conditions for hyper saline water to develop in open pit lakes (Wright 2001). The one region in the state that runs contrary to this is the southwest corner (near the coast), where the rainfall rate generally exceeds the evaporation rate and it is in this area of the state that Lake Kepwari (Wesfarmers Premier Coal's former mine site) is located. The end-use options for open voids in a region such as this are generally greater than they would be in a region such as the Goldfields for example, due to the higher rainfall and lower evaporation rates.

Figure 2.1: Map of Australian climate zones



Source: Mallet and Mark 1998, p. 5

Site geology

Mining in open voids can have major impacts on the geology of the site and the surrounding ecosystem. The geological nature of the site and the consequence that a mine could have during its operation and closure will be one of the factors that determine the end-use of the final void. An example of the potential negative impact mining can have, occurs when a mine is built below the water table. According to Johnson and Wright (2003) this can range from physical disturbances such as the clearing of native vegetation or changes to former land uses such farming, or native forestry. Additionally, changes to the water table by mine dewatering can have unfavourable effects on local flora and fauna, particularly when mine discharge water is placed into arid environments.

Two of the most prominent issues that occur with open void lakes are high acid and salinity levels. It is important during the planning and permit phase of mine development that these impacts be considered and any potential problems addressed, as over the long term they can have severe and wide-ranging environmental, economic and social repercussions if left unaddressed. Some in the industry, as well as regulators, are starting to consider this, however, it remains a large problem at many mine sites. According to Johnson and Wright (2003) there are two ways to address potential long-term negative effects from open void lakes: 1) Manage the impact of a mine void by developing an appropriate closure design that minimises the impact of the void on the surrounding ecosystem and is as sympathetic as possible to the flora and fauna; 2) Set an appropriate timeframe for the closure of the void, beyond which point it would be considered unreasonable for the mining company to continue care and maintenance of the site.

The geology of the site and the potential impact the mine will have on the surrounding ecosystem are important considerations to be considered when determining end-use options for an open void (Mallet and Mark, 1995). The site geology, climactic conditions such as rainfall and evaporation rates and the type of ore mined will influence the acidity and salinity levels and will need to be addressed from the planning stages, particularly if end-use options include recreational/commercial pursuits.

Social settings

If a mining region is wholly or heavily dependent on mining for its existence, then the closure options for a site will be of prime economic importance to the region. On the other hand, a region that has a more diverse economic base may place less importance on a mine closure, as it will have other industries that will lessen the economic impact of closure. A good example of this is in the Hunter region in New South Wales, which has a diverse range of industries, existing in tandem with the major role of the mining industry, helping to provide a greater range of options when it comes to mine closure considerations (Tivy, 1984).

The shire of Collie in the southwest of Western Australia, on the other hand has traditionally been heavily dependent on the coal mining industry. The town has developed as a mining community with a small economic base and few significant industries aside from coal mining. However, there has been some attempt to make the region more economically diverse in recent years, but it has been slow to develop (Ashton and Evans, 2005). In the case of Collie there is a need to ensure that mine closure options are carefully considered as they can assist in diversifying the region’s economic base. In particular, this diversification in Collie will require a move towards tourism and recreational based activities. This was the focus in Collie for the rehabilitation of Premier Coal’s former open pit mine site, which is planned to be turned into recreational lake (Lake Kepwari), with a strong focus on tourism (Ashton and Evans, 2005).

Also warranting consideration in relation to social settings is the location of the town and the infrastructure surrounding the town site as this can have a significant impact on closure requirements. For instance mine sites in the Kimberley region that are located in remote regions with poor surrounding infrastructure will have fewer options for closure than mines that are located in the Hunter region of New South Wales that have good infrastructure and are also close to major population centres (Johnson and Wright, 2003). Recreational use of mine voids may not suit all communities affected by mine closures, however, it can provide the potential to diversify the economic base of a community upon the cessation of mining and use a former mine void for a sustainable post mining land use (Johnson and Wright, 2003).

2.6 Conclusion

The final decision relating to mine void closures should be arrived at by adopting one of the three mine void closure methods outlined by Wright (2001). These are waste storage, water storage and an open cut void. Each approach provides benefits and costs environmentally, socially and economically. The option decided upon by mining companies and regulators at the end of a mine’s useful life must be one that is environmentally sound, meets social expectations and will not prove cost prohibitive to either the mining company, or the community in which a mine is situated.

Waste storage is an option that is not always a sustainable option as a mine void closure strategy due to the potential that exists for contamination into the ecosystem from stored materials. It can be a less costly option initially for companies from a monetary viewpoint; however, if contamination issues arise over time, it may well prove to be a long-term exercise that proves more costly. It is also generally only economically feasible if the amount of ore extracted is less than the overall waste material.

Use of a mine void for water storage as an additional source of water for a mine has obvious benefits for a mining company during the life of a mine. The water can reduce reliance on outside water supplies and hence save a company considerable amounts of money over the life of a mine and the mine can be reopened should such an option become viable. However, communities do not necessarily benefit from this option, at least initially, as it is beneficial to the mining company, but there are possibilities for irrigation use over the longer term. This illustrates the need for local communities to be actively engaged in this process, as they would need to determine if the benefits of this option outweigh the costs and indeed what benefits the community would gain.

The option of leaving an open void after mining and using it for recreational, or commercial purpose is one that can have post mining benefits for the community in which a mine is situated. This option can be the most costly, as there is a need to consider a number of factors before deciding on pursuing this option. The decision to turn a former mine void into a recreational lake is not an option that has been widely undertaken in the past in this country. Currently there are only two examples of where this has been done, one in Collie in Western Australia in a former void (yet to be signed off for recreational use) and the other being the Penrith Lakes scheme in Western Sydney. However, Penrith Lakes is a former quarry and hence does not carry the problems of acidity and high metal concentrations that can be problematic in base metal mine closures.

The next chapter of the thesis follows on from the beneficial end-uses and closure strategies for mine voids by looking at sustainable development and mine closure in the mining industry. The chapter will critically analyse literature surrounding sustainability and the issue of mine closure examining what changes have occurred in the industry over the last 15 years in relation to mining closure practices.

Chapter 3. Sustainable development and mine closure in the mining industry

3.1 Introduction

During the last 10-15 years to 2013, there has been an attempt by the mining industry, governments and other statutory bodies, mining communities and the media, to address issues surrounding sustainable development in the mining industry. A subset of the multitude of reports are discussed in this chapter to provide some insight into the latest discussion in the mining sector on sustainable development and the holistic approach that is being recommended (and followed by some companies, including Rio Tinto, Alcoa and BHP Billiton) by mining industry governing bodies and various non-government entities. The key point to come out of these reports is the notion that mining needs to be sustainable, however the term sustainable possibly has a number of different meanings for different groups of people. The meaning most commonly used in these documents and which this thesis will adopt comes from the report commissioned by the World Commission on Environment and Development known commonly as the Brundtland report (1987, p. 3) which states that:

> "…firstly it is the elimination of poverty and deprivation. Second, it requires the conservation and enhancement of the resources base, which alone can ensure the elimination of poverty, is permanent. Third, it requires a broadening of the concept of development so that it covers not only economic growth, but also social and cultural development. Fourth, and most important, it requires unification of economics and ecology in decision-making at all levels…"

This chapter will provide an overview of some of the major reports undertaken by the mining industry under the guise of making the industry and closure more sustainable over the long-term, examines the key themes that have emerged, and compares and contrasts the issues that have arisen.

3.2 Overview of key documents

There have been a number of reports from various bodies associated with the mining industry that have attempted to address the issues of sustainability in the industry through examining ways of closing mine sites by adopting a more holistic approach. What has been most interesting about the release of these reports is that the overwhelming majority have been released by industry bodies, rather than regulatory bodies and hence many of the outcomes and recommendations are merely intended as guidelines or points of consideration for mining companies, rather than legislated requirements (some examples include: ACMER, July 2005, *Workshop on sustainable mine closure – fact, fiction or financial liability*, Environment Australia, (2002), Mine Decommissioning: Best practice environmental management in mining series; Lacy (2000), *Planning the process of closure 'close as you go'* (as part of the Australian Centre for Geomechanics Seminar in 2009).

This does not understate the importance of these reports nor their ability to bring about change in the industry, but neither should the importance of forced regulatory requirements and their ability to change long-term practices and behaviour is underestimated. The reports will be briefly discussed in chronological order, as this is the most logical way to present them with a discussion to follow on the key issues that have arisen under a series of headings. The reports are also taken from various mining and NGO bodies across the world, as the aim is to develop a best practice approach in determining what sustainable means to the mining industry and how closure can be beneficial for a community in the long term.

***Minerals Industry Code for Environmental Management* (1996), Minerals Council of Australia -** In 1996 the Minerals Council of Australia decided to introduce an environmental code for the mining industry, with a revised edition of the report released in 2000 (Minerals Council of Australia, 2000). Part of this code included details for new levels of community involvement in the industry. The aim of the code was to demonstrate the industry's commitment to continuous improvement in environmental management and to improve the industry's communication methods to the mining communities in which they operate by becoming more open and transparent in their dealings with them (AMMEF, 2003). This report was not specifically about mine closure; however, it detailed a need to develop comprehensive environmental management programs for mine rehabilitation and closure.

***Strategic Framework for Mine Closure* (2000), Australia and New Zealand Minerals and Energy Council and Minerals Council of Australia -** In 2000 the Australia and New Zealand Minerals and Energy Council and the Minerals Council of Australia released the first wide-ranging report related to mine closure and its significance in the mining process ANZMEC/ANZMEC/MCA, 2000). The report was unique at the time in that it recommended that mine closure needed to be considered from the initial mine planning phases and undertaken through the life of the mine. One of the major objectives of this document was to provide a consistent framework for mine closure across the country (ANZMEC/ANZMEC/MCA, 2000); although it did stress that the document was not a detailed set of guidelines for mine closure, instead believing that this needed to be legislated.

***Towards Sustainable Mining Initiative* (2001), Mining Association of Canada -** The Mining Association of Canada (MAC) introduced the Towards Sustainable Mining initiative (TSM) in 2001 (Peeling 2004). The TSM followed on from the 1994 Whitehorse Mining Initiative and was designed to further the principles established by that program and gather greater support from the mining industry and the public in Canada. The Towards Sustainable

Mining initiative was established by the 27 members of the Mining Association of Canada with the aim of improving the image and credibility of the industry in those communities for whom mining is a major employer and improving the image of the mining industry to the public. A panel of members was established to guide the TSM principles and ensure their implementation by the industry. These panel members represented a broad spectrum of people with interests in the mining industry. They included aboriginal community members, labour force members, community representatives from areas where mining plays a significant role, representatives from environmental and social NGO's, representatives from the investment community and senior mining representatives (Peeling 2004, p. 11).

***Minerals Mining and Sustainable Development Report* (2002) -** The Mining, Minerals and Sustainable Development project was planned as a background to the World Summit for Sustainable Development in 2002 (MMSD, 2002). Nine of the world's largest mining companies initiated a project to examine how the mineral sector contributed to Sustainable Development. A two-year study was initiated through the World Business Council for Sustainable Development, with the study being conducted by the International Institute for Environment and Development (IIED) (MMSD 2002). This report was seminal to the mining industry as it set recommended standards for the operation of the mining industry throughout the world including ensuring that mine closure is sustainable, specifically from an environmental viewpoint.

***Australian Minerals and Energy Environment Foundation Report* (2003) -** In 2003 AMEEF released a report that along with the Minerals Council of Australia code of conduct recognised the gains the mining industry has made in environmental management techniques (AMEEF, 2002). The report states that sustainable development involves recognising that the environment and the community are interconnected and valuation of environmental management techniques must be both socially and culturally based. The AMEEF report states that employing local labour and indigenous labour is important in all areas of decision making about resource management, including employing local labour in ecological monitoring and rehabilitation (AMEEF 2003).

***World Bank Extractive Industries Review* (2004) -** The Extractive Industries Review (EIR) was an initiative by the World Bank that began in 2000 to examine the bank's involvement in the activities of the extractive industries (which includes mining production, oil and gas) (World Bank, 2004). Part of this review involved a stakeholder consultation process that produced a set of recommendations for the future of the World Bank's role in the extractive industries sector. The report was released in 2004, with the World Bank Management Committee releasing its recommendations on the report in September of that year. The Extractive Industries Review had two fundamental recommendations that were endorsed by the World Bank Management Committee; namely that the World Bank would continue to support extractive industries if they assisted in reducing poverty and were truly sustainable; and that projects implemented by these industries generate benefits for the local communities in which they operate (Worlds Bank Group Management, 2004).

***Global Environmental Management Initiative* (2004) -** The corporate world during the latter part of the 20th Century and into the 21st Century has increasingly begun to focus on the concept of the triple bottom line – that is a company no longer reflects on just the financial aspect of the business, but must also acknowledge the environmental and social impacts of their business. The Global Environmental Management Initiative (GEMI) discusses how fund managers and shareholders are starting to take into account the triple bottom line when deciding their investment strategies. This has implications for all industries, but particularly those so-called 'dirty' industries such as mining, that have traditionally been viewed with disdain by many in the environmental movement, who are now starting to have their voices heard by mainstream society, after decades of being confined to the extreme fringes.

Mine Closure and Completion: Leading practice sustainable development program for the mining industry – The *Mine Closure and Completion: Leading practice sustainable development program for the mining industry* is a handbook compiled by the former Federal Government Department of Tourism and Resources. It outlines sustainable mine closure practices and recommendations for closing mines that incorporate increased community involvement in mine closure outcomes. It was designed for use as a toolkit for mining companies to develop sustainable practices throughout the mining process and although titled mine closure and completion its focus was broader. The document was not designed as a Commonwealth entry into legislating on mining in Australia (a fact which it was keen to highlight) and nor was it designed as a comprehensive toolkit (also emphasised). It was an attempt by the Commonwealth to recognise the importance of sustainable mining that planned for life after closure.

***Planning for Integrated Mine Closure* (2008), International Council on Mining and Metals** – The Planning for Integrated Mine Closure Report (2008) follows on from the above reports in discussing the need for sustainability in the mining sector. However, for the first time at a global level the emphasis is on mine closure and the need to recognise mine closure as a core part of a mining business (ICMM, 2008). The document is designed to act as a practical toolkit for those in the mining industry and represents the first step towards developing a holistic approach to mine closure by the mining industry at not just a national but on a global level.

3.2.1 Summary of key documents

On their own, these documents do not represent best practice mine closure and in many respects they are just a first step towards sustainability and mine closure gaining greater recognition within the mining industry. However, taken as a whole, they offer a glimpse into the future of mine closure with an emphasis on a more holistic approach to the issue and more engagement with and input from local communities into how mine closure outcomes can be sustainable and how beneficial end-uses can be achieved for mining communities that provide growth in the long term.

The next section of the chapter will outline the key issues generated by the documents, discussing them under headings based around four key issues: Environmental; Social; Economic; and Governance.

3.3 Environmental issues

The first of the reports dealing with this issue was the 1996 Minerals Industry Code for Environmental Management, which recommended a set of guidelines for companies to adhere to in order to generate best practice environmental outcomes. This report was the first to recommend a national set of standards for addressing the environmental impacts that mining has on the ecosystem in which it is operating. Similarly, each of the documents preceding the Minerals Industry Code developed processes for addressing environmental issues within the mining industry that have been categorised in this thesis as the following: Rehabilitation; Responsible use of products and production; Protecting natural capital; and Environmental legacy.

3.3.1 Rehabilitation

Rehabilitation is the key environmental issue addressed by each of the documents. All of the documents stress the need for progressive rehabilitation of mine sites and the need to ensure open and transparent communication of environmental rehabilitation programs with local communities. As an example, the Minerals Industry Code for Environmental Management (1996) recommends that mining companies that are signatories to its code produce public annual environmental reports benchmarked against their progress in implementing the principles of the code (ANZMEC/MCA, 2000).

The ICMM Planning for Integrated mine closure toolkit (2008) goes one step further than the other documents in relation to rehabilitation in that it states the need for a conceptual closure plan (with detailed rehabilitation outcomes) developed during the feasibility stages of a mine project before exploration has even commenced. This plan will then feature as part of a more detailed closure plan once mining has commenced that will be an evolving document during the life of the mine. The toolkit also stressed the importance of community involvement in this process for the communities to be satisfied with closure plans before mining companies finalise their design.

These two documents and the Strategic Framework for Mine Closure (2000) provided the most comprehensive overview of rehabilitation and its importance to the mine closure process, in part due to the fact that their focus was on both environmental management (MCA code) and mine closure (Strategic Framework document and ICMM toolkit). The other documents reviewed tended to be broad in their scope focussing on wider issues surrounding sustainability such as the need for environmental stewardship and leaving behind a positive legacy from mining operations.

3.3.2 Responsible use of products and production

Both the AMEEF Report (2003) and the Code for Environmental Management (1996) make specific mention of the importance of recognising and understanding the life cycle of the products that are used in the mining industry and in doing so develop techniques that promote the recycling of products where possible, and if not, at least safe handling in their disposal. They also highlight the need to recycle and minimise waste at mine sites along with ensuring the efficient production processes in energy, material and resource consumption (ANZMEC/MCA, 2000). They go further in this respect than any of the other documents, again due to the nature of these documents as they are specifically dealing with environmental management and in the case of the Code for Environmental Management are meant to be used as a benchmark for signatories to the code.

3.3.3 Protecting natural capital

Natural capital can best be described as the ecosystem in which a mine operates and it is important for all involved in the mining process, the mining company who are granted a licence to mine the ecosystem in a community, the local community who have to live in the particular environment both during and after mining and the wider community (at a state and federal level) who may well be forced to foot the bill for any clean up costs associated with a poorly planned and implemented mine closure.

Natural capital is mentioned by all of the reviewed documents with the exception of the GEMI document, which does not mention it specifically and is aimed more at share market pricing of companies (although a mining company that is abiding by the triple bottom line will need to protect the natural capital they are mining). As an example, the Towards Sustainable Mining Initiative (2001) refers to the need for the mining industry to minimise their impact on the environment and protect the diversity of the ecosystem. The World Bank Extractive Industries Review (2004) goes one step further and recommends protecting bio-diversity hotspots by making sure they are ‘no-go’ zones, although it does not state how such a proposition could be undertaken by the Bank, particularly as this is a matter for sovereign governments to decide and not an area where the World Bank would have anything other than some degree of moral authority.

3.3.4 Environmental legacy

Following on from the above point, environmental legacy is what mining companies leave behind once they have finished a project. It is a popular theme throughout the reviewed documents as it is a way for mining companies to develop their image as good corporate citizens and move away from the problems of past environmental legacies (in places like Rum Jungle in Australia and the Summitville mine in the Unites States both of which appear in Appendix A as examples of poor closure practice.

The literature reviewed does not necessarily refer to an environmental legacy; instead, they use statements such as ‘fostering sustainable resource stewardship’ wherever a mine operates (Towards Sustainable Mining Initiative, 2001). The MMSD Report (2001) proposes that mining companies have a unique opportunity when they develop a mine site to leave the site in a state which is better than that which existed prior to mining and in so doing leave a beneficial legacy behind for future generations. This statement was not just discussing a mine’s economic contribution to a community, it is also taking into account the aesthetic value that a mine can contribute post closure, with such an example being provided by the Waihi mine in New Zealand, a review of which is undertaken in Appendix A.

ICMM Planning for Integrated Mine closure (2008) takes a more strategic direction and discusses the community ownership of post closure options and the need to leave the legacy for the community. This approach is the most holistic of the literature reviewed as it recognises the importance of a mining company leaving an environmental legacy, whilst acknowledging that the legacy ultimately becomes an asset (or burden if closure is not undertaken effectively) to the community well after the mining company has left.

3.3.5 Summary

The history of mine closure for both mining companies and indeed regulatory bodies has often been marred by poor mine closure outcomes that have not only given the industry a poor reputation, but in some instances cost communities and governments vast amounts of money to rehabilitate and fix the mistakes. This was not necessarily the fault of mining companies, as often regulatory requirements were such that a mine’s environmental impact was given little consideration in mining regulations and sometimes was deliberately left out of agreements between mining companies and governments (an example is provided in the case study Appendix of the Mount Lyell mine in Tasmania). Over time, the expectations of communities and the regulatory environment have evolved to a point where it is expected that mining companies rehabilitate a site after they have finished mining and leave it in a state that is at least comparable to that which existed prior to mining.

It is therefore not surprising that changes in community expectations and the regulatory environment in which mining companies operate became more stringent in their requirements for environmental impacts of mine closure. This section highlighted such changes and has identified the recognition that environmental legacy now has in the way mining companies operate. It is no longer as easy for mining companies to leave behind a mine site plagued by environmental problems (although they still occur as highlighted by the Windimurra vanadium mine in Appendix A. Indeed, the industry now recognises that there are implications for them that go beyond regulatory problems (such as poor public relations, which can have flow on effects on share prices and even on gaining approval for new projects).

3.4 Social issues

The impact that mine closure has from a social perspective has traditionally been seen as the poor cousin to the environmental effects of mine closure and from a legislative viewpoint is not considered in mining legislation in Australia. The social issues surrounding mine closure are however of significance to the communities in which a mine operates as the closure of a mine can affect the whole social structure of a town or region. Social issues that can affect a community once a mine site has closed can be wide ranging and can have long-term ramifications for the survival of a community or region. These can vary from population decline in a town or region as displaced workers migrate to find employment elsewhere, to issues such as alcoholism and depression associated with unemployment. Any decline in population will also have consequences for local educational facilities, sporting and other recreational clubs and will influence housing stock with potential oversupplies of housing.

Each of the documents reviewed highlights a lack of social investment by mining companies in the past. The earlier documents such as the Minerals Industry Code for Environmental Management (1996) tend to be concerned only with mentioning a need for mining companies to address social concerns that arise from mining practices; however, they are mainly discussing the issue from an operational perspective, rather than from the viewpoint of mine closure. Later documents that specifically relate to developing a holistic approach to mine closure deal more specifically with the need to engage more with the local community on social issues surrounding mine closure. In addition, a number of the documents highlighting social issues discuss it in terms of mining companies and their dealings with the developing world (the MMSD report and the Strategic Framework for Mine Closure Toolkit are two examples of this), but they are also issues that have not previously been well addressed by the mining industry in the developed world either.

The key themes that the literature review has uncovered under the social issues to be discussed include: respecting culture and rights; determining stakeholders; community development; community consultation and engagement.

3.4.1 Respecting rights and culture

The need to respect rights and culture was not a common theme throughout the reports. However, it was seen to be of high importance by both the Minerals Mining and Sustainable Development Report (2002) and the World Bank Extractive Industries Review (2004). Both of these reports were written from the perspective of the importance of respecting rights and culture from a developing world perspective, however there is some relevance to the developed world as well.

As an example, the World Bank Extractive Industries Review (2004) recommends that the mining sector can promote sustainable development when projects preserve the rights of affected people. This can be achieved if the benefits they generate are well used, for instance in poverty reduction and sustainable economic growth post mining. Although not designed for the developed world, such a goal can be an outcome for remote mining communities in Australia that currently have a number of social issues relating to gaps between mining and non-mining employees and the ramifications of mine closures on these communities over the long term, particularly in regards to the viability of some of these communities.

In response to this, the MMSD (2002) report states that there is a need for mining companies and governments to ensure that there is a fair distribution of the benefits (and costs) of mining to all those alive today. It does not state how to do this or the feasibility of making such a broad statement and so in some respects appears to be more of a feel good statement. It is an important point though, as within this context can be the discussion over mining taxes and royalties and their applications for redistribution back to local communities for ensuring continued social and economic development after the cessation of mining.

The World Bank Extractive Industries Review (2004) discusses how any projects that it is involved in will not be allowed to proceed unless there is broad community consensus and support for the project and this includes indigenous support for the project. Again, this point was written from the perspective of the developed world, but it is relevant for countries such as Australia, where there has been concern expressed, in the case of some projects, about a lack of broad community support. Such an example is provided in the case study of the Lake Kepwari mine in Collie, Western Australia where the mining company Premier Coal chose to proceed with the development of the former mine void into a recreational lake after broad community support for the project was obtained.

The Towards Sustainable Mining Initiative report (2001) discussed a need to respect the culture, customs and values of the people and communities in which a mining company operates. Although again a broad statement, it highlights that each community in which a mine operates is different and that even within countries such as Australia and within those communities, there are different values that need to be considered by mining companies not only during the operational phase of a mine, but also during the closure of a mine. As an example some communities will place a great deal of emphasis on post mining landscapes looking like they did pre-mining, whilst other communities may require a post mining landscape to provide some form of commercial orientation that assists in developing the economic base of a community (Peeling, 2004).

Interestingly none of the reports specifically discusses respecting the rights of Indigenous cultures, instead the issues surrounding indigenous cultures is addressed in terms of the economic benefits that can accrue, such as developing employment targets for Indigenous people on mining projects and providing them with poverty reduction strategies (through employment and business development programs). It appears that this is a glaring hole from a social issues viewpoint, particularly in countries such as Australia where mining leases often occur on land held by Indigenous people.

3.4.2 Determining stakeholders

In effective mine closure planning stakeholders can be classified as both external and internal according to the Planning for Integrated Mine Closure Toolkit (2008). The toolkit discusses the need to bring the parties together to achieve outcomes for a mine site that are mutually beneficial to both parties. The toolkit does not discuss specifically who the external stakeholders may be, instead providing a set of questions that should be asked as a guide in determining what constitutes an external stakeholder. As an example, the toolkit states that it is important to ask questions such as whom in the vicinity of a mine are directly and indirectly affected by a mining operation; and who has the ability to affect the ability of the mine to retain its licence to operate (ICMM, 2008). Internal stakeholders on the other hand are those within the organisational structure that will influence the mine closure strategy, which the toolkit states is linked closely to the organisational structure. The document provides a comprehensive table of the organisational teams (for example a mine closure team) that should be involved in the closure process. The problem with this section however is that the examples the document provides are not necessarily representative of all mining companies (which the document acknowledges) and hence is somewhat limiting for companies that are not well resourced.

The Strategic Framework for Mine Closure (2000) adopted a more specific approach to identifying stakeholders breaking them down into three broad categories, the Company, the Community and the Government. The document then further breaks down who some of the key individuals and groups will be in these circumstances. For example, from a Company perspective it is employees who will be most affected by a mine closure and who therefore have a stake in the process; from the Community it is the LGA who provide the most vital link with the community; and from the Government, aside from the lead agency, it will also include those agencies responsible for assisting displaced workers and welfare agencies (ANZMEC/ANZMEC/MCA, 2000).

Both of these documents recommend identifying stakeholders early in the mine closure process and communicating with them on a continuing basis. Both of these documents highlight the need for mining companies to continually engage stakeholders regarding mine closure and realise that stakeholders will change during the life of the mine and there is a need to reflect this in the closure process.

Of the literature reviewed, these two documents devoted the most time to the concept of identifying stakeholders in the closure process. The remainder of the literature either does not mention the concept of stakeholders, or makes a brief reference to them in terms of including them in consultation over mine closure. It is an important difference between the Strategic Framework for Mine Closure and the Planning for Integrated Mine Closure Toolkit and the remainder of the literature. The former both specifically focus on the concept of a more holistic approach to mine closure and provide an in-depth focus on the topic, whereas the other documentation is concerned with the broader concept of sustainable development within the entire mining cycle, with mine closure being just one aspect of this process.

3.4.3 Community development

Within the context of social issues, community development is not concerned as much with the economic aspects of closure, such as post closure economic development (however there is a link between the two), but rather with the health and wellbeing of the community both during the closure process and post closure. This can range for example from ensuring that social networks (such as sporting and community clubs) continue to operate post closure to maintaining facilities such as libraries, community centres that may struggle once a mine closes, particularly if that town was heavily dependent on the mine.

Each of the documents reviewed as part of this chapter made some mention of community development needing to become an entrenched part of the mining industry's approach towards engaging with a community. The majority of the reports only made some mention of it, as an example the Towards Sustainable Mining Initiative (2001) mentions community development in the form of providing lasting benefits to local communities through programs that improve on the community's social standards. It mentions achieving this aim mainly through mining companies investing in community projects throughout the life of a mine to provide long lasting assets after closure (Peeling, 2004).

The most wide-ranging overviews of how mining companies can contribute to community development post mining is undertaken by the Strategic Framework for Mine Closure (2000), the Planning for Integrated Closure Toolkit (2008) and the Minerals Mining and Sustainable Development Report (2002). Each of these documents stresses the need for mining companies to invest in the social capital of the community in which they operate through projects that are self-sustaining and can be maintained by communities once the mining company has left. The MMSD report emphasises that in effect this is mining companies giving something back to the communities and ensuring that the mining company will replace the depleted natural resources with other forms of capital (MMSD, 2002).

The ICMM Planning for Integrated Mine Closure Toolkit (2008) provides the most comprehensive guide for community development with a variety of tools to assist companies in undertaking community development programs. The organisation developed a separate Community Development Toolkit for use in conjunction with the Closure Toolkit, providing a variety of tools to employ as a way of improving partnerships between mining companies and the communities in which they operate. For example, there is a social baseline study tool designed to develop an information database on the sustainability of closure goals, which is linked to the social conditions of the local area (ICMM, 2008).

Community development is regarded as an important process both during the operational phase of a mine and after mining has ceased. It is suggested mining companies recognise the importance of partnering with communities and ensuring that programs developed during the life of a mine can be sustained once the mine has closed (MMSD, 2002). As important as this process is, aside from the ICMM Toolkit, the Strategic Framework for Mine Closure document, the MMSD report and to a lesser extent the Towards Sustainable Development Initiative, only small amounts of detail is provided on the idea. Conversely, the ICMM toolkit provides a comprehensive device for mining companies to use in the field when undertaking community development (ICMM, 2008).

3.4.4 Community consultation and engagement

Many mining companies and indeed regulatory agencies look at consultation and engagement as interchangeable terms; indeed this seems to be a common misconception across industry sectors. The reports themselves even use the terms interchangeably with the Strategic Framework for Mine Closure using the heading 'Stakeholder Involvement' yet a few paragraphs into the section outlines how consultation can be successful (ANZMEC/MCA, 2000). However, there are differences between the two (which will be discussed in more detail in the next chapter) and from a mine closure point of view it is one thing to consult with a community on mine closure outcomes, but quite another to engage them in the process by ensuring that any end-uses of the mine are both beneficial and sustainable.

Building relationships may have potentially long-term benefits that need to be seen in light of what is often regarded as short-term financial costs. Companies in some instances are beginning to recognise the need to involve communities in the decision-making process from the outset. There is a need for local governments and communities to deliver benefits from the mining process, rather than just mining companies assuming these roles. Community groups and NGO's can act as facilitators and partners in the flow of information between mining companies and communities.

In all of the reports there was a need identified for better relationship building between mining companies and the communities in which they operate, including a need to establish this contact as early as possible. In some cases the reports were not referring directly to consultation/engagement and mine closure (for example AMEEF, Minerals Industry Code for Environmental Management), however the principles can be applied to the mine closure process.

The MCA report recognises the need for community consultation in the mining process and acknowledges the need for technical experts within the mining community to become more open in social processes. Similarly, the Australian Minerals and Energy Environment Foundation (AMEEF) is stating that it will become necessary for mining companies to employ people with experience in the area of community relations, including indigenous experience (this is already occurring to a degree due to requirements of the *Native Title Act* (AMEEF 2003).

According to the AMEEF report, consultation and engagement with local communities is vital for the long-term success of a mining project and also in developing positive company-community relations. Engagement with local stakeholders can be important as stakeholders feel more at ease when they understand activities being undertaken; mining companies can receive early signals of discontent; and stakeholders can assist companies to identify cost-effective impact mitigation measures (AMMEF, 2003).

The MMSD (2002) report recommended a shared development path for communities affected by the mining process. The findings stated that local community engagement begins with the mining plan and is an ongoing process through to closure. The community and the company need to ensure that mechanisms that are implemented are appropriate for that community and that there is a degree of continuity between participants from both sides involved in the process.

Mining companies need to ensure that the communities in which they operate will be able to sustain themselves once the mining process has finished. There is a need, according to the MMSD report, to involve the local community and when awarding contracts related to the mine, give preferential rights to local contractors. The report believes this will assist a company in building its profile within the community and is a means of facilitating community awareness, capacity building and involvement and breaking down barriers between mining companies and communities (MMSD, 2002).

The ICMM Planning for Integrated Mine Closure Toolkit (2008) demonstrates the evolution of the industry over the last decade in relation to stakeholder engagement, as it differentiates between engagement and consultation. The toolkit refers to tools that it has provided for companies to engage in a two-way dialogue with communities to ensure mutually beneficial outcomes are achieved. These tools include, community profile mapping and how to develop social impact assessments, which can be used throughout the mining process, but which are particularly useful for mine closures as they can assist in determining what effects a closure will have and how these effects can be mitigated.

3.4.5 Summary of social issues

These documents have highlighted how the importance attached to social issues that arise from mine closures have evolved over time going from a couple of lines or paragraphs in a document to becoming prominent sections in documents that are devoted to sustainable development and mine closure. All of the documents reviewed made mention of the importance of engaging, or at the very least consulting with communities (often interchangeably) in two-way dialogue that takes into consideration the concerns and ideas of the community. Mining industry bodies have realised that in order for mining companies to gain a social licence to operate they need the support of the communities in which they operate. Over time, they are concluding that after closure communities will have differing requirements that companies have obligations to meet in order to develop self-sustaining communities in the long term.

In addition, companies need to develop dialogue with communities early in the mine process and recognise that the stakeholders will change over time and alter their dialogue to reflect this. This dialogue also needs to include Indigenous communities, recognising their rights and culture, which is an issue that appears to have been overlooked by the literature. It is however important in countries such as Australia, Canada and the United States, all of whom have mining sectors that deliver significant income and where recognition of indigenous rights and culture can be vital in securing support for a project and hence any closure outcomes.

3.5 Economic issues

The issues surrounding the economics of mine closure appear at times to overlap with the social issues, which is understandable as there are many linkages between the two, notably in the fact that a company that is economically viable will have the financial capital and resources to devote to sustainable mine closure programs (Peeling, 2004). The Minerals Mining and Sustainable Development Report (2002) outlined a number of factors associated with the economic issues of mine closure. These included that it needed to maximise human well being, ensure that resources were used efficiently and ensure that the enterprise remained viable (MMSD, 2002). These were rather broad statements, some of which could be considered common sense from a financial point of view (i.e. ensuring viability), but they highlight a desire by mining industry bodies to at least start thinking about the economic impact of their members operations on a community.

To a degree, each of the reviewed pieces of literature places some emphasis on economic issues; however, it is not always clearly focussed on mine closure specifically, although there is applicability for mine closure issues. The main themes found under this section included: effects of closure; revenue sharing; shareholder maximisation; financial provisioning; risk assessment and reduction.

3.5.1 Effects of closure

The effects of closure tend to be discussed around the theme of mitigating the economic impacts of mine closure on communities by providing long–lasting, beneficial, closure outcomes. The World Bank Extractive Industries Review highlights that it will only support mining projects when linkages are encouraged between local businesses to ensure greater local involvement in projects and assisting these businesses in capacity building. Similar themes are developed in the other documents, notably in the MMSD report and the AMEEF report; however, it is difficult to see this option as providing sustainable benefits once a mine closes, particularly if these businesses become heavily dependent on the mine.

One area where the DITR Mine Closure and Completion Handbook (2006) and the ICMM Integrated Planning for Mine Closure Toolkit (2008) recognise that there are possible long-term economic benefits for communities post mining is in the provision of former mine infrastructure. This could be in the form of plant and equipment for local businesses, and road and/or rail infrastructure for use in developments such as business parks (an example of this is the case study of Kennecott's Flambeau mine in Wisconsin in Appendix A). The DITR handbook suggests this is part of a wider community and economic development strategy aimed at business development opportunities post mining and a process that should be undertaken continuously throughout the life of a mine.

The ICMM Toolkit (2008) recognises the role that a company can play in mitigating the effects of mine closure on a community; however, the document also mentions the role of other (external) stakeholders in this process. Most importantly this includes the community, who with their knowledge and expertise on the community are best placed to inform on how to develop economic and social closure outcomes. Governments at all levels, local, state and federal, can also provide the institutional support necessary to assist in mitigating the negative effects of closure and developing capacity building projects (for example retraining programs for displaced workers, business development programs, welfare assistance packages) to sustain communities after a mine has closed (ICMM, 2008).

3.5.2 Revenue sharing

Revenue sharing was a concept that was not widely mentioned throughout the literature; however, it was given some credence in two of the reports, the MMSD report (2002) and the World Bank's Extractive Industries Review (2004). Both documents discussed the idea of revenue sharing between mining companies and local communities, with the MMSD report (2002) stating that this could be achieved through agreements between mining companies and governments. Through these agreements, revenue from the mine would be directed to various community and economic development projects within the local community in which a mine operates.

The goal of the World Bank in this process was to ensure that development programs that were financed through their subsidiary the International Finance Corporation were sustainable and protected the rights of the poor, with the aim of reducing poverty. The review stated that the way to achieve this was through the involvement of stakeholders with mining companies and the World Bank in all stages of a mine project, with the stakeholders monitoring the outcomes of these projects, particularly the mine closure (World Bank, 2004). Revenue from projects was to be shared with local communities to support economic development projects.

It is difficult to foresee any company willingly to share revenue with a local community without some financial input from the local community or government in the project. At any rate, the World Bank undertook the review in 2004 and there has been no evidence of this recommendation being adopted in any mining project supported by the World Bank up to 2011. A better alternative to this can be found in the case study (See Appendix A) of the Flambeau mine in Wisconsin where the State government redistributed a percentage of the mining taxes it received from the project back to the local community to support various development projects.

The Western Australian government's Royalties for Regions Program, which returns 25% of the State's mining and onshore petroleum royalties back to regional areas each year (Department of Regional Development and Land, 2011) may be a more realistic option for generating returns from mining back to local communities. Although this system is not perfect and would possibly be better spent on returning the royalties to the mining communities it is at least not going to affect potential investment in the way that revenue sharing as discussed by the MMSD and World Bank reports could.

3.5.3 Shareholder returns

The most comprehensive outline of shareholder returns in relation to mine closure was undertaken by the Global Environmental Management Initiative whose report (GEMI 2004) focussed on the importance of a company's environmental record in increasing the value of its shares. In their article entitled "Building Shareholder Value", GEMI discuss how Environmental Health and Safety (EHS) became an important part of valuing a company as investors and fund managers began to use this as one of the tools to value the investment potential of a company, noting that this was particularly important in some key industry sectors, one of which was the resources sector.

The corporate world during the latter part of the 20th Century and into the 21st Century has increasingly begun to focus on the concept of the triple bottom line. The Global Environmental Management Initiative (GEMI) discusses how fund managers and shareholders are starting to take into account the triple bottom line when deciding their investment strategies. This has implications for all industries, but particularly those so-called 'dirty' industries such as mining, that have traditionally been viewed with disdain by many in the environmental movement, who are now starting to have their voices heard by mainstream society, after decades of being confined to the fringes (Peeling, 2004).

The GEMI (2004) report conducted research on industry analysts, examining their views on the importance of EHS. An overwhelming 86% believed that with regards to the oil, gas and the resources sector, their compliance (or lack of) with regulatory requirements, community involvement in their operations and environmental infractions will influence the value of a firm.

Of the literature reviewed, the GEMI report provided the most detail on shareholder returns. However a number of the other documents discussed this in an indirect manner in terms of maintaining a social licence to operate (MMSD, Strategic Framework for Mine Closure, Mine Closure and Completion), the failure of which will influence the bottom lines of organisations and ultimately their share price.

As an example of the growing importance of the triple bottom line, the Dow Jones Index in the United States introduced the Dow Jones Sustainability Index and the Sustainable Asset Management Index (2011); designed to place additional pressures on companies to meet increased social expectations. A company listed on this index must meet strict standards of social and environmental responsibility. This index is still relatively small, in terms of overall market capitalisation (at 30th June 2010 it was US$8 billion); however, it is setting the benchmark for social responsibility standards (Dow Jones Sustainability Indexes, 2011), containing 2,500 of the largest capitalised companies on the Dow.

A variety of forces is placing competitive pressures on companies and is requiring companies to become more proactive in their work practices. Some of these pressures also include company reputations; with greater access to information, communities today are able to quickly ascertain for example, whether a company has a good history of environmental management. Similarly, shareholders are also beginning to demand better environmental practices from companies and in both instances companies that are unable to present a positive record of environmental management may find it difficult to obtain approval for a development project.

3.5.4 Financial provisioning

Financial provisioning involves ensuring that mining companies set aside enough funding to be able to complete their closure obligations. A number of the documents reviewed provide some detail on the need for companies to account for the cost of closure and that the community will not be left with a liability post closure. The DITR handbook mentions that mining companies are now obliged under the *Australian Accounting Standards Board 137: Provisions, Contingent Liabilities and Contingent Assets* to account for mine rehabilitation and closure costs. , the costs for mine rehabilitation and closure are listed as liabilities in a balance sheet (DITR, 2006), which means that there is an obligation on mining companies to be transparent in their cost estimates of closure.

Three of the documents provide the most comprehensive overview on this particular issue, with the Strategic Framework for Mine Closure providing a number of principles that it recommends companies follow to meet their closure obligations. These include: developing cost estimates for the closure; regular reviews of the closure costs; and bonding mechanisms that are enough to protect communities from liabilities associated with a closure (ANZMEC, 2000). Nevertheless, this last point is really out of the control of mining companies and is something that governments need to regulate more effectively. In response to this, the Federal Governments Mine Closure and Completion Handbook proposes that governments need to adopt more effective methods of financial assurances in order to reduce criticism by the public of industry practices in this regard (DITR, 2006). The handbook does not outline what a more effective mechanism would be, nor provide any guidance as to what a realistic financial assurance would be, with the only clarifying statement being that it should not place a company under financial duress or suppress investment.

The ICMM (2008) report emphasises the need for mining companies to own the cost estimates for closure at the site level (as opposed to a head office accounting entry) and that these costs should be factored into the annual operating activities. The reason for this is that this brings ownership for the mine closure to the site level and makes them more accountable for developing accurate closure costs. This document also highlights the need for mining companies to develop risk assessment tools that estimate the probability of exceeding closure costs and make provision for this in the closure plan. This also highlights what all of these documents make in relation to financial provisioning, that closure plans need regular monitoring and updating in order to account for changes to either the company operations, or even changes to the final design of the mine site due, for example, to an increase (or decrease) in the size of a mine site.

Ensuring adequate financial resources are available to implement a mine closure program would seem like common sense. However, too often in the past, mines have closed without making adequate financial provisions for the closure of the mine (an example in Appendix A of the Summitville mine case study provides an example of this). This has caused issues not just at the mine site, but within the local community and often at a higher government level who are left to deal with the associated clean-up costs (Warhurst and Mitchell, 2000). The ICMM toolkit, ANZMEC framework and the DITR report are at least acknowledging the need for mining companies to be held more accountable for their actions in this area (the changes to the Accounting Standards also help); however, more work is required at a regulatory level to ensure that assurances are adequate to meet unexpected or unplanned events.

3.5.5 Risk assessment and reduction

Risk assessment and reduction is partly related to the financial provisioning, as it is about reducing the risks associated with the closure of a mine by ensuring that adequate resources are available for the closure process. Again, not all of the reviewed literature deal with this process, as it is specifically dealing with mine closure and it was dealt with mostly by the literature focused on mine closure outcomes. The DITR Mine Closure and Completion Handbook (DITR, 2006) stresses that risk management has always been part of the planning and operational phases of mining. It suggests this should also be a part of the mine closure process as a way of identifying the risk associated with mine closure (such as possible groundwater contamination) and put in place control measures to rectify any risks.

The DITR Handbook (DITR, 2006) also states that mining companies should develop a series of mine closure options as part of an initial mine closure planning feasibility document detailing the risks and benefits of such an approach. The handbook claims that this process should be undertaken with the local community, notably nearby landowners and local governments in order to determine the most cost-effective and viable closure strategies. The handbook also states that part of this risk assessment should involve the development of a risk register that focuses on identifying issues, risks, and priorities associated with mine closure, examining all factors, including the environmental, economic, social and regulatory risks.

The Strategic Framework for Mine Closure (ANZMEC, 2000) only briefly mentions the need for adopting a risk-based approach to mine closure. It is rather narrowly focussed in that it only recognises the benefits of doing this from an environmental and engineering perspective; mainly to do with quantifying subjective factors (such as landscape design for example) and carrying out an analysis of the uncertainty associated with design (Morrey, 1999).

The ICMM Toolkit on the other hand is again the most comprehensive of these documents in providing an outline of how to determine the risk factors associated with mine closure. As with the DITR Handbook, the Toolkit outlines six risks associated with mine closure with these ranging from health and safety risks, to risks associated to reputation and the financial risks (ICMM, 2008). The document recommends that risk assessment should be continuous with the aim of maximising lasting beneficial closure outcomes, and provides a risk opportunity/assessment tool that can be used as part of this process.

While it is important to recognise these risks, what the handbook does not consider and yet is of significance is that risk assessments on the costs and benefits of closure should not be conducted in isolation, but need to be undertaken holistically with the partners in the process, namely the local community and all levels of government. The DITR Mine Closure and Completion Handbook and the ICMM Toolkit both mention the need for greater government involvement in the mine closure process at the start of the handbook, yet fails to consider this in this section. If mine closure is to be properly assessed, the people most at risk from it (the community) need to be part of the process.

3.5.6 Summary of economic issues

As with the social issues surrounding mine closure, the economic issues have tended to be ignored in the mine closure process by all parties. There has been little concern about the costs associated with mine closure, whether it is to the community, or the environment (Wright, 2003). The literature reviewed for this section at least demonstrate that the mining industry and to a lesser extent government are deeming these to be important considerations as part of a more holistic approach to mine closure. Part of this change has been driven by the industry itself, however part can also be attributed to societal changes leading to demands for greater accountability from mining companies in the way they approach mine closure. There is also growing recognition that poor closure practices will come under greater scrutiny from investors and can have an impact on the share value of a company.

The literature itself although not necessarily always comprehensive in its coverage of the issues associated with mine closure, at least provides some useful tools for practitioners in the industry to use as part of their closure approach. This is most notably the case in the Strategic Framework for Mine Closure (2000), the Mine Closure and Completion Handbook (2006) and the Planning for Integrated Closure Toolkit, each of which demonstrated their own strengths in various areas. The other reviewed literature tended to be somewhat lax in dealing with the issues surrounding this theme, which may in part be explained by their broader focus on sustainability in the mining industry. However, there is an argument that sustainability in the industry includes mine closure as it is the ultimate legacy that a mining company leaves behind.

The major failing of all the documents in this section was a lack of focus on working more closely with local communities to overcome the economic issues associated with mine closure. While it was mentioned, there appears to be a greater need to recognise the benefits of developing an inclusive approach to the economic issues of mine closure and working more closely with not just government agencies, but particularly the local communities and by design the local government areas in which a mine is situated.

3.6 Governance issues

Governance can relate to both governments and corporations. From a government perspective, governance is what a government does; it is the act of governing. In terms of corporate governance, it relates to cohesive policies and processes and a consistent approach to management (OECD, 2004). In relation to this chapter, it revolves around a number of key areas, or themes, that relate to mining companies being more accountable for their actions, adopting more open methods of communication, ensuring that all levels of an organisation are working towards the same principles and making mine closure more sustainable. Common themes concerning governance came out of the literature review and they will be discussed under the following headings: Policy and legislation, Closure planning, Cooperation and development, and Transparency.

3.6.1 Policy and legislation

The literature review uncovered few references to policy and legislation in any of the reviewed documents. Even in the DITR Mine Closure and Completion Handbook, little reference was made to regulatory requirements. However, the DITR Handbook (2006) mentioned one aspect of government policy that needs to be more effective in mine closure, financial bonds, or assurances (as they are sometimes known). The Handbook mentions that often in the past these have been inadequate to cover the costs of rehabilitation and closure, particularly in the case of unplanned closures. An example of this is provided in the case studies (see Appendix A for more detail) of the Rum Jungle site in the Northern Territory where the closure of the mine (which was not supported by an adequate bond mechanism) has seen an ongoing clean-up campaign that has cost the Northern Territory government $20 million (Appendix 1, p. 28).

The ANZMEC Strategic Framework for Mine Closure refers to the need for changes to mining industry approaches to mine closure and refers to its desire to have governments work in conjunction with industry to develop complementary policy and legislation to that outlined in the Strategic Framework for Mine Closure (ANZMEC, 2000). In addition, the Strategic Framework document highlights one of its key aims is to have a consistent and uniform set of guidelines that operate across all jurisdictions as they would provide more certainty for the industry (ANZMEC, 2000).

The MMSD Report (2002) recommends that governments with a strong minerals sector should review their legislative and policy framework in this area in order to ensure a strong commitment to the idea of sustainable development. It suggests it may be a good idea for communities along with governments and mining companies to develop an integrated social and environmental impact statement called a Community Sustainable Development Plan (CSDP). According to the report, this plan should be based on how a mine can best contribute to the community's social, economic and environmental goals.

The CDSP plan should provide a framework for determining relationships among the company, community, government and other parties. It should indicate the roles and responsibilities of all parties, as well as including performance indicators that measure whether or not objectives are being met (MMSD 2002). The MMSD said in relation to the

Community Sustainable Development Plan that it should clearly articulate a uniform goal, the specific roles of each party and performance objectives to determine whether those goals are being met (MMSD, 2002).

In the case of corporate governance policy for mine closure, the Minerals Industry Code for Environmental Management and the Strategic Framework for Mine Closure were developed as codes of conduct for signatories to follow. The code does not set rigid standards, as the aim of the code is to encourage companies to follow the main points of the code and perhaps expand on its aims. The focus of the code is on environmental issues; however, the Minerals Council of Australia (MCA) is as an organisation aiming to encourage its members to be more pro-active in the cultural and social objectives of the code (MCA, 2003).

The signatories of the code represented 90% of mineral production in Australia as at 2002 (no later information was found regarding this) (MCA 2003). These were, however, mostly the major mining companies, smaller and medium-sized enterprises are not signatories to the code and as the report stated there was no means by which the smaller companies could be lured to become signatories to the code and change their governance practices (AMEEF, 2002).

In fairness to the authors of the documents reviewed for this process, the aim of the vast bulk of them was to provide tools for mining industry practitioners to use and was about making improvements within the mineral sector. However, this would by necessity involve changes to government policy and legislation, as sustainable mine closure needs to be holistic and involve all parties in the mining process. Codes of conduct are a step in the right direction towards recognising the importance of sustainable mine closure, although they are by their very nature voluntary and not enforceable and hence, unlike legislation, will not force companies to become more open and consultative.

3.6.2 Closure planning

All of the documents reviewed are in consensus on closure planning, stating that closure planning should commence as early as possible in the mining process. The only current legal requirement for this in Australia is that a mining company submit a conceptual closure plan during the planning phase, though there are no requirements for the plan to alter until the cessation of mining and there are no legal requirements to undertake any social or economic impact assessments of mine closure (ANZMEC, 2002). Despite this, some documents refer to the need for companies to undertake regular closure plan evaluation and to consider the social and economic impact of a mine closure on the community (for examples the Mine Closure and Completion Handbook, the Planning for Integrated Mine Closure Toolkit).

The Strategic Framework for Mine Closure recommends that a mine closure plan take into account not just the legal requirements (which are generally environmentally related), but also the economic and social factors of the site in which they operate. The document outlines the content of a typical closure plan and a number of key objectives that it believes mining companies should pursue as part of the closure process; ranging from protection of the environment including reducing environmental impacts post-mining, work towards establishing pre-determined land end-uses and reduce the need for long-term maintenance and monitoring (ANZMEC, 2000). The interesting paradox between the objectives and the statement outlining the need for determining economic and social considerations is that the objectives do not actually include any economic or social objectives as part of the closure plan, despite the document stating that these are important considerations in mine closure.

The ICMM Toolkit again sets the benchmark on closure planning, stating that it should commence during the initial mine planning phase with the development initially of a conceptual closure plan (ICMM, 2008). The document then goes on to state that a detailed closure plan should be developed as quickly as possible during the early operational phase as this allows time to fine tune and optimise closure outcomes and it also allows for the mine to deal with an unplanned closure should it occur (ICMM, 2008). Further to this, continuous monitoring and research on the rehabilitation and closure program can lead to significant cost reductions during the life of a project (Pierce and Wen, 2006).

The ICMM Toolkit suggests continual updating and revising of the detailed closure plan during the life of a mine with target objectives and goals that need to be measurable. The document provides a number of tools to assist in refining goals if needed and it recommends a series of processes for undertaking this refinement. These include stakeholder engagement, focussing on environmental, social and economic goal setting, and risk assessment tools (ICMM, 2006). The idea is to develop an evolving, living document that provides all players a sense of guarantee about the closure process.

Mine closure planning is an important part of the mine closure process. Traditionally it has not needed to be undertaken until the final years of a mine’s life and legislatively this is still the case (although a conceptual mine closure plan does need to be submitted during the initial planning phase). These documents highlight that industry bodies and some regulatory authorities recognise that detailed closure plans developed during the early life of a mine that are evolving documents and that incorporate environmental, social and economic factors into the plan represent best practice closure planning. At present though, this is still the exception rather than the norm and there is still a deal of work to do before this becomes standard practice.

3.6.3 Cooperation and development

Cooperation and development is a concept used in the MMSD report (2002) and in the World Bank Extractive Industries Review (2004), with the aim of developing a set of common goals that all parties were working towards (MMSD, 2002). Both the documents discuss this idea in terms of the benefits it would provide for the developing world; however, there may be some applications of the concept for mining dependent communities in the developed world.

The Canadian Mining Industry's Towards Sustainable Mining Initiative (2001) stated to its members that part of an approach towards shared development involved putting in place an agreement with local communities that there would be a set percentage (to be determined through a legally binding agreement) of local businesses that would be contracted to a mining project throughout the life of a project, including closure (Peeling, 2004). The MMSD report takes a similar approach by stating that preferential rights are given to local contractors when awarding mine contracts throughout the life of a mine (MMSD, 2002). The report also states the need to be inclusive throughout the life of the mine and become an active part of the community in a number of areas, particularly in social development programs that have the capacity to become self-sustaining after a mine has ceased operating.

According to the AMEEF report (2003) this building of relationships may have potential, long-term benefits that need to be seen in light of what is often seen as short-term financial costs. Companies in some instances are beginning to recognise the need to involve communities in the decision-making process from the outset. There is a need for local governments and communities to deliver benefits from the mining process, rather than just mining companies assuming these roles. Community groups and NGO's can act as facilitators and partners in the flow of information between mining companies and communities (AMEEF, 2002).

The World Bank's Extractive Industries Review (2004) stated that its future investments would be more selective, focussing on the needs of poorer people, emphasising good governance and investing in projects that are environmentally and socially sustainable. The World Bank are advocating for greater involvement of local communities in mining projects throughout the life of the project, with support from the community required before a development can proceed (World Bank, 2004). It is difficult to determine the benefits of this approach as there was little in the way of measurable goals that would be used to determine whether or not this has been achieved and the World Bank has something of a mixed record in this area in other sectors in which it has invested (Mugonda, 2006)).

According to the Mining Association of Canada, the TSM initiative is working because it does not force the key principles upon its member base, but instead works co-operatively with them to build on the work it claims that many of these companies are already undertaking in the area of community and sustainable development (Peeling, 2004). The TSM, the MMSD report and the ICMM Toolkit are demonstrating that many in the mining industry are attempting to develop more uniform standards of governance across the industry. This move towards greater cooperation and development standards is also partly in response to community expectations as more communities are using their power to veto, or speak out about projects that are of limited economic or social benefits.

3.6.4 Transparency

One of the other governance issues that arose from the literature was that of transparency (ANZMEC, 2000; MMSD, 2002; World Bank, 2004,). This was in part about businesses being more accountable for their actions, which again has partly been a response to societal expectations about the way business is conducted and changes in the way media (both social and mainstream) are able to quickly turn public opinion against corporations that are not acting responsibly.

The MMSD report states that part of effective governance involves ensuring that all stakeholders in a mining project are provided with relevant and accurate information, including for example access to company reports related to the mine, and accounting reports detailing financial liabilities associated with a mine closure (MMSD, 2002). The report states that part of being transparent also involves companies being more accountable to communities for their decisions and actions, which should force companies to undertake more comprehensive and reliable analysis.

The DITR Mine Closure and Completion Handbook adopts greater transparency as one of the key principles of mine closure in its framework on sustainable mine closure. The handbook states that through communication and engagement with communities mining companies can develop closure outcomes that are mutually beneficial and understood by all parties. Furthermore, the Handbook states that independently verifying reporting arrangements adds more transparency in mining companies dealing with communities, as third parties add a degree of independence and can generate trust within communities (as it demonstrates that mining companies have nothing to hide) (DITR, 2006).

According to the AMEEF report (2003), building relationships may have potential long-term benefits that need to be seen in light of what is often seen as short-term financial costs. Companies in some instances are beginning to recognise the need to involve communities in the decision-making process from the outset. There is a need for local governments and communities to deliver benefits from the mining process, rather than just mining companies assuming these roles. Community groups and NGO's can act as facilitators and partners in the flow of information between mining companies and communities (AMEEF, 2002).

According to the AMEEF report (2003) in order for stakeholder engagement to be successful, contact between all involved in the process should be established as early as possible and be open and transparent from the outset. The report states that it is important that all stakeholders participate and take ownership of processes and outcomes as part of a more open communication path between mining companies and communities.

These reports certainly demonstrate that mining industry bodies and certainly some in government believe that greater transparency is vital in communities accepting mine closure strategies. A more transparent approach can also assist companies in gaining approval for projects in other locations, particularly if they have a proven record of openness and accountability. Such a position assisted Kennecott mining company in gaining support for their mine in Wisconsin in the United States, a detailed analysis of which is provided in Appendix A. Companies that are more transparent in their engagement processes with communities are also more likely to find that communities will be more inclined to actively participate in planning and implementing a closure strategy as it generates a level of trust.

3.6.5 Summary of governance issues

Governance is not a concept that applied solely to governments; there is also a concept of corporate governance that relates to how decisions are made within an organisation and the processes used to arrive at those decisions. It is about the need for corporations to be open and accountable to the stakeholders that have a vested interest in the company whether shareholders, or in the case of mining companies, the communities in which they operate.

The review of literature in relation to governance issues has demonstrated that there is an increasing awareness of the need for better corporate governance, at least from industry bodies, however good corporate governance is something that is difficult to enforce. This was expressed in a couple of the documents that admitted they were merely guidelines and/or recommendations and not enforceable. This is not an area for which there is an easy fix, social expectations, ethical shareholder decision making and negative public relations will play a role in forcing companies to become more open and transparent, however in many respects it is largely an area of self-governance.

Competitive pressures are being placed upon companies from a variety of forces and are requiring companies to become more proactive in their work practices. Some of these pressures also include company reputations; with greater access to information, communities today are able to quickly ascertain for example, whether a company has a good history of environmental management. Similarly shareholders are also beginning to demand better environmental, and socio-economic practices from companies and in both instances, companies that are unable to present a positive record of environmental or socio-economic management may find it difficult to obtain approval for a development project.

3.7 Benefits of sustainable development and mine closure

The approach taken in this chapter has been to examine what information some of the major pieces of literature on mine closure and sustainable development have to impart in regards to mine closure. What the literature review has shown is an evolutionary change in the way the mining industry approaches the issues of sustainable development and mine closure. The initial document reviewed the Minerals Council of Australia's Minerals Industry Code for Environmental Management (1996) was unique as it emphasised uniform environmental standards for the industry and encouraged greater community engagement between mining companies and local communities in all phases of the mining cycle. The Code was the first Australian developed code of conduct in the mining industry that required all signatories to abide by a set of voluntary rules in relation to mining projects that are undertaken.

At the other end of the spectrum, over twelve years later, the International Council for Mining and Metals (ICMM, 2008) introduced a toolkit for practitioners on the mining industry that provided a set of tools to use in a practical setting towards developing an integrated approach to mine closure. The toolkit is the most comprehensive and provides mining industry practitioners with a systematic approach to mine closure from a corporate perspective. The document is not a prescriptive approach to mine closure and nor is it legally binding. What it does though is highlight that mine closure needs to be holistic and that mining companies do not work in isolation at a site. Furthermore, the toolkit is designed for use across both the developed and the developing world, and for the first time in this field has global applications.

The benefits from these documents in relation to sustainable development and mine closure are that the industry bodies want a more sustainable approach to mining development and closure with a focus on long-term benefits to the communities in which mining companies operate. There is recognition that poor mining practices from the past have harmed the industry's reputation and made communities more reluctant to allow mining developments proceed unless there are clear benefits and a more sustainable approach to environmental management standards, particularly post-closure, and that mining legislation across the world recognises this feature.

Therefore, mining companies that have poor reputations for environmental management and increasingly socio-economic management of communities will increasingly find themselves subject to potential share price downgrading and sustainable fund managers directing their clients funds to other companies with better track records. The increasing global power of the Dow Jones Sustainability Index is evidence of such an approach.

Recommendation has come from some of the documents for a review of government legislation in the area of sustainable development and mine closure, with the Minerals Council of Australia recommending that governments develop legislative guidelines more in sync with their document the Strategic Framework for Mine Closure. While not outright critical of the current regulatory environment, they state that one of the benefits of their framework is its applicability across jurisdictions.

The documents also mention the benefits of engaging with local communities from the early phases of a mining project across a range of issues relating to mine closure. There is consensus among the documents dealing specifically with mine closure that this approach is beneficial not just for the community but for the mining company as it builds greater community awareness of their operations and community knowledge that can be used when determining end-use outcomes for a mine site. The process of community engagement needs to recognise the stakeholders in a mine project and include them in the decision-making process making this an ongoing process throughout the life of a mine project. Hence, there is a strong emphasis in the documents on better corporate governance in the industry and the development of more openness and transparency throughout the entire mining process.

The documents also emphasise the importance of mine closure plans being developed as part of the mine planning process and not just conceptual closure plans as required by mining legislation (at least in Australia), but detailed closure plans that become living documents that are reviewed and updated regularly when conditions change (for example changes to the mine site, new ownership of the mine, changes in technology). These plans need to develop a number of end-uses for a site that are assessed by benefit-cost analysis as to their suitability for the community and their long-term sustainability.

There is also recognition that these closure plans need to adopt new grounds for mine closure planning documents in that they need to incorporate the environmental, economic and social impacts of mine closure as part of their objectives. They also state the need for building better relationships with governments at all levels, particularly in relation to the socio-economic effects of mine closure and use their expertise to assist in the closure process.

The other advantage from the approach to sustainable development and mine closure that has come from the review of these documents is a recognition that in the past mining companies and governments have been neglectful in allowing for the full costs of mine closure resulting in poor closure outcomes for communities and in some instances ongoing financial costs for governments. As a result, there is recognition that mine closure needs to be accounted for by both mining companies (through Accounting Standards which are now mandatory) and through governments ensuring that financial assurances (or bonds as they are sometimes referred to) are comprehensive enough to cover any costs associated with unplanned closure. Hence, there is increased need for risk assessments incorporating such factors to be included in mine closure plans.

3.8 Summary

There were a number of issues common across all of the documents reviewed for this chapter. These issues were discussed under four broad topics, namely, environmental, social, economic and governance issues, with various specific themes arising from these topics. The documents were compared and contrasted in regards to their focus on these issues with some detail provided when documents provided specific information that was of relevance to mine closure. None of the documents reviewed could be described as providing detailed mine closure guidelines, however the International Council on Metals and Mining Planning for Integrated Mine Closure Toolkit provided the most practical information for mine closure practitioners and hence could be construed as a useful tool for the industry. Moreover, the Minerals Mining and Sustainable Development Report provided the most comprehensive overview on sustainable development in the mining industry and is a useful reference for adopting a whole of mining approach to sustainability.

What is important about these documents is that they represent a step towards recognising the importance of sustainability and mine closure in the mining process and the need for all parties to work together towards long-term benefits for local communities post closure. However, these documents alone will not alter poor mining practices and they are not a panacea for dealing with the issues that affect mine closure. There is a need to see more of this theory used practically in the industry and for regulators to work with companies and industry bodies to use these documents as a guide towards developing specific mine closure legislation.

Chapter 4 follows on from this chapter on sustainable development and mine closure by looking in detail at one of the key factors in sustainable mine closure, namely mine closure planning. The chapter analyses in more detail the need for mine closure planning as part of a holistic approach to mine closure; what part the community plays in the process of mine closure and how mining companies can engage them in determining mine closure outcomes.

Chapter 4. Mine closure planning and community engagement

4.1 Introduction

Environment Australia (2002) makes it clear that most mine closure planning is centred on environmental issues, but in the future it will need to incorporate economic and social objectives into the process and that this will be driven by community expectations which will in turn change legislative policy. Khanna (2000) believes that local communities need to and are increasingly being forced to play a more active role in planning of mine closures by becoming less dependent on handouts after a mine has closed and relying on a mine as a main source of economic and social activity during the operational phase He suggests local communities need to become more active in planning for the long-term needs of the region and adopt a long-term approach to the benefits of mining that incorporates post-closure development.

Trezise (2004) states that communities are becoming more vocal and more empowered when it comes to mining operations in their community. Trezise also states that companies that do not listen to local communities could threaten their social licence to operate, which will adversely affect the operations of a company. An example provided from the case studies in Appendix A (p.87) of Ridgeway mine in South Carolina demonstrates how effective community opposition to a mine can be in halting a mining project. When the mining company Kennecott Minerals first developed plans to mine the Ridgeway site in the early 1980's, the community opposition to the project (notably the closure plans for the site) was such that the company was actually forced to abandon initial plans to mine the site. The company did reapply again, but was only successful because it listened to the community and redesigned the closure plans for the mine site to suit the needs of the community.

Jackson (2000) in examining issues surrounding sustainable mine closure from a number of experts from various fields presented research on best practice planning for mine closure. Jackson outlined a number of issues that need to be considered if governments, companies and stakeholders in the mining industry are to adopt world's best practice in their operations. One of the issues that came out of this paper was that there was a clear need for governments to adopt specific mine closure legislation that not only considered the environmental aspects of mine closure but also took into account the socio-economic affects. Part of this needs to include governments at all levels providing services that diversify local economies and that take ownership of mine closure plans (particularly in the case of local governments) and ensure that the outcomes delivered by them are sustainable. In addition to this Khanna

(2000) recommends that mine projects are incorporated into regional development programs, not be developed in isolation.

Jackson (2000) also states that government regulatory bodies need to take more of an active role in considering the socio-economic effects of mine closure in their licensing of mining activities instead of focussing on just the environmental effects. As part of this process Trezise (2004) states that there is a role for internationally designed mine closure legislation or regulatory guidelines that would provide uniform closure standards across the globe and could be referenced by both governments and industry alike.

Jackson (2000) states that there is a clear need for governments and organisations to identify who the stakeholders in the mine closure process are and develop an ongoing and transparent relationship with them, sharing information about the mine closure process throughout the life of the mining project. Part of this process would involve the sharing the risks and benefits of various mine closure options for a site in order to allow well-informed decision making on the mine closure process.

This chapter will examine the role that governments and corporations play in the mine closure process, also reviewing as separate sections how to identify stakeholders in the mine closure process and the role that community engagement plays in the mine closure process, reviewing the literature on what constitutes community engagement and how it differs from community consultation. Finally the chapter will briefly examine the costs of not planning for closure and provide an overview of the benefits of mine closure planning.

4.2 Governments role in mine closure planning

There appears to be a need for better governance in the mining sector from the mining companies, legislators, local councils, and communities. The MMSD report (2002) said in relation to regulatory governance structures that they need to focus more on mine closure outcomes and become less bureaucratic, but better enforced, more accountable and more transparent.

The government itself has three main roles in the closure of mines – licensing agency, regulator and service provider to local communities. In many respects they act as the conduit between the local community and the mining company throughout the life of the mine from the exploration stage through to the closure phase. It is important for governments at all levels to play an active role in the mine closure process, as aside from the mining company they are the one constant throughout the entire mining operation and are best placed to consider not just the interests of the mining company but also the best interests of the community.

This section of the chapter will look at five areas where the role of governments in the mine closure process have been consistent themes in the literature reviewed for this section. These include communication, transparency and dialogue with stakeholders; economic development; community development and the legal and regulatory framework that governments develop for mine closure.

4.2.1 Communication, transparency and stakeholder engagement

Part of stakeholder engagement process involves governments at a regulatory level ensuring that there are open and accessible mechanisms for complaints from stakeholders and access to adequate resolution of those complaints. This process should be established from the outset of the mining process and be ongoing through to closure and according to Jackson (2000) is best overseen by local governments who are the closest link to these stakeholders, rather than being overseen by higher level government regulators. The MMSD (2002) when discussing this issue believed that establishing an independent mechanism to monitor and report on these complaints would be a better outcome. Such a process may indeed provide a better outcome and in the case of Australia such a role could be undertaken by the Federal Government who currently only plays a limited role in the mining process and could act initially as an independent body with the establishment of an independent statutory authority to oversee such a mechanism.

Governments need to ensure that stakeholder communication with affected people in the mine closure process occurs as early as possible (Fleury and Parsons, 2006). The engagement of stakeholders requires a trusting and effective environment in order to work efficiently. The government must identify the main stakeholders in the mine closure process and engage with them and the mining company from the initial mine planning phase. All groups with a stake in the mining process need to feel that they have involvement in the process. This process must evolve to deal with past mining practices, as well as current mining operations and must not ignore the problems of the past as they are often synonymous with some of the negative animosity that plagues mining developments today.

Governments have been the traditional group representing community interests. According to Trezise (2004), increasingly, communities are becoming more distrustful of government involvement on their behalf and are demanding a greater say in the mining process. This is part of general trend by some groups in the community to demand better local representation in the development process and is in part due to people being better informed and having greater access to information, particularly in relation to company performance and standards. Although this argument is not without its merit it appeared to be aimed at national and state governments, as it is a difficult case to argue in relation to local government, who are realistically the major community stakeholders in the mining process and whose local communities are most affected by the environmental, social and economic effects of mine closure. According to Khanna (2000) local governments need to be the most pro-active in determining long-term sustainable solutions for mine closure.

Governments need to be transparent and open in the communication process that they establish between themselves and the local community. They also need to establish similar dialogue between themselves and the mining company (Fleury and Parsons, 2006). This communication process needs to include governments at all levels from national through to state and local governments all of whom have a role to play in the mine closure process (Fleury and Parsons, 2006).

4.2.2 Economic development

Economic development and community development are sometimes discussed in the same context in the literature on mine closure and sustainable development (Sirolli, 1995; Jackson, 2000; Khanna, 2000) and although there are synergies between the two, they are two separate issues and hence in this section of the chapter they will be discussed separately. As with all issues surrounding mine closure, this is not the sole province of either government or mining companies, or indeed local communities, it is nevertheless a process that needs to be undertaken holistically with all parties playing a part.

Hegadoren and Day (1981) also raise an interesting point that has still not gained a lot of attention in current literature. They believe that governments should assign Economic Development Co-ordinators to areas affected by mining, who would be responsible for overseeing the closure and assist in minimising the negative impacts on a region, so often associated with closure. Hegadoren and Day (1981) singled out the need for specific legislation to deal with the socio-economic impacts of mine closure, an issue that is only now being addressed in the literature – with governments possibly still many years away from actually implementing legislation in this area. In this case, the researchers are referring to the Canadian province of Ontario; however, their comments are applicable to any region where mining plays a significant role in the economy:

Jackson (2000) states that benefits generated from a mine (through provisions such as mining taxes and royalties) need to be saved to assist communities with development post closure. This was a theme discussed in the last chapter and so it will not be emphasised in this chapter, other than to say that this is a theme common throughout the literature for this chapter with nearly all stating that it is something that has in the past not been undertaken very well by governments (Mugonda, 2006). The Western Australian governments royalties for region program is a step in that direction, however as discussed in Chapter 3 has shortfalls that do not necessarily benefit the actual mining communities as readily as they should and prepare them for post closure life.

Additionally, authors including Khanna (2000), Jackson (2000) and Molefe et al. (2006) suggest mining projects be incorporated into broader regional development programs in order to maximise opportunities from the mine for other businesses within the local community and region. Molefe et al. (2006) admittedly were referring to regional development in poor South African mining dependent communities; however, their findings have some relevance to Australian mining dependent communities. They found that mining companies alone do not have the capacity or knowledge to assist non-mining businesses in mining communities post closure. There is a need for greater synergies between mining companies and governments through formal relationships that match the social and economic plans of a mining company with the social and economic plans of the local community and region, with a focus on employment options post mining. Currently in Australia the relationship between businesses and governments in this regard is almost non-existent and there is no formal requirement for the development of such a relationship.

There was not a lot of discussion in the literature on economic development as to how local governments should plan for their local economies once mining has ceased. What was not discussed was the need to incorporate mine closure into economic development plans, which generally can span anywhere from 5-20 year time frames (Sirolli, 1995). They can be used as a planning tool for local governments to attract new businesses to the region to diversify local economies and to attract higher level government assistance packages by demonstrating the impacts a closure can have on a community from an economic perspective.

Hegadoren and Day conducted research on the Marmoraton mine, an iron-ore mine located in Ontario, Canada in a region that had been dependent on resources for its economic growth over the last 158 years. They were advocating as far back as 1981 that it was necessary for local councils to begin planning for closure before mining commenced and to have contingency plans in place as actual mine operations have a tendency to differ to the often optimistic projections outlined during the planning stages. The researchers noted that more often than not, these projections are at the time given in good faith, but that does not preclude local governments and communities from ensuring that they are not caught out by a lack of strategic planning.

Hegadoren and Day (1981) found that in the case of Marmoraton, the local council was too slow to react to the closure of the mine, despite having known for over 20 years that the mine would close. As the date for closure drew nearer, the council acted too late and did too little to attract new industries to the region. Attempts to attract new industries failed due to a lack of expertise on various development committees and a poorly coordinated response to the mine closure by Federal and Provincial agencies, particularly in assisting the unemployed former mine workers.

Governments have an important role to play in assisting local economies to grow after mine closure. One of the major points in the literature on economic development is that traditional approaches of mining companies and governments working in isolation in developing economic plans post closure have not been effective (Molefe, 2006) and that the best approach is the development of synergies between mining companies and local governments on mine closure economic development strategies (Khanna, 2000) . Interestingly, despite the mention of increased local government involvement (Jackson, 2000) little mention was made of the need for local governments to plan strategically for mine closures incorporating it into their long-term planning outcomes.

4.2.3 Community development

Community engagement becomes intertwined with the idea of sustainable development, according to Humphreys (2000), whereby the establishment of a community policy framework includes the establishment of activities that are designed to continue after mining has ceased. This can take the form of infrastructure development, the creation of enterprises designed to operate after mine closure, or the retraining and educating of employees in new skills, designed to assist them once the mining operations cease. As stated, there is a strong link between community development and economic development programs and in many respects it is not possible to have one without the other (Dymock, 2004).

Molefe et al. (2006) found in relation to community development that it was often the case that companies will provide infrastructure for use by communities post mining (for example building new libraries, or use of former mine buildings), but the community (namely local government) would not necessarily have the capacity to maintain this infrastructure over the long term, once funding from the mining company ceases. Kenny (1999) claimed in relation to comments such as this that it is important for local governments to work with their state and federal counterparts in ensuring that community development projects are in the best interests of the community and suit the needs of that community, contributing to the long-term viability of the community.

As an example of how this can work successfully, in the Bowen Basin in Queensland the BHP-Billiton Mitsubishi Alliance (BMA), is working towards ensuring that it is meeting the needs of the communities in which it operates (Trezise, 2004). The company is adopting a holistic approach to its mining operations, investing in social infrastructure and attempting to engage with the community through a range of social programs, aimed at boosting their community image.

As communities such as those in the Bowen Basin have become more vocal and to an extent more empowered, they are starting to become more demanding when it comes to mining operations (Trezise, 2004). The mining company in the Bowen Basin along with state and local governments, welfare and community groups have established a number of development programs in six areas: youth support, business and skills training, community welfare, sports and recreation, arts and entertainment and the environment (Dymock, 2004). These types of programs that build on establishing long-term sustainable outcomes through a number of specialist agencies have more chance of succeeding than programs that are company driven and lack the support of a range of stakeholders (Trezise, 2004).

Community development is intertwined with economic development programs; however where economic development is concerned primarily with impacts on the local economy through areas such as business development and employment generation, community development is more concerned with social outcomes, such as the development of youth programs, community support networks, and development of the arts as some examples. Much of the reviewed literature tends to talk about the two areas interchangeably and although there are synergies, it is important to distinguish between them in order to develop programs that are complementary and mutually beneficial from a government and community perspective.

4.2.4 Economic and social impact assessments

Social and economic impact assessments should be undertaken as part of the mine planning process and are documents that could be developed separately by both governments and mining companies as recommended by Jackson (2000) and Dowd and Slight (2006), or they could be undertaken jointly as recommended by ANZMEC (2000) and ICMM (2008) with the government playing the lead role due to their institutional capacity and access to a range of social and economic information. Despite the disagreement over who should conduct impact assessments there is agreement on the necessity for them to be conducted, which marks a change from previous industry thinking on the topic where the focus was on environmental impact assessments with little regard to developing socio-economic assessments (Warhurst, 2000).

The social impacts of mine closure are reasonably well documented (Warhurst, 2000; Molefe et al., 2006; ICMM, 2008) and include psychological issues associated with losing employment, negative health effects such as increased blood pressure, higher risks of heart attacks and strokes; there are also increased levels of substance abuse, increase in family violence, and marital break-ups (Warhurst, 2000; Dowd and Slight, 2006; Saeedi, et al., 2006). In order for the social impacts to be adequately assessed and mitigated, the recommendations are that the Social Impact Assessments of mine closure need to be undertaken prior to or as part of feasibility studies for a mine site and then reviewed and updated on a regular basis throughout the life of a mine to account for changes to the mine site and the local community (Dowd and Slight, 2006). The impact of closures on a community will also be affected by how many jobs are lost relative to the size of the community, the dependence of the community on the mine, the social fabric of the community and how cohesive the community is (Molefe et al., 2006).

The literature was somewhat mixed on the need for economic impact assessments, with some (including as examples Dowd and Slight, 2006 and Molefe et al., 2006) believing that social impact assessments were comprehensive enough for the mine closure planning process. There are nonetheless linkages between the social and the economic impacts of mine closure and a need to look at both issues at least initially independent of one another. The economic impact of mine closure needs to examine the issue from the perspective of the company and the local community, as both are inexorably linked economically when a mine closes, with companies closing mines at a time when the operation is not viable economically as cash flow ceases and the value of liabilities outstrips the value of assets (Saeedi et al., 2006). The community begins to see rises in unemployment, with subsequent loss of income and expenditure in the town flowing through to non-mining businesses such as supermarkets, restaurants and cafes, accommodation providers and many other associated businesses. Economic impact assessments as with social impact assessments begin during the feasibility studies for a mine site and are ongoing throughout the mining operation with the development of programs to assist in diversifying local businesses and the local economy (particularly if it is mining dependent) (Warhurst, 2000).

There is some criticism in the literature of the use of both social impact assessments and economic impact assessments as being expert driven, by technocrats that do not always engage communities in their outcomes (Vanclay, 1999). Vanclay (2005) believes there needs to be a shift away from impact assessments that just lessen the damage from negative impacts and instead a greater focus on the identification of goals for development, ensuring positive outcomes are maximised and that stakeholders are engaged as part of this process. There is an argument in social impact assessment circles for the development of a quality assurance process for conducting SIA’s and EIA’s similar to the ISO 14000 Environmental Management System that is used in environmental impact assessments (Vanclay, 2005) and that the process of SIA’s and EIA’s as external assessments is turned on its head and they become part of an internal course of action, which are judged on the effectiveness of their processes.

In the case of environmental outcomes it is the company that plays a pivotal role in the outcome design and delivery of results, whereas in social and economic outcomes it is the role of governments to play a key role. The local community has the local and historical knowledge to apply to the development of social outcomes. Governments at all levels have the ability to develop programs on a local, state and national level that address the capacity of institutions to cope with mine closure from economic, social and cultural perspectives to deliver sustainable closure outcomes. This does not abrogate the company from playing a role in these programs but the literature indicates that impact assessments are most beneficial if the lead role is taken by those institutions that specialise in socio-economic development of communities (ICMM, 2008), namely governments, with companies playing a supporting role through the provision of information, support and even funding for these assessments.

4.2.5 Legal and regulatory framework

The legal and regulatory framework that governments develop in relation to the mining industry is not as detailed on the issue of mine closure and much of the literature reviewed pointed to a distinct lack of legislative framework in this area. Jackson (2000) found that many countries had some form of framework on mine closure related to environmental matters, but there were virtually no operational guidelines in relation to the social and economic aspects of mine closure.

Governments may need to regulate and enforce issues surrounding mine closure through legislative and policy frameworks, ensuring implementation and adherence, with an emphasis on greater co-operation between national and local authorities (Trezise 2004). This was a theme that was fairly common in relation to mine closure and the role of governments in the process, with some authors arguing for the development of specific mine closure legislation (Biggs, 2000; Fleury and Parsons, 2006) and one calling for the introduction of an international set of regulatory guidelines for mine closure (Khanna, 2000).

It is not difficult to foresee the argument for specific mine closure legislation gaining some support with government agencies. However to coordinate an international regulatory framework for mine closure, whilst of immense benefit, would be difficult until countries such as Australia, Canada, the US and some of the European nations started to take the lead and first develop specific legislation for mine closure. In the case of Australia, Biggs (2000) argued for a national framework on mine closure to oversee the process in this country, although he was arguing the case more from an environmental perspective and not so much the socio-economic perspective, which Khanna (2000), Jackson (2000) and Trezise (2004) are arguing is of equal importance. It could be argued that in some ways the Federal Department of Industry Tourism and Resources *Mine Closure and Completion Handbook* from 2006 was an attempt to create some type of national framework. However, this document stipulated that it was not an attempt to override state regulatory frameworks and the handbook was aimed at the mining industry as an audience rather than their state regulatory counterparts.

In terms of the industry itself, according to the Australian Minerals and Energy Environment Foundation (2003), the government appears to be moving away from more regulation to greater self-regulation by the industry, with government audits to ensure compliance with broad standards, or guidelines. Companies themselves need to recognise (and many, particularly larger companies need to take the lead role) and ensure more community participation, dialogue and engagement in the mining process in order to meet social obligations. Whilst there may be some evidence of some move towards self-regulation, it is not supported in the other reviewed literature and it is not a concept that appears to have a lot of support even from industry bodies. The Minerals Mining and Sustainable Development report (2002) argue that the law in relation to mining and mine closures needs to be enforced, not so much among the larger mining companies, which it argues are more visible and more affected by pressure from various interest groups, but enforcement needs to be undertaken to ensure compliance amongst all operators and that self-regulation allows too many smaller operators a free ride.

4.2.6 Summary of governments role in mine closure planning

The review of the literature for this section found that governments at all levels had more strategic roles to play in the mine closure process with a need to focus on facilitating two-way communication between local communities and mining companies. As well, it was found that local governments need to have an enhanced role in the closure process, acting as representatives for local communities and ensuring that the interests of stakeholders are considered in the delivery of closure outcomes.

In addition, it was found that governments have a vital role to play in both economic and community development, although at times there was not necessarily a demarcation between the two. The closure of a mine can have enormous social and economic impacts on a mining community and can cause total dislocation for mine dependent communities. It was important for governments, mining companies, business and community groups to work together in the development of community driven projects that are able to continue once the mining company leaves the region.

Finally, the legal and regulatory framework for governments in regard to mine closure could be the most contentious (at least from the perspective of mining companies), as the overwhelming consensus was the need for mine closure legislation that was holistic in its approach to the issue and that preferably was administered at a national level, with some support for a regulated international framework. It is difficult to determine when such an outcome would be achieved, however in 2011, the Western Australian Government introduced a Mine Closure Guidelines document that is intended for use by the industry as part of their mining project approval and development which will be discussed in more detail in the next chapter on legislation.

4.3 Company role in mine closure planning

The role of the company in mine closure planning cannot be underestimated as they are ultimately responsible for determining how a site will look post closure. This does not mean that this process should occur in isolation or that other parties (such as governments and stakeholders) should not be engaged with mine closure; their input is vital to the success of the process (Jackson, 2000). It is mining companies that need to incorporate mine closure into their overall planning for a site and it how they undertake this process that determines the success or otherwise of a closure project (Humphreys, 2000).

In the literature reviewed for this section of the chapter there was broad agreement that mine closure planning is as important as planning for the design and operational life of a mine (MMSD, 2002; ICMM, 2008; Molefe, 2006). Likewise there was consensus among the documents reviewed that it was important for mining companies to continue to update mine closure plans during the life of a mine in order to account for changes to the operation, or external factors that will influence the final closure outcome (Biggs, 2000; Dowd and Slight, 2006). Similarly there was broad consensus about the need for ongoing engagement with the local community and all levels of government in the mine closure development, although there were some differences about the level of engagement needed and some misunderstanding of the difference between consultation and engagement (ICMM, 2008).

In this section some of the key themes developed from the literature on the role of companies in mine closure are reviewed and analysed under the following topics: Early closure planning; stakeholder engagement; impact assessments; employment and business development; and community investment.

4.3.1 Early closure planning

There appeared to be consensus that planning early for mine closure is essential in order to reduce liabilities and increase the potential for long-term sustainable outcomes (Khanna, 2000; MMSD, 2002; Molefe, 2006). The longer mine closure planning is left during the operational phase of a mining operation the more likelihood there will be for increased liabilities and the less the likelihood of the closure process developing sustainable outcomes (Dowd and Slight, 2006). It appears that from the literature reviewed and from industry bodies such the Minerals Council of Australia (2003) and the Australian New Zealand Minerals and Energy Council (2006) that support for mine closure planning during the mine planning phase should be the norm for all mining projects.

In addition there is an argument advocated by the International Council on Metals and Mining (2008) for the mine closure plan to incorporate a conceptual plan during the mine planning phase, and then develop a detailed closure plan at the start of the operational phase. This argument had some support within the literature (Biggs, 2000; Khanna, 2000; MMSD, 2002), however it was not widely discussed as a topic, with the main arguments revolving around the need for early mine closure planning not differentiating between conceptual and detailed closure plans (Johnson and Wright, 2003; Dowd and Slight, 2006). There is a need to develop this idea of developing detailed closure plans during the operational phase of mining as it is in this plan that detailed objectives for the mine closure can be outlined and final closure options developed (Dowd and Slight, 2006).

One of the key themes that have come out of early closure planning is the need to incorporate closure plans into the day-to-day operation of a mine project and implement into the life cycle of a project (Biggs, 2000; Molefe, 2006). These plans need to cover not just the environmental, but the social and economic effects of mine closure, including the effects on employees, ensuring that there is enough financial provision to cover the closure costs (Dowd and Slight, 2006). This represents a change in thinking on mine closure within the mining industry, which traditionally has not seen closure as something that needs to be considered until the last few years of a project and where little consideration was given to the wider effects of a mine closure (Johnson and Wright, 2003).

The literature is indicating a shift in the way that the mining industry thinks about mine closure planning with more discussion on the benefits of early closure planning and a need to incorporate broader socio-economic issues into the mine closure planning program alongside the environmental considerations. Part of this is being driven by financial benefits early closure provides, but also a realisation that mining closure planning needs to demonstrate that it can provide beneficial long-term benefits once a mining company has ceased operating.

4.3.2 Stakeholder engagement

Mining companies need to incorporate community consultation and engagement into their day-to-day running of the organisation, according to Humphreys (2000). In other words it becomes part of a business unit, like any other business unit within the organisation. Humphreys provides Rio Tinto as an example of a company that has successfully implemented a community affairs business unit into its organisational structure. This unit must meet strict business principles, similar to other business units within the organisation. Some of these principles include understanding key community issues, either through consultation, surveys or anthropological studies. The unit must also set itself quantifiable objectives to meet; this assists in providing a structure in which to gauge the success of community interaction. In other words, Rio Tinto is developing implied contracts with the communities in which they operate, incorporating notions of mutual respect and mutual interest (Humphreys 2000).

Stakeholder engagement is a theme that has become increasingly common throughout the mining industry as the industry attempts to move away from the historical image of poor rehabilitation and closure practices and little dialogue with stakeholders throughout the mining process (Slight and Dowd, 2006). This engagement process should commence at the mine planning stage with closure plans developed with input from the local community on the final designs of a site (Trezise, 2004). This input from community members should be sought not just as a process for strengthening dialogue with them, it should also be seen as a way of using vital local knowledge on what options the community sees as being sustainable in a post-closure options. Of course, the community will not be able to decide on post-closure options for a site in isolation and there is a need to conduct a benefit-cost analysis of closure options (ANZMEC, 2000). However, when this type of engagement is undertaken early on during a mining project the ability to analyse a number of closure options is much greater (World Bank and IFC, 2002).

The documents reviewed for this section all outlined the importance of communicating with stakeholders early in the mining process virtually from the initial exploration phase and ensuring that this was ongoing throughout the life of a project (MMSD, 2002; Dowd and Slight, 2006; ICMM, 2008). This applied to all facets of the mining, including closure, which Dowd and Slight (2006) saw as the most important part of the mining process as it was at closure that a mining company's legacy is truly left behind. What is not mentioned so readily is how to achieve this process of stakeholder dialogue given that community engagement is recognised as being critical to the mine closure process. Little mention was made of the need to make community engagement a legislated facet of the mine closure process in the same way that it is required for the initial planning for a mine site. The MMSD report (2002) recommends a legal and regulatory closure framework complemented by a voluntary code of practice from those in the mining sector. The report called for an open, transparent process that compulsorily involves all stakeholders, from the mining companies, to local communities, to governments at all levels and that enables performance targets or benchmarks. At the same time, the report recommends that the government have the ability to undertake action against companies that do not meet not just their environmental, but also their economic and social obligations. The option for achieving this would be through the development of dedicated mine closure legislation that mandates community engagement obligations. However, it would not work unless there was broad support from the industry for how to undertake such a process and who to include in this process. As with most of the issues to do with mine closure, a holistic approach is required that includes all parties to contribute to the outcomes. This is an area that the industry itself admits has not done well in the past and in which there is significant room for improvement from industry. There is consensus that it needs to be undertaken early in the mine planning process and that the community needs to guide the closure outcomes, as they are ultimately the long-term beneficiaries of a mine closure (ICMM, 2008).

4.3.3 Business support and community investment

Business support differs from economic development in that it is a process that mining companies can undertake in partnership with government agencies to lessen the dependency of local businesses on a mine (Khanna, 2000). This was not a topic discussed by all of the reviewed literature as it appeared to be an issue discussed under the broader umbrella of economic and community development and there is a place for this discussion in those areas. However, where it has been discussed separately it has been developed as an issue that companies can address as part of a wider social and economic development program.

From the start of the mining process, staff, contractors and other support staff employed at the mine need to have skills training that are transferable and not totally reliant on the operation of the mine (Dowd and Slight, 2006). This process can in part be alleviated by mining companies working with other local businesses in the region to ensure that development opportunities extend beyond the mine’s life and look at development in the wider context of the mine site (Molefe et al., 2006). In part Jackson (2000) was talking about this when discussing the need to incorporate mine closure into regional planning and it is an area where companies can play a role that goes beyond their investment in the mine.

Investments in community projects need to consider the intergenerational impact of mine closure with an equitable distribution of benefits to ensure that future community members benefit from the impact of mining on their community (Warhurst, 2000). When undertaking programs of community investment, the review found a need for mining companies to understand the capacity of communities to deal with impacts and issues after a mine has ceased to operate. A way to achieve this can be through the development of a foundation, or trust fund that operates after a mine has closed (Dowd and Slight, 2006). An undertaking such as this would be able to provide ongoing support for community development programs many years beyond the closure of a mine until a community has the capacity for these programs to become self-sustaining.

In the United States, a successful example of a business and community investment program is provided by Kennecott's Flambeau mine in Wisconsin. This mine was in operation for four years, but is estimated to have generated US$27 million in investment activity (Humphreys 2000). The mine closed in 1997, but at the time 185 jobs were estimated to have to have been created through new investment projects post closure. These investments included a new public library, an extension to an industrial park and new manufacturing outlets.

There was support in the literature for investment by companies in a capacity building program to operate post closure, although it still needed to be part of a wider holistic approach to community and economic development with mining companies, governments, community groups and support agencies working in unison (Warhurst, 2000; Dowd and Slight, 2006). Mining companies can still play a role in the community post closure, even if that is to finance the delivery of programs and support services that it helped establish during the operational life of the mine.

4.3.4 Environmental Impact Assessments

Environmental Impact Assessments have been an established part of the mine closure process from both a company and regulatory perspective for a number of years (Khanna, 2000). All of the literature reviewed discusses the importance of environmental rehabilitation to the mine closure process, and the need to progressively rehabilitate a mine site, rather than leave the rehabilitation until just before closure, which was traditional practice in the industry (Biggs, 2000). This is in addition to the need to engage with the local community in the environmental management process for closure in order to gain community acceptance of any environmental rehabilitation programs developed for a site (Garcia, 2008).

When to complete Environmental Impact Assessments for mine closure is a topic that is debated in the literature. This debate centred not so much around the need to conduct EIA's for closure during a mine's operational life, the main debate was when during that phase. Some authors argued that environmental impact assessments for closure should be undertaken during the mine planning phase as part of the overall closure planning process (World Bank, 2002, Dowd and Slight, 2006; ICMM, 2008). Others argued that they were of more relevance if conducted when the mine was operational due to a better understanding of how the ecosystem was responding to the mining process (Morrey, 1999; Grant, 2006).

Environmental impact assessments for closure need to consider the impact of the mine closure on the wider ecosystem and need, potential water quality from any pit lake formed by the mine, any tailings facility discharges from the mine site and any potential threat for mine water entering local waterways (Dowd and Slight, 2006). Other examples include the type of vegetation that will be used in the rehabilitation process and any impacts that this may have on native flora and fauna and soil conditions (Dowd and Slight, 2006). As well, there is also a need for ongoing research during the rehabilitation program as it is possible that methods used in early rehabilitation programs will prove unsuccessful over time or can be improved upon by technological changes (Grant, 2006). An example of this is provided in the case study appendix of the Jarrahdale mine site in Western Australia, owned by Alcoa Australia Ltd (Appendix B, p. 32). The initial rehabilitation used non-native species, but over time as other areas of the site were rehabilitated and new techniques used it was decided to revisit the old rehabilitation sites and revegetate them with species native to the area (Grant and Koch, 1998).

Environmental assessments are important parts of the mine closure process and the research indicates a need to undertake them early in the mining process and review and update them on a regular basis. Part of this process is progressive rehabilitation which is now virtually standard practice in the industry and can effect long-term cost reductions for closure.

4.3.5 Financial provisioning

Financial provisioning is allowing enough money for the closure of a mine site, part of which includes developing risk assessments for various closure options for a mine (Dowd and Slight, 2006). There is recognition, at least in some of the literature, that mine closure can be the most expensive part of a mine operation, particularly if not planned properly as it is during the final days of a mine that revenue streams cease and liabilities increase (World Bank, 2002).

There was recognition that financial provision needed to allow for closure and post closure activities and that in not doing this companies can face liabilities not only just economically, but environmentally and socially, which causes a risk to reputation and potentially future mining proposals (Kunanayagam, 2006). Further, the legacy that a company leaves behind is not judged by its operational practices, the number of people it employs, or even the revenue stream it generates, instead its legacy for sustainable development is judged after the mine has closed (Fleury and Parsons, 2003). This is an area where the mining industry has done a poor job in the past. Even today, there appears to be a lack of detail on financial provisioning for closure (ICMM, 2008). Given the long-term costs associated with closure, there appears to be a need to ensure that the operational life of a mine provides enough revenue to cover the costs of closure and post closure activities.

Risk assessments were mentioned as part of the mine closure planning process that ranks issues according to the definite and the perceived impact that will occur with closure (Dowd and Slight, 2006). This includes managing liabilities after the closure of a mine and ascertaining the opportunities that a mine closure presents, including development of new business opportunities, development of new recreational facilities for the local community and pioneering new land uses for the site (Dowd and Slight, 2006). Also, the risk assessment process should be open and transparent to all stakeholders in the closure process, providing them with knowledge on what decisions are being made and how they are being undertaken (ICMM, 2008).

Ensuring that there are enough funds for the closure of a mine site should be a simple exercise and an almost common sense exercise for mining companies (and indeed for governments to ensure that companies have the funds to achieve this). However, too often this is not the case and this is highlighted throughout the case studies in Appendix A where mine closures were not adequately funded and cost governments and communities financially, environmentally and socially.

4.3.6 Summary of company role in mine closure planning

From the perspective of a mining company, closure has traditionally been something that has been left until just before a mine ceases production and was often almost an afterthought to the ‘real’ businesses of the mining operation. The review of the literature has at least found recognition amongst the industry that this is no longer a realistic option for mining companies (even though there is admission that it still occurs) and that mine closure is as important as the operational aspects of mining, as it is after all the legacy of a mining company.

This is why mine closure planning is gaining recognition as an important feature of the mining process and one that should be undertaken as early in the mining process as possible. There is some conjecture about when the best time is for mine closure planning to occur, some argue the feasibility stage, and some during the planning phase, whilst others argue the operational phase is the most opportune time to plan. In some respects each is a valid argument, but the one feature that all share is that leaving this process until late in the phases of a mine’s operational life will cause potential problems upon closure that will cost an organisation financially and possibly socially. This is one of the reasons that providing financially for mine closure is gaining increased recognition, although there still appears to be some reticence within the industry and a need for regulators to be more proactive in enforcing this.

Part of this mine closure planning process must include the engagement of stakeholders and their involvement in the closure planning for the knowledge they bring to the operation and the acceptance that such an action will bring for the closure plan. Companies have not been particularly good at this, a flaw that much of the literature is happy to admit to. Changes need to be made to the way companies communicate with stakeholders in the mine closure planning process and a more open and transparent dialogue needs to be undertaken.

The mining industry also needs to consider the best way to assist communities post closure in their environmental, economic and social development. It is best if this is part of the mine planning process that is ongoing throughout the life of a mine and becomes a living document. In terms of environmental assessments the industry has improved markedly over the last decade, partly in response to community concerns and legislative requirements and also partly of their own doing. They are nevertheless still lacking in business and community investment assessments and it appears that this is an area where partnerships with various stakeholders would provide better closure outcomes. There is also the possibility that mining companies could establish trust funds or foundations to assist in this process, although this was not widely mentioned in the literature reviewed, but it does have some merit and could greatly assist the very communities that give up their land for companies to profit from.

4.4 Costs of not planning for closure

Communities need to focus on where they want to be when a project ends, as the mining process is by its very nature a finite process. This involves identifying where a community wants to be once the mining process is completed and ensuring the resources to meet these needs are available. The MMSD report (2002) suggested that governments should plan for closure by examining ways to capture the rent from mineral resources using the revenue from this to build capital (human, social, financial) and plan for closure at a local and national level. Conversely, companies need to ensure that they have adequate financial and human capital available both for closure and post closure activities (Kunanayagam, 2006).

Mine closures can cause significant problems to all parties if not planned properly. Some examples of these include environmental damage such as contaminated waterways, groundwater pollution, increased acidity, social problems such as unrest and community dislocation, alcoholism and economic issues such as unemployment, loss of income to a region, loss of royalties and taxes to governments and loss of businesses dependant both directly and indirectly on the operation of a mine (Humphreys, 2000; MMSD, 2002; Kunanayagam, 2006). The other major issue is that governments are often forced to step in and pay for rehabilitation costs and assist with community and economic development programs to alleviate the impacts of inadequate planning.

Mine closures can occur for a variety of reasons and despite the best of intentions they do not always run to planned closure dates and mineral reserves are not always totally extracted. Mines can close due to a variety of other reasons than depletion of the resources, including costs associated with the mine operation, falls in commodity prices that make the mine unsustainable, decline in the quality of the reserves, loss of market to supply and a company going into administration or receivership, flooding, government decisions, health and safety issues, or environmental problems (Laurence, 2006). The review of the literature found that planned closures are the easiest to manage (Jackson, 2000; Dowd and Slight, 2006; Laurence, 2006) and provide the community with a degree of certainty.

In contrast, unexpected closures, which occur due to some of the factors mentioned above, have the most disruptive effects from an environmental, economic and social point of view. They also cause problems for the long-term sustainability of a site from the perspective of all parties, the community, governments (including regulators) and even the mining company (Laurence, 2002). A totally planned mine closure that depletes all reserves during the planned operational phase and then closes by the planned date meeting all rehabilitation and closure outcomes will provide optimal benefits for all parties in the mining process who will have had the opportunity to adequately work together to achieve sustainable outcomes.

An unexpected closure does not have to be an unplanned closure and although unexpected closures will still have some negative outcomes (they are unavoidable) developing detailed closure plans from the commencement of mining can serve to mitigate the problems of an unexpected closure (Dowd and Slight, 2006). Some authors recommend that mining companies develop closure plans for unexpected mine closures in addition to closure plans that run for the expected project life (Dowd and Slight, 2006; Fleury and Parsons, 2006, ICMM, 2008) and in both cases should provide financially in order to meet the expectations of stakeholders with the aim of attaining positive, sustainable outcomes for closure and post closure uses (Pierce and Wen, 2006).

The case study appendix A provides examples of unplanned closure and the costs of their impact to both the local community and the wider community through government funded remediation programs. One example of this was the closure of the Summitville mine in the United States (Appendix A, p. 30), a former gold and silver mine whose owners Summitville Consolidated Mining Company filed for bankruptcy in 1992 claiming they could no longer financially provide for the site. The United States Environmental Protection Agency had to take responsibility for the rehabilitation of the site and up to 2000 had spent just over US

$133 million (Appendix A, p. 39). The site also has environmental issues that are still being rectified in 2011 and with this, associated social issues that have been caused by the unexpected Summitville closure.

It is imperative then that mining companies develop mine closure plans as early as possible and that they develop technical data for the closure program costs and calculate closure expenditure to cover this (including ongoing liabilities such as post closure monitoring programs). This ensures that this plan becomes the basis for continual updates and reviews during the life of the project to take into account changes to the closure plan (Fleury and Parsons, 2006).

The role for governments includes ensuring that companies have the financial capital to meet their closure commitments and that financial assurances set by governments are adequate enough to cover closure and post closure costs should a mining company be unable to meet its obligations (DITR, 2006; ICMM, 2008). There was some support for a review of government regulations. There was concern about their lack of flexibility, a lack of consistency on when a mining company should no longer be liable for site maintenance and the need to examine the amount of assurances paid by companies, taking into account company cash flows and ability to fund closure and post closure liabilities, history in rehabilitation and mine closures (ICMM, 2005; Dowd and Slight, 2006; Fleury and Parsons, 2006).

What is clear from the literature is that the costs associated with not planning for closure are substantial and that despite evidence providing the benefits of early closure planning there are still many in the industry that fail to adequately plan for closure (ICMM, 2008). The cost to a company’s reputation and its social licence to operate can ultimately affect a company’s bottom line. There is also a need for better planning from governments in this area, as communities and governments can incur costs for clean up, social dislocation and unrest for many years and generations to come.

4.5 Community engagement

Community engagement is not an activity that mining companies have traditionally been very good at and there has been almost a reluctance to consult or engage with communities, particularly when it comes to mine closure planning (Jackson, 2000). This is starting to change as increasingly mine closure planning gains significance within mining companies, with at least some recognition that closure and planning for it is now equally as important as the operational phase of mining (Fleury and Parsons, 2006).

This section of the chapter will examine community engagement, in particular highlighting the differences between consultation and engagement and how it is important in mine closure. It will examine why it is important to engage with communities and how to keep the lines of communication between all parties open and transparent. The final sections will look at what the literature says on how to determine the stakeholders in the closure process and finally how to manage those stakeholders and ensure that their voices are heard and that they actually want to take ownership of the mine closure process and outcomes.

4.5.1 Consultation and engagement in mine closure

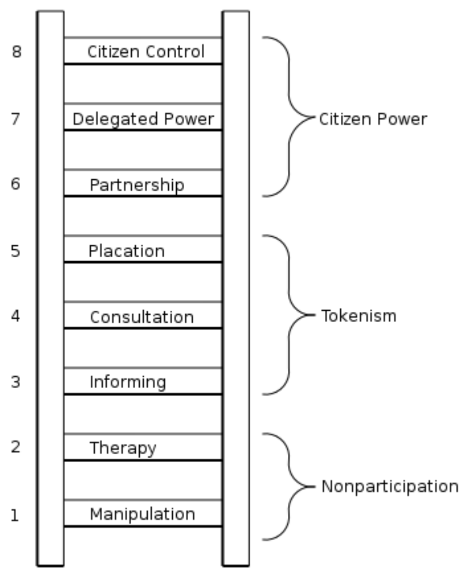
One of the key themes to emerge from the literature on planning for mine void closure (e.g. undertaking impact assessments, developing end-use options, or demonstrating the financial viability of a mine closure) was the consensus that the community needed to be engaged in the process (Biggs, 2000; Jackson, 2000; Khanna, 2000; DITR, 2006; ICMM, 2008). Interestingly, in almost all of the literature reviewed the concept discussed was engagement, rather than just consultation; there was a belief that the community need to feel as if they own the closure and a recognition that the community is best placed to decide on closure outcomes (Molefe et al., 2006).

In the last five years, there have been community engagement manuals produced by mining industry bodies and associations that provide a number of tools for the mining industry to use in their engagement with local communities and their stakeholders. Two such documents include the Principles for Engagement with Communities and Stakeholders written by the Ministerial Council on Mineral and Petroleum Resources (2005) and the Stakeholder Engagement: Environmental Excellence in Exploration written by the Prospectors and Developers Association of Canada (2007). Both documents are useful tools for industry practitioners and at least provide some direction for engagement practitioners within the industry. However, they are not specific to mine closure and although many of the tools can be applied across all aspects of mining, closure has some unique issues (such as loss of employment, ongoing care and maintenance of a former mine site post closure) that are not encountered in other phases of mining and require a different approach to community engagement. Nonetheless, such documents mark a step forward in the mining industry in their relations with communities and an acknowledgement that community engagement can no longer be avoided.

There have been many documents written about community consultation and engagement over the years discussing the concepts of community engagement and at what point in time communities are actually engaged in comparison to listening passively. A seminal article on this topic was Arnstein (1969) who developed a ladder of citizen participation with an ensuing discussion on power structures in society and how they interact. Arnstein (1969) stated that there were eight rungs on the ladder of citizen participation ranging from manipulation by power holders at the bottom of the ladder to citizen control where the community actually controls the outcomes of a project or program.

Figure 4.1 is a reproduction of Arnstein's ladder of citizen participation outlining the hierarchy. The bottom rungs represent non-participation where the objective is not participation in planning or project development, but rather the education of participants by power holders. The tokenism rungs, notably informing and consultation allow participants to hear and have their voices heard, granting them the ability to offer advice, but those with the power still maintain the right to decide (Toker, 2007). The higher levels of the ladder allow citizens power in the decision-making process whereby they ultimately have the power to make decisions and power over the management of projects. Arnstein's model of citizen participation stated that there are significant degrees of citizen participation ranging from company controlled outcomes to the ultimate aim of citizen empowerment whereby citizens manage outcomes (Connor, 1988).

Figure 4.1: Eight rungs of citizen participation



Source: Arnstein 1969, p. 217

Many people tend to use the terms consultation, participation, and engagement interchangeably. They are , quite different and in terms of the idea of engagement in the mine closure process, it is possible that people may be consulted, participate, be involved, but not actually be engaged in the closure process (Aslin and Brown, 2004). A definition for each of the terms follows:

Consultation – occurs when an agency, group, community, or individual goes out to seek advice from someone else. It implies a purpose-driven process in which someone takes the initiative to seek advice. It does not necessarily imply anything about what will be done with that advice when and if it is received (Aslin and Brown, 2004).

Participation – simply means the act of participating, in whatever form. People can participate by writing letters, ringing up, attending events, sending e-mails or using a host of other forms of communication (Aslin and Brown, 2004).

Engagement – goes further than participation and consultation. It involves capturing people's attention and focussing their efforts on the matter at hand – the subject may often mean something personally to someone who is engaged and is sufficiently important to demand their attention. Engagement implies commitment to a process, which has decisions and resulting actions (Ansell, 2002).

The CSIRO (Ansell, 2002) developed a five-step process by which mining companies can be seen to engage with the community:

1. Strictly Business, whereby companies see no necessity to deal with the community beyond any legal minimum requirement.
2. Benefactor, whereby the relationship is defined in terms of what the company gives to the community in fields such as employment or social funding.
3. Manage and Measure, community relations are managed and measured like any other business variable.
4. Practical Partnerships, mining companies seek mutual interest partnerships with elements of the community, but it usually determines the parameters.
5. Sensitive New Age Miners, in which individuals in companies may approach relationships in a less instrumentalist and more holistic fashion. Their contributions may not be valued internally and they may struggle within more conservative company cultures.

This approach was directed at the mining process as a whole and was not specific to mine closures. However, the process has some applicability at closure level as the method demonstrates progressive steps from sharing of information towards a consultative approach with an eventual sense of ownership with regards to outcomes, which Fleury and Parsons (2006) describe as an important factor in successful mine closure.

It is important to define the difference between consultation and participation, as one implies actual involvement by stakeholders, whilst the other may only imply involvement on a superficial level, with decisions made by those outside the process. The distinction becomes important in the mine closure process, as one method provides communities with empowerment, whilst the other could leave the community feeling powerless and frustrated.

4.5.2 Reasons to consult and engage with communities in the mining closure process

The effective closure of a mine involves bringing together the opinions, viewpoints, ideas, knowledge, ambitions and desires of stakeholders in the development of beneficial outcomes for a mine closure. It is no longer possible for mining companies to undertake mining in general and specifically mine closure without engaging the communities in which they choose to operate. There is some consensus in the literature that engagement with communities should be a necessity in any mine closure program and that tokenism as outlined by Arnstein should no longer be acceptable in any mine closure project (Khanna, 1999; Saeedi, 1999; ICMM, 2008).

According to Humphreys (2000), the pressure to include community consultation and engagement in the mining process arises for two reasons. One of these reasons is the sheer weight of community expectations that has forced companies to become more proactive in the area of community engagement. The second is the increased competitiveness between mining companies and changes in the mining sector in general that have forced them to become more transparent. A third reason is the damage that can be done to a company's reputation if it is derelict in its protection of the environment in which it operates (Garcia, 2008).

Few of the early articles or books reviewed paid attention to the issue of local community consultation, or engagement in the void closure process. Clifford (1999), Barbier (2003) and Chadwick (1998) placed most of their emphasis on the issue of sustainable development and the need for mining associations such as the Australia and New Zealand Minerals and Energy Council (ANZMEC) and the Minerals Council of Australia (MCA) to adopt a more pro-active approach to the issue of mine void closure, by adopting industry standards (which they have since done and were reviewed in Chapter 3).

Later documents such as the Minerals Mining and Sustainable Development Report (2002), the Department of Industry Tourism and Resources Mine Closure and Completion Handbook (2006) and the International Council on Metals and Mining's Planning for Integrated Closure Toolkit (2008) began to highlight how community consultation and the idea of engaging communities increasingly needed to become an accepted and essential feature of mine void closure. A variety of sources will continue to pressure companies to become more open and consultative in mine void closure. Companies will increasingly need to report and disclose information relating to mining activities in order to help restore faith in the entire mining process. In articles on the issue, Khanna (1999), Jackson (2000) and World Bank (2002) stated that pressure on mining companies came from a number of groups including:

- Environmental pressure groups, such as Minewatch, Greenpeace, Friends of the Earth, and the Mineral Policy Centre, all of whom have a generally negative attitude towards mining.
- Non Government Organisations such as the World Bank, United Nations Environmental Programme, and the International Council on Minerals and the Environment, all of who are providing the industry with guidelines to follow.
- National Governments whose responsibility includes the establishment of legislation and ensuring compliance with the legislation (except in the case of Australia, where state governments are responsible).
- Mining associations that through guidelines and codes of practice are assisting members to improve environmental, social and economic performance. The implication behind the 'codes of practice' is that corporate peer pressure is enough to encourage members to comply voluntarily.
- The international media, whose coverage of mining disasters can be intense and bring such news very quickly to the attention of the general public who gain most or all of their knowledge about a company, mine or event by reading newspapers, magazines or journals, watching television or surfing the Internet.

Where there once was little discussion in the literature on the need to engage with local communities about mine closure, there has been a change in opinions on the need not to just consult but actually engage in the closure process. CSIRO in a report on community consultation in the mining industry (Solomon, 1999), believe that engagement is a more positive step towards helping people feel empowered. However, there is recognition that this is not always occurring in practice (ICMM, 2005, 2008; DITR, 2006) and that in this respect the industry is still not proactive enough and indeed nor are regulators enforcing the need for a more proactive approach to community engagement (Biggs, 2000; World Bank, 2002).

4.5.3 Communication and transparency

It will be important for mining companies to ensure that local communities in which they wish to undertake mining are fully informed of the void closure process right from the initial planning phases of a project (Peck, 2005). This will help ensure that communities feel they have some input into the outcome of mining operations. This type of two-way dialogue may , enable communities to be more open to the idea of mining. Perhaps if miners demonstrated the same commitment to mine closures in terms of communicating with stakeholders that they do when it comes to the process of mining it may be that communities might be more accepting of miners (Lazzaro and Pooley 2003).

The idea of a more transparent and open communication flow between mining companies is one that has gained acceptance around the globe, however, actually implementing a more open, transparent communication process in an industry that is traditionally quite secretive is easier said than done. The issue of communication about mine void closure raises such questions as ‘who needs to know?’ and ‘how much information do they need to know?’

There are some issues surrounding mining that are unique to the industry and hence can make the communication process a difficult one. The first problem is that forecast reserves and actual operational extraction can sometimes be wildly different. It is not always easy to obtain correct profit projections, as commodity prices will fluctuate, often quite markedly over the life of a mine. This alone can cause problems with communication, as what is communicated at the start of the mining process may often be different to that communicated during the mine’s operation and at closure (Lazzaro and Pooley, 2003). This is more often than not out of the hands of the mining company and what may later turn out to be seen as a communication error, may well have been provided in good faith at the time.

The mining industry itself is also very secretive as it is highly competitive and does not want competitors finding out information about ore reserves for example, or other important geological and site information. Therefore, this can produce problems in the communication process as companies can be accused of a lack of transparency and being secretive. These are sometimes the claims that many anti-mining groups use when they talk about the guarded practices of the industry. As Jackson (2000) pointed out, mining companies often do not like issuing information publicly as this information can then be readily accessed by their rivals. Therefore developing a more transparent communication process between mining companies and stakeholders may not be as easy as it should be.

Nevertheless, this does not abrogate mining companies of their responsibility to be open, transparent and participative in the communication process with their stakeholders. This is particularly important during mine closure, because in many communities the mine may be their single largest economic and social contributor.

In the process of negotiating with communities, it is necessary to ensure that the communication process is effective. Aslin and Brown (2004) believe that due to the often disparate nature of groups involved in the closure engagement process, different experiences, knowledge, levels of communication, and expectations will be brought into the process. This system combines communication and knowledge to develop a more integrated approach to communication with communities. It is a theme common in the literature, which concludes that using knowledge in the closure process assists in delivering more sustainable closure outcomes (MMSD, 2002; Peck, 2005). The idea is based on the following processes (Aslin and Brown, 2004):

Local knowledge is the local reality based on lived experience in the region, built through shared stories, memories of shared events and locally specific relationships between people and places.

Specialised knowledge is the collected advice from a wide range of experts, for example people such as geologists, ecologists, economists, engineers, sociologists, etc., each constructed within a particular knowledge framework or paradigm.

Strategic knowledge is the tactical positioning of people and resources for future action within given political and administrative systems.

Integrative knowledge is the mutual acceptance of an overarching framework, direction or purpose, derived from a shared interpretation of the issues.

The literature review for this section found that there is a change in thinking with regards to the role of local communities in the mine closure process. No longer can they be thought of as passive participants, they need to become active contributors in deciding how a mine site will look post closure. It is the knowledge that local communities can bring to deciding mine closure outcomes and their commitment towards their area will assist in developing sustainable post closure outcomes.

4.5.4 Identifying stakeholders

Stakeholders are parties that are affected or potentially affected by a mine closure and the processes and outcomes and who can be distinguished from those that may have an interest in the mine closure processes and outcomes (MCA, 1996). It is important that in any engagement process for mine closure that there is widespread agreement on the closure objectives and outcomes, as the challenges of closure can be multi-faceted, particularly when a mine has been operating for many years in a remote location and the community located near the mine have few employment options post closure (Ellis, 2003). In this type of scenario there needs to be a multi-disciplinary approach to closure and the engagement of stakeholders in the decision making process (Ellis, 2003).

Those involved in the mining industry tend to use the terms communities, society and stakeholder almost interchangeably (Ellis, 2003; Dowd and Slight 2006), and Solomon (1999) argued that the terms are often used interchangeably, yet they all have quite distinct meanings. These can be classified as (Solomon, 1999):

Community can refer to groups of people who share interests or locality: a city suburb, a country town, or the environmental movement, for example. However, it is important to remember that communities are not homogeneous and contain diversity on values and aspirations. A community can be people who have a common interest in a particular project, but who do not necessarily live near one another.

Society can be defined as the people, institutions and technology that make up a recognisable human system. The boundaries of society may be set by national (for example Australia, New Zealand) or cultural (for example Western world, Middle East) borders.

Stakeholders are those who perceive themselves to be affected by, or can affect you or your activities. Stakeholders could be groups, individuals, or individuals representing groups, and are essentially defined through the 'stake' they hold in an activity and its organisation. This definition can also be taken further to include any person with an interest in an issue, whether that interest is financial, moral, legal, personal, community-based, direct or indirect (Aslin and Brown, 2004).

Stakeholders can be many and varied, often resulting in a time-consuming and sometimes difficult process, particularly in relation to large, multi-faceted projects. It is also possible that these stakeholder groups will have different and competing interests in a project and this has the potential for negative conflict if not handled correctly. It is therefore important for companies to recognise what impact each stakeholder may have on a project and the contribution these groups can make to a project's outcome (Solomon, 1999).

In other words, stakeholders are part of the wider community and society and hold values that as individuals may differ from those of their wider community and society. These values may change over time and as different situations and the need to respond to them arises. In the social sciences values have three broad meanings. In the first instance, the term value can mean its value from an economic perspective i.e. to place a dollar value on an entity (Solomon, 1999). The second meaning relates to the 'desirability conception' that is held constant by an individual or groups for example, a desire for world peace (Burningham and O'Brien 1994). There is a correlation between the values and objects and between the values and subjects. The third approach views values as linguistic used by people to justify their conduct for example, 'I do not want this mine located close to my property, as it will disturb my peace and have an adverse affect on the environment around me'. This view may change over time as people's opinion's change, or their justifications for opposing or supporting a particular point of view change (Burningham and O'Brien 1994).

Whilst these social science models of stakeholders have applicability to the mining industry, there has been some concerted effort by the mining industry to develop its own models of stakeholder determination specific to mine closure during the last decade as a way of incorporating community engagement into mainstream thinking within the industry. Two of the most widely referred to models are the ANZMEC/MCA (2000) which refers to stakeholders in three broad categories, the company, the community and the state. Within these three categories lie various sub groups of stakeholders that have an interest in the closure process and outcomes.

ICMM in their Integrated Closure Planning Toolkit (2008) developed the other model within the industry specifically associated with mine closure that discusses the concept of internal and external stakeholders. The internal stakeholders are the company employees that are involved in or affected by the mine closure. The external stakeholders are those individuals or groups that are directly or indirectly affected by the closure or have an interest in it (Fleury and Parsons, 2006).

In many respect the two models can be used interchangeably and are not dissimilar, as the internal stakeholders as referred to in the ICMM toolkit represent the company on the ANZMEC/MCA framework, whilst the external stakeholders are the community and the state. The list provided by each document is by no means exhaustive and they do not list every stakeholder in a mine closure project. They present models for identifying stakeholders to a mine closure, models that have been lacking in an industry that has not been known for its embrace of the social sciences (Solomon et al., 2007).

Identifying stakeholders is an important part of the mine closure process and can assist in gaining wide community support for a closure program. Stakeholders are not always easily identified and it is important that mining companies (and indeed regulatory agencies) recognise who they are in order to ensure that groups and individuals are not left out of a closure project, something which could have negative ramifications (such a legal actions) down the track. The literature is starting to include conclusions that stakeholder identification for mine closure needs to be undertaken early (during the mine planning phase is best) and that this is not an easy process but one that is necessary if mine closure is to be accepted by the community and sustainable.

4.5.5 Management of stakeholders

A mining company has an unequal power distribution with many of the stakeholders in a mining project and the company, in order to be seen to be conducting its business in an ethical manner, will need to ensure it does not unfairly disadvantage stakeholders (Cragg et al., 1995). The authors say these stakeholders do not have access to the resources that mining companies do and are often at a disadvantage when it comes to determining the costs and benefits that a mining operation can bring (Cragg et al., 1995).

A mining company will also need to ensure that costs and benefits are fairly distributed (Cragg et al., 1995). Mining companies will need to ensure that their operations are sensitive to local issues such as environmental protection, cultural, social and economic impacts when undertaking mine closure programs (Hegadoren and Day, 1981; Elliot, 2003)

There was also consensus that mining companies will need to ensure that stakeholders are fairly compensated for costs that are unavoidable, e.g. relocation of Indigenous people (Cragg et al., 1995). As well, mining companies have a responsibility to ensure benefits from mining operations are fairly distributed; including investing in social and environmental projects during the mining operation, as well as investing in projects that will benefit the community once a mine has ceased operation (Allen, 2001). The literature review found that it is important to develop some type of consensus building with local communities, as this provides the community with a feeling of empowerment in the decision-making process and in the long run can result in fewer disputes in managing stakeholders as the mining closure progresses.

It is not always necessary to provide all stakeholders with equal weight in the decision-making process, which may appear at odds with the idea of adopting the triple bottom line in a mining project. Nevertheless, stakeholders will appear and disappear during the life of a mining operation, depending on the phase of the project and the stakeholder’s interest in that phase (Lazzaro and Pooley, 2003). The difficult part for a mining company is determining how to balance stakeholder interests and ensure that all stakeholders believe their interests are being met. There is no doubt that mining companies need to incorporate ethically focussed social and environmental issues regarding closure into their mining operations from the planning and development phase.

Part of this process of managing stakeholders involves balancing the views and expectations of stakeholders as there will be differing viewpoints on what is and is not possible concerning closure outcomes (Elliot, 2003). The views of various stakeholder may change over time, as may the stakeholders themselves and it is important to ensure that closure outcomes are achievable and realistic, can be funded and that stakeholders are fully supportive of the closure plans (ICMM, 2008). It is necessary to ensure that participants arrive at the closure outcomes together during closure planning as this is the best possible way of achieving ownership of the mine closure end-uses.

Stakeholder management in best practice closure outcomes is about redressing the power imbalance that exists between mining companies and local communities, ensuring that communities become empowered by determining closure outcomes. The management of stakeholders needs to be equitable in the delivery of outcomes; however, the literature suggests that in the decision-making process about closure, equity is not always possible and it is a balancing act ensuring that all stakeholder voices are heard. There is also a need to ensure that stakeholder expectations and commercial realities are not widely disparate and part of this involves stakeholders being involved in an open and transparent mine closure planning process where stakeholders take responsibility for the decision-making process, not necessarily a common feature of mine closure activities as they currently stand.

4.5.6 Summary of community engagement

The mining industry has started to move away from the rhetoric of community consultation and started to talk about actually engaging communities in mine closure over the last decade. The industry has produced handbooks designed to assist practitioners in their communication with local communities and although these are not specific to mine closure they at least provide recognition of the importance of the topic. Unfortunately regulators have been a slower to develop such rhetoric and still use the term consultation as an interchangeable concept with engagement.

Communities and societal expectations have forced mining companies to engage more proactively with local communities and be more transparent and open in their communication with them. This does not mean that this is always occurring in the industry, a fact that many authors admit is still an issue in an industry that is traditionally very secretive and sensitive to allowing use of its information.

The section also outlined the importance of working out who the stakeholders are in the mine closure process as early in the process as possible, preferably during the mine planning phase. The literature highlighted that early identification of stakeholders will assist in developing acceptance of the closure process and ultimately ownership, which is important if mine closure is to be sustainable. Part of this process involves managing the stakeholders and ensuring that their expectations for what is possible in regards to mine closure outcomes are realistic and achievable and importantly acceptable to the community for the long term.

4.6 Discussion on community engagement and planning mine closure

There is consensus by the authors reviewed for mining companies to commence mine closure planning at the earliest possible stages of the mining process. There is debate about when this is best, with some conjecture about whether it should commence during the mine planning phase, or during the early start of operational mining. The best time from a viewpoint of developing long lead times and determining stakeholders and engaging them, appears to be in the mine planning phase (Solomon, 1999; 2007; Dowd and Slight; 2006). This also increases the chances of the success of a closure and gives companies the ability to allocate financial and human resources to the project and for government agencies and other partners to coordinate their approaches to mine closure and develop mitigation strategies and support programs.

Some suggest there is a need for governments to plan better for mine closures and a requirement to work with mining industry bodies to develop at the very least uniform mine closure guidelines across the country (Hegadoren and Day, 1981; MCA, 1996), although it would be more efficient to enact legislation that was focussed on mine closure from a national level. Such an outcome would enable governments to make compulsory community engagement strategies and develop communication guidelines between mining companies and communities on mine closure. Australia could lead the world in developing a mandated set of international closure guidelines (Jackson, 2000) that would ensure that communities in developing nations are afforded the same protections and rights as those in the developed world.

Part of this planning process from governments needs to involve the incorporation of economic development programs into mine closure planning using the resources of government at all levels to assist in diversifying local economies, many years before mine closure (Hegadoren and Day, 1981). The literature found that this needs to be incorporated with community development programs that require governments working with mining companies to ensure that infrastructure provided to the community during the life of a mine is able to be continued after a mine has closed and that the local community is able to contribute financially to the continued delivery (Peeling, 2004).

In the delivery of these economic and community development programs it is necessary for both governments and mining companies to undertake social and economic impact assessments on mine closure from the commencement of the mine planning phase. At present these are delivered separately, if they are conducted at all (Dowd and Slight, 2006). However, given the long-term impacts of mine closure on a community and sometimes on the wider region it is best practice to examine, for example, how a community functions with the operation of a mine, what other industries there are to support the community post closure, how strong the community bond is and how mine infrastructure can be used to the benefit of a community post closure. These need to be in addition to an environmental impact assessment that mining companies currently conduct as part of the monitoring process for mine closure and which mining companies have generally been very good at undertaking (Khanna, 1999). However, mine closure is about more than the environmental effects, it is also involves the social and economic impacts and the interrelatedness of all three factors.

ICMM (2008) suggest mining companies have obligations to communities to develop closure planning during the initial mine planning phase, but instead of developing conceptual closure plans, there is a need to develop detailed mine closure plans that are living documents reviewed on a regular basis and updated as the mine evolves. These plans need to include provisions for unexpected mine closures that cover the possibility of a mine closing earlier than expected and that will not leave communities and governments facing large reclamation costs. They also require adequate financial planning and provisioning of cash to cover not just the initial closure costs (including unexpected closure), but also ongoing care and maintenance associated with mine closure (Fleury and Parsons, 2006).

There was a recommendation that mining company's establish a trust fund, or foundation that assists local communities after mine closure and provides business and community development support funding (Dowd and Slight, 2006). Such a process could also have contribution from governments as a way of increasing the funding available and as another way of developing a cooperative approach between mining companies and governments in the closure process.

There was recognition that community engagement needs to be distinguished from consultation and that the industry's and indeed governments past record in this area was inconsistent (Solomon, 2007). , There is still a need for the industry and government to improve in this area of mine closure planning. One of the reasons community engagement is seen as important in mine closure is that if stakeholders are engaged from the outset and contribute to the planning process there is a greater chance that they will take ownership of the closure outcomes and develop a better understanding of what options are achievable.

Part of the engagement process is the identification of the stakeholders in the mine closure process and the recognition that this process needs to be commenced again as part of the mine closure planning procedure. Two models have been developed with regards to determining who stakeholders are specifically in relation to mine closure; however they are basically similar in that they recognise three broad stakeholders in mine closure, government regulators, the community and the company (ANZMEC, 2000). These models are useful tools, however it is still incumbent on the mining companies and governments to conduct their own research to determine who these stakeholders are and then engage them in the closure outcome approach.

A current example of the failure of a mining company to successfully engage with the local community can be found in the case of LD Operations and their proposed underground , which was to be located 15 kilometres from the centre of Margaret River in Western Australia (Bartlett, 2010). Although the focus was not actually on the closure of a mine, it was instead about a proposed mine development, the case was a good example of a mining company, and to an extent the state government, failing to listen to the needs of the local community. From the outset of the proposal, the mine was opposed by local residents with a number of high profile local public residents (including Chef Ian Parmenter and vigneron Vanya Cullen) who started up an organisation to oppose the proposed mine, 'The No Coal!tion Margaret River' (ABC, 2010). The organisation attracted thousands of signatures to its 'Say no' campaign and in addition to this campaigned against the proposed mine to the government, with the local MP for the area also opposed to the development, despite being a member of the government (The West Australian, 2010). The local council, the Margaret River Augusta Shire Council was also opposed to the project on environmental grounds claiming that the mine had the potential to damage the local groundwater supplies, which are vital to the local vineyards (Margaret River/Augusta Shire Council, 2010).

The Environmental Protection Authority eventually rejected the mine proposal on environmental grounds. However, there were many people that were left asking why and how the proposal got as far as it did given the vocal opposition to the project both locally and even nationally and internationally (LD organisation's parent company is based in the United States) (Bartlett, 2010). The Company is still appealing the decision and wants to continue with its plans to mine the area (Perth Now, 2011) claiming that the EPA report contradicted advice from other government departments regarding the suitability for the proposed (Perth Now, 2011). The fact that the company is choosing to appeal the decision, despite what appears to be overwhelming community opposition highlights that despite the rhetoric of the industry, it still has a way to go before it can say with conviction that it truly engages and listens to stakeholders.

4.7 Conclusion

Mine closure planning is increasingly seen as one of the most important facets of the mining process and has gained recognition in the review of literature for this thesis. It is no longer seen as acceptable environmentally, socially, or economically to plan for closure just before the mine operation ceases. Instead, there is a growing chorus of industry practitioners calling for mine closure planning to commence during the mine planning phase and for the production of detailed closure plans, rather than just concept closure plans that are currently required. Of course, this does not mean that every company is conducting their operations in this manner and nor is there a legislated requirement for them to do so. However, there are a number of companies leading the way in closure planning and eventually it is hoped that regulators will force early detailed closure planning to become standard practice.

Further to this, the key players in the mine closure process, the company, governments and the community stakeholders need to develop a more cooperative approach to the mine closure planning process with a more open and transparent communication methods and a more cohesive focus on community and economic development programs both during and post mine closure. This may include the establishment of trusts and foundations to run mine closure community and economic development projects with funding coming from mining companies (and possibly governments) and the coordination and development process being driven by government agencies.

The review of the literature found that there is a requirement for companies to ensure that they have enough money to fund closure projects (both planned and unexpected) and also the post closure period and a need for governments to become more rigorous in the enforcement of this process. This area requires improvement from both companies and the regulatory bodies as closure is a long term and expensive process that can last many years after cash flow from a mine has ceased.

The era of community consultation (at least theoretically) has gone as best practice. It is no longer just a matter of what Arnstein called tokenistic participation from companies and governments, but actual engagement in the closure process from the outset of mining and ensuring that this ‘citizen empowerment’ continues throughout the life of a mining project in order to ensure its long-term success.

The costs of not planning effectively for closure are many, they are environmental, they are social and they are economic. They affect all parties involved from the companies to the government and most importantly the community in which a mine is situated. The history of mining is littered with examples of poorly planned and executed mine closures, the challenge lies not just in the rhetoric of the literature but in the actions of the industry and the governments that regulate it.

The next chapter will examine the regulation of mine closure on the mining industry both in Australia and a number of overseas jurisdictions including Canada, the United States, the United Kingdom, and New Zealand. The chapter will analyse influences on the legislation and various aspects of legislation that impact on mine closure. The first part of the chapter will investigate international legislation whilst the second part of the chapter will study the Australian legislation, comparing and contrasting it with the international legislation, with a summary of the key aspects of legislation and guidelines for mine closure both internationally and within Australia.

Chapter 5. Guidelines, regulations and legislation for mine closure

5.1 Introduction

Chapter five on the guidelines, regulations and legislation for mine closure, compares and contrasts mine closure legislation and policy development from key English speaking nations, the United Kingdom, United States, Canada and New Zealand, with legislation and policy on mine closure in Australia. It examines mine closure with the structure of the chapter being organised according to themes that have emerged consistently from the literature and that cover both the international and Australian legislative guidelines in order to undertake a consistent comparison. They include: Influences on legislation and guidelines; Rights of companies and landowners; Indigenous rights; Impact assessments; Financial assurance; General requirements; Process of mine closure; Stakeholder and community engagement; Requirements for environmental safeguards and rehabilitation; Mine closure planning; Waste, water and pollution; Outcomes for closed mines; Effectiveness versus Adequacy of the legislation; and Self-regulation versus enforcement.

The objective of this chapter is to examine current policy and legislation in regards to mine closure from various jurisdictions throughout the world and examine themes related to the issue. This is followed by a review of the Australian legislation using the same criteria as the international legislation to enable an accurate comparison and contrast with international law. The chapter is ultimately about finding what represents best practice mine closure from a regulatory perspective both internationally and in Australia.

5.2 An overview of international legislation and guidelines

International mining legislation on mine closure, even in those countries, which have some of the best practice mines as outlined in the case studies in Appendix A, and B, is still focussed toward the environmental rehabilitation aspects of mining. It often excludes any reference to the need to ensure that communities are not socially and economically disadvantaged by a mine's closure (Queensland Resources Council, 2001).

Reference to economic assessments in guidelines, regulations or legislation often refers to economic resources having been extracted or to unplanned closure that may have occurred due to changes in economic markets. It is uncommon for guidelines, regulations or legislation to refer to the economic impact of mine closure, and even more unusual to detail what those economic impacts might be (Garner, 2004). Similarly, international mining guidelines, regulations or legislation may also refer to social impacts, socially sustainable mining or the social cost of mining, but they do not necessarily detail what those social impacts or costs might be and indeed how the international mining community might make mining more socially sustainable.

The literature reviewed for the international section of this chapter examined the legislative requirements mostly for the other key English speaking nations, the United Kingdom, United States, Canada and New Zealand. This was done deliberately as they share similar political, economic, legal, social and cultural systems to Australia and mining has been or remains an important industry for these nations in terms of its contribution to GDP and export income. Examples from other nations are used if their legislation represents a best practice approach to mine closure that can provide lessons for the world in mine closure.

5.3 International legislation and guidelines

Like Australia, the rest of the world appears to lack specific mine closure guidelines, regulations or legislation, instead mine closure addresses the environmental rehabilitation aspects of a mining operation. Of the countries reviewed it was found that there is mine closure legislation enacted in three main jurisdictions, they are the United Kingdom, Nevada in the United States and Ontario in Canada (Clark and Cook, 2005). There are mine closure guidelines, regulations or legislation, but they are written with rehabilitation as a guiding principle and are predominantly concerned with the environmental impact of mining and restoring the land to its pre-mining state (Clark and Cook, 2005). Certainly, in some countries, the effect of mining on people, society or the economy is mentioned, but largely it is done with ecological sustainability in mind. However, the review indicates that best practice closure involves more than just addressing the environmental aspects of mine closure, it also needs to consider the socio-economic effects (ICMM, 2008).

In New Zealand, for example the *Resources Management Act 1991 (RMA)* is the main legislative guideline for mining. The aim of the act is to promote the sustainable development of natural and physical resources to benefit future generations and to ensure that long-term negative impacts are minimised (NZMIA 2004). There is no detail as to how people should be provided for by mining companies in order to promote their wellbeing. It is perhaps inferred that this should be done from an economic perspective, however, it does not seek to clarify whether this is before, during or after mining has commenced, or indeed closed. Further, the principle perspective of the RMA appears to revolve around the notion of environmental protection.

In the United States, a national strategy regarding the issue of reclamation/ rehabilitation was introduced into law in 1977 (after 10 years of debate). This law became known as the *Surface Mining Control and Reclamation Act 1977 (SMCRA)*. It contains over 100 specific performance standards that have made it one of the most complex statutes ever written

(Jackson 1991). The SCRMA is the primary law in the United States that regulates the effects of coal mining on the environment. Its doctrine has established performance standards in both environmental protection and mine reclamation. Mining Law in the United States is complex and concerning the environment, comprehensive. While the SMCRA is Federal legislation, the States are also able to enact their own legislation if the overseeing federal body – The Office of Surface Mining Reclamation and Enforcement (OSMRE) - approve of such a move (Jackson 1991). The State Act can take precedence; however, the OSMRE will still oversee the State program. The provisions of the State Act must also exceed the requirements of the Federal Act. Government involvement and responsibility for mine legislation in the United States also extends to Local Governments, who along with Federal and State bodies are responsible for granting access to operate a mine. Indeed, the mining approval process in the United States can take many years (Office of Surface Mining Reclamation and Enforcement, 2003)

In Canada, the Provinces have full jurisdiction over the restoration requirements. The Federal government only becomes involved over issues of air and water pollution, particularly where issues may arise in more than one Province (Jackson 1991). An example of the Canadian legislation can be provided by looking at surface coal mining, which is primarily undertaken in three Canadian Provinces, Alberta, British Columbia and Saskatchewan. Each of these Provinces has legislation regarding mine rehabilitation that is quite flexible and based around a concept of Ministerial discretion. In other words, the minister has the ability to decide if rehabilitation has, or has not met required standards (National Orphaned Abandoned Mines Initiative, 2001). In Alberta, continuous interaction occurs between the Government and the coal mining companies to deal with the rehabilitation and closure issues as they arise. The legislation is still primarily concerned with the environmental aspects of mine closure. It does not deal with the social and economic issues and hence is quite narrow in its focus. The concept of the Minister being directly responsible for issues that arise with mine rehabilitation has some merit. However, this leaves open the possibility of concern from stakeholders regarding the transparency of such a process, as opposed to having an independent statutory body that enforces regulatory guidelines.

While mine legislation and guidelines focus on the environmental aspects of rehabilitation and closure and often fail to address the socio-economic issues (Cooney, 2004), there is a trend for the mining industry to be ahead of their regulatory counterparts when it comes to the issue of mine closure (ANZMEC/MCA, 2000; ICMM, 2008). Further, there is a need across the world for regulatory bodies to become more proactive when it comes to the implementation of mine closure legislation and perhaps work in tandem with the industry bodies on the issue (ANZMEC/MCA, 2000; ICMM, 2008).

5.3.1 Influences on the legislation and guidelines

Internationally, legislation and guidelines on mine closure appear to have been developed to reduce environmental damage, which has in part been driven by the past actions of mining that have led to some notable environmental disasters (the Summitville in the United States and the Rum Jungle case studies in Appendix A are two such examples). Internationally regulators appear to lag behind their industry counterparts in developing specific mine closure policies (Khanna, 2000). There are a number of influences on mining legislation both nationally and internationally. Governments legislate for the mining approvals process and the lease of the mine site. In this instance, governments are seeking to contain the rights of companies by limiting the area of land that can be explored; further, they are establishing a revenue stream through leasing arrangements, which is particularly beneficial if it is government land (Burningham et al., 1994). They seek to ensure that the land is rehabilitated, and in this instance, the key influence is the environment. First Nation and Indigenous rights are an influence on legislation and are similarly influenced by legislation in many countries, often in the form of treaties (e.g. Treaty of Waitangi in New Zealand (NZMIA, 2004)), which assign land rights to the indigenous population.

As well, mining legislation is enacted to ensure mine safety in many countries, the risk to human life in this industry demands that governments establish stringent regulations (AMEEF, 2002). In many countries mining royalties are paid to governments as a revenue stream that is often critical to expanding a government’s tax base, particularly in developing nations where mining can become a significant contributor to economic development (Molefe et al., 2006).

Little of the legislation reviewed for this chapter includes the social and economic consequences of mining and more specifically mine closure. There appears to be only minimal concern with the economic and social effects of mine closure and little detail on mine closure planning with much of the planning left until after a mine site has ceased operating (Khanna, 2000).

5.3.2 Rights of companies and land owners

The rights of companies and landowners are entrenched in legislation, varying from country to country. In most, mineral resources belong to the government and companies in those countries are not able to extract or sell any mineral commodity without government approval. Their rights to mine closure are generally covered under various rehabilitation clauses in countries such as the US, Canada, and the UK. In the UK for example, there is a requirement that land be returned to its pre-mining state as much as this is possible (Cooney, 2004).

Originally in the United States, individuals or organisations that owned the surface of the land owned the mineral resources. These land rights became known as "surface rights" or "fee simple estate". Under the law enacted in 1872, the use of the word fee meant that the owner of the land controlled the surface, the subsurface and the air above the property and consequently, the owner had the freedom to sell, lease, gift or bequeath the land and ensuing rights as they saw fit (United States Department of the Interior, Bureau of Land Management, 2011).

Today, State Law in the United States modifies much of the Mining Law of 1872, governing both the transfer of mineral rights from one owner to another and the mining and drilling activity on that land (United States Department of the Interior, Bureau of Land Management, 2011). In the US, state legislation can override federal legislation on mining if the Federal Office of Surface Mining Reclamation and Enforcement (OSMRE) approve and if State requirements for mine rehabilitation exceed federal provisions (Jackson 1991).

With the exception of five key minerals in the UK, gold, silver, coal, gas and oil, all other minerals are predominantly in private ownership. On privately owned land in the UK, the ownership of mineral rights often lies with the surface owner. However, the rights to the surface and the minerals are often separated. It can sometimes be difficult to locate the mineral rights owner (Minerals UK Centre for Sustainable Minerals Development, 2011). For example, "Crown Land" is a concept that dates back to 1066 and today, the assumption remains that unless it can be proven otherwise, land is crown land. Further legislation has been enacted for land-based exploration with a licence being granted for exclusive rights to explore for oil and gas onshore within Great Britain, however rights of access (i.e. to access the land) are not granted and for this they need to obtain consent through local planning authorities (Minerals UK Centre for Sustainable Minerals Development, 2011)

What is clear from the US and UK examples of legislation surrounding landowners rights and company rights in mining is that some of the mining legislation is steeped in history and does not necessarily take into account mine closure issues, other than environmental concerns. Where amendments to the legislation have occurred in the case of the United States, the provisions of State-based legislative changes have been sufficient to override any need to resort to Federal legislative requirements.

In relation to mine closure specifically, there is little evidence that such legislation exists internationally at all. Certainly, there are reports on recommended guidelines on mine closure such as for example the European driven report, *Mining for Closure: Policies,* *practices and guidelines for sustainable mining practices and closure of mines*, a report funded through the United Nations Environment Security initiative (Tremblay, G, 2005). Written in 2005, this report sought to outline corporate practice, regulatory frameworks, and governance, financial and insurance guidelines for the South Eastern Europe region. Further, it aimed to deal with the legacies of past mining activities in the region while directing future mining activity. Legislation in this part of Europe has not outlined the rights and responsibilities for landowners and companies, something which this report hoped would change over time and which the report hoped would generate debate on the issue (along with a number of other issues surrounding mine closure) (Tremblay, G, 2005).

While the recommendations of this report could have been used as a set of guidelines, it has not been enacted on a practical level and has largely been ignored in favour of industry-based documents on mine closure (Garcia, 2008). At best, this report discusses the funding and execution of mine closure and mine rehabilitation inclusive of recommendations and guidance published by other international bodies. While the report references social and economic conditions, it does so with the view of ensuring these conditions are optimal for new and ongoing mining activities rather than a social and economic impact perspective for closure, although it provides limited detail of the social risks that may occur in mine closure.

The literature review did not uncover comprehensive mine closure law in any one country or continent and therefore little in the way of best practice closure outcomes that provide comprehensive rights for landowners and companies, other than through often old legal statutes that are more focused on the mining process, rather than the closure outcomes (Garcia, 2008).

5.3.3 Indigenous rights

The story of Indigenous or First Nations not receiving the benefits of mining and not having their land rights respected, is a theme which reverberates around the world amongst First Nations (Tobin, 2008). In British Columbia, the IHRC (2010) called for legal reform. The aim of this reform was to guarantee that all stakeholders in mining, be it industry, government or first nations, have a more equitable share of both the benefits and burdens of mining. Further, the IHRC (2010) emphasised the need for consultation during the approval process, suggesting, this too, should be legislated. The International Human Rights Clinic (IHRC) of The Harvard Law School in June 2010 found that “...First Nations suffer the consequences of a regime that favours mining over the environment and indigenous culture" (International Human Rights Clinic, 2010, p. 2). When speaking specifically about British Columbia, Canada, as an example, the IHRC (2010) found that British Columbia should reform its laws to elevate fundamental aboriginal rights. Mining activity, both past and present was a significant threat to the way of life of British Columbia's indigenous Takla people. Indeed, much of the habitat and wildlife has been damaged by mining activity. Further, there was a fear of contamination of both soil and water sources and it appeared that the community had been the beneficiary of few of the benefits of mining in the area.

Worldwide, First Nations are seeking more recognition in the mining sector. At the International Indigenous Summit on Energy and Mining held in June 2011, in Ontario Canada, there was a view that indigenous participation in the sector was an opportunity for indigenous people across the world to shift the view from what is too often seen as the 'indigenous problem' to one of 'indigenous potential' (Assembly of First Nations, 2011).

The summit provided an opportunity for key stakeholders in the mining sector to discuss and identify approaches to resource and energy development that respected indigenous rights and treaties signed between governments and indigenous peoples (Assembly of First Nations, 2011). During the course of the summit, First Nations identified that they are not opposed to development, but were opposed to development at any cost (Assembly of First Nations, 2011). They also advocated for adherence to the United Nations Declaration on the Rights of Indigenous Peoples, seeking consultation and engagement with first nations prior to development early in the mining process (Ward, 2011). This was seen as necessary to establish the relationships required to build effective partnerships and agreements between First Nations, governments, and industry.

Internationally, there was little literature to indicate that there is a push to develop indigenous rights concerning mine closure; however, this is perhaps reflective of a lack of mine closure legislation worldwide. Instead, the lessons from the International Indigenous Summit on Energy and Mining and forums such as the IHRC are that First Nations have rights under treaties that must be adhered to by law, but no longer is that enough to sustain a successful and trusting relationship with the mining industry (Atleo, 2011). Indigenous people expect to be recognized as stakeholders in the mining process and engaged accordingly. The IHRC (2010) points to the possibility of enacting legislation to recognise indigenous peoples as stakeholders in mining projects in British Columbia as a possible solution to issues occurring with the Takla people and it is perhaps a solution worldwide. To date however, no such legislation has been enacted in British Columbia.

5.3.4 Impact assessments

Environmental Impact Assessments (EIS) are expected when assessing a mine's viability and its impact on the environment. The requirement to conduct an EIS is enacted into much of the reviewed global legislation on mining. This requirement has been driven in part by mining practices in the past that have had detrimental environmental effects, but also by societal changes which have forced regulatory action on mining and its effects on the environment (Marcus, 1997)

In the United States, the laws regarding Environmental Impact Assessments are complex. They exist at both a state and federal level and are required for mine development plans, with the EIS incorporating the rehabilitation aspects of the mine operation (Marcus, 1997). As an example the *US National Environmental Protection Act 1969* (NEPA) requires state agencies to ensure that mining companies prepare Environmental Impact Statements (EIS) for projects that are on federal lands, that may significantly affect the environment and that are not covered by state-based environmental legislation (Colorado Department of Public Health and Environment, 2010).

Similarly, in the United Kingdom and European Union, an Environmental Impact Assessment (EIA) is a requirement as part of the mine operation process. In the UK, this requirement was developed from a European law, Directive 85/337/EC, *The Assessment of the Effects of Certain Public and Private Projects on the Environment*, amended by EC Directive 97/11/EEC. This directive is implemented through the *Town and Country Planning Act 1990* in the United Kingdom (European Environment Commission, 2010). There has been criticism of the implementation of this European Union Directive in the UK, with claims that it does not fully interpret the EC Directive and that unlike in other European countries that have implemented the Directive, the UK legislation does not always require Environmental Impact Assessment's to be undertaken, even in mining projects (European Environment Commission, 2010). Environmental Impact Assessments for mining projects in the United Kingdom are required only if the development exceeds a certain size (in terms of the area it covers and the amount of capital required), its location is near environmentally sensitive areas, or the nature of the mining to be undertaken is close to urban areas (Friends of the Earth, 2010). What the EC Directive offers, despite some issues with the UK interpretation of it, is a generally unified approach to the requirement to conduct Environmental Impact Assessments that enables regulators and mining companies to develop some consistency concerning the development of Environmental Impact Assessments in the European Union.

While Environmental Impact Statements or Assessments have become a standard in legislation and mine closure practice in much of the world reviewed for the literature, Social Impact Assessments largely remain conceptual and subsidiary documents (Joyce 2001). A number of key issues around the world have heightened the profile of this kind of assessment and issues such as cultural survival, indigenous rights, the anti-poverty mandate of development banks, and anti-globalization rallies have raised serious new challenges about the projects being undertaken. Further, the principles of sustainable development and stakeholder and community engagement imply that society's voice be heard and an SIA is one of the tools that can be utilized to achieve this.

While SIA's largely remain a concept for best-practice mine closure, there are many mining companies that will undertake a SIA on a more self-regulatory basis as part of mine planning and there is some evidence in the international community that legislation on SIA has started to be enacted (ICMM, 2008). For example, the Congolese Parliament requires mining companies to undertake both an Environmental and Social Impact Assessment (ESIA) (Heydenrych, 2008). However, the Congolese ESIA are not required throughout the life of a mining project, are not treated as living documents and nor is there a specific focus on mine closure; it is a broad impact assessment related to the project as a whole.

The requirement to undertake an ESIA is also influenced by the Equator Principles. The Equator Principles (EPs) have been adopted by 60 financial institutions in the international community and require that these financial institutions manage and assess social and environmental risk as part of their obligations to financing mining projects and require mining companies to undertake these assessments as part of the lending criteria (Equator Principles, 2006). The principles apply to lending criteria across a range of industries including the resources sector and they apply to all projects with capital costs of US$10 million or more (Equator Principles, 2006).

The Equator Principles for the resources sector were established because of two key issues. Firstly, no one regulatory body governs the mining industries and given the complexities on international law, there is unlikely to be. Indeed, countries must first establish mine closure legislation in their own right before embarking on something as complex as an international mining regulatory body. Secondly, the EP's were established to emphasise the importance of closure for both socially conscious and fiscally responsible banking purposes (Garcia, 2008). The Equator Principles represent good financial practice for the development of mining projects and it again demonstrates that in some respects industry is actually ahead of their government counterparts when it comes to the issue of adopting a more holistic approach to mining and sustainable development.

The requirement to undertake impact assessments, specifically in relation to mine closure, were not found in the review of the literature on legislative outcomes and it appears that the main requirement from a legislative viewpoint internationally is to undertake broad environmental impact assessments that cover the rehabilitation aspects of closure. This is not a negative aspect of the reviewed mining legislation. It indicates that there is a need for regulatory bodies worldwide to become more proactive legislating mandatory requirements for Environmental and Socio-Economic Impact Assessments (developed in partnership by mining companies and governments) specifically for mine closure. These could be part of the initial mine planning document and then reviewed on an ongoing basis effectively becoming living documents.

5.3.5 Financial assurance

Financial assurances refer to rehabilitation bonds, sometimes known as rehabilitation funds, or financial sureties and/or assurances. They are a mechanism that governments use to obtain funds from mining companies to cover the costs of mine rehabilitation should a company fail to meet its reclamation obligations (Jones, 2006). The idea is similar to the bonds that are required when properties are rented, which are used to cover costs should a tenant fail to leave a property in the state it was in when they moved in. The types of sureties used by governments across the world are wide ranging and include third-party guarantees or Bonds issued by financial institutions, irrevocable letters of credit, cash deposits, trust funds, insurance policies and Pledge of Assets (Fleury and Parsons, 2006). Internationally it appears that no option is more commonly used than the others and it appears that it is an area that requires further research. Industry is calling on governments to become more site specific by using a case-by-case approach to the issue and to employ financial specialists to work with mining companies to determine the amount of financial sureties as a way of ensuring best practice outcomes for both industry and local communities (Fleury and Parsons, 2006, Jones, 2006; ICMM, 2008).

In the United States, this is a State issue (unless mining occurs on federally owned lands, when they then come under *NEPA (1969)*) and the requirement is that mining companies must pay a reclamation bond for the area that is to be mined. However, in a number of states in the US (examples include, Arizona, California, New Mexico, Utah, Washington, Wyoming) bonds are not required at all to cover closure costs (Clark and Cook, 2005). Where they are, part of the bond is returned to the mining companies as and when rehabilitation standards are met satisfactorily. There is however, some of the bond withheld, which is not returned to the mining company until it can demonstrate that adequate plant growth has occurred over a number of seasons (Jackson, 1991).

In Canada too, bonds are required of mining companies. An example of this is in the Quebec legislation, the *Mining Act (1987)*. This Act requires establishment of an independent fund to cover the costs of closure before mining production commences (Bocheseiche, 2004). The lodging of a security bond that covers 70% of the cost of restoring the site must occur. While in theory an excellent idea, the question of how to derive the 70% figure of restoration costs must surely be questionable, as it is handed over at the planning phase of the mining operation. The idea of an independent fund covering closure costs is unusual as it is usual practice for governments to hold this money.

The main methods of providing for bonds in the UK are letters of credit, performance bonds, trust funds, insurance policies, parent-company guarantees and pledging of assets (Minerals UK, 2009). The financial surety provisions (rehabilitation bonds as they are known in Australia) are enforced if the owner fails to meet their obligations at the time of closure, or if the organisation is forced to close prematurely. Research conducted between 1982 and 1990 found that 27% of mine sites in the UK were not rehabilitated to an agreed standard, or were not rehabilitated at all (Ricks, 1995). The main reasons for this were financial failure of the mine owner, technical failure by the operator, poor implementation of mine planning (by both the regulator and the mining company), other reasons such as disputes over site ownership and inability to finance the closure process. It was also found that mine owners were less concerned about failure to rehabilitate than regulatory authorities (Ricks 1995). However, this research was conducted at a time when the notion of sustainability in the mining industry was all but unheard of by many mining companies and had very little public profile.

The issue of rehabilitation bonds is a challenge for governments across the world, as they need to struggle with the idea of minimising financial burdens to mining companies in order to ensure investment in their jurisdictions. At the same time, they face the need to assure local communities that should a mining operation fail there will be adequate finance available to effectively close a mine with preferably no cost to the community, something that governments have not always been successful at as demonstrated by the poor practice case studies in Appendix A (p. 14). This is not an issue dealt with satisfactorily internationally and there is debate about the best way to approach this issue from both regulatory and company perspectives.

There is little doubt that until companies can demonstrate to both governments and financial markets that they are able to meet their closure obligations, which can often run for many years after the operational cash flow from a mine has ceased, the need for financial assurances will continue. As yet, no other financial mechanism exists by which governments can recover some financial restitution for unplanned mine closures.

5.3.6 General requirements

The general requirements section of mine closure will look at two issues that can adversely affect mine closure if it is not undertaken comprehensively. The first issue is the process that companies and regulators must follow internationally, which the review of the literature found is not always straightforward and can be quite onerous and complex. The other issue is the process of stakeholder engagement required for mine closure. While there are requirements for community consultation, often they are ambiguous about what consultation requires and there is not always scope for a more equal two-way dialogue, as recommended by both the MMSD report (2002) and the ICMM Mine Closure Toolkit (2008).

Process of mine closure

The process of mine closure refers to the requirements and standards that exist for mine closure and what procedures are in relation to mine closures. Generally, mining companies must consult with legislative bodies and or authorities and meet legislative requirements, guidelines and regulations to successfully close a mine. However, the requirements, standards and process for mine closure vary widely from country to country, as do the number of Acts that a mining company must refer to (Garcia, 2008). None of the countries reviewed have specific Mine Closure legislation; instead, closure is normally referred to within the discourse of existing Acts and sometimes within the context of quasi-legislation such as guidelines and regulations.

The International Council for Mining and Minerals (ICMM) has examined the mine closure process in detail and has found very few case study examples of successful integrated mine closure (ICMM, 2008). While there is broad industry acceptance of the need to integrate social, economic, environmental and engineering processes into closure considerations, legislators have not moved to enact mine closure legislation and unite requirements under one banner anywhere in the world (Trezise, 2004; ICMM, 2008).

The United States legislation is an example of the complex nature of the mine closure process. The approval process for granting access to operate a mine can take many years in the United States. Permits must be obtained from Federal, State and local bodies. The mining approval process requires the undertaking of detailed mining plans, including reclamation plans and activities that include hydrological, soil and overburden analysis, water management plans, pond designs and contour maps and requires them to be updated on a yearly basis (Jackson, 1991).

There are a number of issues with the process for mine closure in the US. Firstly, it adopts a multi –governmental approach in that the Federal, State and Local Governments are involved. This becomes more complex when State legislation overrides or supersedes the Federal legislation. Secondly, mine closure planning in the US can be prescriptive in that mining plans are written yearly and do not appear to be flexible (Warhurst and Mitchell, 2000). However, in response to this and concerning coal mining rehabilitation and reclamation, the Office of Surface Mining Reclamation and Enforcement (2003) noted that coal mining was just a temporary use of the land. In addition, it stated that reclamation needs to commence before mining has ended and the land needs to be returned to its original use or to new uses that are beneficial to the communities in which the mine operates. At the end of mining, the land should be able to blend with the surrounding landscape with little indication that mining had been undertaken.

The United States has adopted some of the most comprehensive rehabilitation and closure standards in the world, and in some respects leads the world in rehabilitation of mine sites. The process however is complex and is a tangled web of Federal, State and Local government requirements that has met with resistance from some in the industry (Jackson, 1991). Nevertheless, the evolution of rehabilitation standards has helped pave the way for a change in thinking among mining companies in the United States about rehabilitation, ensuring that future needs are taken into consideration and that this process begins during the initial planning phases of mining.

The *Resources Management Act (1991)* (RMA) is the main legislative guideline for mining in New Zealand. The act aims to promote sustainability in the management of resources and to minimise future impacts of mining activities on the environment. Resource consents are needed to conduct mining in New Zealand and these cover areas such as water, discharge and waste permits and are also used to conduct assessments on the environmental effects of the mine operation (Resources Management Act, 1991).

The local council deciding upon the application has the power to decide what conditions to place on the resource consents, such as noise and dust limits, and set the standards for discharge from the site to ensure that it is complying with the Resources Management Act. It can also determine how the rehabilitation work is to be carried out (New Zealand Minerals Industry Association, 2004). If the council or regulatory agencies believe the company is not meeting the environmental conditions, or is failing to comply with resource consents, then they have the power to close a site down. In New Zealand legislation, failure to comply with the conditions of the RMA can see company directors and managers held personally liable and imprisoned for up to two years (New Zealand Minerals Industry Association, 2004).

New Zealand has a combination of private and public (Crown Land) ownership. The Crown in New Zealand owns all gold, silver, uranium and petroleum. Nearly 30% of the land area in New Zealand is administered by the Department of Conservation and is considered Crown Land. Permits for mining on Crown land are granted by the Ministry of Commerce under the *Crown Minerals Act* (Department of Conservation, 2010).

The New Zealand mining legislation is concerned mainly with the environmental effects of mining rehabilitation, with little concern for the social and economic impacts that mine closure can have on a community, nor is there any continuous mine closure planning process. The New Zealand Minerals Industry Association was involved with helping draft the guidelines for the MMSD report, but there appears to be little in the way of government recognition of these guidelines in either policy, or practice in New Zealand. Given the amount of land classified as Crown Land, it would seem logical that government regulators (at national and local levels) at least recognise the guidelines laid down in the MMSD report. It appears that from a regulatory viewpoint, New Zealand still has a way to go before the mining sector can be seen to be practicing the principles of sustainable mine closure.

In Quebec, Canada, the *Mining Act (1987)* covers the rehabilitation of mining sites. All companies are required by the legislation to file closure plans and provide financial guarantees (Ministry Resources Naturelles Faune et Parcs 2003). The Ministry requires the rehabilitation plan before mining commences at a site. The MRNFP must approve the plan and the Act requires a revised rehabilitation plan to be submitted every five years. Some examples of processes that must be included as part of the plan include: a description of the site and completed mining activities, the type of rehabilitation work to take place during the operational phase, rehabilitation work to be undertaken at the cessation of mining, and a schedule of the cost of the rehabilitation work (Ministry Ressources Naturelles Faune *et* Parcs 2003).

The process of mine closure around the world from the literature reviewed for this section highlights a degree of complexity in terms of regulatory requirements and the course of action undertaken to achieve it. The requirements for mine closure are generally only considered in terms of rehabilitation and the environmental impacts, and are linked with the operational and initial planning aspects of mining, it is not an ongoing process and nor is the closure planning process holistic and inclusive.

Stakeholder and community engagement

Stakeholder and community engagement in mine closure internationally are often not undertaken to any degree until the final stages of a mine’s life. There is a significant amount of rhetoric in the mining industry internationally regarding community engagement for mine closure. The ICMM state that critically, this should occur at the commencement of the mining process and continue throughout the mining life cycle including the social and economic aspects that impact on a community (ICMM, 2008).

To date though, the review of the literature found that there is little evidence of legislative requirements for stakeholder and community engagement to analyse these issues in relation to mine closure in the international community. There are requirements for community consultation, normally in relation to rehabilitation, although as stated in Chapter 4 there is a difference between engagement and consultation (Solomon, 2007), but the distinction between the two is not always recognised at a regulatory level.

The New Zealand *Resource Management Act (1991)* requires that all people that may be affected by mining must be consulted and the Act also requires that the Treaty of Waitangi be taken into account, before any mining permits will be granted (Resources Management Act, 1991). The regional, or local council, then makes its decision on whether or not to allow mining to commence, normally after submissions have been received from parties affected by the potential mine operations. The rehabilitation plan from mining companies is displayed as part of this process with submissions accepted as part of the overall submissions process (New Zealand Minerals Industry Association, 2004).

In Ontario, Canada, there is a requirement that mine closure plans be developed either before advanced exploration begins, and/or before commencing mine operations. The public is consulted in the process, with a requirement that a company publish a notice in a local newspaper and hold an information session in the area where the mine is located. Information is provided on the size of the project, the type of work that will be undertaken and then addresses any concerns raised by the public in the development of the final closure plan that is submitted to the Director of Mine Rehabilitation (Canary Institute, 2011). The public have the opportunity to comment on a final closure plan (which is posted on the Ontario Environmental Registry), usually within a 30 day period, with the *Ontario Mining Act (1990)* requiring any public comments to be considered as part of the final approval process (Ontario Environmental Registry, 2011). As well, there is also a requirement that Aboriginal people are consulted when a mine development and subsequent closure directly affects their land; their comments must be included as part of the closure plan process (Ontario Mining Act, 1990)

Many of the various Mining Acts and mining related acts reviewed for this chapter require a public consultation process as part of both the approval of a mine and in the review of the closure processes. They do not however; appear to specify what adequate public consultation is, so it is difficult to determine the amount of consultation and just what is meant by consultation. Does this mean for instance that communities have input into the mining process, or is this just one-way communication? The reviewed literature found that there was little in the way of requirements for community and stakeholder engagement in the mine closure process and that unless instigated by mining companies themselves, communities had minimal legislated input into deciding mine closure outcomes (Garcia, 2008).

5.3.7 Requirements for environmental safeguards and rehabilitation

One of the areas where there has been consistency across jurisdictions has been in the approach to environmental protection and the process of rehabilitation after mine closure. It represents a real change in the way mine closure is viewed from a regulatory, company and community perspective with environmental safeguards required, often before mining commences. The industry itself through key bodies such as the International Council on Mining and Metals, the Canadian Institute of Mining, Metallurgy and Petroleum, the Institute of Mining and Metallurgy have produced documents on sustainable development and rehabilitation guidelines for use by the mining industry.

Some regulatory agencies also publish guidelines on rehabilitation, which cover environmental safeguards as part of their mining acts or as separate, publicly available guidelines. As an example, the Ontario and Quebec governments in Canada and the Environmental Protection Agency in the United States publish these. Mine rehabilitation and the protection of the environment appear to be one of the few areas of mine closure where there is a degree of synergy between the mining industry and government on what is occurring in practice and the regulatory regime that covers it.

5.3.8 Plans for mine closure

In regards to planning for mine closure, mine rehabilitation plans are generally required prior to the commencement of mining across the jurisdictions reviewed for this chapter. The requirements generally are onerous and there is normally more than one regulatory agency that mining companies need to consult as part of any rehabilitation plan that they develop for a site. It is at this stage that companies are required to demonstrate that they have the financial resources to devote to any rehabilitation program and to monitoring work, which is a requirement after a mine has been rehabilitated and closed. There is however not necessarily any requirements to develop more comprehensive mine closure plans at the commencement stage of the mining process.

In Quebec, Canada, as an example the *Mining Act (1987)* covers the rehabilitation of mining sites. All companies are required by the legislation to file closure plans (Ministry Ressources Naturelles Faune *et* Parcs, 2003). Indeed the MRFNP require that the rehabilitation plan be submitted before mining commences at a site and is revised and re-submitted every five years. In essence, this is a form of living document and allows for flexibility in mine closure planning. The plan must contain a description of the site and completed or projected mining activities, rehabilitation work scheduled to take place during the extraction process where circumstances permit and a description of the rehabilitation and restoration work scheduled to take place once mining has ceased. Further, it must be inclusive of a stage-by-stage implementation schedule, an assessment of the cost of the rehabilitation work and a description of the financial guarantee provided for the restoration of storage sites (MRFNP, 2011). Whilst the Quebec and Canadian mining legislation is complex due to differing requirements between the provinces in this area of mine closure, it has some of the most comprehensive rehabilitation requirements in the world and there has been a genuine desire to protect the environment throughout the mining process (Canary Research Institute, 2011).

Mine Closure Planning in the UK is complex, with a number of guidelines, regulations and legislative frameworks and a number of departments, planning authorities and or levels of government responsible for administering this legislation (Ricks, 1995). A further complexity arises in that EC directives also affect the legislative requirements for the environment in the UK. From a mining company perspective, there are limited guidelines in legislation on mine closure planning, mostly focussed on broader guidelines for rehabilitation planning and the requirement to undertake environmental impact assessments as part of this process (Friends of the Earth, 2010). The issue with much of the UK guidelines, regulations and or legislation is that it is more prescriptive as to what is required from the local planning authority than the companies who undertake the work (Business and Biodiversity Centre, 2011).

In the United Kingdom, the UK Mineral Planning Authority (MPA) is responsible for planning relating to mining and quarrying. In England, MPA's include major towns, Country Councils, and National Park Authorities, in areas where there is a two-tiered system of government. The EC Directive 97/11/EC requires all quarries and mines greater than 25 hectares carry out environmental assessments; these EIA's must include outlines of main alternatives to development (Business and Biodiversity Centre, 2011).

Further, The Department of Communities and Local Government in the UK issue Planning Guidance Notes (MPGs) and Minerals Policy Statements. These set out the Government's policy on minerals and planning issues, offering advice to both local governments and the mining industry on how the planning system (including rehabilitation planning) operates with regard to minerals (Department of Communities and Local Government, 2010). The Department of the Environment has issued *Minerals Policy Statement 1 (MPS1),* which is the main planning policy document for all minerals in England. It provides advice and guidance to planning authorities and the minerals industry and is designed to integrate the needs of the industry and society in a way that minimises the environmental impacts of mine rehabilitation on society (Department of Communities and Local Government, 2006). MPS 1 seeks to encourage companies to incorporate good environmental management practices into their day-to-day operations. Further, it suggests that environmental impacts are minimized during all stages of operation. It does not though suggest the need for mine closure planning to incorporate the social and economic effects on the local community to ensure that they too are minimised.

The closure of a mine requires regulatory authorities to consider the impacts that the closure will have on the future environmental quality of the site, as well as ensuring that any potential problems that may occur as a result of inadequate post-closure planning will be limited (Department of Community and Local Government, 2006). The regulatory agencies also need to take into account the consideration of environmental resource conditions and potential after-use, as well as public health, safety and socio-economic conditions, something that is not currently a requirement of the UK legislation (Garcia, 2008).

Rehabilitation planning has become more complex and comprehensive over the last twenty years as societal expectations about minimising negative environmental outcomes of mining have become more vocal. In addition, regulatory authorities have become more stringent in their requirements for mining companies to protect the environment not just at closure, but also to ensure that post closure outcomes are sustainable over the long term (Friends of the Earth, 2010). Rehabilitation planning requirements have become mandatory (at least in the literature reviewed for this chapter) as regulatory agencies work more cooperatively with mining companies (through more transparent planning processes) to develop strong rehabilitation standards. However, more comprehensive mine closure plans that take into account the economic and social impacts of mine closure and determine post closure end-use options for mine sites are yet to become standard practice in the reviewed legislation.

5.3.9 Waste, water and pollution

The issues surrounding mine waste, water issues such as runoff from mine sites and possible threats from mining to underground water supplies for example, along with pollution issues associated with mining are complex issues for regulatory authorities to deal with. There are many examples from overseas of mines that have been closed due to issues surrounding one or sometimes all of these factors together that have been caused due to inadequate legislative guidelines (Warhurst, 2000). Requirements are far more stringent today and the review of the literature for this section found that a more concerted effort is being undertaken by all parties in the mining process to ensure that mine waste, water and pollution issues are addressed.

The management of any waste presents complexities and mining waste is certainly no exception. Mine waste can range from waste associated with tailings, to waste from the day-to-day operations of the site and wastewater associated with the operation of the site. Throughout the review of the literature, it became clear that governments and indeed mining companies themselves are attempting to develop standards that ensure that any waste or pollution associated with a mine site are contained and removed, do not enter local water supplies and do not become a source of pollution for local or wider communities (Ricks, 1995).

In the UK, *Directive 2006/21/EC* of the European Parliament and of the Council on the management of waste from extractive industries was adopted on 15 March 2006 (Communities and Local Government, 2008). The directive is usually known as the *Mining Waste Directive (MWD)*. The purpose of the MWD is to provide for measures, procedures and guidance to reduce the risk to and or prevent where possible adverse effects on the environment. In defining the environment, the MWD makes particular reference to water, air, soil, fauna and flora and landscape. It also seeks to negate the risk to human health brought about by the management of waste from the extractive industries. Extractive industries in the context of the MWD refer to land-based industries that extract waste of mining and quarrying activities (Department for Environment, Food and Rural Affairs, 2010).

Further to the MWD, the UK has established Environmental Impact Assessment guidelines, which are based on *European Union Directive EIA 97/11/EC*. This directive acknowledges that a number of factors will have direct and indirect effect on a mining project (Ricks, 1995). These factors include humans, flora and fauna, soil, water, air, climate and landscape. It also highlights the importance of both material and cultural assets, and requires a description and assessment of the relationship between all of these factors (Department of Communities and Local Government, 2008). Each of these directives seek to ensure paramount care is taken of the environment and seeks to clarify that the environment is inclusive of humans, flora and fauna, soil, water, air, climate and landscape. The MWD makes direct references to extractive industries and places requirements upon the industry and both implicit and explicit (Business and Biodiversity Centre, 2011).

The USA has a number of federal environmental safeguards in place, which aim to protect the environment. The *Comprehensive Environmental Response, Compensation and Liability Act (CERCLA),* commonly known as Superfund was enacted in 1980. This law requires operations to report releases of hazardous substances to the environment and requires cleanup of sites where hazardous substances are found. The Superfund program was established to locate, investigate, and clean up hazardous waste sites nationwide and is currently being used by the US Environmental Protection Agency (EPA) to clean up mineral-related contamination at numerous locations (US EPA, 2011).

Further legislation includes the *Federal Water Pollution Control Act (Clean Water Act) (1977), The Resource Conservation and Recovery Act (RCRA),* enacted in 1976 and the *National Environmental Policy Act (NEPA),* enacted in 1970. The first places requirements on mining operations including mining operations to meet prescriptive water quality and the second limits the discharges to surface water from mining operations (Clean Water Act). These acts are designed to regulate the generation, storage, and disposal of solid waste and hazardous waste, using a "cradle-to-grave" system, meaning that these wastes are governed from the point of generation to disposal (Clark and Cook, 2005).

Mining operations have a responsibility to protect the land, water and air, however, this has not always been the case and internationally mining operations have left behind environmental legacies that cost many millions of dollars to clean (Canary Research Institute, 2011). The environmental controls to prevent environmental damage from mining operations were not always comprehensive in their requirements and there was a lack of understanding of the negative impacts on the environment (Clark and Cook, 2005). There is now however, a change in the way regulators approach the issue of mine waste, water discharges and pollution and a more cooperative approach with industry in ensuring that environmental controls are in place to limit the damage that can be caused by mining (Tobin, 2008).

5.3.10 Outcomes for requirements for closed mines

Internationally, the outcome requirements for closed mines was similar in that generally most jurisdictions have basic expectations that land will be returned to a state that existed prior to mining (Garcia, 2008). This is a basic expectation, the requirements in terms of the types of activities considered for post mining use and the amount of time required to monitor a former mine site, vary considerably from country to country. Further, the number of regulatory bodies that oversee the process also varies considerably, making the process quite laborious from a mining company (and most likely community) perspective (Clark and Cook, 2005).

In the United States the *Surface Mining Control and Reclamation Act (1977)* requires that land that has been mined be returned to approximately the original contour and that the land be returned to productive use that is equal or exceeds its pre-mining state. Any decision to turn a site to recreational use or for residential or industrial use must be approved by communities and local and state governments. If the site is on federal lands, it requires regulatory approval from the EPA (OSM, 2011). Land designated, as farmland must be returned to agricultural use. The act also encourages the restoration of land to its former native use and the establishment of wildlife reserves (Jackson 1991).

The closure requirements in the United States vary from state to state and can be affected by local planning laws, in addition to Federal environmental laws, which must also be considered as part of mine closure outcomes. However, there are some general requirements that all closed mines across the United States must adhere to and they include: monitoring of a site from between 5 and 30 years depending on the mining activity undertaken; companies are allowed to keep leach heaps and tailings impoundments on a site as long as rehabilitation has occurred; ongoing assessments of soil and water conditions as part of the monitoring program; sampling of groundwater quality including a record keeping and reporting schedule; contingency plans for the closed mine should there be physical damage to the mine site or issues with discharge from the site that affect local waterways, including groundwater; and keeping physical facilities such as site buildings that may be used for local community groups (Clark and Cook, 2005, Garcia, 2008, United States Code, 2008).

In the UK as an example, the closure needs to take into account the types of facilities (i.e. underground, or surface facilities), water management, rehabilitation of spoil and tailings pond areas and the socio-economic impacts of the mine closure (Ricks 1995). The main aim of the regulatory authorities in the UK appears to be ensuring that the conditions once mining has ceased will pose a negligible threat to local people and the environment, over both the short and long term (Department of Communities and Local Government, 2006).

Before UK mine owners/operators can walk away from a decommissioned site, they must firstly instigate a programme of rehabilitation that involves both active and passive rehabilitation after a detailed closure plan has been implemented (Department of Communities and Local Government, 2006). This is quite a detailed requirement for mining companies in the United Kingdom and helps to ensure that mine closure and rehabilitation are serious considerations for mining companies (Ricks, 1995). These rehabilitation and closure programs require an active care program, which occurs after mining has ceased. It involves mine decommissioning, site rehabilitation and the elimination of all pollution and other hazards. A passive care program is also required, which is a period of sampling and monitoring that demonstrates rehabilitation has been successful and that the mine can officially be decommissioned (Business and Biodiversity Centre, 2011). The regulatory provisions for post closure monitoring is an issue that the mining industry sees as a potential problem as it varies widely from jurisdictions and within jurisdictions, for example in Ontario, Canada, the monitoring period can last from between 5-100 years (Canary Research Institute, 2011). The industry claims that it would like to see uniformity on the issue of post-closure monitoring with a set period of time, with the end of that time marking the relinquishment of the mining company’s responsibility for the mine (Fleury and Parsons, 2006).

Mining sites that have not been turned into productive agricultural land once mining has ceased, have been used for housing, golf courses, playing fields, parks and lakes and ski slopes (Jackson 1991). The United Kingdom is not necessarily a world leader in mine closure practices, but thanks to European Union directives and greater focus on sustainable development by mining companies, governments and the general community have started to ensure that mine closure is now taken as seriously as the actual mine operation phase.

There have been some notable examples of mine closure in the UK that has seen former mine sites turned into recreational and tourism facilities. One such example is the Rother Valley Country Park in the midlands area of Britain that was a former coalmine site and has since been turned into a major tourism attraction for the region (Appendix A, p. 137). The rehabilitation for this site was an ongoing process that attracted financial and regulatory support from five local boroughs initially and has since proven to be a big tourism drawcard for the borough of Rotherham that is now responsible for the site (Appendix A, p. 142).

Of the two countries used for discussion in this section, one (the United States) has federal, state and local government legislative requirements that mining companies must meet and that would appear to be contradictory, yet in some respects are quite complementary in the outcomes that they achieve, particularly in relation to environmental outcomes. On the other hand, the United Kingdom is overseen by a national regulatory system that is influenced by European Union Guidelines, and yet is enforced at a local government level, working alongside the Department of Environment (Minerals UK, 2009). Neither system is perfect, yet each regime has good points, for example the UK requirement for local government involvement and the United States Federal Agencies responsibilities for environmental standards, however, they are complex and still mainly focussed on environmental outcomes with little apparent concern for socio-economic outcomes.

5.3.11 Effectiveness v adequacy of legislation

In as much as international mining law seeks to regulate the elements of mine closure specifically concerned with the environment, rehabilitation and reclamation, it has been effective. In many countries, the requirements of mining companies to undertake environmental impact statements prior to commencing mining have been enacted into legislation. Further, in some countries in state or provincial jurisdictions, mine closure plans are a requirement and the need has been enacted into legislation. Where the effectiveness of the legislation comes into question is in its complexity and some key issues that affect implementation of mine closures.

The first criticism in terms of the adequacy of international legislation is that the mining law in any one country can be covered under any number of acts. If we take the United States as an example, mine legislation includes but is not limited to, the following Acts, *The General Mining Act (1872), Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)(1980), National Environmental Protection Act (NEPA) (1980), Surface*

Mining Control and Reclamation Act 1977 (SMCRA) (Clark and Cook, 2005). These are some of the Federal Laws under which the mining industry in the US must operate. This perhaps does not seem so complex, however when you then add that these laws are administered by different regulatory bodies and further, that State legislators can enact mining laws, including federally where the State requirements supersede Federal requirements, the law becomes quite complex (Garcia, 2008).

International mining law covering the industry on a global scale does not exist. There have been several arguments for international mining law to be created, including a need to regulate the industry better across jurisdictions (Jackson, 2000; Khanna, 2000; Garner, 2004). While the royalties of mineral extraction remain sovereign, questions remain as to whether this industry would be better regulated with one international regulatory guideline and enforced by sovereign nations, with international courts intervening in disputes (Garner, 2004). Several key mining giants who operate across international borders such as BHP Billiton and Rio Tinto and would benefit from international legislation and the surety that it would bring by enabling each of their operations to be conducted under one legislative regime (Garner, 2004). Such an approach would also mean that issues that exist across many if not all nations could be addressed in a consistent manner. These issues include first nation or traditional ownership, environment, waste and pollution, rehabilitation standards and sustainability and socioeconomic (Khanna, 2000). It is doubtful however, that mining law could be enforced internationally due to the difficulties with sovereign states enforcing laws outside of their territorial jurisdictions. In addition, the current system of international law implementation and enforcement is seen as inadequate when it comes to an industry as complex as mining (Garner, 2004).

Internationally, the closure of mines is administered haphazardly and under the auspices of a number of guidelines, regulations and acts (Garcia, 2008). Often, legislation calls for a mine closure at the commencement of mining and fails to acknowledge that the mine is a living entity and its operation will change and therefore change plans for closure (Clark and Cook, 2005). Without question, the environment is the paramount concern internationally in regards to mine closure and with these environmental concerns, the issues centre on reclamation, waste and pollution and sustainability. There is evidence that the world has taken notice of the need to legislate for environmental conservation in the mining industry (MMSD, 2002, ICMM, 2005; 2008; GEMI, 2004). Internationally, however, social and economic ramifications in mining and mine closure have not been specifically taken into account (Jackson, 2000; Joyce, 2001). In this area, legislation and legislators are not effective and have not considered the human cost of mine closure.

The legislation, while being effective in many countries in terms of limiting environmental damage and enforcing rehabilitative standards, is not necessarily adequate when examining mine closure from a holistic perspective that is inclusive of social, economic and environmental ramifications and stakeholder engagement.

5.3.12 Self-regulation versus enforcement

Self-regulation is the practice by any industry seeking to go beyond minimum regulatory requirements. In essence, by operating above the standard set by regulatory requirements, only those standards set by legislation, regulations or guidelines may be enforceable. Standards over and above the regulations are perhaps an example of a company seeking to be a good corporate citizen or building up goodwill in the community (Johnstone and Sarre, 2004). In the 1990s, the mining Industry in Australia addressed the challenges posed by regulations and external analysis through increased stakeholder engagement with both industry critics and community (Brereton, 2004). The industry sought to promote voluntary industry codes such as the MMSD and ICMM codes, as a legitimate alternative to government regulations and currently operate above regulated standards (Brereton, 2004). Enforcement implies that there is a punitive or penal element to ensure the party complies with legislation and by definition; it would become a legal matter for the company to deal with (Johnstone and Sarre, 2004).

Without question, the rhetoric on social and economic responsibility in mine closure is increasing. However, it is yet to be incorporated fully into international legislation and is thus not enforceable (Joyce, 2001). Self-regulation in the mining industry on socioeconomic issues seems to be the way forward; however, this is not the ideal and certainly not best practice.

In as much as social and economic responsibility are currently gaining favour in the mining industry (MMSD, 2002, ICMM, 2008), the environment is one of the core political and social issues surrounding mining and mine closure and has remained so for at least the last 30 years. It is environmental requirements that are enforceable at law, although the legislation remains fragmented across a number of mining and mining related acts across the jurisdictions reviewed for this chapter.

Another common theme to emerge from international legislation is the requirement for Environmental Impact Assessments or Environmental Impact Statements. The EU and UK are perhaps the bests examples of this as the origin of legislation is from the same source that is *Directive 85/337/EEC, The Assessment of the Effects of Certain Public and Private Projects on the Environment*, amended by *EC Directive 97/11/EEC* (Department of Communities and Local Governments, 2010). Other nations too have adopted the practice of requiring environmental assessments from mining companies for example in the US, the *National Environmental Protection Act* (NEPA), requires the preparation of Environmental Impact Statements (EIS) for projects that may significantly impact the environment (US EPA, 2011). The requirement to submit Environmental Impact Assessments and Environmental Impact Statements are legislative requirements and thus enforceable at law.

In its document *Planning for Integrated Mine Closure: (Toolkit) 2008*, the ICMM seeks to promote within the industry a more disciplined approach to mine closure, one that is not prescriptive but is nevertheless versatile, in that it can be applied uniformly across the mining sector and to mines of various sizes. Within its pages, it discusses conceptual and detailed closure plans and their audiences, decommissioning and post closure planning, and tools for mine closure inclusive of stakeholder engagement, community development, Integrated Mine Closure Planning, Risk/ Opportunity Management, Social and Environmental Goal Setting, Change Management and Biodiversity among other things (ICMM, 2008). The document is ahead of much of the international legislation and regulatory guidelines in that it discusses the benefits of obtaining a social impact assessment, taking economic baseline studies and examining communities who are at risk, such as mono-industry communities. While this is a huge step forward in thinking holistically, it is not legally enforceable and places the onus on mining companies acting in a responsible manner, something that has not always occurred in practice.

The evidence from the literature reviewed for this section suggests that mining companies are far more proactive at self-regulation than governments are at legislating on broader issues surrounding mine closure, such as stakeholder engagement, social and economic issues and certainly the commentary reflects that. In principle, governments could learn from the mining industry and engage them in many instances, when formulating new mining legislation.

5.3.13 Summary of international legislation

The review of the literature for this section of the chapter was designed to examine what is happening in mine closure internationally from a legislative point of view. The review was limited to the United States, Canada, New Zealand and the United Kingdom mainly due to the sheer diversity of the information uncovered and the similarities these countries share with Australia from a legal, political, economic and social perspective. The review uncovered differences in some respects, yet similarities in others, particularly in the legislative guidelines towards protecting the environment from adverse impacts due to mining.

There is no stand-alone legislation for mine closure in the countries reviewed, although in some jurisdictions mine closure provisions are in the broader mining legislation. Mine closure provisions are for the most part concentrated with the environmental effects and rehabilitation aspects of mine closure with little mention of the socio-economic impacts. Much of this focus derives from changes in public attitudes towards the impacts of mining on the environment and a greater awareness by regulators of the effects that mining has on the ecosystem, the community and the mining companies themselves. There is also a broad requirement in North America, the UK (and indeed the European Union) and New Zealand for companies to undertake Environmental Impact Assessments as part of the mine planning process in order to determine the long-term effects that the mine will have post closure and undertake remediation strategies to prevent any adverse impacts.

One area where there was broad consensus was in the development of mine closure plans from the outset of the mine planning phase that included programs for rehabilitation. These rehabilitation, or reclamation programs as they are sometimes known, are generally required to be ongoing throughout the life of a mine and need to ensure that the environmental impacts from a mine are minimised. Part of this process includes the provision of rehabilitation bonds, which are designed to cover the costs of an unexpected closure or failure of rehabilitation programs. There was concern about how these bonds are calculated and their ability to cover future taxpayer liabilities.

The rights of companies, landholders and indigenous peoples is complex due to the rights being entrenched as part of a broader mining or mining related acts, rather than being specific to closure. The rights are often steeped in history, particularly in the US and the UK and go back to surface rights ownership laws. In terms of Indigenous rights, the picture is somewhat less clear-cut, with little evidence found in the way of closure rights, perhaps due to a lack of closure specific legislation. Indeed, it appears that indigenous people have been left out of the mining process altogether, although this is changing as Indigenous peoples mobilise and attempt to become stakeholders or partners in mining projects.

Indeed in terms of the issue of broader stakeholder engagement, it was found that much of the legislative requirements are concentrated on consultation rather than community engagement and is not always specific on what constitutes consultation. This differs from the industry itself at an international level, which as mentioned in the previous chapter now uses the term engagement to discuss its dialogue process with local communities.

In terms of post-mining land uses at former mine sites, the basic requirement was to return land to a state that existed prior to mining. This is not to say that other end-use options cannot be considered. However, they are not always included in legislation and when they occur it is not usually a direct result of the regulatory process. Rather, they are due to processes that have occurred outside the regulation guidelines, in an almost self-regulatory fashion between mining companies and communities (through local governments), but with some support from higher level government (i.e. state or federal). Indeed, this was in part a criticism of the regulatory guidelines, which do not necessarily adopt a holistic approach to mine closure, with the focus somewhat prescriptive, focusing only on the environmental and not on social and economic outcomes and that there is a need for more productive dialogue between regulators and mining companies (Jackson, 2000; Khanna, 2000).

5.4 Australian legislation and guidelines

There is generally little in Australian legislation dealing with mine closure. The legislation deals with rehabilitation as part of the mine closure process that has traditionally been left until a few years before mining ceases. This is beginning to change as regulators and companies recognise the need to include closure plans during the initial planning phases of a mining project, however, there is little in the way of legislative requirements regarding this, it is still self-regulatory. The other main issues with respect to mine closure are the economic and social impacts of closure and there has been little consideration of these factors in closure plans in the past, but it is likely that this lack of focus will have to change in the future as the pressure for more sustainable development increases. This section will critically examine some of the legislative requirements for mine closure in a number of the various Australian states and territories.

5.4.1 Commonwealth legislation for mine closure

There is currently no Commonwealth legislation for mine closure in Australia. The Commonwealth can become involved in mine closures, but only when there has been a severe impact on the environment; it does this through the *Environmental Protection and Bio-diversity Act 2000* (DITR, 2006). This leaves the states to implement their own legislation concerning mine closures; hence, there is a complete lack of uniformity on the issue, instead mine closure provisions are written into broader mining and mining related legislation that is enforced on a state-by-state basis. Mining legislation is different across the country with each state and territory having different requirements.

5.4.2 State legislation for mine closure

Since this research began, there have been reviews in a number of jurisdictions on mining legislation. These reviews are underway in New South Wales, Victoria and the Northern Territory (NSW Department of Trade and Investment, 2011; Victorian Department of Primary Industries, 2011; NT Department of Resources – Minerals and Energy, 2011). Additionally in South Australia, the former rehabilitation plans known as MARPS’s are set to be replaced by Programs for Environmental Protection and Rehabilitation (PEPR's), however at the time of writing they were known as MARP's on the department website and hence are referred to (Primary Industries and Resources SA, 2011).

In NSW for example, the *NSW Environmental Planning and Assessment Act 1979 Part 3A* attempts to encourage ecologically sustainable development particularly where development of mineral resources provides significant benefits to NSW from both a social and economic perspective (NSW Mining Act, 1992). It also provides a framework for prospecting and mining operations in the State and a framework for landholders, detailing requirements where loss or damage occurs. Details on appropriate returns to NSW from mineral resources are also detailed, as too are the security requirements for rehabilitation, in the form of bonds. The key principles of this act are ecological requirements with *Part 3A* outlining the requirements for effective rehabilitation where land and or water have been disturbed. Notably, it identifies the need for the development of mineral resources in a way that minimizes environmental impact (NSW Mining Act, 1992).

Nevertheless, this Act has limitations. Firstly, it discusses economic and social issues solely from the perspective of the economic and social benefits to the NSW economy from the mining operation (Environmental Defenders Office, 2011). This limited viewpoint therefore does not account for the fact that both a community's economy and society can themselves be affected by mining in terms of issues such as job creation upon commencement of mining and job loss when mining ceases.

Secondly, within *Part 3A*, there is no mention of stakeholders or the community as one of the principal stakeholders of mining (Environmental Defenders Office, 2011). Prior to the WA guidelines, the NSW legislation was possibly the most comprehensive on mining and mine closure (McGlynn, 2002). Certainly, the WA guidelines have set a new benchmark, but neither compare to the ANZMEC and or ICMM guidelines, which the industry is able to use to self-regulate and through that surpass any governmental requirements.

The NSW government in February 2011 published a scoping paper titled *"NSW Coal and Gas Strategy – Scoping Paper"*. The paper was written because a Ministerial Sub-Committee was formed in 2010 to lead the development of a Coal and Gas Strategy for NSW (NSW Department of Planning, 2011). The aims of the strategy were: to develop sustainability in the mining industry, notably in the coal and coal seam gas sector; ensure efficient regulation of the industry (although this was not spelt out in detail); strengthen communication between government, industry and the community on mining related matters; minimise the adverse impacts of the industry in the areas of community health and wellbeing, agricultural land use and on the wider environment (New South Wales

Department of Planning, 2010). The scoping paper does not mention mine closure specifically; however, as tends to be the case in relation to mining in this country, reference is made solely to rehabilitation of mine sites, with a focus on minimising any adverse environmental effects, with no mention of socio-economic and wider effects that accompany mine closure (New South Wales Department of Planning, 2010).

The aims of Australian mining legislation related to closure have been for mine sites to be rehabilitated to a state that existed prior to mining. The focus has been on ensuring that there are no adverse environmental effects associated with mining and that mined lands are returned to an acceptable state. Mine closure has always been part of broader mining and mine related acts and generally is focussed on the environmental issues surrounding mine closure. The new mine closure planning guidelines in Western Australia certainly place mine closure planning at the start of the mine planning process, however they still rely on environmental outcomes and the aims of the guidelines certainly reflect this.

5.4.3 Influences on the legislation and guidelines

The influences on the legislation and guidelines in Australia are mostly concerned with addressing any potential negative environmental impacts associated with inadequate, poorly planned and financed mine closures. In many respects this mirrored what has occurred overseas in respect to legislative influences, however in Australia, Western Australia has moved a step closer to developing a more comprehensive approach to mine closure through the introduction of the *Guidelines for Preparing Mine Closure Plans* in 2011.

The Western Australian legislation focuses heavily on the ecological aspects of mine closure heavily influence the Western Australian legislation. While it encourages mining companies to examine closure options from a socio-economic perspective, there is no requirement for companies to submit a closure plan that includes a social impact or socio-economic impact assessment (Department of Mines and Petroleum, 2011). Even so many mining companies undertake social or socio-economic impact assessments as a matter of course. Their purpose is to be seen as socially responsible corporate citizens and it is a course of action recommended by industry bodies and the federal government (MMSD, 2002, DITR, 2006).

The legislative requirements for mining in New South Wales are in the *Mining Act 1992*. This act regulates rehabilitation and environmental protection standards in the state, establishing a commitment by mining companies to provide for community relations and liaison during the submission of the Annual Environmental Management Report (McGlynn 2002). The rehabilitation aspects of a Mine Operational Plan (MOP) should be progressively developed and implemented from the Strategic Framework for Mine Closure, which is one of the key influences in the development of the New South Wales legislation, particularly in regards to rehabilitation and community consultation (NSW Minerals Council, 2011).

The *New South Wales Mining Act 1992* requires that mining companies involve stakeholders in the MOP rehabilitation plan, with the plan needing to be revised on an ongoing basis and altered according to changes in the mine operations (McGlynn, 2002). This legislation is probably the most comprehensive in Australia, in terms of its rehabilitation criteria and its requirements on community consultation (not community engagement) (AMEEF, 2002). The legislation mirrors many of the guidelines established in the *Strategic Framework for Mine Closure,* published by the Australia and New Zealand Minerals and Energy Councils and the Minerals Council of Australia. Until the release of the *Western Australian Guidelines for Mine Closure Planning* in 2011, it was the only document in Australia that explicitly acknowledged the adherence to these guidelines and is probably the pacesetter regarding issues surrounding community consultation and involvement (McGlynn, 2002).

The influences on the New South Wales and Western Australian closure planning guidelines come from the *Strategic Framework for Mine Closure* published jointly by the Australia New Zealand Minerals and Energy Council and the Minerals Council of Australia (1996/2000). They are the most comprehensive in the country in terms of their rehabilitation requirements and require some form of community consultation (although notably not engagement) during the planning process for mine closure. They still lack any requirement to minimise the socio-economic effects of mine closure, despite it being recommended as best practice by the ANZMEC framework (ANZMEC/ANZMEC/MCA, 2000).

5.4.4 Rights of companies and land owners

As legislation for mining is State based, the legislative requirements for companies and landowners generally fall under the auspices of State mining legislation, the exception being the *Native Title Act (1993)*, which is Federal legislation (Jackson, 2000). Generally, companies and landowners' rights at closure are entrenched within broader mining legislation and are not necessarily specific to the closure of a mine, instead covering the exploration and operational life of a mine.

With the change of government, the NSW legislation is under a period of transition. Adding further complexity is that exploration and mining are covered by a number of acts including, the *Mining Act (1992),* the *Petroleum (Onshore)Act (1991),* the *Petroleum (Offshore) Act 1982,* the *Environmental Planning and Assessments Act (1979), State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* and *SEPP (Major Developments) 2005* (Environmental Defenders Office, 2011). Accordingly, landowners' rights are not straightforward and this is as true in mine closure, as it is in exploration.

Further, the Minister has some power over restorative work once restoration has occurred. For example, the Minister can require a person who either holds or has held an exploration title to take steps to rehabilitate the land where exploration activities occurred if rehabilitation was a condition of exploration. This is a provision of both the *Mining Act (1992)* and the *Petroleum (Onshore) Act (1991)* (Environmental Defenders Office, 2011). Under the same Acts, the Minister can arrange for restorative work to occur if the company has failed to carry out the rehabilitation and can recover the costs from the exploration titleholder, or whoever held the title but is no longer actively exploring the site (Environmental Defenders Office, 2011).

In NSW the Department of Primary Industries require a Mine Operational Plan. When proposing a rehabilitative plan, companies must consult with all stakeholders, including landowners. The plan must be extremely detailed and include physical and chemical characteristics of mining, how the waste will be processed, the method of land shaping, the soil composition, vegetation and species, maintenance activity requirements, final landform profile and slopes. Further, other aspects of rehabilitation must be addressed including future land use, closure criteria for land, buildings and infrastructure, post mining rural land capability, and the ability to manage and mitigate both pollution and safety risks (NSW Department of Trade and Investment, 2011). The NSW guide suggests that extracts from the *"Strategic Framework for Mine Closure" (2000)* should be used in conjunction with the NSW guide in the closure process to ensure that all relevant aspects of closure have been undertaken (Environmental Defenders Office, 2011). Within the NSW guidelines, there is little reference to landowner rights, though it is clear that a mining company must ensure that land is returned back to an agreed capacity, through the checks and balances put into place by the DPI and the various Acts in NSW governing mining (Department of Trade and Investment, 2011).

In South Australia the government have as at July 2011, updated guidelines for landowners. Titled "*Landowner rights and access arrangements in relation to mineral exploration and mining in South Australia*". The Department of Primary Industries and Resources South Australia (PIRSA) guidelines for landholders have been written to inform landholders of their statutory rights when a mine is operating on or near their land (PIRSA, 2011). In this South Australia is unique, and nationwide information on landowners/holders' rights is difficult to locate unless that individual or group is of indigenous descent, and then the information becomes more transparent.

In general, in South Australia, exploration and mining activities are conducted in accordance with the requirements of appropriate Australian Standards, the South Australian *Mining Act 1971,* Regulations, and site-specific approval requirements (PIRSA, 2011). The rhetoric in the guidelines highlights that each of these documents seeks to create an environment of best-practice operations. For proposed explorations sites and mines, a mining and rehabilitation plan (MARP) must be completed in South Australia. It is a critical document in the mining process and is used to regulate the ongoing operation. Included in the MARP are details of the mines construction, operation and proposed closure. It must include conditions that are part of the agreed outcomes of the leasing arrangement made with the landholder (Mining Act, 1971). Most large mining leases granted will be required to submit a mining and rehabilitation compliance report (MARCR) to PIRSA, which details the operations carried out to date and compliance with the MARP made under lease conditions, within a two-month anniversary of the lease being granted. The standards favour the landowner, and indeed, there are more protections for the landowner concerning rehabilitation standards than under the previous guidelines (PIRSA, 2011). The rights of companies and landowners are entrenched in mining legislation from an exploration and mining operational perspective; however, in regards to closure the law is not as clear. Certainly there are provisions for the rehabilitation of sites and some consideration of economic and social impacts but these latter two are not compulsory and are at the discretion of mining companies and do not take into account the community as a whole (Environmental Defenders Office, 2011).

5.4.5 Indigenous rights

Currently Australia is experiencing a resources boom, which is in part due to the drive for modernization by the two Asian powerhouses of China and India. These countries are driving the demand for iron ore and coal (Roth, 2011). The mineral resources boom in Australia has increased the wealth of mining companies (and to a degree their shareholders), however many indigenous communities have not profited or indeed benefited from the resources sector who at times are leasing traditional land to further explore and extract resources. A recent New York Times article outlined the perception that the mining industry has left out indigenous people, who are already disadvantaged economically and socially with low levels of education, high unemployment rates, low levels of home ownership and problems with alcoholism and disease (Onishi, 2011). The rights of Indigenous peoples at closure are generally covered under rehabilitation clauses in the various mining acts around the country through native title provisions, however they receive no more special rights at closure other than returning the land to its former state (AMEEF, 2002).

However, there is some evidence that Aboriginal Elders are exercising their rights as traditional owners to negotiate deals and involvement with companies. For example, the

Central Land Council (CLC) in the Northern Territory under the auspices of the Aboriginal Land Rights (Northern Territory) Act (1976) has statuary responsibility to carry out agreements that satisfy both traditional owners and all other interested parties (Central Land Council, 2011). Traditional owners have extended leases to a number of oil and gas companies for a period of more than 20 years. The deals ensure the Aboriginal landowners a number of protections, including sacred site protection and environmental protection. Further, it provides traditional owners with some compensation, employment and training (Central Land Council, 2011).

The view of the Central Land Council is that under both the Northern Territory Land Rights Act and the Federal Native Title Act (1993), they have established agreements with a number of mining companies to ensure that there is some compensation, that jobs and training are provided and that other economic development opportunities (such as the development of new businesses, provision of social infrastructure) for their region are realised. Further, they are able to guarantee protection of sacred sites and environmental protection through the *Aboriginal Land Rights (Northern Territory) Act* (Central Land Council, 2011). Where perhaps these Acts fall down is that once traditional owners give consent, they are not able to refuse subsequent mining (Aboriginal Land Rights (Northern Territory) Act 1976). Knowing this and that mining exploration can affect neighbouring communities once exploration licences have been granted can make the decision-making process to grant the licences a difficult one.

The New York Times discusses the potential windfall for Indigenous communities in negotiating deals with mining companies as possibly being hundreds of millions of dollars. The Aboriginal Elders, according to the New York Times, say this compensation from mining (in the North West of Australia) will rescue their communities from dependence on welfare and enable them to become economically independent (Onishi, 2011). The question is, will these communities become dependent of this income, and can it be used to benefit them upon the cessation of mining as part of a broader economic development strategy (Onishi, 2011).

The literature found that Indigenous rights in regards to mine closure in Australia are tied in with broader aspects of mine development and covered under the various state and federal native title acts. According to the Central Land Council, the Northern Territory Aboriginal Land Rights Act (1976) provides indigenous people in the Territory with control over their lands in the case of mining development (and therefore closure) (Central Land Council, 2011). However, as was pointed out by Onishi (2011) indigenous people across the country and even within communities are not achieving equity.

5.4.6 Impact assessments

Just as in many international jurisdictions, there is a requirement in Australia for mining companies to submit Environmental Impact Statements/Assessments (EISs or EIAs). Each state has its own Environmental Protection Authority or similar agency that is responsible for the administration of environmental legislation (Peck, 2005).

The law in this area is complex and in each state is covered by a number of statutes and departments. For instance, In South Australia the two main Acts covering EIA are the *Development Act 1993* and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (PIRSA, 2011). The *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* requires that a *Controlled Action* must be assessed before it can be approved. *Controlled Actions* are defined as actions that are likely to have a significant impact on a matter of national environmental significance (MNES) (Australian Government, 2011). This is possibly simple enough, however when coupled with the South Australian requirements for the mining industry, which is predominantly influenced by the *Mining Act 1971 (SA)*, and which is then also regulated by Commonwealth legislation, conducting an EIS and meeting all the requirements of the variety of departments becomes a lengthy process (Environmental Services Commission, 2011).

In July 2011 in Western Australia, "*Guidelines for Preparing Closure Plans June 2011*" were introduced. Significantly, the Office of Environmental Protection Authority (OEPA) will no longer assess mine closure as part of its EIA process "...pursuant to Part IV of the Environmental Protection Act ...", the caveat being unless the OPEA discern that there is a significant environmental risk (McQueen and Somerford, 2011).

Within Australia, there appears to be no requirement for Social Impact Assessments (SIAs) to be conducted as part of mine closure planning and certainly, no legislative requirement (Trezise, 2004). Some SIAs are undertaken in Australia for specific projects, as SIAs were conducted for the Ranger Uranium Mine (NT). However, there is no mandatory requirement to conduct them; more often than not, it is a broad recommendation that normally is conducted as part of an initial Environmental Impact Assessment (ERA, 2009).

The Queensland State Government published a document in 2008, "*Sustainable Resource Communities Policy: Social impact assessment in the mining and petroleum industries*". This document suggested mining companies should conduct social impact assessments as part of the broader Environmental Impact Assessments. The Government would conduct EIAs in conjunction with mining companies to provide them with a range of information about the social impact of mining projects on communities, information that would then be used for development, funding, service delivery and infrastructure decisions (Department of

Tourism, Regional Development and Industry, 2008). Queensland now requires Social Impact Assessments for all resource developments that require Environmental Impact Assessments under either the State's *Environmental Protection Act (1994)* or the *State Development and Public Works Organisation Act (1971)* (Department of Employment, Economic Development and Innovation, 2011). This requirement still does not cover closure and it is not an ongoing process as recommended in the ICMM Toolkit for closure (ICMM, 2008). It represents a process of cooperation between governments and the mining industry in recognising the socio-economic impacts of mining, albeit from an operational perspective.

Federally, in a handbook published in 2006 for the mining industry on best practice mine closure and completion by the former Department of Industry Tourism and Resources, it was recommended that both Environmental Impact Assessments and Social Impact Assessments be conducted as separate documents to provide information on the baseline conditions, in the community. These Impact Statements would be undertaken at the pre-production stage of mining, that is before mining commenced at the site, and incorporated into the mine closure plan. This was never meant to be enacted as legislation, but was established as a guideline for the mining industry (DITR, 2006).

At issue with these guidelines and the legislative requirements for Economic and Social Impact Assessments is that any assessment conducted at the commencement of a mine's life, does not take into account unexpected occurrences and activity during its life (ICMM, 2008). The concept of mine closure plans being living documents (ICMM, 2008) should possibly be extended to the environmental impact statements. Social impact statements should also be living documents as part of the mine closure planning process, though a significantly less complex and uniform process is required in each state, if it were not conducted under the auspices of national legislation.

5.4.7 Financial assurance

In Australia despite the use of financial assurances being a common tool used by regulators to attempt to recover the costs of unexpected mine closures, mining companies have not always been able to meet these costs, as demonstrated in Australia in cases such as the Rum Jungle mine in the Northern Territory (Appendix A, p. 14). There are a number of different financial assurance options available to mining companies, which have been discussed in previous chapters, however it is seen by mining companies as an onerous impost and there have been concerns raised about the number of financial assurance instruments used by governments and the contingent liability costs to companies (Fleury and Parsons, 2006).

Rehabilitation in the Northern Territory was not initially enshrined in legislation, but was outlined by a series of guidelines that relied on company's goodwill in adhering to them. The

Northern Territory government has waived or reduced adherence to mining bonds to enable developments to proceed, according to the Environment Centre of the Northern Territory (2003).

The Mt Todd gold mine as an example of the failure of mining legislation in the Northern Territory is discussed in (Appendix A, p. 22). This mine began operation in 1994, new owners took over in 1996, operations were suspended in 1997 and then re-opened in 1999 (Wakeham and Blair 2003). The company associated with the mine closed down in 2000, but no rehabilitation had been required by the government to begin operating, other than the initial rehabilitation bond paid by the first mining company to commence operations in 1994. The Northern Territory government was left with only the initial $900,000 rehabilitation bond. The estimated cost of cleaning the site, however, is $20 million dollars and the Northern Territory community will be forced to pay the remaining $19 million cost, or accept the environmental problems associated with the site, which include acid drainage (Wakeham and Blair 2003).

In 2001 the Northern Territory government replaced the *Mine Management Act* and the *Uranium Mining (Environmental Control) Act* with the *Mining Management Act 2002* (Henderson 2001). The Department of Business, Industry and Resource Development is responsible for the administration of the new act, with the Minister being responsible for granting authorisation to carry out mining activities (Henderson 2001). The new act also requires the lodgement of a security bond to cover costs associated with mine closure. The bonds cover the securing of an operator's obligation to comply with the Act or an Authorisation Payment of costs and expenses in relation to an action taken by the Minister to complete rehabilitation of a mining site or to prevent, minimise or rectify environmental harm on a mining site (Henderson 2001).

The passing of the Tasmanian *Mineral Resources Development Act (1995)* was designed to provide a modern approach to mine development and management in the state and to protect the environment from the excesses associated with mining under the previous Act (Pemberton and Munro, 2004). In the past, many mines in Tasmania have been abandoned without any rehabilitation of the mined land occurring, with the government having little recourse to compensation, as rehabilitation bonds were not required under the previous Act (Koehnken, 1997).

In order to counter the problems associated with the lack of rehabilitation bonds, the Tasmanian Government charged Mineral Resources Tasmania with the authority to rehabilitate any lands affected by former mining and exploration activities under the Rehabilitation of mining lands trust fund. The Tasmanian Government worked in conjunction with the mining and quarrying industries in Tasmania to establish the Trust Fund under the Act, agreeing to increase mining royalties to the State by 1%, the proceeds of which established the fund (Department of Primary Industries, Parks, Water and Environment, 2010). Furthermore, the Act allows the Government to rehabilitate a mining site using money from security funds that have been forfeited by mining companies that may have prematurely closed a mine (Pemberton and Munro, 2004). In Tasmania, the history of mining was such that development was often undertaken at the expense of environmental controls and mine rehabilitation was all but ignored as a prerequisite for mining (Koehnken, 1997). In some cases this lack of environmental controls has led to former mine sites in the state becoming tourist attractions with the most notable being the Mount Lyell mine site near Queenstown (Appendix A, p. 45). However, the drawcard for tourists has come at a significant cost to the surrounding ecosystem and the government in terms of the financial costs associated with clean up (Stauber, 2000).

In Queensland the aim of the Environmental Protection Act (1994), which sets financial assurances for mine rehabilitation in that state, is to determine how much financial risk exists to government through the progressive rehabilitation process and how it is best to limit government exposure, whilst at the same time ensuring that it is not cost prohibitive to industry (Wilson 2004). This action is undertaken under s. 364 of the *Environmental Protection Act* with the department required to consider a number of factors that could affect the state should the operator fail to finish a mine rehabilitation program. These include: the degree of risk that harm will be caused to the environment; environmental record of the mining company, the likelihood that action will be needed to restore a site and/or protect the environment (Department of Environment and Resource Management, 2011). In addition to the requirement for financial assurance under the *Environmental Protection Act (1994)*, Queensland Mines and Energy may also request a security through the *Mineral Resources Act (1989)* as a further security against unplanned or unexpected mine closure (Department of Environment and Resource Management, 2011).

As in international legislation, financial assurances or rehabilitation bonds is a difficult issue in Australia and one that both mining companies and governments to some extent disagree on (Jones, 2006). There is a school of thought within the mining industry (both in Australia and overseas) that financial assurances should not be required from every company, particularly those that have a good environmental management record (Jones, 2006). It is however doubtful that any government would allow this to occur as they have a requirement to stakeholders to ensure them that should a mining operation fail for whatever reason there will be sufficient funds to cover any restoration costs and damage caused to the environment (ICMM, 2005). The poor closure practice case studies highlighted in Appendix A provide a good example of why governments will continue to pursue some form of assurance system. , the system is still evolving with no best practice system yet to emerge (Jones, 2006).

5.4.8 General requirements

The general requirements of the legislation deals with the process of mine closure, which is that legislation on mine rehabilitation and closure is currently not addressed at a federal level, instead it is addressed state by state. The general requirements of mine legislation are for some rehabilitation and or restoration of the environment in which the mining was undertaken. In WA, there is now discourse about stakeholder and community engagement and addressing the economic and social impact of mine closure, though those issues have not yet been addressed by every state through the legislative process.

The legislation in Australia is regarded as amongst the most comprehensive in the world in relation to the rehabilitation process (MMSD 2002). Nevertheless, the legislation deals mainly with environmental issues surrounding mine closure, with little information about the social and economic needs of mining communities once mining has ceased. This is left to the goodwill of mining company’s and local communities to deal with, but not all companies, or communities for that matter, have the capacity to deal with the social and economic issues surrounding mine closure.

The Minerals Mining and Sustainable Development (MMSD) report included a set of guidelines for mine closure, part of which involves companies preparing social and economic impact assessment statements, similar to the environmental impact assessments currently required by the various state and territory legislative regimes around Australia. The only state in Australia that has adopted these guidelines is New South Wales, but the MMSD report suggests that for mining to become sustainable in the future and to shed its poor image in the wider community, the recommendations found in the report will need to become standard practice in both the industry and government.

As discussed in the international section of the chapter, engagement and consultation are often used interchangeably when they are two distinct terms (Solomon, 2000). The Queensland government appears to be recognising this by incorporating more community involvement in the closure process. The mining industry supports this, notably the Queensland Resources Council, who believes that this what has been missing in Queensland policy (Queensland Resources Council, 2001). However, as with the rest of Australia, this is still mainly discussed in terms of mining operations, rather than a focus on closure outcomes an issue where Australia and those countries reviewed for the international section seem to have commonality (Solomon, 2007).

5.4.9 Process of mine closure

The process of mine closure varies from State to State. There is no enacted mine closure legislation in Australia so much of what is discussed below is in relation to closing a mine as it stands under current legislation, which is mostly related to the rehabilitation and environmental aspect of the mine process.

The Western Australian *Mining Act (1978)* is regulated by the Department of Mines and Petroleum with the main aim of the act being to prevent adverse environmental impacts at a mine site. The granting of the lease provides for the rehabilitation and environmental protection of areas that mining operations disturb (Johnson and Wright, 2003).

The other major act in Western Australia that regulates the mine closure process is the *Environmental Protection Act 1986*. The aim of the EPA is to prevent and control any pollution that arises from the mining process. The EPA does apply a strictly enforceable approach to environmental considerations at a mine site (Johnson and Wright, 2003). The Act attempts to foster a more unified approach from both regulators and mining companies to environmental processes at a mine site. To some extent, the act is self-regulatory with the Department of Environment seeking greater commitment from mining companies to their environmental responsibilities (Environmental Protection Act, 1986).

The introduction of the *Guidelines for Preparing Mine Closure Plans* now make it compulsory for all mine sites in Western Australia to have a planning process in place to enable the mine site to meet the Western Australian regulatory requirements (McQueen and Somerford, 2011). The new guidelines enforce as a condition of tenement the development of a mine closure plan that will guide the closure process for a site under the conditions of the *Mining Act (1978).* The guidelines outline a major change to the closure process in the state, as the Environmental Protection Authority no longer is required to assess mine closure as part of Part IV of the *EPA Act (1986)*, unless it believes there is a significant risk to the environment from a mining project (McQueen and Somerford, 2011). If it is deemed that there is a high risk then the Environmental Protection Authority and the Department of Mines and Petroleum (McQueen and Somerford, 2011) will assess the closure plan jointly

The *Mineral Resources (Sustainable Development) Act (1990)* is the act responsible for covering mining operations in the state of Victoria. The act requires mining licensees to submit a work plan that must include a rehabilitation plan (Department of Primary Industries 2002). The MRD act requires rehabilitation to be progressive and also takes into account issues that may affect the land, including the surrounding environment, any special circumstances of the land including a need to stabilise the land and the desirability of returning the land to agricultural use and to a state that existed prior to mining (Department of Primary Industries, 2010).

The Victorian legislation requires that rehabilitation is planned from the outset of the mining operation and should be an ongoing process. The legislation requires two parts to the rehabilitation planning process. The first part of the process involves designing a final concept plan that outlines the general end-uses of the site and what general features the site will have once mining has ceased (Department of Primary Industries 2002). The second part of the process involves the progressive plan; the aim of this is to provide more detail regarding rehabilitation, including the type of rehabilitation and the period. The progressive plan can cover the entire life of the mining operation, or a shorter period, but it must specify completion criteria during the rehabilitation (e.g. what type of end-use, the type of vegetation, whether it will be returned to agricultural use (if on pastoral land)) (Department of Primary Industry 2002). In this area of closure requirements, the Victorian legislation is amongst the best in the country, with its requirements for progressive rehabilitation recognised by the Minerals Council of Australia as a requirement for world's best closure practice (MMSD 2002).

The Victorian legislation like its New South Wales counterpart is quite comprehensive concerning the environmental requirements of the mine site. The legislation also adopts world's best practice with the detailed requirements for progressive rehabilitation and continuous monitoring of the site (ICMM, 2008). The legislation fails to meet world's best practice in its lack of detail concerning community involvement in the closure process and hence any social considerations, a common problem with legislative requirements in this country (Solomon, 2007). As with New South Wales, many of Victoria's mines are located close to large population centres, making closure an important consideration for local communities. In 1996, Sassoon argued that the emphasis for the management of the environmental aspects of mine closure and decommissioning has shifted towards the idea of "planning for closure". Some fifteen years later, in Australia, there is evidence of mine closure planning occurring in industry, but it is under the auspices of good corporate citizenship rather than enacted legislation. While WA has planning guidelines for mine closure, other States have been slow to move. Notably, in the context of any discussion of mine closure outside the mining industry, there is little written on issues not related to the environment (ANZMEC/ANZMEC/MCA, 2000).

5.4.10 Stakeholder and community engagement

Stakeholder and community engagement in the mine closure process is traditionally not an area that legislators have regulated with any clarity in Australia. As much of the legislation on mine closure in Australia was focussed on the environmental aspects of mine site rehabilitation, the involvement of communities has tended to be limited to public displays on mine rehabilitation plans, with any engagement left to the discretion of the mine company itself (Jackson, 2000). Change in this process is occurring however, with signs that regulators are starting to incorporate community engagement requirements into a broader mine closure program that examines economic and social closure impacts in addition to the environmental outcomes.

In Australia, like other parts of the world, stakeholder and community engagement are discussed widely in the mining industry, but there is little in the way of legislative requirements that oblige mining companies to engage with stakeholders as part of the closure process. The legislative process also uses the term community consultation, whereas mining industry documents such as the ICMM (2008) toolkit and the MMSD (2002) report refer to the term engagement when discussing communication between mining companies and the stakeholders in a mining project.

A requirement of the Mine Operations Plan in NSW is to involve stakeholders in the development of plans and outcomes. The NSW legislation also requires that mining companies adhere to the guidelines in the *Strategic Framework for Mine Closure,* making the NSW legislation quite comprehensive in the requirement for community involvement (McGlynn 2002). These stakeholders include landholders, community and other agencies that have assisted in the preparation of proposed rehabilitation outcomes (McGlynn 2002).As well as requiring community involvement in the mining operations phase, the legislation in NSW establishes a commitment by mining companies to provide for community relations and liaison during the submission of the Annual Environmental Management Report (McGlynn 2002). The following is an outline of what is required by companies in terms of community consultation during the Mine Operations Plan; the company needs to identify and involve stakeholders in the rehabilitation planning process, agreed land uses and outcomes that are achieved through the undertaking of an Environmental Impact Statement and community consultation (NSW Department of Trade and Investment, 2011).

The legislation mirrors many of the guidelines established in the *Strategic Framework for Mine Closure*, published by the Australia and New Zealand Minerals and Energy Councils and the Minerals Council of Australia. It is the only legislation in Australia that explicitly acknowledges the adherence to these guidelines (AMEEF, 2002). The need for community consultation and involvement is, however, probably greater in New South Wales, due to the number of mines operating in close proximity to urban areas. In South Australia, the *Mining Act 1971* actually refers to the communication process between mining companies and stakeholders in terms of the need to engage, rather than just consult. The Act requires that mining proposals and mining and rehabilitation plans (MARP) must deliver long-term lasting benefits to the community, it must be sustainable and the community need to be engaged in the mining proposal process (Primary Industries and Resources SA, 2009). The benefit of the project is derived by assessing the positive economic, social and environmental effects against the negative social, economic, environmental, health and safety and final land use issues. This outcome will then determine the risks associated with a project and the need for the lease terms to be more prescriptive and stringent (Primary Industries and Resources SA, 2009). This process includes identifying relevant stakeholders in a mining project in South Australia by using the guidelines laid out by the DITR report in 2006. The Act suggests that stakeholders in a mining project are wide ranging and lists a number of potential stakeholders including for example, owners of nearby properties, local communities, Indigenous groups, local councils and state government agencies, the media, utility owners, state and federal politicians and local contractors (SA Chamber of Mines and Energy, 2009).

The South Australian regulatory regime requires mining companies to demonstrate evidence of their engagement with local communities with a mining project and to show a summary of responses to any issues raised during the engagement process and what steps the company will take to address these concerns (Primary Industries and Resources SA, 2009). The South Australian Resources Industry have developed a Code of Practice for stakeholder and community engagement that they recommend for use by mining companies undertaking projects in South Australia in order to assist them in meeting their regulatory requirements for stakeholder engagement in the mine approval process in that state (SA Chamber of Mines and Energy, 2009). There is however, no statutory requirement in South Australia for mining companies to engage with communities in the review process for mining and rehabilitation programs (Primary Industries and Resources SA, 2009) and therefore none for the mine closure process. The department that oversees the mining process in South Australia, the Department of Primary Industries and Resources, recommends that mining companies engage with local communities throughout the mining process in order to keep them informed and address any concerns that communities may have about the mine project and rehabilitation process (Primary Industries and Resources SA, 2009).

The rhetoric of community consultation is changing within the mining industry towards a style of communication that attempts to engage with local communities rather than just consulting with them, particularly in the closure process (DITR, 2006; MMSD, 2002). However the regulatory process in this area lags behind industry self regulating standards despite attempts as demonstrated in this section by states such as New South Wales and South Australia to ensure that community consultation and engagement become statutory requirements under mine and mine related acts. There is still a way to go before mine closure and the engagement process is best practice from a regulatory viewpoint.

5.4.11 Requirements for environmental safeguards and rehabilitation

Requirements for environmental safeguards and rehabilitation have been an area where there is a degree of consistency across the Australian jurisdictions reviewed for this chapter. The Australian regulations on rehabilitation requirements are amongst the most comprehensive in the world with stringent requirements on beneficial outcomes that return former mined lands to a state that existed prior to mining (Garner, 2004; MMSD; 2002). As with the international review, there are guidelines published by industry to assist mining companies in dealing with the regulatory environment on mine rehabilitation and closure planning, including documents published by the Minerals Council of Australia and the Australia New Zealand Minerals and Energy Council.

The review of the literature for this chapter found that as with international regulatory bodies, the Australian regulatory authorities publish guidelines on rehabilitation and meeting legislated environmental standards that are designed to assist companies with the regulatory approvals process.

Rehabilitation in New South Wales must be progressive and must be part of mine planning and operation. The act states that rehabilitation of sites must ensure there are stable and permanent landforms inclusive of voids, pits and water-bodies, on the proviso that they are part of the agreed outcome. The site must also be suitable for agreed land use post-mining and where possible be compatible with the fabric of the land and the land use requirements. The land must also be sustainable and have landforms, soil, water and ecosystems that require no greater maintenance than the existing and surrounding land (McGlynn, 2002). Further, there are requirements that the waste substances are securely and safely contained so as not to present a hazard to humans, stock or native flora and fauna and there must be minimal environmental impact outside the site, or disturbed area (Mineral Resources, NSW 2004).

The legislative requirements surrounding mine rehabilitation in Tasmania are concerned only with the environmental impacts of mining and as with all legislation on this issue in Australia do not address actual mine closure and the economic and social consequences that follow the rehabilitation and closure of a mine. The Tasmanian requirements for a rehabilitated mine site are similar to the legislative requirements for rehabilitation in other Australian jurisdictions. These requirements include as examples: removing the risks to health and safety; stabilising the site and reducing or removing the impact of erosion; increasing bio-diversity of species near the mine; remove contaminated areas; remove any features limiting the beneficial use of the site; improving the visual amenity of the site (Mineral Resources Tasmania, 2009). The act also specifies that the rehabilitation must take into account any special characteristics of the land and surrounding environment so that the land is returned to a state that is as close as reasonably possible to its former state before the mining lease was granted (Tasmania Legislation Online, 2007).

Tasmania is a good example of a state that has come a long way on its attempts to regulate the mining sector. Like many parts of Australia, the state has an important mining heritage and the industry has been a key contributor to the development of the state, however this development has often been at the cost of both the environment and the long-term welfare of local mining communities. Legislative changes to the State's mining laws have attempted to redress problems associated with mine rehabilitation and closure in the past, by requiring detailed rehabilitation and closure plans and placing more emphasis on sustainable development by ensuring that company's meet numerous environmental regulations (Minerals Resources Tasmania, 2009).

Rehabilitation and closure planning are areas of mine closure where regulatory authorities are adopting best practice and continuously revising various pieces of mining and mine related legislation to reflect changes in both mining practices and community standards (Garcia, 2008). In general, the requirements for mine rehabilitation across the country are uniform, however as the review of the literature has found there is still room for improvement notably in the area of community and stakeholder engagement and indeed in the role of governments in the process.

5.4.12 Plans for mine closure

Mine closure and rehabilitation planning has for some time been recognised as one of the most important components of the mine closure process. In 1981, Hegadoren and O'Day undertook a study of the mine closure process at a mine in Ontario, Canada with their findings indicating that mine closure and rehabilitation planning should commence during the mine-planning phase and should be ongoing throughout the life of the mine, involving mining companies, governments and stakeholders (Hegadoren and O'Day, 1981). Their approach at the time was unusual as standard practice had been to leave rehabilitation and closure planning until the last few years of mining.

In the opening pages of the guidelines, the Department of Mines and Petroleum state that mine closure planning is a key part of the mine process and that a plan should provide detailed information that covers the life of a mine and takes into account the differing stages of a mine project (Department of Mines and Petroleum, 2011). Stakeholder consultation should be a key component of the mine closure and rehabilitation planning process

(Department of Mines and Petroleum, 2011). Effective from July 1 2011, the Department of Mines and Petroleum (DMP) in Western Australia requires that all applications made under the *Mining Act 1978 (WA)* be submitted with a Mine Closure Plan (Department of Mines and Petroleum, 2011). the document, which requires Mine Closure Plans accompany all mining proposals is titled "*Guidelines for Preparing Closure Plans June 2011*" and is quasi-legislation as it refers to the requirements of other legislation, for example the *Mining Act 1978 (WA)*, but is not legislation, however the requirements will be enforced by the Department of Mines and Petroleum.

Notably, the Mine Closure Plan will be enforced as a condition of tenement and further the guidelines are retrospective, as mining companies which have an approved Mining Proposal and/ or Notice of Intent under the *Mining Act 1978 (WA)* prior to July 1 2011, will be obliged to review their Mine Closure Plans (Department of Mines and Petroleum, 2011). There is a June 30, 2014 deadline for these mining operations to meet compliance requirements of the "*Guidelines for Preparing Closure Plans June 2011*" (Department of Mines and Petroleum, 2011). Mine Closure Plans for existing sites will also be introduced by the DMP in the future. However, as there are approximately 270 mines in Western Australia (Department of Mines and Petroleum, 2011), the scheduling of closure plans will be dependent on the how close a project is to closure, though each tenement will be advised of the requirement by mid to end 2011 (Department of Mines and Petroleum, 2011).

In Western Australia under the *Mining Act (1978)* regulators also require an Environmental Impact Assessment (EIA) before mining can commence, with some public consultation also required (Johnson and Wright 2003). Part of the requirement of the environmental guidelines in the Act is the requirement for a bond in case environmental conditions are not met. The Act also requires lessees to be liable for environmental conditions even if they surrender a lease.

The *Mining Act* is regulated by the Department of Mines and Petroleum with the main aim of the act being to prevent adverse environmental impacts at a mine site. The granting of the lease provided for the rehabilitation and environmental protection of areas that mining operations disturbed (Johnson and Wright, 2003). Jackson (1991), Khanna (1999), Hall (2002) and Johnson and Wright (2003) all review or analyse aspects of these acts or similar acts elsewhere in the country. The authors generally all realised shortcomings within the act, stating that mine approvals in the past paid little to attention to the issue of closure, with closure plans generally not being undertaken until just before the cessation of mining (Khanna, 1999; Hall, 2002; Johnson and Wright, 2003).

The introduction of the Mine Closure Planning Guidelines in July of 2011 were designed to reduce this problem by ensuring that a plan is in place from the initial mine planning phase and ensuring that mines are closed in an ecologically sustainable way to meet regulatory requirements (McQueen and Somerford, 2011). The Guidelines for Preparing Mine Closure Plans also aim to ensure that post-mining land uses are acceptable and that there are no unacceptable liability risks to the state of Western Australia (Department of Mines and Petroleum, 2011). The guidelines aim to ensure that mine closure planning is continuous throughout the life of a mine and that changes are reflected in the plan throughout the life of the mine. Although the WA guidelines are impressive, they fall short is that they focus principally on the environmental or ecological aspects of mine closure planning and rehabilitation and simply encourage mining companies to consider the socio-economic impacts of mine closure on local communities. In addition, it is not a statutory requirement of the guidelines that mining companies undertake social impact assessments (Department of Mines and Petroleum, 2011).

There has been criticism of the new guidelines, with claims that it adds a new level of complexity to the mine approval process and increased costs to mining companies due to the need to pay consultants to complete the mine closure plans, along with the need to continuously update the plans (McQueen and Somerford, 2011). The interesting aspect of the criticism is that industry body documents (ANZMEC/MCA (2000); AMEEF (2003); ICMM (2008)) all discuss the need for mine closure planning to begin either during the mine planning phase, or even as early as the feasibility study stage, indicating that over the long term this is actually proven to be the most cost-effective approach.

5.4.13 Waste, water and pollution

In Australia, waste, water and pollution are regulated by state legislation. Federally, the Department of Sustainability, Environment, Water, Population and Communities is responsible for the environment and accordingly is able to override a state or territory assessment where the matter is of national significance (Department of the Environment, Water, Heritage and the Arts, 2009).

The Western Australia Mine Closure Plan must provide a summary of the best data available, including soil and waste material characterisation, as this is considered critical to the success of progressive rehabilitation of a mine site. This progressive approach is expected to commence at the commencement of exploration and continue through the life of the mine (McQueen and Somerford, 2011). Further, existing sites and or sites with approved commitments that have committed to closure outcomes, for example waste dump heights, are encouraged to contact the DMP environmental officers and work with them to achieve best practice outcomes (Department of Mines and Petroleum, 2011).

The characterisation of soil and waste allows for the separation and placement of materials at the mine site so that successful revegetation can occur and long-term pollution can be minimised. The view is that if this on an ongoing basis, vegetative cover will be sustainable, which is the principal desired outcome of all mine rehabilitation (Department of Mines and Petroleum, 2011). The Mine closure Plan must also provide a summary of best available data on local water resources including type, hydrology, quality, quantity and environmental value (such as what are the ecological and beneficial uses for the water). In addition, it should detail all anticipated adverse effects on surface and groundwater quality and provide details of design and maintenance plans for surface water management structures (Department of Mines and Petroleum, 2011).

The West Australian guidelines cite that there is limited reliability of water quality predictions from EIAs for hark rock mine proposals and it was concluded that the impact of mining on water quality is in most instances underestimated in the EIA process. The conclusion drawn was that geochemical characterisations should be part of the EIA in order to ensure more accurate predictions (Department of Mines and Petroleum, 2011).

Part V of the *Environmental Protection Act 1986* of Western Australia regulates pollution from mine sites. The Act has the power to issue a closure notice to a decommissioned mine site that requires ongoing monitoring, reporting and active management after a mine licence has ceased to have effect. This too has been written into the WA Mine Closure Guidelines and it ensures a comprehensive approach to waste, water and pollution is adopted by mining companies is adopted, certainly at the time the Mine Closure Plan is submitted, if not during the life of the mine (Environmental Protection Act 1986, 2011).

Mining activities in New South Wales require Environment Protection Licences for air pollution, water pollution, noise pollution, blasting and waste management. One of the acts where this is undertaken is the Protection of the Environment Operations Act 1997 (administered by the NSW Office of Environment & Heritage). The main objectives of the POEO Act are to protect, restore and enhance the quality of the environment in NSW through pollution prevention and cleaner production, the reduction of harmful discharges and wastes, the reduction in the use of materials and improved re-use, recovery and recycling of materials (NSW Minerals Council, 2011).

The Mine Operations Plan required under the New South Wales legislative guidelines for mining state that in regards to the commencement of mining, the MOP as an example must demonstrate the extent of all mining and mineral processing, where waste is to be placed, ore stockpiled, water management systems, infrastructure development and rehabilitation processes to be undertaken (NSW Department of Trade and Investment, 2011). At the end of the Mine Operation Plan period (which can last for a period of seven years), the mining company must show for example, the annual sequence of mining over the term of the MOP, where waste emplacements are located, ore is stockpiled, hazardous materials storage areas, minerals processing plants and the where the containment areas for contaminated water are to be located (NSW Department of Trade and Investment, 2011). In addition to this, the MOP must meet the outcome objectives of any Environmental Impact Assessments undertaken by the mining company as part of the mine approval process (Mineral Resources NSW, 2004).

The New South Wales legislation also requires that mining companies submit Annual Environmental Reports as part of their ongoing licence to operate which are used to undertake any changes required to the MOP and provides government agencies such as the Department of Primary Industries – Mineral Resources who oversee the Act in the state (Mineral Resources NSW, 2004). The Department of Primary Industries use the two documents as a way of assessing a company's environmental performance and to assist in the calculation of financial assurances for the site (NSW Department of Trade and Investment, 2011).

There is little dispute regarding the stringent environmental processes for mine closure both in Australia and internationally and the review of the literature in this area has found that the processes for environmental management are sound and updated quite regularly (DITR, 2006). In Australia, Tasmania and the Northern Territory both previously known for a lack of stringent requirements when it comes to mining waste and water issues have amended or introduced new mining and mine related legislation designed to regulate more effectively the minerals industry in their jurisdictions (Koehnken, 1997; Central Land Council, 2011). However, this will not prevent communities from attempting to prevent mine projects from occurring, particularly as the resources boom continues and mining companies look at exploring for new ore bodies, increasing the potential opportunity costs as tradeoffs between agricultural/pastoral and mining uses continues (Environmental Defenders Office, 2011).

5.4.14 Outcomes for requirements of closed mines

From an Australian perspective, the review of the literature found that, as with the international review of regulatory outcomes, requirements for Australian jurisdictions are quite generic in that a mine site should be returned as much as possible to its pre-mined state (Jackson, 2000). There is a need for a more consistent approach to mine closure and relinquishment as one of the main issues to come out of the literature in terms of outcomes after mining has ceased, is the monitoring period required for mining companies to supervise a site, after which the site is returned to the Crown, and used for public access (Jones, 2006). The Victorian Mineral Resources (Sustainable Development) Act (1990) requires that a rehabilitation plan must have as its goal the ability to return mined lands to a state as close as possible to that, which existed prior to mining (Mineral Resources (Sustainable Development) Act 1990). The Victorian legislation requires that rehabilitated sites be regularly monitored, with the actual outcome compared with the completion criteria established in the Rehabilitation plan. The rehabilitation criteria also requires that the site should be visually appealing once mining has ceased, and requires that landscaping take into account a ‘critical view’ of the final form of the mine site. The legislation recommends that mine pit slopes in the rehabilitated sites be neither too steep nor too long (Department of Primary Industries 2002).

As an example in the case of mine voids, the Department of Primary Industries in Victoria requires that pit slopes and walls are structurally stable and that any overburden is stable, has long-term stability and has been revegetated. All pit walls and floors need to have been rehabilitated progressively during the life of the mine project. If the open cut sits below the watertable, then the regional water authorities and the Department of Sustainability and Environment will also need to become involved to assess risks to waterways and groundwater sources (Department of Primary Industries, 2002). The Victorian legislation requires that once a mine is closed, the public should have limited access to the site with safety and security of the public a high priority including ensuring that any water bodies left after mining pose minimal risk to the public (Department of Primary Industries, 2003). However, use of these sites is hampered by a stringent requirement for the water to have a pH level of 5.0 or above before, regulatory authorities will allow them to be used for recreational purposes (World Health Organisation, 2003). This requirement could be construed as being too strict, particularly when some countries overseas, notably Germany allow swimming in mine void lakes with a pH of 3.0 (World Health Organisation, 2003).

In Queensland rehabilitation is undertaken under the Environmental Protection Act (1994), the key objective of rehabilitation is to reduce disturbance caused by mining and minimise potential for environmental harm in the long term (Department of Environment and Resource Management, 2011). Mining projects in Queensland require an Environmental Management Plan that states the objectives for progressive and completed rehabilitation, along with completion criteria that determine how the outcomes of the rehabilitation plan met the objectives (Environmental Protection Act, 1994). The legislation requires mining companies to adopt both general and site-specific rehabilitation outcomes, which are dependent on the type of land use that existed at a site prior to mining (Department of

Environment and Resources, 2011). In general, all mine closure outcomes in Queensland must ensure that land is useful, safe, stable and non-polluting, meets objectives set out in the Environmental Management Plan, assesses residual risk and makes provisions for monitoring after rehabilitation (Rodgerson, 2006). The types of land use outcomes that the Queensland legislation allows for need to take into account the previous use of the land and the views of surrounding landholders (Queensland Mining Council, 2001). Land can be used for cropping, grazing, forestry, or be returned to native vegetation. In an unusual outcome for the legislation, the Queensland Department of Environment and Resources admit that it is difficult under the current mining provisions in Queensland to enforce future land use constraints for rehabilitated land after a mining lease has been relinquished. Post mining land use may require a ‘statutory restraint’ to prevent or limit future inappropriate land use of rehabilitated land (Department of Environment and Resources, 2011).

The outcomes also need to consider a number of other factors, examples of which include safety and health issues, water management and the need to control runoff into surrounding water supplies, socio-economic impacts if the mining occurred on agricultural land and the post closure outcomes identify a return to such a use (Environmental Protection Act, 1994). Mining companies are required to monitor a mine site post closure, however the time frame is not clear and the mining company is required to provide a risk assessment and report detailing how it has met its closure objectives, at which point an independent assessment will be appointed by the regulator. If it provides evidence of a successful rehabilitation program, the mine lease will be surrendered to the state and the state then has responsibility for future liabilities (Department of Environment and Resources, 2011).

Under the EPA Act (1994) in Queensland, the *Guideline Mining Rehabilitation Requirements for Mining Projects* published by the Department of Environment and Resources Management are designed to assist companies in meeting outcomes in their mine rehabilitation plans. These are not guidelines specific to mine closure, but refer to final rehabilitation requirements in conjunction with progressive rehabilitation requirements. These guidelines reference the ICMM Toolkit (2008) and discuss social and economic issues arising from mining. Even so, there is more emphasis on the environment in this regard than social and economic issues such as employment loss, closure of mine related businesses and slowdown in other local businesses, which often occur in mining communities post closure and can often have detrimental effects on communities and are part of the closure outcomes (Laurence, 2002). Indeed, the policy framework referenced in the guidelines is taken from the Federal Governments National Strategy for Ecologically Sustainable Development and the ANZMEC Guidelines, which are industry guidelines and not legislation (Department of Environment and Resources Management, 2011).

These guidelines are perhaps a precursor to best practice industry guidelines, incorporating stakeholders, social and economic issues such as job growth and decline, housing growth, inflationary issues in conjunction with ecological issues. This is a shift in direction, however while the guidelines take a holistic approach they do not address the economic and social outcomes required for a mine closure to be successful. The closure outcomes discussed are broadly representative of the closure outcomes across the country in that they are heading toward best practice closure outcomes for the environment and therefore best practice legislation for the environment at this time in Australia. Where the legislation falls short is in areas currently covered by Industry Guidelines and a lack of detail on best practice closure outcomes that take into account the economic and social needs of the community. To provide some certainty in the mine closure outcomes process for mining communities, State governments need to ensure that other possibilities for mine closure outcomes are considered including mine tourism possibilities, however this should be considered at the start of the mine planning (Laurence, 2002).

5.4.15 Effectiveness versus adequacy of legislation

Restoration and rehabilitation requirements have found their way into mining legislation over the last 30 years and community expectations have forced some mining companies to recognise that they have a responsibility to the communities in which they operate. Even so, the legislation, particularly regarding mine void closure, is lacking in detail and not all mining companies feel the weight of community expectations (Khanna, 2000). Biggs (2003) believes that regulators will increasingly need to respond better to the closure issues, making an example of poor performers in the industry and rewarding good performers.

It has also been suggested that perhaps there should be an overriding legal entity that is responsible for mine voids once mining has ceased and that will also take responsibility for any issues arising after closure if a more effective approach to mine closure is to be realised (Biggs, 2002). This of course raises the question of the period that would be required to monitor mine closure and what role, if any, a regulator would play. It also raises the question of who would sit on such a body – would it need to be made up of industry, government and community members – in order to ensure that such a body had broad representation (Jackson, 2000). There is a question as to how enforceable guidelines or regulations from such a body would be? Would the body have the power of the Industrial Relations Commission or any other judiciary authority? To be truly representative of ICMM and other guidelines, it is likely that legislation would need to be enacted on a national basis before such a body could be established.

Some of the problems that exists for regulators attempting to deal with the issues brought about by mine closure and that highlight some deficiencies in the current regulatory process include how to assist former mine employees to find employment post closure. This is particularly salient in mono-industry towns, or rural communities. One of the issues local councils face after a mine has closed is where to find revenue to keep social facilities and mine infrastructure funded in an adequate manner post-closure and how to generate business and new economic development post closure (Jackson, 2000).

An area of the legislation in Australia where there appears to be a lack of certainty over the closure and relinquishment of mining tenements is in the areas of post closure monitoring and land use acceptability. As an example, in Western Australia there is a requirement for a ten year minimum monitoring period (Department of Mines and Petroleum, 2011), whilst in Queensland it is dependent upon the regulator deeming that the mining company has successfully met its rehabilitation objectives and can provide evidence to support the success (Department of Environment and Resources Management, 2011). There is concern in the industry over the lack of agreed monitoring periods and the possibility of a potential source of disagreement and the commitment to sustainability from mining companies in the future (Fourie and Tibbett, 2006). It is an area where regulators are unlikely to waiver as the aim of the new wave of rehabilitation standards is to ensure that future generations are not left with enduring risk to the environment or human health and ultimately future taxpayers (Fourie and Tibbett, 2006).

In Australia, there is no legislation relating specifically to mine closure. Several States, most notably WA and Queensland, appear to be moving towards this, with their guidelines on Rehabilitation requirements for mining projects (Department of Environment and Resource Management, 2011). Indeed, the Queensland guidelines discuss issues which dominate industry guidelines, such as stakeholder engagement and the social and economic impact of mine closure, though the guidelines themselves, are not mine closure specific (Department of Environment and Resource Management, 2011).

The omission in the Australian legislative landscape is that no state fully legislates on stakeholder engagement and the social and economic impact of mining and mine closure and while it is discussed broadly, it is by no means discussed adequately and in depth (Environmental Defenders Office, 2011). There is no reference to the issues that surround a community when a mine opens and then closes some years later, including for example skills shortfalls, training issues and inadequate housing which are just some of the issues that can face a community when a mine opens. When that mine closes after a number of years, unemployment, economic downturn among business who have lost customers, oversupply of housing, higher crime and welfare dependency, are some of the issues that face a community from an economic and social perspective. It is these issues that are currently not adequately legislated, whereas many of the Acts, which cover mining around the nation, more than meet best practice requirements from and ecological and or environmental perspective (Jackson 2000).

5.4.16 Self-regulation versus enforcement

In Australia, guidelines, regulations and legislation is predominantly administered by State and Territory Governments. The Commonwealth (Federal) Government's *Environmental Protection and Biodiversity Conservation Act 1999* does, where State provisions are inadequate, supersede the State Legislation (Department of Environment, Water, Heritage and the Arts, 2009).The current mining legislation is not closure specific and the absence of it makes holistic mine closure less effective in Australia from a regulatory standpoint (Trezise, 2004). Certainly, industry is seeking a degree of self-regulation by following industry guidelines, alongside the State guidelines where they exist. However, if the mining industry in Australia were truly to be best practice, adequate legislation would be inclusive of stakeholder engagement, including the community and all the aspects of the social and economic impacts that mining and mine closure can have on a community. Further, it would seek to ensure that a life cycle approach is taken, with impact assessments, both environmental and socioeconomic conducted over the life of the mine, not just at the commencement of mining and with both mining companies and governments involved in the process (ICMM, 2008).

Rehabilitation in mining and under current legislation is State based and progressive and although it requires stakeholder involvement, it does not always address this in an ongoing manner and specifically for mine closure where the needs of stakeholders may differ from those during the operational life (ICMM, 2008). The current lack of a unified, nationally consistent approach to closure has beset regulatory authorities for some time (Biggs, 2000; Khanna, 2000), but certainly a unified approach covering all issues in mine closure would be more representative of best practice standards.

As is occurring internationally, the mining industry in Australia through its representative bodies is leading the way on mine closure by establishing guidelines and recommendations on best practice outcomes (ANZMEC/ANZMEC/MCA, 2000). The industry and government are working together in developing best practice outcomes for mine closure, with many of the regulatory guidelines on rehabilitation and environment standards and the Western Australian closure planning guidelines incorporating industry standards as part of their documentation. Currently, the industry is self-regulating on socio-economic issues, with minimal requirements in the legislation on this process, a similar outcome to what is occurring at an international level.

In Australia, mining companies can look to a number of sources to provide insight on best practice for mine closure that represent an element of self-regulation. The ICMM for example have in 2008 published a *Mine Closure Toolkit*, which details among other things, the need for Stakeholder and Community Engagement, Risk Assessment, the need to conduct EIAs and SIAs, Closure Costs Models and Biodiversity Management (ICMM, 2008). There have also been Mine Closure Guidelines published by ANZMEC, titled "*Strategic Framework for Mine Closure" (2000)* and the *Mine Closure and Completion* (DITR 2006) document published by the federal government. Many of the guidelines published by regulatory authorities in Australia direct mining companies to industry body publications for information on rehabilitation and closure practices and objectives (NSW Department of Trade and Investment, 2011). To some extent, this provides a degree of self-regulation as the industry is setting the standards on mine rehabilitation and closure outcomes. This however is not necessarily an incorrect approach as this type of approach to regulatory guidelines demonstrates that governments and mining companies can work together to achieve best practice outcomes (Queensland Mining Council, 2001).

To some degree, there has been a trend towards self-regulation by the industry in the area of mine closure over the last 15 years. Witness to this are the number of Australian and international guidelines and toolkits that have been published on mine closure during that period, many of which have been discussed in this thesis. The regulatory authorities are themselves quoting these documents in their own regulatory guidelines demonstrating to an extent the validity of these publications, particularly the ANZMEC/MCA, MMSD, ICMM publications that are routinely referred to by regulatory guidelines throughout the country. There is a requirement however for some of these guidelines to find their way into legislation over the coming years in order to cover those mining companies that do not necessarily adhere to industry adopted best practice.

5.4.17 Summary and comparison

The changes and reviews currently underway on mine legislation in Australia and referred to earlier in the chapter demonstrate both the changing nature of the industry and regulation that surrounds it as regulators attempt to keep up with not only industry standards but also societal and economic pressures about the impacts of mining. In addition to this they need to be able to balance and harness the positive effects of mining (such as royalties, employment growth and skills development) whilst mitigating the negative effects (such as loss of royalties, loss of employment and movement of skills and income to other locales).

The review of the literature for Australian regulations covering mine closure has attempted to cover all of the Australian jurisdictions where mining has a substantial presence. This was merely an overview and not a comprehensive legal analysis and is general in the discussion of specific topics. This has been intentional as there is simply not enough scope in this PhD for it to be otherwise.

Australian legislation, like its US and Canadian counterparts, is complex and due to the nature of the federal system different between the various jurisdictions. The US EPA seems to have more rigorous powers than its Australian counterparts do when it comes to mining in the United States and hence provides a uniform process in terms of environmental requirements. However, all countries reviewed for the literature lack stand alone mine closure legislation and a holistic approach to mine closure requirements that would see governments and mining companies working in unison on the mine closure process as is recommended by both non- government organisations and industry representative bodies.

Table 5.1 below provides a summary of the key legislative components of this chapter, highlighting the key similarities and differences between Australia and the overseas jurisdictions that formed part of the chapter analysis. These include a lack of mine closure legislation both in Australia and overseas and a reticence to develop a holistic approach to mine closure and the issues that are associated with it. There were some areas, however, where both Australian legislators and their overseas counterparts have developed proactive approaches to mine closure. These include the issue of rehabilitation and a requirement for companies to submit mine rehabilitation plans during the initial mine planning phase. In all of the jurisdictions reviewed and in Australia, environmental requirements were stringent, with the return of a mining site to its natural state being a condition of the granting of a mining lease.

Table 5.1: A comparison of Australian and international legislation

Key Legislative Points	Australia	International (UK, USA, Canada, New Zealand)
Mine Closure Legislation	There is no stand alone mine closure legislation.	There is no stand alone mine closure legislation.
Mine Closure Planning Guidelines	Only Western Australia has mine closure planning guidelines.	There is no mine closure planning guidelines.
Mine Closure Rehabilitation Plan Required	All State and Territory jurisdictions require that a mine rehabilitation plan be submitted. Mine site rehabilitation is required to be an ongoing.	Mine rehabilitation plans are required for submission as part of the mine approvals process. Mine rehabilitation is progressive.
Environmental Impact Assessment	Environmental Impact Assessments are required for submission in all States and Territories.	Requirement that Environmental Impact Assessments be conducted as part of the mine approvals process, normally submitted as part of the rehabilitation plan.
Social Impact Assessment	Only required in relation to the operational impact of the mine and included as part of the Environmental Impact Statement.	Occurs in regards to the operational impact of the mine and not the closure of the mine. Undertaken at the discretion of the mining company rather than any legislated requirement.
Financial Assurances	A requirement in all Australian States and Territories and are used by governments to cover costs associated with unexpected closure.	Internationally, the requirements of financial assurances are mixed. In the United States, it is an issue for the States and not all States require them in the granting of a mine lease. In the other jurisdictions reviewed for the chapter financial assurances is a requirement for the granting of a mining lease.
Landholder Rights and Rights of Companies	The rights of landholders and mining companies in Australia related to the exploration and operational aspects of mining, rather than being specific to mine closure.	Internationally as with Australia, the rights of landholders and companies are closely linked to exploration and operational activities of mining, rather than closure outcomes. The legislation covering this internationally is very complex and often covered by legislative provisions dating back many years (notably in the UK).
Indigenous Landholder Rights	The rights of Indigenous people are related to the exploration and operational aspects of mining.	The rights in relation to Indigenous people are determined as part of exploration and mine operational activities.
Stakeholder Engagement	It occurs at the commencement of mining and yet there are no statutory obligations for engagement concerning closure outcomes. This is at the discretion of mining companies.	It also must occur at the commencement of mining and yet there are no statutory obligations for engagement concerning closure outcomes. This is at the discretion of mining companies.

Closure Outcomes	A mine site at the end of a mine's life should be returned as safe and structurally sound. The site should be returned as close as possible to its original state. End uses that go beyond this i.e. for recreational purposes are determined outside the regulatory environment.	A mine should be returned safe and structurally sound. The site should be restored as close as possible to its original state. End uses that go beyond this i.e. for recreational purposes are determined outside the regulatory environment.
Holistic Approach to Closure	A whole of life mine closure approach incorporating environmental, social and economic factors and stakeholder engagement is not undertaken.	A whole of life mine closure approach incorporating environment, social and economic factors and stakeholder engagement throughout is not undertaken.

All of the jurisdictions reviewed required the submission of environmental impact assessments as part of the rehabilitation plans, however social impact assessments were not required in all jurisdictions and in the case of the international countries reviewed, were at the mining companies' discretion and in all cases they were only required to consider the impacts during the operational phase, not at mine closure. Other similarities between Australian and the international jurisdictions included a requirement to incorporate the rights of landholders and Indigenous landowners at the mine planning and commencement phases, but not necessarily factor these same rights into the closure process.

One key point of difference emerged however in relation to mine closure, with Australia being the only country reviewed in the literature that has developed government endorsed mine closure guidelines. These have been undertaken in Western Australia and represent the first attempt by any of the jurisdictions reviewed to develop a mine closure guidance process designed to provide some uniform mine closure course of action.

The next chapter provides an overview of the desktop case studies found in the Appendix, highlighting inferior and best practice closure examples from Australia and across the world. The case studies analysis was conducted to determine whether there was a link with the findings in the literature review on poor and best practice closure outcomes and compare and contrast the findings from them.

Chapter 6. Desktop case study analysis

6.1 Introduction

What has been learned from the review of the literature review is that the lack of regulatory guidelines on mine closure has meant that mining companies, governments and communities are almost flying blind when it comes to closing a mine. There are a lot of gaps and areas that are being missed in mine closures, not just in this country, but also around the world. Specific mine closure legislation or regulatory guidelines are required if mining is to have beneficial and sustainable outcomes in the long term.

This chapter is designed to provide an overview of the desktop case studies that highlight inferior and best practice mine closures. The detail of these case studies is in Appendix 1. Five desktop case studies of poor closure practices in Australia and overseas were examined to determine if there were similarities in the closure of these mine sites and if these correlated with the findings from the literature review in the determination of poor closure practice. In addition to conducting research into inferior mine closure, nine desktop case studies of best practice mine closure were examined to compare and contrast with the inferior mine closures and demonstrate why these are considered best practice.

Chapter 6 provides an overview of the findings on mine closure from the desktop case study research and in Chapter 7 evidence from four of the best practice case studies is strengthened through field research interviews to consolidate the findings from the desktop studies.

6.2 Method of case study analysis

6.2.1 Choice of case study method

The basis for collecting the data was to develop a greater understanding of the issues surrounding mine closure identified by the literature review and determine features both common and unique to mine closure. Case studies from Australia and the United States, Canada, the United Kingdom and New Zealand were used to generate different mine closure strategies and end-use options.

The reason for conducting case study research was to develop a better understanding of what the literature was identifying as the issues surrounding mine closure, and from this identify what features were common to mine closures both good and bad and determine what features were unique to mine closures. This is what Morris and Wood (1991) referred to as developing an understanding of the background of the research and processes enacted by it by undertaking an explanatory and exploratory research approach. Using this approach, the decision was made to use examples from across the world and within Australia in order to investigate different closure strategies and from this and the issues identified in the literature, begin to use the information to commence the development of a best practice framework for mine void closure. The decision to use the case study approach was also influenced by the need to challenge the existing strategy for mine void closures and develop a new series of further research questions to expand on this existing knowledge (Saunders et al., 2009).

A multiple case study approach (George, 1979) was applied in order to determine whether the findings were replicated across the case studies. This is an approach recommended by Yin (2003) stating that multiple case studies are useful methods for determining if the findings from the first cases study are repeated in the other case studies and what generalisations can be made from this.

The research data for the case studies was collected using a Triangulation approach to data collection for case studies as referred to by Yin (2003). The research in this case study approach is both explanatory and exploratory and hence used a variety of data collection techniques, including documentary analysis as a means of gathering further information and data for the research.

The PhD thesis commenced in Collie, Western Australia, the state's only coalmining community, which produces upward of 3.25 million tonnes of coal per annum (Appendix A, p. 39). The thesis initially focussed on the Collie mining activity and the development of Lake Kepwari as a post closure option. Through community consultative committee meetings between the mining company, government and community representatives that were attended by the author, evidence of closure issues were highlighted and as a result the scope of the PhD was broadened to include examples of both past and current poor and best practice closure options in coal mining and in the broader mining industry.

The use of multiple sources of evidence for the data collection in order to develop converging areas of investigation is recommended by a number of authors when undertaking case study methodology due to the increased reliability associated with collecting data from a range of sources (Yin, 1994, Patton, 1997, Padgett, 2008, Saunders et.al, 2009). Furthermore, according to Yin (1994) and Patton (1987), the findings from a case study are likely to offer a more convincing argument and develop more thorough conclusions by the use of several information sources. As recommended by Yin (1994) the case study used two or more sources of evidence to reach a point where the findings yielded similar results. The sources of data included newspapers, journal articles, mining handbooks, company documents such as financial statements and prospectuses, websites, mine closure conference documents, documents from non-government agencies such as the International Institute for

Environment and Development that were responsible for funding the MMSD report, and government books.

6.2.2 How the case study data was organised

The case study research findings uncovered a number of factors that were common to both inferior and best practice mine closures that were developed as a spreadsheet table (Appendix C). It was developed from the factors that were common to poor and best practice closures through a series of questions. These questions included for example: how many people were employed at the mine site; were mine closure plans required from the commencement of mining at a particular site; did the site meet or exceed legislative requirements; did the mine closure consider the environmental, economic and social needs of the community. The questions that arose from the common case study data along with the findings from the literature review led to the development of nine closure criteria. The case study analysis along with the literature review findings were examined and used to narrow the broad factors and develop the criteria, which then enabled the case studies to be measured as to how they did or did not meet the criteria. The nine criteria are discussed below.

The location of the mine

The location of the mine was found to determine the successful closure, or otherwise of a mine (Cowan and Robertson, 1999; ANZMEC/ANZMEC/MCA, 2000). The location of the mine is a significant determinant in the extensiveness of the rehabilitation program. It suggests that a mining company is more likely to go above rehabilitation standards if a mine site is close to an urban locality. Mine sites in more remote communities will exhibit different characteristics and have different closure requirements to mines near urban areas (Ashton and Evans, 2006).

The size of the community where the mine is situated

The common theme from the case studies regarding the size of the community and mine closure was that communities with larger populations and a more diversified industrial base tend to be less affected by a mine closure than communities that are mining dependant (Cowan and Robertson, 1999). This affects the end-use of the mine site, as communities that are more reliant on mining may have requirements for the mining site that include an economic focus, for example the development of tourist facilities. For communities that are larger and more diversified, the end-use may need to be only aesthetic, for example rehabilitation of a mine site to its pre-mining status.

The size and profitability of the mine

A profitable mine can provide a company with the resources to rehabilitate a mine and in all of the best practice case studies the mines were profitable. There may be many factors associated with this that cause a company to engage in successful rehabilitation, but the key factor appears to be the ability of the mining company to draw on its capital reserves and put this into a robust rehabilitation program (Fleury and Parsons, 2006). Mines that have not been successfully rehabilitated have not been profitable and hence the companies did not have the resources at their disposal to take on the often-expensive process of rehabilitation (Fleury and Parsons, 2006).

Profitability is also associated with the prices of commodities and the evidence from the case studies is that poor closure practices are often associated with low commodity prices, which directly affects the viability of a mine. A mine that is not financially feasible will struggle to develop sufficient capital reserves to implement a successful rehabilitation program (World Bank and IFC, 2002).

The data available for the size of the mine varied at each mine as some were provided in square kilometres, some in square miles, some in hectares, hence the variation in sizes of mine sites. Also, data relating to the depth of pit sizes was not always accessible and not able to be included as part of the data set.

The ownership of the mine

Ownership of the mine will have a significant impact on the end-use and rehabilitation of a mine void. A larger organisation will have greater access to capital reserves that it can use to develop a strong rehabilitation program (Pierce and Wen, 2006). Large organisations will also be able to employ more resources to work on rehabilitation programs and are more likely to be actively involved in research and development projects on end-uses for mining voids (Pierce and Wen, 2006). Limited financial resources do not preclude small organisations from engaging in successful mine closure, however, the more resources an organisation has at its disposal, the more likely it will be that those resources will be used in the rehabilitation process (MMSD, 2002).

The data for the ownership included information on the number of employees at the mine site, with the data in the spreadsheet included as rounded numbers (for example 250 plus) rather than exact numbers as the number of employees at a mine site over the life of the mine will fluctuate according to the cycle of the mine (Jackson, 2000). In addition, contractors will also be employed at a mine site, however not necessarily directly by the company. For the purposes of consistency, the data for this section include only those employed directly by the mine site.

When the mine closure was planned

The findings from the desktop case studies have invariably indicated that successful mine closure requires a strategic level of planning, normally carried out at the start of the mining process during the early planning phases (Fox, 2007; Fitzgerald, 1998). Even before they commence operations, mining companies should be planning for the closure of the mine, no matter how long it is estimated that the resource reserves will last. This is a difficult undertaking for both companies and regulators, as most mining leases require only a basic closure plan with the guarantee that a site will be returned to a pre-mining state. As the case studies have shown, however, this does not always occur even in today’s more stringent regulatory environment, as governments are powerless to prevent companies from going bankrupt for example and not meeting their regulatory obligations in relation to mine closure (Phaceas, September, 2004).

How the mine closure was planned and conducted

How the mine closure was planned and conducted is about the strategy for closure. Was the closure and rehabilitation of the mine considered during the mine planning process, or was it left until the last few years of the mine’s operational phase? Was the rehabilitation of the mine carried out progressively during the operational life of the mine? In addition, what if any of the rehabilitation and closure process were funded through the operational budget of the mine? (ANZMEC, 2000).

Planning for closure is an integral part of the mining process and will assist not just mining companies, but also communities in the structural adjustment process that occurs after a mine is closed. Companies that have developed sound rehabilitation and closure plans for a mine site will generally be better placed to gain approval from local communities for mine site developments (Fox, 2007). This approach also enables communities to factor future mine closure plans into their strategic plans for economic development (Fox, 2003).

Alternative closure options

Alternative closure options are determined in part by the criteria already discussed, but also by factors such as the type of mine and water quality that is left after a mine has ceased operations (Johnson and Wright, 2003). Mining companies can consider a number of alternatives when determining options for a mine site once mining is completed. There are a number of factors that are important in the closure of a mine (Environment Australia 2002, p. 2):

- Public safety hazards and risks
- Ecological compatibility
- Potential as an ongoing source of pollution

- Community expectations
- Future land use and resource development

It was established that there are three broad, but basic mine void closure strategies, or options that companies can undertake and that have been discussed at length in earlier chapters. They include, waste storage, water storage and open void (Johnson and Wright, 2003). Other factors also considered and that were examined earlier include: the climate of the area in which the mine is located, the geology of the mine site, the diversity of the community in which the mine is situated (Mallet and Mark, 1995).

The legislation under which the closure was conducted

Successful mine closure as measured by whether or not a mining company meets its legislated rehabilitation requirements is not necessarily an accurate measure of the outcome of mine closure (Biggs, 2000). The desktop case studies provide examples of cases where mine closure was successful and the mining companies went well beyond their legislative requirements for both the rehabilitation and closure and in all instances took into consideration the impact that closure would have on the local community.

Engagement with stakeholders

The literature review established that the terms consultation, participation, involvement and engagement tend to be used interchangeably by many companies (and indeed the same can be said of many government agencies), the reality, however, is that they are quite distinct concepts. Mining companies may consult with local communities, or seek their involvement and even participation, however, they may not actually engage them (Dowd and Slight, 2006). Engagement means that post-closure development plans are developed for local communities, with input from local communities in order to mitigate the negative effects often associated with mine closure, such as a lack of alternative employment options once mining ceases (Humphreys, 2000).

6.2.3 Selection of case study sites

Examination of a multitude of mine closures based on the nine criteria outlined above led to the current list of standout closures, both in terms of best and poor closure practices. The desktop case studies were broken into inferior mine closures and best practice mine closures with each assessed under the nine criteria, highlighting how they met or did not meet the criteria. These case studies were chosen based on how they met each of the criteria (or did not meet it in the case of the poor practice closures) with the idea that if the closure occurred overseas there were lessons that could be learned from it for this country and applied as part of a more holistic approach to mine closure. In some cases it was found that mining companies and communities actually worked outside these criteria and these were highlighted as requirements for the recommendations from this thesis.

The following cases studies were categorised and analysed as inferior mine closures:

- Rum Jungle and South Alligator River Mine, Northern Territory
- Mount Todd, Northern Territory
- Summitville mine, Colorado, USA
- Mount Lyell, Queenstown, Tasmania
- Windimurra mine, Mt Magnet, Western Australia

The best practice closure case studies were as follows:

- Flambeau Mine, Wisconsin, USA
- Ridgeway Mine, South Carolina, USA
- Elliot Lake, Ontario, Canada
- Golden Cross, Waihi, New Zealand
- Rother Valley Country Park, Rotherham, UK
- Penrith Lakes, Penrith, New South Wales
- Cadia Hill, Orange, New South Wales
- Jarrahdale, Western Australia
- Lake Kepwari, Collie, Western Australia

From these desktop case studies, four Australian case studies were chosen for further field research (Lake Kepwari; Jarrahdale; Cadia Hill; Penrith Lakes) that is presented in Chapter 7. The remainder of this chapter will highlight the findings from Appendix A using the nine criteria as the basis for the outline and highlighting poor and best practice case study mine closure examples to demonstrate the findings.

6.3 Inferior and best practice mine closure summation

The case studies chosen for the inferior mine closure section failed to conform to best practice mine closure criteria. In each of the case studies there were common characteristics that were contributing factors to their categorisation as inferior closures. These included poor closure planning, being located in remote locations with small populations, fluctuations in demand and prices for commodities that were being mined at the site, changing mine ownership during the course of the mine’s life, negligent legislation regarding mine site rehabilitation and hence closure, and poor or non-existent community consultation and engagement.

The analysis of best practice mine closure is also organised under the same nine key criteria to maintain a consistent approach and provide a contrasting picture with what occurred in the inferior mine closure examples. Although each of these case studies meets these criteria to one degree or another, there are still gaps that are currently not being addressed by either regulators or the mining companies. Over time, with changes both in mining practices and legislative guidelines, these case studies may come to be seen as minimum examples of best practice mine closure. Each of the sites share common characteristics including good closure planning, urban locations with medium to large populations (or being close to large urban areas), strong demand for commodities, consistent mine ownership during the course of the mine's life, sound legislation and continuous regulatory involvement regarding mine site rehabilitation and hence closure, and in nearly all cases regular community consultation and engagement.

This section of the chapter outlines the nine criteria highlighting how they contribute to poor and best practice mine closures and providing examples from the case studies in Appendix A as a way of highlighting the key points from the criteria.

6.3.1 The location of the mine

The findings from the case studies indicated that in the case of inferior mine closures the more remote the location, the more likely that it will be left in a state of disrepair. This is in part due to the nature of remote locations where there is less likely to be pressure from interest groups than in urban areas where there is often a more organised and cohesive approach (both opposing and supporting) towards mine closure options. A summary of each mines level of isolation is provided in Table 6.1. Table 6.1

Table 6.1: Isolation of case study mines

Mine Site	Isolation from urban or major rural locality
Inferior closure	
Rum Jungle	Isolated locality. 65 kilometres from Darwin.
Mount Todd	Isolated mine site. 250 kilometres from Darwin
Summitville	Isolated mine site. Located 40 kilometres from Del Norte in remote southwest Colorado
Mount Lyell	Isolated mine site. Located in Queenstown, southwest Tasmania
Windimurra	Isolated mine site. Located in Windimurra 600 kilometres northeast of Perth.
Best practice closure	
Flambeau	Isolated mine site. Located in a remote region of northern Wisconsin
Ridgeway	Isolated mine site. Located in a semi-rural area of northwest South Carolina
Elliot Lake	Isolated mine site. Located in sparsely populated region of northern Ontario.
Golden Cross	Isolated rural location. Located in rural Coromandel region of New Zealand 151 kilometres from Auckland.
Rother Valley	Urban location. Located in heavily populated region of central England.
Penrith Lakes	Urban location. Part of the Greater Sydney metropolitan region.
Cadia Hill	Close to major rural location. Located 25 kilometres from Orange in central New South Wales
Jarrahdale	Close to major urban location. Part of Perth metropolitan area, 45 kilometres from Perth
Lake Kepwari	Close to major regional locality. Located 50 kilometres from City of Bunbury

As an example, at the Mount Todd gold mine site located 50km from Katherine in the Northern Territory (refer Appendix 1, p. 22); the Jawoyn People claimed that they felt a sense of powerlessness when the gold mine closed due to financial difficulty, despite signing an agreement with the Mining Company (Zapopan Ltd), and the Northern Territory Government. Instead, they were left with an environmental and financial closure problem that is still in the process of being resolved, with an estimated cost to the Northern Territory Government of $20 million (Appendix 1 p. 28). Despite being a well known case, the remote nature of the site and its location away from an urban area and on Indigenous land, has meant that the mine does not enter into the consciousness of many people. Environmental problems associated with the mine (acid mine drainage, pollution of both groundwater and surrounding waterways) are well away from the public eye and hence out of mind.

As this example and the other case studies demonstrate, when there is a lack of scrutiny surrounding mine site closures (whether planned or unplanned) and this is particularly noticeable in more remote locations, there tends to be less concern about mine closure than occurs in urban areas where a greater degree of scrutiny (and it must be said concern) is expressed due to the number of people that will be affected by the mine closure.

As with the case studies from the inferior mine closures, a mine’s location plays a role in the closure outcomes and the end-use options available to a mine in best practice examples. A mine that is located in or near a major urban centre, for example, may have more end-use options available to it, particularly those that may be related to recreational pursuits, as there will be a large population catchment that will be available to use the facilities. In the case studies such an example is provided by the former mine site in the United Kingdom known as Meadowgate.

Meadowgate, formerly an opencast (open pit) , which is now known as the Rother Valley Country Park and is located in Rotherham in the South Yorkshire region of the United Kingdom (Appendix 1, p. 137), highlights why a mine located near an urban area, increases the possibilities for end-uses at a site. The region is heavily populated and although the town of Rotherham where the mine is located has a population of only 254,000, the wider South Yorkshire region has a population of over 2 million (Appendix 1, p. 139). Furthermore, the Yorkshire area is in the geographical centre of Britain and in close proximity to major centres such as Manchester, Leeds, and Birmingham, which provide a potentially large tourism base for the Park.

A Country Park was first mooted in the early 1970’s by the then five Local Government areas that bordered the site who wanted to turn what had once been a former coal mining area that was never properly rehabilitated and had become a polluted and weed infested open space, into a recreational space for the region. Development of the former mine into a recreational park was made possible due to its proximity to a large urban environment and substantial population located within one to two hours drive of the park and easily accessible by both road and rail.

Such a large development may not be possible to emulate in many regions of Australia where mining occurs and given that mining companies are concerned with profits, share prices and returns on investment rather than being funded by government, may make such an outcome in Australia more difficult. What it demonstrates, however, is the need for detailed planning and how close cooperation between mining companies and local governments can achieve positive outcomes from mine closure and demonstrates the need for local governments to become more involved in the process, including financially, particularly when in the end a mine closure affects their community the most.

The Flambeau gold and copper mine in Wisconsin in the United States (Appendix 1p.72) provides a good contrast to the Rother Valley site in that it is in a small rural community nearly 370 kilometres away from the State’s major metropolitan centre of Milwaukee and is located in a sparsely populated farming region of the State. The mine itself was only 43 metres from the Flambeau River and just 2.7 kilometres from the City of Ladysmith (Appendix A, p. 73). The City of Ladysmith residents were widely involved in the final design of the Flambeau mine closure. They expressed their desire to turn the former mine area into a recreational facility for local residents and tourists alike, with the void being backfilled and returned to a state that existed prior to mining, without the commercial element that occurred in the case of the Rother Valley.

In New Zealand, the Golden Cross mine located in Waihi in the Coromandel region (Appendix A, p. 121) was a large open pit goldmine. As with the Flambeau mine in Wisconsin, Golden Cross is in a sparsely populated region on the North Island's east coast 151 kilometres from Auckland. The mine was just 8 kilometres from the town of Waihi and was surrounded by farmland and native forests, with high rainfall and mountainous terrain and hence end-use options for the site were limited. The community was involved in the mine closure process, determining that the site at closure would be returned to the state that existed prior to mining with the mine void being backfilled and the site turned into a recreational facility. The site is now a tourist attraction and recreation area for locals and has added to the industry base of a town that has traditionally been a mining and agricultural town.

Rother Valley was also possible due to the size of the region in which it was located and its proximity to large urban centres. While these characteristics are uncommon in Australia, in some mining areas, notably the Hunter Valley (NSW) and La Trobe Valley (Victoria) this type of development may be able to be emulated, albeit on a smaller scale. The two other case studies of Flambeau in the United States and Golden Cross in New Zealand provide a study in contrasts between themselves and Rother Valley. Both mine closures were in remote rural communities with small populations. In both cases, the end-use options for the mine sites suited the needs of the community and took into account their locations and the environments in which they were located. Large-scale, post mining development was not possible at these two sites and nor was it what the communities desired. A balance was found that enabled the sites to be closed in a manner that was both a sustainable and suitable end-use for the locations.

A mine's location will determine how the closure is undertaken. This occurs for a number of reasons, the main ones being the location, which determines proximity to an urban area, alternative uses and climate, and economic diversity.

6.3.2 The size of the community where the mine is situated

The size of a community is often determined by its location, particularly in Australia, which is a country with a large land mass and a small population base and many mining communities based in remote areas of the country. These towns often have a small industrial base and mining may be the major industry in the town, hence the closure of a mine can have a substantial affect on both the economic and social fabric of a town (Ashton and Evans, 2006). This will also affect the types of closure options available to a community, as small, mining-dependent communities may have a greater need for assistance to cope with the mine closure, including the end-use options for the mine site (Ashton and Evans, 2006). In larger communities with a more diversified industrial base, the impact of a mine closure may not be as severe and the need for assistance to deal with the closure may not be as great. In addition, the end-use options for mines in these communities may only require a return of the site to its pre-mining state (indeed this may be what the community demands), rather than attempting to use the site to generate new economic activity (Tivy, 1984).

All the case studies of inferior mine closure occurred in relatively small mining dependent communities, where the mine closure affected the towns concerned socially, economically and environmentally. The case studies included Windimurra vanadium mine near Mount Magnet in Western Australia (Appendix 1, p. 60) which closed prematurely in 2004 after the owners of the Xstrata decided that the mine was no longer a feasible operation (due to low vanadium prices at the time) and decided not to proceed with mining at the site. Mount Magnet is 600 kilometres northeast of Perth, with the mine a further 80 kilometres southeast of the township (Appendix 1, p. 60). The town's population of just 642 and the shire area of 13,888km^2 means that a lot of the infrastructure and facilities taken for granted in communities with large populations (such as advanced health facilities, social centres, paved roads) are not available, or do not meet the needs of the population. When it opened in 1998, the Windimurra mine promised the creation of thousands of jobs, both during construction and in the mining phase, plus the delivery of infrastructure to a region where paved roads for example are rare (Appendix 1, p. 60). The small population means that the industrial base of the town is limited (mainly to being pastoralists and tourism operators) and the development of the mine would have provided a much needed growth industry for the shire.

The sudden closure of the mine meant that the promised infrastructure was not delivered and new employment opportunities and a chance to diversify the local economy were lost. After this closure, the town's population declined by 14% between 2004 and 2008 (Appendix 1, p. 63). How much of that decline is precisely attributable to the closure of the mine is unknown, however, the decline occurred after the closure of the mine and there was no other event that occurred in the region that could account for such a large fall in population.

Towns with small populations and a lack of economic diversity often lack the capacity to mitigate the effects of mine closure, whether it is planned or unplanned. Small communities appeared to be affected the most by mine closures in all of the case studies, and in the examples used in the study, communities and levels of government dealt ineffectively with unplanned closures and were ill prepared to deal with the economic, social and environmental effects of a mine closure.

Table 6.2 outlines the mine sites from the case studies, breaking them down into inferior and best practice closure examples. The table also describes whether or not the town in which the mine was located had a population above or below 10,000 and whether or not it had a diverse industry base. From this table and the case study research it can be concluded that towns with populations above 10,000 and diverse industry bases have more options available to them post closure and are better able to withstand the effects of a mine closure.

Towns with small populations and a lack of economic diversity often lack the capacity to mitigate the effects of mine closure, whether it is planned or unplanned. Small communities appeared to be affected the most by mine closures in all of the case studies, and in the examples used in the study, communities and levels of government dealt ineffectively with unplanned closures and were ill prepared to deal with the economic, social and environmental effects of a mine closure.

Table 6.2: Mining town size and industry diversity

Mine Site	Population above or below 10000	Diverse industry base
Inferior closure		
Rum Jungle	Less than 10000	No
Mount Todd	Less than 10000	No
Summitville	Less than 10000	No
Mount Lyell	Less than 10000	No
Windimurra	Less than 10000	No
Best practice		
Flambeau	Above 10000	No
Ridgeway	Less than 10000	No
Elliot Lake	Above 10000	No
Golden Cross	Less than 10000	No
Rother Valley	Above 10000	Yes
Penrith Lakes	Above 10000	Yes
Cadia Hill	Above 10000	Yes
Jarrahdale	Above 10000	Yes
Lake Kepwari/ Collie	Less than 10000	No

In all the inferior cases the communities, whether large or small, tended not to factor the closure of a mine into their strategic or economic development planning processes. This suggests it should be a necessity for all local governments (who need to work in partnership with State governments and mining companies) to put in place plans for the closure of a mine (including unexpected closures) in order to mitigate the effects of mine closure on the local community. It will not be possible to completely mitigate the effects of mine closure;

however, programs can be delivered to assist with the diversification of an economy. Such programs can include business start-up programs, business expansion programs, education and training programs for displaced mine workers and in worst cases relocation packages for those unable to find alternative employment, or who do not wish to stay. In each of the inferior case study examples, a lack of planning for any type of closure was a noticeable aspect in the failure to deal with the closure.

The size of the community is in part related to the location of the community (ICMM, 2008). This is certainly the case in the two largest mining states in Australia, Western Australia and Queensland, where many of the largest mines are located in remote regional areas far away from major population centres and in some cases mining may be the major industry in the region with few other industries to support the town after mining ceases.

The ability of a relatively small mining dependant community to be able to reinvent itself and survive after the closure of its mining industry is illustrated in the case studies by Elliot Lake (Appendix 1, p. 101). Elliot Lake, in Ontario, Canada, was established as a mining town in the 1950's to mine for uranium to supply the United States and Britain in addition to Canada's own nuclear industry. As demand and prices for the metal fluctuated so too did the fortunes of Elliot Lake. The town initially had a population of 25,000 when mining first commenced in the town. However, by the 1960's the population dropped to under 6,000, rising again to 14,000 in the 1970's when demand again increased for uranium. The population declined when the last mine closed in 1996, stabilising at around 11,500 at the time of the last Canadian census in 2006 (Appendix 1, p. 104).

The reason all of this is important to this criterion is that it assisted in the transformation of Elliot Lake from a mining town to a retirement and tourism based region. The decision by the Ontario government and the mining companies to invest in the region in the 1950's enabled the establishment of good infrastructure and recreational facilities, as well as the creation of affordable housing for the mine workers. The mining companies, working with the local, provincial and federal governments, assisted workers in finding alternative employment and offering retirement packages to eligible employees with the offer of buying the former mine rental properties as an incentive to retire in the town. The company was left with around 2,000 former mine rental properties at the end of the closure of the last mine and rather than demolish them, working with the City of Elliot Lake, they chose to sell the homes and market Elliot Lake as a cheap retirement and tourism destination, within easy access to the major Northern Ontario city of Sudbury (160 kilometres from Elliot Lake) (Appendix 1, p. 116).

The example of Elliot demonstrates what can be done when mining companies and local communities (through Local, State and Federal governments) work together to find unique solutions to the closure of a mine. This does not mean that an Elliot Lake is possible within every mining community, nor could Elliot Lake be classified as booming. Since mining ceased it only managed to stabilise its population during the decade to 2006 (Appendix 1, p. 104) and it is not necessarily a destination that would appeal to everyone, as there is still a negative perception about uranium, no matter how extensive the rehabilitation efforts at the site. Elliot Lake contrasts with the former Meadowbank in the United Kingdom now known as Rother Valley Country Park.

The size of a community will shape its ability to attract new businesses, or expand existing ones and hence find alternative employment for former mine workers when a mine closes. Communities that are smaller, located away from major population centres, and mining dependant will by their very nature have a more difficult time overcoming the problems associated with mine closure, however it does not have to spell the end of these communities. This would also enable governments at all levels to target communities in need of assistance and tailor mitigation programs (such as retraining and skills upgrading, providing welfare assistance to displaced mine workers, assisting communities to attract new businesses and expand existing ones, and utilise mine infrastructure to benefit the local community). This would not necessarily protect communities from downturns post-mining; it would however provide a measure of assistance and relief that is currently missing from the mine closure process in this country.

6.3.3 The size and profitability of the mine

Mines that are larger by nature tend to be more profitable. Similarly, mines that are more capital intensive tend to be more productive and therefore more profitable over the long term. The case study research found that for mining companies, extracting the highest grade ore possible at the lowest possible cost is the best option for improving the bottom line of the organisation (Appendix 1, p. 3).

The profitability of a mine and the mining company will influence the amount of money available for the rehabilitation and closure of a mine and it will therefore influence the resources to maintain any ongoing maintenance after a mine closes. In all of the case studies on inferior mine closure, the mine site was either not profitable, or the mining company was facing financial difficulties and was unable to commit to any rehabilitation and closure program. In all of the case studies, the mine closed prematurely before ore reserves were depleted, with little or no rehabilitation being completed, often leaving behind substantial environmental problems.

An example of such a problem is provided by the Summitville Gold and Silver Mine site in Colorado in the United States (Appendix 1, p. 30). Mining had commenced at the site in the 1870's and it was this early mining that caused many environmental problems that occurred at the site in the latter part of the 20th Century (namely the diversion of a local river and the dumping of poisonous tailings into the same river system during these early years). The United States Geological Survey claimed in 1993 that it only ever considered the mine site to be marginal, as its reserves were thought to lie deep below the surface and were low grade (Appendix 1, p. 31).

Despite the claims made by the United States Geological Survey, the Summitville Consolidated Mineral Corporation commenced mining at the site in 1984, before eventually filing for bankruptcy in December 1991 (with the mine closing in 1992). During the life of the mine, the Company was estimated to have produced US$81 million worth of Gold and Silver at the site (Appendix 1, p. 32), but when the mining ceased the company had no funds available for the rehabilitation of the Summitville site.

The company did not undertake any progressive rehabilitation at the site and the company experienced ongoing confrontations with State regulators over environmental problems. When the mine prematurely closed in 1992, the United States Environmental Protection Agency took responsibility for the site and implemented a rehabilitation program, which is still ongoing and is estimated to have cost the Agency (and hence taxpayers) US$133 million in 1997 alone, when a major restoration program was undertaken at the site (Appendix 1, p. 39). The Colorado regulatory authority, the Colorado Government, held US$4.7 million in bonds for the site to cover the costs of unexpected closure; however, most of this money was in the form of plant and equipment, which was inadequate to deal with the costs associated with the cleanup. Colorado mining legislation was amended due to the Summitville case, ensuring that rehabilitation be undertaken on a progressive basis during the mining phase, however, the bond process did not alter and hence there are still no safeguards for communities (or Regulators) if a mine closes unexpectedly. As this example demonstrates, mining companies that experience financial trouble will have difficulty in undertaking any type of rehabilitation and mine closure program.

The best practice case studies demonstrated that those mines that have extensive ore bodies and are profitable are more likely to be rehabilitated and closed in a manner that meets or exceeds regulatory guidelines. The Flambeau mine site in Wisconsin in the United States (Appendix 1, p. 72) started out as a mine project facing objections from local residents and was opposed by the community during the company's first attempt to mine the large ore body of the site in the early 1970's. The site was highly profitable for Kennecott Minerals and for the State of Wisconsin, which received US$16 million in taxes from the mine.

US$10 million of this was redistributed back to the City of Ladysmith (the Local Government responsible for the site) to offset the negative impacts of the mine closure by attracting new businesses to the town (Appendix 1, p. 75).

Table 6.3 provides a brief overview of the size of each of the mines from both the inferior and best practice examples in the case study. It also highlights whether or not the mine was a profitable site, which assists in providing one of the explanations as to whether or not a mine site was classed as inferior or best practice. It also shows that in most of the cases of inferior mine closures (with the exception of Mount Lyell) the mines were not profitable and this contributed to early, unplanned closures.

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Table 6.3: Size and profitability of mine site

Mine Site	Mine size	Profitability of mine site
Inferior closure		
Rum Jungle	Large mine site with mine depth of 100 metres	Not profitable mine site
Mount Todd	Large mine site of 160,878 ha	Not profitable mine site
Summitville	Small mine site covering an area of 2.2 km^2	Not profitable mine site
Mount Lyell	Large open cut mine site. Was the largest copper mine site in Australia	Profitable mine site
Windimurra	Medium mine site with lease of 300ha and pit depth of 40 metres	Not profitable mine site
Best practice		
Flambeau	Small to medium mine site covering 73 ha and a pit depth of 67 metres	Profitable mine site
Ridgeway	Small to medium size mine site covering an area of 153 ha. with two open pit mines	Profitable mine site
Elliot Lake	The mine consisted of twelve mine sites and was the largest uranium production site in Canada.	Profitable mine site
Golden Cross	Medium to large size open pit mine covering an area of 240ha.	Profitable mine site
Rother Valley	Medium to large size open pit covering an area of 367ha.	Profitable mine site
Penrith Lakes	Large series of open pit mines covering an area of 2000ha.	Profitable mine site
Cadia Hill	Medium to Large open pit mine reaching a depth of 460 metres and covering an area of 230ha.	Profitable mine site
Jarrahdale	Large mine site covering an area of 4090ha.	Profitable mine site
Lake Kepwari	The mine was a medium to large size open cut mine covering an area of 188ha and a pit depth of 75m.	Profitable mine site

In addition to the tax generated by the mine, Kennecott Minerals invested money into the community through various community development projects including school scholarship programs, a new library and Visitor Centre. The profitability of the mine enabled the company to undertake an extensive progressive rehabilitation program (US$20 million was invested by the company in the project) that has seen the site mature into a series of wetlands, nature trails and the establishment of a business park at the site using the old mine infrastructure. The open pit was backfilled (which is a more expensive option than leaving an open pit) and the site recontoured to its pre-mining state. This complied with the communities wishes and enabled the company to meet its regulatory obligations (the Flambeau site actually exceeded Wisconsin’s mining legislation); to the point where in 2001 the company was granted a certificate of completion at the site (Appendix 1, p. 79).

Flambeau demonstrates why the profitability of a mine site is an important determinant in the success or otherwise of a mine rehabilitation and closure program. Companies require significant money to rehabilitate a mine. In the case of Flambeau, this cost was further increased by the community's desire to have the open void backfilled and returned to its natural state. Had the company not undertaken this step, however, it is doubtful whether the mining project would have commenced at all, as the company lost its social licence to mine the site during its first proposed development in the 1970's when the community opposed the proposed development on its aesthetic appeal. The mine generated a positive return on investment for the company, but it had to alter its project significantly, no doubt at the expense of its original projected income. The project shows why companies need to obtain a social licence to mine and this will increasingly become the norm particularly as mining intrudes further into urban areas and so positive work undertaken by companies in previous communities will assist companies to gain approval for projects in the future.

There are a number of factors relating to the size and profitability of a mine that enable a company to complete a successful rehabilitation and closure program, however the most common reason is the ability of a company to be able to draw on its capital reserves and put this into a feasible mine rehabilitation and closure program. An example of how this occurs is provided in the case studies by Elliot Lake and the costs associated with compliance at Elliot Lake (this also reiterates the importance of companies having a sound financial balance). The closure costs associated with Elliot Lake (across all of the former mine sites) include Canadian $140 million capital costs from the initial phase of the project, Canadian $5 million annually in the transitional phase of the closure, which has since decreased to Canadian $1 million annually and a perpetual care and maintenance cost of Canadian $15 million (Net Present Value – based on the regulatory requirement of a 50 year maintenance period) (Payne et al. 2002). The 50 years is a requirement under Canadian Law for uranium mines, it is normally 30 years for other metals (Payne et al. 2002). This highlights the importance of ensuring that a company is sound financially not only in terms of its operating budget, but also in the money that it is allocating to mine closure. Also important is the need for separate mine closure legislation that requires continuous reporting and monitoring of a company's financial position so that governments and communities are not faced with a costly ongoing rehabilitation and closure bill should a mining company be unable to meet its closure financial liabilities.

6.3.4 The ownership of the mine

The ownership of a mine can have a significant effect on mine rehabilitation and closure, as large mining firms will have access to resources (both financial and human) to assist in mine closure and they are also more likely to be involved in research and development programs on end uses (World Bank and International Finance Corporation, 2002). In the case of inferior mine closures, it was more likely that the mining companies involved were small to medium in size (based on market capitalisation) and were more likely to be in financial difficulty, which resulted in the early closure of the mine (see Table 6.4).

In mine closures that occur unexpectedly or early, the companies involved did not appear to embrace a culture of sustainable mining practices throughout the organisation. The key factor for deciding to mine an area was profit, which is expected in a free market economy, but many of the world's top mining companies (including BHP Billiton, Rio Tinto, Alcoa, and Newmont) have incorporated sustainable development policies throughout the mining process. However, this is not practised throughout the industry, despite attempts to develop a number of worldwide guidelines on sustainable mining practices (such as the Minerals Mining and Sustainable Development Report 2003),

Table 6.4 highlights what company owned the mine site and the number of employees employed directly at the mine site which in part demonstrates that in the past not all large mining operations have closed mine sites in a best practice and sustainable manner. It also shows the mining companies are large employers in many of the towns in which the mines are located and that a mine closure will affect a large portion of the population.

The Windimurra vanadium mine in Western Australia (Appendix 1, p. 60) was an exception as the mine was initially owned by Xstrata, a large multinational corporation with over US$30 billion dollars in revenue in 2010 (Appendix 1, p. 64). Despite the size of the company and its commitment to sustainable development (the company devotes a webpage to its sustainability practices), the Windimurra Vanadium mine closed prematurely with claims by Xstrata that the mine was not financially viable (the mine was initially a joint partnership with Precious Metals Australia). As well, the West Australian Government provided money to assist with the development of the site, notably in infrastructure that was to be of benefit to the local government at the end of mining.

Xstrata certainly had the financial resources to clean up the mine site and perhaps keep it in suspended operations until a buyer was found, but it believed that ceasing production and closing the site was its most cost-effective option. During the period 2003-2004, prices for vanadium, the cost of developing the site and an unfavourable exchange rate meant that the company could not hope to recover the costs of the mine (Appendix 1, p. 62).

Table 6.4: Mine ownership and number of employees at mine site

Mine Site	Mine Ownership	Number of employees at mine site
Inferior closure		
Rum Jungle	CRA/RTZ (Now known as Rio Tinto	200 plus at the site
Mount Todd	Pegasus Gold Ltd. Company no longer in operation	200 plus at the site.
Summitville	Summitville Consolidated Mine Company (Company went into bankruptcy).	200 plus at the site
Mount Lyell	Mount Lyell Mining and Railway Company	400 plus at the site
Windimurra	Xstrata	200 plus at the site.
Best practice		
Flambeau	Kennecott Minerals Ltd (Rio Tinto subsidiary)	200 plus at the mine
Ridgeway	Kennecott Minerals Ltd (Rio Tinto subsidiary)	150 plus at the mine site
Elliot Lake	Denison Mines and Rio Algom Limited	7000 plus at the mine sites.
Golden Cross	Couer D'Alene Mines Corporation	200 plus at the mine site
Rother Valley	National Coal Board Opencast Executive	150 plus at the mine site
Penrith Lakes	Boral Ltd	400 plus at the mine site.
Cadia Hill	Newcrest Mining Ltd	200 plus at the mine site
Jarrahdale	Alcoa Australia Ltd	200 plus at the mine site
Lake Kepwari	Wesfarmers Premier Coal	200 plus at the mine site.

In the case of Golden Cross mine (Appendix 1, p. 121), which is located in the town of Waihi on the east Coast of the North Island of New Zealand, a former gold and silver mine was successfully rehabilitated and closed. Golden Cross mine was the first New Zealand mine to initiate a successful planned closure and rehabilitation program (Appendix 1, p. 136). It was the site of an historic mine that first began operating in the region as an underground mine in 1895 and continued until 1920. The site was then returned as farmland and remained that way until mining commenced again at the site in 1991.

The mining at the site was conducted via a joint venture partnership between Coeur D'Alene Mines Corporation (who acquired the site from the original owners Cyprus Gold) and Viking Mining Ltd (a New Zealand based subsidiary of the Todd Corporation, a large private firm that has subsidiaries across a range of resource and telecommunications industries among other sectors). The joint partnership favoured Coeur D' Alene who controlled 80% of the partnership, with Viking Mining Ltd playing only a minor role both in the mining process and in the rehabilitation of the mine site (Appendix 1, p. 125).

The site was mined from 1991 until 1998 and consisted of both an open pit and underground mining operation. From the outset residents clear that upon completion of the mine they wanted the open pit backfilled and recontoured back to what existed prior to mining (a considerable feat, as the open pit extended to a depth of 70 metres). The mine was a profitable site, earning the Joint Venture partners New Zealand $430 million in revenue during the life of the mine and employing nearly 1,000 people both directly and indirectly at the mine site (Appendix 1, p 123). The companies also chose to use mainly local people to work at the mine site, training them at the site and developing an expanded skill set for the local population, in addition to providing a large income boost in the town during the life of the mine.

When the mine ceased production in 1998 it became the first New Zealand mine to move into planned rehabilitation and closure, with the final rehabilitation and closure plans for the site being developed three years prior to the mine ceasing operation after input from the community on the end-use concept. The rehabilitation at Golden Cross was progressively undertaken during the operational phase of the mine project, with the aim of making the site available as a recreational facility for the town through the development of hiking trails, picnic facilities, wetland habitat and in the long-term plans for a recreational fishing facility (this last facility is however still to be realised). The mining company developed a new cyanide recovery process as part of the rehabilitation program at Golden Cross, which aimed to remove cyanide from the discharge before it went into the tailings dam. This meant that the water going into the dam was free from any contaminated materials and could enter the local waterways without polluting them (Appendix 1, p. 128).

The Joint Venture partnership established a Community Consultative Group and a Peer Review Panel during the operational phase of the mine project to assist in determining the end-use layout of the project. Despite the name, the consultative group was actually involved in deciding on the end-use outcomes for the site and were responsible for reporting the outcomes to the Waihi community. The Peer Review Panel included technical specialists, whose role was to oversee the technical aspects of the rehabilitation and report their findings, recommending any changes to the rehabilitation process to the mining companies and regulatory authorities. This panel also acted as the technical advice specialists to the community consultative group on the rehabilitation aspects of the mine closure project (Appendix 1, p. 134-135). The Joint Venture partnership went beyond their regulatory requirements for mine closure at this site, however, they also spent millions of dollars more than they had originally forecast on the rehabilitation program (Appendix 1, p. 136). The project was technically difficult due to the geographical and climatic features of the region, which forced the companies to undertake complex rehabilitation projects.

The companies were both profitable and were able to use their capital reserves to fund this project; however it is difficult to say whether they would have gone beyond their regulatory requirements had the community not been so vocal about their desire to see the site returned to its pre-mining state, without the open pit. There is also no mine closure legislation in New Zealand; rather there is one overriding national piece of legislation, the Resources

Management Act (1991). The regulatory guidelines in New Zealand for mine rehabilitation as in Australia cover only the environmental aspects of mine closure and do not mention the social or economic aspects.

Golden Cross highlights best practice mine closure and provides a good example of how a company can close a mine successfully, exceeding their regulatory requirements, spending more on the rehabilitation program than planned and keep their promises to the local community. The mining legislation was not necessarily responsible for the outcome at Golden Cross, as it was more likely than not that pressure from the community and a desire by the mining companies to maintain goodwill within the community played a role in the outcomes at Golden Cross. The legislation did not require that the mining company assist the community post closure; however the Joint Venture partners assisted workers in finding alternative work at the nearby Mount Martha mine site.

The ability of smaller miners to rehabilitate and close a mine is not an impossible task; however, it requires a large amount of capital (physical and financial) and the ability to continue caring for a site many years after a mine has ceased operating. It is not an option for many smaller mining companies, who may simply not have the capacity to undertake a long-term investment post mining (Pierce and Wen, 2006). This is where regulatory agencies need to determine the ability of an organisation to meet closure requirements; a requirement that does not exist in today's regulatory environment. It highlights the need for dedicated mine closure legislation where financial viability becomes part (needs to consider the size and profitability) of the mine closure requirements.

6.3.5 When the mine closure was planned

No closure planning was undertaken in the inferior cases (see Table 6.5) and in most was not required by legislators. This has changed as legislation in Australian states and territories now generally require a rehabilitation plan be undertaken before mining commences. Still, the actual closure plan is normally not a requirement of this process, leaving the mines and communities exposed to many of the problems that eventuated from the lack of planning.

The year the mine closure was planned at each of the respective mine sites examined in the desktop case studies is shown in Table 6.5. The table also contains the requirement at each of the sites for mine closure plans. The table shows the evolution of mine rehabilitation planning with mine rehabilitation and closure planning becoming a requirement from regulatory bodies from the 1980's onwards. However, it also shows that closure planning is still generally only required towards the end of a mine's life and focuses heavily on rehabilitation requirements.

Table 6.5: Year of closure and need for closure plans

Mine Site	Year closed	Closure plan requirements
Inferior closure		
Rum Jungle	1971	No closure plan required
Mount Todd	2000	No closure plan required
Summitville	1992	Closure rehabilitation plan required near end of mine operation
Mount Lyell	1992	No closure plan required
Windimurra	2004	Mine closure rehabilitation plan required.
Best practice		
Flambeau	1997	Closure rehabilitation plan not required until end of mine life. However mining company developed closure plan with local government before mining commenced
Ridgeway	1999	Closure rehabilitation plan not required until end of mine life. However mining company developed closure plan with local government before mining commenced
Elliot Lake	1991	Closure rehabilitation plan not required until end of mine life
Golden Cross	1998	Closure rehabilitation plan not required until end of mine life
Rother Valley	1981	Closure rehabilitation plan not required until end of mine life, however local councils developed closure plan with company from the commencement of mining
Penrith Lakes	2012	Closure rehabilitation plan not required initially, was developed towards latter stages of mine operation
Cadia Hill	Ongoing (due to close 2013, lease extended in 2011 for 30 plus years)	Closure rehabilitation plan required from commencement of mine operation
Jarrahdale	1998	Closure rehabilitation plans required near end of mine's life.
Lake Kepwari	2000	Closure rehabilitation plans required near end of mine's life.

Mount Lyell in Queenstown, Tasmania (Appendix 1, p. 45) provides a good example of where no mine closure planning was undertaken and has resulted in a landscape that has been described as moonlike due to the barren nature of the landscape surrounding the mine. Not all of the landscape surrounding Queenstown is associated with mining, as some of it was caused by deforestation from logging and acid rain from smelters operating in the area. The mine has contributed to heavy pollution in the nearby waterways that feed Macquarie Harbour and has been doing so since mining commenced in Queenstown in 1883 (Appendix 1, p. 48).

Mining at Mount Lyell was characterised by a focus on the economic benefits of mining to the region and no concern with environmental impacts let alone closure of the mine. Part of the reason this occurred was because the mine was considered to be part of the economic and social fabric of the town and the environmental damage caused by the mine has actually made the town infamous as a tourist attraction. Regulators paid little attention to the environment at the Queenstown site and various State governments exempted the operators of the mine site (Mount Lyell Mining and Railway Company) from environmental regulations (Appendix 1, p. 54). The mine also became the dominant industry in the region and was a major employer in the town, in addition to providing export (and royalty) income for the State of Tasmania.

The operators of Mount Lyell along with regulators never planned the closure of Mount Lyell as the site was only valued for its economic benefits. What occurred at Mount Lyell was not just the result of the lack of a closure plan; it was a lack of regulatory vigour surrounding the entire mining process. When Mount Lyell initially opened, closure planning and environmental concerns were not factored into mining operations, however even in the latter stages of the 20th Century with changes to the Tasmanian Mining legislation (Appendix 1, p. 55) to remediate the impacts of mining on the environment, this mine site was discharged of responsibility from its impact on the environment. In a strange twist to this saga, in 1994 the Mount Lyell Railway and Mining Company were required by a change in its agreement with the State Government to rehabilitate the site. However, the State Government promptly ordered a stop to this due to opposition from local residents who were against the remediation of the site, claiming that the site needed to be revegetated naturally. The Mount Lyell Railway and Mining Company ceased operating in 1994 and the lease for the site was taken over by Copper Mines of Tasmania in 1995, with a new agreement between the company and the State Government that required the company to adhere to best practice environmental guidelines as required by the *Copper Mines of Tasmania Pty. Ltd. Agreement Act 1994.* However, the new company had no responsibility for environmental damage caused by previous mining at the site (Appendix 1, p. 49).

The situation at Mount Lyell demonstrates what can occur with a development at all costs approach to mining and how failing to plan and regulate mining can cause costly problems for local communities and indeed for the wider community, particularly when state and federal governments must bear the financial cost of remediating past mistakes. Although mining commenced at this site at a time when mine rehabilitation was unheard of, later decades saw rapid advancements in mine rehabilitation techniques and changes to legislation to more stringent requirements for mine rehabilitation. The case demonstrates a complete lack of concern by both regulators and the company of the impact that mining had on the local region and indeed on the surrounding ecosystem.

The Meadowbank in the town of Rotherham in the United Kingdom provides a good example of mine closure planning that was actively undertaken by local government taking the initiative, rather than the mining company (Appendix 1, p. 136).The end-use planning for the mine however did not occur due to the mining legislation at the time. It was solely a Council driven initiative and demonstrates how local government can become involved in the mine closure planning and development process including funding part of the project if it is feasible.

Not all communities will have the capacity to become involved in mine rehabilitation in the manner that the five councils involved in Rother Valley Country Park did. Communities will have differing resources and differing requirements when it comes to the closure of a mine site. What is certain however is that all communities need to be involved in the planning process for mine closure from the commencement of the mine planning phase in order to achieve the most sustainable outcomes (Biggs, 2000). Local communities are best placed to determine what they believe to be the best end-use outcomes for a mine site, as they will bear the benefits (or costs if closure is not well planned) for generations (World Bank and International Finance Corporation, 2002).

6.3.6 How the mine closure was planned and conducted

The discussion on planning and conduct of mine closure follows on from the previous section by more broadly considering strategies put in place to deal with mine rehabilitation and closure. In the case of all of the inferior mine closures, there was no planning for closure, as economic imperatives overrode any environmental and social objectives (see Table 6.6). Mine closures that are not properly planned and conducted can lead to an area that has pollution problems for many years, often well after the mineral reserves have been exhausted. In cases of poor closure, a lack of planning by all parties involved in the process (Mining companies, State and Local Governments) is one of the key factors causing these mines to be considered inferior mine closures.

An outline of whether or not any mine closure plans that were conducted at each of the case study mine closure sites considered the environmental, social and economic needs of the community in which the mines were located is shown in Table 6.6. In addition to this, the table highlights whether or not any closure plans took into account the post closure needs of the community. The research from the case studies showed that in all of the inferior closure examples the future of the community post closure was not considered in planning for the mine. In the best practice examples, however, there was at least some degree of consideration for the post closure needs of the community in the mine planning process.

Table 6.6: Planning for communities closure needs

Mine Site	Environmental, economic & social factors in plan	Future of community post closure in plan
Inferior closure		
Rum Jungle	No environmental, economic or social factors considered	No
Mount Todd	No environmental, economic or social factors considered	No
Summitville	No environmental, economic or social factors considered	No
Mount Lyell	No environmental, economic or social factors considered	No
Windimurra	Environmental factors only considered as part of initial rehabilitation plan	No
Best practice		
Flambeau	Closure planning considered environmental, economic and social factors.	Yes
Ridgeway	Closure planning considered environmental, economic and social factors.	Yes
Elliot Lake	Environmental factors only considered as part of initial rehabilitation plan	No
Golden Cross	Environmental factors only considered as part of initial rehabilitation plan	No
Rother Valley	Closure planning considered environmental, economic and social factors.	Yes
Penrith Lakes	Closure planning considered environmental, economic and social factors.	Yes
Cadia Hill	Environmental factors only considered as part of initial rehabilitation plan	No
Jarrahdale	Environmental factors only considered as part of initial rehabilitation plan	No
Lake Kepwari	Closure planning considered environmental, economic and social factors	Yes

In the example of Rum Jungle (Appendix 1, p. 14), no rehabilitation or closure plans were enacted when mining at the site ceased in 1971 due to large uranium stockpiles, low commodity prices and poor demand for the ore. The Commonwealth through the then Australian Atomic Energy Agency was responsible for the site, although management and mining of the site was conducted by private industry, notably by CRA RTZ (later to become Rio Tinto). Mining commenced in 1954 in response to demand for uranium from the US and UK energy agencies, however, much of the ore body was stockpiled during the life of the mine, due to insufficient demand from these agencies. Copper from the site was also mined by a subsidiary of what was to later become Rio Tinto, which was more successful in selling its product, however this also fell victim to poor commodity prices (Appendix 1, p. 15).

The Finnis River was diverted through the site, with the tailings from the mine being deposited into the river during the life of the mine, contributing to massive pollution at the mine both during and after mining. The region's high rainfall (it sits in the monsoon zone) contributed to acid runoff causing further pollution in the surrounding ecosystem. No rehabilitation was undertaken during the life of the mine (nor was there any requirement to do so by Federal regulatory bodies). The then Australian Atomic Energy Agency undertook research after the site closed in 1971 that determined that pollution at the site and surrounding areas was extensive, however the Australian Government elected not to allocate any funding at that stage to rehabilitation.

A working group was eventually established to examine options for rehabilitation in 1977; however, it was not until 1983 that money was committed by the Federal and Northern Territory Governments to commence rehabilitation and a cleanup of the Finnis River system (Appendix 1, p. 18). By 1990 more money was provided by the Federal Government to clean the waste dumps at the former mine site, however as late as 2001 there was still acid drainage and the site has been described as having the one of the worst environmental problems for a mine site in the country (Appendix 1, p. 18).

The Rum Jungle site highlighted problems with mining legislation in Australia and in particular at the time in the Northern Territory a failure to require rehabilitation bonds from mining companies (this changed after the establishment of the 1977 working group into the Rum Jungle mine). The Federal Government through the then Australian Atomic Energy Agency failed the people of the area (as they have also been most affected by the closure of this site) as well as what was a pristine environment by not requiring any type of mine rehabilitation or closure planning process to be carried out. The companies responsible for mining at the site were absolved of any responsibility for rehabilitation and their refusal to rehabilitate the site upon the cessation of mining highlighted a lack of vigour in the regulatory process at both Territory and Federal levels.

Although Rum Jungle was not entirely the fault of the companies and much of the blame needs to lie with the regulators at both levels of government, it demonstrates how poorly planned mine closures can resonate within the communities for many years and can be used as campaign material to generate support against particular mining activities. The case proves that it is vital for regulators to ensure that the mining process is both rigorous and transparent and that mine closure planning and management is not just an afterthought. The case studies indicate (Table 6.6) that the largest companies in the country Rio Tinto (Kennecott and Ridgeway mines), Wesfarmers (Lake Kepwari), Alcoa (Jarrahdale), and Newcrest (Cadia mine) plan for the rehabilitation and closure of a mine during the early phases of the mining process.

At the Kennecott Minerals mine in Ridgeway, South Carolina (Appendix 1, p. 87) the local community were strongly opposed to the development of a mine site in an area that had previously not been mined, in a state that is not known for its mining industry. Local residents were opposed to mining at the site because it would negatively affect the local ecosystem and because of the impact it would have on what was a quiet rural community. Locals were so opposed to the mine that they brought a lawsuit against Kennecott Minerals to prevent them from mining the site. The mining company managed to circumvent the lawsuit by drawing up a legal agreement with the local community that bound the company to a number of guarantees for the site post closure. These guarantees included features such as the development of a wildlife management plan, providing financial payment to locals should their wells become contaminated from mine site water, with an independent groundwater consultant monitoring water at the site (other aspects of this agreement can be seen in Appendix 1, p. 90-91). This agreement forces the company to alter its initial rehabilitation and closure plans for the site to meet the expectations of locals who wanted the site returned to a state better than existed prior to mining.

The Ridgeway mine incorporated the open voids into the final landform design at the site, with the open pits developed into two non-recreational lakes, wetlands and prairie grassland with the site rehabilitated on an ongoing basis. Additionally, the company established a larger than required buffer zone around the mine site to reduce both noise and the physical impact of the site on the surrounding landscape. The extra cost to the company in meeting the demands of the community were quite substantial with a trebling in costs from the company's initial closure plan from US$9.5 million to US$28.3 million upon completion of the project in 1999 (Appendix 1, p. 90).

This site and the potential legal problems forced Rio Tinto (Kennecott Minerals is a subsidiary of Rio Tinto) to alter the way it closes mine sites and saw the company adopt a framework for sustainable development that has been incorporated into company policy (Appendix 1, p. 91). The company admitted that it did not necessarily handle the early phase of the mine development well and that they initially ignored the community's wishes about the mine proceeding. Kennecott Minerals believed that their experience at Ridgeway yielded insight into the mine closure process that it used as a baseline for future mine closures. This included planning for both short-term community benefits that occur during the operational phase (such as developing recreational facilities, establishing community grant programs) and long-term sustainable development opportunities that are designed to benefit a community once mining has ceased (such as assisting with retraining programs, new business development opportunities, or developing a mine site for alternative uses). They also found that the formal agreements, like they signed with the Ridgeway community, actually improve community acceptance of projects and enable them to address the long-term consequences of a project. Similarly, a well planned mine closure project from the start will gain greater community acceptance for post closure usage and enable decisions to be made about the provision of infrastructure (Appendix 1, pp. 92-93).

Despite the legal wrangling over this site and probably because of the legal issues surrounding Ridgeway, this has become a success story for mine closure. The actual planning process was well instigated; however, it took a concerted effort by those opposed to mining before the mining company changed its outlook for the site and addressed community concerns. The path that Kennecott took in signing a legally binding agreement with the community meant that the community had recourse if the mine closure outcomes did not meet expectations. Such events would not have to occur if mine closure legislation were introduced that allowed communities to have input into the mining process from the outset. Under such legislation, the outcome at Kennecott may well have been the same, without the need for the community to feel that their only recourse for action was through the courts.

6.3.7 Alternative closure options

The closure of a mine presents mining companies with an opportunity to consider a number of options for land use after mining; however, without exception in each of the inferior case study examples, not one had options for alternative land uses at the site as all closed unexpectedly and without any closure planning in place. Table 6.7 lists the end-use developments that occurred at each of the case study sites and the current status of the end-uses for each of the mines. As the table demonstrates many of the inferior closures feature abandoned mine sites that in a number of instances are still costing both local communities and governments (at all levels) not just in economic consequences, but also environmental and social.

Table 6.7: Alternative closure options

Mine Site	Mine end use development	Current status
Inferior closure		
Rum Jungle	Abandoned mine	Remains abandoned
Mount Todd	Abandoned mine	Remains abandoned
Summitville	Abandoned mine	Remains abandoned
Mount Lyell	Scarred landscape	Land still awaiting rehabilitation
Windimurra	Abandoned mine	Remains abandoned
Best practice		
Flambeau	Recreational area	Status as intended end use
Ridgeway	Recreational area	Status as intended end use
Elliot Lake	Recreational area	Status as intended end use
Golden Cross	Recreational area	Status as intended end use
Rother Valley	Lake/Recreational area	Status as intended end use
Penrith Lakes	Recreational area	Status as intended end use
Cadia Hill	Native forest	Progressive rehabilitation
Jarrahdale	Recreational area	Status as intended end use
Lake Kepwari	Lake/Recreational Area	Awaiting regulatory approval

Alternative closure options for some mining companies and even for regulators may well be contentious because the easiest option is to rehabilitate a mine to at least its pre-mining state (which is the requirement of all State and Territory legislation in this country) rather than thinking about post-closure uses, particularly during the mine planning stage. In deciding on alternative closure options mining companies, governments and communities have to determine what they want done with the mine site and if the void is not backfilled what they want done with the void. Evidence from the case studies is that there are three options available for use of an open void, with options being dependant on how large a community is, its distance from major population centres and its accessibility from them, the economic diversity of the region, the climate of the region and reliability of rainfall, the regions geology and ability of the ecosystem to cope with any development post-mining for recreational usage. This is discussed in further detail in Appendix A pages 9 and 10, but the key point to come out of this section is that mining companies and regulators need to listen to the needs of the community early in the process or risk a proposal never gaining acceptance. As Fred Fox the former Director of Health Safety Environment and Reclamation at Kennecott minerals stated in relation to this as one of the lessons learned from their Ridgeway mine (Appendix A, pp. 92-93):

> "Informed, transparent, inclusive and equitable decision making processes with all known stakeholders are needed well in advance of deciding project scope, budget and schedule along with reclamation and closure objectives..."

At Kennecott's Flambeau mine, the company originally proposed an open pit that would be mined to a depth of 91 metres and would have an operating life of approximately 11 years. This was opposed by the local council and some residents (particularly those close to the proposed site) and the company decided to shelve the plans for the site until 1986 when they reapplied for a mining lease. The new proposal was scaled back significantly as the company realised after listening to the concerns of the community that the original proposal was too large and that residents wanted all processing done off site and the pit backfilled and recontoured to match the landscape. The company complied with these wishes signing a legally binding agreement with the local community to ensure that the changes were undertaken as promised by the company (Fox, 2003).

There is no one option for a mine closure that is suitable for a community. Each community is different and hence each mine closure needs to be addressed at a site-specific level. Successful mine closures such as Flambeau demonstrate the importance of all parties working together to achieve the best possible outcomes for a mine closure. If mine closure is to be truly sustainable it needs to ensure the end-use outcomes are what are needed for a particular community. The agreement signed between the local government areas and the mining company may not have been required had mine closure legislation been in place that required the parties to negotiate at a local level in the first place. As has been stated it is the local communities that have to live with the long term costs and benefits of mining projects and it is important that they are able to influence the outcomes and that their interests (environmentally, socially and economically) are protected through a more formal process.

6.3.8 The legislation under which the closure was conducted

The inferior mine closure examples all demonstrate how legislation requirements failed not only from an environmental, but also from a socio-economic perspective (Table 6.8). Regulators were also unsuccessful in these cases, although to be fair they were often working within regulatory guidelines that did not provide them with the ability to rectify the problems that occurred at these sites. In each of the inferior mine closures, poor regulatory environments contributed to the problems experienced both with and after the closures and in some instances allowed for a premature closure of the site with few ramifications for the organisations concerned. More stringent regulatory requirements or guidelines specifically related to mine closures and forcing companies to prove that projects are economically feasible, are required in order to mitigate unexpected closures (Garcia, 2008)).

Table 6.8 lists whether or not the case study mine sites required the payment of rehabilitation bonds (also known as financial assurances) as part of the mine closure legislative process. As can be seen in the table, evolving legislative requirements over the years have forced many governments to include financial assurance payments as part of the mine approvals process. The second part of the table details whether or not a mine site met or exceeded its legislative closure requirements. In the inferior example cases, the mine sites did not meet the regulatory requirements and despite the use of rehabilitation bonds in some of the inferior case studies the costs of rehabilitating the sites was greater than the amount provided by the bonds. In each of the best practice examples, the mining companies met or exceeded their regulatory requirements in regards to the rehabilitation and closure of the site.

Table 6.8: Requirements of closure legislation

Mine Site	Rehabilitation bonds required	Met or exceeded regulatory requirements
Inferior closure		
Rum Jungle	No	No
Mount Todd	No	No
Summitville	Yes	No
Mount Lyell	No	No
Windimurra	Yes	No
Best practice		
Flambeau	Yes	Yes
Ridgeway	Yes	Yes
Elliot Lake	No	Yes
Golden Cross	Yes	Yes
Rother Valley	No	Yes
Penrith Lakes	Yes	Yes
Cadia Hill	Yes	Yes
Jarrahdale	Yes	Yes
Lake Kepwari	Yes	Yes

At Elliot Lake, the last mine closed in 1996 at which time the mining companies were working with the Canadian Nuclear Safety Commission to instigate the largest mine rehabilitation program ever undertaken in Canada and one of the largest in the world. The aim of the project was to rehabilitate all 12 mine sites to the same standards using the same guidelines and criteria for each (this was on top of the work done on a voluntary basis). At the same time, the Commission, the mining companies and the local and provincial governments began undertaking measures to address the socio-economic aspects of the mine closure, including assisting the relocation of displaced workers, allowing early retirement for mine workers through the provision of retirement packages, allowing mine workers to buy at a reduced rate the former mine rental properties around the town, and providing financially for the maintenance of former mine infrastructure around the town (Appendix 1, p. 116).

What set the closure of Elliot Lake apart from other mine closures was a decision by the Federal and Provincial Governments to allow just one body (the Nuclear Safety

Commission) to oversee the entire rehabilitation and closure project around the mine sites. This meant that all parties had to only report to one body for all issues relating to the rehabilitation and closure, rather than dealing with separate institutions as is normally the case. Unfortunately, this has been the exception rather than the norm to this day in mine closures across the world, despite the process being recognised by the International Atomic Energy Agency as the best way to conduct mine closure (Appendix 1, p. 115).

Elliot Lake was by no means a prefect mine closure from a regulatory perspective, the regulatory regime under which it operated, particularly in the early days of mining demonstrated little concern for the rehabilitation and closure of the mines. The fact that the mining companies felt the need to operate within the Provincial legislation on a purely voluntary basis speaks volumes about the lack of rigour in the early Federal legislation governing uranium mining in particular. The decision to use one regulatory body to oversee the rehabilitation and closure of the former mines proved to be a wise decision. It was a complex project involving many mines that had not all been rehabilitated to the same standard.

There were concerns about the effects of both acidity and possible radiation leakage into the surrounding environment that required a great deal of research and mitigation techniques. There was also the socio-economic impact of the mine closure. This was a mining town first and foremost, and at the time of closure had a fairly large population of 14,000 by the time of the last mine closure and which required some substantial planning to assist the City in overcoming the negative impacts of the mine closure and diversify the local economy (Appendix 1, p. 105). Unfortunately, Canada like Australia still has no closure legislation in place and each of the provinces and territories continue to regulate mining independently yet Elliot Lake stands out as an example of how best practice mine closure can be achieved, sometimes operating outside of current governance structures.

The issue with the lack of mine closure legislation as it stands in this country today is not the companies meeting or exceeding their regulatory requirements it is reigning in the companies that do not meet their obligations, or that ignore the post mining impacts on a community. Legislation in Australia presently measures successful mine closure by the success or otherwise of the rehabilitation program undertaken at a mine site.

6.3.9 Engagement with stakeholders

Despite its relatively small footprint, mining can have an enormous impact on the environment. This is particularly the case with open cut mining where the mine voids if not backfilled at the end of the mining process can leave large bodies of often acidic and/or saline water behind. It is not surprising then that communities can become quite anxious over the impact a mining project is going to have on its environment. Cases such as Rum Jungle, Mount Todd, and Windimurra leave behind negative perceptions of the mining industry and are used by communities wishing to reject a mining project in their area. Unfortunately for the mining industry, its past actions have left it vulnerable to perceptions from the wider community that the industry is polluting, opportunistic, concerned only with digging holes in the ground.

Each of the inferior case studies provided (Table 6.9) examples of why engaging with local communities is vital if best practice closure outcomes are to be realised. In each of the inferior case studies in this section, the interests of the community was not factored into the mine closure, in all of the cases the community was barely engaged in the operational phase of mining let alone the mine closure process. A lack of involvement by the community from the outset of mine planning contributed to poor closure outcomes.

The community engagement processes that were undertaken at the mine sites examined as part of the desktop case study process are shown in Table 6.9. It demonstrates there were varying levels of consultation and participation at each of the sites, including the best practice examples. In terms of community engagement, few of the sites studied demonstrated a strong community engagement process.

Table 6.9: Stakeholder engagement

Mine Site	Community consultation/participation	Community engagement
Inferior closure		
Rum Jungle	No	No
Mount Todd	Limited	No
Summitville	No	No
Mount Lyell	No	No
Windimurra	Limited	No
Best practice		
Flambeau	Yes	Yes
Ridgeway	Yes	Yes
Elliot Lake	Yes	Yes
Golden Cross	Yes	Limited
Rother Valley	Limited	No
Penrith Lakes	Yes	Limited
Cadia Hill	Yes	Yes
Jarrahdale	Yes	No
Lake Kepwari	Yes	Yes

In the case study of the Summitville mine in Colorado (Appendix 1, p. 30), there was no community consultation regarding closure plans for the site, due in part to the unplanned nature of the closure, but also to the lack of any closure plan for the site by the company. The site became synonymous in the United States with bad mining practices as a result. A federal body (the US EPA) took over responsibility for the site after it was closed and it was the EPA that provided the local community with input into the rehabilitation program that it undertook at the site. The EPA worked in conjunction with the Colorado Department of Public Health and Environment to establish a community advisory panel, the Community Technical Assistance Group who are still working with these regulatory bodies to deliver rehabilitation outcomes for the site. The Technical Assistance Group had six key areas of involvement as part of their terms of reference (Appendix 1, p. 40), ranging from ensuring that open communication exists between the regulatory authorities, the Technical Assistance Group and the wider community, to determining what rehabilitation programs have been successful and what have not.

The two regulatory bodies have recently released a five year rehabilitation plan for the Summitville site that has been compiled with input from the local community that is driving the future rehabilitation projects at the site. Due to the nationwide exposure that the site has gained and the cost of the restoration project to US and Colorado taxpayers (US $133million up to 2010) (Appendix 1, p. 39), US Congressional leaders are taken on regular tours to demonstrate the changes being made by the rehabilitation program and no doubt to determine whether or not taxpayers are getting value for money. The irony of Summitville from a community engagement viewpoint is that the community became engaged with the project after bankruptcy of the company. The pity of this is that the input from the community arrived after the closure and the damage that had been done at the site due to lax regulatory requirements governing the mining industry in the state of Colorado at the time.

This case demonstrates why the social and economic issues surrounding mine closure can be just as important as the environmental and why rehabilitation is only one part of the mine closure process. The ability of the community to rally around the rehabilitation program demonstrates how communities can be used as allies and provides valuable input into the mine closure process.

Evidence from the cases studies is that even in the best practice examples there were differing levels of community involvement or engagement in the mine closure process (Table 6.9). The blame for this cannot be laid solely at the feet of the mining companies, as best practice engagement is something that should not be left to the discretion of the mining companies. Regulatory agencies have traditionally been happy for just some form of dialogue between mining companies and local communities and have not necessarily been concerned with whether or not these communities have felt empowered by the process. This lack of community involvement can also be blamed in part on the nature of mine closure, which has traditionally been an afterthought in a mine project and not a feature requiring careful planning and consideration from all parties.

The Flambeau mine in Wisconsin (Appendix 1, p. 72) provides a good example of how to actively engage the local community in a mine project both during the life of the mine and post closure. The mining company and the three local government areas whose boundaries the mine abutted (City of Ladysmith, Rusk County and Town of Grant) signed a legally binding agreement that provided a number of guarantees to these communities as part of the mine development. The agreement was known as the Local Agreement and Conditional Land Use Permit and was designed not only to overcome opposition to the mine, but also to prove the company's commitment to the community. There were a number of key factors to the agreement, some of which were (the list in full is in Appendix 1, pp. 84-85):

- At least 75% of employees had to be local, living within 10 miles of the Rusk County Border
- The development of a Visitors Observation Area to watch the mining and rehabilitation work being undertaken and the development of this into the final plan for the site
- Local Governments given the right of first refusal for any properties being sold by Kennecott at Flambeau
- Annual inflation indexed payments of US $100,000 were made to the three local governments.
- Net proceeds taxes were returned to the local governments from the state government as a way of attracting new economic development opportunities to the region post closure
- Kennecott worked with the Ladysmith Community Industrial Development Corporation to develop an industrial park at the mine site using the old mining infrastructure including a railway spur.
- The company developed an agreement with the City of Ladysmith to build a series of hiking trails at the site for use in the post mining development.
- The company formed a land use management committee in 2004 (that still operates today) to develop and maintain a land use plan for the site. The committee consisted of local government and community representatives.

A report on the socio-economic benefits of the mine was compiled by a local planning authority in 2005 to highlight how the mine benefitted the community both socially and economically and also to determine local attitudes towards the development. The report found that public and private investment in development projects associated with both mining and post mining development totalled US$33 million across the three regions (Appendix 1, p. 86). The report also found that the vast bulk of respondents (90%) believed that Kennecott Minerals rehabilitated the mine consistent with what they had promised and brought economic benefits to the region both during and after mining, as promised. The findings from this report demonstrated how Kennecott Minerals had managed to go from having the mine resisted by the community, to being seen as socially responsible corporate citizens with 75% of people saying they would not oppose another development if it were proposed by the company in this community (Appendix 1, p. 86).

In terms of their social engagement with the local community, Kennecott Minerals provided community sponsorship grants for a variety of community programs including school scholarships, building a playground for a local school and funding a new library development (Appendix 1, pp. 75-76). This was in addition to a number of committees that were established during the life of the mine to examine a range of issues from the rehabilitation program to post mining land uses for the site.

Flambeau occurred due to the positive interaction between mining companies, the State government and most notably and (unusually for a mining project) local government. The record of engagement at Flambeau is not always been replicated in mine closures. In New South Wales, the *Mining Act (1992)* requires mining companies to consult with communities regarding their rehabilitation programs on a regular basis (Appendix 1, p. 10) making it the most comprehensive in this respect in the country.

6.4 Conclusion

The case studies on inferior mine closure are meant to provide salient lessons on how not to close mine sites and provide evidence as to why governments, local governments and communities and the mining companies themselves need to consider a holistic approach to mine closure that takes into account not just environmental but also economic and social factors. The inferior or poor mine closures have all occurred due to a lack of any comprehensive closure plan that would have prevented some of the problems that arose as a result of poor planning. These case studies illustrate why it is so important that planning for mine closure begins during the initial mine planning phase and covers not just the rehabilitation plan, but also the socio-economic impacts of a mine closure.

They also highlighted financial liabilities as an area where many mining projects seem to come undone. It is an area that government regulators are reluctant to address when it comes to granting approval for mining projects. There is a need for projects to demonstrate that they are financially viable throughout the life of the mine and for either regular financial updates regarding a mine site to be made available to regulators, or at the very least for a mining company to prove that a project is no longer financially viable for them before proceeding to close a mine site.

This of course may cause some concern among mining companies about the costs of doing business and regulatory burdens, however, the cost of an unplanned closure on taxpayers and local communities, as has been demonstrated by these few case studies, outweighs any benefits that they may have gained from the operation of these mines. The inferior case studies examples have highlighted what can go wrong when mining companies, regulatory bodies and governments at all levels fail to address mine closure from the outset of the mining process.

The desktop case studies were chosen for their unique perspectives on inferior and best practice mine closure. They are by no means comprehensive, nor are they the only examples. The process is designed to show in detail how each case study met or did not meet the closure criteria that was determined by the research to highlight what is currently missing from mine closure in this country and what constitutes best practice. This chapter was designed to highlight the key points from the desktop case studies demonstrating how individual cases did or did not meet the criteria and illustrating how at times various mining companies, regulatory bodies and communities thought outside their legislative guidelines to develop a unique approach to mine closure.

The case studies indicate that the size of a mining company, its profitability and the mine ownership are important determinants in the success or otherwise of a mine rehabilitation and closure program. The larger a company and the more profitable a mine the greater the likelihood that mine rehabilitation and closure will be undertaken. In part this reflects the ability of the company to devote the resources (financial and human) to a mine closure program. It is also in part due to larger companies facing more scrutiny from the public in their operations and any negative sentiment can affect the value of a company (particularly if it publicly listed) and also affect their social licence to mine. This does not mean that all large corporations will close a mine with a best practice outcome (as seen in the inferior case studies) and it highlights why specific mine closure legislation with specific closure requirements is needed. It will not prevent mining companies from closing a mine prematurely, what it can do however is put in place strategies to deal with this type of event, such as providing financial guarantees for rehabilitation and assistance packages to employees and communities.

Each of the poor practice examples failed to meet the mine closure criteria and were consistent in demonstrating how poor regulatory guidelines and corporate governance results in mine closures that are not only noteworthy for their environmental costs, but also the social and economic costs that local and wider communities inevitably have to endure. There is a common theme running through all of the inferior closure examples and that is a failure by all parties to plan for closure (both expected and unexpected). Despite the current mining boom, all mining projects carry with them a degree of strategic risk and this includes the risk of mines closing prematurely. Too often regulatory authorities fail to factor this risk into their approval processes. Likewise, local governments all too often ignore this element of risk, yet it is precisely them and their communities that are most adversely affected by an unexpected and unplanned closure. The old adage 'failure to plan is planning to fail' has never been more apt than in mine closure. In order to prevent some of the failures that have been demonstrated in the case studies it is vital that mine closure planning becomes part of the initial mine planning phase.

The next chapter is a continuation of the desktop case study, using four Australian case studies, two each from New South Wales and Western Australia. It takes a more in-depth view of the closure process, using interviews conducted from sources familiar with the mine site rehabilitation and closure programs associated with the four case studies. The chapter provides a summary of the interviews conducted across the four mine sites with the aim of determining whether the data from the desktop case study research correlates with the data collected from the interview process.

Chapter 7. Stakeholder views of best practice mine closure in Australia

7.1 Introduction

In-depth investigations of mine closures in four mining locations in both New South Wales and Western Australia were integral to the research for this thesis. The sites chosen were Penrith Lakes in Penrith, New South Wales, Cadia Gold Mine in Orange New South Wales, Jarrahdale Mine in Jarrahdale, Western Australia and Lake Kepwari in Collie, Western Australia. Of the sites chosen, two have ceased mining and two are still in operation, although one of the latter is due to close in 2012 and has been used for recreational purposes. This approach was taken as the mines still in operation have conducted a program of progressive rehabilitation throughout the mining operation, adopting a best-practice approach with end-use plans developed during the early years of mining. The remaining two mines have both ceased operating and have been rehabilitated and closed with one of the mines planning to turn a former mine void into a recreational lake and utilise the area surrounding the lake for recreational activities, the first time such a task has been undertaken in a former mine void in this country.

The aim of the chapter is to report on the field research undertaken at these sites. The field research consisted of in-depth interviews and investigation of the four mine sites, in conjunction with in-depth interviews with relevant staff from surrounding councils and government authorities and an independent community member.

7.2 Objectives of best-practice analysis

The objectives of the in-depth analysis of four best practice case studies were to:

- Determine if there are common criteria to best practice closure outcomes based on the nine criteria that were developed from the desktop analysis.
- Determine whether the gaps identified in the desktop research on mine closure are acknowledged as gaps by industry, LGA’s and community groups.
- Develop an outline of best practice closure, including identifying the gaps in mine closure practice.
- Highlight whether or not the gaps that have been found in this thesis in relation to mine closures are identified by industry and local governments (those most affected by mining) and seek their opinions on how to rectify them.

7.3 Methodology

Four desktop case studies were chosen from the fourteen desktop case studies used in Chapter 6. The four case studies were chosen as they represent best practice mine rehabilitation and closure as it currently stands in Australia. Although in all cases they fall short of what was found from the desktop analysis to constitute best-practice closure, they all met and generally exceeded the current regulatory requirements and provided some valuable insight into what is good with current regulatory guidelines and how the legislation falls short in relation to mine closures.

The case study method was chosen in order to develop a holistic approach in the analysis of best practice mine closure. This approach to case study analysis concurs with what both Yin (2004) and Padgett (2008) found in relation to the use of a multiple case study inquiries where holism is required over disaggregation. The case study inquiries are also designed to further knowledge development (Padgett 2008) on mine closures (both good and bad) as a means of developing a broad framework for mine closure. In-depth, semi-structured interviews were conducted with some of the key players associated with the mines for the case studies and included the mining companies, the local government areas, community members and some regulatory bodies.

7.3.1 Overview of four case study sites

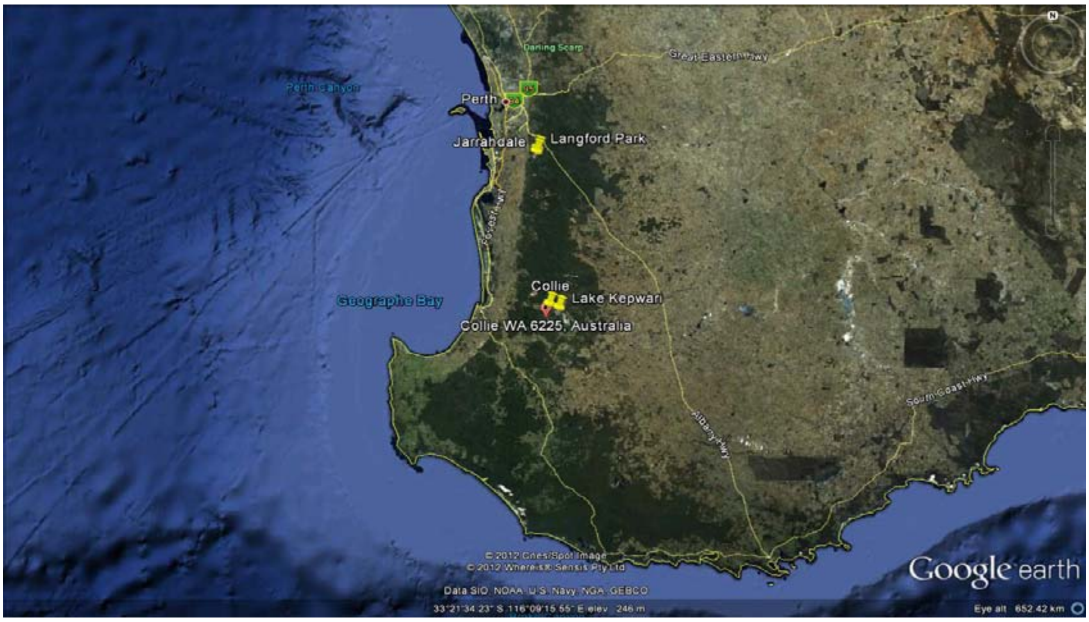
This section of the chapter provides an overview from the desktop findings of the four case studies providing a brief summation of the sites, including for example; where the mines are located, the type of mineral mined at the site, the size of the mine site and the end-use options for the site. The aim of the section is to demonstrate why these four studies were chosen and why they represent best practice closure as it currently stands in Australia. Further detail on the four case studies is provided in Appendix 2 with the case studies being examined using the nine criteria used in the case studies for Appendix 1, in order to generate consistency in the case study methodology. The four case studies are:

- Penrith Lakes, New South Wales
- Cadia Hill, New South Wales
- Lake Kepwari, Western Australia
- Jarrahdale, Western Australia.

Their locations are as shown in Figure 7.1 and Figure 7.2.

Figure 7.1: Location of two New South Wales mine sites

Figure 7.2: Location of two Western Australian mine sites



Penrith Lakes, New South Wales

Penrith Lakes was not an ore body mine, but rather a series of sand and gravel quarries operating in Penrith, approximately 55 kilometres from the centre of Sydney at the base of the Blue Mountains. This was Australia’s largest sand and gravel quarry mine site, at one of a number of former voids that have been turned into recreational lakes and wetland areas with other recreational facilities including parklands, walking and bike trails and picnic facilities being developed at the site as part of the closure plans.

The mine site itself is vast, covering over 2,000 hectares, with part of it still being mined, with final closure due within the next five years (Appendix 2, p. 27). The mine site's position on the suburban outskirts of Sydney, places it in within easy driving distance for the nearly 5 million people in the city. This was one of the reasons the site was developed in the manner that it was, with the Penrith Lakes development now attracting approximately 500,000 visitors per annum (Appendix 2, p. 28). The plans to turn the site into a recreational attraction began in 1979 when the then mining companies (Boral, Readymix and Pioneer) formed a Corporation (Penrith Lakes Development Corporation) to oversee the rehabilitation, decommissioning and eventual closure of the site.

The site was able to be turned into a series of recreational lakes as it did not have the water acidity problems and potential groundwater issues that are associated with mining ore bodies such as coal, gold, and silver. Thus, the site was able to be developed without the environmental problems that often plague other mine sites and was also able to include a residential component as part of the long-term plans for the site (the site is located just 3 kilometres from the centre of Penrith (Appendix 2, p. 31).

Cadia Hill, New South Wales

Cadia Hill is an open cut gold mine owned by Newcrest Ltd that is still an operational mine that operates 24 hours a day, 7 days a week. The mine is approximately 25 kilometres from the town of Orange in the Central West of New South Wales (Appendix 2, p. 19) in a rural environment surrounded by farmland. Orange has a population of 38,000, with a broad economic base ranging from agriculture, light manufacturing and tourism, with the mine now becoming a major employer in the town generating $47 million to the local economy (Appendix 2, p. 19). The mine borders three local government areas aside from Orange, with the other two being Cabonne (population 13,246) and Blayney Shires (population 7,180), however, the biggest impact from the mine economically, appears to be in the Orange city region.

Since early 2011 the mine has been granted a further mining lease after new reserves were discovered within the mine lease, extending the life of the mine by between 30 and 50 years. This will change the original conceptual closure plans for the site because of the extended life and as the mine is expected to leave a larger void at the end of mining operations. It was chosen for its approach to ongoing mine rehabilitation, its preservation of local history at the site which actually assisted the mine in the approval process and the work the mine has undertaken with the community in developing the rehabilitation program at the site.

As part of the closure plans, Newcrest engaged widely with the local community, with the overwhelming consensus being that they wanted the land returned to its pre-mining use

(Appendix 2, p. 22). These included backfilling the pit (although with the extension of the operational life of the mine and the generation of a larger pit this option may not be economically feasible) and returning the site to pasture for grazing, open grassland and native forest. The mining company has established a Community Consultative Committee to maintain dialogue with the community on the operations of the site and keep them informed on the mine operations and on the progressive rehabilitation of the site.

Cadia Hill provides an example of best practice rehabilitation and early closure planning. The decision to engage the community in the early stages of mine rehabilitation and closure planning and listen to their concerns regarding how they envisaged the final design of the site, represents best practice engagement and has enabled the company to be seen in a positive light by the community in this regard (Appendix 2, p. 24).

Lake Kepwari, Western Australia

Lake Kepwari is a former open pit located in Collie, Western Australia, approximately 200 kilometres south of Perth. The former mine site was owned by Wesfarmers Premier Coal and was part of the companies mines used to supply coal for electricity generation in the state. Collie itself is a coal mining town, with mining and mining related industries being the largest employers in the town (Appendix 2, p. 40). The town is located in the South West of the state, which is the second largest tourist region (in terms of visitor numbers) in Western Australia. The proximity to Perth also allows the region to capitalise on the large population base of that city as a source of day trippers and weekend visitors to the region.

The decision to turn the former mine void into a recreational lake was made after the company canvassed ideas from the local population on the possibilities for the former mine void that was known as Western 5B (Appendix 2, p. 41). The depth of the void (75 m) and the large volume of water that it could hold, made it ideal as a recreational lake and was widely supported for this use by the Collie community, who were already using former disused mine voids as recreational facilities (although this is technically trespassing as none have been deemed open for recreational purposes).

In order to turn the void into a recreational lake, Premier Coal reshaped the void to make it safe for recreational use, adding an additional $2 million dollars to the rehabilitation costs (Appendix 2, p. 42). As well, with the support of regulatory authorities and the local community, the company diverted the Collie River into the mine site to allow the lake to fill with water more rapidly than would have been the case by allowing the lake to fill naturally. This enabled the lake to fill within four years and was a catalyst for the end-use designs of the lake that are aimed at making the lake suitable as a tourist facility for the town.

The company has invested in a series of investigations on other options for the former mine site that include the development of hiking trails, 4wd trails, picnic and camping facilities in addition to the lake that would add value to the site. The aim in part has been to use the lake as a catalyst for broadening the economic base of the Collie region and capitalising on its proximity to Perth and its location within the South West tourism region. The local government has been an active supporter of the project, however, they have handed their role over entirely to the State Government funded South West Development Commission who are now responsible for seeing the lake turned into a recreational facility open to use by the public. Once this lake is developed for this purpose it will be the first of its kind in Australia, making it a unique undertaking for a former mine void in this country.

Jarrahdale Mine, Western Australia

The Alcoa Australia owned Jarrahdale mine was a former bauxite mine that operated for 35 years between 1963 and 1998 (Appendix 2, p. 10). The mine is in the semi-rural Serpentine Jarrahdale shire, 45 kilometres south of Perth, however when the mine opened the area was largely rural and undeveloped. The mine operated in what is known as the South West botanical province, which is recognised as one of the world’s bio-diversity hot spots.

This mine was chosen as it was unique example in Australia of rehabilitation undertaken on a progressive basis and commenced from the outset of mining. The company went beyond its regulatory requirements at the time, which under an Agreement between the company and the State government in 1961 (the Alumina Refinery Agreement Act 1961), only required the company to replant the mined area. The Agreement was not specific as to what type of vegetation had to be planted (Appendix 2, p. 13). The company used non-native eucalypts and pine trees in the early phases of the rehabilitation, however, one of the unique virtues of the rehabilitation and closure program at Jarrahdale was the company’s decision to change the rehabilitation program during the life of the mine.

Early phases of the rehabilitation program at Jarrahdale were revisited and replanted in later years as other areas of the mine were rehabilitated and new rehabilitation techniques undertaken. In the older areas of the mine site, the company planted species native to the area, including jarrah which replaced the introduced eucalypts and pines from the early phases of the rehabilitation program (Appendix 2, p. 12). This is one of the reasons why this site was chosen as an example of best practice rehabilitation as the company undertook continuous rehabilitation at the site from the outset of mining (unique to the industry at the time and at the time not a requirement of the legislation) and at the same time the company was undertaking research on its rehabilitation program at the site and adapting rehabilitation practices as new strategies were identified.

The site is now a recreational area known as Langford Park and consists of numerous facilities such as picnic areas, walking trails and a lake that was once a former mine void. However, it is not used for swimming or other recreational pursuits as it is not deemed legally safe for recreational pursuits. Hence the site is a good example of an early mine site rehabilitation that exceeded its legislative requirements and adopted continuous rehabilitation techniques that were not practiced at other mine sites in this country. The site has been the recipient of environmental awards for rehabilitation, including being placed on the United Nations Environmental Program Global 500 Roll of Honour; the first mining company in the world to be recognised for this award (Appendix 2, p. 13).

Conversely, the community was not consulted on mine rehabilitation and closure and was all but ignored in this process. The site was a good example of a mining company undertaking an initiative without input from the local community (and succeeding to a degree). However, if local knowledge had been used initially it may have prevented the initial planting of non-native species and hence saved the company some of the later expenses they incurred as part of the replanting scheme in the latter phases of the mine rehabilitation. It is also possible that the community may have had other end-use options they wanted for the site, however as they were not involved in this process any alternative end-use options were not considered. This highlights the need to engage communities from the outset in determining end-use outcomes using their local knowledge to determine outcomes that suit the needs of the community and in turn the local environment.

7.3.2 Design of interview guides

In-depth, semi-structured interviews were conducted with a representative from each mining company, local government unit and where available community group associated with the mine closure process for the selected case studies. Yin (1994) describes open-ended interviews as essential sources of case study information that can be used to corroborate evidence from other sources, one of the reasons why this method was chosen in addition to the desktop analysis.

Interview guides were constructed using questions taken from the case study analysis using the information from the nine criteria used for analysis of the best practice and inferior case studies. The information from the desktop analysis of the case study mines helped in refining the interview guides so that the information from the literature review and the desktop analysis corresponded with what was occurring in practice in the mining industry and at a local community level. The initial part of the interview focussed on gaining background information on the company and the mine itself in order to ensure that information obtained about the mine through the initial desktop research was correct.

The remaining questions followed the literature review outlines with questions based around the types of end-use options considered for the mine sites and how these end-use options would be sustainable over the long term. Additional questions covered community involvement in the mine closure process, the planning process for mine closure and the adherence to legislative guidelines on the closure of a mine and whether or not the mine closure went beyond legislative requirements. Some of the same questions were asked of each mining company, local government area, the sole community representative and government body in order to generate consistent responses from interviewees. Only minor variations were made when there were pertinent mine closure issues that were found to have occurred that were unique to a particular mine site. The questions from the interviews are in Appendix 4, broken down according to the mine site and the participants to be interviewed from particular mine sites.

It is acknowledged that using four case studies as the basis for a questionnaire would not provide as much detailed information as using a higher number of studies. Nor is using mining companies, local government areas and some community members in the questionnaire process as rigorous as interviewing other figures in the mining process such as a broader range of regulatory authorities, however, there was limit to the number of personnel able to conduct the interviews, the budget and the time available to conduct the interviews and these limitations placed constraints on the amount of interview data that could be collected. The data that was collected however was comprehensive and due to the open-ended nature of the questions allowed interviewees to expand on topics and provide their knowledge of current mine closure practices in this country.

This researcher was the sole interviewer for the interview process, as cost limitations prevented the employment of more experienced interviewers for this process. The researcher has conducted interviews previously as part of an Honours thesis and during the course of my employment, however by no means do I consider myself an experienced interviewer; hence any limitations in the process are the result of a lack of experience rather than as a result of respondent's answers.

The questionnaire design process was concerned with ensuring that the words, terms and concepts could be easily understood by interview respondents (Czaja, 1998). In addition to this, there was a need to design the questionnaire in a manner that ensured that the questions were not too complex for respondents and that were worded in a manner that made the questions easily understood (Converse and Presser, 1986). Due to the nature of the desktop case study findings it was necessary to ensure that the way respondents addressed the question corresponded with the research measurements (Czaja, 1998). As the researcher was the only interviewer in this process, the main task was to ensure that responses were recorded accurately and were complete (Martin and Polivka, 1995). This was achieved through the use of a digital data recorder that was professionally transcribed, plus note taking during the interview process.

One of the weaknesses of this approach to interview design is the possibility of reflexivity, whereby respondents tell the interviewer what they want to hear, in a manner that is basically corroborating evidence (Yin, 1994). In order to overcome this bias Yin (1994) and Merton et al. (1990) recommend that interviews be conducted with range of respondents that hold differing viewpoints on a subject. It was for this reason that it was decided to attempt to interview not just mining personnel, but where possible local government representatives, state government personnel and community members in order to obtain a wide range of opinions and perspectives on the mine closure process.

Once the questionnaire design process was completed, the questions were sent to the PhD supervisors for pre-testing assessment of the questionnaire design and suggestions on changes to the design of the questionnaire. The response to the initial questionnaire design were that the questions were not designed in a manner that enabled open-ended responses and that the questions were too specifically focussed on formulating yes/no responses, or eliciting responses that would lead respondents to provide answers that supported the information obtained in the desktop case studies. Those questions that did not elicit open-ended responses were redesigned until the research team (the PhD researcher and Supervisors) was confident that this would be able to occur. The end result was a series of questionnaires that provided mostly open-ended responses in addition to clarifying information contained in the desktop case studies such as for example mine ownership, local populations, type of mineral mined.

The questionnaire was sent for ethics approval once the researcher and PhD supervisors were satisfied that the questions were able to draw more in-depth responses from interview participants. The questions asked of respondents were not of a sensitive nature and data collection was based solely on face-to-face interviews with little in the way of ethical issues that could cause concern for participants. Ethical approval for the interview research process was granted in early 2010 with the process deemed to be of low risk to participants.

7.3.3 Conduct of interviews

The interviews were conducted in New South Wales during early May 2011 and in Western Australia during the middle of May 2011 with each interview lasting for between one and one a half hours. They were conducted with mine personnel, local government personnel, government regulatory authorities (from Western Australia) and the head of one of the mine site community consultative groups in New South Wales. Unfortunately, not all of the main parties in the mine closure analysis chose to take part in the interview process, with one LGA declining to be interviewed and a number of community participants and regulatory bodies also declining. This was disappointing; however, it is an acknowledged limitation with interviews as a methodology (Seidman 2006; Padgett 2008).

There were 13 interviews conducted with 14 people from the different organisations involved in each of the mining operations. These organisations included Newcrest Mining Ltd, Orange City Council, Blayney Shire Council, Cabonne Council, and a member of the Community Consultative Committee in relation to the Cadia mine site in Orange, New South Wales. In Penrith, New South Wales interviews were conducted with representatives from Penrith Lakes Development Corporation and Penrith City Council. In Western Australia at the Jarrahdale mine site interviews were undertaken with representatives from Alcoa Australia and Jarrahdale Serpentine Council. In Collie, Western Australia at the Lake Kepwari site interviews were conducted with representatives from the Wesfarmers Premier Coal, the Department of Environment and Conservation and the South West Development Commission. Representatives of the mining companies were visited and interviewed at their offices near the site of the mine, and where possible, LGA and community representatives were interviewed.

7.3.4 Method of analysis and presentation of the data

The findings from this method follow the nine closure criteria that were used in the desktop case studies in order to maintain consistency and due to the fact that the questions were developed from the information gathered through the case study analysis of desk top research. The responses were analysed for each mine location and by interviewee's organisation to determine both differences and similarities in the closure process.

The field research headings mirror the desktop case study research criteria which as discussed in Chapter 6 were developed from the findings of the desktop case studies and the literature review, particularly the MMSD report and the ANZMEC/MCA reports. The process of conducting the stakeholder field research interviews involved emulating the case study desktop research headings. This approach to the methodology enabled a comparison between the case study desktop analysis findings and the results from this chapter.

The method of developing uniform criteria for Chapters 6 and 7 allowed for discrepancies between the desktop research and the stakeholder views of the mine closure process to become clear. This process was particularly important in gaining some insight into how stakeholders saw their roles in determining mine closure outcomes and finding out whether the theory mirrored what occurred in the field.

Although qualitative research can be time consuming, in both the desk top analysis and field research a more in depth analysis of the topic and research criteria was undertaken as a result of this approach (Culp and Pilat, 1998). Through qualitative research the "why" questions were able to be answered. Open-ended questions and interview transcripts were used in field research to either substantiate or repudiate the desk top research (Taylor-Powell and Renner, 2003) The qualitative research also enabled insight into respondents answers, in conjunction with their position on the questions they addressed and concerns most often raised on the basis of anonymity. Further, the data gathered as a result of the qualitative research undertaken was also used to formulate policy recommendations (Taylor-Powell and Renner, 2003).

The literature review established the nine criteria or themes undertaken in both the desk top and field research. Perhaps the single discrepancy or adjunct to the nine criteria, was the reluctance of two of the mining company representative, who stressed a desire for anonymity, to have government on any level regulate community engagement. Tables were organized subsequently to both summarize data and bring meaning to the text from the case study and literature review findings (King, 2004).

7.4 Results and discussion

This section uses the nine criteria from the desktop case study research with the data obtained from the interviews discussed under each of the nine criteria. The findings from the interviews are used as the basis for a discussion on the similarities and differences between the desktop information and stakeholder views on what actually occurred during the mine closure process. The nine criteria are:

- The location of the mine
- The size of the community where the mine is situated
- The size and profitability of the mine
- The ownership of the mine
- When the mine closure was planned
- How the mine closure was planned and conducted
- Alternative closure options
- The legislation under which the closure was conducted
- Engagement with stakeholders

7.4.1 The location of the mine

Most mine sites are not in built up and or urban areas with the majority of these case studies outside built-up urban areas, and all of them outside Capital City CBD's. The exception to this is the Penrith Lakes Development Corporation, which operates a quarry of some 1,935 hectares in Penrith City. However, each of the other three mine sites was still only located within a less than 200 kilometre radius of two capital cities, Sydney (population 4,575,532 million) and Perth (population 1,696,065 million) (ABS, 2012). This has implications for the post mining uses at the mine sites, as they are within easy access from major population centres enabling them to consider possible recreational options post mining.

7.4.2 The size of the community where the mine is situated

Council interviewees were asked the population of the LGA. This question and criteria is closely related to the first criteria, the location of the mine, however, the size of a community will play a role in determining its capacity to cope with post mining land-use options for a mine site. As an example, the Penrith Lakes mine site is located within the boundaries of Penrith city, a city, which as at the 2006 Census had a population of 172,140 persons (Penrith City Council, 2011). However, under individual banners, quarrying had been occurring in that area since 1935. In 1933, according to Penrith City Council the population was 7,850 persons, a mere 4.56% of the 2006 population. It is located, however in the wider Sydney metropolitan area, providing it with a substantial population base that are able to use the lakes and park areas for recreational purposes and generate income for a number of businesses (including a restaurant and cafe and sports hire facilities) to operate at the former mine site.

Table 7.1 provides a brief summation of the nine criteria highlighting the key points from the desktop case studies and any similarities or differences that were found in the case study interviews. The most interesting feature between the desktop case study analysis and the interview data is the often different viewpoints between mining company representatives and the other interviewees (LGA and State government representatives and the community) on the respective roles each has to play in the closure process. This is an area that is not readily captured through the desktop investigation.

7.4.3 The location of the mine

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Table 7.1: Summary of findings from desktop case studies and interview research responses

Mines	Desk Top Analysis	Interview Research Response
	<u>Location of mine</u>	
Penrith Lakes	Urban	Urban
Cadia Hill	Regional City	Regional City
Lake Kepwari	Rural	Rural
Jarrahdale	Urban Fringe	Urban Fringe
	<u>Size of community where mine situated</u>	
Penrith Lakes	172,140	Confirmed by LGA
Cadia Hill	38,000	Confirmed by LGA
Lake Kepwari	9,077	Confirmed Government Agency
Jarrahdale	12,900	Confirmed by LGA
	<u>Size and profitability of the mine</u>	
Penrith Lakes	Large series of open pits covering 2000ha. Profitable mine site	Confirmed by Mining Company.
Cadia Hill	Large open pit reaching depth of 460 metres. Covers 230ha. Profitable mine site	Confirmed by Mining Company. Mining company confirmed during interview they had been granted revised lease incorporating expansion.
Lake Kepwari	188ha open pit. Profitable mine site	Confirmed by Mining Company
Jarrahdale	Large mine site covered 4090ha. Profitable mine site.	Confirmed by Mining Company
	<u>Ownership of mine</u>	
Penrith Lakes	Australian and Overseas Company Ownership	Confirmed by Mining Company
Cadia Hill	Australian Ownership	Confirmed by Mining Company
Lake Kepwari	Australian Ownership	Confirmed by Mining Company
Jarrahdale	US Parent Company	Confirmed by Mining Company
	<u>When mine closure planned</u>	
Penrith Lakes	Mine closure plan not required by regulatory body during mine planning phase	Mining company confirmed that no closure plan was required during mine planning phase. No closure planning was actioned by government. At this time the only consideration by LGA was jobs and revenue.
Cadia Hill	Mine closure plan required during mine planning phase	Mining company confirmed that closure plan was required during mine planning phase. No closure planning was actioned by government. At this time the only consideration by LGA was jobs and revenue.
Lake Kepwari	Mine closure plan not required by regulatory body during mine planning phase	Mining company confirmed that no closure plan was required during mine planning phase. No closure planning was actioned by government. At this time the only consideration by LGA was jobs and revenue.
Jarrahdale	Mine closure plan not required by regulatory body during mine planning phase	Mining company confirmed that no closure plan was required during mine planning phase. No closure planning was actioned by government. At this time the only consideration by LGA was jobs and revenue.
	<u>How mine closure was planned and conducted</u>	
Penrith Lakes	Progressive rehabilitation, based on environmental rehabilitation.	Desktop finings confirmed. Decision to use for recreational purposed was made toward end of mines life.
Cadia Hill	Continuous closure process, based on environmental rehabilitation.	Desktop finings confirmed. Original closure plans altered as mines life extended.
Lake Kepwari	Progressive rehabilitation, based on environmental rehabilitation.	Desktop findings confirmed. Closure plans not signed off from regulatory body.
Jarrahdale	Progressive rehabilitation, based on environmental rehabilitation.	Desktop findings confirmed. Mine in care and maintenance mode from mining company.
	<u>Alternative closure options</u>	
Penrith Lakes	Mine became recreational lake	Confirmed desktop findings. State government driven development. Mine began life in 1930s. Plans for closure commenced in the 1980's.
Cadia Hill	Being progressively rehabilitated.	Confirmed desktop findings. Due to the mines extended life the closure plans will change. The mine was to be returned to native grasses. Community against use as recreational lake.
Lake Kepwari	Mine became recreational lake	Confirmed desktop findings. Presented as the only alternative closure option and embraced by the
Jarrahdale	Returned to native forest	Confirmed desktop findings. Community did not feel part of closure process. Lack of engagement.

Mines	Desk Top Analysis	Interview Research Response
	Legislation under which the closure was conducted	
Penrith Lakes	Mine has met or exceeded legislative requirements.	Confirmed desktop study findings. Mining company felt that the closure guidelines were very broad at time and easy to meet. All mining companies had differing views on the need for mine closure legislation and the breadth of legislation. LGAs all supported the need for legislation.
Cadia Hill	Mine has met or exceeded legislative requirements.	Confirmed desktop study findings. Mining company felt that the closure guidelines were very broad at time and easy to meet. All mining companies had differing views on the need for mine closure legislation and the breadth of legislation. LGAs all supported the need for legislation.
Lake Kepwari	Mine has met or exceeded legislative requirements.	Confirmed desktop study findings. Mining company felt that the closure guidelines were very broad at time and easy to meet. All mining companies had differing views on the need for mine closure legislation and the breadth of legislation. LGAs all supported the need for legislation.
Jarrahdale	Mine has met or exceeded legislative requirements.	Confirmed desktop study findings. Mining company felt that the closure guidelines were very broad at time and easy to meet. All mining companies had differing views on the need for mine closure legislation and the breadth of legislation. LGAs all supported the need for legislation.
	Engagement with stakeholders	
Penrith Lakes	Consultation/ Participation.	Mine companies believed in the need for engagement with the communities but were unsure of legislating for engagement. What the mine companies thought of as engagement vs. what the literature has found engagement actually involves differed. LGAs and communities saw themselves as being independent of one another, even though one represented the other and they often had common goals.
Cadia Hill	Engagement	Mine companies believed in the need for engagement with the communities but were unsure of legislating for engagement. What the mine companies thought of as engagement vs. what the literature has found engagement actually involves differed. LGAs and communities saw themselves as being independent of one another
Lake Kepwari	Engagement	Mine companies believed in the need for engagement with the communities but were unsure of legislating for engagement. What the mine companies thought of as engagement vs. what the literature has found engagement actually involves differed. LGAs and communities saw themselves as being independent of one another
Jarrahdale	Consultation/Participation	Mine companies believed in the need for engagement with the communities but were unsure of legislating for engagement. What the mine companies thought of as engagement vs. what the literature has found engagement actually involves differed. LGAs and communities saw themselves as being independent of one another

This contrasts with Collie for instance where the former mine site is currently in the process of awaiting regulatory approval to be turned into a recreational lake, but on a smaller scale to the Penrith Lakes development. The population of 9,077 and a distance of approximately 180 kilometres from Perth limit to a degree the available post-mining land-use options and the ability for viable businesses to establish themselves at the lake and generate positive cash-flow. The mining companies in each of the LGA’s are major employers, particularly where populations are smaller, such as in Collie Western Australia, where Wesfarmers operates. One of the council employees stated that due to this it is incumbent on mining companies to plan for closure, as the residents and the local economies are financially impacted by a mine closure.

7.4.5 The size and profitability of the mine

Mining companies were asked to describe the size of the mine pit and the profitability of the mine site. The mines varied in size between 1,935 hectares or 19.35 km^2 and 5,000 hectares or 50 km^2. The deepest of these mines is approximately 500 metres.

One of the mines currently employs 1,500 people at the site visited. Given its total workforce is approximately 13,000, 1,500 people represents 11.5% of its total workforce, a significant number. The size of the mine is generally an indicator that the mining company and the mine itself are more profitable. The variable factor for any mine development is the orebody, as the prices paid for it will fluctuate according to demand for commodities, which in turn will affect the profitability of a mine site. The other variable is the richness of the orebody and ease of access which determines costs. The desktop research identified that each of these mine sites were profitable for their respective organisations, however exact figures were not always readily accessible, though each of the mining company representatives interviewed indicated that the mines were indeed profitable, with one representative noting that their particular mine was ‘during its peak, the most profitable mine site for the organisation’.

Another mining company representative suggested the profitability of the mines should be transparent to government as this would: a) enable government to monitor mines not profitable and likely to close, to ensure they are not derelict in their duty to rehabilitate the mine, and b) enable government to develop a financial surety program that is more comprehensive than the current bonding mechanism to ensure that mines are able to meet their rehabilitation and closure costs.

7.4.6 The ownership of the mine

The mining companies interviewed don’t own the mine site, but lease the sites from the Crown, through state governments. In mining, like many industries which operate in the global economy, there is both local and international leasehold and investment, as is evidenced by the two examples above. As to whether this makes any difference to a mining company’s commitment to good closure practices, the mining company’s closure practices are not solely based on ownership or lease arrangement, but rather on mine closure planning early in the planning process, and the profitability of both the mine and the company (Fourie and Tibbett, 2006) . Each of the mine companies were profitable ones for the respective companies, with each of the companies having considerable assets and equity in their company balance sheets.

The Penrith Lakes development site is owned by three shareholders, Boral, Holcim and Hanson. Each of these companies are multinational organisations with substantial assets and equity. Boral in 2011 had assets totalling $5,668.0 (millions) and net equity of $3,156.4

(millions) (Boral Limited). Holcim in 2011 had net assets of $46,819.0 (millions) equity of $16,698.2 (millions) (Holcim Ltd, 2011).Hanson (known globally as Heidelberg) in 2011 had net assets of $36,823.0 (millions) and equity of $17,216.0 (millions) (Heidelberg Cement Group, 2011).

Newcrest Mining Limited controls the Cadia Hill operations near Orange in New South Wales and is a large Australian headquartered mining operation. The company has recently listed on the Toronto Stock Exchange following increased international expansion activities. The company in 2011 had total assets of $19,037.0 (millions) and equity of $14,754.0 (millions) (Newcrest Mining Limited, 2011).

The former Jarrahdale mine site in Western Australia was mined by Alcoa Australia, who are a subsidiary of Alcoa, a United States based commodities producer. The company has substantial market share in the commodities sector, particularly in bauxite and aluminium production in Australia. In 2011 the company had total assets worldwide of $38,920.6 (millions) and equity of $13,430.1 (millions) (Alcoa Inc., 2011).

Premier Coal was part of the Wesfarmers group (it was sold in 2011 to Chinese company Austar) a large Australian based conglomerate with diversified interests in mining, retail, energy, and chemicals. The company's diversity has enabled it to become one of Australia's biggest employers, particularly in the retail sector. The company had total assets in 2011 of $42,199.0 (millions) and equity of $24,479.0 (millions) (Wesfarmers, 2011).

7.4.7 When the mine closure was planned

Planning of mine closure needs to be addressed from two separate but not disparate view points. The first is that of the mining companies and the second is the LGA's in which the mining companies operate. There is also a third perspective and that is of community representatives, although only one was available for this study.

A mine closure plan was not required during the mine planning phase for 3 of the 4 mining companies interviewed. The closure plan for the remaining mine, which was required at the commencement of mining, mandated that the mining void be left for water to fill. This is best practice as it currently stands in Australia, in terms of mine closure planning. While it represents a step forward on previous practices which involved no plan at all, it does not represent a sustainable end use for the land and community, environmentally, economically or socially.

At the time of closure in WA, neither of the WA mines was required to submit a closure plan. The fact that both undertook extensive rehabilitation was undertaken at their own initiative and expense. Both the NSW sites are required under the Mining Act 1992 to undertake ongoing rehabilitation or progressive site rehabilitation, one mine under a Deed of Agreement with the state government, and the other under legislative requirements.

A council or community member cannot nominate a date for mine closure, but councils in particular, have a responsibility to plan for closure as it is their community who will be affected socially, environmentally and economically. None of the councils interviewed were involved in mine closure planning when mining commenced in their community. Some of the comments from councils regarding closure planning included:

> "...I don't believe Council has really looked that far at this point in time".
>
> "State Government has worked with the mining companies to ensure that the rehabilitation works have been undertaken in accordance with their original consent". "..Council's main interest, I suppose is employment and maintenance of infrastructure i.e. roads".

The councils' responses to the questions "How did Council address the mine closure aspects of this project?" and "What strategies did Council put in place to deal with the closure?" appear to be relatively short sighted and or they passed the responsibility onto the State Government. The community representative believes that "... Local Government didn't understand it at all when the carrot was dangled in front of them about jobs, jobs and more jobs and revenue of course". In other words, the Local Governments attitude or view point was to consider the short term. The LGA, in his opinion, thought that a mine would bring jobs and revenue to the community and the local economy. Planning for the mines closure was and is not a process the council has undertaken.

7.4.8 How the mine closure was planned and conducted

Mine closure in half of the case studies is ongoing, as the mining is still occurring. Therefore rehabilitation is progressive and planning for closure is continuous and conducted simultaneously with mining. In two cases, mine closure has concluded, however, in each of these sites the mining companies have an obligation to care for and maintain the site.

With respect to the role of the selected mining companies in terms of closure, two of the four organisations conducted research when planning closure and ensured voluntary redundancies, early retirement or redeployment to another mine site. Further, they concluded that the bulk of its employees came from one town and through its desire to ensure minimum economic impact to employees, was able to minimize the economic and social consequences to the community.

Two of the four mines conducted extensive research with both government and the community to decide on an end use for its facilities. This included discussions with voluntary organisations, educational facilities and government departments. They sought opinion and managed the closure to deadlines, in the end choosing an option that did not leave any unknown risks.

From the perspective of all four mining companies, the community had a role in planning mine closure, although that role has been limited in two instances with the LGA standing in to represent the community. The roles of the community mentioned by the mining companies included involvement in the land management planning, a push to establish an administrative body through state government or a community sentiment for the end use of the mining void. Each of the mining companies agree that the community was involved, and as it currently stands, this is best practice as outlined earlier in this thesis. Where current best practice could be improved is in ongoing community representation through the LGA. In only two of the four case studies, does a Community Consultative Committee exist, but when members of such a committee move or die, information could be lost. If such a body was established with the LGA as the Chair and key body, information would be available in perpetuity, no matter who was on the committee. In two of the case studies, the community's role is ongoing, and in one case that is principally because the mining is yet to conclude and thus in essence, the community has a role in the operational process rather than the closure process at this particular site.

From the purview of the mining companies, three of the four companies stated that Councils had a role in planning for closure, though it appears that that role was inconsistent across each of the four case studies, as was the community's role. For example one mining representative provided an answer about the Council being the primary stakeholder, but not an explanation about the role they played in the mine closure. In another instance, a local government representative said the council was represented on a working group and enthusiastic about the mines redevelopment. In another case, the local council was involved in mine closure planning from a socioeconomic perspective, in terms of jobs being directed to another site within the town boundaries and also examined future training options with the mine (Local Government representative). In one of the cases, there appears to be some disharmony between the mining company and council, with the mining company clearly thinking they consult more than the Local Council think they consult.

What is clear is that planning and closure is not conducted consistently. Each mining company approaches it differently and within that context, they interact with the community and LGA's in a disparate manner because there are no consistent guidelines or requirements from state or federal government as to how much involvement each party should have with the other, particularly in regards to mine closure.

As an example, one mining company stated that they had gone beyond their legislated requirements regarding mine closure planning and had involved the community in the process from the outset. Another mining company representative stated that the community's role in the end-use outcomes was important; however, ultimately the mining company and the state government regulators should have the final say in the end-use outcomes as they are "best placed to ensure that regulatory outcomes are met".

Of course, just as the mining companies have a perspective on how they conducted mine closure planning, councils have a perspective on their ability to effectively plan for mine closure. Each of the councils was asked to comment on how the mine closure formed part of their strategic plan, and further, how the effects of the mine closure would be mitigated. The answers from the councils were disparate and included:

> "None whatsoever"
>
> "I don't believe that we've addressed that issue.... I think most of the City would see this (mining) as a continual...operation"
>
> "Not that I'm aware of, and I'm not even really too sure what the, what the effects would be..."
>
> "It would be nice to have an economic development strategic plan, which we don't"

It became apparent that only one of the councils took a strategic approach to mine closure, that is, took a long-term perspective about the mines closure, with the remaining councils not planning for the eventuality of mine closure in their LGA. Nonetheless, there were ruminations about job stability, growth, changes in socio-economic demographics and the need for businesses in the LGAs to plan for mine closure. Some of councils' comments were:

> "Once we have them here (management level employees), we have the opportunity for them to look at the region, to provide jobs, and in particular higher order jobs"
>
> "…there's going to be some need for those businesses to re-organise themselves as the, as time changes, I guess."
>
> "So, it balances out, and at the end of the day, we've stayed about the same population level. So, I think if they go, hopefully something else would come in to fill the void."

While not expressing the view that they lack a strategic approach to mine closure in their LGA, it is clear that little thought is generally given to the closure of the mine. In most cases, the sole community representative best sums up councils outlook as being about "... jobs, jobs and more jobs and revenue of course". The perspective is understandable to a degree, mining brings jobs and therefore revenue in terms of company expenditure and personal expenditure, there may be an increase in houses being built should workers choose to buy in the area, thus ongoing employment for builders, plumbers and electricians, not to mention more rates for council.

The community representative was very informed on mine closure planning in the LGA in which he lived, perhaps more so than council. In his interview he spoke of a plan being developed:

> "In this last 12 months... (the mine)...have been developing a document entitled Mine Rehab/Closure with the community consultative committee, which have five Local Government, land holder representatives on, and that's been passed by us to go through it and make any comments which we've done. It's still a draft document. It hasn't been approved or signed off by the Minister."

While the draft document is not available, it is clear that all parties, whether or not well informed of the fact, are working toward a unified closure approach. However, it appears both LGAs and mining companies need to be more proactive in planning closure at the commencement of mining, indeed recognize that in the long term, closure is as certain as the short term benefit of jobs.

7.4.9 Alternative closure options

There are ways in which a mining company can rehabilitate the mined land. For instance a company could rehabilitate mined areas back to a native forest and grasslands, and as the regulatory requirements currently stand this type of rehabilitation could be undertaken progressively or towards the latter stages of the mine's life. Alternatively, the site could be considered for development as a lake for recreational or aesthetic uses, depending on the water quality. What is certain is that at the commencement of the mining process there are options available to mining companies, communities and regulatory bodies for the end-uses of a mine site; however, if end-uses are to be achievable and sustainable, closure options need to be developed early in the process.

The case studies presented the opportunity to examine two mines that had been rehabilitated into lakes and one that had been returned to native forest. The fourth mine was undergoing progressive rehabilitation and the possibility remained that part of the closure options may change.

In one of the sites, the mining company presented a recreational end-use to stakeholders as the only rehabilitative option available. The mining company felt that there appeared to be some acceptance by the community that the rehabilitated void could be used as an asset by the community, in this case as a recreational facility used to attract tourists (Mining company representative). A representative from a government agency had a different perspective; they believe that in this case, the mining company planned to rehabilitate the site for commercial recreational purposes; they should have used their "social licence" and turned the site into a passive recreational site without the commercial focus. Perhaps the truth lies somewhere in between. This was a reasonably cost effective option for the mining company at $15 Million up to 2006 and hence, they were happy to comply with community wishes. According to the mining company representative, the alternative closure option of back filling the void "would cost you a hell of a lot more".

One of the other mine sites examined, included a number of mine closure options. The original site intercepted a groundwater spring, and at closure formed a lake. For a second site, a number of options were examined including options to utilize existing structures, indeed, according to the executive interviewed; the government of the day asked them to examine options for the structures. A scout group examined taking over the mines herbarium, but this fell over due to financial constraints and distance. A TAFE spent considerable time with the mine, examining use of structures and space, indeed it went as far as developing business plans to establish a training facility for the mining industry. It was suggested:

> "Ultimately (the plan) fell over around incompatibility with the drinking water catchment, business, the business plan, affordability, and ability to give guarantees for closure, all of those sorts of things. And in the end, I guess the deadline loomed, and in the end, we decided no, we'll do what the majority of the Government agencies wanted, which was just turning it back to the forest".

The LGA at one of the NSW mines, articulated that it was them who pushed State Government

> "...for some form of coordinated control, to address environmental concerns, how (the mine)...would be rehabilitated and the impacts that the mining was having on the community".

He went onto say

> "as a result of that, the government decided to set up the current company....., and it decided to take over control of the lands through the preparation of a regional environmental plan. And the regional environmental plan was accompanied by a regional environmental study which looked at what were the impacts and the benefits of mining for the site and what would be the preferred way for rehabilitating the land when mining was completed. And because there were government, not so much royalties, but government benefits out of mining, on the site, there was a commercial aspect to it and that commercial aspect was reflected in the signing of a deed between government and the new conglomerate mining firms, called the .....".

This was not disputed by the mining company.

The closure options considered at the other New South Wales mine site are ongoing as this is an example of progressive rehabilitation and were they to document it, would be an excellent example of a living document as it is a fluid plan, which is considering options to best rehabilitate the land including:

> "... enhanced ecological water resources in terms of riparian planting, potentially using some wetland structures, opportunities to improve water quality, the possibility of returning some land to a state that would enable grazing and a biodiverse open woodland, consistent with the character in terms of land forms of its pre mining state. Further, the company will examine the use of any infrastructure, particularly buildings that might be used for alternative uses".

The desktop case studies found that consideration of alternative mine closure options at the various mine sites was undertaken on an ad-hoc basis and generally later in the life of the mine, during the operational phase, rather than during the mine planning phase. The interviews generally corroborated these findings and found that there was a level of frustration from Local Governments about a lack of communication regarding closure options for mine sites. At the same time it was established both through the desktop analysis and through the interviews, that local governments were equally remiss in their lack of consideration for mine closure options within their own council planning and did not necessarily worry about mine closure end-uses, nor did they believe it was part of their charter as local governments.

7.4.10 The legislation under which the closure was conducted

The mines chosen for best practice closure sites to examine consisted of two mines in NSW and two in Western Australia. The legislation under which these mines closed, or commenced closure, was different to current legislation, in other words, the original legislation has undergone or is undergoing some amendments.

Mining companies were asked how their mines closure would meet or exceed the legislated rehabilitation requirements. Responses were uniform in that, regardless of the State the mine was in, legislation was broad at the time of closure, so the companies were able to meet expectations, which were, that the mines be rehabilitated to a standard that existed prior to mining. The new mine closure guidelines in Western Australia may mean some closure aspects have to be revisited. The new guidelines now require water quality to meet a specific pH level and salinity level and for these levels, they refer to the federal government website Department of Sustainability, Environment, Water, Population and Community (Department of Mines and Petroleum 2011, p. 78), which states that the pH of water for recreational use should be between 5.0 and 9.0.

All interviewees were asked if they believe closure legislation in Australia should become part of the mine planning process, as it currently does not exist. A range of answers were given to this question and include, but are not limited to: -

> "Does the Company believe such legislation should become part of the mine planning process? ... I think, from a very high level it does, absolutely. You've got to have an idea of where your overburden dumps are going to go and where your voids will end up".

> "I support the notion that operations should be designed for closure; have closure in the back of their minds. That there should be a conceptual closure plan throughout the life cycle of, of a mining operation...... I think the idea of a conceptual closure plan; I also think a financial assurance around conceptual closure is also desirable. I've had a lot to do with the ICMM, the International Council on Mining and Metals, and they've provided some guidance on closure..... I'm pretty strongly aligned with those views....".

> "I think through the approvals process that we have at the moment, because mine closure is taken into account at that, that time that the need for specific legislation isn't there. I think there's, there's an ability through a more performance based approach and by the actual initial project authorisation approval permitting the terminology changes, that there's sufficient in the jurisdiction that I operate within to ensure that there's that adequate mine closure component. There's also obligations on us in terms of having progressive rehabilitation and that that provides a pathway to mine closure. So I don't see that as being a need in our particular area".

> "Yes, simply, I think that should be legislation. And that should deal with what the existing situation was before mining started and how you will, you're never going to be able to return the site to how it was pristine before mining, but there needs to be a formal yardstick or a legal yardstick that you can put across an application and say OK, if you've got this sort of cast land, this is the level that it needs to be taken back to. So, should the mine site be taken back to a level where previously it was used"

> "(It) is not very sophisticated to my knowledge in New South Wales. The closure to mining in New South Wales, as my understanding, is once it's rehabilitated, you just hand it over.... And so the social community implications, the loss of jobs, all of those types of things just aren't considered.... That, there needs to be a legacy associated with the impacts that the mine has had. And that legacy goes far beyond vacant parkland or a landscaped mound, or a water body that's left stagnant. There needs to be management authorities, there needs to be jobs to replace the mine, all those types of things".

These extracts from the interviews highlight that most interviewees felt it is desirable to have closure legislation. The sole voice of dissent was a mining company representative who felt that the approvals process was enough and therefore there was no need for closure legislation. It was also a mining company executive who said "... that's probably the one thing that we would advise against, would be making it (the legislation) too prescriptive". This is probably an accurate view to hold as commodity prices change; there are technological changes, financial implications and the changing needs of the community to consider.

> Any concerns about the impact on a local economy and society from a mine closure, appears to come from the LGA's: "... the loss of jobs, all of those types of things just aren't considered..." That is certainly true as the legislation to date does not consider the impact of closure on a community or its economy other than in the impacts of not rehabilitating the environment. It isn't however, within the power of an LGA to legislate, let alone legislate on mining. When mining companies were asked, whether the a mining companies impact on society and the economy should be legislated, the view was quite clear, one executive saying "....I would hate for that to be in the hands of the regulator.... their expectations would far in exceed the practicalities". Another executive commented that he believed social and economic issues should be considered at the commencement of mining but ".... they're very hard to forecast at the start of a mine ....."

Mine site closure is an accepted responsibility of mining companies operating within the context of state or territory-based legislation. In some cases companies rehabilitate mines well beyond required rehabilitation requirements. Examples of this are illustrated in the field research undertaken, as the mines selected were chosen on the basis of being current best practice mine closure examples.

One mining operation representative said:

> "Through a series of steps over a number of years, we actually voluntarily took over the whole rehabilitation programme and the costs of it... we very early in the piece had some people with a lot of foresight who saw that the performance of our mining and environmental management and rehabilitation operations was, was critical for our long term licence to operate in the Jarrah Forest and therefore, we felt that we could do, we would do a better job of doing it ourselves. And, our rehabilitation practices in our Australian ... mines have been, and remain ahead of legal compliance".

7.4.11 Engagement with stakeholders

There are many stakeholders involved in mine closure. The principal stakeholder is perhaps the mining company themselves. The community, is a term used to describe all within the community and includes businesses, house and landholders, the LGA, those who work within the community but perhaps do not reside there, and each one of these parties in the community are stakeholders in the mine's closure. So too is the mining company and if we are to extrapolate, shareholders of the mining company, the state and indeed the nation.

Remembering that the case studies are current best practice mine closure in Australia: Did the mining companies feel they engaged with stakeholders, and what of the view of the stakeholders? While the views of any one state or nation cannot be sampled, they are to an extent reflected in terms of legislative requirements where the focus traditionally has been on rehabilitation requirements, with community engagement processes traditionally missing at a state and federal level. Shareholders views too, were not analysed.

During the course of the interviews held in May, participants were asked to comment on the success of community engagement during the life of the mine. Each cohort had of course different perspectives, though it is an accurate reflection to say, not one thought community engagement was unimportant.

The mining companies are really the stakeholder that needs to seek community engagement. They have varying opinions of course but as examples of current best practice mines, they either sought and or listened to community sentiment.

One of the mining companies interviewed intimated that the community, as a stakeholder, was a powerful lobby group that through a member of the community who was a State MP, were able to push for the development of lakes and recreational facilities as the mines ongoing rehabilitative requirements. This is interesting in that it raises the possibility of the community as a stakeholder and lobby group (in addition to the LGA who can also act as a lobby group). That is not the perspective of the LGA of this particular mine, who believe that it is them who pushed state government for the final outcome.

The mining companies also rightly suggest that where rehabilitation is or has been progressive, community sentiment may change and will be an ongoing process. This again highlights the significance of not only establishing a closure plan at the beginning of the mine's life, but also ensuring that as a living document it is flexible. If circumstances change, such as new ore bodies being found, a mine's life might be extended, indeed the mining company may need more community engagement and an alteration to plans.

It was felt by one mining company that regular forums were important for personalizing mining companies and putting a face to the name. That face-to-face contact enabled community members to have a point of contact and a connection with the company. This was echoed by more than one LGA involved in the interviews. In one instance, the mining company's Communications Manager is credited as being a pivotal contact and while not establishing the mining companies name in the community on her own, she is seen as the go to girl who will listen and act on problems voiced.

Stakeholder engagement is not without its perils. More than one LGA commented that while the mining company went to extreme lengths to be a good corporate citizen, indeed punching above their weight "... It just seems a little bit too good to be true that all these things can be resolved as well as they are". It appears to some extent then that no matter how good at stakeholder engagement you are or the mining company, there may be some in the community who view your feedback, information and or resolution of issues, with a level of suspicion.

Community Consultative Committees (which include in some instances employees from LGAs) exist for at least three of the mines; however, significantly, only one member of one Community Consultative Committee (not from an LGA) was available to interview. It was his considered opinion that the mine in his LGA has not addressed mine closure with the community, other than to say it is progressive, however, he felt they were very conscious of having a good image in the community. They regularly held public meetings, had appointed an excellent Communications Manager and had established a hotline for the community to raise issues and concerns to be addressed by the Communications Manager.

Interestingly, as stakeholders, LGA's and Communities most often see themselves as independent of each other, however, it is the LGA that will be permanent in the community and therefore a permanent stakeholder in the mine. Community members, including those who sit on community consultative committees, can be transient, lose interest or become disenchanted with the project and therefore were neither easy to locate and or meet with for interviews. Indeed one government agency identified that in the instance of the mine concerned, the LGA saw themselves as representing the community. This is what they are elected and employed to do.

What was clear from the case study analysis and the interview process is that consultation with a community is often taken to mean the same as engagement and that by merely consulting with a community on a final landform for a mine site mining companies are interacting sufficiently with communities. This of course is not the case and best practice is that communities become part of the mine closure process by deciding on the final use for a mine site and working with the mining company to see this process through to its conclusion. There will be debate about whom and what actually constitutes a community, however, it is clear that the one constant in the entire process is the LGA who in many ways represent the community as a whole. The findings from this section of the chapter indicate that with regards to community engagement all parties see it as important to the mine closure process; however its implementation in practice has been less than perfect.

7.5 Conclusions

The findings from this chapter indicate that best practice mine closure occurs when all parties in the mining process are engaged. Unfortunately, even though these case studies represent best practice as it stands in this country today it appears that local communities can feel as if they have little say in mine closure. The interviews with local government personnel indicate that from a local government (and hence to a degree a community) perspective mine closure needs to be more inclusive and undertaken from the commencement of the mine closure plan.

Across all of the interviewees there was a broad consensus on the need for a more holistic approach to mine closure with all parties working together to achieve sustainable outcomes for local communities. There was a majority belief that governments at all levels should assist communities to deal with mine closure and that planning for this should occur from the outset of the mine planning stage. Mining companies, working with their government counterparts, should incorporate socio-economic problems that can arise after a mine closure into mine closure planning.

The mining companies were generally of the belief that specific mine closure legislation would be a positive step towards recognising the importance of mine closure, however they stressed that such a step should not be prescriptive. Conversely, mining companies were divided over the need for national mine closure legislation.

One of the key findings of this section is that it is the councils who represent the community; they are the constant in the community. Overall, community members can be transient, perhaps not residing in a community for more than a few years at a time and , the council's ability to represent their needs and wants is critical. Not planning for mine closure, which in most of the LGA's from this interview process were key employers, is not planning for the future environmental, social and economic needs of the community.

Following on from this chapter, the next chapter examines the Lake Kepwari mine closure in Collie, Western Australia. The chapter highlights the findings from a benefit-cost analysis conducted on the mine closure, using the end-use options considered for the lake as part of a closure options analysis undertaken by a project management group back in 2003. It also demonstrates how benefit-cost can be used as a tool by mine companies and local communities in determining closure options during the mine planning phase of a mining project.

Chapter 8. Economic evaluation of mine closure alternatives: A benefit-cost analysis of Lake Kepwari

8.1 Introduction

A range of techniques can be used in economic analysis to assist in the decision-making process when comparing alternative options. When benefits and costs are not obvious, economic analysis techniques can be useful in directing the decision-making process towards obtaining the most efficient and beneficial options for a particular investment choice over a period of time (Department for Communities and Local Government, 2009; Henson and Masakure, 2009).

Economic analysis has applications across society and it is useful when supporting decision making when resources are scarce and the relative costs and benefits are not necessarily apparent (Henson and Masakure, 2009). It is useful as a tool to guide decision makers towards choices that yield the most efficient outcome, providing the most benefit based on the level of investment (Fabrycky et al., 1997). Some examples of economic analysis that could be used as tools to analyse post-mining options include benefit-cost analysis (both financial and social), fiscal impact analysis, cost-effective analysis and cost-analysis (Fabrycky, 1997).

Each method has their advantages and applicability to different projects and various sectors of the economy, as well as optimal usage for both the private and public sector. In reviewing options for this thesis it was determined that fiscal impact analysis was too narrow as it mainly focussed on the impact from a government perspective. Cost-effective analysis was too narrowly focussed on resource uses and cost-analysis was concerned mainly with policy development, or decision making related to government programs (Department for Communities and Local Government, 2009). Benefit-cost analysis (BCA) was chosen as it is not limited to governments as an analysis tool, but is also embraced by the private sector as an economic evaluation technique and can also be used over a an extended period of years. For the purpose of this thesis, a financial BCA was chosen because it could be used to illustrate some of the issues and because of time and resource constraints to conducting a full social benefit-cost analysis (SBCA). However, it is acknowledged that a full SBCA would be a better option (Federal Geographic Data Committee, 2009) that should be investigated in future research, but it was beyond the scope of this thesis.

In terms of its use for this research, a financial benefit-cost analysis was determined as the most useful tool to investigate how beneficial any development options would be at Lake

Kepwari as it provides the most comprehensive method of allowing all benefits and costs associated with the mine development to be measured. The cost of undertaking these various development options was analysed and from this analysis it was determined whether the community will benefit from development of the lake from a financial perspective. The analysis also provides costs on any development at the lake, providing a tool that can be used to determine how viable these options will be.

This chapter will provide a financial analysis of development options for Lake Kepwari, as proposed by the original consultancy report in 2003. A benefit-cost analysis will form the basis of the chapter as a means of demonstrating the costs associated with mine closure options and the need to ensure that sufficient capital is available to meet those costs.

8.2 Benefit-cost analysis

In the context of this PhD thesis, a financial analysis was undertaken in the form of a benefit-cost analysis. Benefit-cost analysis was chosen as it is useful in determining the best possible end use for a mine void. It allows appraisal of the advantages and disadvantages of closure options, valuing as many of these as possible in monetary terms (Elliot 2003). It is also a tool to assist in the making and understanding of decisions. Benefit-cost analysis is a widely used financial and economic appraisal tool and it is considered a rigorous analysis tool (World Bank, 2011). Benefit-cost analysis ensures quality, rigour and objectivity when assessing the viability and validity of projects. It is a tool that permits for organisational transparency and informed decision making (World Bank, 2011). Three measures used to assess the various mining void options in relation to benefit-cost analysis (BCA) are the Benefit cost ratio, net present value and internal rate of return of the investment project. The first section will discuss the importance of a Social Benefit-Cost Analysis as part of a full economic analysis and provide an explanation as to why it was not incorporated into this thesis.

8.2.1 Social benefit-cost analysis

A social benefit-cost analysis (sometimes referred to as a full benefit-cost analysis or simply benefit-cost analysis) is the combination of both financial and social analysis, valuing the social benefits and costs of the project. It is a methodical and comprehensive approach that involves the financial elements of a project, such as costs and discount rates and the monetisation of the social impacts of a project on a community, examples of which would include the environmental impacts, effects on indirect labour, and impacts on housing and legal implications. A social benefit-cost analysis examines the direct, indirect and external impacts of a project (Morrison and Bennett, 2000). The principle aim of a social benefit-cost analysis is to determine and affix prices to as many elements of the project as possible with the view that such an inclusive analysis will be able to measure the impact of the project upon a diverse society (Novick, 1973).

The benefit-cost analysis in this thesis only examines the financial elements of the Lake Kepwari development. In essence it opts to examine this development from a commercial perspective with a long term view to profit maximisation, which is perhaps a narrow perspective in that the items monetized are those which are directly impacted by the project (Fujiwara and Campbell, 2011). However, as the thesis also seeks to examine options for mine closure, best practices for mine closure, stakeholder participation, mine closure legislation and further develops a framework for economic modelling and policy development for mine closure, the breadth of the BCA undertaken was determined to be appropriate as the broader undertaking of financial and social analysis would in and of itself constitute a separate thesis.

Whilst a financial analysis focuses on monetizing items directly impacting the project, a social benefit-cost analysis would have focussed on monetized items directly affecting the project, in addition to those items indirectly affecting the project and would also incorporate the externalities (Wells, 1975). It is likely that further research could be undertaken on the social costs of mine closure to a community. Certainly in an era of corporate responsibility, mining companies should view mine closure with not only the most efficient use of corporate resources from a shareholders' perspective, but also from the benefit or loss to society (Novick, 1973).

Without doubt, following the undertaking of a full social benefit-cost analysis, even more significant inroads could be made in policy development and government regulation when considering mine closure scenarios and legislation (Wells, 1975). However, the difficulty with undertaking a full economic analysis in this project was not only the breadth of the existing thesis, but further accurately valuing indirect impacts and externalities and incorporating these into the thesis, the inclusion of which can be argued as important, but would substantially increase the scope of the study which was not possible due to time constraints, hence is instead suggested as an area of further research (Brent, 1984). Further consideration too needs to be given to the fact that in the Collie River Valley community, as in many mining communities, the population is transient and therefore there is continual shift in the community from a social context, a consideration which would require substantial analysis, outside the scope of this thesis.

It can be argued that there are concerns that require consideration when undertaking a social benefit-cost analysis, for example there may be concern on the accuracy of the data, when for example monetizing an externality and for this reason as with a financial BCA the use of sensitivity analysis would be required when undertaking an SBCA (Haezendonck, 2007). The development of a social benefit-cost analysis was once viewed as a tool by which political perspectives could be inserted into complex financial data (Fujiwara and Campbell, 2011). A social benefit-cost analysis is now viewed as a strength and a representation of the impacts of a project on society, however risks remain, such as the possibility of undervaluing future effects, overcorrecting prices for possible market distortions and the cost of doing nothing (Fujiwara and Campbell, 2011).

The determination of social prices is based on the theory of shadow pricing or the cost to society of one unit (less) or more. As an SBCA is based on social prices rather than market prices it tends to be based on market failure and or non-existent markets and for this reason too, there are questions as to the accuracy of monetizing this data (Haezendonck, 2007). While it is true that there are some negatives or questions raised about judgement values and monetization of externalities, there are positive considerations and just reasons for conducting a SBCA and it is for these reasons that further examination of this aspect should be given in a future research project. These reasons include the fact that a SBCA examines the positive and or negative impact of a project on a whole community or society. Developing a more holistic understanding of the economy of a community and the potential impact a project, (or in this case a mine closure) can have on a community, the more accurately a company, government or both are able to mitigate any negative consequences of a project, such as a mine closure or alternately enhance a communities facilities, for example determining the most optimal end-uses (Ivanova et.al., 2007).

The Department of Finance provide further weight to the argument that a social benefit-cost analysis (SBCA) is an appropriate research tool for Lake Kepwari by signifying its usefulness in the absence of commercial transactions taking place but in the situation where a project imposes costs (for example pollution from lake water that is acidic, or erosion from a poorly rehabilitated site) or benefits (for example the amenity value, or the benefit to the ecosystem) on third parties. Finally, they argue, that where a project is of a large scale, it is important to be fully cognisant of the broader economic impact on the community (Commonwealth of Australia, 2006).

A social benefit cost analysis, undertaken as further research and as an adjunct to this thesis would have the benefit of incorporating a financial measurement of social sustainability as a theme, the benefits of which have been discussed within the broader literature review context of this thesis. While this thesis seeks through its broad examination of mine closure, to influence policy, the development of further analysis incorporating a SBCA, will refine the decision-making process through the provision of a broader community impact tool on mine closure, providing further information to policy makers, mining companies and communities in their decision-making process about mine closure (Ivanova et.al., 2007). Placed within the context of this thesis, which is already broad in its application, the financial analysis of the goods and services directly impacted by the Lake Kepwari Development is detailed enough in justifying current recommendations contained within the body of the research.

8.2.2 Benefit-cost ratio

The benefit-cost ratio (BCR) compares the total discounted benefits with the total discounted costs and is a measure of the profitability of a project (World Bank, 2011). The benefit-cost ratio is calculated by dividing the present value of the benefits of a project and by the present value of all the costs (World Bank, 2011).

The benefit-cost ratio is a variant of net present value, as costs and benefits are measured in their present value as occurs with net present value (International Centre for Development Oriented Research in Agriculture, 2010). The benefit-cost ratio is not recommended as a tool for determining the optimum choice of mutually exclusive projects, nor is it useful when projects have differing economic lives (Elliot, 2003).

Benefit-cost analysis traditionally was a signature tool of the World Bank. In part, it cemented the World Banks reputation as a knowledge bank and was empirical evidence of a commitment to providing measurable results and ensuring accountability. Overtime however, the percentage of projects that were justified by the use of benefit-cost analysis declined (Independent Evaluation Group World Bank, 2011). A recent study (2011) by an Independent Evaluation Group of the World Bank drew two broad conclusions on the use of benefit-cost analysis, firstly, the World Bank needed to revisit its policy for benefit-cost analysis. Secondly, benefit-cost analysis must be carried out in a manner that ensures quality, rigour and objectivity (World Bank Independent Evaluation Group, 2011).

The implications of the study by the Independent Evaluation Group of the World Bank are clear: benefit-cost analysis, when carried out in a rigorous manner is a useful tool in justifying projects. However, the report by the Independent Evaluation Group argued that benefit-cost analysis should recognize that there are legitimate difficulties in quantifying all benefits (World Bank Independent Evaluation Group, 2011). Secondly, it argued that data must be from a quality source, be consistent and objective. According to the study, poor data and analysis provides misinformation and therefore does not allow informed, quality decision making (World Bank Independent Evaluation Group, 2011).

The Independent Evaluation Group go on to argue that benefit-cost information should be presented summarily, in a single table for each topic or point and be inclusive of the major costs and benefits. The table should be presented, along with a discussion of assumptions that details the information behind the numbers. Further, the analysis should make available the spreadsheets or data from the spreadsheets as an appendix for review.

The Australian Department of Finance argues that a benefit-cost analysis can provide direction on the proficient allocation of resources. While they apply this argument to public sector resources, they also suggest that a benefit-cost analysis can be used to provide information where no market currently exists (Commonwealth of Australia, 2006). Lake Kepwari would be a perfect exemplar of this, as no market currently exists for the services suggested at this site.

The argument for the reassertion of benefit-cost analysis as a signature tool for analysis at the World Bank and the recognition of its quality, rigour and objectivity provides the basis for a strong argument that a benefit-cost analysis form part of the research for this PhD thesis. As well, development of Lake Kepwari potentially imposes costs or benefits on a third party, the community and it is a large scale project.

8.2.3 Net Present Value

As part of the Benefit-Cost analysis, the thesis also calculated the Net Present Value of the possible development options at Lake Kepwari. Net present value is in essence an assessment of the long-term profitability of a project. The Lake Kepwari development is a long-term project, therefore NPV is the best way of determining the viability of the various project possibilities. NPV estimates the revenues and costs of a project and subsequently discounts them, compared to the original investment. The view is that projects with negative NPVs should be rejected as the present value of benefits is not sufficient to recover the costs of the project (Commonwealth of Australia, 2006).

NPV is calculated by adding together all the revenue a project can be expected to achieve over its whole life and deducting the costs associated with the project, using an appropriate discount rate for future costs and revenues (Sharma, 2006). In the case of this research, the discount rate that has been used is 7%, which is the Commonwealth Government Guaranteed Security Rates, as recommended by the Australian Accounting Research Foundation (2006).

The Office of Best Practice Regulation (OBPR), an Australian government department that operates through the Department of Finance and Deregulation recommends the use of Net Present Value calculations when conducting benefit-cost analysis, as in conjunction with a benefit-cost ratio, it provides the most accurate assessment of the long-term viability of a project (Department of Finance and Deregulation, 2009). In addition, the OBPR identified NPV and BCR as the two main methods of assessing a proposal’s net social benefits. While the OBPR is referring to government projects solely, the application of these methods to the Lake Kepwari project and their use in the thesis has similarities in that the Lake Kepwari project has social benefits and potentially, a large proportion would be funded by the government (Department of Finance and Deregulation, 2009).

One of the disadvantages of using Net Present Value in a financial benefit-cost analysis is that it does not take into account any intangible benefits that may be gained over the life of a project (Elliot, 2006). Furthermore, it does not take into account opportunity cost and it is based on future cash flows and discount rates which are difficult to estimate accurately (Sharma, 2006). Both Net Present Value and Benefit-Cost ratio also suffer from the fact that they ignore how the costs and benefits are distributed among society and what proportion of the costs and benefits are distributed through the community, a problem associated with calculating only the financial costs and benefits (Sharma, 2006).

A difficulty in using NPV alone is that it assumes risk to be equal among competing projects; however, in reality risk is rarely equally spread across projects (Sharma, 2006). As well, several smaller projects will generally have less risk than one large project (all other things being equal). Moreover, NPV favours larger projects, despite the fact that smaller projects carry less risk (Martin, 1997). Another problem with NPV is that it is used generally to compare projects within an organisation, usually using the same discount rate (Martin, 1997).

8.2.4 Internal Rate of Return

The Internal Rate of Return (IRR) is the discount rate at which the present value of costs equals the present value of benefits (Department of Finance and Deregulation, 2009). It is sometimes referred to as the second discounted cash flow method where the discount rate of the NPV equals zero (Martin, 1997). The Office of Best Practice Regulation does not recommend its use in regulatory Benefit-Cost Analysis, but it goes on to state that it is useful as a measurement tool in Benefit-Cost analysis for projects (Department of Finance and Deregulation, 2009). The Internal Rate of Return is not necessarily useful in government analyses as in most cases IRR calculations require cash inflows in addition to outflows and there is no IRR for a negative cost stream, which makes the use of IRR an issue for government projects where no revenue is generated (Martin, 1997).

One of the strengths, however, of calculating IRR is in the comparison of project cost streams comparing the difference between a baseline figure and alternative cost streams (Martin, 1997). Another advantage of calculating IRR is that it is a rate, or a ratio, rather than a total amount and is a more useful tool for the calculation of differing investment projects and projects that differ in size and hence is useful for projects such as those proposed for the Lake Kepwari development (Sharma, 2006).

8.2.5 Sensitivity analysis

Due to the uncertainty involved with benefit-cost analysis and the possibility that there will be conjecture on whether or not the prices and assumptions used in the Lake Kepwari analysis are correct, sensitivity analyses were undertaken as part of the benefit-cost study (Jones et. al., 2007). The sensitivity analyses included an examination of the break-even point for each lake development, in order to determine at which point the revenue equals the cost associated with receiving any revenue from the project (Covello and Hazelgren, 2006).

Once costs and benefits have been identified, they are valued and compared. The only practical way to compare differing costs and benefits directly is to give each a monetary value. The benefit-cost analysis of the Lake Kepwari site in Collie, Western Australia evaluates the development options post closure. These options include developing the site into a Lake, Lake with Cafe on site, Lake with Water Sports Park, or Lake with Cafe and Water Sports Park. There is of course the option of doing nothing at the site, however this is a default solution and in the case of this thesis, this was not an option as it was measuring a range of development opportunities for Lake Kepwari identified in a state government and Wesfarmers Premier Coal commissioned report. In many projects it is acceptable as it is maintaining what is known, or the status quo. The cost of doing nothing is an opportunity cost, it may be seen as acceptable due to its risk averse nature, but demonstrates a focus on cost-cutting over results, organisational fatigue, or scapegoat thinking i.e. it is someone else's problem. The latter point has perhaps been the persistent past attitude of mining companies and governments (Civil Aviation Safety Authority, 2007). Little by way of policy development on mine closure exists in Australia and the long-term sustainability of communities post-closure and the direct, indirect and externalities associated with closure have not been considered.

The Benefit-cost analysis of Lake Kepwari were undertaken as part of a development proposal written by a consultancy group contracted to develop a plan for the post mining use of former mine void W5B now known as Lake Kepwari (APP, 2003). The figures provided by APP were adjusted for inflation in order to provide a more accurate assessment. The authors outlined different options for the site that were used in this thesis to form the basis of a benefit-cost analysis of the different development options.. No such analysis was undertaken by APP, yet the literature on the subject of developing mine closure options recommends undertaking benefit-cost analysis as part of the mine closure options process (ANZMEC/MCA, 2000; ICMM, 2005).

The establishment of various recreational and commercial facilities at Lake Kepwari in the Collie region of Western Australia will require, in some cases, significant start-up capital and strong ongoing tourism numbers before they will become commercially viable enough for private enterprise to operate them. However, some recreational options could be considered for the lake in the initial years of operation that will potentially require smaller start-up costs and would be the catalyst for an increase in tourist numbers to the region.

The vision for the lake, a former coal mining void owned and operated by Wesfarmers Premier Coal, is to turn the site into a recreational lake that will be a showcase for sustainable mining and rehabilitation and provide a new and unique tourist facility for the region. Tourism is still in its infancy in the Collie region, with an estimated 39,000 visitors to the town annually averaged over four years (Tourism Research Australia, 2008). In comparison Bunbury, which is just 40 minutes drive from Collie had an annual average of 189,700 visitors over four years for the same period (Tourism WA, 2010). In the Southwest region of Western Australia, visitor numbers totalled 1,602,100, representing 31% of total visitors to Western Australia, making the region the state’s second most popular tourism destination after Perth (Tourism WA, 2010). These figures demonstrate the potential for growth in the Collie region, particularly as the numbers for Collie as a whole are low compared to the numbers for the region. The development of Lake Kepwari would be ongoing with new business ventures developed as visitor arrivals permit. The purpose of this analysis is to determine the viability of the suggested development options of the site and determine the expected usage of these businesses.

The first part of the analysis involved a brief outline of possible development options for the site, as well as the anticipated time frame for any development. The options have been factored into a the benefit-cost analysis on the assumption that the cafe and watersports facility would initially be run by the private sector, however either a state government agency such as the Department of Environment and Conservation, or the local government, Collie Shire Council would need to manage the overall site. The benefit-cost analysis is examining three broad closure options for the site.

The discount rate used in the analysis is 7% nominal which is the Commonwealth Government Guaranteed Security Rate and which for the sake of consistency has been applied to all of the developments analysed in this chapter, including all the benefits and costs associated with the development (Australian Accounting Research Foundation, 2009). Nevertheless, particularly in the case of the cafe and watersports facility, which are most likely to be privately run, a higher discount rate of up to 15 per cent would be the more likely rate required for the operation of a private business (Australian Accounting Research Foundation, 2009).

The first option is the initial development of the lake into a recreational facility. This has one-off development costs that would need to be borne by the government in order to make the lake attractive to potential visitors. The development options report released by APP Project Management (2003) outlined options for the lake development that is briefly discussed in Section 8.4, the lake development section of this chapter. However, more detail on the Assumptions that form the basis for the benefit-cost analysis is provided in Appendix C of the thesis which contains a summary of the benefit-cost analysis.

The second option is the development of a cafe at the site, which may initially require either the state or local government to develop the site and possibly run the site initially with the aim of leasing the site over time as visitor numbers to the lake increase. The report developed by APP listed development costs for the site that have been used as the basis for the benefit-cost with adjustment for inflation.

The third option for the lake is the development of a water sports facility at the lake as outlined in the APP report, which recommended a number of possibilities for water-based recreational activities. This type of option may again initially need to be operated by either a state government department such as the Department of Environment and Conservation, or the Shire of Collie with the aim of eventually tendering out the facility (possibly as part of the cafe development) to a private operator (APP Project Management, 2003).

8.3 Lake development options

The development of the lake would prove a unique drawcard for the Collie region and has the potential to increase visitor numbers to the area and assist in developing the economy away from a reliance on mining (South West Development Commission, 2005). In addition, there is strong support from the Collie community and local council towards the proposed development (South West Development Commission, 2005). The mining company Wesfarmers Premier Coal also spent an additional $2 million in the rehabilitation and closure program in order to develop the lake for recreational purposes which may play a role in the decision-making process for the lake development (APP, 2003).

The facilities under consideration as per the APP recommendations have all been factored into the benefit-cost analysis as initial outlays for the mining company, government and private industry in order to make the lake an attraction for visitors; these have been factored in as initial one-off costs in the analysis. The three options will be discussed initially as three separate options and presented with their individual benefit-cost analysis and will be then presented as one total development with the associated benefit-cost analysis.

8.4 Lake development

One of the proposed features of the lake development involves the establishment of a walking/hiking track around the 103 ha lake that would play an important role in attracting visitors and provide additional activities for the site (South West Development Commission, 2005). A track of this kind could also incorporate an interpretive education trail into its design featuring both the history of the site and also the history of the area's traditional owners. These interpretive signs could feature snapshots depicting the changes to the site over time during both the mining and rehabilitation phases. The site could be used as an educational feature for possible school visits to the area, similar to what has occurred at Penrith Lakes in Western Sydney (Penrith City Council, 2005).

It may be possible over time to link any walking/hiking trail to the Bibbulmun track in order to increase tourism opportunities at the site. This will also provide further incentives for tourists to visit and may encourage overnight visits once camping facilities are made available. The linking of this track with the Bibbulmun track may not prove to be feasible; however, it may still be possible to link the site as part of the Bibbulmun track experience.

A walking/hiking track at the site would need to be constructed as soon as Lake Kepwari is open for public access. A trail around the site would have a synergistic relationship with other development options at the lake and would be a relatively low-cost option, compared to other possible development considerations. If entrance to the lake is to attract a fee, then it would be possible to recoup some of the costs of building any track through an entrance fee. The completion of a beach area, jetty facilities, boat ramp and general recreation areas could help attract visitors to the site and generate some benefits for the facilities that the APP report recommended be made available as part of the lake development. A vehicle entry fee would provide a possible revenue stream to use as a means of assisting with the upkeep of facilities at the site, such as car park resurfacing, signage upgrades that would be required due to wear and tear (APP Project Management, 2003)

8.4.1 Assumptions

The timeframe for the benefit-cost analysis is 20 years with the assumption that some of the investment projects associated with the lake development will require further outlay for upgrades during the 20 years. These upgrade costs have been included as part of the capital costs.

It may be possible for the Government to charge people an entry fee for the use of the Lake, as occurs in some recreational facilities around Australia, most notably in National Parks. It is likely, however, that this would not be a popular option and visitors may not be willing to pay for such a recreational facility in Collie. For the purpose of the benefit-cost analysis it has been assumed that a fee per vehicle charge of $12 per vehicle is applied at the Lake as a way of generating revenue for the site. Currently, there are no charges for vehicles into Western Australian National Parks, however, New South Wales charges $7 per vehicle at some of its parks (Office of Environment and Heritage, NSW, 2011) and Victoria charges between $32 -$35 per vehicle at its snow resorts (Ker, 2011). The figure of $12 was used for the Collie site as it sits between the costs of entering the NSW and Victorian resorts and is assumed to be a cost that visitors would be willing to pay due to the activities available at the site. Based on projected visitor numbers to the site of 59,000 it is assumed that there would be approximately 23,000 vehicles through the site[1]. The figures assume a 2% increase in the number of vehicles to the site per year based on average annual increase in tourist numbers to Australia (Tourism Australia, 2011).

The figures for the costs at the site have been arrived at using a number of assumptions that have been applied to all of the costs to allow for consistency across the costing. These figures are based on cost assumptions by APP Project Management (2003, Appendix 3). It is assumed that the costs would be borne by State and Federal Governments. The costs associated with the development of the lake options are expensive and highlight the need for mine closure planning during the mine planning phase in order to undertake economic analysis of closure options and ensure that funding is available for closure options from the commencement of mining (Fourie and Tibbett, 2006). The capital costs associated with the lake development options are shown in Table 8.1 and in Appendix 3.

As the table demonstrates, the costs associated with the development are high and highlight a key issue associated with mine closure options such as this proposed development, namely if communities and governments wish to pursue post closure development opportunities, there is a cost, which raises the question of who pays for these costs. Is it the mining company that generated revenue from the lease of this site during the life of the mine, or is it the community and hence the government who benefitted indirectly through employment, royalties and taxes from the mine site development, which would not have occurred had mining never taken place. There is some argument for the sharing of costs associated with post closure development, as all parties benefit to some degree from the mining process, however ultimately it is the community that are left with a mine void once mining has ceased (Khanna, 1999; World Bank, 2002; Fox, 2007). In Appendix 3, the operating costs associated with the lake development are included. The operating costs associated with the development include the employment of staff to maintain the facilities and to contribute to the day–to-day running of the facility. As with capital costs, the operating costs are high over the 20-year period of the development and again highlight the need to consider the costs associated with such a development and the question of who pays.

[1] (based on 59,000 divided by the average household size in Australia, which is 2.6 people (ABS, 2006)).

Table 8.1: Summary of capital costs, salvage values and assumptions for the lake development

Capital Investments	Cost ($)	Life span (years)	Salvage value ($)	Assumptions
Walking/Hiking Trail Establishment	320,000	25	64,000	APP Project Management (2003) and ATO (2011)
Car Park	65,000	25	13,000	APP Project Management (2003) and ATO (2011)
Beach/Swimming Area	40,000	25	8,000	APP Project Management (2003) and ATO (2011)
Amenities Building	220,000	25	44,000	ATO (2011)
Sewerage Costs	220,000	25	44,000	APP Project Management (2003) and ATO (2011)
Potable Water	140,000	25	28,000	APP Project Management (2003) and ATO (2011)
Power	190,000	25	38,000	APP Project Management (2003) and ATO (2011)
Roads and Drainage	350,000	25	70,000	APP Project Management (2003) and ATO (2011)
Phone Lines	27,500	25	5,500	APP Project Management (2003) and ATO (2011)
Lookout Area	37,000	25	7,400	APP Project Management (2003) and ATO (2011)
Car Park - Watersports	430,000	25	86,000	APP Project Management (2003) and ATO (2011)
Boat Ramp	290,000	25	58,000	APP Project Management (2003) and ATO (2011)
Playground	265,000	8	132,500	APP Project Management (2003) and ATO (2011)
Trail Bike Tracks	155,000	25	31,000	APP Project Management (2003) and ATO (2011)
Wetland Areas	35,000	30	11,667	APP Project Management (2003) and ATO (2011)
Recreation Areas - Day use	430,000	25	86,000	APP Project Management (2003) and ATO (2011)
Jetties	76,000	25	15,200	APP Project Management (2003) and ATO (2011)
Signage	76,000	12	25,333	APP Project Management (2003) and ATO (2011)
Motorsport Link Upgrade	130,000	25	26,000	APP Project Management (2003) and ATO (2011)
Landscaping and Grassed Areas	265,000	25	53,000	APP Project Management (2003) and ATO (2011)
Footbridges	55,000	25	11,000	APP Project Management (2003) and ATO (2011)
Hall Facility	300,000	25	60,000	APP Project Management (2003) and ATO (2011)
Motor Vehicle	20,990	8	10,495	APP Project Management (2003) and ATO (2011)

8.4.2 Benefit-cost analysis

The results from the benefit-cost analysis are shown in Table 8.2. The analysis assumes that 23,000 vehicles pass through the lake in the first year and assumes that a per car vehicle entry fee is charged as a way of providing revenue for the lake development. The number of vehicles is arrived at by using the figure of 59,000 (APP Project Management, 2003) people and dividing it by the average household size in Australia of 2.6 people (ABS, 2006). The decision to charge a vehicle entry fee, rather than a per person fee was deemed as the best option due to the fact that the lake is located outside of the Collie town boundaries and the only option for arriving at the lake is by private vehicle. This analysis assumes an entry price of $12.00 per vehicle, however there would be no other charges associated with the use of other facilities, once this fee is paid.

The figures for the benefit-cost analysis show that the lake development would prove a costly undertaking, with a net present value of -$2,680,860, and an Internal Rate of Return of -1.58%. The benefit-cost ratio for this proposal of 0.58 signifies that the project will be a cost to the government and the community and be a loss. Any benefit that the project does bring will be based on the introduction of an entry fee to the development, which may prove to be a disincentive for some people to visit the lake.

Table 8.2: Financial results for Lake Kepwari development for discount rate of 7 per cent

Criteria	
Net Present Value	-$2,680,860
Internal Rate of Return	-1.8%
Benefit-cost Ratio	0.58

The issue with this particular project is the initial high capital costs associated with the development that are required in order to attract the visitor numbers of 59,000 that were forecasted for the development (APP, 2003).

8.4.3 Sensitivity analysis

A series of sensitivity analyses were conducted for the lake development option with a number of scenarios built into the analysis as a way of determining how changes to a number of key variables might alter the outcome for the development. These variables included changing the number of vehicles to the park, the discount rate used for the analysis and the price of entry to the lake. **Error! Reference source not found.** illustrates the results from the sensitivity analysis and as the results show even slight changes to entry price and vehicle numbers can alter the Net Present Value of the development.

Table 8.3: Sensitivity analysis of lake development (Net Present Value)

Number of Cars	19,000	21,000	23,000	25,000	27,000
NPV	-3,272,222	-2,976,541	-2,680,860	-2,385,178	-2,089,497
Discount Rate	3%	5%	7%	9%	11%
NPV	-1,919,292	-2,359,273	-2,680,860	-2,919,943	-3,100,761
Park Entry Fee (per car)	$8	$10	$12	$14	$16
	-3,814,305	-3,247,582	-2,680,860	-2,114,137	-1,547,414

As an example changing the number of vehicles to the site from the proposed 23,000 to 21,000 causes a further reduction to the NPV outcome of almost $300,000 over the life of the development and illustrates a possible scenario should possible visitors to the lake find it difficult to accept a vehicle entry fee. By contrast, raising the number of vehicle entries to the site by 4,000 to 27,000 vehicles decreases the NPV loss at the site by approximately $890,000 over the life of the development; however, the lake still operates at a substantial loss. The sensitivity analysis showed that if entry fees to the park were lowered by $2 to $10, assuming all other variables remained constant, then the lake development would make a loss of -$3,247,582, almost $600,000 more than with an entry price of $12. If the entry fee were raised to $16, then the NPV would fall to just -$1,547,414 over the analysis period suggesting an entry fee may need to be nearer to $20 to prove a going concern to government. However, it represents a high cost to users of the lake and there is no other development of this type in Western Australia to use as a comparison to determine if such a cost would be acceptable to users.

As with the other variables used in the sensitivity analysis of the lake, altering the discount rate has an impact on the Net Present Value result, however, in this case the impact is not dramatic. As the table demonstrates, if the discount rate were lowered to 5% the return from the lake would still be in the negative, and the resulting gain to the bottom line, would only represent a savings of around $300,000. At the other end of the spectrum, a discount rate of 11% would leave the lake development with a Net Present Value of -$3,100,761.

8.4.4 Break-even analysis

If the lake were to break even and prove cost neutral, then as Table 8.4 illustrates, a number of factors need to change substantially. The cost of entry into the park would need to rise to $21.46, or the number of vehicles visiting the site would need to rise to 41,133 or the discount rate would need to be -2%. These changes reveal why the development of this lake is a difficult concept for any one party to take in isolation and also indicate the need for benefit-cost analysis to form the basis of any mine closure process as a way of demonstrating the costs to the parties involved in any mine closure (ANZMEC/MCA, 2000).

Table 8.4: Break-even analysis of lake development

Variable	Current	Break Even
Cars	23,000	41,133
Discount rate	7%	-2%
Park entry	$12	$21.46

The decision to develop the lake for recreational purposes by investing in a capital works development program is the catalyst for the other development options proposed in the APP report. One such option is the establishment of a cafe at the lake that would serve light meals and refreshments with some capacity for a sit down dining area. This option is outlined in the next section of the chapter.

8.5 Cafe

A café at the site could possibly be used as part of the development of a caravan/camping facility and also as a water sports hire outlet. The facility may initially operate on a seasonal basis, however, over the longer term may operate year round, if enough facilities and tourists are encouraged to the site. For the basis of this benefit-cost analysis it was assumed that the lake would operate on a year round basis, with the assumption that the lake would be drawing enough visitors to make a year round operation viable, however, it is likely that even if the cafe operated year round, that the peak periods would be the warmer months, the student holiday breaks and during the Christmas and Easter holiday periods.

A cafe at the lake would be able over the long-term, to take advantage of its location by offering good quality meals, attracting further visitors to the site and making the destination a culinary one, something that would be unique in the Collie region, for its setting by a water location. A good quality eating establishment at Lake Kepwari may prove the catalyst for destination style cafes/restaurants to open in the Collie region, providing a new direction for the town. This has occurred with Cessnock in the New South Wales Hunter Valley region as it moved from a primarily mining-based town to one that was able to diversify into a region with a strong food and wine tourism focus.

The cafe could be built partially over the lake in a manner similar to the very successful Lakehouse Café on Lake Daylesford, Victoria that has won many awards, for both its food and its setting (Walkabout Australia, 2005). The setting for this restaurant has some similarities with Lake Kepwari, as the Lake Daylesford site was a former gold mine site that was turned into a recreational lake in 1929 (Walkabout Australia, 2005). Daylesford is located in central Victoria, approximately 90 minutes from Melbourne and was a former mining town that during the 1980’s and early 1990’s faced a declining population and few business opportunities. The town managed to turn to tourism during the mid-1990’s and has since become one of the most popular tourist destinations in Victoria (Spa and Wine Country, 2005). The lessons learned from Daylesford could be applied to the Collie region, which like Daylesford has the advantage of being close to a major capital city, and has the added advantage of being located in the second most popular tourism destination in Western Australia's South West Region (WATC 2004).

8.5.1 Assumptions

The establishment of a cafe at the Lake Kepwari site would need to be a priority in the initial development of the site, as the site is approximately 13 km from the town centre (South West Development Commission, May 2005) and there are no other such facilities within the vicinity of the lake. Initially this site may require that the state government department manage the site (likely to be the Department of Environment and Conservation), or possibly the Shire of Collie until the site could be contracted out to a private operator. The assumptions made for the benefit-cost analysis have been undertaken on the basis of a privately owned operation at the site.

The sales assumptions are based on expected visitor numbers of 59 000 per year, as outlined by the APP report commissioned in 2003. The expected sales figure was arrived at by using the expected visitor numbers to Lake Kepwari and assuming that 40 per cent of these visitors used the café, spending an average of $16 per head. The industry average for restaurant spend per head is between $11 and $15 (Gehrisch, 2005), however the assumption is made that the spend at the Collie site would be slightly higher as the cafe is at an isolated location with no other food venues nearby and no other competitors in the vicinity of the cafe. The sales data for the 20 year period have been calculated using growth rates of 2.5% which is consistent with growth rates for the other lake options. However restaurant industry growth trends that saw a ten year average between 4 per cent and 5 per cent, making it possible for the cafe to actually achieve higher sales figures over its life (Gehrisch 2005, p. 2).

The costs for the benefit-cost analysis were broken down into capital and operating costs that would be incurred at the site, again using the data supplied by APP as the basis for the proposed cafe. Some adjustments to the figures were made to account for inflation. The assumptions have been listed in detail in the benefit-cost calculations in Appendix C with this section of the chapter providing a general overview of the assumptions with some examples to demonstrate how calculations were undertaken. Table 8.5 below provides an overview of these costs.

Table 8.5: Summary of capital costs, salvage values and assumptions for café development

Capital Investments	Cost ($)	Life Span (years)	Salvage value ($)	Assumptions
Building and Site Costs	350,000	25	70,000	APP Project Management (2003), ABS (2006)
Electricity				Western Power (2009)
Account Establishment Fee	28			
Connection Fee	28			
Three Phase Meter New	240			
Water				Water Corporation of Western Australia (2006)
Service Charge - Water 25mm meter	722			
Service Charge - Sewerage	1,283			
Telephone Connection and Fee				
Fixed line connection	209			
Commercial Coffee Machine	5,500	8	2,750	Supreme Coffee Machines (2009)
Commercial Oven	5,530	10	0	Sydney Commercial Kitchens (2009)
Commercial Fridges	4,158	10	0	Sydney Commercial Kitchens (2009)
Cake Display	4,741	10	0	Sydney Commercial Kitchens (2009)
Commercial Deep Fryer	2,771	5	0	Sydney Commercial Kitchens (2009)
Commercial Dish Washer	3,703	8	1,852	Sydney Commercial Kitchens (2009)
Cash Register	1,188	10	0	Sydney Commercial Kitchens (2009)
Commercial Rangehood (Exhaust Fan)	2,658	8	1,329	Retravision Australia (2009)
Café furniture				Hillcross Commercial Furniture (2009)
Tables	2,000	10	0	
Chairs	7,000	10	0	
Cutlery	2,500	10	0	
Glassware, Cups,				
Glassware	356	1	0	QCC Hospitality, Perth WA (2009)
Cups	356	1	0	
Miscellaneous	5,752	10	0	QCC Hospitality, Perth WA (2009)

The building and site costs have been taken from a report produced by APP Project Management (2003, Appendix C) on the development of Lake Kepwari. The report costed the building and site costs for the project at AUS$350 000. Other capital costs included in the costing for the site that were not listed in the APP report, but considered necessary in undertaking the benefit-cost analysis were chosen based on personal communication with two former cafe and restaurant owners in New South Wales and Western Australia who have spent 10 years each in the hospitality industry both as owners and employees of restaurant and cafes (personal communication, 2006). Capital items include a range of items that would need to be purchased for the operation of a cafe, including for example an oven, a coffee machine and cutlery. The full list of capital cost assumptions are listed in the benefit-cost analysis in Appendix C. Two examples from the capital cost assumptions are as follows:

- Cutlery, glasses and cups - The information for costs associated with cutlery, glasses, and cups have been sourced from QCC hospitality in Perth. The items selected are in the mid-price range and have been selected for their durability: Cutlery 10 boxes @ 249.95 per box; 150 glasses @ $2.37 per glass; 150 cups @ $2.37 per cup (QCC Catering, 2009).
- Commercial Deep Fryer - This would be used for the proposed cafe side of the business and would need to be of a high standard as it would potentially become a major feature of the take-away side of the business (Sydney Commercial Kitchens, 2009).

The operational costs were derived from the report by APP along with research on industry averages for operational costs in the hospitality industry. Operational cost items include for example utilities, wages, and food. The cost assumptions are outlined in detail in the benefit-cost analysis in Appendix C, however two examples are provided below in order to develop an understanding of how the costs are calculated.

- Water - The water costs are based on the average water usage rates per capita in Australia which equate to 1540 kL/year (CSIRO, 2001). The assumption over the 20 year period is that water costs will rise every five years as the cafe increases its sales over that period by 16 per cent. The forecast increase would be 3 per cent and is based on industry averages (Gehrisch 2005).
- Food - The operational costs for food would include ordering of food and spoilage with these costs averaging between 25-30 per cent of total sales (Hales, 2005). The estimate used in this study was 25 per cent. This is the figure that is used over the twenty-year period.

8.5.2 Benefit-cost analysis

The results of the benefit-cost analysis for this option are shown in Table 8.6.The option for developing a cafe at Lake Kepwari would prove to be beneficial, as the benefit-cost analysis demonstrates that the operation would generate a positive cash flow over the 20 year period of study. The Net Present Value of the proposed cafe demonstrates a positive discounted cash flow for the period analysed, with positive cash flow being generated after year three of operations.

Table 8.6: Cafe financial results for a discount rate of 7 per cent

Criteria	
Net Present Value	$1,309,086
Internal Rate of Return	37.9%
Benefit-Cost Ratio	1.41

At 37.9% per cent, the Internal Rate of Return for the cafe development also demonstrates that the rate of return for the business is good, given the relatively high capital and operating costs associated with such a facility. The rate of return for the cafe is close to the industry average for such a facility, with the IRR actually closer to that experienced by more profitable cafes and restaurants (Gehrisch, 2005).

The benefit-cost ratio of 1.41 makes the proposed cafe a sound investment, given the discount rate of 7 per cent used in the analysis. As the period of analysis is over twenty years, the BCA ratio highlights that positive returns would enable any potential private operator to generate good cash flow returns.

8.5.3 Sensitivity analysis

A sensitivity analysis was also undertaken for the cafe proposal by altering the parameters of the visitor numbers and the average spend per visitor to the cafe, the results of which are shown below Table 8.7.

Table 8.7: Sensitivity analysis of cafe development

Visitors	**19,000**	**21,000**	**22,724**	**25,000**	**27,000**
NPV	575,007	969,249	1,309,086	1,757,733	2,151,975
$ Spend per Capita	$12	$14	$16	$18	$20
NPV	189,242	749,164	1,309,086	1,869,008	2,428,930

The results from the analysis show that increasing visitor numbers to the cafe of 26,000 and keeping the visitor spend constant at $16 would generate a Net Present Value of $1,954854. However, increasing visitor numbers to 29,000 would change the Net Present Value substantially by $1,237,131 to $2,546,217. Changing the cafe spend per person alters the Net Present Value quite significantly over the analysis period. As Table 8.5 also shows, increasing the cafe spend from $16 to $24 increases the Net Present Value figure over the analysis period to $3,548,774.

8.5.4 Break-even analysis

The break-even analysis for the cafe shows that in order for the cafe to operate on a cost neutral basis the number of visitors going to the cafe needs to be 16,083 and the average spend per visitor needs to be $11.32 (see Table 8.8). This demonstrates that the cafe has a good chance of succeeding as a commercially viable operation, given projected visitor numbers to the lake and the fact that it would operate as the sole food business at the lake providing the cafe with a captive audience.

Table 8.8: Break even analysis cafe development

Variable	Current	Break Even
Visitors	22,724	16083
Spend	$16.00	$11.32

The cafe facility would prove to be a beneficial option for the development of the lake and as an investment one that would generate positive returns within a relatively short period of time, despite initially high capital costs. However, the cafe development is just one of the options for the proposed lake outlined by APP (2003). One of the other choices considered for the site is the development of a watersports facility with such a facility being able to have some synergies with the cafe and to an extent, all of the proposals add value to one another.

8.6 Watersports facility

The establishment of a water sports facility at Lake Kepwari would provide a drawcard for tourists to the lake and would provide a point of difference between other lakes in the region, with only Wellington Dam currently providing water sports facilities, however, this is mainly limited to canoeing (CALM, 2005). A water sports facility would prove a beneficial addition to the cafe and could develop linkages with the cafe, via a number of cooperative arrangements such as for example: joint advertising, offering discounts for cafe patrons, providing booking facilities through the cafe. These have not been factored into the BCA; however, they represent possible areas of cost sharing and ways to promote Lake Kepwari and its attractions.

The types of water sports offered at the watersports facility could include the hire of jet skis, catamarans, canoes, windsurfers, inflatable equipment such as inner tubes and rafts that could be hired out to day visitors to the facility.

8.6.1 Assumptions

It is important to note from the outset that the watersports facility would most likely need to operate as a single enterprise, rather than as a series of enterprises. The analysis has been calculated in this analysis as one enterprise; however, this will mean that the NPV and IRR will be higher than would be the case for a series of individual enterprises. A series of individual enterprises would not necessarily be able to obtain the economies of scale needed to make such an operation viable. The development of a water sports facility would potentially be able to have one commercial entity operating a number of water-based activities. These could include hire boats, such as canoes, kayaks and row-boats that would be hired out to the public on a charge by the hour basis. The establishment of such a facility would depend on the number of tourists using the lake. It is assumed that tourism numbers would increase to the lake as more facilities opened and the lake became oriented to tourism.

Unlike other proposed developments for the site, a water sports facility could be established within the first year of operation of the site, as it would be a relatively low-cost/low-risk business to establish. It is possible that initially such an operation would be able to operate out of any café established at the site, to reduce overheads and running costs (it could be operated as an addition to a café. This study will assume that such an operation, however, operates as an independent business.

A summary of the capital costs and assumptions for the watersports is provided in Table 8.9.

Table 8.9: Summary of capital costs, salvage value and assumptions for watersports development

Capital Investments	Number	Price ($)	Cost ($)	Life Span	Salvage Value ($)	Assumptions
Hire Shed	1	52,000	52,000	25	10,400	APP Project Management (2003), WA Department of Sport and Tourism (2009)
Jet Ski Purchase	5	15,000	75,000	5	0	APP Project Management (2003), WA Department of Sport and Tourism (2009)
Catamaran Purchase	5	8,690	43,450	10	0	APP Project Management (2003), WA Department of Sport and Tourism (2009)
Windsurfer' s Purchase						
Board	10	1,296	12,960	10	0	APP Project Management (2003), WA Department of Sport and Tourism (2009)
Sail	10	590	5,900	3	0	APP Project Management (2003), WA Department of Sport and Tourism (2009)
Canoe Purchase						
Canoe	10	980	9,800	15	6,533	APP Project Management (2003), WA Department of Sport and Tourism (2009)
Surfski	10	540	5,400	15	3,600	APP Project Management (2003), WA Department of Sport and Tourism (2009)
Inflatables Purchase	10	159	1,590	3	0	APP Project Management (2003), WA Department of Sport and Tourism (2009)
Ski Purchase	5	479	2,395	3	0	APP Project Management (2003), WA Department of Sport and Tourism (2009)
Electricity						Western Power (2005)
Account Establishment Fee	1	28	28			
Connection Fee	1	28	28			
Three Phase Meter	1	240	240			Telstra (2005, 2009)
Telephone Connection and Fee						
Fixed line connection	1	209	209			
Water						Water Corporation of Western Australia (2006)
Service Charge - Water 25mm	1	722	722			
Service Charge - Sewerage	1	1,283	1,283			
Cash Register	1	1,188	1,188	10%	0	Sydney Commercial Kitchens (2009)
Motor Vehicle	1	20,990	20,990	??	10,495	CCH Small Business Guide (2006)

The figures for the number of people using the watersports facility have been arrived at by using the estimated visitor numbers for Lake Kepwari of 59 000 per annum (APP Project Management 2003), it has then been estimated that approximately 8 per cent of these visitors will use the hire facilities. This figure has been based on the estimated number of people that participate in water sports activities in Australia that according to research conducted by the Western Australian Department of Sport and Tourism (2005) is around 3 per cent of the population. A figure of 8 per cent has been used for this analysis and for the purpose of consistency has been applied to all activities, with the assumption that people would be coming to the lake specifically for some type of water-based activity, therefore the number of participants in water sports would be above average. The hire cost for use of the watersports facilities was arrived at by determining average hire costs for the use of this type of equipment at other watersports facilities in the country, the average hire cost was rounded up to $30 for the purpose of the analysis. The capital and operational costs for the proposed watersports facility have been costed using data from the APP report on the proposed Lake Kepwari development, however specific operational costs have been arrived at through research with businesses specialising in water sports activities. Brief examples of two capital and two operational costs are provided below:

- Jet ski hire: The Jet Ski hire facility would have the potential to become one of the more popular facilities of the lake. They are costly to run (the models chosen have 60 litre tanks) and may have some issues with liability costs. It was estimated that due to the $15 000 price tag, that only five would initially be required (Gold Coast Sea-Doo, 2009).
- Windsurfing hire: The windsurfers were chosen for the popularity of the sport (particularly in Western Australia) and the relatively easy maintenance of the sport. It was considered that 10 boards would be required for hire in order to make the business viable. Board Model: RRD SX125 2005 10 @ $1296 each; Sail Model: Tushingham Storm Sails 10 @ $590 each (RPS the Board Store, 2009).
- Maintenance of jet skis and windsurfers - The costs include maintenance for all of the water equipment. The highest and most frequently incurred maintenance costs would be associated with the jet skis. The costs associated with jet ski maintenance are service costs @ $150 every 50 hours of use over 52 weeks. The service for commercial usage would be approximately every three months (Bayside Marine Geraldton, 2009).

8.6.2 Benefit-cost analysis

For the benefit-cost analysis, a discount rate of 7% was once again used. The period of analysis for the BCA was 20 years. The results of the benefit-cost analysis are summarised in

Table 8.10. The results from the analysis show that the watersports facility is only marginally profitable, with a Net Present Value of $146,296, an Internal Rate of Return of 14.6% and a Benefit-Cost ratio of 1.09.

Table 8.10: Watersports financial results for discount rate of 7 per cent

Criteria:	
Net Present Value @	$146,296
Internal Rate of Return	14.6%
Benefit-Cost Ratio @	1.09

The analysis of watersports facility demonstrates positive cash flow from year two of the operation with a solid Net Present Value over the 20 years analysis period. This would make this option favourable as an investment option, as it provides a good return given the initial capital costs associated with the business. Over the life of the business however, future capital outlays are quite low and returns are positive due to the relatively low operational costs over the 20-year period analysed.

Likewise the Benefit-Cost Ratio for the project demonstrates that the project benefits outweigh the associated costs and therefore the development of a watersports facility would prove beneficial for those financing such an investment. The development and running of this facility would enable the enterprise to be put out to tender for a private operator to run.

8.6.3 Sensitivity analysis

The sensitivity analysis for the watersports facility altered the hire cost for use of the watersports facilities and the number of users. As the table shows, altering the hire cost by just $5 raises the Net Present Value by $300,000 over the period of the analysis to $440,992. If the price is raised to $55 the Net Present Value increases to $1,619,775. The results are summarised in Table 8.11.

Table 8.11: Sensitivity analysis of watersports facility (Net Present Value)

Spend price	**$20**	**$25**	**$30**	**$35**	**$40**
NPV	-443,096	-148,400	146,296	440,992	735,688
Watersports participants	**1,000**	**3,000**	**4,784**	**7,000**	**9,000**
	-1,252,277	-513,074	146,296	965,333	1,704,537

The Net Present Value for watersports options using the sensitivity analysis showed that increasing the number of users to the site to 7000 provided the watersports facility increased the cash flow to $819,037. Increasing the number of visitors to the watersports facility to just 7,000, or around 12% of total visitors, altered the Net Present Value to $965,333, a substantial increase on the base figure of 4,784 visitors using the facility. If however, the number of visitors using the watersports facility drops to 3000, the facility will make a loss of -$513, 074 and dropping this figure to just 1000 people, the facility makes a substantial loss of -$1,252,277. Likewise decreasing the spend price by just $10 to $20 would provide the watersports with negative NPV of -$443,096. These figures demonstrate the need for the facility to not only obtain the optimal price structure for the use of the facilities, but also the need to attract visitors to the facility, which could prove a difficult ask as the busy periods for the site would only be during the warmer months of the year.

The relatively low operational costs associated with the watersports option would enable this business to generate a return that would make it a likely option to be tendered out to a private operator should the development of the lake proceed.

8.6.4 Break-even analysis

Table 8.12 provides the break-even analysis of the watersports facility. The table demonstrates that the watersports facilities like the cafe would be able to be commercially viable, assuming visitor numbers are achieved. Due to the relatively low operating costs, the watersports facility would provide a modest income for any operator, however it would be very seasonal.

Table 8.12: Break even analysis watersports

Variable	Current	Break Even
Entry price ($)	30.00	27.52
Number of users	4,784	4678

The watersports option at Lake Kepwari would require a hire cost of $27.52 to break even for any potential operators. This figure is less than the proposed hire cost of $30, in addition, the break-even user numbers required are 4,678, just 106 visitors less than the figure used as the initial starting point for the analysis, highlighting the relatively viable nature of the option. This choice has synergies as stated with the cafe and the development of one would assist in the making the other a viable option. These two developments are to an extent somewhat mutually beneficial and it may be possible that one private operator could take responsibility for both should they be tendered out at some later stage in the lake’s development.

8.7 Combined lake, cafe and watersports development

This was not mentioned as an option in the APP report, however for the purposes of the study of this development a decision was made to provide a Benefit-Cost analysis of all of the options as one combined development. The reason for undertaking a combined development analysis was to highlight the cost to governments of attempting to develop a former mine void into a commercial recreational lake. The figures will be discussed in more detail however, they highlight the fact that any attempt to develop a mine into a recreational lake, will require financial partnerships to be formed if the community is not to be left with an expensive development project whose economic returns are at best marginal.

8.7.1 Assumptions

In combining all of the options together as one overall development, the financial analysis has not altered the assumptions to a large extent as it is assumed that the capital costs and operational costs would remain the same as there would still be a need to operate the watersports and cafe as separate businesses.

8.7.2 Benefit-cost analysis

The benefit-cost analysis for combining the lake development, the cafe and the watersports facility showed that this would not provide an outcome that is favourable for the development, with a Net Present Value of -$1,225,478. The negative outcome again highlights the high capital costs associated with the actual lake development and demonstrates a need for governments to consider how post closure mine options are financed and who should ultimately bear the costs for this. Table 8.13 provides an overview of the combined development option. The Internal Rate of Return of 3.8% and benefit-cost ratio of 0.89 also reflect the capital costs associated with the actual lake development and inability to recover those costs through lake entry prices. The positive returns generated by the cafe and watersports businesses prevent the combined overall benefit-cost ratio from being lower and make the lake option marginally beneficial, however, as both of these options would be privately run, the government and hence the wider community would be left with the lake development costs and an asset that generates negligible returns.

Table 8.13: Overall financial results for combined developments at Lake Kepwari for discount rate of 7 percent

Criteria	Lake	Cafe	Water	Total
Net Present Value	-$2,680,860	$1,309,086	$146,296	-$1,225,478
Internal Rate of Return	-1.8%	37.9%	14.6%	3.8%
benefit-cost Ratio	0.58	1.41	1.09	0.89

8.7.3 Sensitivity analysis combined lake development

The sensitivity analysis for the lake altered a number of the variables from the development to demonstrate how minor alterations can make sometimes significant differences to the outcomes. Table 8.14 provides an overview of these variables, demonstrating for example that altering the discount rate used can have a profound impact on the Net Present Value. If for example the rate is decreased from 7% to 5%, the Net Present Value result decreases by nearly $700,000 to -$516,090, which still represents a loss over the life of the analysis period, however the loss is less significant than when the discount rate is 7%. At the other end of the scale, a discount rate of 17% delivers a Net Present Value result of -$2,982,505.

Table 8.14: Sensitivity analysis overall results for combined developments at Lake Kepwari (Net Present Value)

Discount rate	**3%**	**5%**	**7%**	**9%**	**11%**
NPV	431,642	-516,090	-1,22,5478	-1,765,176	-2,182,406
Lake entry price	$8	$10	$12	$14	$16
NPV	-2,358,923	-1,792,201	-1,225,478	-658,755	-92,032
Visitors to development	**19,000**	**21,000**	**23,000**	**25,000**	**27,000**
NPV	-2,903,371	-2,064,425	-1,225,478	-386,531	452,416
Average cafe spend	$8	$12	$16	$20	$24
NPV	-3,465,166	-2,345,322	-1,225,478	-105,634	1,014,210

As Table 8.14 shows, the sensitivity analysis also measured other variables including entry price, visitor cars and average cafe spend. An examination of the entry price shows that changing the price from the proposed $12 to $16 still does not provide the combined development with a positive cash flow over the period of analysis and suggests that a figure closer to a $20 entry price would alter the figures from the current negative result to a positive outcome. As stated earlier, however, due to the lack of precedents in Western Australia for a user pays system to national parks, let alone entry into a former mine void, it is difficult to imagine users to the lake willing to pay $20.

In another example, if the number of vehicles entering the lake was increased by 4,000 to 27,000 but keeping all other variables constant, the lakes Net Present Value would be positive, with a figure of $452,416. At the other end of the scale, decreasing the number of vehicles to the site by just 2,000 to 21,000 would see the lake lose nearly an extra $800,000 to -$2,064,425.

Likewise altering the spend at the cafe, but again keeping all other variables constant provides some rather large differences to the Net Present Value outcomes. Decreasing spend at the cafe by just $2 would see the lake lose an additional $1,119,844 to bring the Net Present Value loss to -$2,345,322. However, a spending increase of an extra $8 from the base figure of $16 would enable the lake to generate a positive cash flow of $1,014,210.

The sensitivity analysis outcomes emphasize the reliance of the lake development on a number of key outcomes being achieved before the lake would actually generate a positive cash flow for the community and the government. The analysis also highlights how in some cases, minor changes to key variables can significantly impact on the Net Present Value figure, adding to the case for this to become a requirement for post mine development proposals to be undertaken from the outset of the mine process and continually reviewed.

8.7.4 Break-even analysis combined lake development

As illustrated in Table 8.15, in order for the combined lake development to break even, there needs to be some significant changes to key variables. The entry price to the lake (assuming other variables remain constant) would need to rise to $22.47, which as mentioned previously would be a high price to charge in a state not familiar with a user pays system.

Table 8.15: Break-even analysis – overall results for combined developments at Lake Kepwari

Variable	Current	Break even
Entry price ($)	12.00	22.47
Visitor numbers	23,000	30,825
Cafe spend ($)	16.00	26.60

The number of vehicles needed to enter the park at the base charge of $12 would be 30,825, a large number of vehicles in a town that currently sees only 39,000 vehicles per annum visiting the region. The other figure used in the break-even analysis was the average visitor spend at the cafe, which to break even would require a spend of $26.60 per person, which is above the industry average of between $11- $15 per person, however in a situation such as that proposed for Lake Kepwari, where a cafe would be the only food outlet, it is not an unreasonable possibility.

The findings from the benefit-cost analysis for combining all of the development options indicate that it is unlikely to generate benefits if it is to proceed. Such a development would require the development proponents to accept that the project would generate a negative cash flow and generate low yields during the life of the project and hence would unlikely be viable in the present form. The project would require ongoing government assistance if it is to remain viable and provides an argument for partnerships to be developed between governments, mining companies and communities in order to create a sustainable outcome.

8.8 Summary

The development options provided as the basis for the benefit-cost analysis for this thesis were arrived at by using the development plan proposal that was written by APP, a consultancy firm engaged by the South West Development Commission and Premier Coal to look at various closure options for the site. The thesis used the main options outlined by the plan, which included the lake development process, the development of a cafe and opening up a watersports facility. There were inflationary adjustments made in order to keep the costs accurate in current dollars and various assumptions made about both capital and operational costs associated with each of the projects. The benefit-cost analysis used a discount rate of 7% which is the Commonwealth Government Guaranteed Security Rate (Australian Accounting Research Foundation, 2006). The period of the analysis was 20 years which was chosen to provide a sound basis for calculating the cash flows.

The main assumption with the benefit-cost analysis is that the proposed development would be developed and overseen by government, particularly due to the large capital outlays associated with the development proposal and the fact that the lake development becomes Crown land once Premier Coal and the State government reach an agreement on relinquishment of the mining title. The cafe and watersports facilities would be run by private operators, as in the long-run they provide the possibility of generating positive cash flows.

The overall lake development proposal as outlined in the APP report would prove to be an expensive undertaking for any government that chose to go down this path. This option is initially focussed on large capital outlays that would be required in order to make the lake development attractive to visitors and encourage the other proposed developments contained in the APP proposal. The only cash flow option open to governments would be to charge a vehicle entry fee into the park, which is common practice in National Parks in New South Wales and in the ski fields of Victoria; however it is uncommon practice in Western Australia. This revenue stream was factored into the current analysis, however the findings are that the proposed development is likely to have both a negative cash flow and negative rate of return and based on this finding, the proposal would be unlikely to proceed. As well, if the lake were not developed as proposed by APP it is unlikely that any of the other proposed developments would proceed.

The second development option proposed by the APP report was the establishment of a cafe facility for the lake. The findings from the benefit-cost analysis were such that this proposal is one that would generate positive returns for any operator. The cafe option generates positive cash flows from year three and year two in the sensitivity analysis and has an internal rate of return that sits around the industry average.

Likewise, the watersports facility would generate positive cash flows over the analysis period and has positive net cash flows from year two in both scenarios. The capital and operational costs associated with this proposal are relatively small given the income that can be generated from the equipment used in this proposal enabling the business to generate substantial revenues early in the life of the business and maintain these throughout the analysis period. This business and the cafe demonstrated the most optimal closure options for the lake development with the watersports generating an Internal Rate of Return of 14.6% and the café, an Internal Rate of Return of 37.9%.

It has been stated throughout this research that planning for mine closure needs to commence at the start of the mine planning process and that it is at this stage that community engagement should be undertaken to determine what type of post-closure options the community wants for the mine site (Khanna, 1999). In addition, if mine closure was included in the initial planning phase then it would allows any projected benefit, or cost outcome to fit within the context of the mine development itself and will not make it so critical that any post-mining use needs to be profitable.

Once some closure options are decided upon, then a series of benefit-cost analyses should be carried out as a way of determining the costs of any proposed end-use options and at this stage decisions can be made regarding the cost-effectiveness of such options, and enable informed decision making on whether a development is feasible. This thesis only included a financial benefit-cost analysis of the proposed development options due to time and scope limitations of the thesis and the already broad nature of the research. The benefit-cost analysis is just one component of the research. However it is acknowledged that it would be valuable to also perform an economic analysis that incorporates the social costs and benefits associated with mine closure in future. The thesis looks at the various mining closure options as against the do nothing option, to provide direction for policy development and to illustrate post-closure possibilities.

Planning early for mine closure and determining the costs of mine closure alternatives would also enable mining companies to provide for the costs of mine closure beyond their current legal requirements of rehabilitating a mine site and instead provide for mine closure that perhaps continues to provide economic activity post mining (Fox, 2007). The findings from the Benefit-Cost Analysis provide weight to the argument also stated throughout the thesis that mine closure is not an issue that can be left until just before mining ceases, but that in many respects can be just as important as the operating phases of a mine (World Bank and IFC, 2002; Fleury and Parsons, 2006; Peirce and Wen, 2006).

Finally, when considering options for mining voids, benefit-cost analysis provides a useful tool for both mining companies and governments to determine end-use options for a mine site (MCA, 2002; World Bank, 2002). Undertaking such an analysis however should occur early in the mine planning process as part of an overall mine closure plan that develops a number of post closure options for communities to consider (Jackson, 2000, Biggs, 2002). The proposed development plan for Lake Kepwari occurred seven years after the mine closed in 1996 and was undertaken with the view that the community expected some form of development to proceed at the site (Hall, 2004). The costs associated with this proposal may have been able to have been shared between the mining company and the government had such an analysis been undertaken a number of years before the mine was due to close, with the possibility that some form of trust fund, or annuity could have been established to assist in paying for the post closure development.

The next chapter will bring together the key findings from the thesis, around a number of discussion points. The aim of the chapter is to develop the framework for mine closure that was stated as one of the key objectives of the research. It is the aim of the chapter to demonstrate why in many ways this was a scoping paper on mine closure the findings of which can lead to further research on this issue.

Chapter 9. Discussion

9.1 Introduction

This thesis has provided a broad overview of the mine closure process both in Australia and overseas with aim of developing an understanding of the rigours that must occur in order for the closure process to be best practice. The discussion chapter will highlight the key points from each of the chapters emphasizing the gaps that exist in mine closure with the aim of providing a framework that can be used as a tool for further areas of research on the subject.

What has been consistent throughout the research is that past mine closure practices where closure planning, rehabilitation and the closure program were left until the last few years of mining are no longer tenable in the current or future regulatory environment. For their part, industry has led a lot of change in these areas, particularly industry bodies such as the Australia New Zealand Minerals and Energy Council, the Minerals Council of Australia, the International Council on Mining and Metals and the Institute of Materials, Minerals and Mining, which have been at the forefront in developing strategies and guidelines for mine closure. In addition, various international organisations such as the World Bank, the International Finance Corporation, and the International Institute for Environment and Development (who produced the MMSD report) have also been active in developing guidelines and strategies for mine closure and sustainable development on a global basis. There has also been increasing research into the field by universities; however, there are further research opportunities that have become evident because of the research undertaken for this thesis.

Research for the thesis exposed societal expectations as having played a part in the focus on positive mine closure outcomes, in part led by poor closure practices in the past, inadequate regulatory regimes that were ill equipped to deal with the challenges posed by mine closure and governments that promoted development at all costs over sustainable environmental, economic and social outcomes from mining. Communities will increasingly oppose mining development that they deem as not viable in their own backyard, with such opposition occurring in the Margaret River region in Western Australia over a proposed underground and the Darling Downs region in Queensland and the Hunter region in NSW over coal seam gas exploration. If a mining development proceeds, it is unlikely that communities will not play an active role in the development of the mine and also in the closure process that is an inevitability in mining.

Politicians and regulatory authorities are attempting to respond to these pressures by developing legislative requirements, guidelines and or regulations that are more stringent, particularly in regards to the requirement for environmental outcomes. However, there is still a gap in the way mine closure is undertaken throughout the world, notably in the lack of standalone mine closure legislation. Furthermore, there has been a lack of engagement with stakeholders in the mine closure process, understanding and mitigating the economic and social effects of mine closure and a failure to approach mine closure holistically through partnerships between governments, mining companies and communities. Through research, analysis and discussion, this thesis has exposed the gaps that exist in the current mine closure process. The following dialogue will highlight where theses gaps occur and outline the principles for a best practice approach on the issue.

9.2 Beneficial end-uses and closure strategies for mining voids

In Chapter 2 the various end uses for mining voids was determined and concluded that the end use for a mine void is determined by a number of factors including the type of ore body, the method used in the mining process, regulatory rehabilitation requirements, and physical constraints at the site that will limit the end use options (Department of Environment and Heritage, 2008).

The research from both the Department of Environment and Heritage and Johnson and Wright (2003) highlighted that there is a need for these factors to be considered during the mine planning phase, despite the difficulties associated with forecasting how a site will look post mining. It is important that this closure planning includes input and guidance from local councils and community representatives (where possible) as it is ultimately the local community that is left with the long-term impacts of a mine closure and they need to feel ownership of the process and any end-uses at the site.

One of the gaps that the research uncovered in relation to beneficial end-uses and closure strategies is that further consideration is required by mining companies and regulatory authorities for financial feasibility studies to be conducted into end-use options in order to determine their viability and their sustainability for the community over the long-term. These studies should be undertaken jointly by all parties in the mining process from the mining companies to governments at all levels, as it is the local community that is left with the post closure site many years after mining has ceased and for them any options for closure need to be sustainable and cost-effective.

Not all mine closures occur in urbanised environments, or near major population centres, there are mining areas in Australia in which the end-use of the void is of little significance due to remoteness of the mine site. This will change the requirements for rehabilitation of such a site, with the end-use requirements more likely to focus on rehabilitation that is safe for human and animal access and the environment. However, it should not preclude mining companies from undertaking best practice closure outcomes at mines located in remote areas. In today's society it is necessary that industry, regulators and governments at all levels pay greater attention to the economic, environmental, social and visual impacts surrounding mine voids and the research has found that this is not being undertaken sufficiently by all parties in the mining process.

The chapter concluded that the best practice decisions for mine voids is arrived at by adopting one of Johnson's and Wright's (2003) three methods for mine void closure: Waste storage, Water storage, or Open void. The chapter found that the company mining the site, the best decision will depend on which option is most feasible based on the financial surety available. This decision needs to be arrived at early in the mine planning process, which along with progressive rehabilitation is now recognised as best practice closure planning (ICMM, 2008), more cost effective (Fourie and Tibbett, 2006) and in some jurisdictions is now a requirement of the mine approval process (WA Department of Mines and Petroleum, 2011).

The end-use options post closure for mine sites are currently undertaken on an ad-hoc basis with a need for mining companies, governments and communities to adopt a more inclusive and cooperative approach to post closure options that is more likely to result in long-term community acceptance. Therefore, it also needs to be undertaken as part of the mine planning process and be ongoing through the life of the project. Such an approach is more wide ranging than the current process of determining beneficial end-uses and would provide a better determination of post mining tradeoffs.

9.3 Sustainable development and mine closure in the mining industry

Chapter 3 reviewed the literature on sustainable development and mine closure in the mining industry. The Brundtland Report's definition of sustainable development was used as the focus for the chapter as it is also the most commonly used definition for sustainable development in the mining industry (World Commission on Environment and Development, 1987). The definition is as follows (WCED, 1987, P):

> "…firstly it is the elimination of poverty and deprivation. Second, it requires the conservation and enhancement of the resources base, which alone can ensure the elimination of poverty, is permanent. Third, it requires a broadening of the concept of development so that it covers not only economic growth, but also social and cultural development. Fourth, and most important, it requires unification of economics and ecology in decision-making at all levels…"

The chapter then provides an analysis of the literature on sustainable mine closure drawing out the key themes. It did not cover every piece of literature written on the subject of sustainability and mine closure, however it did analyse the main documents written on this subject and analysed literature from both Australia and internationally in order to provide a balanced worldwide analysis and assist in determining best practice.

The reports covered in the chapter analysis included: the Minerals Industry code for environmental management (1996); the Strategic Framework for Mine Closure (2000); Towards Sustainable Mining Initiative (2001); Minerals Mining and Sustainable Development Report (2002); Australian Minerals and Energy Environment Foundation Report (2003); World Bank Extractive Industries Review (2004); Global Environmental Management Initiative (2004); Mine Closure and Completion: Leading practice sustainable development program for the mining industry (2006); Planning for integrated mine closure (2008).

The conclusion from the review of the reports was that on their own they do not offer solutions to the issues that affect mine closure, however when analysed as a whole they provide information that a more holistic approach to mine closure is required with input from mining companies, governments and mining stakeholders. Four key issues or themes were developed from the reports, which were environmental, social, economic and governance. Each will be discussed briefly.

9.3.1 Environmental

The section on environmental issues found that rehabilitation planning should commence as early as the feasibility phase and be ongoing through the mining process; in essence, the closure of a mine should be a living process that adapts and changes during the mine's life. Further, the rehabilitation plan should be a detailed plan, rather than a conceptual one, which is the current requirement under Australian jurisdictions (WA Department of Mines and Petroleum, 2011). This is the missing element to the rehabilitation requirements for mine closure in Australia and Internationally. The requirements for mine rehabilitation are quite stringent in Australia. However, there is a need for the early planning phase to become more comprehensive and inclusive with greater involvement from the community and other key stakeholders in establishing the rehabilitation options, which will be determined by the end-use options chosen.

The review of the literature on this section concluded that although there has been a concerted effort by many companies in the mining industry to develop sustainable environmental practices into their corporate values and indeed the practice of annual environmental reports by organisations such as Wesfarmers (2010), BHP (2011) and Alcoa (2010) provides some evidence of this. As well, companies that are signatories to the ANZMEC/MCA Mine closure guidelines are required to produce annual environmental reports as part of their obligations to being signatories to the guidelines (ANZMEC/ANZMEC/MCA, 2000).

Changes in regulatory requirements have forced mining companies to undertake more comprehensive rehabilitation programs than were required in the past along with more regulatory scrutiny of pollution issues such as waste and water management, and recycling programs at mine sites. There is an increased focus on leaving behind positive environmental legacies at mine sites and this is achieved in part through ensuring that comprehensive rehabilitation programs are undertaken. However, the review also found that despite some authors calling for more community involvement and ownership in post mining options (MMSD, 2002, Trezise, 2004, ICMM, 2008), there is still a lack of strategic thinking from regulators and mining companies on this issue. It also found that there is a need to pursue more community engagement and ownership of options for mines post closure, perhaps through contractual partnerships. One area where this could be achieved is by improving communication flows between mining companies, governments and communities in the mine closure process, with regulatory requirements for regular community engagement forums throughout the year.

9.3.2 Social Issues

A review of the literature indicated a trend in recognition that social issues have become increasingly important in mine closure literature over the last decade, particularly through industry bodies such as the Australia New Zealand Minerals and Energy Council, the Minerals Council of Australia, the International Council on Metals and Mining. The review found that social issues of importance include respecting culture and rights, determining stakeholders, community development, community consultation, employment and engagement.

To a degree, social issues have come to the forefront of mine closure as mining companies increasingly become reliant on gaining a social licence to operate which in part is determined by a company’s previous mining history in areas such as environmental management, community engagement, mine closure outcomes and community development (Garcia, 2008; Jackson, 2000). In addition, as mining companies increasingly seek to mine in areas deemed environmentally sensitive and close to human habitation they will come up against community resistance and the approach they take in engaging in constructive two-way dialogue with the community in this process may well determine their success in gaining a licence to mine. Such an example occurred recently in Margaret River in Western Australia where staunch community resistance forced the abandonment of plans to mine the area’s coal reserves (Bartlett, 2010).

The literature reviewed for this section highlighted a gap in engagement with indigenous communities. There was little recognition of the importance of respecting indigenous rights and culture in the literature, despite the fact that in countries such as Australia, where mines are proposed on or near traditional land, it is a requirement to engage with local indigenous communities in order to gain approval for a mining project. It should be a necessity then that the same open and transparent dialogues are necessary when developing closure outcomes. As with wider community engagement, some form of contractual partnership could be developed as part of the mine closure process in order to achieve mutually beneficial closure outcomes with the mining company, indigenous community and wider community among the key stakeholders in the closure process. Such outcomes could include post-mining tourism development, business development and enhancement programs and community development programs.

The most important finding was that despite the reviewed literature recognising the importance of social issues in mine closure, many mining companies are still to incorporate social issues into their mine closure process. Mining companies need to adopt some of the recommendations from industry documents such as the Strategic Framework for Mine Closure (ANZMEC, 2000) and the Integrated planning for mine closure toolkit (ICCM, 2008) and put them into practice across the globe, from mining operations in the developed world, to those in developing nations.

9.3.3 Economic Issues

The economic issues associated with mine closure in some respects overlap with the social issues. The discourse in the literature was broad in its analysis of economic issues surrounding mine closure and , most of the documents reviewed did not specifically examine mine closure and instead discussed the economic issues as they relate to mining as a whole. The main themes from the review of economic issues included: effects of closure; revenue sharing; shareholder maximisation; financial provisioning; risk assessment and reduction.

One of the key issues to come out of this section of the literature review was that the documents reviewed do not address in a comprehensive manner what actions can be taken to minimise the impacts of closure on local communities, particularly in regards to maintaining economic (and social) fabric. What they provided was a broad framework that can be used, though it needs to be done in a cooperative manner between mining companies, governments and local communities.

The Chapter also revealed that the idea of using programs similar to the Royalties for Regions program adopted by the Western Australian government for community and economic development programs in regional Western Australia using 25% of funds from the

State's mining and offshore petroleum royalties was a productive use of the proceeds from mining development. However, a more prolific use of this funding would be to use the money specifically for economic development in mining communities, as they have generated the royalties and potentially suffer the most when a mine closes. This option could also eliminate any potential that such a fund has to be used as a slush fund by governments to finance election promises. Additionally, companies could establish community trust funds as a way of assisting communities with post mining funding for community development programs and mine infrastructure.

There is a lack of focus in all of the literature reviewed on the need to work more closely with local communities on economic issues surrounding mine closure. Much of the focus in the literature is on sustainability in the mining industry, but sustainability also means that communities need to be able to sustain themselves economically after a mine has closed. What is required in practice is a more cooperative approach to mine closure and the economic issues that surround it. Government agencies at both state and federal level need to commence working with communities in which a mine is situated (or indeed planned to be situated), while the mining companies could begin developing support and structural adjustment programs that can be initiated before closure commences in order to mitigate the effects of a mine closure. This would also help to lessen the risks associated with mine closure and ensure that benefits reach those most in need such as workers displaced by unemployment and contractors who were dependent on the operation of the mine.

9.3.4 Governance issues

Governance as covered in the literature review related to both corporate governance and governance from the perspective of government. There were a number of areas that were common to the documents reviewed in terms of governance issues including Policy and legislation, Closure planning, Cooperation and development, and Transparency.

Mining industry bodies such as the Minerals Council of Australia and the International Council on Metals and Mining are moving towards better governance procedures across the industry. They are undertaking this through documents such as the Strategic Framework for Mine Closure and the Integrated Planning for Closure Toolkit (ANZMEC/ANZMEC/MCA, 2000; ICMM, 2008) that represent an attempt by the industry to adopt uniform guidelines and practices by their members. Nevertheless, many of the industry documents are guidelines or recommendations that are not enforceable and in many respects are self-regulating.

In many respects, societal changes are forcing companies to become more proactive in terms of governance. In turn, this is forcing regulators to alter mining legislation, guidelines and regulations to enable them to ensure that mining companies are meeting societal expectations. However, there are mining companies that go beyond current governmental requirements, exceeding those expectations and acting more in accordance with the guidelines established by industry.

The process of governments legislating according to societal expectations has already occurred in terms of environmental outcomes with changes in rehabilitation standards and requirements. They include an expectation both at a regulatory and even at a company level that for example rehabilitation be progressive throughout the life of a mine and that the end use expectation for a site is that it will be returned to a state that existed prior to mining (or better). As well, the community should not be left with an environmental financial burden at the end of a mine's life (WA Department of Mines and Petroleum, 2011). Where there is still room for improvement is in adapting socio-economic standards to governance in a manner similar to what has occurred from an environmental perspective. From an industry perspective, there is at least some acknowledgement of the need to consider the socio-economic factors; from a regulatory point of view there is a lack of rigour in this process and a need to regulate more effectively on the socio-economic effects of mine closure.

9.3.5 Benefits of sustainable closure

The literature reviewed for this chapter has been an evolutionary process that has progressed from the ANZMEC/MCA Strategic Framework for Mine Closure document that adopted a uniform approach to environmental management for all companies that were signatories to the document, including the requirement that signatories publish environmental reports to demonstrate that they were meeting their obligations under the framework. This document also recommended that companies engage with communities in the closure process, rather than just consulting with them (ANZMEC, 2000). In 2008 an international mine closure document was published; the ICMM Planning for Integrated Mine Closure Toolkit went further recommending a holistic approach to mine closure with all parties to the process being involved and that the focus needs to be on the economic and social issues of mine closure in addition to the environmental aspects. The document provided a number of tools for practitioners to use in the field that are able to be applied both in the developed and the developing world, the first time a closure document has been able to achieve this.

The documents are an attempt to provide a more holistic approach to mine closure and recognition that mine closure is just as important in the mining process as the operational phase. There is also acknowledgement that mining communities need to be able to determine the shape of their community post closure and that this needs to be undertaken as part of the mine planning process with input, involvement and ownership from the local community, government agencies in addition to the mining company themselves. This is a fundamental change in industry practice towards community involvement in the mine closure process and recognition that past practices on mine closure had not always benefited the local community.

There was concerned raised by the Minerals Council of Australia about the lack of uniformity in mining legislation in Australia, including on mine closure and a recommendation that legislative standards in Australia become more uniform using the Strategic Framework for Mine Closure document as a guideline.

The review of the literature found support for the notion that detailed mine closure planning be part of the mine planning process. It established that the closure plans need to be living documents that take into effect changes that occur during the life of a mine, such as changes to the size of the site and technology changes that may affect the rehabilitation practices (MCA, 2003; ANZMEC, 2006; ICMM, 2008). This process should also include the development of detailed end-use options for mine sites (rather than conceptual plans that have been historical practice in the industry) whose feasibility are assessed by benefit-cost analysis.

The literature reviewed for this chapter was focussed on industry best practice and sustainable development and has been written with industry in mind. It consists mostly of a series of guidelines and/or recommendations and is not in any way enforceable in a regulatory environment. In some respects, it is little more than a series of discussion papers for industry on sustainable mine closure practices, due to the lack of enforceability. However, the discussion on mine closure practices represents an acknowledgement by industry of the importance of mine closure to the industry and a starting and discussion point for regulators, mining companies and communities to work together in the development of a broader framework for mine closure. The key factor in determining sustainable long-term closure is therefore in planning for closure and engaging the local community in the mine planning process in order to ensure that they take ownership of mine closure.

9.4 Mine closure planning and community engagement

Chapter 4 on Mine closure planning and community engagement was divided into two sections; mine closure planning and community engagement. The sections were linked together as one chapter, as the review found that community engagement was a significant aspect of the planning process for mine closure in order to ensure that as part of this process the community takes ownership of the closure options so that options are maximised (Jackson, 2000). This chapter was aligned to the objective of investigating a process that determines what level of stakeholder participation is needed in the closure of mine voids and who are the stakeholders that should participate.

Mine closure planning is one of the most important aspects of the mine closure process and it should be undertaken as early as possible, preferably during the mine planning phase (Jackson, 2000; Khanna, 2000; Trezise, 2004). Governments have an important role to play in the mine closure planning, but they have generally played only a minor role in this process. However, they need to adapt a more active role in the closure process, notably in the socio-economic effects of mine closure, particularly in the mitigation of the negative impacts (Jackson, 2000). The chapter examined mine closure planning from the perspective of two of the key players, the government and the mining companies. A brief discussion of each will ensue.

9.4.1 Governments role in mine closure planning

The review on the role of governments was broken into four key areas: transparency and dialogue with stakeholders, economic development, community development, and the legal and regulatory framework that governments use to regulate mine closure. It found governments need to significantly alter legislation, regulations and guidelines to ensure that mining companies improve transparency and dialogue with stakeholders; ensure that economic and community development occur and that the issues surrounding closure are given due consideration from both an economic and social perspective.

It was determined that past poor mining practices had caused negative sentiment to sometimes be directed toward mining companies and mining development. This is despite the fact that in some instances, mining companies go beyond what is required legislatively. The sentiment too has been directed at government who are often accused of not doing enough to protect environmental assets. Thus, there is a social requirement on governments to be more transparent in their actions to legislate the mining industry. Governments could follow the lead of the mining industry itself, and legislate on all the issues surrounding mine closure, taking a life of the mine approach, including stakeholder engagement and economic and community issues.

Communication is critical to the success of a mining operation and a dialogue with stakeholders imperative. If open and honest, it establishes trust and two-way communication. Ideas are exchanged and much of the fear can be removed from the mining process. Research revealed that in much of current literature the emphasis on communication discussed by the various authors examines communication from a company perspective, rather than from the government or community perspective. However, Khanna (2000) and Fleury and Parsons (2006) acknowledged the important role that governments play in the closure process, notably in ensuring the interests of the local community are protected in any mining development. What of the community themselves? Largely, they fall under the heading of stakeholder engagement, rather than communication, though their voice can be influential and should not be discounted.

In economic development during the mining operation and mine closure process governments have an important role in assisting local economies to grow after mine closure. If governments legislate for a life cycle approach to mine closure, that is, mine closure commences in the development stage, then governments involvement in the closure should commence in the development phase of a mine. This could be achieved by a number of means; for example, the government and mining company could establish a community trust fund and redistribute a percentage of the mining royalties and taxes back to local communities for use in developing businesses post closure and or developing post closure tourism options at a former mine site. The literature reviewed did not discuss the need for local governments to develop mine closure into their strategic planning, however if economic development post closure is to be sustainable, then local governments need to develop their strategic planning around business development post closure.

As in economic development, the government have a role to play in community development, indeed, while some will view them as disparate issues, they are intrinsically linked. While economic development is concerned about monetary issues such as the impact of unemployment on a region after a mine has closed, for example, community development is concerned with the human or social aspect of unemployment. Issues such as a rise in alcoholism, depression or crime arising from unemployment due to a mines closure are the types of issues associated with unemployment that community development programs may have to consider.

It can be discerned through the literature that social outcomes are important in holding communities together and are important post closure as a means of developing community ties. Community development focuses on areas such as for example the arts, youth development programs, neighbourhood regeneration programs. The development of such programs would need to be undertaken through partnerships between local and state, or national governments in order to ensure that the programs are financed adequately in order to meet desired outcomes.

Just as all levels of government need to form a cooperative partnership, so too do all levels of government and the mining companies. Both desktop and field research indicated that while the local community has the local and historical knowledge to apply to the development of social outcomes, both mining companies and governments, particularly those of State and National capacity, have the resources at their disposal to deal most effectively with mine closure from economic, social and cultural perspectives. Indeed, much of the literature recommended that governments actually undertake the delivery of social and economic impact assessments related to mine closure, working in partnership with the local community and the mining company as a way of delivering sustainable long-term outcomes.

It is essential that government are transparent in their requirements for mining, that dialogue with stakeholders occur, that they pursue post closure economic and community development options from the commencement of the mining process. Though, perhaps government's most critical role is to provide the legal and regulatory framework for mining companies to follow.

The regulatory framework for mine closure is in many countries limited or non-existent, although changes are being made to the regulatory framework in Western Australia, at least in relation to mine closure planning, which is now a required as part of the mine approval process in that state (Department of Mines and Petroleum, 2011). The review of the literature found that there is an argument in Australia for dedicated mine closure legislation that is nationally regulated or at least consistent across the states and territories in order to ensure that the mine closure process is the same across jurisdictions.

In countries other than Australia, the legislative framework differs. The United States, Canada and the United Kingdom, three countries with similar living standards to Australia, have similar legislation. Like Australian legislation, regulations and guidelines, the regulatory framework of these countries in largely focussed on the environment, with minimal focus on the economic and social issues surrounding mine closure and the evidence points to a degree of self-regulation on these two areas.

9.4.2 Company role in the mine closure process

Companies are ultimately responsible for determining how a site will look post closure. This does not mean that this process should occur in isolation or that other parties (such as governments and stakeholders) should not be engaged with mine closure; , as discussed previously their input is vital to the success of the process. Nevertheless, it is mining companies that need to incorporate mine closure into their overall planning for a site and it is how they undertake this process that determines the success or otherwise of a closure project.

There was consensus among authors on mine closure that mine closure planning is as important as planning for the design and operational life of a mine (MMSD, 2002; Johnson and Wright, 2003). This role falls to the company, and while stakeholders may have agreed to a closure plan and the regulatory authority may approve the plan, the plan is generated by the mining company. Likewise there was consensus among the documents reviewed that it was important for mining companies to continue to update mine closure plans during the life of a mine in order to account for changes to the operation, or external factors that will affect the final closure outcome. In essence, a mine closure plan becomes a living document, one that is agile and adaptable to the changing circumstances a mining company may face. Similarly, there was broad consensus about the need for ongoing engagement with the local community and all levels of government in the mine closure development, although there were some differences in emphasis about the level of engagement needed and some misunderstanding of the difference between consultation and engagement.

The review found that there were a number of topics that were related to companies and mine closure; these included early closure planning, stakeholder engagement, impact assessments, employment and business development, and community investment. The mining industry is increasingly seeing mine closure planning as an important feature of mining practice recognising the benefits of planning early for mine closure. In addition, there is a focus on the need to incorporate social and economic aspects of mine closure into the closure planning process, including recognition that this requires better cooperation and coordination between mining companies and governments of all levels. Mining companies are driving closure planning for financial reasons. Indeed, early planning for closure resulted in a reduction of the long-term costs of closure for a mining company (Fourie and Tibbett, 2006). Further, early closure planning provides communities in which the mine is located with the ability to plan for mine closure from both a social and economic perspective and thus take ownership of post closure options.

Stakeholder engagement is one area that the industry itself admits it has not done well and in which there is significant room for improvement. There is agreement by industry that the community needs to be involved in the mine closure planning process and that they need to determine the direction of the closure outcomes as it is the community that ultimately benefit from successful outcomes. Communication was noted as important in achieving best practice mine closure and that there needs to be open two-way dialogue. The best way of ensuring that engagement and two-way communication occur would be the requirement for it as part of a mine closure legislative process that forced all companies to follow this practice and not just the pro-active mining companies with good corporate governance practices.

There is a role too for companies to provide business support and community investment programs. It is true that many of the mining companies with excellent corporate governance practices do this, do it well and extend themselves far beyond any regulatory requirements; many investing in capacity building programs after a mine has closed. However, this process cannot be undertaken solely by companies and a best practice approach to business support and community investment programs would involve companies working with governments, community groups (such as local Chambers of Commerce and Arts Councils for example) and various support agencies (such as state development and investment agencies, community services agencies and organisations such as Centrelink for example). This would provide post closure support for services, programs and businesses that were supported by the mine during its life.

Industry, government and other literature established that EIA’s should be undertaken early in the mine planning process (in Australian jurisdictions, this is now a requirement) and to review and update these plans on a regular basis, whether or not this is a legislated requirement. In essence, the literature reflects a living document approach to the environmental aspect of mine closure. There was also an increased shift toward recognizing the importance of local social and economic issues in the mine closure process and a drive toward conducting economic and social impact assessments. The general sentiment being that armed with the information from social and economic impact assessments, stakeholders inclusive of community, would feel a sense of empowerment.

Mining companies need to be able to fund mine closure for many years. As has been discussed, for some, mine closure planning at least from an environmental perspective, commences when the mining operation is in the planning stages. A mines closure can occur in stages and continue many years after the mine has ceased to be profitable.

From a company’s perspective, planning and including in these plans provisions for the closure program, including any costs associated with monitoring a site post closure is critical. Plans should consist of contingency provisions such as providing for an unexpected or unplanned closure that ensures that local communities are not left with potential environmental catastrophes and governments not left with large rehabilitation and closure bills. Moreover, if plans are truly to be best practice, they should take into account the social and economic costs of closure in conjunction with the environmental consequences. This often fails to be the case, and the case studies in Appendix 1, such as Rum Jungle in the Northern Territory and Windimurra in Western Australia, highlight the costs (social, economic and environmental) that are incurred by communities and governments when mine closure is not adequately financed.

What are the costs of not planning for closure? They are considerable. When companies do not plan for closure, the indirect cost to the company can include a cost to a company’s reputation, particularly when negative environmental, economic or social outcomes ensue from a poorly planned closure. The review uncovered that despite the supporting evidence stating that financing for closure can actually reduce long-term costs (ICMM, 2008; MMSD, 2002; Fourie and Tibbett, 2006; World Bank, 2002), it is still an area that mining companies fail to plan adequately for. There was evidence that governments needed to regulate the area of mine closure better and to plan better themselves for the closure of a mine by ensuring that the effects of closure on a community are mitigated through a variety of programs (Dowd and Slight, 2006; Fourie and Tibbett, 2006). Such programs could include for example employment support assistance for displaced mine workers, social support programs for workers and their families, business development grants to assist start-up companies, or grow existing companies.

This thesis has highlighted the need for closure specific legislation or at the very least closure specific guidelines (overseen by regulators) that mining companies would integrate into the mine-planning phase (this should also cover unplanned closures). Guidelines or regulatory requirements would assist not only regulators, but also provide a degree of certainty for communities where the mines are located and mining companies about the closure process and could be used as a tool to assist with mitigating the effects of closure on both employees and local communities. It may assist communities in preventing some of the types of problems that have beset the communities affected by poor mine closure practices.

9.4.3 Community engagement

The review of literature indicated the importance of distinguishing between consultation and engagement, which are sometimes used interchangeably by both industry and government when discussing dialogue between companies and communities. Community consultation in the mining industry occurs when the mining company discusses its plans with the community, whereas engagement in the mining industry is the practice of continual consultation through the mines life, where the company acts on feedback from the community.

There is a need for both governments and mining companies to improve in the area of community engagement and a need to ensure that communities are engaged from the commencement of closure planning, as they are more likely to own the closure program outcomes and develop an understanding of what can be achieved as part of the closure process.

As with all aspects of mine closure, identification of stakeholders needs to begin at the start of the mine planning process. There were three broad categories of stakeholders that were identified through the research and they consisted of the community, government regulators and the company. However, despite the tools available for mining companies to help them identify stakeholders, the findings indicate that it is necessary for companies and governments to work out who the stakeholders are in a project from the outset of the mining process and engage them in developing closure outcomes. This process will need to continue throughout the life of a mining project as stakeholders come and go depending on the stage of the project, transiency and their interest in the closure outcomes. This process is also important as it keeps the community involved and is less likely to engender a feeling of frustration if people feel that they have made a worthwhile contribution to the outcomes of a mine closure.

The theoretical concept of community consultation in the mining industry has moved from the idea of gestures that were designed to feign participation in closure outcomes, to the idea that communities warrant actual regular engagement, where information is given in the form of two-way communication and feedback is acted upon. However, this is still not practiced by all companies in all communities and it is not in the true sense of the word engagement, or? a legislated requirement (other than as token community consultation) by governments. If communities are to take ownership of the mine closure process they need to feel empowerment in the process and have to know that they have contributed to closure outcomes. If communities are to feel empowered then governments need to ensure that the regulatory environment recognises the importance of the mine closure process and develops legislation that reflects this.

9.5 Guidelines, regulations and legislation for mine closure

Mine closure legislation and literature on mine closure legislation were reviewed for the United Kingdom, United States, Canada, New Zealand and Australia in order to determine what currently represents best practice closure from a regulatory perspective. The literature leads to the conclusion that legislation corresponding to the closure of mines from both an international and Australian perspective deal mostly with the environmental aspects associated with mine closure. It was clear in the literature that legislation specific to mine closure does not exist. Though countries are addressing this by developing guidelines, it is ad hoc and often state/province based. The current legislation on mine closure is predominantly found within the wider context of mining and mine related acts. Further, legislation relating to mine closure predominantly omits the need to assess and address the social and economic impacts associated with mine closure as a means of ensuring that mining communities are not disadvantaged when a mine closes.

The international and Australian requirements for mine closure entail the need for undertaking an environmental impact assessment as part of the approval process for a mine and it is normally undertaken in the context of a mine rehabilitation or closure plan. There were few instances uncovered where social or economic impact assessments were required and if they were it was generally expected as a component of an environmental impact assessment on the effect of the mining operation as a whole, not necessarily in terms of mine closure. The review of the literature also found that the requirement to undertake impact assessments rested with the mining companies and not governments as recommended by some of the documentation on social and economic impact assessments. Further, there was a school of thought in the literature that these documents become living documents that are reviewed on a regular basis, as is required in some jurisdictions for environmental impact assessments.

Both at an international level and in Australia there was generally consensus among authors that there needs to be legislated requirements for not just environmental rehabilitation plans, but also conceptual closure plans to be developed as part of the planning process for a mine. In addition, environmental rehabilitation as an ongoing process throughout the life of the mine is a requirement both internationally and in Australian jurisdictions. In both New South Wales and South Australia, there is a requirement for annual environmental reviews to be conducted as part of the rehabilitation program as a way for regulators to determine how the outcomes from a company's environmental program are meetings its objectives (Primary Industries and Resources SA, 2010; NSW Department of Trade and Investment, 2011).

An area that is linked to rehabilitation programs is the issue of financial assurances (or rehabilitation bonds as they are also known) with some concern in the literature from a number of sources about how they are calculated and their application (World Bank, 2002; Dowd and Slight, 2006; Fourie and Tibbett, 2006). These assurances or bonds are an important part of mining regulation and are designed to cover the costs of an unexpected closure so as to reduce the financial burden on local communities should a mine close without a mining company being able to fund its closure. There is no clear-cut way to resolve this issue. Mining companies will always want to free up funds that are otherwise locked away in assurance accounts and regulators will want to protect local communities from the costs associated with unplanned closures. Cases such as Summitville mine in the USA (Appendix 1, p. 30) highlight how unplanned closures can be very costly and last for many years after a mine has ceased to operate.

The other area related to closure that is also related to rehabilitation and financial assurances and that has the potential to cause problems between mining companies and governments, notably in the area of sustainability, is the relinquishment of a mine lease. Legislation in this area both internationally and in Australia lacks consistency and there are concerns about the length of time and the lack of legislative guidance surrounding post closure monitoring periods. As an example, in Western Australia there is a minimum monitoring period of 10 years, whilst in Queensland the period required is at the discretion of the regulatory body and is dependent on the mining company meeting its rehabilitation outcomes (Queensland Department of Environment and Resources Management, 2011; WA Department of Mines and Petroleum, 2011). This is an area that requires some clarity and the development of stand-alone mine closure legislation that is consistent across jurisdictions would be able to achieve this by including it as part of the regulations.

Much of the focus internationally and in Australia in regards to the rights of landholders at closure was vague as there is no specific mine closure legislation and much of the emphasis on the rights of landholder centres on their rights during the exploration and operational phases of mining. However, in Australia, the rights of landholders are better protected than they are in the international countries reviewed, where landholder rights can be more ambiguous than they are in Australia.

In contrast, indigenous landholders in Australia were left out of the mining process, with few of the rights attributed to non-indigenous landholders. This changed with the introduction of state and federal native title legislation (that came about from the Mabo decision 1992). They provided indigenous people with a greater say in the mining process, notably in the areas of exploration and mine operational activities, which also influence the closure outcomes for a site. The ability to have a degree of control over mining exploration and operational activities provides indigenous people with some ability to guide the closure process as they can use the rehabilitation requirements to develop a post closure outcome that benefits their community under the specific native title act. Nevertheless, specific closure legislation would provide greater clarity about this process.

From a regulatory perspective, there is less of an emphasis on engagement at mine closure internationally and in Australia. While it is sometimes undertaken, at a regulatory level, it is often interpreted as consultation and there is little scope for communities to become involved in determining outcomes. It appears to be at the discretion of the mining companies themselves to determine the level of engagement. This is an area where organisations such as the Minerals Council of Australia (2000) and the World Bank (2002) suggest changes be made to regulatory requirements throughout the world.

There is little scope in the mining legislation either in Australia or internationally for end-use options that are community driven. Legislative requirements require that former mine sites be safe and structurally sound and rehabilitated to a state that existed prior to the commencement of mining. In Australia as an example, there are legislative requirements that allow for post closure outcomes such as recreational use, landfill, or irrigation purposes; however, they are ambiguous in their interpretation and are not favoured by regulatory agencies due to the problem of determining responsibility for such sites over the long term. There is scope for mine closure legislation to be developed that provides better clarity on post-mining uses and that gives communities a greater say on the end-use outcomes, adopting a more holistic and best practice approach to mine closure outcomes.

Australian legislation like its UK, US and Canadian counterparts is complex and due to the nature of the federal system different between the various jurisdictions. The USEPA seems to have more rigorous powers than its Australian equivalent when it comes to mining in the United States and hence provides a more uniform process in terms of environmental requirements. However, all the countries lack stand-alone mine closure legislation and a holistic approach to mine closure requirements that would see governments and mining companies working in unison on the mine closure process as is recommended by both non-government organisations and industry representative bodies.

The next chapter was an overview of the case studies provided in Appendix A and B. The case studies were chosen to examine both poor practice mine closure and best practice mine closure to determine the similarities and differences between them. The case studies were organised around a number of key themes on mine closure that were developed from the review of literature in the first four chapters.

9.6 Desktop case studies

The desktop case studies were chosen for their unique perspectives on inferior and best practice mine closure. They are the stand out case studies but clearly not inclusive of all of the inferior or best practice mine closures. The case study methodology illustrated how each mine did or did not meet the closure criteria that had been determined. The criteria developed highlighted what is currently absent from mine closure worldwide and what constitutes best practice. It became evident from analysis of the case studies what was required from mining companies, regulatory bodies and communities to achieve best practice; moreover, it was apparent that legislative guidelines were not a barrier to thinking when developing a unique approach to mine closure. The case studies were organised around nine criteria that formed the basis of the case study discussion. These nine criteria were:

- The location of the mine
- The size of the community where the mine is situated
- The size and profitability of the mine
- The ownership of the mine
- When the mine closure was planned
- How the mine closure was planned and conducted
- Alternative closure options – Partly determined by above, but also by type of mine factors (for example water quality, public safety hazards and risks, community expectations

- The legislation under which the closure was conducted
- Engagement with stakeholders.

Examination of the case studies revealed that the size of a mining company, its profitability and the mine ownership are important determinants in the success or otherwise of a mine rehabilitation and closure program. For instance, a global mining company with significant financial resources could be more likely to undertake mine closure planning and rehabilitation. This is because the more sizable mining companies are able to devote resources, whether financial, human, plant and equipment or infrastructure to a mine closure program. Further, many larger companies, some of whom have high public profiles can be subject to public scrutiny or in some cases, media analysis and attention. Clearly, negative community sentiment, particularly in the event a company is publically listed, can affect share price, stock valuation and therefore the value of the company and further, the social value of the company, and therefore its ability to mine. This does not mean that all large corporations will close a mine with a best practice outcome (as seen in the inferior case studies) and it highlights why specific mine closure legislation with specific closure requirements is needed. Specific mine closure legislation would be a preventative tool for early mine closure as the value of minerals, solvency of the company and indeed the economic conditions, cannot be legislated. Legislation specific to mine closure can provide a strategic framework for premature mine closure, for instance to ensure that financial guarantees have been set aside by the company for rehabilitation and assistance packages to employees and communities.

The poor practice examples did not successful meet the mine closure criteria. It was apparent that the combination of a poor regulatory framework and weak corporate governance resulted in mine closures that incurred significant environmental, social and economic costs affecting its employees, the local and wider communities. The universal premise for all of the inferior closure examples was the absence by any stakeholder to plan for the eventual closure of the mine (expected and unexpected). Despite the current mining boom, all mining projects carry with them a degree of strategic risk and this includes the risk of mines closing prematurely. Too often, regulatory authorities fall short in their risk management practices when assessing a mine’s viability in the approvals process. Local governments too are guilty of ignoring the risk elements associated with a mining venture in their community; after all, a government larger than their own has approved the project. Unfortunately, it is local governments and their communities who are most dramatically affected by unforseen closure through issues such as unemployment arising from mine closure, decreased productive capacity in the local economy, an oversupply of housing and social issues such as possible increases in the incidence of depression, suicide and crime. Companies who fail to plan mine closures will most likely be unable to provide the right resources to rehabilitate the mine site effectively, support employees left without correct entitlements and support communities who face an uncertain future in the wake of significant unemployment. In order to preclude some of the failures that were discussed in the case studies it is critical that mine closure not only becomes part of the initial planning phase, but also continues as an adaptive document throughout the mines lifecycle.

To establish best practice in mine closure, planning must be inclusive not only of the current regulatory requirements for mine site rehabilitation, which focus on environmental issues, but also include an assessment and plan to deal with the social and environmental issues than can and do result when a mine closes. A more integrated approach must be adopted. The suggested framework is that a unified and multi-level government approach be adopted, offsetting the costs of mine closure. While governments have the capacity to develop long-term strategies to assist communities post-closure, they could also guarantee similar action from mining companies by legislating holistic and best practice mining standards.

All case studies, regardless of the standard of the mines closure, highlighted substantial gaps in the legislation surrounding mine closure (both in Australia and overseas). While there is no guarantee that specific mine closure legislation in Australia would address all of these gaps, it would be a substantive start. Specific mine closure legislation that addresses the nine criteria (as a starting point) would enable uniform closure standards to be applied across the country; in other words a set of national regulatory guidelines so that mine closures across the country can be conducted in a more structured and uniform manner. If such legislation were successfully enacted, then in the long term, Australia may have a moral obligation to assist developing countries and communities achieve the best practice standards Australia would enjoy.

Any legislation developed in line with best practice guidelines should not be applied in a blanket fashion. They should be flexible enough to be site specific and consider local influences. This more tempered approach would aid in the prevention of some of the regulatory failures that were evident in the inferior mine closure examples and would support the mining companies by providing clear homogeneous direction on mine closures across the country.

Community engagement is a fundamental ingredient of mine closure; yet the case studies illustrate that it is unusual for communities to become involved in the mine closure process. The thinking is that involvement should be encouraged and occur at the commencement of the mine planning process, a process that by best practice closure standards is inclusive of closure planning. By best practice standards this would be a lifecycle process, adaptive to change from internal and external pressures, including changes in the community profile. During the initial planning phase, communities' regulators and mining companies would ideally incorporate a number of closure options into their mine closure plans. The provision of options is important as it facilitates the end-use of the mine and or mining void in the community, in other words, what they want the post-closure landscape to look like. Again, examination of the case studies revealed that this does not always occur and yet seeing these plans to fruition, can influence a community's growth post-closure. Certainly, not every community will want or need a variety of end-use options presented to them, Indeed, issues such as the mines location, climate, size of the community, who is representing the community on a stakeholder committee and funding available for the project must be considered as part of this process.

Communities who are actively engaged in the mining process from the planning phase and that feel empowered will be more willing to accept the mining company as an active member of the community. If mining companies are, under law, obliged to provide some social and economic guarantees to community, they will garner greater acceptance from them as they are likely to feel more secure. Since a mine's life can span decades, such an approach will likely build a long-term productive working relationship with the community that will result in successful sustainable development outcomes that will provide for the community both socially and economically, long after the mining operation has ceased production and profitability.

9.7 Case study interviews

Best practice mine closure occurs when all parties in the mining process are engaged. This was certainly indicated by the dialogue with companies, local government, the sole community representative and other government organisations. Unfortunately, even though these case studies represent best practice as it stands in this country today, it appears that local communities in particular can feel as if they have little say in mine closure. The interviews with local government personnel indicate that from a local government (and hence to a degree a community perspective) mine closure needs to be more inclusive and undertaken from the commencement of the mine closure plan. Certainly, through the course of research, it became apparent that in many instances Local Government was a quasi-representation of the community, due in part, to the transient nature of communities.

There was broad consensus among interviewees that the need in the mine closure process, was that it must occur in a more holistic manner, with all parties working together to achieve a sustainable outcome for the community. It was a majority opinion, that governments at every level had a role to play in assisting communities in planning for closure. Across the spectrum of people interviewed, there was agreement that planning for closure should occur at the commencement of a mines life and continue throughout as a life cycle approach to closure. Further, the opinion was expressed that socio-economic factors must be considered in mine closure planning and that a more strategic and cooperative approach was critical in the future.

Mining companies generally believe that specific mine closure legislation would be a positive step towards recognising the importance of mine closure, however they stressed that such a step should not be prescriptive. Of critical concern for mining companies was the expectations of government would not be realistic. A voice of dissent arose when discussing the possibility of national mine closure legislation, which is odd as some of these companies are national if not international and , it might be expected that a unified national approach would make mining simpler. The fact that mining companies were somewhat divided over the need for national mine closure legislation, highlights a potential problem in one of the key findings from this thesis, the need to make mine closure legislation nationally based, or at the very least uniform across all states and territories. Why then undertake such an approach if not all agree? Firstly, national or consistent state-based legislation enable mining companies and indeed communities to understand expectations and provisions across the country. Secondly, regulatory authorities would be able to work more closely with their counterparts in other states and territories and once established maintain a consistent approach that reflects reasonable societal expectations when developing sustainable end-uses for mines.

9.8 Benefit-cost analysis – Lake Kepwari end-use options

The financial benefit-cost analysis conducted in Chapter 8 on the proposed developments for Lake Kepwari demonstrated that developing a former mine void into a recreational lake would prove a costly exercise for any government that decided to proceed with it. Based on the costs provided in the lake development options document released by APP, the net present value of the cash flow was -$2,680,860 (Chapter 8, Table 8.1). The negative internal rate of return of -1.8% for the proposed project would make this undertaking a high cost venture for a state government to fund solely on its own. The only way to initially generate some form of positive cash flow for the lake would be to charge a vehicle entry fee similar to that which occurs in New South Wales and Victoria (Ker, 2011; Office of Environment and Heritage NSW, 2011). A fee or $12 per vehicle was assumed, which is $5 above the standard charge of $7 in New South Wales for vehicle entry into National Parks. However, there may be some resistance to such a levy in Western Australia, where there are no entry charges for national parks (Office of Environment and Heritage NSW, 2011).

The other proposed developments at the lake (the cafe and watersports facility), depend on a capital works program being undertaken at the lake that adds value to the former mine void. This would make it an attractive option for tourists in the region (and indeed country) that is better known for its surf beaches than recreational lakes, particularly ones that have been developed out of former mine voids. There would be a need therefore for companies possibly working in conjunction with governments and communities to undertake the capital works development if they wished to proceed with the other proposed options for the lake.

The benefit-cost analysis conducted on cafe and watersports facilities found that both the cafe and watersports facility would generate positive cash flows and strong yields over the analysis period and that the benefits of developing these options outweighed the costs associated with them. However, in both cases a conservative discount rate of 7% was used, in order to maintain consistency across the analysis. It would be more likely that as both the cafe and watersports are proposed as commercially operated ventures that a higher discount rate could be required. The analysis considered the effects on the Net Present Value, Internal Rate of Return and the Benefit-Cost Ratio if all three developments were undertaken. The results provided a slightly better Net Present Value of -$1,225,478, an Internal Rate of return of 3.8% and a Benefit-Cost Ratio of 0.89, but still indicating a project that would generate more costs than benefits (Chapter 8, Table 8.10). The result is a development that would require substantial investment in order to keep the gates open and provide the community with a facility that unlike other closed mines in the Collie region could be used legally for recreational purposes (Lund, 2001).

Undertaking the benefit-cost analysis for the proposed Lake Kepwari developments highlighted a number of issues with regard to determining end-use options for mine sites. The first issue is that there are going to be substantial capital costs associated with any such development, but it needs to be weighed against another option such as undertaking no development and leaving the lake for aesthetic purposes. The option of no development would mean that the lake would require security to prevent people from entering the site in order to prevent possible liability issues. In the case of Lake Kepwari, the Premier Coal rehabilitated the mine with the express intent of the mine void being used as a recreational lake (Appendix 2, p. 43). There was also overwhelming community support for developing the lake as a recreational attraction (Appendix 2, p. 51)

The second issue is the need to undertake full economic benefit-cost analysis that incorporates financial, social and environmental benefits and costs of possible end-use options early in the mine planning phase, with the submission of a detailed closure plan that outlines possible end-uses for a site post mining. In the case of Lake Kepwari, the development options were prepared seven years after the mine had closed and a decision had already been made to develop the lake for recreational purposes (South West Development Commission, 2005). Preparing an end-use options report during the mine planning phase as part of the mine closure plan would allow the mining companies and the government to ascertain the costing for possible end-use options and use these to assist themselves and mining communities in the decision-making process. This approach is recommended as best practice by for example the World Bank (2002), the International Council on Metals and Mining (2008) and the Minerals Council of Australia (2000).

Another issue that arose with the Lake Kepwari benefit-cost analysis was the need to undertake financial analysis during the mine planning phase to allow all parties in the mining process the chance to determine what closure options are feasible and the budgetary allocations required for funding various options as it is through financial analysis that funding is allocated. The Western Australian government’s ‘Royalties for Regions’ program now provides one such source of revenue that government can use to allocate to develop end-use options and diversify the economic base of mining regions in the state, however this program is solely based on revenue outcomes, rather than considering other factors, such as social benefits and costs and externalities for example. This program is unique in Australia and other governments may require the development of a trust or annuity funds program using the proceeds from mining royalties and taxes to allocate revenue for these types of post mining developments (WA Department of Regional Development and Lands, 2011).

The Lake Kepwari benefit-cost analysis was a useful tool in determining the expenses and revenue associated with various proposed end-use options for the former mine void. Conducting a full economic benefit-costs analysis that incorporates financial and social benefits and costs for mine site end-uses however would prove to be more beneficial if undertaken as part of a mine closure plan during the mine planning phase as it can determine both the costs of a proposed development and the opportunity costs associated with foregone alternatives. The benefit-cost analysis is not the only tool in the mine closure process; it is but one component of a number of steps that should be undertaken in best practice closure outcomes.

9.9 Summary

The thesis provides an outline of the types of beneficial end-uses available for mine voids once mining has ceased. The end-use options available to a mine will depend on a number of factors that should be considered in the determination of closure outcomes. In addition to this, closure outcomes in urban environments will differ from those in rural and regional areas where there may be less scope for economically derived end-uses for a site. The decision on optimal end use options for a site will also require mining companies and governments to engage with local communities and present them with post closure alternatives that are feasible for a particular location. This requires the development of some form of valuation technique such as benefit-cost analyses that can be used to aid the decision-making process. Significantly, research in both the desktop case studies and the field research interviews specified that a life cycle planning approach to mine closure was necessary from the commencement of a mine's life.

The next section of the thesis is the conclusion that will provide an overview of the key themes that have emerged from the study and will develop the broad framework for best practice mine closure and highlight future areas of research that could be undertaken from the findings.

Chapter 10. Conclusion and implications

10.1 Introduction

The main objective of the thesis outlined at the beginning of the research was:

To develop and explore a framework for evaluating the end-uses of mine voids. In addition there were five other objectives that formed part of the research question. These objectives were to:

- Examine the different options for mine void closure.
- Investigate a process that determines what level of stakeholder participation is needed in the closure of mine voids and who are the stakeholders that should participate.
- Establish a framework for economic modelling that will assist in determining the use/non-use values of these mining voids at closure.
- Determine world's best practice for mine void closure.
- Suggest a policy framework for the closure of mine voids.

At some point a mine's resource will be exhausted and it will no longer be possible for it to continue operating, it will have no other option but to close. Alternatively, the price of the resource may be insufficient to justify the costs of extraction. One of the issues with mine closure is that it lacks the positive news associated with a mine opening, which can boast about the number of jobs created, the money it will bring into a local economy, and the revenue generated for an organisation. Mine closure marks the end of the revenue stream, loss of employment and less income for a region and it is not likely to see a company's share price rise.

However, mine closure does not have to be all bad news, from an organisational and community viewpoint it should be positive news with the ability to demonstrate how a former mine area has been rehabilitated and at least left in a state that is similar to when mining commenced. It can also demonstrate a mining company's sustainability credentials and if done well can be something that a mining company uses as an example of their commitment to a community, assisting them in gaining approval for future mine developments in other communities. In some cases the community can gain if a mine is closed in a sustainable manner, as they can be left with a long-term asset that benefits future generations and result in the creation of new employment opportunities for former mine employees and other members of the local community.

The size and profitability of a mine along with the ownership of a mine were found to play a role in its closure as they will have also be a factor in determining end-use options for a site and also the possibility of an unplanned closure. The larger and more financially viable a mine and the larger and more profitable a mining company is, the greater the financial and human resources that it will have at its disposal to spend on mine rehabilitation and closure. This is also affected in part on commodity prices, fluctuations in which can have serious repercussions on the viability of a mine site and can result in unplanned mine closures.

Large and profitable mining companies will not always rehabilitate and close a mine to a best practice outcomes and nor do smaller companies always close a mine to best practice standards. There exists a gap in the ability of legislators to adequately deal with the financial provisions associated with mine site rehabilitation and closure and there is a need for regulators to ensure throughout the mining process that companies are financially viable and able to meet their rehabilitation and closure commitments. This means regulators undertaking regular financial assessments of mining projects and requiring that developments facing financial difficulties report this to regulators in order to assess ways to keep a project operational or determine premature closure options and find funding to achieve this.

Mine closure has rarely been addressed well by mining companies, regulators or communities in the past and in those cases classified as best practice by this thesis closure has been undertaken in spite of any regulatory guidelines rather than because of them. In many of the best practices examples, were it not for the generation of different ideas by a number of bodies working outside of regulatory boundaries, it is doubtful that the closures would have been able to be classified as best practice.

Unfortunately for the mining industry (and indeed for regulatory bodies) mine closures have tended to be carried out in a less than sustainable manner with some mining companies seemingly concerned about the bottom line rather than the environment or the local community and the impact a mine closure has on their economy. Indeed the term closure can be somewhat misleading. The actual process of closure can be lengthy as in most cases even after a mine site has been rehabilitated, decommissioned and then closed, a mining company may still be required to monitor the site for years before regulatory bodies will take a site back into the care of the Crown. For the purpose of this thesis, closure is that point in time when mining ceases, the mine is no longer operational and has been rehabilitated, as it is at that point that a mine site can be opened to the public again. It is also rare for mining companies to relinquish a lease, as they will normally want to leave open the possibility of mining in the future.

10.2 A framework for evaluating the end-uses of mine voids

The main objective of this research was to develop and explore a framework for evaluating the end-uses of mine voids. The research findings from this thesis have led to the conclusion that this needs to be addressed as a much wider policy structure developing a policy framework for mine closure and not just limit this framework to mine voids. The major policy recommendation from this thesis is the development of specific mine closure legislation, or at the very least a set of regulatory guidelines to direct the closure process. This process also meets the objectives of determining what is world's best practice for mine void closure (extending this to mine closure as a whole), and the objective of developing a policy framework for world's best closure, with the findings determining that legislated policy guidelines are the best way to guide the mine closure process. Factors that will need to be considered as part of this legislated mine closure guidelines and that are currently missing from mining policy and legislation, will now be discussed. They include:

- Develop nationally-based mine closure legislation
- Appoint one regulatory body to oversee the closure process
- Examine the location of the community in which a mine is situated
- Planning early for mine closure
- Engaging stakeholders in the closure process

10.2.1 Develop a nationally-based mine closure legislation

The main issue with mine closure in this country (and indeed throughout the world) is the lack of specific closure legislation, or at the very least regulatory closure guidelines. At present in Australia the only mine closure guidelines have been developed by the Australian and New Zealand Minerals and Energy Council and Minerals Council of Australia "Strategic Framework for Mine Closure" a detailed document released in 2001 outlining how a mine closure should be conducted so that a former mine site can return to a self sustaining ecosystem. The guidelines have been written by the mining industry for the mining industry to use in the closure of a mine and although perfectly acceptable for their stated purpose, they have one key problem; it is a purely voluntary set of guidelines and mining companies are not bound by them in any way.

The Western Australian Framework for Closure Guidelines provides a starting point for the development of mine closure legislation in this country. The introduction of mine closure legislation will need the support of the mining industry and the development of legislative guidelines that are similar to those developed by industry but with more of a socio-economic focus. Mine closure legislation would also require all levels of government (but particularly State and Local governments) to become more actively involved in the mine closure process by working in conjunction with mining companies. This would mean that governments take a financial stake in a mine closure project with financing being made available from royalty and tax redistribution specifically for mine closure mitigation programs. In other words, the money needs to be used for specifically targeted projects. This worked well in the Flambeau (Wisconsin, USA) case study where mining taxes were redistributed back to the local community for the development of the community post closure. This type of redistribution demonstrates a commitment to mining communities financially and is also giving back to the communities that benefit from mining, but also have a lot to lose when a mine closes down.

Currently legislation and legislative guidelines for mining in Australia are state-based and none specifically addresses the closure of mines. Legislation needs to be nationally based, rather than a state or territory based system, as this provides more certainty for all parties in the closure process and enables mining companies to apply the same closure standards at a range of mine sites across the country. This also provides greater certainty to mining communities who would be able to use such legislation to guide their own closure planning and work with other communities across the country going through similar processes.

In addition, it was found that best practice mine closure should be tackled holistically with all levels of government, mining companies and communities contributing to the closure process. The research also uncovered other factors that influence mine closure that have formed a series of criteria that need addressing if mine closure is to be considered best practice.

The review found that legislation has not kept pace with what is occurring in industry and that to some extent industry has set the pace for mine closure regulatory guidelines both in Australia and overseas. In addition, the review found that there were gaps in regulations surrounding mine closure in their almost uniform failure to adequately address the economic and social issues that surround mine closure. In addition, these do not feature prominently in mining company closure plans, despite the importance placed on them by industry bodies such as the Minerals Council of Australia, the International Council on Mining and Metals and the Australia and New Zealand Minerals and Energy Council.

10.2.2 Appoint one regulatory body to oversee the closure process

The evidence from the Elliot Lake mine closure and from the interviews conducted with mining companies and local governments provided strong support for allowing one regulatory body to oversee the mine closure process. This does not necessarily have to be a federal body, the state regulatory authorities are currently better placed (as they have the expertise) to oversee this course of action at the moment, however in the long term it would be more streamlined if this were run by a national body. In the case of the Elliot Lake closure, it was decided to have one regulatory body responsible for the closure of the mine site. This meant that all parties in the mine closure program had to report to only one regulatory body, instead of the numerous bodies, as is normally the case in mine closures, enabling the process to be streamlined by providing uniformity. The use of one body to oversee the closure at Elliot Lake was undertaken as a one-off method for mine closure; however, its success at Elliot Lake demonstrated why it could be an ongoing feature of mine closure projects.

10.2.3 Examine the location of the community in which a mine is situated

One of the key elements in the development of mine closure legislation and an area that has tended to be overlooked, as shown in the case studies of inferior closure practice, was an examination of the communities in which a mine is situated. In this sense, any legislative guidelines would need to be flexible in determining closure outcomes, including end-use options and not necessarily prescriptive as each community is different and will have a number of different needs and options. This is one of the reasons why this thesis is recommending increased community involvement in the mine closure process as they are left with the long-term impacts of a mine closure and they need to be provided with the capacity to make a mine closure sustainable. This also relates to one of the objectives of the thesis of examining different options for mine void closure, as it was found that end uses are dependent on a variety of factors including a mine’s location and the social settings of the community in which a mine is located.

There are a couple of key criteria that were found to be necessary when deciding how a community is to deal with a mine closure. These criteria were part of the nine criteria used as the basis for the inferior and best practice case study mine closures and are important in deciding on end-use options for a mine site. These criteria include the location of the mine and the size of the community.

A mine’s location is a key determinant in a mine closure. A mine located near an urban environment has more potential end-use options available to it for mine closure as it can draw on this population for recreational purposes for example. By contrast, a mine that is located in an economically diverse region may not need to concern themselves with the economic outcome of a mine closure as there may be a wider variety of employment options for mine employees post mining. Furthermore, the research found that climate will play an important role in this process as it will influence the end-use options for a mine site; this is particularly the case in the more remote and arid regions of the country.

The Rother Valley Country Park example in the UK provided a best-practice example of how a community’s size and its location can play a determining role in end-use options for a mine site. This former site was successfully turned into a series of recreational lakes and parklands with the decision to do so based in part on the location of the former mine in the heavily populated central midlands area of the UK near Sheffield. The location in the virtual geographic centre of England meant that the former mine site was able to be accessed by a substantial population providing a new tourism facility for the region in addition to turning a former polluted field into a recreational area for locals. The result has been a popular tourism destination that attracts close to 1 million visitors per year and that has turned a once polluted river and meadow area into a recreational spot for anglers, hikers and swimmers.

The location and size of a community will also influence the amount of community support and/or opposition to a mining project and therefore any closure options. In many instances larger communities that are closer to or located in urban environments will have more end-use options available to them, particularly if these end-use options include commercial or tourism possibilities. Economically diverse communities will be less affected by mine closures than communities that are mining dependant and may well require less assistance from mining companies and government agencies.

Communities of varying sizes will have differing needs and mixed ways of dealing with mine closures. There is not a one-size fits all policy for dealing with mine closures and hence the reason why it is recommended that any mine closure outcomes allow flexibility for each community. Some communities will require more assistance programs than will other communities and some regions will be better placed to cope with a mine closure, particularly those with diverse economies. What is critical however is the need for local governments to develop strategic planning that incorporates a mine closure component in order to begin assessing strategies a number of years before closure to help mitigate the effects of a closure.

10.2.4 Planning early for mine closure

Mine closure however does not have to be all bad news stories and negative share values, the research on best practice mine closure finds quite the opposite can be true. Companies increasingly need a social licence to mine and in the age of social media, the internet and instant information, mining companies can no longer afford bad publicity surrounding their rehabilitation and closure practices. A well planned and well orchestrated mine closure can assist a company in the long term as it will help develop a positive image for them and help them in future mining ventures particularly if they can demonstrate their sustainability credentials. This will not negate the need for mine closure regulations; however, it does add another dimension to the mine closure process helping to raise the importance of mine closure to the mining equation.

It is a recommended that any legislation governing mine closure includes provisions to ensure that mine closure planning is conducted at the commencement of the mine planning phase. This planning needs to consider not just the environmental aspect of mine closure (i.e. rehabilitation), but also the economic and social costs associated with mine closure as the research has found that they are as important as the mine rehabilitation. All three are important in the mine closure process, implying the need to adopt a holistic approach to closure.

A number of themes emerged from the review on mining and sustainable development that were common to all of the documents, namely that mine closure revolves around four key themes those being environmental, economic, social and governance. The key point to emerge from the documents were that all parties to the mine closure process including companies, governments and communities need to work cooperatively and ensure that closure planning is undertaken early and continuously throughout the life of the mine if best practice closure outcomes are to be achieved.

Planning for closure has traditionally been the least understood aspect of the mining process. In the past, mine closure planning has been left until the last year or two of mining, or more often than not was not carried out at all. It was found that there were a number of reasons why mine closure planning has been undertaken in such a poor manner including the fact that mine closure is not a good news story for companies, or for governments at all levels. The very nature of mine closure tends to mean the loss of jobs, a loss of income for a town, infrastructure that needs to be maintained post closure, no increase in value for shareholders and mine sites that will require ongoing care and maintenance. Mine closure appears to be a bad news story and it is still treated by all parties in the mining process, something that is best left unsaid.

The approach to closure planning must be holistic and inclusive of all issues that arise during the life of a mine. Closure planning should not be the sole concern of the mining companies; it needs to be undertaken by governments at all levels, as they will ultimately take responsibility for a site and a community once a mine ceases to operate. The following are points that need to be undertaken in the planning process.

Planning that is holistic

As part of holistic planning, it is recommended that all of the parties in the mining process, the mining companies, federal and state governments, local governments and their communities develop a cooperative working relationship when it comes to mine closure as each party has a role to play. Mining companies have an obligation to recognise the economic and social impacts that mine closure can have on a region, the negative effects of which can have a longer impact than the opening of a mine. However, the socio-economic effects of mine closure should not have to be addressed solely by mining companies. As part of a holistic approach to planning for closure it is suggested that governments at all levels play a greater role in these aspects of the mine closure process. Governments that are responsible for approving these mines in the first place have an obligation to assist these communities upon the cessation of mining. There are a number of areas that governments would need to provide assistance, including retraining of displaced workers, employment assistance packages, providing funding to maintain disused mine infrastructure, offering business development and business attraction programs. It is important for governments and business to recognise that mining is not just about the physical impact and that its impact can extend much further into the social and economic sphere of a community.

Planning allows for flexibility

It is recommended that the planning document for a mine closure allows for flexibility and that it not become a prescriptive document that does not allow for changes. There are a number of reasons for this including a need to take into account changes to the wider economy such as commodity price fluctuations that can have an impact on the viability of a mine. Changes can also occur to mine ownership which may have an effect on the final outcomes for a mine site. As an example, new owners may choose to extend a mine's life, or reduce its life, which will cause changes to any planning. As well, technological changes will influence the type of end-use options available to a site and in a mine with a 20 or 30 year life span, this can mean that options not available under original mine closure plans, suddenly become feasible. Communities may also change their viewpoints with regards to closure outcomes and end-use options and any closure plans need to be able to factor this into their plans.

Planning acknowledges the possibility of unplanned closure

Following on from the above point, the research is advising that mine closure plans allow for the possibility of an early, unplanned closure and develop strategies to deal with such an occurrence. The case studies highlighted the potential problems associated with unplanned closures and the associated costs (financial, environmental and social). It is vital that any closure planning allows for contingencies that put into place strategies to mitigate the effects of unplanned closure. Such strategies could involve financial rehabilitation plans, employee assistance packages, and structural adjustment programs to assist local communities with the closure and the use of bonds to cover the costs of rehabilitation.

Planning involves a framework for economic modelling

One of the objectives of the thesis was to establish a framework for economic modelling to assist in determining the use/non-use values of a mine void at closure. The findings concluded that any mine plans also need to consider the development of alternate end-use options for a mine site as it will allow time for feasibility studies to be undertaken. This should be undertaken, using a social benefit-cost analysis of the various options as this is a comprehensive way to value end-uses of mine sites. Allowing for a number of end-use options also provides communities with a variety of choices at the end of a mine's useful life allowing them to make a decision on how they want a mine to look post closure. It also allows a way to develop sustainable long-term options for mine closures, planning for them many years before actual closure and through benefit-cost analysis determining projects long-term viability.

The financial benefit-cost analysis for Lake Kepwari in Collie, Western Australia was developed using data from a development option plan for the lake that was commissioned by the South West Development Commission and Wesfarmers Premier Coal. The analysis highlighted that the development of the lake for recreational use would be a costly undertaking for a government, but that other development options at the lake depend on the proposed capital works program for the lake. The financial analysis found that if the lake attracts the proposed visitor numbers then two of the three businesses proposed for the lake would be viable options. The conclusion from this section was that in order for benefit-cost analysis to be effective it is preferable to undertake any closure option analysis as part of the mine closure planning process.

It was also acknowledged that this area requires future research, notably to take into account social and environmental costs associated with mine closure, to determine both use and non-use values for mine closure options. Limitations on the size and scope of the thesis and available data for the site necessitated the development of a financial BCA for Lake Kepwari, however the research found that best practice mine closure involves the development of robust economic modelling that places a value on both use and non-use options.

Planning for inclusion of local communities

The review of the literature found that Governments play a key role in assisting the growth of local economies after mine closure. It was found that the approach of mining companies and governments working on post-closure economic development strategies has not been effective and that there needs to be greater synergies between them in developing post closure strategies (Khanna, 2000). In respect of local communities and the local governments that govern them, little mention was made of the need for local governments to incorporate post-closure planning into their strategic planning process.

Best practice closure planning needs to include local communities and local government areas should become an integral part of the mine closure process, allowing them a greater role in determining how a mine closure should occur. Local governments are best placed to deal with this as they are generally the one constant in a community during the life of a mine and they have to deal with the economic, social and environmental issues surrounding mine closures on a daily basis. The findings from the literature indicated the need for governments to assign Economic Development Co-ordinators to areas affected by mining, with these people being responsible for overseeing the closure and then assist in developing strategies that minimised the negative impacts that are often associated with a mine closure.

This also will mean that local governments will require some financial stake in a mine closure, particularly with regards to maintenance of mine site infrastructure and facilities post closure. As occurred in the case of Rother Valley Country Park it may be possible in future mine closures that some local government areas take a financial stake in an end-use project, particularly if the end use has the potential to become an income source.

Plan for continuous rehabilitation and closure

Mine closures should be ongoing and commence at the start of a mining project. The research found that the most cost-effective way to rehabilitate a mine site is to undertake a program of ongoing rehabilitation. This needs to be a minimum requirement of mine closure planning and needs to also incorporate commencement of the socio-economic aspects of mine closure, as this will also be of benefit should a mine face premature or unexpected closure.

10.2.5 Engaging stakeholders in the closure process

Engaging stakeholders was one of the objectives of the thesis, namely to investigate a process that determines what level of stakeholder participation is needed in the closure of mine voids and who are the stakeholders that should participate. The findings are that this process has rarely been undertaken well by the mining industry or regulators, even in the best practice case studies. Community consultation is the term often referred to by mining companies and regulators when they talk about their involvement with the local community. This process can be misleading, as shown in the thesis, which demonstrated the difference between consultation and engagement, or involvement in the mine closure process. An often underrated fact associated with mine closures is that it is the local communities that live with a mine closure long after the mining companies and regulators have left. Mining projects can last as long as 30 years, by comparison mine closures last for an eternity. The state that a mining company leaves a mine site in is the legacy that it leaves for a community, not the actual mining project itself, which by comparison is a relatively short-lived affair, whose benefits often go to people quite remote from the community.

While mining companies have not addressed this issue well in the past there is increasingly a need to be more inclusive in the closure process at all levels including with regulators and the communities in which they operate. Part of the move to a more inclusive dialogue with communities has come about as a result of social factors that have made companies more accountable for their actions and in part financial factors such as share prices which can be affected by negative sentiment towards companies that are seen not be acting in a socially responsible manner.

The reason this thesis is recommending that community engagement become part of the mine closure process is that too often in the past communities have been overlooked in the mine closure process and had little say in how a mine closure should look. The findings from this thesis indicate that there is a need for communities to determine what end-uses they want for a mine site and how that site should look post closure. Communities through their local government areas need to become involved with the mine closure from the initial planning stages with a stake in how a mine site should look post closure and the type of end-use options available. Community members should be allowed to participate in this process, however, the research has found that local governments are best placed to represent their communities due to their longevity and the broad interests of the community that they represent.

Community engagement and involvement is about empowering communities in the mine closure process. Knowing that mining companies are legally obligated to provide certain social, economic as well as environmental guarantees will assist in gaining greater acceptance for a project. If mining companies and regulators are then required to work closely with communities from the planning stages, then it is more likely to result in the development of long-term partnerships that result in sustainable development outcomes providing long term economic and social benefits.

In some ways mine closure is the most important part of the mining process as this will last for generations and is ultimately the legacy that mining companies leave behind upon the cessation of mining. Unfortunately, all too often the end of mining can leave a negative contribution with future generations left to pay for the costs associated with the cleanup of a site, highlighted in all of the inferior practice case study examples. In many instances communities and governments were left with huge rehabilitation costs and former mine sites that many years after closure are still in a state of disrepair.

This thesis is arguing that missing from any mine closure planning at present is a focus on the economic and social impacts of mine closure on local communities, in addition to the environmental impacts. As well, closure planning can no longer just be the responsibility of mining companies, it also needs to include input from federal, state and local governments as they are best placed to examine the social and economic impacts of mine closure and put in place measures to mitigate the impacts of closure.

10.3 Limitations of the research

This has been a broad-based thesis with the aim of developing a framework for mine closure and therefore has not been concerned with the minutiae of certain aspects of mine closure, instead recommending that further research be conducted in these areas. The objectives of this research were deliberately wide ranging, as there was been no previous academic research conducted on developing such a broad legislative framework for mine closure.

As stated in the research process section of Chapter 1, this thesis adopted a pragmatist approach that was due to the wide-ranging nature of the study. The mixed methods approach that framed the research process was used to enable the use of both quantitative and qualitative data in the research process (Tashakkori and Teddlie, 2003). It is acknowledged that this process can lead to unanticipated outcomes (Bryman, 2007, Sammons et al., 2008). In order to counter this effect, the specific outcomes that were desired from the research were clearly stated. However, the research did find some outcomes that were not anticipated and hence the reasoning behind the need to conduct further research with the aim of influencing policy development in this field. Moreover, the need identified to conduct further research is also reflective of the broad nature of this topic.

Technically, a mixed method approach to research is a process of application and integration (Curry et al., 2009). It is argued that the data collected through mixed methods research is of greater validity than data collected through other approaches due to the variety/variation in data collection and the ability through this variation to data collection to answer questions from a number of perspectives and ensure no gaps exist in the research (Tashakkori and Teddlie, 2003). This thesis achieved this on the whole, however the quantitative analysis was conducted from a purely financial perspective, rather than conducting a full economic analysis that incorporated a social benefit-cost analysis. This was one of the objectives of the research, however, it was discovered during the course of the research that such an undertaking required considerably more resources than were available for this project and as such is one of the areas warranting further research in order to assist in better informing policy development.

Open-ended standardised questioning for the semi-structured interviews and standardised criteria for the case studies provided the basis for an objective analysis. The structure of the interview questions enabled participants to offer their own options and answer using their own interpretation of the questions, allowing this researcher more objective, than subjective data collection. Though one of the limitations of the positivist approach is said to be emotion, these professional interview respondents tended to edit their own comments as although their data was anonymous, the number of respondents were limited. Further, emotive comments, if made, were edited to ensure responses provided were factual.

Additionally, objectivity is more likely to be achieved by a mixed methods research approach, as used in this thesis, as the use of a single methodology does not provide all the answers and the use of mixed methods can allow greater confidence in the conclusions reached (Saunders, et al., 2009).

Further weight can be given to the methodology chosen as the data is both replicable and credible due to the standardised data criteria and questions that were used in both the case study and interview methodologies. There were, however, some limitations regarding the interview process, namely regarding the availability of community members willing to be interviewed about the mine closure process. In some cases, this was due to the time a mine was operational and the inability to find community members still actively involved with any community consultation process. There was also reluctance by some community members to discuss the mine closure and hence they did not make themselves available to comment on the process. In the shire of Collie, the local government handed over its responsibility for the closure of the Lake Kepwari mine to the South West Development Commission and deferred the interview process to the Commission.

The decision to use ten desktop case studies was based on the need to show a range of good and inferior closure practices from around the globe, as it was felt that best practice outcomes are not necessarily confined to Australia and that there are lessons from around the globe that can be learned in relation to inferior mine closures. There are of course many other mine closures that could have been used as case study examples in this thesis, but limitations on the amount of data in a thesis have naturally constricted the number. Nevertheless, the ten that were chosen as examples provide some of the best (and worst) examples of mine closures available in the developed world. It is hoped that any future research on this issue involving the use of case studies can supply some examples from elsewhere in the world (including from developing nations) as a means of adding further depth to the research on mine closure.

Budgetary limitations also prevented the researcher from providing more in-depth case study analysis than the four provided. Access to a larger budget and the use of a number of interviewers would enable a greater number of mine sites and local governments to be questioned and this should form the basis of future research into the development of this framework.

10.4 Opportunities for future research and policy development

The key finding from the research and one that meets the two thesis objectives of determining world’s best practice and suggesting a policy framework for the closure of mine voids; is the development of a national framework for mine closure that one national regulatory body would manage to provide consistent guidelines for mine closure across the country, whilst at the same time allowing for flexibility at individual sites based on the capacity of communities to deal with a mine closure. Future research and policy development recommendations in this field could include:

- Investigating how to implement a nationally-based legislative framework for mine closure. Included in this process would be the role of the states and territories in this process.
- Investigate the process involved in using one regulatory body to oversee the mine closure process. This would involve further detailed analysis of mine closures in areas such as Elliot Lake (where this approach was used) to understand how this could be applied in Australia.
- Further interviews of mining companies and all levels of government in order to develop greater understanding of how mine closure regulations would work in practice. This will also provide more insight into the role that each player sees for themselves in the mine closure process.
- Examination of how to monitor the financial viability of mining companies and ensure that unexpected mine closures no longer cause the economic, social and environmental problems they currently can. This would include determining the most appropriate bonding mechanism to apply at mine sites notably the most appropriate amount of money to prevent governments and communities being left with the bill for unplanned mine rehabilitation and closure.
- Development of a risk-based program to deal with the effects of unplanned closures and the strategies that need to be put in place to mitigate their effects.
- Widening the scope of future studies beyond financial analysis, to include an examination of the social and economic effects mine closures, ensuring that full economic analysis is undertaken.
- Determine how an expanded local government role would work in the mine closure process and the exact role that local governments can play in the mine closure process, including the possibility of taking a financial stake in end-use projects and how this could be funded.
- How to incorporate the socio-economic impacts of mine closure into the mine planning process and the role of governments (at all levels) and mining companies in this process.
- Development of a community engagement strategy in mine closure legislative guidelines and determination of how this process would be undertaken.

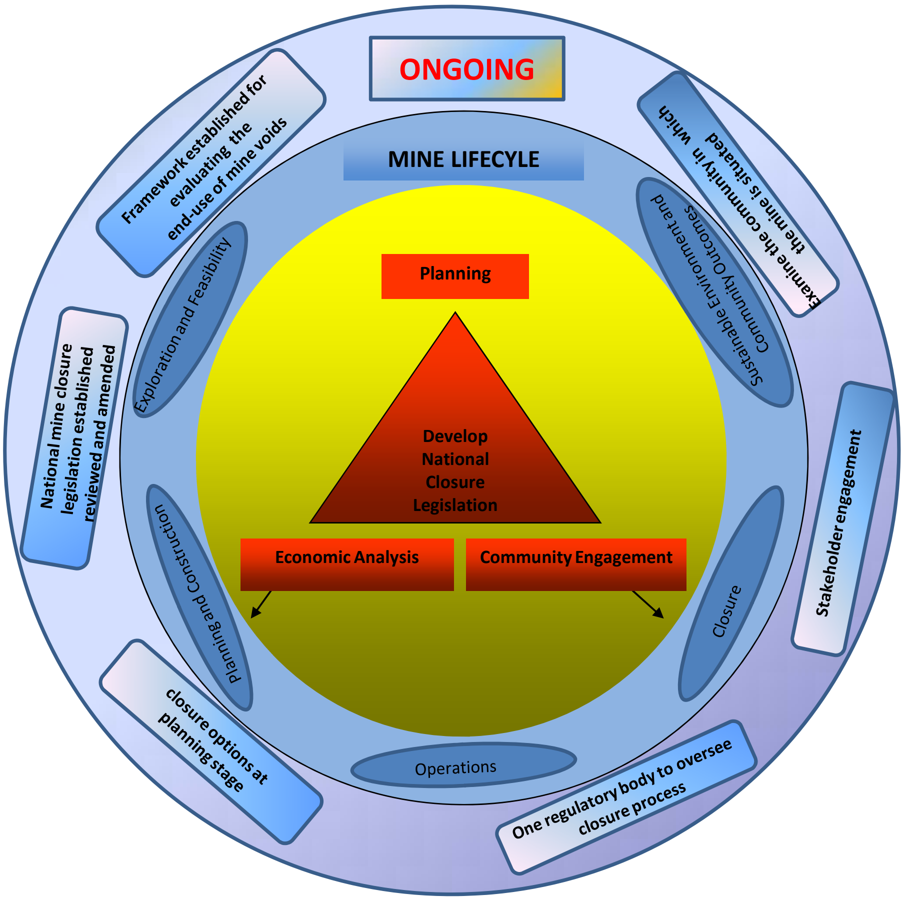
10.5 Conclusion

The key question arising from the thesis was: What is an appropriate legislative, analytical and stakeholder participation framework for the end-use of mining voids in Australia?

Based on the findings from the research it is clear that the major feature lacking in mine closure is legislation or a set of nationally consistent regulatory guidelines that are mine closure specific and that can be used as the basis for mine closures across the country. This thesis and the framework established form the basis of a closure framework that should be applied to all mine sites in the country and given the lack of international legislation, may have application abroad. It is through this legislative process that the research question can be addressed and through the recognition of the need to develop this nationally consistent regulatory guideline that this thesis is contributing to a new and wider body of knowledge around the issue of mine (void) closure.

In Chapter one an elementary figure was included to diagrammatically demonstrate the mine closure process. During the course of the thesis, a number of key research findings added to the understanding of the processes involved in mine closure that would assist in making it world's best practice. These implications have been discussed in this Chapter and have been integrated into the revised diagram, Figure 10.1, which incorporates those findings and will assist in forming the base for further research and policy development in this area:

Figure 10.1: Mine closure process



Mine closure planning should be continuous and flexible and undertaken throughout the life of a mine. It should initially be undertaken as part of the mine planning phase, which would include options for end-uses that enable communities, legislators and companies to determine early in the mine planning phases what options are not only acceptable to communities, but what options might be economically viable.

This requires undertaking economic analysis that preferably provides a discounted cash flow over a period of years as one of a series of decision-making tools. Benefit-cost analyses of closure options that examine use and non-use values and incorporate social and environmental outcomes, in addition to financial outcomes would provide communities, governments and companies with a variety of options stating the feasibility or otherwise of a number of closure options, preferably using a number of variables in the analysis process.

The closure planning process then needs to be underpinned by a strong community engagement process that allows communities to become actively involved in the decision-making progression around closure and end-use options. Best practice in this community engagement course of action will involve the development of partnerships between mining companies, local communities, and all levels of government. These partnerships will need to be ongoing throughout the life of the mining process in order to take into account changes that occur both within the local community and throughout the wider economy and also allow for environmental and technological improvements that may alter initial mine closure end-use plans. Ultimately, however, any closure planning and end-use outcomes need to be driven by the local community and this is the essence of best practice engagement, the community becomes the main player in the closure process, as ultimately they will live with the end-use long after the mining company and government agencies have left the area.

Chapter 11. References

ABC Rural, Monday 21/03/2011, *Anti-Coal protestors from Margaret River WA have a win,* retrieved from http://www.abc.net.au/rural/news/content/201103/s3169557.htm on 27/09/2011.

Accounting Handbook 2005, CPA Australia, *"Volume 1 of the Accounting and Auditing Handbook 2005,* Published for CPA Australia by Pearson Australia Group Ltd, Melbourne.

Adlam, N., August 25th 2010, *Plenty of gold left at Mt Todd mine,* NT News, retrieved from http://www.ntnews.com.au/article/2010/08/25/174721_nt-business.html on 02/09/2010

Alcoa Ltd, 2011, *Alcoa won't wait: Taking Decisive Action in a Turbulent World*, retrieved from http://www.alcoa.com/global/en/investment/pdfs/2011_Annual_Report.pdf on 04/03/2012

Alcoa Australia, 2010, *Alcoa Sustainability Report 09*, Perth, Western Australia, retrieved from http://www.alcoa.com/australia/en/pdf/Sustainability_Report_2009_Final.pdf on 11/10/2011

Alcoa Australia, 2009, *Alcoa Sustainability Report – Jarrahdale, retrieved from* Alcoa, 2009, retrieved from http://www.alcoa.com/australia/en/info_page/mining_jarrahdale.asp on 12/06/2010

Alinta Gas, 2006, *"Your Business>Pricing Options"*, retrieved from www.alinta.net.au/business/pricing/standardPricing.aspx on 15/02/2006

Alinta Gas, 2005, *"Business fees and charges"*, retrieved from www. alinta.net.au/business/pricing/feesCharges.aspx on 08/11/2005

AMEEF (Australian Minerals and Energy Environment Foundation), 2002, *Facing the Future: The Report of the Mining, Minerals and Sustainable Development Australia Project*, Canberra

AMES Construction Inc, 2010, *San Manuel Mine Closure*, retrieved from http://www.amesconstruction.com/markets/mining-projects.cfm?id=40 on 15/10/2010

ANZMEC/MCA, 2000, *"Strategic Framework for Mine Closure"*, Commonwealth of Australia Legislative Services, Canberra, ACT

APP Project Management, March 2003, *"Western Five Lake Development Plan: For South West Development Commission"*, APP Project Management, Bunbury, Western Australia.

Arizona Department of Commerce, 2009, *San Manuel Community Profile*, retrieved from http://www.azcommerce.com/doclib/COMMUNE/san%20manuel.pdf on 11/11/2010.

Ashton, P. and Evans, L., (2006), *"Community Development through Mine Site Rehabilitation Projects"*, retrieved from www.minerals.org.au/_data/assets/pdf_file/10102/Ashton_Peter6B3.pdf on 03/05/2006

Assembly of First Nations, 2011, *International Indigenous Summit on Energy and Mining, June, 2011*, Ontario, Canada, retrieved from http://www.afn.ca/index.php/en/news-media/events/international-indigenous-summitt-on-energy-mining2 on 24/11/2011

Atlantic Ltd, 2010, *Building a world class resources group, Windimurra acquisition finalised*, retrieved from http://atlanticltd.com.au/upload/documents/InvestorRelations/presentations/101015InvestorPresentation-WindimurraAcquisitionFinalised.pdf on 22/10/2010

Atlantic Ltd, 2010, *Windimurra Vanadium Project*, Atlantic Ltd, retrieved from http://atlanticltd.com.au/?id=321 on 23/10/2010

Atleo, S, 2011, "*There is an election on isn't it time we talked*", CBC News, Canada, retrieved from http://www.cbc.ca/news/canada/story/2011/04/13/cv-election-atleo-oped.htm on 27/06/2013

Austmine Smart Mining, 2011, *Mincom research reveals top challenges facing mining companies today*, retrieved from http://www.austmine.com.au/AustmineNews/tabid/790/ArticleType/ArticleView/ArticleID/405/Default.aspx on 23/02/2011

Australian Accounting Research Foundation, 2006, *Australian Accounting Standards 2006*, Melbourne, Australia

Australian Accounting Research Foundation, 2006, "*Determination of Discount Rates for Measuring Certain Liabilities at Present Value*", Prepared and issued by the: Public Sector Accounting Standards Board of the Australian Accounting Research Foundation and by the Australian Accounting Standards Board, retrieved on 25-03-2006 from http://www.aasb.com.au/public_docs/guidance_releases/AAG13_7-93.pdf

Australian Broadcasting Corporation, February 18 2009, *Hundreds of Windimurra mine jobs in doubt*, retrieved from http://www.abc.net.au/news/stories/2009/02/18/2495194.htm on 15/09/2010

Australian Broadcasting Corporation, January 7 2005, "Contamination concerns over vanadium mine", *ABC News Online*, ABC, Australia

Australian Broadcasting Corporation , 2004 "Mining Company pulls out of west coast clean-up", *ABC Premium News*, ABC, Australia

Australian Bureau of Agriculture and Resources Economics, 2011, *Minerals and Energy, Major development projects – April 2011 listing*, Canberra, retrieved from http://adl.brs.gov.au/data/warehouse/pe_abares99010544/MEprojectsApril2011_REPORT.pdf on 23/04/2012

Australian Bureau of Statistics, 2006, *"Measuring Australia's Economy Curriculum Activities Price Stability Lesson Fourteen: Trade Weighted Index and the CPI"*, retrieved from www.abs.gov.au/websitedbs/D3310116.NSF/0/ABF0380F0A0ECBCA256F3B0018A2F2?Open on 15/11/2006

Australian Bureau of Statistics, 2012, 3101.0 *Australian Demographic Statistics*, Australian Bureau of Statistics, Canberra, retrieved from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3101.0Sep%202011?OpenDocument on 01/04/2012

Australian Bureau of Statistics 2010, *National Regional Profile – Mount Magnet (S) 2004-2008*, retrieved from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/LGA558102004-2008?OpenDocument&tabname=Details&prodno=LGA55810&issue=2004-2008&num=&view=& on 17/08/2010

Australian Bureau of Statistics 2006, *2006 Census Quick Stats: Katherine*, retrieved from http://www.censusdata.abs.gov.au/ABSNavigation/prenav/LocationSearch?collection=Census&period=2006&areacode=UCL703600&producttype=QuickStats&breadcrumb=PL&action=401 on 01/09/2010.

Australian Bureau of Statistics, 7th February 2006, *"Consumer Price Index, Australia, December 2005"*, retrieved from www.abs.gov.au/ausstats/abs@nsf/e8ae5488b598839cca25682000131612/938da570a34a8edaca2568a900139350!OpenDocument 0n 20/01/2006

Australian Bureau of Statistics, 7th February 2006, *"Consumer Price Index, Australia, December 2005"*, retrieved from www.abs.gov.au/ausstats/abs@nsf/e8ae5488b598839cca25682000131612/938da570a34a8edaca2568a900139350!OpenDocument on 20/01/2006

Australian Bureau of Statistics, 2006, *Census Quick Stats: Queenstown*, retrieved from http://www.censusdata.abs.gov.au/ on 12/01/2010

Australian Bureau of Statistics 2002, *"Basic Community Profile 6225 (POA 6225)"*, Australian Bureau of Statistics, Census 7th August 2001, Catalogue No. 2001.0

Australian Bureau of Statistics 1998, *"Population Distribution: Small Towns: which ones are in decline"*, Australian Social Trends, 1998, Australian Bureau of Statistics, Catalogue No. 4102.0

Australian Industrial Relations Commission, 2005, *"Liquor and Allied Industries Catering, Café, Restaurant Award 1998"*, Australian Government Publishing, Canberra.

Australian Government, 2011, *Environment Protection and Biodiversity Conservation Act, 1999*, Canberra, Australia, retrieved from http://www.comlaw.gov.au/Details/C2011C00751/Html/Volume_1 on 10/10/2011

Australian Mining, 2011, *Australian Mining: This is our story*, Australian Mining, Canberra, retrieved from http://www.thisisourstory.com.au/our-contribution.aspx on 15/07/2011

Australian Stock Exchange, 2009, Listed Company Information – Newcrest Mining Limited, Sydney, Australia, retrieved from http://www.asx.com.au/research/market_info/most_traded_shares.shtm on 13/03/2010

Australian Stock Exchange, March 22nd 2005, *"Precious Metals Australia Business Summary"*, Australian Stock Exchange Online, www.asx.netquote.com.au/summary.asp?sale on 13/10/2006

Australian Taxation Office, May 2011, "*Guide to depreciating A*ssets 2011", published by the Australian Taxation Office, Canberra.

Australian Trade Commission, 2011, *Australian Industry Capability: Mining: Cutting edge technology at work in global operations*, Australian Trade Commission, Canberra, retrieved from http://www.austrade.gov.au/Buy/Australian-Industry-Capability/Mining/default.aspx on 22/09/2011

Baker, B, 2002, *Introducing Urban Sustainability at Penrith Lakes, Sydney*, The Regional Institute, Adelaide, South Australia, retrieved from http://www.regional.org.au/au/soc/2002/2/baker.htm# on 15/06/2006

Baker, B.L., Barnett, G. and Nolan, A. 2000, *Developing Design Principles for Urban Sustainability at Penrith Lakes. An interactive CD prepared for Penrith Lakes Development Corporation Ltd.*, (CSIRO Wildlife and Ecology, Canberra).

BHP Billiton, 2006, *BHP Billiton Sustainability Report, Environment Case Studies – San Manuel Mine*, retrieved from http://sustainability.bhpbilliton.com/2006/environment/caseStudies/rehabilitationAndClosure/sanManuel.asp on 11/11/2010

Bartlett, L., August 28, 2010, *Why a Margaret River is madness*, The Sunday Times, retrieved from http://www.news.com.au/why-a-margaret-river-coal-mine-is-madness-liam-bartlett/story-e6frg2qc-1225911326116 on 26/09/2011

BHP Billiton, 2011, *Our Future Sustainability Report 2011*, Melbourne, Victoria, retrieved from http://www.bhpbilliton.com/home/aboutus/sustainability/reports/Documents/2011/BHPBillitonSustainabilityReport2011_Interactive.pdf on 11/10/2011

BHP Billiton, 2005, *BHP Billiton's Sustainable Development Policy*, retrieved from http://hsecreport.bhpbilliton.com/2005/docs/repository/SustainabilityPolicy.pdf on 09/09/2010.

Biggs, B., 2000, *Developing a national strategic framework on mine closure.* In Khanna, T. (Ed) Mine closure and sustainable development: Results of the Workshop organised by the World Bank Group Mining Department and Metal Mining Association of Japan. Mining Journal Books Ltd. London, pp.139-143

Blainey G., 2000, *The Peaks of Lyell (6th ed.) ed.*, St David's Park Publishing, Hobart.

Blayney Town and around website, 2011, *Cadia Hill – Ridgeway Mine*, Blayney Shire Council, retrieved from http://www.blayney-nsw.com/Cadia_Mine.html on 22/06/2011

BoardSports, 2009, *"Catalogue – Surf, skate, snow, wind"*, retrieved from http://www.boardsports.com/400005.html on 20/11/2006

BoardSports, 2009, *"Sail – lifespan"*, retrieved on 20/11/2006 from http://www.boardsports.com/470008.html on 20/11/2006

Bogan, C.E., English, M.J., 1994, *Benchmarking for best practices: winning through innovative adaptation*, McGraw Hill, New York

Bolton D and Alexander J, 2004, *Windimurra Vanadium Deposit, Murchison Region, WA*, CRC LEME Organisation, Perth Western Australia, Retrieved from http://crcleme.org.au/RegExpOre/Windimurra.pdf on 25/06/2008

Bonzle Mining Photo Collection, 2010, *Mount Todd tailings facility*, retrieved from http://maps.bonzle.com/c/a?a=col&fn=j9exmer4&c=44&col=show&or=3&sz=3&pg=0&yr=0 on 02/10/2010.

Boral Ltd, 2009, *Boral Annual Report 2008/09*, Sydney, Australia, retrieved from http://www.boral.com.au/Images/common/pdfs/2008_Report_Annual.pdf?site=boral on 01/02/2010

Boral Limited, 2011, *Boral Limited Annual Report, Reinforcing the core*, retrieved from http://www.boral.com.au/Images/common/pdfs/annual-reports/2011_annual_report.pdf on 03/03/2012

Boral 2004, "Penrith Lakes gains a new vitality", *Boral News*, March**,** pp. 1-6.

Brent, Robert, 1984, A three-objective social welfare function for cost-benefit analysis, *Applied Economics, 1984, 16, 369-378*

Bryman, A, 2008, *Social Research Methods, third edition*, Oxford University Press, United Kingdom

Bryman, A, 2006, *Integrating quantitative and qualitative research. How is it done?* Qualitative Research, Vol. 6. Pp. 97-113

Bureau of Land Management, 2006, *BLM Announces 2006 Reclamation and Sustainable Mineral Development Award Winners*, United States Department of the Interior, retrieved from http://www.blm.gov/co/st/en/BLM_Information/newsroom/2006/2006RSMDAwards.html on 23/06/2009Bureau of Meteorology, 2011, *Climate Statistics for Australian Locations*, Melbourne, Australia, retrieved from http://www.bom.gov.au/climate/averages/tables/cw_063254.shtml on 17/06/2011

Bureau of Meteorology, 2005, *"Climate Averages for Australian Sites – Averages for Collie"*, retrieved from http://www.bom.gov.au/climate/averages/tables/cw_009628.shtml on 19/11/2005

Business and Biodiversity Centre, 2011, *Mining and Quarrying*, The Earthwatch Institute, United Kingdom, retrieved from http://www.businessandbiodiversity.org/mining.html on 23/09/2011

Canary Research Institute for Mining, Environment and Health, 2011, *Ontario Mining Act Fact Sheet Mine Closure Plans Your Right to Know! Part VII – Rehabilitation of Mining Lands*, Ottawa, Canada retrieved from http://www.canaryinstitute.ca/Publications/Ontario_Closure_Brochure.pdf on 30/09/2011

Civil Aviation Authority, 2007, *"Cost-Benefit Analysis Methodology Procedures Manual*, Canberra, Australia, retrieved from http://www.casa.gov.au/scripts/nc.dll?WCMS:OLDASSET::svPath=/manuals/regulate/acm/,svFileName=257r003.pdf on 27/05/2013

CCH Small Business, 2006, *Business Guides – Food and Hospitality*, retrieved from http://www.cchsmallbusiness.com.au/product/product.asp?loc=19.17.203 on 06/03/2009

CEMEX Ltd, 2009, *Annual Report 2008/09*, retrieved from http://www.cemex.com/CEMEX_AR2008/eng/pdf/CEMEX_ar2008.pdf on 01/02/2010

Central Land Council, 2011, *Mining and Development*, Central Land Council, Alice Springs, Northern Territory, retrieved from http://www.clc.org.au/building_the_bush/mining.html# on 28/09/2011

Centre for Sustainable Mine Lakes, 2005, *"CSML Research Projects – Overview"*, retrieved on from http://www.csml.curtin.edu.au/research_programs/projects.html#ten on 21/11/2005

Centre for Sustainable Mine Lakes, 2005, *"CSML Scientific Review – Field Trip Component"*, CSML, Technology Park, Bentley, Western Australia.

CGU Insurance, 2009, *"CGU Business Insurance"*, retrieved from www.cgu.com.au/commercial/business.shtml on 12/01/2009

City of Elliot Lake, 2011, *About the City of Elliot Lake*, retrieved from http://www.cityofelliotlake.com/en/cityhall/aboutthecityofelliotlake.asp on 22/05/2011

Clark, A. L, Cook Clark, J., 2005, *An overview of legal frameworks for mine closure*, Mining Policy Research Institute, Montevideo, Uruguay, retrieved from http://www.elaw.org/system/files/11198931391clark_jcclark.pdf on 23/08/2011

Coggan, M., 2004, "Mount Todd gold mine management", In *Stateline Northern Territory* ABC, Australia, 18-06-2004, 7.30 p.m. Retrieved from http://www.abc.net.au/stateline/nt/content/2003/s1135518.htm on 02/04/2006

Colorado Department of Public Health and Environment, 2010, *Hazardous Materials and Waste Management Division – Summitville Mine*, retrieved from http://www.cdphe.state.co.us/hm/summitville.htm on 12/10/2010

Colorado Department of Public Health and Environment Hazardous Materials and Waste Management Division, 2010, *Summitville Mine Superfund Site – 2010 5 – Year Review Report Summitville Mine Superfund Site, Rio Grande County, Colorado*, retrieved from http://www.epa.gov/superfund/sites/fiveyear/f2010080003754.pdf on 15/02/2010

Collie River Valley, 2009, *Collie River Valley – About*, retrieved from http://www.collierivervalley.com/view/about/ 15/09/2009

Collie Visitor Centre, 2003, *"Discover the Collie River Valley"*, retrieved from www.collierivervalley.org.au on 9/10/2003

Commonwealth of Australia, 2006, *Handbook of Cost Benefit Analysis*, Barton, Australian Capital Territory.

Connor, Desmond. M, 1988, *A new ladder of citizen participation*, National Civic Review, Volume 77, Issue 3, 1988, pp. 249-257

Converse, J. M and Presser, S., 1986, *Survey Questions; Handcrafting the Standardized Questionnaire*, Sage, California.

Cooney, R., 2004, *The Precautionary Principle in Biodiversity Conservation and Natural Resources Management: An issues paper for policy- makers, researchers and practitioners*, IUCN, Gland, Switzerland

Copper Mines of Tasmania, 2010, *Copper Mines of Tasmania – Corporate Profile*, retrieved from http://www.cmt.com.au/ on 11/03/2010

Culp, K. and Pilat, M., 1998, Converting Qualitative Feedback into Quantifiable Categories, *Journal of Extension*, October 1998, Volume 36, Number 5, retrieved from http://www.joe.org/joe/1998october/iw3.php on 02/04/2012

Covello, J. A, Hazelgren, B. J, 2006, *The Complete Book of Business Plans: Simple Steps to Writing Powerful Business Plans*, Sourcebooks Inc., Naperville, Illinois, USA.

Cowan, W. R. and Robertson, J. G. A., 1999, *Mine Rehabilitation in Ontario, Canada: Ten Years of Progress*, Ministry of Northern Development and Mines, Sudbury, Canada http://pdf.library.laurentian.ca/medb/conf/Sudbury99/MiningSociety/MS22.PDF on 23/07/2007

Curry, Leslie, A., Nembhard, Ingrid, M., and Bradley, Elizabeth, H., 2009, 'Qualitative and Mixed Methods Provide Unique Contributions to Outcomes Research', *American Heart Association Journal, 2009: 199*, pp. 1442-1452

Czaja, R., 1998, Questionnaire Pretesting comes of age, *Marketing Bulletin*, 1998, 9, 52-66, Article 5, retrieved from http://marketing-bulletin.massey.ac.nz/V9/MB_V9_A5_Czaja.pdf on 08/02/2012

Department of Chemistry, University of Sheffield, 2005, *"Table of Elements"*, University of Sheffield, retrieved from www.shef.ac.uk/chemistry/ on 13/06/2005

Department of Conservation, 2010, *Annual Report; for the year ended, 2010*, Department of Conservation, Wellington, New Zealand retrieved from http://www.doc.govt.nz/upload/documents/about-doc/annual-report-2010/annual-report-for-the-year-ended-30-june-2010.pdf on 13/10/2010

Department of Communities and Local Government, 2006, *Minerals Policy Statement*, London, United Kingdom, Retrieved from http://www.communities.gov.uk/documents/planningandbuilding/pdf/152993.pdf on 30/09/2011

Department for Communities and Local Governments UK, 2010, *Minerals Policy Statement I: Planning and Minerals*, London, United Kingdom, retrieved from http://www.communities.gov.uk/publications/planningandbuilding/mineralspolicystatement5 on 30/09/2011

Department of Consumer and Employment Protection, 2009, *"Labour Relations: Minimum Conditions of Employment Act"*, Western Australia Government Publishing, Perth, Western Australia

Department of Environment and Heritage, 1998, *Landform design for rehabilitation. Best practice environmental management in mining*, retrieved from www.deh.gov.au/industry/industry-performance/minerals/booklets/landform/land on 16/05/2004Department for Environment, Food and Rural Affairs, 2010, *Mining Waste Directive*, London, United Kingdom, retrieved from http://archive.defra.gov.uk/environment/waste/topics/extractive-industries/index.htm on 03/10/2011

Department of the Environment and Heritage, 2001, *"Australia State of the Environment Report 2001 (Theme Report)"*, CSIRO publishing, Canberra, Australia

Department of Environment and Resource Management, 2011, *Rehabilitation requirements for mining projects*, Brisbane, Queensland, retrieved from http://www.derm.qld.gov.au/register/p01673aa.pdf on 10/10/2011

Department of the Environment, Water, Heritage and the Arts, 2009, *Matters of National Environmental Significance: Significant Impact Guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999*, Canberra, Australia, retrieved from http://www.environment.gov.au/epbc/publications/pubs/nes-guidelines.pdf on 02/10/2011

Department of Employment, Economic Development and Innovation, 2011, *Social Impact Assessment*, Brisbane, Queensland, retrieved from http://www.deedi.qld.gov.au/cg/social-impact-assessment.html on 19/09/2011

Department of Finance and Deregulation, Office of Best Practice Regulation, 2009, *Best Practice Regulation Guidance Note: Decision rules in regulatory cost-benefit analysis*, retrieved from http://www.finance.gov.au/obpr/docs/Decision-Rules.pdf on 28/08/2010

Department of Tourism, Regional Development and Industry, 2008, *Sustainable Resource Communities Policy: Social Impact Assessment in the mining and petroleum industries*, Brisbane, Queensland, retrieved from http://www.qrc.org.au/_dbase_upl/FINAL%20SIA%20Policy.pdf on 15/09/2011

Department of Regional Development and Lands, 2011, *Royalties for Regions*, retrieved from http://www.rdl.wa.gov.au/royalties/Pages/default.aspx on 14/08/2011

Department of Resources, Energy and Tourism, 2002 *Rum Jungle mine site – environmental rehabilitation fact sheet*, retrieved from http://www.ret.gov.au/Department/Documents/Rum%20Jungle%20factsheet.pdf on 20/01/2009

Department of Minerals and Energy Western Australia, 1996, *"Fact Sheet 12: Coal"*, published by Public Affairs Branch, Department of Minerals and Energy, Perth

Department of Minerals, Petroleum and Resources Western Australia, 2006, "*2005 Golden Gecko Awards for Environmental Excellence*", published by Department of Minerals, Petroleum And Resources, State Government of Western Australia.

Department of Minerals, New South Wales, 2004, "*Environmental Management: Cadia Hill*", www.nswmin.com.au/virtual_tours/cadia_hill/pages/rehab/rehab.html on 23/08/2006

Department of Minerals, New South Wales, 2004, "*Environmental Management: Cadia Hill*", www.nswmin.com.au/virtual_tours/option_9_7/ on 23/08/2006

Department of the Environment and Heritage, (2003), "Golden Cross Mine New Zealand: Closure and Rehabilitation", *Industry Performance*, Vol. 2003, Department of the Environment and Heritage, Canberra.

Department of Industry Tourism and Resources, 2008, *Minerals and Petroleum in the Australian Economy*, Canberra, Australia, retrieved from http://www.ret.gov.au/resources/Documents/Minerals%20and%20Petroleum%20Exploration/Guide_for_%20Investors_1MineralsandPetroleum.pdf on 01/03/2011

Department of Minerals NSW, 2004, *Cadia Hill progressive rehabilitation*, Sydney, New South Wales, retrieved from www.nswmin.com.au/virtual_tours/cadia_hill/ on 13/05/2006

Department of Mines and Petroleum, and Environmental Protection Authority, 2011, *Guidelines for Preparing Mine Closure Plans*, Perth, Western Australia, retrieved from http://www.dmp.wa.gov.au/documents/Mine_Closure(2).pdf on 29/08/2011

Department of Planning NSW, 2005, *Assessment Report – Proposed Sand Extraction – Camenzuli Property Penrith Lakes Scheme*, Sydney, NSW, retrieved from http://www.planning.nsw.gov.au/assessingdev/pdf/da4_assessment_report.pdf on 11/08/2009

Department of Primary Industries, Parks, Water and Environment, 2010, *Options to address Mount Lyell Acid Drainage Pollution*, retrieved from http://www.environment.tas.gov.au/index.aspx?base=216 on 13/09/2010 Department of Sustainability, Environment, Water, Population and Communities, 2010, *Australia State of the Environment 2001*, retrieved from http://www.environment.gov.au/soe/2001/publications/report/pubs/soe2001.pdf on 17/06/2007

Department of Primary Industries (Victoria), 2004, Guidelines for Environmental Management in Exploration and Mining: Rehabilitation Plans and other environmental aspects of work plans, Melbourne, Victoria, retrieved from http://dpi.vic.gov.au/__data/assets/pdf_file/0018/21285/3_GFEM.pdf on 17/09/2011

Department of Trade and Investment, 2011, *Guidelines to the Mining, Rehabilitation and Environmental Management Process*, Sydney, New South Wales, retrieved from http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0007/96118/EDG03-Mining,-Rehabilitation-and-Environmental-Management-Process-Guide.pdf on 03/10/2011

Department of Transport and Regional Services, (2000), "*Investing in Northern Australia – key opportunities – emerging industry sectors*", Department of Transport and Regional Services, Canberra.

DesignSigh, 2008, *Travel – Tasmania*, retrieved from http://www.designsigh.com/2008/08/tasmania/ on 15/09/2009

Dorey, R, Willow, M and Duckett, R, 1999, *Open Pit Mining and the Kennecott Ridgeway gold mine*, in Tailings and Mine Waste 1999 proceedings of the Sixth International Conference, Balkema, Rotterdam.

Dow Jones Sustainability Index in Collaboration with SAM, 2011, DJSI Key Facts, retrieved from http://www.sustainability-index.com/07_htmle/other/faq.html on 15/08/2011

Dowd, P and Slight, M, 2006, *The business case for effective closure*, in Fourie, Andy and Tibbett, Mark (Eds), Mine Closure 2006 , Proceedings of the First International Seminar on Mine Closure, UWA Press, Perth, Western Australia

Dowling Stephen, 2010, *Mineral Resources to take over mid-west vanadium* in Plain Talking, retrieved from http://stephendowling.wordpress.com/2009/11/25/mineral-resources-to-take-over-mid-west-vanadium/ on 09/09/2010

Drive WA, 2011, *Collie*, retrieved from http://www.drivewa.com/Display/poilink/id/1484/title/collie on 13/06/2011

Drucker, P, F, 1993, *Post Capitalist Society*, Butterworth-Heinemann, Oxford.

Duckett, R., Fox, F., 2007, *Kennecott receives State and National Environmental Awards*, Kennecott Minerals, retrieved from http://www.flambeaumine.com/documents/news_releases/Ridgeway_Mine.pdf on 23/10/2009

Dunlap, J., M. 2001, *"A Port of Entry: California Restaurant Industry Serves Up Opportunity for State's Workforce"*, Cal-Tax Digest, published by California Taxpayers Association, Sacramento, California.

Economics and Industry Standing Committee Western Australia, *"Inquiry into Vanadium Resources at Windimurra"*, November 2004, Government Printer, State law publisher, Perth

Editor, Sydney Morning Herald - Business, "WA government wants say in mine closures", *Sydney Morning Herald*, November 12 2004, p. 51

Editor, Environment, "Fight on bare mountain", *Environment*, Vol. **36,** Issue 1, p. 21.

Editor, Metal Bulletin "PMA sues Xstrata over Windimurra shutdown", *Metal Bulletin*, London, August 16th 2004

Editor, Engineers Australia "WA government commits to mine safety", *Engineers Australia*, January 2005, p42

Electronic Code of Federal Regulations, 2011, *Title 30 Mineral Resources*, National Archives and Records Administration, retrieved from http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=5c9c9ad6ed9152505a2a9bd3f1cdc2c4&rgn=div8&view=text&node=30:3.0.1.1.1.0.1.4&idno=30 on 29/09/2011

Environment Australia, 2002, *Overview of Best Practice Environmental Management in Mining*, Commonwealth of Australia, Canberra

Environment Centre of the Northern Territory, 2007, *Mine site Rehabilitation in the Northern Territory*, retrieved from http://www.ecnt.org/html/cur_mining_rehab.html#2 on 06/04/2007

Environmental Defenders Office, 2011, *Mining Law in NSW; Discussion Paper*, Sydney, New South Wales, retrieved from http://www.edo.org.au/edonsw/site/pdf/pubs/110628mining_law_discussion_paper.pdf on 05/10/2011

Environmental Defenders Office, 2011, *Fact Sheet – Mining*, Sydney, New South Wales, retrieved from http://www.edo.org.au/edonsw/site/factsh/fs05_1.php on 26/09/2011

EPA Tasmania, 2010, *Options to address Mt Lyell Acid Drainage Pollution*, retrieved from http://www.environment.tas.gov.au/index.aspx?base=216 on 15/09/2010

Erik, Eklund, “A rich vein in the rock”, *Workers Online*, edition 21, Vol. 2004, Melbourne, retrieved from www.workers.labor.net.au/ on 02/02/2006

Equator Principles, 2011, *Best Practices and Resources*, London, United Kingdom retrieved from http://www.equator-principles.com/index.php/best-practice-resources on 23/07/2011

ERA, 2009, *Guidelines for Preparation of an Environmental Impact Statement – Ranger Uranium Mine: Heap Leach Facility*, Energy Resources Australia, retrieved from http://www.nt.gov.au/nreta/environment/assessment/register/ranger/pdf/eis_guidelines.pdf on 10/10/2011

European Environment Commission, 2010, *Environmental Assessment: Council Directive 97/11/EC of 3rd of March 1997 amending Directive 85/337/EC on the assessment of the effects of certain public and private projects on the environment*, Official Journal No. L.073, 14/03/1997 P.005 retrieved from http://ec.europa.eu/environment/eia/full-legal-text/9711.htm on 02/10/2011

Faculty of Mining, University of New South Wales, 2006, *Cadia Hill mine site overview*, retrieved from http://www.mining.unsw.edu.au/KCMI/Mines/Mine_Cadia_01_Overview.pdf on 02/02/2007

Fair Work Australia, 2011, *Liquor and Allied Industries Catering, Cafe and Restaurant Award (1998)*, retrieved from http://www.fwa.gov.au/consolidated_awards/ap/ap787016/asframe.html on 13/02/2011

Federal Geographic Data Committee, 2009, *“Economic Justification: Measuring Return on Investment and Cost Benefit Analysis”*, Virginia, USA, retrieved from http://www.fgdc.gov/policyandplanning/newspbp/EconomicJustification_ROI-CBA-Tutorial_v2_052809_FinalVersa.pdf on 27/05/2013

Ferret – Australia’s Manufacturing, Industrial and Mining Directory, 2005, *All Profit from Mt Lyell remediation*, retrieved from http://www.ferret.com.au/n/All-profit-from-Mt-Lyell-remediation-n678991 on 23/06/2007

Financial Times, 2009, *Financial Times Market Data – Heidelberg Cement Group*, London, United Kingdom, retrieved from http://markets.ft.com/tearsheets/performance.asp?s=de:HEI on 01/02/2010

Finn Kayaks, 2009, *“Finn Kayaks Boat and Price Catalogue 2009”*, retrieved from www.finnkayaks.com/ on 15/02/2009

Fisher, Don & Young, Richard, n.d, *“Energy: Put the control in your hands”*, FisherNickel Corporation, retrieved from www.fishnick.com/education/presentations/Put_the_Control_in_Your_Hands.pdf on 04/07/2006

Fitzgerald, G, 1998, *Resource community formation and change: a case study of Ohai.* Christchurch, Taylor, Baines and Associates and Fitzgerald Applied Sociology

Flambeau Mining Company, 2009, *Flambeau Mining Company 2009 Annual Report*, retrieved from http://www.flambeaumine.com/reports/annualreport_2009/section2.pdf on 29/09/2010

Fleury, A and Parsons, A.S., 2006, “*Integrated Mine Closure Planning*, in Fourie, Andy and Tibbett, Mark (Eds), Mine Closure 2006 , Proceedings of the First International Seminar on Mine Closure, UWA Press, Perth, Western Australia

Fourie, A. and Tibbett, M., 2006, *Minimising closure costs by integrating incremental rehabilitation into mining operations*, in Strategic versus Tactical Approaches in Mining, Perth, Western Australia, March 8-10, 2006, retrieved from *http://www.strategic2011.com/__data/page/6969/4_Fourie2.pdf* on 12/06/2010

Fox, Fred, 2007, *"Kennecott Sustainable Development – A focus on the Flambeau Mine"*, Kennecott Minerals, Salt Lake City retrieved from http://www.minerals.org.au/__data/assets/pdf_file/0007/10123/Fox_Fred5A1.pdf on 12/10/2010

Fox F.D., 2003, *Mining and Sustainable Development Flambeau and Ridgeway Mines – Lessons Learned*, Kennecott Minerals Company, Salt Lake City, Utah, retrieved from http://www.riotinto.com/documents/3Kennecott_Minerals_12Sept06.pdf on 03/02/2006

Freebairn, J., "Make Labour More Attractive", *Australian Financial Review*, Tuesday August 15th, 2006, page 63.

Freedom Furniture, 2005, *"Freedom Online Catalogue"*, retrieved from www.freedom.com.au/catalogue/onlinecat.asp on 11/11/2005

Fretwell, S, 28th April, 2004, *Former Ridgeway South Carolina mine gets new life as ecological research centre*, Knight Ridder Tribune Business News, retrieved May 17th 2009, from ABI/INFORM Dateline database. (Document ID: 624832501).

Friends of the Earth, 2005, *Environmental Impact Assessment: a campaigners guide*, retrieved from http://www.foe.co.uk/resource/guides/environmental_impact_asses1.pdf on 13/03/2011

Fujiwara, Daniel and Campbell, Ross, 2011, *Valuation Techniques for Social Cost-Benefit Analysis: Stated Preference, Revealed Preference and Subjective Well-Being Approaches*, HM Treasury, Department for Work and Pensions, retrieved from http://www.hm-treasury.gov.uk/d/green_book_valuationtechniques_250711.pdf on 27/05/2013

Garcia D., 2008, *Overview of International Mine Closure Guidelines*, published for the 3rd International Professional Geology Conference, Flagstaff Arizona, September 20-24, 2008, retrieved from http://www.srk.com/files/File/papers/Mine-Closure-Guidelines.pdf on 14/05/2011

Gardner, J. and Stoneman, G., 2006, *Bauxite mining and conservation in the Jarrah forest in South West Australia*, retrieved from http://www.globalrestorationnetwork.org/uploads/files/CaseStudyAttachments/141_bauxite-mining.pdf on 24/09/2010

Garner, E.L., 2008, *The case for an international mining law*, Deakin University, School of Business and Law, Melbourne, retrieved from http://www.ap.urscorp.com/_pdf/Papers/The%20Case%20for%20an%20International%20Mining%20Law.pdf on 23/06/2010

Garner, E, 2004, "International Treaties Governing Mineral Exploration", *Environmental and Engineering Geology, Vol. III*

Geology.com, 2010, *Mineral Rights: Basic information about mineral, surface, oil and gas rights*, retrieved from http://geology.com/articles/mineral-rights.shtml on 14/06/2011

George, A. L., 1979, “Case studies and theory development: The method of structured, focused comparison, in P. G. Lauren (Ed.), *Diplomacy: New Approaches in history, theory and policy*, pp. 43-68, New York, USA

Geoscience Australia, 2007, *Australia’s Identified Mineral Resources 2007*, Canberra, Australia, retrieved from https://www.ga.gov.au/image_cache/GA11251.pdf on 16/04/2009

Gehrisch, M., 2005, *“2005 Forecast for CVB & Destination Decision Making”*, International Association of Convention and Visitor Bureaus (IACVB), Washington, DC.

Gold Coast Sea-Doo, 2009, *“Recreational Craft Catalogue”*, retrieved from www.goldcoastseadoo.com.au/seadoo-recreationalcraft.htm on 05/01/2009

Google Maps, 2010, *Google Maps, Queenstown Tasmania*, retrieved from http://maps.google.com.au/maps?rlz=1T4ADFA_enAU389AU390&q=queenstown+tasmania&um=1&ie=UTF-8&hq=&hnear=Queenstown+TAS&gl=au&ei=Kgm8TPecEI-avAO3sLDqDQ&sa=X&oi=geocode_result&ct=image&resnum=1&ved=0CCQQ8gEwAA on 18/10/2010

Government of South Australia, 2011, *Mining Act 1971*, South Australian Government, Adelaide, South Australia, retrieved from http://outernode.pir.sa.gov.au/__data/assets/pdf_file/0005/156092/Mining_Act_1971_July2011.pdf on 06/10/2011

Griffin Coal, 2005, *“Operations: Mining”*, retrieved from www.griffincoal.com.au/Mining.html on 15/12/2005

Griffin, S., 2005, “Unhidden Costs”, *Boating Life*, retrieved from http://www.boatinglife.com/article_content.jsp?ID=37299&typeID=135&categoryID=157 on 15/11/2006

Haezendonck, Elvira, Ed., 2007, *Transport Project Evaluation, Extending the Social Cost Benefit Approach*, Edward Elgar Publishing Ltd, Cheltenham, UK

Hales, J., A., 2005, *“Accounting and Financial Analysis in the Hospitality Industry”*, Butterworth-Heinemann Hospitality Management Series, Boston

Hales, J., A, 2005, *“Accounting and Financial Analysis in the Hospitality Industry”*, Butterworth-Heinemann Hospitality Management Series, Boston

Harle, K, et.al, “Mud, Mines and Rainforest: a short history of human impact in Western Tasmania, using pollen, trace metals and lead – 210”, *Australian Journal of Botany*, Volume **50,** pp. 481-197.

Harvard Law School, 2010, *First Nations’ Rights Need More Protection From Mining Activities*, retrieved from

http://www.law.harvard.edu/programs/hrp/news/First_Nations.html on 03/04/2011

Heidelberg Cement Group, 2009, *Heidelberg Cement Group Annual Report 08/09*, retrieved from http://www.heidelbergcement.com/NR/rdonlyres/7C9B6F38-3AC4-46C0-BA2C-4F84A7452FBB/0/GB_2008_en_print.pdf on 01/02/2010

Heidelberg Cement, 2011, *Annual Report 2011, Securing success*, retrieved from http://www.heidelbergcement.com/NR/rdonlyres/0639C65D-9BE2-4DC6-9D01-EF6398E1141D/0/GB_2011_E_WebLinks.pdf on 03/03/2012

Hobie West, 2009, *“For Sale – Boats”*, retrieved from http://www.hobiewest.com.au/forsale.html on 28/10/2009

Hogan, Lindsay and Berry, Peter, 2000, "Mining and Regional Australia, some implications of long distance commuting", *Australian Commodities*, vol.7, no. 4, December, 2000

Holcim Ltd, 2011, *Annual Report, Annual Report Holcim Ltd 2011*, retrieved from http://www.holcim.com/uploads/CORP/GB_2011_E_korr.pdf on 03/03/2012

Hill Cross Furniture, 2009, "*Online Furniture Catalogue"*, retrieved from www.hillcrossfurniture.co.uk./prodpage.asp?ProdID=689 on 12/12/2009

Hinde, S., 2004, "River of Poison", Independent *Media Collective*, April 11, 2004, *Darwin*, pp. p. 1.

Hinde, S., 2004, "Mine may cost $20 m", *Sunday Territorian*, 11 July 2004 Darwin, pp. 1.

Humphreys, D, 2000, 'A Business Perspective on Community Relations in Mining, *Resources Policy*, vol. 263, pp. 127-131

Huxtable, C., H, A., 1997, *"Project C3054: Rehabilitation of open cut coalmines using native grasses"*, Australian Coal Research Limited, Canberra, pp. pp. 1-4, www.acarp.com.au/Completed/Open_Cut/briefs/oc/3054breif.html on 15/07/2006

IEN Europe, 2010, *Mineral Rights Ownership –what is it and why is it so unique in the USA?* Retrieved from http://www.ieneurope.com/pdf/Mineral.pdf on 03/04/2011

IIED and WBSCD, 2002, *Breaking New Ground: The MMSD Final Report*, International Institute for Environment and Development and the World Business Council for Sustainable Development, Earthscan publications, London

IKEA Australia West, 2009, "*IKEA Online Catalogue"*, retrieved from http://cebas.ikea.com.au/prod_template3.asp?page=1&Cat=9$scat=38$se_id=37$page_id=11946300251009 on 21/11/2009

Independent Evaluation Group World Bank, 2011, *Cost-Benefit Analysis in World Bank Projects*, Washington DC, retrieved from http://web.worldbank.org/external/default/main?noSURL=Y&theSitePK=1324361&piPK=64252979&pagePK=64253958&contentMDK=22703501 on 30/05/2012

Indigenous Studies Program, 2003, "*Agreements, Treaties and Negotiated Settlements*", University of Melbourne, www.atns.net.au/biogs/A0001036.htm on 22/08/2006

International Atomic Energy Agency, 2008, *Canadian Uranium Production, From start to finish: The beginning; the 50's to the 70's; the 80's to present*, International Atomic Energy Agency, Vienna, Austria, retrieved from http://www.iaea.org/OurWork/ST/NE/NEFW/documents/RawMaterials/TM%20JOR/31%20talk3-U%20production.pdf on 01/12/2010

International Atomic Energy Agency, 2002, *Environmental Remediation of Uranium Production Facilities*, International Atomic Energy Agency, Vienna, Austria, retrieved from http://books.google.com.au/books?id=XkcPQMd48E0C&pg=PA153&lpg=PA153&dq=elliot+lake+mine+closure+legislation&source=bl&ots=1wKphU-rmr&sig=0jCiRmDxod4tnxmDvMvD0xlUaSI&hl=en&ei=cZlHTZKMOYTmvQO7zOiiBQ&sa=X&oi=book_result&ct=result&resnum=3&ved=0CCEQ6AEwAjge#v=onepage&q&f=false on 03/02/2010

International Council on Mining and Metals (ICMM), 2008, *Planning for Integrated Mine Closure Toolkit*, London, retrieved from http://www.icmm.com/page/9568 on 13/10/2009

International Council on Mining and Metals (ICMM), 2003, *ICMM SD Framework*, retrieved from http://www.icmm.com/icmm_principles.php on 18/05/2005

International Human Rights Clinic, 2010, *Bearing the Burden: The Effects of Mining on First Nations in British Columbia, October, 2010*, Harvard Law School, Cambridge, Massachusetts

Interstate Mining Compact Commission, 2010, *Interstate Mining Compact Commission Annual Reclamation Awards Program*, Interstate Mining Compact Commission, Herndon, Virginia, retrieved from http://www.imcc.isa.us/Photos/Photos.htm on 06/12/2010

Ivanova. Galina, Rolfe, John, Lockie, Stewart, Timmer, Vanessa, 2007, *Assessing social and economic impacts associated with changes in the coal mining industry in the Bowen Basin, Queensland, Australia*, Centre for Social Science Research, Central Queensland University, Rockhampton, Australia, retrieved from http://www.bowenbasin.cqu.edu.au/Ivanova%20et%20al%20Mining%20impacts.pdf 27/05/2013

Jackson, L.J, 1991, *Surface Coal Mines: Restoration and Rehabilitation*, IEA Coal Research, London

Jackson, R.T, 2000, "Mine Closure: An Introduction", in *Mine Closure and Sustainable Development: Results of the Workshop organised by the World Bank Group and Metal Mining Agency of Japan*, Mining Books Ltd, London

Johnstone, R. and Sarre, R., 2004, Regulatory Conflict and Regulatory Compliance: The problems and possibilities in generic models of compliance, retrieved from

http://www.aic.gov.au/documents/B/A/0/%7BBA0FC2D0-B43E-4CB6-A5AD-95ACE70542AA%7DRPP57.pdf on 17/07/2008

Johnson, S.L. and Wright, A.H., 2003, *Mine Void Water Resource Issues in Western Australia*, Water and Rivers Commission, Resource Science Division, Perth, Western Australia

Jones, C. P, Shamsuddin, A., Naumann, K.,, 2007, *Investments Analysis and Management*, John Wiley and Sons Brisbane, Australia.

Jones, D, 1997, Water quality and quantity in final voids, The Australian Coal Review, CSIRO, Division of Coal and Energy Technology

Jones, H, 2006, *The Surety Conundrum*, in Fourie, Andy and Tibbett, Mark (Eds), Mine Closure 2006 , Proceedings of the First International Seminar on Mine Closure, UWA Press, Perth, Western Australia

Joyce, S., A., 2009, Social Impact Assessment in the Mining Industry: Current Situation and Future Directions**,** Warwick Business School, West Midlands, United Kingdom

Katherine Town Council, 2010, *Weather/Climate*, retrieved from http://www.ktc.nt.gov.au/About-Katherine/Weather-Climate on 15/08/2010.

Kennecott Minerals Company, 2003, "*Ridgeway Mine Reclamation Site*", www.kennecottminerals.com/public/report/ridgeway.htm#top on 13/10/2010

Kennecott Minerals Company, 2005, *"Annual Report 2005, Flambeau Mine"*, retrieved from http://www.flambeaumine.com/reports/annualreport_2005/annualreport_2005.html on 13/10/2010

Kennecott Minerals Company, 2003, *2003 SME Annual Meeting Cincinnati, Ohio, February 24-26, 2003*, retrieved from http://www.mining.ubc.ca/mlc/presentations_pub/sme/Fox.pdf on 13/12/2010

Kenny, S, 1999, *Developing communities for the future: community development in Australia*, Nelson ITP, Southbank, Victoria

Kesler, S.E., 1994, *Mineral Resources, Economics and the Environment*, Macmillan, New York

Khanna, T, 2000, *Mine closure and sustainable development: results of the workshop organised by the World Bank Group, Mining Department and MMAJ, Metal Mining Agency of Japan,* World Bank, Washington, D.C.

Koehnken, L, 1997, *Final Report Mount Lyell Remediation Research and Demonstration Project*, Department of Sustainability, Environment, Water, Population, and Communities, Canberra, ACT.

Lacy, H., 2000, *Planning the process of closure "close as you go"*, proceedings from the 'Planning for mine closure – an operator's guide, Australian Centre for Geomechanics seminar No. 2009, Perth, Western Australia

Laurence, D.C., 2002, *Optimising mine closure outcomes for the community* – Lessons Learnt Minerals and Energy, Raw Materials Group, vol. 17 No 1, pp27-34 http://www2.mining.unsw.edu.au/Publications/publications_staff/Paper_Laurence_RMG.pdf on 17/09/2006

Laurence, D.C 2006, *Why do mines close?*, in Fourie, Andy and Tibbett, Mark (Eds), Mine Closure 2006 , Proceedings of the First International Seminar on Mine Closure, UWA Press, Perth, Western Australia

Lawson, R., May 02, 2011, *LD Operations concerned over EPA's Margaret River coal project review,* The Sunday Times, retrieved from http://www.perthnow.com.au/business/business-old/ld-operations-concern-over-epas-margaret-river-coal-project-review/story-e6frg2qu-1226048643751 on 26/09/2011

Legal Services Commission of South Australia, 2011, *Environmental Impact Assessment,* Adelaide, South Australia, retrieved from http://www.lawhandbook.sa.gov.au/ch18s06s01.php on 03/10/2011

Local Agreement, August 1988, *Local Agreement between Rusk County, The Town of Grant, The City of Ladysmith, and Kennecott Explorations (Australia) Ltd. For development of the Flambeau Mine.*

Logie, M. and Raynes, J., 2008, *Environmental and Social Impact Assessment: Kalukundi Copper/Cobalt Mining Project, Democratic Republic of Congo,* Africo Resources, retrieved from http://www.africoresources.com/r/files/ESIA_Nov_08.pdf on 13/03/2010

Lund, M, 2001, "Controlling acidity in flooded Collie (WA) coal voids – Is it necessary and how can it be achieved?", *AMEEF Groundwork,* 2004, pp. 7-9.

Main Roads Western Australia, 2005, *"Touring WA, Distance from Perth",* retrieved from http://www.mainrods.wa.gov.au/Internet/Regions/touring_wa/distance_perth.asp on 21/11/2005

Main Roads Western Australia, 2010, *Using Roads – Distance from Perth,* retrieved from http://www.mainroads.wa.gov.au/USINGROADS/TOURINGWAMAPS/Pages/distance_perth.aspx#m on 08/02/2010

Mallet, C. W., and Mark, M. R., 1995, *Review of the management and impact of mining voids,* Minerals Council of Australia, 20th Annual Environmental Workshop, 260-275pp

Marcus, Jerrold J., 1997, *Mining Environmental Handbook: Effects of Mining on the Environment and American Environmental Controls on Mining.* London: Imperial College Press

Martin, E & Polivka, A, E, 1995, Diagnostics for redesigning questionnaires, *Public Opinion Quarterly*, 59 (4), 547-567

Martin, R., 1997, *Internal Rate of Return Revisited*, Financial Economic Network, retrieved from http://members.tripod.com/~Ray_Martin/DCF/nr7aa003.html on 28/08/2010

Maxwell and Williams Designer Homewares, 2009, *"Online Product Catalogue"*, Retrieved from www.maxwellwilliams.com.au/itemWithSide.asp?file=CU2499958 on 20/11/2009

Merton, R.K., Fiske, M and Kendall, P.L., 1990, *The focussed interview: A manual of problems and procedures,* (2nd, ed.), Free Press, New York.

McQueen, P., Somerford, R., 2011, *New Mine Closure Plan Guidelines – Effective 1 July, 2011*, Environmental Law E-Newsletter, retrieved from http://www.lavanlegal.com.au/images/galleries/New_mine_closure_plan_guidelines_effective_1_July_2011.pdf on 04/10/2011

Metal Bulletin, 16/08/2004, *PMA sues Xstrata over Windimurra shutdown*, retrieved from http://www.metalbulletin.com/Article/1506432/PMA-sues-Xstrata-over-Windimurra-shutdown.html on 14/06/2006

Miller, C.G., 1998, *Use of financial surety for environmental purposes*, retrieved from http://www.icmm.com/library_pub_detail.php?red=100. On 20/06/2007

Mineral Information Institute 2004, *"Mine Reclamation Metals – Flambeau Mine"*, *www.mii.org/Flambeau/flam.html* on 20/03/2005

Mineral Information Institute 2004, *"Mine Reclamation Metals – Ridgeway Mine"*, www.mii.org/Ridgeway/ridgeway.html on 20/03/2005

Minerals Council of Australia, 2011, *Annual Report, 2010*, Melbourne Australia, retrieved from http://www.minerals.org.au/file_upload/files/reports/AR_2010-Final-30-05-2011.pdf on 13/11/2011

Minerals Council of New Zealand 2002, *"Green from Gold: The rehabilitation of Golden Cross"*, www.minerals.co.nz/html/green_from_gold/gx.html on 10/02/2006

Minerals UK Centre for Sustainable Minerals Development, 2011, *Legislation and Policy: Mineral Ownership*, retrieved from http://www.bgs.ac.uk/mineralsuk/planning/legislation/mineralOwnership.html on 03/04/2011

Minerals UK Centre for Sustainable Minerals Development, 2011, *United Kingdom Minerals Statistics*, retrieved from http://www.bgs.ac.uk/mineralsuk/statistics/UKStatistics.html on 03/04/2011

Mining Australia, 27th November 2001, "Mount Todd legal actions settled", In *Mining Australia*, 2004, Sydney, retrieved from http://www.ferret.com.au/n/Mount-Todd-legal-actions-settled-n730717 on 08/07/2006

Mining, Minerals and Sustainable Development, 2002, *Research on Mine Closure Policy,* World Business Council for Sustainable Development, International Institute for Environment and Development, United Kingdom, retrieved from http://pubs.iied.org/pdfs/G00541.pdf on 14/07/2003

Mining Journal Online, 20th August 2010, *Vista's Mount Todd plan forecasts revival*, retrieved from http://www.mining-journal.com/mining-journal-issues/200810 on 23/08/2010

Molefe, N. Molapo, M.P. Chunderdoojh, B.P., 2006, *Socio-economically sustainable communities post mine closure - A case study of the South African coal mining industry*, in Fourie, Andy and Tibbett, Mark (Eds), Mine Closure 2006 , Proceedings of the First International Seminar on Mine Closure, UWA Press, Perth, Western Australia

Morrey, D.R, 1999, Principles of economic mine closure, reclamation and cost management, in *Remediation and Management of Degraded Lands*, M.H. Wong et.al (eds.), Lewis, New York.

Morris, T and Wood, S, 1991, Testing the survey method: continuity and change in industrial relations, *Work Employment and Society*, 5(2): 259-282

Mulligan, D. (ed.), 1999, *Environmental Management in the Australian Metals and Minerals Industry – Principles and Practices*, University of New South Wales Press, Sydney, New South Wales

Mugonda, M, 2006, *The Socio-economic implications of mine closure – A South African and Zimbabwean Scenario*, in Fourie, Andy and Tibbett, Mark (Eds), Mine Closure 2006 , Proceedings of the First International Seminar on Mine Closure, UWA Press, Perth, Western Australia

National Indigenous Working Group, 1999, "*Joint Venture Gold Mine*", Canberra, www.faira.org.au/niwg/fact_sheets_fs6.html on 14/05/2004

National Insurance Brokers Association, July 26 2009, *"Commercial Rates Drop Again"*, retrieved from http://www.niba.com.au/niba/resource/MR%20rates%20260706.pdf on 16/08/2009

National Orphaned/Abandoned Mines Initiative, 2001, *Action Plan 2000: Status Reports*, retrieved from http://www.abandoned-mines.org/pdfs/ConfReportsPlans/NOAMIstatreport2000-e.pdf on 16/08/2007

Natural Resources Review Supplement, "Premier Success", *Southwest Times*, Thursday, December 10, 2004, p. 10.Newcrest Mining Limited, 2004, *Newcrest Operations Overview*, Melbourne, Australia, retrieved from www.newcrest.com.au/operations.asp on 16/01/2005

Newcrest Mining Limited, 2009, *Cadia Valley Operations – Land Management Plan*, Melbourne, Australia, retrieved from http://www.newcrest.com.au/pdf/PLA_Land_Management_Plan_WEB_VERSION_20090217_AMcKenzie.pdf on 07/05/2010

Newcrest Mining Limited, 2009, *Newcrest Company Profile*, retrieved from http://www.newcrest.com.au//profile.asp on 29/04/2009

Newcrest Mining Limited, 2010, *Newcrest Annual Report*, Melbourne, Australia, retrieved from http://newcrest.ice4.interactiveinvestor.com.au/Newcrest0801/Concise%20Annual%20Report%202008/EN/body.aspx?z=1&p=2&v=2&uid on 22/10/2010

Newcrest Mining Ltd, 2011, *Financial Results*, *Newcrest Mining Ltd*, retrieved from http://www.newcrest.com.au/upload/872_2x10x2012102801AM.pdf on 04/03/2012

Newcrest Mining, 2004, "*Operations Overview: Cadia Hill*", Newcrest Ltd, Melbourne, retrieved from www.newcrest.com.au/operations.asp? On 12/11/2006

News.Com.Au, 2011, *170,000 workers for mining: 170,000 workers for rest of Australia*, News Limited, Sydney, retrieved from http://www.news.com.au/business/workers-for-mining-170000-workers-for-rest-of-australia/story-e6frfm1i-1226151720887 on 13/10/2011

New South Wales Department of Planning, 2010, *Coal and Gas Strategy*, Sydney, NSW, retrieved from http://www.planning.nsw.gov.au/LinkClick.aspx?fileticket=uJ9xSm7xMm4%3D&tabid=497&language=en-AU on 05/10/2011

New South Wales Division of Local Government, 2011, *Local Government Directory – Local Government,* New South Wales Government, Department of Premier and Cabinet, retrieved from http://www.dlg.nsw.gov.au/dlg/dlghome/dlg_LocalGovDirectory.asp?index=1&CN=A#66 on 23/10/2011

New South Wales Heritage Office, 2004, "Cemetery reveals past links", *Historical Archaeology*, retrieved from www.heritage.nsw.gov.au/heritagensw/win00/11_art.htm, on 16/12/2004

New South Wales Minerals Council, 2011, *Planning Assessment and Approvals Process*, Sydney, New South Wales, retrieved from http://www.nswmin.com.au/Policy-and-Advocacy/Planning-and-Mine-Closure/Planning-Assessment-and-Approvals-Processes/Planning-Assessment-and-Approvals-Processess/default.aspx on 23/09/2011

New South Wales Minerals Council, 2011, Reducing our footprint – rehabilitation of mined land, New South Wales Minerals Council, Sydney, New South Wales, retrieved from http://www.nswmin.com.au/Mining-in-NSW/Reducing-Our-Footprint/Rehabilitation-of-Mined-Land/default.aspx on 22/05/2011

New Zealand Minerals Industry Association, 2004, "*Resources Management Act*", Wellington, www.minerals.co.nz/html/main_topics/site_map.html on 23/05/2005

Northern Territory Department of Minerals and Energy, n.d, *Mount Todd information sheet*, retrieved from http://www.nt.gov.au/d/Minerals_Energy/Content/File/Media/MINISTERMTTODDINFOSHEET.pdf on 23/07/2010.

Northern Territory Department of Resources – Minerals and Energy, 2011, *Minerals Titles Act (Documentation),* Darwin, Northern Territory, retrieved from http://www.nt.gov.au/d/Minerals_Energy/index.cfm?header=Mineral%20Titles%20Act%20Documentation%20(for%20viewing%20only) on 02/10/2011

Northwest Regional Planning Commission, April 2005, *Socioeconomic Study*, retrieved from http://www.flambeaumine.com/reports/socioeconomic/socioecon.html on 12/05/2008

Novick, David, October, 1973, Cost-Benefit Analysis and Social Responsibility, *Business Horizons, October, 1973,* Kelley Business School, Indiana University, USA

O'Brien, M., 2008, *Exxon and the Crandon Mine Controversy. The people vs. Giant Companies. A true story of people winning,* Badger Books LLC, Middleton, Wisconsin, USA

OECD, 2004, *Principles of Corporate Governance*, OECD, Paris, retrieved from http://www.oecd.org/dataoecd/32/18/31557724.pdf on 20/06/2011

Office of Surface Mining Reclamation and Enforcement (OSMRE), 2010, *Surface Mining Law*, Washington, United States, retrieved from http://www.osmre.gov/topic/SMCRA/SMCRA.shtm on 03/10/2011

Onishi, N., February 12, 2011, *Rich in land, Aborigines split on how to use it,* New York Times, New York, USA, retrieved from http://www.nytimes.com/2011/02/13/world/asia/13australia.html?pagewanted=all on 28/09/2011

Ontario Environmental Registry, 2011, http://www.ebr.gov.on.ca/ERS-WEB-External/content/about.jsp?f0=aboutTheRegistry.info&menuIndex=0_1 on 17/11/2011

Ontario Government 2004, *"Mines and Minerals Division – Examples of Rehabilitated Sites: Elliot Lake"*, www.mndm.gov.au.ca/mndm/mines/mg/rehab/rehabexmp_e.asp on 26/04/2006

Ontario Mining Act, 1990, Ontario Regulation 240/00 Mine Development and Closure Under Part VII of the Act, retrieved from http://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_000240_e.htm on 23/09/2011

Orange City Council, 2009, *Orange City Community Profile*, Orange, New South Wales, retrieved from http://www.id.com.au/profile/default.aspx?id=262 on 28/03/2010

Orange City Council, 2004, "*Orange Profile*", retrieved from www.orange.nsw.gov.au/index.cfm on 13/05/2005

Paczkowska and Chapman, 2000, The Western Australian Flora: A descriptive catalogue, the Wildflower Society of Western Australia, Nedlands, Western Australia.

Padgett, Deborah, K, 2008, *Qualitative Methods in Social Work Research*, Sage Publications, Thousand Oaks, USA

Patton, M, Q, 1987, *"How to use qualitative methods in evaluation"*, Sage, Newbury Park, California.

Payne, R. , 2000, *"Elliot Lake: A case study in mine closure"*, Mining Journal Books, London.

Peck, J. 2005, *Economic sociologies in space*, Economic Geography 81:129–78.

Penrith City Council, 2010, *Penrith Local Area Profile – January 2010*, Penrith City Council, retrieved from http://www.penrithcity.nsw.gov.au/uploadedFiles/Website/Planning_&_Development/Planning_Studies_&_Strategies/PenrithLocalAreaProfile.pdf on 20/04/2011

Penrith City Council, 2009, *Penrith City Profile*, retrieved from http://www.id.com.au/profile/default.aspx?id=247 on 02/03/2009

Penrith Lakes Development Corporation, 2004, *Penrith Lakes Development Corporation – About Us*, retrieved from http://www.penrithlakes.com.au/mainsite/site/html/about_us.htm on 11/05/2006

Penrith Lakes Development Corporation, 2009, *Penrith Lakes Community Advisory Committee*, Penrith, New South Wales, retrieved from http://www.penrithlakes.com.au/mainsite/site/html/community_advisory_committee.htm on 13/07/2010

Penrith Lakes Development Corporation, (2000), "Penrith Lakes Environmental Education Centre, Sydney, www.penrithlakes.com.au/fact-education.htm on 20/03/2004

Penrith Lakes Development Corporation, (2000), "The Penrith Lakes Scheme", Sydney, www.penrithlakes.com.au/fact-general.htm on 20/03/2004 retrieved 20/05/2005

Perkins, R.W. and Morgan, G.E., 1993, "Infrastructure and the community in the Australian mining and metallurgical industry", in J.T. Woodcock and J.K. Hamilton (eds), *Australian Mining and Metallurgy*, vol.1, second edition, Monograph No.19, Australian Institute of Mining and Metallurgy, Parkville, Victoria

Phaceas, J. , 2004, "Law urged to tackle closures", *The West Australian Newspaper*, 23 September 2004, p. 25

Phaceas J., 2004, “State knocks back Windimurra rescue, *“The West Australian Newspaper”*, May 12, 2004, p. 28Phaceas, John, “Xstrata quits vanadium project”, *The West Australian Newspaper*, May 11, 2004, p. 21

Pierce, G.L., Wen, M.E., 2006, *Planning for In-Perpetuity Mine Closure Costs*, in Fourie, Andy and Tibbett, Mark (Eds), Mine Closure 2006 , Proceedings of the First International Seminar on Mine Closure, UWA Press, Perth, Western Australia

Premier Coal, 2008, *Lake Kepwari Rehabilitation*, retrieved from http://www1.premiercoal.com.au/pdf/pdf%20REHABILITATION.pdf on 23/08/2009

Premier Coal, 2005, *“Mine Rehabilitation – Collie”*, www1.premiercoal.com.au/environ_mine.asp#5th on 15/12/2005

Premier Coal, 2005, *“About Us: History of Premier Coal”*, retrieved from http://www1.premiercoal.com.au/about_history.asp on 15/12/2005

Premier Coal, 2005, *“Mine Operation: Mining History”*, retrieved from http://www1.premiercoal.com.au/mine_history.asp on 15/12/2005

Primary Industries and Resources SA, 2011, *Guidelines: Landowner rights and access arrangements in relation to mineral exploration and mining in South Australia*, Adelaide, South Australia, retrieved from https://sarigbasis.pir.sa.gov.au/WebtopEw/ws/samref/sarig1/image/DDD/MRGMG4.pdf;jsessionid=26AF8D32D9B1F14B5C70B2632FC2CF97 on 28/09/2011

Primary Industries and Resources SA, 2009, *Guidelines for Miners: Mining Approval Process in South Australia*, Adelaide, South Australia, retrieved from http://www.pir.sa.gov.au/__data/assets/pdf_file/0011/94952/mg01_mining_approvals_v1.9.pdf on 13/09/2011

Primary Industries and Resources SA, 2011, *Programs for Environmental Protection and Rehabilitation*, Adelaide, South Australia, retrieved from http://outernode.pir.sa.gov.au/minerals/licensing_and_regulation/mining_operations/mining_and_rehabilitation_programs_marps on 02/10/2011

Proactive Investors, 13/08/2010, *Atlantic to acquire ownership of Windimurra vanadium project*, retrieved from http://www.proactiveinvestors.com.au/companies/news/9336/atlantic-to-acquire-ownership-of-windimurra-vanadium-project-9336.html on 24/08/2010

PR Newswire, August 18, 2010, *Vista Gold Corp. Announces estimated mineral reserves of two million ounces and results of a preliminary feasibility study at its Mt Todd Gold Project, Northern Territory, Australia*, retrieved from http://au.sys-con.com/node/1504361 on 29/08/2010.

PR Newswire Association LLC, 2005, *South Carolina Company Wins Hardrock Mineral Environmental Award*, retrieved from http://www.naturalsciencesacademy.org/textfiles/cer-news%20release%209-26-05.htm on 12/08/2007

QCC Hospitality Solutions Western Australia, 2009, *“Catalogue”*, retrieved from www.qccwa.com.au on 22/11/2009

Queensland Resources Councils, 2001, *Guidelines for Mine Closure Planning in Queensland*, Queensland Resources Council ,Brisbane, Queensland

Queensland Government, 2011, *Environmental Protection Act 1994*, Brisbane, Queensland, retrieved from http://www.legislation.qld.gov.au/legisltn/current/e/envprota94.pdf on 29/09/2011

Queensland Holidays, 2009, *"Fraser Coast South Burnett: Torquay Beach and Jet Ski Hire"*, retrieved from *www.queenslandholidays.com.au/fraser_coast/torquay-beach-and-jet-ski-hire/facilities.cfm* on 21/02/2009

Queensland Mining Council, 2001, *Guidelines for mine closure planning in Queensland*, Brisbane, Queensland, retrieved from http://www.qrc.org.au/_dbase_upl/closure.pdf on 10/10/2011

Quinn, J. B., Mintzberg, H, J. R.M (Eds>), 1988, *The Strategy Process; Concepts, Contexts and Cases*, Prentice-Hall, Englewood Cliffs.

Remenyi, D., Williams, B., and Swartz, E., 1998, *Doing Research in Business and Management: An Introduction to Process and Method*, Sage, London

Reserve Bank of Australia, July 2003, *"Second Statement on the Conduct of Monetary Policy: The Treasurer and Governor of the Reserve Bank"*, retrieved from http://www.rba.gov.au/MonetaryPolicy/second_statement_on_the_conduct_of_monetary_policy_2003.htm on 08/01/2006

Retravision Australia, 2009, "*Online Product Catalogue*", retrieved from www.retravision.com.au/apps/shop/productBrowse.asp?category=1347 on 1/11/2009

Reuters, 2006, "Xstrata Plc – Preliminary Results Part 4", *Reuters Investments Ltd*, March 2nd 2005, www.investing.reuters.co.uk/stocks/QuoteCompanyNewsArticle.aspx?view on 22/03/2006

Richards R. J, Applegate R.J, Ritchie A.I.M, 1996, *The Rum Jungle Rehabilitation Project*, In: Ed. D.R. Mulligan, Environmental Management in the Australian Minerals and Energy Industry – Principles and Practice, UNSW Press and Australian Minerals and Energy Environment Foundation, p. 550-553

Rio Tinto, 2009, *2009 Annual Report*, retrieved from http://www.riotinto.com/annualreport2009/index.html on 15/12/2010

Rio Tinto, 2010, *Chartbook for Investors and Shareholders 2010*, Rio Tinto plc, retrieved from http://www.riotinto.com/documents/investors_databook/Chartbook.pdf on 22/10/2010

Rio Tinto, 2010, *Rio Tinto – Our Approach – Closure*, retrieved from http://www.riotinto.com/ourapproach/17203_closure.asp on 22/12/2010

Rio Tinto, 2006, *Rio Tinto in North America*, retrieved from http://www.riotinto.com/documents/ReportsPublications/north-America-uk.pdf on 02/02/2007

Rio Tinto, 2003, Sustainable Development Policy, www.riotinto.com/community/sustainableDev.aspx on 17/07/2006

Rodgerson, Michael, 2006, *Mine rehabilitation a Queensland perspective*, Fitzroy Basin Association CQ Mining Forum, retrieved from http://www.fba.org.au/news/downloads/CQMiningForum_Michael-Rodgerson.pdf on 10/10/2011

Rotherham Metropolitan Borough Council, 2004, *"Rother Valley Country Park"*, retrieved from www.rothervalleycountrypark.co.uk on 06/06/2005

RPS the board Store, 2009, *"Online Catalogue – Starboard Windsurfers"*, retrieved from www.rpstheboardstore.com/windsurfing.htm on 21/11/2009

Rusk County Wisconsin, 2010, *County Location*, retrieved from http://www.ruskcounty.org/location.asp on 23/10/2010

Ryan, Sarah, 2003, "Gold Footprints", *CSIRO Sustainability Network*, March 2003, CSIRO Waite Laboratories, South Australia, pp. 1-9

Saeedi, G, et.al, 2006, *The economic and social aspects of mine closure at the s of Kerman in Iran*, in Fourie, Andy and Tibbett, Mark (Eds), Mine Closure 2006 , Proceedings of the First International Seminar on Mine Closure, UWA Press, Perth, Western Australia

Sammons, Pam, Day, Christopher and Gu, Qing, 2008, 'Combining Qualitative and Quantitative Methodologies in Research on Teachers Lives, Work and Effectiveness: From Integration to Synergy', *Educational Researcher, Vol. 37, Issue 6, 2008*, pp. 330-342

Sassoon, M, 1996, *Closure or Abandonment*, Mining Magazine, August, 1996

Saunders, M. N.K, Thornhill, A. Philip, L., 2009, *Research Methods for Business Students*, Financial Times Prentice Hall, Melbourne

Saunders, M., Lewis, P and Thornhill, A., 2007, *Research Methods for Business Students (4th edn.)*, Harlow: FT Prentice Hall

Sayer, L., 2004, "Tassie mine of knowledge", *Sunday Tasmanian*, August 15, 2004, Hobart

Sea and Ski Wilderness, 2009, *"Waterskiing Catalogue Prices"*, retrieved from www.wilderness.au.com/waterskiing.html\ on 16/02/2009

Sea World Nara Resort Watersports, 2009, *"Jet Ski Hire and Costs"*, retrieved from www.goldcoastwatersports.com on 27/01/2009

Seidman, J, 2006, *Interviewing as qualitative research*, New York, Teachers College Press.

Senate Committee, 2002, *"Rum Jungle Report"*, Parliament of Australia, Canberra, www.aph.gov.au/senate/committee/uranium_cttee/report/c02-4.htm on 03/02/2006

Senate Committee, 2003, *"Appraisal of Environmental Performance at Ranger and the Olympic Dam Operation"*, Parliament of Australia, Canberra, pp. pp. 1-12, www.aph.gov.au/senate/committee/uranium_cttee/report/c02-4.htm on 03/02/2006

Sharma, V., 2005, *"New Zealand HRI Food Service Sector Annual 2005"*, GAIN Report, United States Department of Agriculture Foreign Agricultural Service, Wellington, New Zealand.

Sharma, V., 2006, *Benefit-Cost Analysis*, University of Colorado, Boulder, Colorado, United States.

Shell Australia, 2009, *"Western Australia Price Search - Collie"*, retrieved from www.shell.com.au/petrolpricing_scuba/suburb.asp?state=WA on 21/02/2009

Shire of Collie, 2006, *"Discover the Collie River Valley"*, Shire of Collie Publications, Collie, Western Australia

Shire of Mount Magnet, 2010, *Community – Snapshot*, retrieved from http://www.mtmagnet.wa.gov.au/default.asp?documentid=117 on 01/10/2010

Short, D, 2011, Manager Health, Safety and Environment, Wesfarmers Premier Coal, *Personal Communication*

Sirolli, E, 1995, *Ripples in the Zambezi*, Institute for Science and Technology Policy, Murdoch University, Western Australia. Skagen Susan K, Hazlewood Robert, Scott Michael L, 2005, *The Importance and Future of Condition of Western Riparian Ecosystems as Migratory Bird Habitat*, United States Department of Agriculture Forest Service Technical Report, retrieved from http://www.fs.fed.us/psw/publications/documents/psw_gtr191/psw_gtr191_0525-0527_skagen.pdf on 13/10/2010

South Australia Chamber of Mines and Energy, 2009, *South Australian Resources Industry Code of Practice for stakeholder and community engagement*, Adelaide, South Australia, retrieved from http://www.sacome.org.au/images/stories/Code_of_Practice_guidelines.pdf on 13/09/2011

South Carolina State Climatology Office, 2010, *South Carolina Climate*, retrieved from http://www.dnr.sc.gov/climate/sco/ClimateData/cli_sc_climate.php on 15/10/2010

South Carolina's Information Highway, 2010, *Overview Map of Fairfield County 2010*, retrieved from http://www.sciway.net/maps/cnty/fairfield.html on 13/12/2010

South Carolina State Legislature, 2010, *South Carolina Mining Act (1974)*, retrieved from http://www.scstatehouse.gov/code/t48c020.htm on 20/12/2010

South West Development Commission, April 2006, *"Shire of Collie Statistics"*, retrieved on 30/05/2006 from www.swdc.wa.gov.au on 30/05/2006

Sperling's Best Places, 2010, *Best Places to Live in San Manuel*, *Arizona*, retrieved from http://www.bestplaces.net/city/San_Manuel-Arizona.aspx on 13/11/2010

Stauber, J., 2001, "Copper bioavailability and amelioration of toxicity on Macquarie Harbour, Tasmania, Australia, *Marine Freshwater Research*, Volume 51**,** pp 1-10.

Strauss, A. and Corbin, J. M., 1998, Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory, Sage, Newbury Park, California Strauss, A & Corbin J, 1990, Basics of qualitative research; grounded theory procedures and techniques, Sage, Newbury Park, California.

Supreme Coffee Machines, 2009, "*Commercial Coffee Machines Catalogue*", retrieved from www.supremecoffeemachines.com.au/productlisting.asp?:CatID=110 on 1/11/2009

Sydney Commercial Kitchens, 2009, "*Catering Equipment Online Showroom*", retrieved from www.sydneycommercialkitchens.com.au/cake/cake.htm on 03/11/2009

Sydney Commercial Kitchens, 2009, "*Catering Equipment Online Showroom*", retrieved from www.sydneycommercialkitchens.co.au/cash/cash.htm on 3/11/2009

Sydney Commercial Kitchens, 2009, "*Catering Equipment Online Catalogue*", retrieved from www.sydneycommercialkitchens.com.au/fryer/fryer2.htm on 3/11/2009

Sydney Commercial Kitchens, 2009, "*Catering Equipment Online Catalogue*", retrieved from www.sydneycommercialkitchens.com.au/washer/dish.htm on 03/11/2009

Sydney Commercial Kitchens, 2009, "*Catering Equipment Online Catalogue*", retrieved from www.sydneycommercialkitchens.com.au/fridge/fridgeup3.htm on 03/11/2009

Sydney Commercial Kitchens, 2009, "*Catering Equipment Online Catalogue*", retrieved from www.sydneycommercialkitchens.com.au/menu/menu.htm#logo on 03/11/2009

Sydney Commercial Kitchens, 2009, "*Catering Equipment Online Catalogue*", retrieved from www.sydneycommercialkitchens.co.au/stoves.htm#blue on 03/11/2009

Sydney Morning Herald, September 7th 2011, *Will Australia's dependence on China's growth come at a cost. Some analysts say that there are worrying signs*, Sydney, Australia retrieved from http://www.smh.com.au/money/investing/dragons-teeth-20110906-1junl.html on 24/11/2011

Sydney Morning Herald, January 4th 2008, *Roderick Smith quits Windimurra Vanadium*, retrieved from http://news.smh.com.au/business/roderick-smith-quits-windimurra-vanadium-20080104-1k7u.html on 17/03/2009

Sydney Morning Herald, 12/11/2004, *WA Govt. Wants say in mine closures*, Fairfax Media, Sydney, Australia

Tashakkori, A and Teddlie, C, 1998, *Mixed Methodology; Combining Qualitative and Quantitative Approaches*, Sage, Thousand Oaks, USA

Tashakkori, A and Teddlie, C, 2003, *Handbook of Mixed Methods in Social and Behavioural Research*, Sage Publications, Thousand Oaks, USA

Tasmania Online 2004, "Tasmania Online: Your comprehensive guide to Tasmania on the Web", *Tasmania Online*, Hobart, retrieved from www.tas.gov.au/tasmaniaonline on 23/09/2004

Tasmanian Minerals Council Limited, 2010, *Copper Mines of Tasmania – Mount Lyell Mine*, retrieved from http://www.tasminerals.com.au/copper.htm on 09/09/2010

Taylor-Powell, E. and Renner, M., 2003, *Analysing Qualitative Data*, University of Wisconsin Extension, Program Development and Evaluation, University of Wisconsin, Madison, Wisconsin, retrieved from http://learningstore.uwex.edu/assets/pdfs/g3658-12.pdf on 04/03/2012

Telstra, 2009, "*Business Solutions – Fixed Phone Plans*", retrieved from www.telstra.com.au/smallbusiness/index.htm?+R=3ps on 19/11/2009

Telstra 2009, *"Fixed Line – Plans –BusinessLine Plus/Fax"*, retrieved from www.telstra.com.au/smallbusinessfixedline/plans/plusfax.htm on 15/02/2009

The Age, February 8th 2004, *Batchelor, Northern Territory*, retrieved from http://www.theage.com.au/news/Northern-Territory/Batchelor/2005/02/17/1108500201589.html on 14/07/2006

The Mining Journal, April 25, 2007, *Kennecott Mine Receives Awards*, retrieved from http://www.eagle-project.com/library/media/MJ_SCAwards%20042507.pdf on 15/08/2007

The No Coal!tion Margaret River, *Margaret River too beautiful to undermine*, retrieved from http://www.nocoalitionmargaretriver.com/ on the 26/09/2011

The South West Times, December 9th, 2010, *Delays hit lake opening*, West Australian Regional Newspapers, Bunbury, Western Australia.

The Sustainable Energy and Anti-Uranium Service, 1999, *Rum Jungle NT – An Ongoing Environmental Calamity*, retrieved from http://www.sea-us.org.au/oldmines/rumjungle.html on 13/06/2008

The West Australian, 11/05/2004, *Xstrata quits vanadium plant*, the West Australian, Newspaper House, Osborne Park, Western Australia

The West Australian, 12/05/2004, *State knocks back Windimurra Mine Rescue*, the West Australian, Newspaper House, Osborne Park, Western Australia

The West Australian, 23/09/2004, p8, *Law urged to tackle mine closures*, the West Australian, Newspaper House, Osborne Park, Western Australia

Thyer, B. A, 2010, *The Handbook of Social Work Research Methods*, Sage Publications, Thousand Oaks, California http://books.google.com.au/books?id=Wx9Qc9HCbEQC&pg=PA234&dq=benefit+cost+analysis+as+research+methodology&hl=en&ei=u2WKTuT2HIOCmQW2lan2BA&sa=X&oi=book_result&ct=book-thumbnail&resnum=7&ved=0CFMQ6wEwBg#v=onepage&q=benefit%20cost%20analysis%20as%20research%20methodology&f=false on 22/08/2011

Tivy, Joy, 1984, *Impact of coal development on recreational land use in the Upper Hunter Valley*, Australian National University, Canberra, Australia

Tobin, P., 2008, *Healthy Land, Healthy Future*, retrieved from http://www.ceaa.gc.ca/050/documents_staticpost/cearref_3394/hearings/SM48.pdf on 13/08/2010

Toker, Z., 2007, *Recent Trends in community design: the eminence of participation*, Design Studies, Vol 28, No. 3 May 2007, retrieved from http://jag85.com/classes/lis490/Recent%20Trends%20in%20Community%20Design.pdf on 13/09/2011.

Tourism Western Australia, 2005, *"South West Tourism Fact Sheet 2004"*, Research Western Australia, Perth, Western Australia

Town of Grant, 2010, *Town of Grant Location*, retrieved from http://www.townofgrant.com/location/ on the 17/08/2010

Toyota Australia, 2009, "*Toyota Hilux – Single Cab Range Overview*", Toyota Australia Homepage, retrieved from http://www.hilux.toyota.com.au/toyota/vehicle/FreeText/0,4665,1588,544,00.html on 24/03/2009

Trading Post, 2009, "*Marine>Power>Jet Skis* [All States}", retrieved from: http://www.tradingpost.com.au/search/cat_Jet+Skis_loc_locRZSQregtAVSCdistRZSQAVSCstateRZSQ9AVSCregRZSQ_off_0_sect_Marine_sort_otRZSQ1BJDZfdRZSQSellingPrice_sqt_1_stpg_1_subs_Power_ on 12/10/2009

Tremblay, G, 2005, *Abandoned Mines in Canada – Responses to the Problem*, Conferencia Internacional de Pasivos Ambientales Mineros, May 3-4, 2005, Santiago, Chile

United Nations Environment Program, 2005, *Mining for Closure: Policies and Guidelines for Sustainable Mining Practices*, New York, retrieved from http://enrin.grida.no/environment-and-security/mining_src.pdf on 13/06/2007

United States Census Bureau, 2010, *Fact Sheet, Fairfield County, South Carolina 2005-2009*, retrieved from http://factfinder.census.gov/ on 12/12/2010

United States Census Bureau, 2010, *Economic Fact Sheet, Fairfield County, South Carolina*, retrieved from http://factfinder.census.gov/servlet/ = on 15/12/2010

United States Census Bureau, 2010, *Fact Sheet, Ridgeway Town, South Carolina 2005-2009*, retrieved from http://factfinder.census.gov/ on 05/12/2010

United States Census Bureau, 2008, *Economic fact sheet, Wisconsin 2006-2008*, retrieved from http://factfinder.census.gov/ = on 15/08/2010

United States Census Bureau, 2008, *Fact Sheet Ladysmith City, WI 2000*, retrieved from http://factfinder.census.gov/ on 15/08/2010

United States Census Bureau, 2008, *Fact Sheet Rusk County WI 2000, retrieved from http://factfinder.census.gov/ y* on 15/08/2010

United States Census Bureau, 2007, *Annual County Population Estimates and Estimated Components of Change: April 1, 2001 to July 1, 2006*, 2006 Population Estimates. United States Census Bureau, Population Division, 22/03/2007.

United States Code, 2008, *Title 30 Mineral Lands and Mining: Chapter 25 – Surface Mining Control and Reclamation*, US Code, retrieved from http://frwebgate.access.gpo.gov/cgi-bin/usc.cgi?ACTION=BROWSE&TITLE=30USCC25&PDFS=YES on 03/10/2011

United States Department of the Interior, Bureau of Land Management, 2011, *Mining Claims and Sites on Federal Lands,* Washington, retrieved from http://www.blm.gov/pgdata/etc/medialib/blm/wo/MINERLS_REALTY_AND_RESOURCE_PROTECTION_/energy.Par.28664.File.dat/MiningClaims.pdf on 04/11/2011

United States Environmental Protection Agency, 2011, *CERCLA Overview*, Washington, United States, retrieved from http://www.epa.gov/superfund/policy/cercla.htm on 05/10/2011

United States Environmental Protection Agency, 2010, *Superfund Program – Summitville Mine, Update, June 2010,* Retrieved from http://www.epa.gov/region8/superfund/co/summitville/ on 27/08/2010

United States Environmental Protection Agency, 2009, *Summitville Mine Superfund Site Community Involvement Plan*, retrieved from http://www.epa.gov/region8/superfund/co/summitville/Summitville_CIPFinal09Aug05.pdf on 13/12/2009

United States Environmental Protection Agency, (2004), "*Superfund*", United States Government, Washington, www.epa.gov/superfund/about.htm on 12/03/2005

United States Department of the Interior (1995), *Science for a changing world*, retrieved from http://pubs.usgs.gov/of/1995/ofr-95-0023/summit.htm on 17/09/2005

United States Department of Agriculture Forest Service, 2010, *Sky Islands Coronado National Forest,* retrieved from http://www.fs.fed.us/r3/coronado/index.shtml on the 15/11/2010.

United States Geological Survey, 1993, *The Summitville Mine and its downstream effects – an online update of open file report 95-23*, retrieved from http://pubs.usgs.gov/of/1995/ofr-95-0023/summit.htm on 23/01/2008\

University of Melbourne, 2004, Agreements, Treaties and Negotiated Settlements Project, 2004 "*Jawoyn Agreement*", University of Melbourne, 2003, www.atns.net.au on 22/03/2006

University of Wisconsin Extension, 2010, *Wisconsin Geological and Natural History Survey*, retrieved from http://www.uwex.edu/wgnhs/Mineral%20Index/Special%20Locations/FlamMin.htm on 23/10/2010

Uranium Information Centre (1995), "*Uranium Mining in Australia*", Uranium Information Centre, Melbourne, http://web.archive.org/web/20080303003408/http://www.uic.com.au/fmine.htm#rumj on 16/02/2006

Vanclay, F, 2005, *Engaging Communities with Social Impact Assessments: SIA as a Social Assurance Process*, Tasmanian Institute of Agricultural Research, University of Tasmania, retrieved from http://www.engagingcommunities2005.org/abstracts/Vanclay-Frank-final.pdf on 22/07/2011

Vanclay, F, 1999, *Social Impact Assessments*, in ed. J Petts, Handbook of Environmental Impact Assessment (Volume 1), Blackwell Science, Oxford, pp. 301-326.

Victorian Consolidated Legislation, 2011, *Mineral Resources (Sustainable Development) Act 1990,* Melbourne, Victoria, retrieved from http://www.austlii.org/au/legis/vic/consol_act/mrda1990432/ on 13/09/2011

Victorian Department of Primary Industries, 2003, *Principles for rehabilitation of agricultural land subject to mining*, Melbourne, Victoria, retrieved from http://www.minerals.org.au/__data/assets/pdf_file/0013/7501/Rehab_principles_final_130503_.pdf on 13/09/2011

Victorian Government, 2010, *Mineral Resources (Sustainable Development) Act (1990)*, Melbourne, Victoria, retrieved from http://www.legislation.vic.gov.au/Domino/Web_Notes/LDMS/LTObject_Store/LTObjSt5.nsf/DDE300B846EED9C7CA257616000A3571/813CA9695125BB24CA2577BF007CAD09/$FILE/90-92a080.pdf on 23/08/2011

Vines, L, 2005, *Good Practice Mining*, Perth, Western Australia, retrieved from http://www.goodpracticemining.org/uploads/mainstreaming1.pdf on 14/07/2007

Virginia Department of Mines, Minerals and Energy, Vol. 37 February 1991, *Virginia Minerals, Precious Metal Mines, Prospects and Occurrences in Virginia – an update*, retrieved from http://www.dmme.virginia.gov/DMR3/dmrpdfs/vamin/VAMIN_VOL37_NO01.PDF on 13/11/2010

Waggitt, P., 1998 "Uranium Mine Rehabilitation: the story of the South Alligator Valley Intervention", *Journal of Environmental Radioactivity*, volume **76,** Issue 1-2, pp. 1-14.

Wakeham, M. and Blair, K., (2003), "*Mining a river? The proposed McArthur river mine expansion*", ECNT, Darwin, retrieved from http://www.ecnt.org/pdf/news_2003_JunJul.pdf on 22/07/2005

Ward, Tara, 2011, "The Right to Free, Prior and Informed Consent: Indigenous Peoples' Participation Rights within International Law", *Journal Of International Human Rights*, Vol.10, Iss. 2 (2011)

Warhurst, A, 2000, *Issues in the Management of the Socio-Economic Impacts of Mine Closure: A Review of Challenges and Constraints.* In Environmental Policy in Mining, Warhurst, A and Noronha, L, Lewis Publishers, Boca Raton, pp 81-99

Warhurst, Alyson and Mitchell, Paul, "Corporate Social Responsibility and the case of the Summitville Mine", Resources *Policy*, Volume **26,** Issue 26 pp. 91-102.

Water Corporation, 2009, "*Water Corporation Business Information*", retrieved from www.watercorporation.com.au/business/Accounts_Rates_Country_Conn.Cfm on 18/11/2009

Water Corporation, 2009, "*Water Corporation Business Information*", retrieved from www.watercorporation.com.au/business/Accounts_Rates_Country_Conn.Cfm on 18/11/2009

Wells, Louis, T, 1975, Social cost/benefit analysis for MNC's, *Harvard Business Review, March-April 1975*, Harvard Business School, Cambridge, Massachusetts, USA

Wesfarmers Premier Coal Limited, 2003, *"50 Years of powering Western Australia: from Western Collieries to Wesfarmers Coal"*, Advance Press, Bassendean, Western Australia.

Wesfarmers, 2011, *Sustainability Reporting*, Perth, Western Australia, retrieved from http://www.wesfarmers.com.au/community-a-sustainability/sustainability.html on 10/10/2011

Wesfarmers Ltd, 2011, *Wesfarmers Annual Report 2011*, retrieved from http://media.corporate-ir.net/media_files/IROL/14/144042/2011_Annual_Report_Financial_Statements_pages_66_180.pdf on 04/03/2012

Western Australian Electoral Commission, 2005, *District of Collie-Wellington – Profile*, Perth, Western Australia, retrieved from http://www.waec.wa.gov.au/elections/state_elections/election_results/2005_state_general_election/district_of_collie-wellington/ on 15/06/2006

Western Australian Government, 2011 *Environmental Protection Act (1986)*, Perth, Western Australia, retrieved from http://www.slp.wa.gov.au/pco/prod/FileStore.nsf/Documents/MRDocument:21016P/$FILE/EnvProtectionAct1986_07-00-00.pdf?OpenElement on 26/07/2011

Western Australian Government, 2011, *Mining Act, 1978, Perth, Western Australia*, retrieved from http://www.austlii.edu.au/au/legis/wa/consol_act/ma197881/s6.html on 26/07/2011

Western Power, 2009, "*Fees Overview, South West Interconnected System*", retrieved from www.westernpower.com.au/business/your_account/pricing_and_fees/business_swis/business_sw_fees_overview.html on 22/11/2009

Western Power, 2009, "*Fees Overview, South West Interconnected System*", retrieved from www.westernpower.com.au/business/your_account/pricing_and_fees/business_swis/business_sw_fees_overview.html on 22/11/2009

Western Power, 2009, *"Running Costs Appliances"*, retrieved from www.westernpower.com.au/home/smart_ways_to_save/in_your_home/running_costs_appliances.html on 15/02/2009

Wilson, K. and Barker, R., 2003, "Green from Gold: the rehabilitation of Golden Cross", *The New Zealand Minerals Industry Association*, Wellington.

Wilson, N., 2004, "Miners still digging away at Collie rationalisation", *The Australian*, Wednesday, November 10, 2004, p. 37.

Windimurra Vanadium Limited, 2008, *Windimurra Vanadium Project: Land clearing and mining below the base of weathering*, Windimurra Vanadium Limited, Perth, Western Australia, retrieved from http://www.epa.wa.gov.au/docs/2725_Bull1288.pdf on 21/03/2009

Windrush Yachts, 2009, *"Windrush Models and prices list"*, retrieved from www.windrushyachts.com.au on 17/02/2009

Wisconsin Briefs (from the legislative reference bureau), November 2000, *Regulation of Metallic Mining in Wisconsin*, retrieved from http://legis.wisconsin.gov/lrb/pubs/wb/00wb15.pdf on the 14/08/2008

Wisconsin Department of Natural Resources, 2006, *Reclaimed Flambeau Mine*, retrieved from http://www.dnr.state.wi.us/org/aw/wm/mining/metallic/flambeau/ on 20/03/2007

Wisconsin State Climatology Office, 2010, *Historical Climate Data, 479144 Weyerhauser, WI*, Retrieved from http://mrcc.sws.uiuc.edu/climate_midwest/historical/snow/wi/479144_ssum.html on 23/10/2010.

World Bank, 2011, *Cost-Benefit Analysis in World Bank Projects*, Washington, DC, retrieved from http://web.worldbank.org/external/default/main?noSURL=Y&theSitePK=1324361&piPK=64252979&pagePK=64253958&contentMDK=22703501 on 30/05/2012

World Bank and International Finance Corporation, 2002, *It's not over when it's over: Mine closure around the world.* Retrieved from http://www.worldbank.org/mining on 23/10/2007

World Commission on Environment and Development (Brundtland Report), 1987, *Report of the World Commission on Environment and Development: Our Common Future*, United Nations, New York, USA

World Health Organisation, 2003, Guidelines for safe recreational water environments, Volume 1, Coastal and Fresh Waters, World Health Organisation, Geneva, Switzerland

World Wild Life Fund, 2001, *Sonoran Desert (NA1310)*, retrieved from http://www.worldwildlife.org/wildworld/profiles/terrestrial/na/na1310_full.html On 06/11/2010.

Yin, Robert, K, 2008, *Case Study Research: Design and Methods (Fourth Edition),* Sage Publications, Thousand Oaks, USA

Yin, Robert, K., 1994, *Case Study Research: Design and Methods (Second Edition),* Sage Publications, Thousand Oaks, USA

Zhao, L, Y.L., McCullough, C. D, Lund, M. A, Newport, M., 2010, *Mine Voids Management Strategy (III): A Monitoring Strategy for Pit Lakes and Connected Water,* Mine Water and Environment Research/ Centre for Ecosystem Management Report, retrieved from http://www.water.wa.gov.au/PublicationStore/first/96277.pdf on 13/09/2011

Appendices

Appendix 1: Poor and best practice mine closure case studies

A1.1 Introduction

The review of the literature surrounding mine decommissioning and closure found that there were both inferior and best practice mine closures, both of which were influenced by a number of common factors. As a result of these factors, the thesis will explore both inferior and best practice mine closure by examining a number of case studies at mine sites around the world where both poor and best practice mine decommissioning and closure practices were undertaken.

The case studies were categorised as either inferior or best practice closure based on their ability to meet the key mine closure criteria that this research is arguing should be regularly used during mine decommissioning and closure. In addition to this, in order to determine best practice closure practice, the desktop case studies include information and discussion on mine site closures from around the world, as this will assist in determining if there were issues surrounding mine closures that were common and or any unique features that could assist in shaping best practice closure.

The desktop studies examining poor closure practices included the following mines, with each being detailed in the following order:

A1.1.1 Inferior Mine Closure:

- Run Jungle and South Alligator River mine in the Northern Territory
- Mount Todd mine in the Northern Territory
- Summitville mine in Colorado in the United States
- Mount Lyell mine in Queenstown, Tasmania
- Windimurra Mine at Mt Magnet, Western Australia

A1.1.2 Best Practice Mine Closure

- Flambeau mine in Wisconsin, United States
- Ridgeway Mine, South Carolina, United States
- Elliot Lake, Ontario, Canada
- Golden Cross, Waihi, New Zealand
- Rother Valley Country Park, Rotherham, United Kingdom

In addition to the desktop case studies, field visits were made to four mine sites in Australia that were determined to have undertaken best practice closure, in accordance with the mine closure criteria. These four sites have also been included as they were accessible due to their locations and their ability to fit within the scope of the resources (both financial and human) available to the researcher on this topic.

Interviews were conducted at the mine sites with personnel from the mining companies involved with the closure, Local Council personnel that were involved with the mine and community members that were involved with the mine closures. The interviews were conducted in order to verify the findings from the desktop analysis, and to provide further insight and information on the mine decommissioning and closure process. The interviews also provide further depth to the desktop research and primary data on the decommissioning and closure process, to either corroborate the research findings or impart new information on the closure process.

The case studies that were used for this section of the research were:

- Penrith Lakes, Penrith, New South Wales
- Candia Hill mine, Orange, New South Wales
- Jarrahdale mine, Jarrahdale, Western Australia
- Lake Kepwari, Collie, Western Australia

A1.2 Mine closure criteria

The closure of a mine will not have the same economic impact in every community that has met with this issue. Rather, there will be a range of factors that will influence the actual closure of the mine and the effect it has on each community. There are a number of drivers that influence the mine closure procedure and therefore the success or otherwise of the mine closure process. It is these factors that have been the main criteria in influencing selection of the case studies for review in this thesis and that will assist in the development of the framework for best closure practice.

The literature search and desktop case study analysis, highlight that there were a number of key factors that played a role in the success or otherwise of a mine closure. These include (Chapter 6, p3)

- The location of the mine
- The size and profitability of the mine
- The size of the community where the mine is situated
- The ownership of the mine
- When the mine closure was planned
- How the mine closure was planned and conducted

- Alternative closure options – Partly determined by above, but also by type of mine factors (for example water quality, public safety hazards and risks, community expectations
- The legislation under which the closure was conducted
- Engagement with stakeholders.

Each of these will be outlined in brief detail below.

A1.2.1 The location of the mine

The location of the mine was found to determine the successful closure, or otherwise of a mine. The location of the mine is a significant determinant in the extensiveness of the rehabilitation program. It suggests that a mining company is more likely to go above rehabilitation standards if a mine site is located in close proximity to an urban locality. Mine sites that are located in more remote communities will exhibit different characteristics and have different closure requirements to mines that are located near urban areas.

Mining companies that operate mines near urban areas will also come under closer scrutiny from regulators and the local communities, some of whom may well be opposed to mining from the outset. The desktop case studies has shown that even in the case of successful mine closures, those mines located near urban areas often came under intense opposition from local residents who were opposed to mining in their communities. This places more pressure on mining companies to get their mine closure right and is different to the scrutiny that companies will face in more remote locations. This does not mean that all mining companies that operate in remote locations will abrogate their closure responsibilities; however, poor mine closure practices tend to occur more often in remote locations where the level of scrutiny may be less noticeable.

A1.2.2 The size and profitability of the mine

These two factors are often linked, as generally a large mine is indicative of a rich ore body and suggests a mine that has been operational for a number of years and that has been able to grow accordingly. Mining companies attempt to extract the largest possible amount of high grade ore at the lowest possible cost, this is generally achieved via high capital and operating costs on areas such as high wages, which attract well qualified staff and the use of expensive capital equipment all aimed at boosting the productive capacity of a mine. Increased productive capacity generally results in improvements to the bottom line.

A profitable mine can provide a company with the resources to rehabilitate a mine and in all surveyed case studies of successful mine closure the mine was operating from a profitable basis. There may be many factors associated with this that cause a company to engage in successful rehabilitation, but the key factor appears to be the ability of the mining company to draw on its capital reserves and put this into a robust rehabilitation program. Mines that have not been successfully rehabilitated have not been profitable and hence the companies do not have the resources at their disposal to take on the often-expensive process of rehabilitation. It is then the government and the local community that are left to deal with problems associated with poor closure practices. Although mining legislation throughout Australia's States and Territories requires that company rehabilitate mines to a standard that existed prior to mining, the reality is that in the case of mines that are not profitable, or where the mining company is facing financial difficulties rehabilitation and closure may simply not be a viable option. Rehabilitation bonds are not always sufficient to cover the costs associated with rehabilitation and closure, often leaving governments and local communities with a burden that may take many years to rectify.

Profitability is also associated with the prices of commodities and the evidence from the case studies is that poor closure practices are often associated with low commodity prices, which directly affects the viability of a mine. A mine that is not financially feasible will struggle to develop sufficient capital reserves to implement a successful rehabilitation program. This is not to advocate that government regulation and the collection of rehabilitation bonds does not work (they are after all designed for this very means), however, it does raise questions about the size of rehabilitation bonds and the ramifications for the wider community when it has to pay (both directly and indirectly) for poor closure practices.

A1.2.3 The size of the community where the mine is situated

The size of the community where the mine is situated is closely related to the location of the mine, as the size of the community is generally dictated by its location. Communities with larger populations often have a more diversified industrial base, where the closure of a mine may not have the same economic and social impact as smaller communities that may be more mining dependent. This will affect the end-use of the mine site, as communities that are more reliant on mining may have requirements for the mining site that include an economic focus, for example the development of tourist facilities. For communities that are larger and more diversified, the end-use may need to be only aesthetic, for example rehabilitation of a mine site to its pre-mining status.

Whatever the size of the community, however, the research indicates that the mine closure and the end-use of the mine site need to be included in the strategic plans of the local council and that mine closure planning should commence with the initial planning phases of the mine. Further, communities of all sizes need to work with mining companies from the outset of mine planning, if the end-use is going to be beneficial to the community

A1.2.4 The ownership of the mine

Ownership of the mine will have a significant impact on the end-use and rehabilitation of a mine void. A larger organisation will have greater access to capital reserves that it can use to develop a strong rehabilitation program. Large organisations will also be able to employ more resources to work on rehabilitation programs and are more likely to be actively involved in research and development projects on end-uses for mining voids.

The research from the literature review, notably the Minerals Mining and Sustainable Development Report (2003:75) found that for mine closure to be sustainable it is necessary for sustainable development practices to be reflected throughout all levels of the organisation. The case study reviews have found that Alcoa is devoting a large amount of resources to mine closure through the development of a research and development team specialising in mine rehabilitation. The case study review on Alcoa’s Jarrahdale mine site found that Alcoa senior management actively promote sustainable mining practices across the organisation, including a provision that rehabilitation practices need to be embedded in the company culture and practiced across all levels of the organisation as referred to in the Alcoa case study (Case Studies: 16)

Limited financial resources does not preclude small organisations from engaging in successful mine closure, however, the more resources an organisation has at its disposal, the more likely it will be that those resources will be used in the rehabilitation process. A large organisation is also more likely to be the subject of public scrutiny and particularly in the case of large multi-national companies who will be trying to publish their credentials as ‘good corporate citizens’.

A1.2.5 When the mine closure was planned

The findings from the desktop case studies have invariably indicated that successful mine closure requires a strategic level of planning, normally carried out at the start of the mining process during the early planning phases. Even before they commence operations, mining companies should be planning for the closure of the mine, no matter how long it is estimated that the resource reserves will last. This is a difficult undertaking for both companies and regulators, as currently most mining leases require only a basic closure plan with the guarantee that a site will be returned to a pre-mining state. As the case studies have shown, however, this does not always occur even in today’s more stringent regulatory environment, as governments are powerless to prevent companies from going bankrupt for example and not meeting their regulatory obligations in relation to mine closure. Rehabilitation bonds are designed to cover such events, but they are not always adequate enough to cover rehabilitation costs, particularly when there are negative externalities such as extreme pollution affecting a site.

Planning of a mine closure must also be evolutionary, as changes in technology may occur during the mining process that will affect the final design of a rehabilitated mine. This occurred during the rehabilitation process of Alcoa's Jarrahdale mine in Western Australia where changes were made to the actual rehabilitation process during the 30 plus year life of the mine as research found that initial rehabilitation techniques did not meet the company's own rehabilitation guidelines during the latter stages of the rehabilitation process. The company voluntarily rehabilitated older areas of the mine site in order to meet the newer standards of rehabilitation and bring consistency to the end-use design.

Much of the literature reviewed and the findings from the case studies indicate that most mine closure is commenced when a mine nears the end of its useful life and not at the outset of the initial planning phases. This has included mine closures that have been classified as being successful, the issue for the communities in which these mines operate however, is that this does not always allow them to plan properly for the closure of a mine and in most instances such a lack of forward planning brings with it the potential for disaster, an example of which occurred in the Northern Territory at Rum Jungle where the East Finnis River continues to be heavily polluted by acids and metals from a poorly planned and regulated mine closure upon the cessation of mining in 1971 (Case Study Chapter, p10). Planning for early closure is still not accepted practice in the mining industry (with the exception of the large companies), despite evidence suggesting that early planning actually results in lower long-run average costs in rehabilitation and closure.

A1.2.6 How the mine closure was planned and conducted

How the mine closure was planned and conducted in part relates to previous sections, as it is asking what strategy went into the closure process. Was the closure and rehabilitation of the mine considered during the mine planning process, or was it left until the last few years of the mine's operational phase? Was the rehabilitation of the mine carried out on a progressive basis during the operational life of the mine? In addition to this, what if any of the rehabilitation and closure process was funded through the operational budget of the mine.

Many of the major mining companies in Australia reviewed for this thesis (including Rio Tinto, BHP Billiton, Wesfarmers Coal Division, Alcoa) Australia plan for mine rehabilitation and closure during the initial planning phases of the mine (legislation in all Australian jurisdictions requires that a rehabilitation plan be submitted (Chapter 5: p28), however,, closure of a mine involves more than just the rehabilitation of a mine). Despite evidence demonstrating that early closure planning results in better social and economic outcomes for mining dependent communities and their workers in particular, there are many mining companies that still only see mine closure as an afterthought, something that they only need to worry about once the productive resources of the mine have been exhausted.

Mine closure that is not conducted in a planned and effective manner can result in an area that becomes a danger and a source of pollution, often for many years after the last reserves of the ore body have been removed. Mining companies that adopt best practice mine closure will consider a number of factors before decommissioning and closing a site including the climate of the area, the hydrogeological features of the area, the landform associated with the mine, the flora and fauna associated with the mine site and the land uses associated with the mine site.

The Australian New Zealand Minerals Energy Council/ Minerals Council of Australia /MCA (2007) guidelines for planning and conducting mine decommissioning and closure are defined by the following:

Mine closure should be integral to the whole of life mine plan:

- A risk-based approach to planning should reduce both cost and uncertainty
- Closure planning is required to ensure that closure is technically, economically and socially feasible
- Closure plans should be developed to reflect the status of the project or operation
- The dynamic nature of closure planning requires regular and critical reviews to reflect changing circumstances.

Mine closure planning is a whole of life process and needs to be undertaken progressively during the life of a mine. Planning for closure is an integral part of the mining process and will assist not just mining companies, but also communities in the structural adjustment process that occurs after a mine is closed. Companies that have developed sound rehabilitation and closure plans for a mine site will generally be better placed to gain approval from local communities for mine site developments. This approach also enables communities to factor future mine closure plans into their broader economic development strategic plans.

A1.2.7 Alternative closure options

Alternative closure options are partly determined by the issues discussed but also by factors such as the type of mine and water quality. Mining companies can consider a number of alternatives when determining options for a mine site once mining is completed. There are a number of factors that are important in the closure of a mine (Environment Australia 2002, p. 2):

- Public safety hazards and risks

- Ecological compatibility
- Potential as an ongoing source of pollution
- Community expectations
- Future land use and resource development

It was established that there are three broad, but basic mine void closure strategies, or options that companies can undertake:

1. **Waste Storage** – where a former mine void is used for storing waste from the mining process through either the storing of waste rock, or tailings. This is only an option for companies when the volume of ore extracted is less than the volume of material extracted. It is generally not considered a best practice closure option, as there have been cases where local groundwater supplies have been contaminated through this practice (Johnson and Wright 2003).
2. **Water Storage** – this process involves allowing water surface runoff to fill a mine void. The process allows mining companies to reopen a mine at a later date, as they only need to dewater the mine. The void is also used, as an additional source of water for the mine site, which is the key reason mining companies, will consider this option. The research has found that issues associated with salinity (particularly an issue in areas that have high rates of evaporation), and acidity are the biggest factors that need to be overcome if companies use this as their preferred method of mine void closure. This option is more likely to be a cost effective use of former mine voids (for both companies and the broader community) and will allow for a more sustainable approach to mine closure.
3. **Open Void** – This option allows an open void to fill with water with the aim of using the void for a future recreational, or commercial use. This is similar to the second option of water storage; however, using a void for water storage is designed primarily to allow a mining company to use the water for the mine site. The option of an open void allows companies to consider a variety of uses for the voids, including recreational uses such as diving, sailing, swimming, fishing, and irrigation supply, the capture of floodwater in areas of high rainfall, use for industry or other mines in the region, or possibly use of the void as a reservoir for town water supplies (it should be noted that this option would probably face considerable community resistance and there is no record of former mine voids being used for this purpose anywhere in the world). This option is generally considered the best option for large mining voids, as it is less expensive than backfilling a mine void and may also provide a cost-effective beneficial end-use for the local community.

There are a number of other factors in addition to the above that need to be considered when determining mine closure and rehabilitation. These include:

- **Climate** – The climate of a region is an important determinant in mine closure decisions. Areas of low rainfall and high evaporation rates are likely to cause hypersaline conditions to develop in open voids, whereas in areas of high rainfall and low evaporation this is less likely to be an issue for open voids and may broaden the closure options for mining companies and communities. As many of Australia's major mines are located in either arid or semi-arid zones of the country the climate will play an important part in the options for mine closure and any ensuing legislation from government and policy development from the mining companies.
- **Site geology** – The geology of a site and the impact that mining will have on that site during the life of a mine impact on the type of closure options that are available. Mining companies need to consider what impact mining will have on native flora and fauna during the life of the mine, how any impacts on them can be addressed and what steps will need to be taken to restore native flora and fauna during the rehabilitation and closure process. If rehabilitation is undertaken in a progressive manner this process can be monitored and if necessary changes can be made to the rehabilitation method if it is found that rehabilitation has not been effective. This approach occurred at the Jarrahdale mine site in Western Australia, where the rehabilitation process was altered during the operational life of the mine, as the company discovered more effective rehabilitation techniques that enabled the establishment of native flora and fauna similar to that which existed prior to mining.
- **Economic Diversity** – the main issue that is considered here is whether or not the region is wholly dependent on mining. If this is not the case and the region has a more diverse industrial base then the impact of a mine closure may be less severe. The research has also found that the location of a mine site plays an important part in the closure process – the more remote the mine, the fewer the closure options available to the mining company and the local community. In addition to this, access to infrastructure also plays an important role in the closure process. Again, in more remote communities infrastructure may be limited and will preclude some closure options that will be available to larger communities that are located close to urban populations.

All of these factors need to be considered in the mine closure process and that no one method of closure is correct. Mine rehabilitation and closure needs to be adapted to suit the needs of each local community and the site-specific circumstances of each mine site. A holistic approach needs to be taken to mine closure with governments, mining companies and local communities working together in the mine closure process. The most successful mine closures have been ones that adopt a holistic approach and are inclusive, as local communities are better equipped to cope with mine closure if they are part of the closure process.

A1.2.8 The legislation under which the closure was conducted

Legislation relating to mine closure in Australia (and indeed across much of the developed world) is limited. All aspects of the legislative requirements in Australia are concerned with rehabilitation of a mine site and do not specifically address mine closure, other than through rehabilitation requirements Across all states and territories in Australia, the legislative requirements of rehabilitation are quite comprehensive, however, closure is about more than the rehabilitation of a mine site, as there are many other concerns that need to be addressed when a mine is closed and much of this is left to the discretion of mining companies which only works when mining companies, are proactive in their approach to closure.

There is no Commonwealth legislation for mine rehabilitation or closure in Australia, it is all state based, hence there is a lack of uniformity in rehabilitation and closure requirements across the country, with some state legislation more comprehensive than others. As an example the legislation in New South Wales (the Mining Act 1992) places greater emphasis on community consultation in the rehabilitation process, using the rehabilitation and Community Consultation guidelines established in the Australian Minerals and Energy Environment Foundation Report (2003) (Chapter Three: p14) The only time that federal legislation will be utilized during mine closure of rehabilitation is if there has been a severe impact on the environment, at which point the *Environmental Protection and Bio-Diversity Act 1999* is employed to pursue offenders.

The desktop case studies provide examples of cases where mine closure was successful and the mining companies went well beyond their legislative requirements for both the rehabilitation and closure and in all instances took into consideration the impact that closure would have on the local community. In addition to this, the mining companies also engaged with the local communities on mine closure ensuring that the community was behind them in their closure plans.

The issue with mine closure legislation (or a lack thereof), however, is not those companies that exceed their closure obligations; it is those companies that do not meet their duties, either ethical or legislated, with regards to closure. In the case study chapter discussing best practice closure the companies provided as examples are meeting and exceeding their legislative requirements for mine closure and in all instances have at the very least consulted their respective communities in the closure process from the outset and enabled these communities to have ownership of the mine closure. Successful mine closure as measured by whether or not a mining company meets its legislated rehabilitation requirements is not necessarily an accurate measure of the outcome of mine closure. Legislation across Australia at present does however the success or otherwise of mine site rehabilitation to be used as the measurement of successful mine closure; however, in terms of best practice mine closure, meeting legislative requirements is only one aspect. Legislation in Australia does not currently adequately address mine closure and is not sufficiently equipped to deal with those companies that ignore their social closure obligations to local communities.

A1.2.9 Engagement with stakeholders

Traditionally mining companies have tended to use the term 'community consultation' when discussing the idea of engagement with communities, indeed some companies still use this term to describe their involvement with local communities. The reality is however far more complex, as there are varying degrees to which local communities can become involved in the mine closure process. As an example in the case of Penrith Lakes mine closure the community was required through the New South Legislative process to be consulted in the rehabilitation and closure practice. To meet these requirements the Penrith Lakes Development Corporation established a Community Consultative Committee working alongside the CSIRO to determine optimum end uses for the rehabilitated site (Appendix A?). One of the outcomes from this process was a strategy to use the former mine site as a mixed recreational and urban area once mining had ceased, the outcome of which has been realised with the final use of the site as both a recreational and urban development site (Appendix A:) .

At the other end of the spectrum, Alcoa's Jarrahdale mine in Western Australia ceased production in 1998 after being progressively rehabilitated since 1963 to a standard that constituted best practice closure (Alcoa was recognised by the United Nations Global 500 Roll of Honour for its mine rehabilitation at the site), however, the consultation process was all but non-existent as the rehabilitation commenced at a time when the idea of community consultation was not a requirement of either regulatory authorities or mining companies.

The examination of the Jarrahdale mine site closure process (Appendix A:) found that Alcoa used the rehabilitation and closure process at the site to undertake a review of its community consultation process, with the result being that the company now undertakes annual reviews of its community consultation processes at each of its mine sites (Appendix A:)

The literature review established that the terms consultation, participation, involvement and engagement tend to be used interchangeably by many companies (and indeed the same can be said of many government agencies), the reality, however, is that they are quite distinct

terms. Mining companies may consult with local communities, they seek involvement and even participation from local communities, however, they may not actually engage (engagement means that post closure development plans are developed for local communities, with the input from local communities in order to mitigate the negative effects often associated with mine closure, such as a lack of alternative employment options once mining ceases) local communities in the mine closure process.
An example from the Case Studies can illustrate this point, in this case the Cadia Hill Mine site in New South Wales which has been included as a best practice closure example and where the community has certainly been consulted on a regular basis on the rehabilitation and closure options for the site, however that consultation has been with local government authorities who by proxy speak for the community interests, but who are not necessarily representative of the wider community.

It is important to define the difference between participation and consultation, as one implies actual involvement by stakeholders, whilst the other may only imply involvement on a superficial level, with decisions being made by those outside the process. The distinction becomes important in the mine closure process, as one method provides communities with empowerment, whilst the other could leave the community feeling powerless. In the literature review, research conducted by the CSIRO (Chapter 4, p23) on engagement demonstrated that communities that are engaged will feel more empowered, these communities are then more likely to find a positive outcome from the closure process, this is particularly so if communities are engaged from the outset of the mining process during the initial mine planning phase.

Actual engagement in the mine closure process is not something that even the most committed of mining companies have done well, particularly in the past. Even in the best practice examples outlined below, much of the process of dealing with local communities was likely to be of a consultative nature rather than actually engaging with local communities. In the case studies that are reviewed for this section of the research all of the mining companies engaged to a degree with their local communities (hence the reason they were chosen for this section of the research), however, it was not necessarily the degree of engagement that the literature would recommend as ‘world’s best practice. This is not solely the fault of the mining companies and is to a degree an issue that governments, particularly at a local level need to address as more often than not in the past they have been happy just to have any form of dialogue with mining companies and have not necessarily been concerned as to whether or not this dialogue has been engaging. It is also true that in years gone by, mining companies have not necessarily seen a need to involve local communities in the closure process, as rehabilitation and closure have been an afterthought rather than an important feature of the mining process.

In order to become more engaged in the closure process, it is important that local government areas ensure that part of their economic development strategic plan includes the development of alternative industries before mine closure is to be undertaken or indeed that such plans start to take place during the mines planning stages, thus remaining proactive.. It is in this area that local governments can work with their state and federal counterparts and the mining companies in diversifying their economic base and mitigating some of the negative effects that are often associated with mine closure.

A1.3 Summary

The above issues are key factors that determine the success, or otherwise of a mine closure and it will be argued are critical issues that need to be addressed in order for mines to close with no cost to the community. These aspects will be addressed in a series of more detailed case studies that will examine where successful mine closure has occurred, or in the case of two studies will demonstrate how progressive rehabilitation by mining companies and early planning for closure is leading to a more positive outlook for mine closure and importantly has the support of the wider community.

A1.4 Desktop case studies of inferior mine closures.

- Rum Jungle and the South Alligator, Northern Territory
- Mt Todd Gold Mine, Northern Territory
- Summitville Mine, Colorado, United States
- Mount Lyell, Queenstown, Tasmania
- Windimurra Mine, Mt Magnet, Western Australia

A1.5 Inferior mine closure

These mine sites were classed as inferior as they failed to meet the mine closure criteria that the research has deemed is necessary in order to demonstrate world’s best closure practice. The site’s range from mines in the Northern Territory, Tasmania and Western Australia, to a former gold mine in the United States, whose poor closure standards forced legislative changes to mine site rehabilitation and closure practices in the United States. Each of the sites share common characteristics including poor closure planning, remote locations with small populations, fluctuations in demand and prices for commodities, changing mine ownership during the course of the mine’s life, negligent legislation regarding mine site rehabilitation and hence closure, and poor or non-existent community consultation and engagement.

Each of the case studies provides a lesson in how not to rehabilitate and close a mine site, along with some salient lessons on minimum requirements for both governments and communities to insist on when dealing with proposed and indeed existing mining operations.

A1.6 Rum Jungle and the South Alligator River – Northern Territory – Uranium/Copper

Mining began at the Rum Jungle and South Alligator River sites in the Northern Territory in the 1870's and there has been little in the way of rehabilitation requirements since that time. In the early days of mining in the Northern Territory the mine sites were often small and rapidly abandoned once mining was completed, leaving behind a scarred, often poisonous landscape.

A1.6.1 The location of the mine

The Run Jungle mine is located approximately 65 kilometres south of Darwin in the South Alligator Valley region. The South Alligator Valley area is located in the wet-dry tropics area, with a seasonal rainfall distribution pattern (Waggitt 2004). Over 95% of the region's rain falls during the months of October-April, with much of the rainfall being characterised by heavy downpours associated with heavy monsoonal storms. Temperature ranges from 12 Degree Celsius to 40 Degree Celsius over the course of the year, with the wet season characterised by high humidity. The South Alligator River flows for most of the year, however, some parts of the river dry up during the dry season.

Figure A 1.1Figure A 1.2: Location of Rum Jungle Mine

Source: Richards et al.1996,p551

A1.6.2 Size and profitability of the mine

The Rum Jungle site is on the East Finnis River (Uranium Information Centre 1995). The Commonwealth Government provided the funds for the establishment of the mine in addition to a treatment plant to provide uranium oxide concentrate (Uranium Information

Centre 1995). The Rum Jungle mine consisted of three main mine pits, White's open cut, Dyson's open cut and Mt Burton open cut (Uranium Information Centre 1995).

Initial mining at the site was conducted underground from 1950-1953; the open cut mine was developed in 1953, with mining commencing in 1954 (Uranium Information Centre 1995). White's open cut mine was eventually developed to a depth of 100 metres until 1958, with Dyson's open cut being mined from 1957-1958. The ore body from these sites was sold to the US/UK Combined Development Agency (CDA) under a contract from 1953-1962 (Uranium Information Centre 1995). The ore that was not sold under contract was stockpiled and treated by Territory Enterprises.

Between 1954 and 1971 around 3500 tonnes of uranium was extracted, in addition to 20,000 tonnes of copper concentrate, nickel and lead (Department of Resources, Energy and Tourism, (Department of Resources, Energy and Tourism, 2002) Much of the uranium that was mined at the site was stockpiled (over 2000 tonnes) right through until mining ceased at the site (Sustainable Energy and Anti-Uranium Service 1999), due to lack of demand for uranium at the time.

Between 1954 and 1971 around 3,500 tonnes of uranium was extracted, in addition to 20,000 tonnes of copper concentrate, nickel and lead (Department of Resources, Energy and Tourism, 2002). Much of the uranium that was mined at the site was stockpiled (over 2,000 tonnes) right through until mining ceased at the site (Sustainable Energy and Anti-Uranium Service 1999), due to lack of demand for uranium at the time.

At the time, the mine was the largest industrial project in the Northern Territory and a new town called Batchelor was created to service the mine (Sustainable Energy and Anti-Uranium Service 1999). The initial orebody was mined as an underground mine, however, this lasted for only three years until the mine site was changed to an opencut operation. During the life of the mine there were five pits in operation at the mine, though demand and prices for uranium at the time did not seem to warrant the production of such large volumes of the commodity.

The tailings deposits from the mine site were deposited directly into the Finnis river for much of the mine's life and upon cessation of mining, the mining companies refused to commit any funds to rehabilitation of the site (nor were they required to do this by law). Upon closure of the site in 1971, it was found that the mine had caused significant environmental damage, including 'destruction of fish, molluscs, crustaceans and flora from pollutants coming from overflowing on-site tailings dams.' (Hinde 2004, p. 1)

Copper and lead were also mined at Rum Jungle at the same time as uranium, with some of the ore from White's open cut used to recover copper. The copper mining process was undertaken by Australian Mining and Smelting Company Limited (a subsidiary of what later was to become Rio Tinto) (Uranium Information Centre 1995). The East Finnis River was diverted into the mine body during this time, adding to the pollution problems at the site.

In 1961 the Commonwealth government developed the Run Jungle Creek South ore body, three kilometres west of Batchelor, despite no sales contract being awarded. The mine body was open cut, to a depth of 67 metres (Uranium Information Centre 1995). As no sales contract existed for the uranium, the ore body from this site was also stockpiled, leaving approximately 2000 tonnes of yellowcake stockpiled by the time the mine area closed in 1971 (Uranium Information Centre 1995). This (yellowcake) is still stockpiled, aside from 239 tonnes that was sold to a United States utility company in 1994 (Uranium Information Centre 1995). The argument from the industry is that yellowcake, being an unprocessed oxide emits low radiation levels and poses little threat by way of radioactivity. This argument, however, receives little support from surrounding communities and environmentalists who are concerned about such a large stockpile of uranium.

Tailings from the extraction process were placed into the White's pit after 1958, resulting in significant contamination at the site. Poor treatment at the site also contributed to environmental problems. The Uranium Information Centre (1995) had the following to say regarding these issues:

> The uranium treatment plant used an acid leach and ion exchange process until 1962 when the latter section was replaced with solvent extraction and magnesia precipitation to treat the Rum Jungle Creek South ore. Tailings were released into a poorly engineered shallow dam initially and after 1958 were put into White's pit.

A1.6.3 The size of the community where the mine is situated

The town of Batchelor where the mine is located was originally an armed services base during WW II. The town became the major supply centre for the mine after uranium mining was established in the area in 1954. The town's population peaked at around 500 people, however, it is currently estimated to be around 350 (The Age 2004). The town is now more famous as the gateway to Litchfield National Park, rather than as the site of Uranium mining. The population of the town dwindled after mining ceased at the Rum Jungle mine site, with no new major businesses ever being developed to assist the region to deal with the mine closure.

A1.6.4 The ownership of the mine

The Commonwealth through the Australian Atomic Energy Agency (later to be known as the Australian Atomic Energy Commission) was responsible for the mine. The management of the site, however, was done under contract with Territory Enterprises Ltd, which was specifically established by Consolidated Zinc Pty Ltd to manage the site (Uranium Information Council 1994). A new town was established (by the Commonwealth) at Batchelor, approximately 8 kilometres from the site, to specifically serve the site. Rum Jungle was mined by CRA and RTZ (now Rio Tinto), with support also coming from the then Commonwealth government.

A1.6.5 When the mine closure was planned

There was no closure plan enacted for this site, as neither the Federal Government nor the mining company initially committed funds for the rehabilitation of the site. After the closure of the mine in 1971 the Australian Atomic Energy Commission (AAEC) (the Commonwealth body that had responsibility for the site) undertook studies to determine the extent of the environmental damage at Rum Jungle, including the sources of pollution at the site. The Commonwealth Government, however, decided that it would not make funds available to rehabilitate the site and the site was left with environmental damage caused by the mining.

The area has high rainfall, with erosion problems causing soil movement into water supplies, leaving Rum Jungle to become one of the worst examples of poor mining practice in Australia (if not the world). The Uranium Information Centre (1995) said this of the site:

> "…the Rum Jungle mine had become one of Australia's most notorious pollution problems, due to oxidation of sulphides by bacteria and the consequent release of acid and minerals into the East Finnis River. The monsoonal climate and 1500 mm rainfall coupled with the pyritic mineralisation in the area created ideal conditions for such processes (which of course were harnessed, without commercial success, in the copper leaching operation).

The Rum Jungle site provides a good case study on the need for closure planning many years prior to the cessation of mining. In addition, the site also demonstrates the need to ensure that those responsible for mining at a site are also charged with the responsibility of planning for the eventual closure of that site, even if they are not ultimately the organisation that is responsible for the rehabilitation and closure of the site.

A1.6.6 How the mine closure was planned and conducted

As mentioned, no rehabilitation, or closure plans were enacted for this site after the mine ceased to operate in 1971. In 1977 the Commonwealth government established a working group to examine ways to establish a rehabilitation system for mining in the Northern Territory. In 1983 the Federal government contributed $16.2 million to clean-up heavy metal contamination in the Finnis River. This joint federal/territory government clean up of the site was meant to remove contaminated soil and tailings into Dyson's open cut. The supervising scientist at the time noted, however, that (Parliament of Australia 2003, p. 9):

> No special preparation of the pit was undertaken prior to the placement of the tailings. The pit was sealed with waste rock and a final soil cover and vegetation. The tailings dam site was covered with topsoil, surface drainage was installed and the whole area revegetated.

This measure ultimately proved unsuccessful due to the sulphides in the ore bodies, which leaked out into the surrounding ecosystem and spread over a 10-kilometre radius into the Finnis River system (Parliament of Australia 2003). It was found that the major source of the pollution came from the copper tailings and soil, not the uranium tailings and soil.

In 1990 the Federal government, in order to clean-up Rum Jungle creek, granted an additional $1.8 million to clean up the south waste dumps (Wakeham and Blair 2003). By 2001 Rum Jungle still had severe environmental problems with acid mine drainage a major issue and the area still classified as being 'in a state that was not fit to return to traditional owners' (Wakeham and Blair 2003, p.4).

What alternative closure options were considered

No alternative closure options were initially considered for this site, as the mining company chose not to contribute anything towards rehabilitation of the site and nor did the Commonwealth Government at the time, despite the Commonwealth effectively being responsible for the site (Environment Centre of the Northern Territory, 2007),

The legislation under which the closure was conducted

The Rum Jungle site was among the first of the Uranium mine sites to be rehabilitated by the Federal and Northern Territory Governments. Once Rum Jungle was rehabilitated there was some rehabilitation carried out, mainly within Kakadu National Park, but this was conducted via Federal government money and was basically a publicly funded exercise. The sites where the rehabilitation was conducted are the former Uranium mines of El Sherana, South Alligator River, and Coronation Hill (Wakeham and Blair 2003 p.4).

The Northern Territory introduced rehabilitation bonds in the late 1970's (after the establishment of the Federal government working group), but mining companies were still not required by law to rehabilitate mine sites. Rehabilitation in the Northern Territory is not enshrined in legislation, but is outlined by a series of guidelines that rely on a company's goodwill in adhering to them. The Northern Territory government, according to Wakeham and Blair (2003), has also been known to waive, or reduce adherence to mining bonds to enable mining developments to proceed.

According to the Environment Centre of the Northern Territory the Northern Territory government needs to at least do the following in order to prevent future environmental problems and bring their laws into conjunction with the rest of the country and at least go some way towards preventing the large environmental currently associated with some mining projects in the Northern Territory. Wakeham and Blair (2003 p.4) state in relation to this matter that:

> Mining companies should be required to lodge a bond with the government equal to the cost of rehabilitating a site at any stage of the development. The larger the mine, the larger the rehabilitation bond. Upon completion of the rehabilitation to an acceptable standard, the bond would be returned to the company.

In April of 2004 the Australian Nuclear Science and Technology Organisation (ANSTO) released a report that confirmed cracks were appearing in covers that were placed on overburden heaps during the rehabilitation of the Rum Jungle site in the 1980's. The leaching that is occurring is flowing into the surrounding ecosystem and causing pollution downstream from the site, which is affecting the 100 people who live downstream from the site and depend on it for fishing and irrigation (Hinde 2004).

The major issue here is that just fifteen years after the Rum Jungle site was rehabilitated (at a major cost to taxpayers), part of the rehabilitation process has shown some significant flaws. A spokesperson for the Territory Environment Department (Hinde 2004, p.1) confirmed that parts of the rehabilitated project were not performing to their optimum level and that adding to the problem were jurisdictional matters between the Territory and Federal governments. According to a report by the *Sunday Territorian* (Hinde 2004, p. 1):

> …components of the rehabilitation project are no longer performing to the design criteria, but…resolving the problem was a tricky business between the Federal and Territory governments.

Figure A 1.3: The former open cut mine at Rum Jungle

Source: ECNT (1997)

A1.6.7 Engagement with stakeholders

Uranium mining has been undertaken in the Northern Territory for over 90 years, with operations in Rum Jungle, Nabarlek, Radium Hill and Mary Kathleen (Waggitt 2004, p2). The early years of Uranium mining in this region were characterised by a lack of rehabilitation of mined sites, with mining companies generally abandoning sites once mining had ceased. There was also a lack of consultation with both the Indigenous and wider community (a common feature of mining in general at the time), but lack of consultation with Indigenous people did change with the introduction of the *Aboriginal Land Rights Act 1976* (Waggitt 2004, p. 3). Waggitt (2004, p. 3) claims that the introduction of this act along with changing community expectations forced the Federal government into the decision to rehabilitate the uranium sites:

> The TO' s (Traditional Owners) were becoming more involved in the management of their land including the part they leased back to the Australian Government for use as the National Park (Kakadu National Park). These actions, combined with growing community concerns about environmental issues in relation to abandoned mines and rehabilitation generally and uranium related issues in particular, led to the Australian Government deciding to rehabilitate the former uranium mine sites.

The site demonstrated a lack of concern not only for the physical site, but also for the surrounding community whose livelihoods depended on the mine. The town of Batchelor in particular was affected by the lack of mine closure planning, as the town was developed specifically to service the mine. There was a lack of strategic direction for the town and an inability to provide a comprehensive closure plan for the town once mining ceased. The Rum Jungle site provides a good example of why communities should be engaged in the closure process, as it is their town's future that is at stake.

A1.6.8 Summary

A parliamentary report released on 2003 recognised that the containment of pollutants was not part of the initial clean-up campaign. Over the twenty or so years of the mine's operation, mining both copper and uranium, over 600 000 tonnes of tailings has spread over an area of 31 ha (Parliament of Australia 2003). The report released by the Federal Parliamentary Senate Committee found that the sustainability of the site is still not certain. This is despite the additional rehabilitation and remediation that has been undertaken over the last 20 years.

Most of the leaching is being caused by heavy metals and not radioactive waste from the overburden heaps, but the issue is the already high cost to taxpayers for the rehabilitation of the site and the cost to communities in the area, as well as the surrounding ecosystem. Rum Jungle was a mine that began operation when mining companies had no legal responsibility to rehabilitate sites once mining was completed and therefore little or no responsibility to the communities they left behind. As one scientific researcher at Rum Jungle stated (Hinde 2004, p. 1):

> The mine operated at a time when no-one considered the effects on the environment so this is being extensively studied to learn what not to do…Rum Jungle is a good example of what not to do…

Figure A 1.4: Rum Jungle, Northern Territory

Source: Senate Committee report site photo, Parliament of Australia (2003)

A1.7 Mt Todd Gold Mine – Northern Territory – Gold

The Mt Todd gold mine in the Northern Territory, about 50 kilometres north of Katherine ceased production in 2000. The mine first opened in 1993 under operators General Gold Resources, but was sold to Pegasus Gold Inc (USA) in 1996. Pegasus Gold Inc initially closed the site in 1997, only to reopen it in 1999 and subsequently close the site e again in 2000, after what the operators claimed were high production costs. The Stateline program (Coggan, 2004) on the ABC reported on the state of the site in June of 2004, with the report claiming that the site has deteriorated to such an extent that the countryside surrounding the mine is under threat.

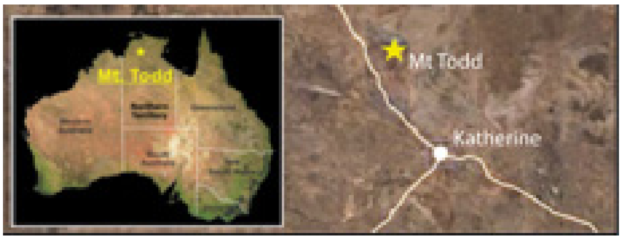
A1.7.1 The location of the mine

The Mt Todd mine is located in the Northern Territory, approximately 50 kilometres north of the township of Katherine and 250 kilometres from Darwin (Northern Territory Department of Minerals and Energy, 2010)

Katherine experiences a tropical savannah climate, with distinct wet and dry season patterns. The annual average rainfall for the region is 1,040 mm, the majority of which falls during the months of January to March. The average temperatures range from 25° to 35° Celsius for the majority of the year, with warmer, more humid temperatures experienced during the build-up to the wet season in November and December (Katherine Town Council, 2010).

The region around the Mt Todd mine consists of mostly tropical savannah woodlands, with some monsoon rainforest in parts of the region (Katherine Town Council, 2010). The isolated and rugged terrain of the area means that it is more prone to environmental damage.

Figure A 1.5: Mount Todd mine location



Source: Mining Journal Online (date??)

A1.7.2 Size and profitability of the mine

The mining tenement at Mt Todd covers an area of 160,878ha and at the time of the initial mining had an estimated nine years of reserves, with the last owners of the mine Pegasus Gold Inc claiming that the feasibility study for the mine showed that the mine would be profitable for the company. , Pegasus Gold Inc took ownership of the site in 1997, but did not commence mining until 1999, due to low gold prices and low demand. Pegasus Gold Inc claimed to have spent nearly $200 million developing the site during this period, despite the fact that the mine was not operational. The mine operated as an open pit mine with paved road access to the Stuart highway, freshwater supply for the site, in addition to power and natural gas (PR Newswire, 2010).

According to a number of reports, including the Environment Centre of the Northern Territory (2007), the mine was always marginal and was never going to achieve the rates of return suggested in the initial feasibility study. The Territory Government in 1999 in order to get the mine operational again, waived the mining companies rehabilitation bond (Environment Centre of the Northern Territory 2007). It was nine months after this that the mine went into receivership, with an estimated rehabilitation cost of $20 million, yet only $900,000 in rehabilitation bonds paid when the mine first started operation in 1994 (PR Newswire 2010).

The mine was initially closed in 1997 due to low gold prices and technical difficulties at the site, at the time no rehabilitation was undertaken as it was assumed that the site would recommence operations at a later, unspecified date. After the indefinite closure of the mine in 2000, the mine’s plant and equipment were sold by the receivers in order to pay back some of the debt owed by the company. Little remediation work was done at the site at the time and as a result the tailings dam was later found to have leaked toxic materials into the surrounding environment.

After the mine closed down in 2000, the Northern Territory Government was forced to use the initial rehabilitation bond money to pay for immediate remediation at the mine site, however, the Northern Territory Department of Minerals and Energy admits in its own factsheet that this money was spent on water management alone at the site (Northern Territory Department of Minerals and Energy. By 2003 the Northern Territory Government had spent $5 million on containment work at the site, all of which was government money, with an estimate of $20 million needed to rehabilitate the site in the long term (Environment Centre of the Northern Territory 2007).

Figure A 1.6: Mount Todd Mine August 2000, just before unplanned closure

Source: Environment Centre of the Northern Territory (2007)

In an interesting turn of events, Vista Gold Corp, an organisation based in the Unites States, brought the Mt Todd site from the receivers of Pegasus Gold Inc in 2006. In August of 2010 the company announced that it had commissioned a feasibility study into the site which found that the mine had estimated mineral reserves of two million ounces and that mining the site would prove profitable for the organisation.

The President of Vista Gold Corp noted in relation to the Mt Todd mine that (PR Newswire 2010):

> ..We believe that the comprehensive program of work that we have undertaken over the last four years has addressed the technical issues experienced by Pegasus, Mt Todd's prior owner. It is our belief that based on our improved understanding of the ore body, together with the selection of a proven milling process and equipment, the proposed reopening of Mt Todd will be technically, operationally and economically attractive at a conservative gold price of $US950 per ounce and very attractive at current gold prices...we believe we may be able to double the project's proven and probable mineral reserves estimates to approximately 3.5 to 4.0 million ounces. Additionally, we believe there is significant potential to grow Mt Todd's mineral resource estimates through exploration on the projects 160,878 hectares of exploration tenements."

It is probably pertinent to point out that the original feasibility study for Mt Todd also found in favour of mining at the site, yet the actual operational phase of mining proved unsuccessful for the company and the poor operational output eventually forced the closure of the mine in 2000. This unplanned closure has caused numerous difficulties for the site and made the mine infamous for poor closure practice throughout the world. The possibility of another unplanned mine closure needs to be taken into account by Northern Territory regulators before allowing mining to recommence at the site.

A1.7.3 The size of the community where the mine is situated

The Mt Todd mine is approximately 50 kilometres from the township of Katherine and is located within the boundaries of the Katherine Town Council municipality. The area around the mine would be classified as remote and sparsely populated, however, the local Indigenous community the Jawoyn people reside in areas surrounding the mine and it was their land that the Mt Todd mine is situated in.

The population of the local government area was 8,194 people (Australian Bureau of Statistics 2006). The vast bulk of the population reside in the Katherine urban area, with over 70% living within the urban boundaries and the remainder scattered throughout the rural areas of the local government area.

A1.7.4 The ownership of the mine

The Mount Todd mine was opened in 1994 by General Gold Resources, with new owners taking over in 1996, the suspension of operations in 1997 and the re-opening of the mine in 1999 (Wakeham and Blair 2003). The Mount Todd mine collapsed in 1997 after problems with the processing and low gold prices made the mine unviable for production. The owner at the time of the collapse was Pegasus Gold Inc (USA).

The companies Pegasus Gold Inc (Canada) and Pegasus Gold Inc (USA) sued Bateman Project Engineering Pty Ltd, Kinhill Pacific Pty Ltd, and Killhorn Engineering Pacific Pty Ltd over their 1995 feasibility study that found mining would be feasible at the site. These three companies then subsequently sued six other companies Svedala Australia (Metso), Australian Mining Consultants, Gurchel Engineering, Knight Piesold, Mining and Resource Technology Pty Ltd and Resource Service Group (Mining Australia 2001).

The action taken in the federal court alleged the following:

> …negligence by the respondents in that they wrongly advised that phase two development was economically viable and that it should proceed immediately and on the design and construction recommended. Further, they failed to obtain representative ore samples and failed accurately to predict gold recovery, grade, labour rates, power costs, power consumption, cyanide consumption, contract mining costs and the likely amount of recoverable gold, the total cost of the life of the mine, cash cost per ounce of gold and other factors.

The cases were settled in 2001, but they were settled on confidential terms, with no details released. These cases highlight problems that can arise in the mining industry after a company goes into receivership. Aside from the difficulties faced by employees and creditors, the impact on local communities can be devastating and the difficulties with site rehabilitation and closure are compounded (as has been demonstrated by this case), by problems over responsibility for costs surrounding rehabilitation. In this case the complications and uncertainty over closure costs, has become an expensive exercise for the Northern Territory government and ultimately the Northern Territory taxpayer. It is cases such as this one that highlight the weaknesses with some aspects of the regulatory regime in Australia and the need for stronger legislative requirements to prevent this happening again in the future.

It was noted earlier in this case study that Vista Gold Corp purchased the Mt Todd mine in 2006 from the receivers of Pegasus Gold Inc and that Vista plan to reopen the mine in the near future based on the positive findings from a feasibility study commissioned by the company.

A1.7.5 When the mine closure was planned

This was an unplanned mine closure, which left the local community and indeed the Territory government with a dilemma as to who has responsibility for the closure of a site if a company is no longer operational. At the heart of this matter is the amount required by governments in rehabilitation bonds and whether or not they are sufficient to cover unexpected or unplanned closures at mine sites. In the case of Mount Todd it would appear that little foresight was provided by regulators regarding the closure of this site and the consequences of this for the local community economically, socially and ecologically.

How the mine closure was planned and conducted

The traditional owners of the site, the Jawoyn people met with Northern Territory government officials in June 2004 to discuss the state of the site and its effect on the surrounding countryside. The issue of the rehabilitation of the site has been problematic due to legal issues about who has responsibility for closure. In its current state, it appears that the taxpayers and the Northern Territory government will be forced to pay for the rehabilitation of the site, which it is estimated could be as high as $20 million (Coggan 2004).

The Jawoyn people claimed that they would never have signed off on the mine, had they realised the depth of the environmental problems that would arise after closure. According to a spokesperson for the Jawoyn people, Mr Robert Lee speaking on the Australian Broadcasting Corporation (ABC) program *Stateline* (Coggan 2004):

> We shouldn’t have signed this agreement if this is what the country looked like, when the mining people walk away from something that we call as a polluter.

Figure A 1.7: Photo of tailings dam at Mount Todd, which is still leaking cyanide into the environment

Source: Bonzle Mining Photo Collection (2010)

A1.7.6 What alternative closure options were considered

The site was an unexpected closure, due to the court action taken by the company involved with the site, however, no closure evidence of a closure plan for the site has been found. This site raises issues surrounding unexpected mine closures, particularly when the closures occur due to financial problems with the mining company, as in the vast bulk of cases, Local, State and Federal governments are left with the cleanup of the site, an expensive and often long, drawn out process.

A1.7.7 The legislation under which the closure was conducted

The company associated with the mine ceased operating in 2000, but no rehabilitation bond had been required by the Northern Territory government to start operating. The Northern Territory government was left with only the initial $900 000 rehabilitation bond. The estimated cost to clean the site, however, is $20 million. The government, and hence the Northern Territory community, will be forced to wear the estimated $19 million rehabilitation cost, or accept the environmental problems associated with the site, including acid mine drainage, (Wakeham and Blair 2003) (this site will be examined further as a case study in its own right).

A spokesperson for the Environment Centre of the Northern Territory, noted that the Mount Todd gold mine is just one of many examples where the Northern Territory Department of Mines has mismanaged the rehabilitation of a site (Coggan 2004). The general manager of the Department of Mines and Energy, however, disputed this statement, claiming that disturbance at the site was within the terms of the mining lease. The general manger also stated there was enough money for the site and that rehabilitation over the long term of the site will be dependent on legal outcomes that are yet to be decided (Coggan 2004).

The Sunday Territorian newspaper reported in July 2004 that the full cost of rehabilitating Mount Todd could be as high as$20 million, whilst the author noted that a rehabilitation bond had been paid by the initial owners of the mine when it first began operating in the mid

1990’s this amounted to only $900,000, far short of the estimated rehabilitation cost (Hinde 2004, p. 1).

The rehabilitation bond money that is left is mainly being used as a stopgap measure to manage the void and prevent run-off into the nearby Edith River. As Hinde reported on this issue (Hinde 2004, p. 1):

> … (rehabilitation) money has been used to manage the site since it went into administration managing the water around the huge hole especially in the wet season, the tailings dams and making sure there are no problems with run-off into the Edith River.

Further to this the Department of Mines acknowledges that this bond money will run out and that they (the Department of Mines) are unsure as to what will happen after that. The Department of Mines said of this issue that (Hinde 2004, p. 1):

> We will keep spending that money until we run out and the next stage is to determine what will happen with the lease if the receivers don’t get someone to buy it but that is a whole new situation.

A1.7.8 Engagement with stakeholders

In 1993 the Jawoyn People entered into a deed of agreement over the Mount Todd gold mine. This agreement was signed between the Northern Territory Government, Zapopan Ltd (the owners of the mine) and the Jawoyn People. As part of the agreement, the Jawoyn people were to forgo any native title rights to the mine and any claims lodged under the *Aboriginal Rights Act 1976* were withdrawn. The Jawoyn people were granted ‘enhanced’ freehold title on land surrounding the mine, and given training and employment benefits at the mine.

The following is a list of some of the details of the agreement (University of Melbourne 2003):

- The Jawoyn will not receive any royalties, rent, or other revenue arising from the operation of the mine
- The benefits that will accrue to the Jawoyn include the title to the land, and economic benefits such as training and employment opportunities arising from government funded positions
- Other benefits for the Jawoyn people include the construction of up to six fully serviced houses on Jawoyn land, and the employment of Jawoyn people at the mine in a variety of administrative and skilled labour roles
- The Jawoyn people will also gain a bus service, as well as both university and non-university scholarships to suitably qualified persons from the Jawoyn community

Zapopan Ltd under the agreement was indemnified from costs arising from a future claim to land by the Jawoyn People. Upon the granting of freehold to the Jawoyn People, the agreement (University of Melbourne 2003) states that the:

> …association cannot create or dispose of any interest in land without first obtaining from the party in whose favour such an estate or interest is created, or disposed covenants in favour of Zapopan and the Territory.

Further to this, the agreement also gave the Northern Territory Government the right to resume any of the land for the provision of access to roads, power, and water and health facilities at the Mount Todd mine.

The Mount Todd agreement between the Jawoyn People, Zapopan Ltd and the Northern Territory government was the first agreement signed following the Mabo decision and was at the time hailed as a success by both the Federal and Territory governments (Department of Transport and Regional Services 2000). The Jawoyn People were also the first Indigenous people in Australia to join a peak mining body council – the Northern Territory Minerals Council, this again was seen as a large step forward in Indigenous relations in the mining community in Australia, particularly with the uncertainty that surrounded the Mabo decision.

The Jawoyn People had strong employment representation at the Mount Todd site, where they accounted for approximately 32% of the workforce (Department of Transport and Regional Services 2000). They also established a contracting company – Mirrworilk - that was provided with the contract to excavate the ore body during the second stage of development at Mount Todd in 1996. The commercial joint venture was financed by a $10 million loan that was to be paid back from profits earned during the mining phase (National Indigenous Working Group on Native Title 1999). The company also gave the mine an aboriginal name Yimuyn Manjerr (Jawoyn for a site near the mine) (Department of Transport and Regional Services 2000), hence, the local Jawoyn People felt and indeed did have a large amount invested in the mine's development.

The new owners of the Mt Todd mine, Vista Gold Corp announced in their intention to reopen the mine that they would meet the required standards for rehabilitation of the site and that their feasibility study included engineering costs necessary to remediate the site for the long term. The statement from Vista in regards to this stated (PR Newswire 2010):

> ...The closure plan was designed to meet all requirements for long term reclamation of the site and cost estimates include provisions for monitoring required under applicable law.

Only time will tell whether or not Vista can succeed where Pegasus failed, however, the local community, particularly the Indigenous community will be hoping that the regulators are more stringent in their monitoring of developments with Vista than they were with Pegasus.

A1.7.9 Conclusion

The Mount Todd situation demonstrates what can happen when the legislative regime and bond mechanisms fail to adequately cover the premature closure of a mine site. The Northern Territory legislation has not been drafted to cope with the issues surrounding mine rehabilitation and closure. The inability, or lack of concern by the government over the bonding mechanism, has led to a situation in the Territory where some mining operators have been able to forgo their obligations surrounding mine rehabilitation and closure. This is most definitely not world's best mining practice and has in many respects left the Northern Territory well behind its counterparts in the rest of Australia, all of whom have at least enacted and enforced bond legislation that goes some way towards covering rehabilitation and closure costs should a mine be forced to shut prematurely.

A1.8 Summitville Mine – Colorado – USA – Gold

Mining for gold in the Summitville area began in the 1870's, in the form of underground mines and started a process that radically altered the region. Prior to mining, the area consisted of wetlands, uplands, and significant mountain ranges. Mining in the region saw the creation of access roads and waste disposal deposits that have contributed to a radical altering of the landscape and the introduction of Europeans to an area that was previously inaccessible. During the 1960's Wightman's Fork was diverted, thus enabling construction to begin on a tailings pond for an open cut mine (Warhurst and Mitchell 2000). It is important to recognise the impact that these early events had on the Summitville mine as they all helped to contribute in part, to the environmental problems associated with Summitville in the 1980's and early 1990's. As Warhurst and Mitchell (2000, p. 93) explained with regards to this issue:

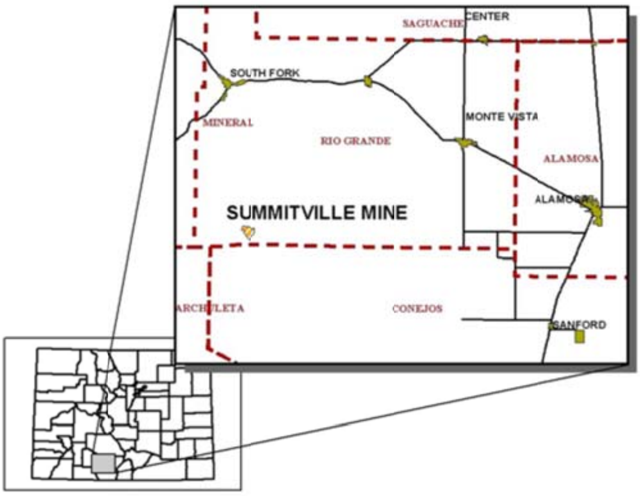
> …by the 1980's when the chain of events that led to the eventual abandonment of the site and its classification as a Superfund site, there already existed a considerable legacy of land and water contamination over and above that resulting from the occurrence of natural mineralisation in the region.

A1.8.1 The location of the mine

The Summitville mine is a former gold mine located in Colorado in the USA. It is positioned in an elevated area of 11,500 feet (approximately 3,500 metres**)** above sea level. The site is surrounded by the Rio Grande National Park; it is bounded in the north by the Wightman fork of the Alamosa River and in the east by Cropsy Creek. The annual rainfall in the area is 1400 millimetres p.a., with evaporation of only 610 millimetres p.a. (Warhurst and Mitchell

2000). The Summitville site has serious water management issues. The groundwater sits in a number of shallow and discontinuous aquifers (Warhurst and Mitchell 2000). The bedrock is fractured and there are numerous springs in the area that seep water to the surface.

Figure A 1.8: The Summitville mine located in the southwest of Colorado in the Rio Grande U.S



Source: EPA 2009, p. ?? if have – but not if electronic

A1.8.2 Size and profitability of the mine

In 1984 Summitville Consolidated Mining Company purchased an area of 5.0km² at Summitville in Colorado, in the United States. They began working the mine as an open pit operation in the same year, with the pit covering an area of 2.2. km² (United States EPA 2010). The mine was historically an underground mining operation, however, mining at the site proved to be not feasible economically and hence mining basically ceased on a large scale until 1984.

Between the mine's opening in 1984 and its early closure in 1991, Summitville Consolidated Mining Corp produced an estimated US $81 million worth of gold and silver at the site, or around 9,155.8 kg of gold and 9,947.3 kg of silver (United States Geological Survey 1993).

The United States Geological Survey (1993) claimed that the mine was only ever considered marginal as a mine site, as the reserves were located deep below the surface and underground mining of the site at least was deemed to be not economically feasible. The open cut mining of the site did produce more significant volumes of metals; however, the company that owned the site, Summitville Consolidated Mineral Corp Inc (SCMCI) went into bankruptcy in December of 1991 and did not have the money to clean the contamination that had been occurring at the mine site. The USEPA estimated that by the time the site was forced to close in 1991, 320 m^3 of contaminated water had leaked from the mine into nearby creeks, in addition to this, the older underground mine was estimated by the United States

Environmental Protection Agency to be leaking 11 m^3 per minute into the surrounding ecosystem (Colorado Department of Public Health and Environment, 2010). Low commodity prices during the latter period of the mine's life would certainly not have assisted the company in its operations, however, the company was continuously in trouble with regulators due to environmental breaches and perhaps this should have raised concern with State regulators.

One of the major problems at the Summitville site was the lack of historical documentation surrounding the environmental impacts on the site. As mining commenced in the late 1800's and the mine changed hands a number of times, records were lost as new owners took over. There was very little documentation on waste deposited at the site hence, Summitville Consolidated Mineral Corp Inc to a degree faced difficulties before mining even commenced.

Despite this, however, Warhurst and Mitchell believe that SCMCI needed to be more pro-active and thorough in their assessment of environmental issues at the site. The researchers found that SCMCI failed to take into account previous environmental feasibility studies undertaken at the site, most notably by mining company Anaconda, and that had SCMCI used these reports they may well have decided that mining was not a viable option at the site.

Further to this, Warhurst and Mitchell found that SCMCI failed to (2000, p. 97):

> …predict potential ARD generation from waste piles through, for example, the application of static and kinetic leach tests. It also had the opportunity to take the opportunity to take the necessary steps to avoid acid-generation by implementing waste management control options (namely the isolation of sulphidic material and minimisation of the exposure of sulphide-rich altered clay zones in the open pit). Evidence suggests it followed neither of these routes.

Figure A 1.9: The Summitville mine as it looked in 1999

Source: U.S. EPA 2009

A1.8.3 The size of the community where the mine is situated

The town of Summitville is located approximately 40 kilometres from the town of Del Norte, which was the major service town for the former mine. The area around the mine is characterised by high mountain ranges (between 3700 and 3800 metres) with heavy snowfall and spring runoff ensuring that the surrounding streams flow year round and hence water leaches into the surrounding soil. The mine is situated in the County of Rio Grande with a population of 12,413, covering an area of 2,360 km² (U.S Census Bureau 2007). The region consists of mostly rural properties and is surrounded by forest and the Rio Grande River, making the area popular with tourists due to the pristine wilderness.

A1.8.4 The ownership of the mine

The mine's surface and mineral deposits were owned by Aztec Minerals Corporation, Gray Eagle Mining and South Mountain Minerals Corporation (Warhurst and Mitchell 2000). In 1984, these owners leased the land to Galactic Resources Inc (GRI), of which Summitville Consolidated Mining Company Inc (SCMCI) was a wholly owned subsidiary (Warhurst and Mitchell 2000, p. 93). It was this company that designed, built and operated the final facility.

The parent company Galactic Resources obtained a mine permit in 1984 from the Colorado Mined Land Division to construct an open-pit mine and heap leach(the process of extracting the gold from the orebody) operation at the Summitville mine site. Almost immediately after construction the heap leach pad began to leak cyanide, to the point where the company was issued with violation notices by both the Colorado Water Control Commission and the Mine Land Reclamation Board (US EPA 2009).

The company was forced to build a water treatment plant on site at the mine to cope with discharge from the mine. The facility discharged treated water into the nearby Wightman Fork, however, it was discovered that the treated water did not meet legislated requirements and the company was permitted by the Water Control Commission to apply contaminated water to the site surrounding the mine. These fluids were then found to be leaking into the Wightman Fork and discharging high concentrations of cadmium, zinc, cyanide and copper into the water body (U.S. EPA 2009). The company was issued with a number of violation notices during 1991 and 1992 for issues relating to contamination both at the site and in the surrounding area.

In 1992 Summitville Consolidated Mining Company announced that bankruptcy was pending and informed the State of Colorado that the company would no longer be able to provide financial support for its site operations after the 15th of December of that year (U.S EPA 2009). The State of Colorado requested emergency assistance for the site in early December of that year in order to prevent an environmental catastrophe in the surrounding ecosystem. The United States Environmental Protection Agency began immediate remediation of the water treatment plant at the site in order to treat the cyanide and acid mine drainage from the site.

The site is still under the control of the United States Environmental Protection Agency, who are working with the State of Colorado and the local community to continue remediation of the site as at December 2009.

A1.8.5 When the mine closure was planned

The Summitville mine site was not a planned closure, but was abandoned in 1992 by Summitville Consolidated Mining Company Inc, the site was not rehabilitated. Rehabilitation/remediation for the site was then conducted by the United States Environmental Protection Agency (USEPA), which took over responsibility for the site, through the USEPA Superfund program (???Need reference for this USEPA year??). The Superfund is a fund established by the USEPA to fund rehabilitation/remediation at orphaned or abandoned sites throughout the United States. The superfund program was established in the 1980’s by the United States Congress to locate, investigate and clean sites throughout the United States where uncontrolled and hazardous waste sites existed. The EPA administers the Superfund program in cooperation with local, state and tribal governments. Money for the Superfund is paid either by the parties responsible for the mine, or the Superfund trust fund. The trust fund was established by taxes from the chemical and petroleum industries. The EPA can recover clean-up costs from companies that refuse, or do not pay for site clean-up.

How the mine closure was planned and conducted

The site was officially closed on December 16 1992 (Warhurst and Mitchell 2000). Upon its closure a severe environmental threat was recognised by state regulatory authorities (the threat consisted of cyanide leakage into the Cropsy Creek, Wightman Fork and eventually the Alamosa River), which felt that they could not deal with the threat posed. It was this threat that saw the EPA step in under the Superfund (Emergency Response) Program. The EPA worked with SCMCI staff to prevent any immediate threat caused by the cyanide (Warhurst and Mitchell 2000).

The Summitville Consolidated Mining Company Inc were not required to clean up prior mining environmental impacts and , met the permitting requirements at the time. The Colorado Mined Land Reclamation Board (CMLRB) accepted the company's assessment of conditions at the site (Warhurst and Mitchell 2000).

Warhurst and Mitchell (2000, p.93) noted that neither the company nor the regulatory authorities addressed the environmental issues that were to arise from the failure to adequately address previous environmental mistakes:

> …the decision not to address past pollution suggests that a potential future problem was being built into the project and; from a CSR perspective we can note a regulatory framework that did not require past pollution to be addressed…that could be interpreted as storing up problems for the future.

In 1984 SCMCI began the process of establishing an open pit in the South Mountain region. To create the open pit, waste rock and ore were excavated with the waste rock being used in road construction, embankments and parking areas (Warhurst and Mitchell 2000).

The company's extraction process also changed during the mining phase, due in part to the halving of the gold price from 1982 to the commencement of mine operations in 1986. A further issue that arose from this was that management and continuity problems arose as SCMCI changed consultants during the mine construction phase, causing communication problems.

The abandonment and closure of the site was sudden, but as Warhurst and Mitchell noted – in hindsight issues with the site abounded almost from its commencement. The Colorado state government regulatory agencies required SCMCI to report on contaminants being released from the site, nearly one and a half years before closure. The company was also being forced to begin measures for progressive rehabilitation of the area. In the eyes of critics of the State regulatory authorities, this was left too late, and should have begun as soon as mining commenced (Warhurst and Mitchell 2000).

What alternative closure options were considered

No alternative closure options were considered for this site, as it was an unplanned mine closure. The Colorado State Government was forced to ask for emergency assistance from the United States Environmental Protection Agency to commence a clean-up of the site which had become severely contaminated due to poor operational management of the mine.

The concern of the EPA and state regulatory authorities regarding the site was the potential cyanide leakage into ground and surface water supplies. The major concern of regulatory authorities, however, was the potential for Acid Rock Drainage (ARD). As Warhurst and Mitchell noted, ARD at Summitville (2000, p. 95):

> …is among the most acidic and metal-contaminated in Colorado and…has been an issue for many decades.

Warhurst and Mitchell go to some extent explaining that ARD was a problem in this region prior to mining (although its effects were nowhere near as potentially devastating) and that the goal of any rehabilitation/remediation work by regulatory authorities is to return the site to pre-industrial conditions, with the emphasis of the EPA on totally rehabilitating the site, it is possible Summitville could turn into what the researchers describe as an 'economic sink'. This describes a situation in which endless amounts of money are poured into a site in an attempt to remediate it, but as one problem is fixed, another arises and it becomes a never-ending cycle. Warhurst and Mitchell do not appear to be advocating that nothing be done in this case, but they are merely suggesting a more cautious approach to mine rehabilitation in cases such as Summitville.

Another significant issue for the site was the pH levels through water discharge from both waste piles and adits (an underground mine entrance) from the former underground mine sites. The pH levels ranged from 2.3 to 3.2 (United States Geological Survey 1993), with high metal and element concentration, the ideal pH levels for mine water are between 5 and 7, although evidence from some overseas mine voids pH levels between 3 and 5 will become less acidic as they accumulate organic material that breaks down acidity over time (Lund, 2001)

It was decided by the EPA and other regulatory authorities that the priority in cleaning up the Summitville site was to control Acid Rock Drainage. A three phase program was decided on at the start of the rehabilitation program, these three phases were chosen for their cost-effectiveness, as much as their environmental quality. The phases included removing acid generating waste from saturated areas, the backfilling of open pits, and reducing the amount of infiltration from the former underground mines (Warhurst and Mitchell 2000, p. 96).

> Phases I and II:

> …consisted of the lining of the north and south open pits with a clay liner and two feet of lime and subsequent removal of the majority of the Beaver Mud Dump, Cropsy Waste Pile and Cleveland Cliffs Tailings Pond to the lined pits. Approximately 3.6 million cubic metres of acid generating waste were relocated to the pits during the period 1993-1996."
>
> Phase III:
>
> …included capping and vegetation of the unfilled south pit in 1995 and revegetation of the sites from which waste had been removed. The north pit backfilling is continuing and eventually it is planned that this will also be capped.

It was hoped that the measures taken to rehabilitate and reclaim the mine site, particularly the revegetation program, might reduce the need for continuous water treatment. The regulatory authorities were hoping that a return to a pre-mining environmental state and reduced water infiltration (along with revegetation) would enable water management of the site to return it to its pre-mining natural environmental state.

The legislation under which the closure was conducted

Despite operating under a poor regulatory framework compared to today's regulatory framework, SCMCI was still found to be in violation of a number of provisions of the *Colorado Mined Land Reclamation Act (1976).* One of these violations included partially, or completely omitting design features outlined in its permit application without consulting either CDMG or CMLRB (Warhurst and Mitchell 2000, pp. 98-99):

> …on 2nd May 1996 SCMCI pleaded guilty to 40 felony violations of federal environmental laws at the Summitville site, and was fined US$20 million. SCMCI entered guilty pleas to charges of conspiracy, unauthorised discharge of pollutants, failure to make required reports and making false statements or documents…
>
> …neither a proactive, nor an integrated approach to environmental management and pollution prevention was apparent in the strategy of SCMCI at Summitville. All this, of course, is in the context of a regulatory framework that limited the regulators capacity to intervene directly.

Warhurst and Mitchell note that prior to abandonment of the mine federal government agencies had also began to monitor the mine. The authors (p. 94) provide a list of environmental and operational issues identified at the site:

- The permit was issued and construction commenced before a number of critical issues were fully resolved, on condition that they would be resolved later on. In a very real sense, planning never caught up with what was happening on the site. This particularly relates to closure planning.
- Difficulties in monitoring the integrity of the liner systems under the heap leach pad, following its construction during the winter. Concerns regarding the bank financing of the operation and the fear of reducing the potential profitability of stock options made

to senior staff appear to have generated significant pressure on contractors to remain on schedule with liner construction despite extreme weather conditions…Deadlines that related to bank loan commitments also appear to have been a contributing factor…moreover a number of changes were also made to the liner system that were neither submitted to the state regulators for approval, nor properly considered prior to implementation.

- Leaks were detected between the upper and lower liners and through the lower liner within a week of beginning leach heap operations in June 1986. This leaked effluent was subsequently pumped back into the heap leach, further aggravating the overall water imbalance (1400 mm per annum precipitation, against 610 mm per annum evaporation) at a site where the leach portion of the project was initially envisaged as being zero discharge…through water entrainment in the leach material, enhanced evaporation and "aggressive" surface water management.
- Failure to stop construction and repair the liner when significant leakage became obvious also contributed to the unfolding environmental impacts and liabilities.

The day before SCMCI filed for bankruptcy it submitted a revised rehabilitation plan to the Colorado Division of Minerals and Geology (CDMG) and the Colorado Mined land Reclamation Board, this included additional costs of between US$26 million and US$38.6 million (Warhurst and Mitchell 2000, p94). On acceptance of this plan the company would then have been required to pay extra rehabilitation bonds related to the new costs of rehabilitation - this of course did not eventuate.

The Reclamation Bonding System established by the Colorado regulatory authorities was insufficient to deal with the environmental problems that arose on the site. This bond was set in place before Colorado had put in place an effective bonding mechanism. The initial bond required was US$1.3 million; this payment did not include water treatment costs and was only intended to cover contouring and grading of the site. In 1989 the company entered an additional US$0.9 million bond, but it still did not include water treatment.

In 1992 the company was required to submit another US$5.2 million in bonds as state authorities recognised that the initial rehabilitation plan was not comprehensive enough. Towards the end of 1992 the company was able to apply to have US$2.5 million of its bond money back, following some site rehabilitation, including some water treatment (United States EPA 2010).

Warhurst and Mitchell (2000) noted that upon the abandonment of the site the bonds held by the state regulatory authorities were US$4.7 million (2000, p95). This money, however, was for use according to the rehabilitation/closure plans and not for any potential environmental problems. As Warhurst and Mitchell also noted, much of this bond was in near worthless plant and equipment and could not be removed from the site to sell and at least attempt to recover some costs. The table below provides an outline of the costs associated with rehabilitation at the Summitville site up to 1998. As the table demonstrates the cost associated with the clean-up of the site will have far outweighed any benefits the site may have generated both for the local community and the Colorado State government. Prior to the publishing of the paper by Warhurst and Mitchell in 2000, it was estimated that water treatment costs at the Summitville site amounted to US$65 million, or approximately 55% of project costs (Warhurst and Mitchell 2000, p96).

Table A 1.1: Costs of remedial action at Summitville mine

Activity	Cost	Comments
Water Treatment	US $55 million to end of 1997	Includes treatment of cyanide bearing water from heap leach pad and ARD
Source removal and pit capping	US $32 million to end of 1997	Does not include cost of capping the north open pit
Adit plugging	US $1.2 million	Total cost plugging completed
Recontouring and reclamation	US $45 million (estimated)	Cost of recontouring and capping the leach pad was US $15 million. Estimated cost to complete site restoration is US $30 million.

`Source: Table reproduced from Warhurst and Mitchell 2000; p.91

The Summitville mine case forced the state of Colorado to alter its mine permit laws. Prior to this mine permits required rehabilitation on closure, however, studies were not required to prove that the company could actually meet its rehabilitation targets. This process changed with the Summitville case, forcing the Colorado state government to alter the mine permit laws, with mine site rehabilitation becoming ongoing during the mining process. It is important to note that the Summitville mine case forced the state of Colorado to amend its permitting and bonding laws regarding mine operations.

Figure A 1.10: Summitville Gold Mine, Colorado

Source: US EPA (2004)

A1.8.6 Engagement with stakeholders

The Summitville mine owners, the Summitville Consolidated Minerals Corp did not necessarily engage with the local community on their closure plans for the site. The community did not become actively involved with the Summitville site until environmental problems began to beset the site in the late 1980's and early 1990's. The site generated considerable publicity both locally and nationwide after the mine went into receivership at the end of 1991 and the State Government requested assistance from the Environmental Protection Agency, at which stage the problems affecting the site became well known.

The Colorado Department of Public Health and Environment (CDHPE) along with the Federal Environmental Protection Agency initiated a Community Involvement Program (CIP) on the site from the beginning of their involvement with the site clean-up. The EPA initially began providing annual site updates in order to provide information on the rehabilitation work being undertaken at the site. In 1994 the community was awarded a grant to establish a local community based technical assistance group (TAG) for the site. This group works alongside the EPA in delivering rehabilitation outcomes for the site and is still in existence today, along with the Alamosa River Keepers who are assisting with monitoring of the waterways in the region (United States Environmental Protection Agency 2010).

The Community Involvement Program has six key areas (United States Environmental Protection Agency 2010):

1. Ensure two-way communication between the community and CDHPE,
2. Develop and maintain open communication between CDHPE, the EPA, community leaders, environmental, or other public interest groups and any other interested, or affected groups,
3. Summarise community involvement program activities that have occurred through progressive phases of remediation,
4. Determine which actions have been most effective and which have not,
5. Identify and respond to community concerns, and,
6. Develop and/or update public involvement and communication methods that address community concerns

The two government departments (US EPA and CDHPE) have released a number of documents relating to current (2010) and proposed rehabilitation developments (2010-2015, 5 year plan) at the site, in addition to hosting numerous public meetings to discuss these developments. In addition to this, the agencies have conducted group based community interviews in order to ascertain community understanding of the rehabilitation being undertaken at the site and also to determine what aspects of the rehabilitation program the community believe need improvement and modification. The agencies have also hosted Congressional and community tours of the site in order to provide first hand information on how the remediation of the site is progressing.

Warhurst and Mitchell (2000) believe that in a well-regulated and well-enforced environment a case such as Summitville need not occur again. They do note, however, that in some countries (notably Australia, Canada and the United States) there is the risk of over-regulation and that mining companies may choose to shift operations abroad where mining laws are less strict, hence shifting potential problems elsewhere. The possibility of environmental, economic and social damage occurring requires a global unified legislative approach to mine closure and to mining in general, with a need by wealthier nations, such as Australia, Canada and the United States to ensure that poor mining and closure practices are not just shifted to developing nations for example Papua New Guinea, Indonesia, Zimbabwe where mining laws and regulations are less stringent. It also means that guidelines outlined in reports such as the Mining Minerals and Sustainable Development needs to be adhered to by all involved in the mining process, throughout the world. This does not mean that mining companies deliberately attempt to abrogate their responsibility with regards to mine operation and closure, nor that all mining companies neglect their responsibility with regards to mine rehabilitation. According to Warhurst and Mitchell (2000, p. 99):

> "Mining – barring a complete paradigm shift in technology – by its very nature will continue to have impacts on the physical environment, be they transient, temporary, or permanent. It is perhaps easier now to envisage a time when negative environmental and social impacts can be properly managed, minimised or eliminated throughout the industry. Technological change and the development of effective environmental management systems have contributed significantly to merit this optimism. Against this must be balanced the benefits that extraction and processing of minerals can bring."

The mining industry has moved on from the past when the industry and the regulatory environment did not always work in tandem to promote environmental, economic and social stewardship. There may even be an argument to say that this is still the case (and Summitville and the others poor practice examples in this case study appendix provide some weight to this), however, regulatory environments have changed and social expectations regarding what is acceptable in terms of the footprint left by mining, now demand that mining companies leave behind a positive legacy once mining has ceased at a site. This does not mean it is possible or even plausible to expect mining companies to rectify environmental problems left behind at a former mining site, if the company met its regulatory obligations at the time (which at any rate would be difficult to prosecute). The case of Summitville however, represents what can happen when companies operate within a regulatory framework that fails to address problems that develop when mining companies exploit weaknesses in the regulatory structure, or indeed just fail to comply. The community and in the case of Summitville the nation are left with a legacy from mining that will take many years to rectify and cost taxpayers vast sums of money for many years to come.

The Summitville mine demonstrates why it is necessary for governments to ensure that the legal framework governing the mining sector is tightly regulated and enforced by government officials to prevent future disasters like that which occurred at Summitville. This also provides reassurance for local communities and goes a long way to ensuring support for future mining projects. Mining companies then need to involve local communities, in addition to the regulatory authorities in the mining process from the planning stages, addressing concerns over past mining practices and demonstrating what strategies and policies the company has to ensure that it meets its social as well as its regulatory obligations.

A1.8.7 Conclusion

The following conclusions can be drawn from the Summitville mine

- Modern, as well as historic mining may be associated with environmental problems
- Proactive baseline monitoring and ARD prediction monitoring and management from the outset are of paramount importance (Warhurst and Mitchell 2000, p.100)
- Environmental liabilities need to be assessed and addressed before new mining begins or when ownership of a site changes – responsibilities need to be defined from the outset (Warhurst and Mitchell 2000, p100)
- Management capacity, as much as technical expertise, is paramount in putting together the elements of what could be considered good practice – ARD and other pollution prevention and management (Warhurst and Mitchell 2000, p.100)
- A cost-effective approach by the industry must be to anticipate and plan effectively, proactively preventing environmental damage rather than reacting to post-facto damage.

The Summitville mine is a good example of where Corporate Social Responsibility (CSR), failed to live up to expectations. The reasons why this may be the case includes:

1. The lack of effective regulatory framework is not the only reason for environmental problems from mining
2. That companies need not be, and in the case of Summitville, were not bound by the regulatory framework, nor do they have to be limited by it

3. There is not necessarily one best way to conduct mining operations – instead companies can choose to go beyond a regulatory framework and hence develop a truly sustainable development framework

Following from this there are three corporate strategy categories that companies can fit into when they move towards the idea of corporate social responsibility:

1. Poor environmental performers exhibiting mismanagement, technical blunders and abuse of a weak regulatory regimes, or regulatory loopholes
2. A compliant performer that is within the law, but exhibits poor performance on account of regulatory weakness or failings and a genuine failure to predict pollution in spite of best efforts
3. Good environmental performers that endeavour to select socially responsible corporate strategies irrespective of regulatory requirements so as to prevent pollution avoid disaster and ensure mining truly contributes to sustainable development goals.

Warhurst and Mitchell suggest that companies, who conduct themselves according to the third style of corporate citizen, may want to report on the exceeding of regulatory frameworks in a comprehensive manner to all stakeholders in the mining process.

It has not just been mining alone that has contributed to environmental problems at the Summitville site. They note that other factors have also contributed to environmental problems, including tourism, agriculture and geological factors. The researchers note this, as it is often too easy to burden mining with sole responsibility for environmental problems at a site, when there can also be other mitigating factors. This does not preclude a mining company from taking responsibility for its actions, it is meant to highlight the fact that often the problems caused by mining are multi-faceted (Warhurst and Mitchell 2000, p. 98):

> …other factors such as local geochemical conditions, construction of logging roads, accelerated erosion and tourism have also been quoted as significantly degrading the quality of the [Alamosa] river.

In the case of Summitville, and as with all cases of mismanagement of mine operations, it is difficult to place blame on any particular party. It usually includes a combination of factors, involving a number of different parties from mining companies, to governments, to regulatory authorities, to mining legislation that together will have contributed to an effective lack of closure. It is therefore, important to note that regulatory frameworks, mining company practice, government involvement, in mining operations are all an evolving process that have and will continue to change as the practice of mining continues to evolve (Warhurst and Mitchell 2000, p. 98).

> …it is accurate to say that none of the different actors were entirely blameless and that none were entirely to blame, and that permitting regulatory frameworks shaped events as much as the mismanagement at corporate strategy level that occurred during site development and operation. The regulatory framework as it existed at the time could be considered in part to a catalyst for the events that followed – leeway and loopholes combined with a lack of corporate social responsibility will often lead to unforeseen and undesirable effects. However, the design, implementation and enforcement of regulations are complex procedures, and as with many human activities can be undermined by human fallibility. Regulatory frameworks must evolve, as must the industry, to incorporate lessons from past shortfalls in compliance and performance…

A1.9 Mount Lyell – Queenstown, Tasmania – Copper and Gold

The landscape of Queenstown, Tasmania is a scarred and battered one that has at times been described as almost moonlike due to the barren hills surrounding the town. The result has been one that runs almost contradictory to good rehabilitation practice, in that it has resulted in the town becoming a tourist attraction due to the poor rehabilitation practices of the past. In a somewhat ironic twist, there have been in the past, attempts by locals to prevent the Mount Lyell mine and surrounding areas from being rehabilitated due to concerns by some locals that the town would lose its unique tourist drawcard.

The Mount Lyell mine is not a closure in that it is actually still an operating mine, however, the open pit mine closed prematurely in 1972 (and has never reopened) and was left in a state of disrepair. Mining at the site reverted to underground processing, but the environmental damages wrought by earlier poor mining practices, particularly with regards to the open pit have left the area around Queenstown infamous around the country (if not the world) for the lack of environmental controls with regards to mine operation and closure.

A1.9.1 The location of the mine

Queenstown is located on the west coast of Tasmania, an area noted for its remoteness, as well as its rugged beauty and small population. Due to its location in the path of the roaring forties, the region is characterised by rainfall of between 2400 – 3200 mm's a year, heavy snowfall also occurs in winter, sometimes making the region inaccessible. The mean annual temperatures vary between 15-18 Celsius, however, the region is characterised by extremes, with temperatures often below 0 Celsius in winter and as high as 37 Celsius in summer (State Library of Tasmania 2004).

The Mt Lyell mine site is approximately 25 kilometres from the Southern Ocean, with the mine sitting between the divide of the King River and its tributary the Queen River which feeds into Macquarie Harbour an enclosed bay of 276 km^2 that flows into the Southern Ocean (Koehnken 1997). Due to the large rainfall of the area, the mine has required a substantial discharge of mine waste water and metal discharge (for example, up to 2 tonnes of copper were discharged from the site each day) in order to keep it dry enough to allow mining at the site. The water discharge from the mine has been very acidic, due to the nature of the orebody being mined and the water runoff from the site.

Figure A 1.11: Location of Mt Lyell Mine

Source: Tasmanian Minerals Council (2010),)

The major fresh water sources draining into Macquarie Harbour are from the pristine waters of the Gordon River south of the Harbour and the mining polluted King and Queen rivers from the northeast. The opening of the harbour into the ocean is only a narrow one, meaning there is limited circulation of the water and widespread stratification of the water column (Stauber et al. 2000, p. 3). Researchers from the CSIRO found that the waters in the harbour are:

> …rich in dissolved organic matter, due to the high rainfall and vegetation, comprising hardwood and softwood forests and button grass plains.

In addition to this, the site, along with the majority of Western Tasmania is isolated from the remainder of the state and sparsely populated. The mine necessitated the development of a railway link from the mine to the townships of Strahan and Teepokana which became important centres for the shipment of copper for export and the importation of mining supplies for the mine site.

A1.9.2 Size and profitability of the mine

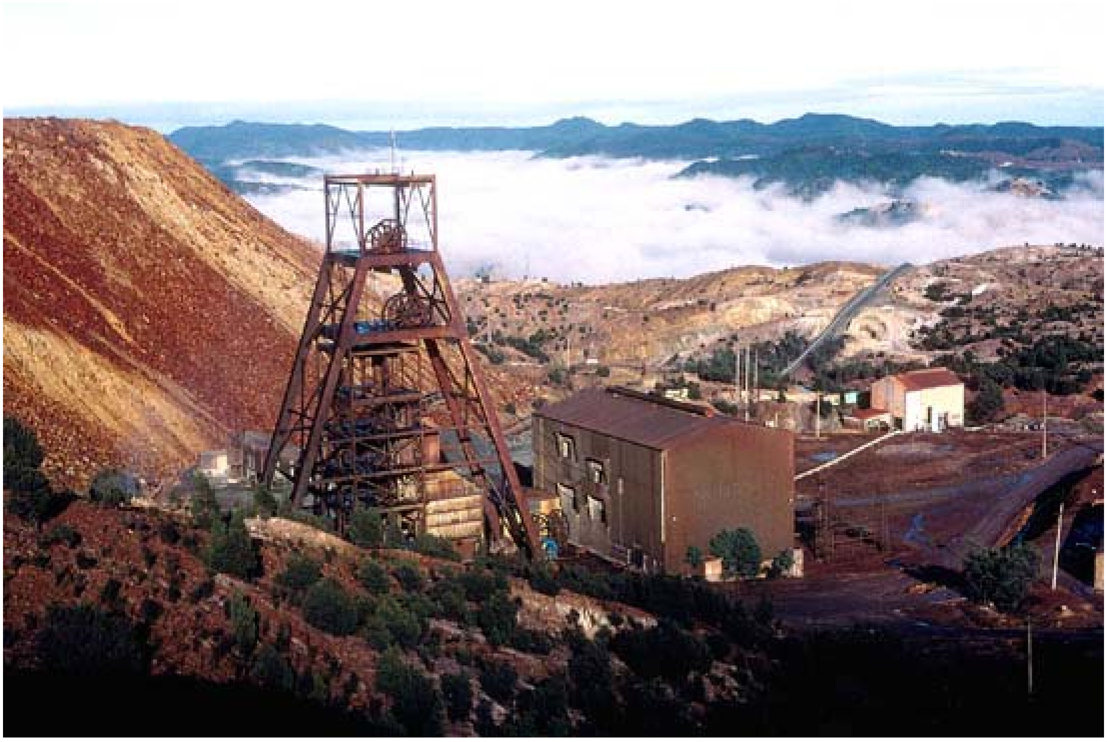
The Mount Lyell Mining and Railway Company formed in 1893 and worked the Mount Lyell Copper and Gold mines until its closure 1994. During the life of the mines, the company produced over a million tonnes of copper, 750 tonnes of silver, and 45 tonnes of gold, worth around $4 billion during the life of the mine (Blainey 2000, pp 2 and 6). The

Mount Lyell mine was one of the first open cut mines in Australia and was the largest producer of copper in the Commonwealth. The open cut mine ceased to be the company's primary source of the metal in 1972 when the open cut closed and mining reverted to underground production (Tasmanian Minerals Council 2010).

A1.9.3 The size of the community where the mine is situated

Queenstown has a population of 2,117 people at the 2006 Census (ABS 2006, Quick Stats Queenstown). The area is quite rich in mineral deposits and has been characterised by periods of boom and bust, depending on world commodity prices, hence it is highly vulnerable to economic cycles, which can have dramatic effects on the economic, social and environmental health of the towns in the region.

Figure A 1.12: Mount Lyell, Queenstown



Source: Tasmania online (2004)

A1.9.4 The ownership of the mine

Mount Lyell is a copper and gold mine that began its life as an open-cut operation in 1883, then in 1909 moved to underground mining (Eklund 1999). The mine reverted to open-cut again in 1935 after it had become commercially viable to mine low-grade ore and it remained an open-cut mine (although there is still some underground operation) until its closure in 1972.

The smelting process at Mount Lyell (which helped produce acid rain in the region) began in 1896 and became a large proportion of employment at the mine and hence, became important to the town (Eklund 1999). The mine site, although not always economically viable, became a major employer in Queenstown and was during times of low commodity prices in particular; kept open through a range of subsidies, tax breaks and other incentives.

Mount Lyell initially was worked by a number of companies, with the most dominant of these being the Mount Lyell and North Lyell companies. According to Eklund (1999), the number of different companies operating in the region caused much of the social and economic infrastructure to be replicated. As an example, Queenstown at one point had three separate railways leading to two different ports (Eklund 1999). The two companies (Mount Lyell and North Lyell) merged in 1903 to form the Mount Lyell Mining and Railway Company who ran the site until 1981, when the three companies merged to become Renison Goldfields Consolidated. The company ceased operating after 1994 in accordance with the *The Mount Lyell Mining and Railway Company Limited (Continuation of Operations) Act 1992 (Koehnken 1997).*

In 1994, Copper Mines of Tasmania, a subsidiary of Gold Mines of Australia took over the lease of the mine site and recommenced mining and processing in 1995. The company has constructed a tailings dam and is required to adhere to best practice environmental management in accordance with the *Copper Mines of Tasmania Pty. Ltd. Agreement Act 1994.* The company is not however, required to remediate or have any responsibility for environmental damage associated with the previous owners of the site. In 1999, Copper Mines of Tasmania was acquired by Sterlite Industries; part of the Indian owned Vendanta Group (Copper Mines of Tasmania 2010).

A1.9.5 When the mine closure was planned

The mine became so important to the economic and social fabric of Queenstown that little effort was made with consideration of closure at the mine, or how Queenstown could develop without the mine and the mining industry. This lack of planning appears to have characterised mining operations in the Queenstown region throughout most of the 20th Century. The mine at Queenstown does continue to operate, however, not in its original form, with little or no rehabilitation being undertaken on the sections of the mining lease that are no longer operational.

The smelter for the mine opened in the late 19th Century and used iron sulphide in the smelting process, which in turn, produced severe acid rain in the area. During this same period, trees were cut down and used for firewood and for buildings. After 1904, the company ceased using iron sulphide in the smelter, but instead used coal, which kept the rain acidic enough to prevent the trees from developing (Tasmanian Minerals Council 2010). The past practices associated with mining at the site and poor regulatory controls from the State

Government have meant that the site has been in poor environmental state for many years and has become something of a tourist attraction for the Queenstown region.

The open-pit mine at the site closed in 1972 as the mine was deemed too uneconomical to continue as an open-cut mine. The mine has since reverted to an underground mining operation, however, the open cut section of the mine remains and has contributed to the environmental problem at site and is typical of what occurs with poor closure planning and inadequate regulation by various State Governments over time in Tasmania, all of whom have considered economic factors associated with the mine to be more imperative than environmental factors. The Supervising Scientist Commissioned by the Commonwealth Government with reporting on the Mount Lyell mine site admitted in his report that little regard was paid by the State Government regulators in protecting the environment (Koehnken 1997)

Mount Lyell has become notorious for the damage it has caused to the hills surrounding Queenstown, however, the mine has also been responsible for drainage into the King and Queen River systems that drain into Macquarie Harbour, near Strahan. A study published in the Australian Marine Freshwater Research journal in 2000, found that over the operation of the mine over 100 million cubic metres of mine tailings, smelter slag and topsoil (Stauber et al 2000, p3) has drained into the King and Queen River systems, which flow into Macquarie Harbour (assisted by the regions high rainfall).

Further to this and to add weight to the claim that further rehabilitation of the Mount Lyell mine site is needed, the researchers found that (Stauber et al. 2000, p. 3):

> "Despite the cessation of tailings dumping, exposed tailings on the river banks and in the delta continually leach iron, manganese, aluminium and cooper, contributing substantially to the metal loads in Macquarie Harbour water and sediments.

The mine site had and continues to have a number of environmental issues associated with the site. The Supervising Scientist's report on the site noted that these include (Koehnken 1997, p. 2):

- Tailings, slag and acid drainage into river and a delta of tailings the size of a city suburb in Macquarie harbour
- All aquatic life in the Queen River and lower King River has been killed
- Waterways contaminated with toxic metals, particularly copper, representing a potential hazard to the fishing industry and other harbour uses
- Vegetation on Queenstown hills destroyed by felling, fire, erosion and toxic fumes from smelting"

The Tasmanian Department of Environment and Land Management commissioned a number of reports on the environmental impacts of mining at Mount Lyell, particularly in relation to the impact on the surrounding waterways. It was these reports that formed the basis for the cooperative approach between the Tasmanian and Federal Governments in the establishment of a remediation program at Mount Lyell.

How the mine closure was planned and conducted

Mount Lyell remediation commenced in response to the environmental damage caused by mining and the lack of environmental regulation at the site over a 100 year period. In response to this, the Federal Department of Environment (now the Department of Sustainability, Environment, Water, Population and Communities), commenced a program of remediation at the Mount Lyell site, known as the Mount Lyell Remediation Research and Demonstration Program. The program was a joint program between the Supervising Scientist Australia and the Tasmanian Department of Environment and Land Management to address the environmental problems associated with mining at the Mount Lyell mine site.

The program was claimed by the Supervising Scientist to be Australia's most 'comprehensive response to large-scale environmental damage (Koehnken 1997). As part of their condition of closure, the Mount Lyell Mining and Railway Company left the State Government a trust fund with $1.5million towards rehabilitation of the site (Department of Primary Industries, Parks, Water and Environment 2010). This amount was not sufficient to rehabilitate the site, or to plan for its closure, hence the reason the State Government approached the Federal Government to assist with the rehabilitation of the site. At the same time, that this was occurring, the Mount Lyell Mining and Railway Company ceased to operate and the mine was closed, however, due to the mine's economic importance to the region the State Government wanted to keep the mine operational and was searching for a new company to operate the mine. The Tasmanian Government was conscious of the fact that any new operator of the mine would be unable to afford the costs associate with rehabilitation and that it would be a deterrent to potential buyers and therefore the Government decided to pursue the remediation option with the Federal Government.

The Mount Lyell Remediation Research and Demonstration Program commenced around the same time that new operators were found for the Mount Lyell site, Copper Mines of Tasmania. The program's main objectives according to the Federal Department of Sustainability, Environment, Water, Population and Communities (2001) were:

1. To involve the west coast community and other stakeholders in determining the long-term environmental quality objectives for the Mount Lyell lease site, the King and Queen Rivers and Macquarie Harbour.

2. To develop a better understanding of the environmental impacts caused by past activities on the Mount Lyell mine site and tailings in the Queen and King Rivers and Macquarie harbour, in order to enable the development of strategies to reduce or eliminate these impacts.
3. To demonstrate remediation methods to determine their practicality, cost and effectiveness in order to make recommendations as to the most cost-effective means of achieving the environmental quality objectives.
4. To identify and carry out any remediation works which can be carried out and implemented within the time frame and budget of the program.

The program’s budget was $2 million, with $0.5m being allocated from the Mount Lyell rehabilitation trust program and the remaining $1.5m being funded by the Commonwealth (Department of Sustainability, Environment, Water, Population and Communities 2001). The specific objectives with regards to the Mount Lyell lease site were as follows (Koehnken 1997, pp. 11 & 12):

- Emissions of acid drainage from the areas are reduced to the point that they do not compromise the environmental quality objectives for the King and Queen Rivers and Macquarie Harbour;
- The land is stabilised to minimise erosion and the effects on water quality;
- The ‘bare hills’ landscape should be maintained, although there are differing views on where the hills should remain bare. Most agreed that the view field coming into Queenstown should be maintained;
- Infestation by exotic species will be minimised
- Culturally significant artefacts will be preserved
- Exiting remediation works will be maintained.

The program reports were finished in 1997, with a report released by the Commonwealth’s Supervising Scientist through the Department of Environment providing a number of possible for the rehabilitation of the Mount Lyell site and the surrounding waterways. The report found that the Mount Lyell mine site was a major source of acid drainage related pollution in the rivers and harbours of the area. By comparison, metal contamination from tailings and slag deposits was minor (Koehnken 1997).

The report found that the priority for remediation needed to be the mine lease site and that the Queen and Lower King Rivers were ‘essentially lifeless due to acidity and high metal concentrations’ (Koehnken 1997, p. 4). The report made nine recommendations for the remediation of the mine site (Koehnken 1997: pp. 5 & 6):

1. Any remediation strategy should focus particularly on the Mount Lyell lease site.

2. Remediation must ultimately eliminate virtually all acid drainage from the lease site. Interim measures which achieve short term progress are not substitutes for the long-term remediation required for downstream recovery.
3. Lease site water management is a key to successful remediation and reducing acid drainage sources through the diversion of clean water should be a top priority. Remediation must include containing and treating acid drainage contaminated storm waters as well as ‘normal flows’. As mining evolves, the quantity and quality of acid drainage from the lease site will change, and today’s remediation effort must be flexible enough to respond cost-effectively to tomorrow’s development.
4. Remediation work implementation and management needs a negotiated agreement between Government’s and the lease occupant, recognising the present legal framework affecting mining. The agreement must provide a legal, logistical and financial framework within which remediation can proceed.
5. The preferred remediation strategy is neutralising 100% of the acid drainage to pH 6.5, to be implemented progressively.
6. Copper recovery technology (selected after feasibility studies) should be implemented in conjunction with the neutralisation system, as this offers the potential to offset some of the neutralisation costs (depending on negotiations with the present mine operators).
7. Improving water quality in the Lower King River so fish use its tributaries is an early target, even if the mainstream King remains uninhabitable.
8. Remediation of the King River banks, bed and delta through revegetation should be encouraged by involving community based groups, improving the visual amenity and reducing dust emissions. The best remediation option for the King River is to clean the water leaving the lease site.
9. No specific remediation works are recommended in Macquarie Harbour at this time, though long-term monitoring is warranted. Remediating the site and reducing/eliminating the discharge of acid drainage is also the best remediation strategy for the harbour.

The costs of rehabilitating the Mount Lyell site to a point where acid neutralisation would occur were estimated to be between $10 and $16 million in capital costs and between $1.6 million to $10 million in annual operating costs (EPA Tasmania 2010). This was cost prohibitive for both State and Federal Governments and it was deemed that it was not feasible to conduct such a large scale rehabilitation program. Instead, a number of feasibility studies were conducted between 1998 and 2002 to determine more cost effective options for the site, based on the 1997 Federal Government sponsored report by Koehnken which found that the most cost effective option for remediating the site would be to complete a series of rehabilitation projects rather than remediating the entire site at once. This report was then used as the basis for rehabilitating the Mount Lyell site, due to the comprehensive findings from the report.

The researchers from the Mount Lyell Remediation and Research Demonstration Program found that the most cost effective technology for removing copper from the waterways surrounding the mine and hence reaching an acid neutral target was to use a process known as copper cementation; a plant was built at the site for $7.2 million with funds from the Federal Government. This process basically solidifies the copper sulphate from the mining process, solidifying it. It was not the preferred option for the research team as it produces a lower return for the copper than alternative measures; however, as a technology it has lower capital costs and removes the copper from the waterways (Ferret 2005). The site now also has more storage dams and tanks and clean water is now diverted around the site into clean water holding ponds, reducing the risk of clean water being contaminated at the site.

The rehabilitation of this site is still continuing, following the recommendations of the Mount Lyell Remediation and Research Demonstration Program. The site has long way to go before it could be classed as rehabilitated and there still exists no defined closure plan for the site. The new company is however, complying with its legislated requirements regarding the environment and there is recognition by the Tasmanian Government and indeed the Mining Industry (Tasmanian Minerals Council 2010) that such an environmental disaster should never be allowed to occur again in Tasmania.

What alternative closure options were considered

Mount Lyell was never planned for closure, as the site was always seen more for its economic benefits, rather than any ecological costs that may be associated with closure. Hence, alternative closure options were not considered for the site. In addition to this, the fact that the mine reopened after closing in 1994 only further added to a reluctance to consider closure options for the site. The best that could be hoped for at the Mount Lyell site was some form of remediation work that may assist in undoing the poor mining practices of the past.

Figure A 1.13: Mount Lyell Mine showing scarred landscape

Source: Tasmanian Minerals Council (2010)

The legislation under which the closure was conducted

The Mount Lyell mine was unusual in that although the mine although covered by the *Tasmanian Mining Act 1929,* it was also the subject of an agreement between the Tasmanian Government and the Mount Lyell Mining and Railway Company that provided the company with financial support from the State Government and also exempted it from certain environmental regulations. The mine was seen by various State Governments as being important to the development of the West Coast of Tasmania and it was virtually treated as a ‘development at all costs’ site in order ensure that the West Coast of the state industrialised at a pace consistent with the remainder of the State. The mine also became an important source of income and employment for the region exporting copper around the world.

According to Koehnken (1997, p. 3) in terms of environmental regulation at the site:

> ...During the development and much of the operation of the mine, environmental controls were non-existent, and environmental controls were not a concern of the operator. In Tasmania, The Environmental Protection Act 1973 established emission limits for industrial discharges into fresh waters, but Mount Lyell was issued with a Ministerial Exemption in 1974 which allowed the company to not comply with these limits. This arrangement continued throughout the life of the Mount Lyell Mining and Railway Company’s operation of the mine.

Mount Lyell Mining and Railway Company did make some attempt to undo some of the damage caused by their mining practices over the century they operated the mine site. A spokesperson for the Mount Lyell mining company in 1992 pointed out that due to changes in Tasmanian law the company was actually required to rehabilitate the site (Koehnken 1997, p. 21):

> The company says it is required to revegetate the area under the *Mount Lyell Mining and Railway Company Limited (Continuation of Operations) Act 1992*. In addition, the company points out, the vegetation that is growing back on its own is predominantly exotic weeds, not native plants…the revegetation program (by the company) focuses on cultivating a mix of native tree species.

At the time the company was proposing its rehabilitation program, the Queenstown region was attracting approximately 140 000 tourists a year, primarily attracted to the lunar-like landscape of the bare hills. This was one of the reasons local residents were against the rehabilitation proposed by the company. The local Member of Parliament at the time, Peter Schulze said '[The bare hills] embody the history and cultural heritage of the town' Koehnken 1997, p. 21).

At the time, the then State Government ordered the mining company to stop its revegetation program and stopped the company from spraying fertiliser on seedlings it had planted. Peter Schulze believed many residents of Queenstown were not convinced of the need to rehabilitate the area and would prefer the area be left to let the vegetation regrow naturally. Mr Schulze (Koehnken 1997, p. 21) stated that '…the bare hills will regrow in 10-15 years…let it happen naturally, not by artificial means'.

Copper Mines of Tasmania took over the lease of the site in 1995 under the terms of the *Copper Mines of Tasmania Pty Ltd. Agreement Act 1994* (this act was superseded by the *Copper Mines of Tasmania Pty. Ltd. Agreement Act 1999).* The Act required CMT to develop an environmental management plan based on best practice environmental management, which included rehabilitating their mining operations and disposing of waste water without any polluted discharges into the waterways surrounding the mine site (Environment Tasmania 2010). Under the new agreement, Copper Mines of Tasmania is also not liable for any environmental damage caused by previous operations.

The regulatory standards at the Mount Lyell site have been characterised by lax environmental standards, Government financial support for the Mount Lyell Mining and Railway Company Limited and a desire to support development at any cost. The site is finally being rehabilitated, however the costs associated with this are enormous and progress has been slow, with little being done since the completion of the Mount Lyell Remediation and Research Demonstration Program Report in 1997. At the same time as of September 2010, there is still no closure plan for the Mount Lyell mine site and little work on remediating the vacant open pit site at the mine.

Figure A 1.14: Former open cut pit at Mount Lyell

Source: DesignSigh (2010)

A1.9.6 Engagement with stakeholders

Community engagement has not been a strong feature of the Mount Lyell mine site, particularly in the area of mine rehabilitation and closure, mainly because these two areas have not been features of the Mount Lyell mining landscape. The people of the region have been largely excluded from the mining process at Mount Lyell and to some extent they have often been portrayed as apathetic towards what has occurred at the site.

The former Tasmanian Department of Environment and Land Management and the Mount Lyell Remediation and Research Demonstration Program (MLRRDP) held a series of public meetings around the region in the 1994/95 prior to writing the 1997 report by Koehnken which examined various remediation options for the Mount Lyell site. The residents of the region expressed concern about the environmental problems caused by the Mount Lyell site and these concerns were used to determine the objectives of the MLRRDP report.

The initial consultations were followed by a number of public meetings at Strahan and Queenstown after the release of the report and the development of a rehabilitation plan for the site. All members of the public were invited to attend the meetings and were well attended according to the final report (Koehnken 1997). In addition to this, the public was invited to attend a series of tree plantings on the tailings banks of the King River.

The research team also met again with the community after they had listed the proposed MLRRDP programs in order to ensure that the community were happy with the projects that were identified. This yielded changes to some of the proposed programs and the creation of additional programs after the community input. The community according to the research has been happy with the rehabilitation program aims; however, it appears that most of the community involvement has been in the form of consultation and not actually engaging the community in the process. In other words the community had been listened to for their advice on what remediation activities should occur at the site; however, this advice was not necessarily acted upon, nor developed as part of any remediation program by the research team. It also appears that there has been little community involvement in the remediation program at Mount Lyell since the release of the MLRRDP report.

The residents of Queenstown have in the past attempted to fight the rehabilitation of the hills surrounding the mine site surrounding the Mount Lyell mine. The movement against the rehabilitation of the site began during the early 1990's when the mine was still owned by the Mount Lyell Mining and Railway Company (who had owned and operated the mine for most of its life).

Over the last decade, however, the argument appears to have swung full circle, with the Mayor of Queenstown, floating the idea of establishing a centre of excellence in the region, focusing on environmental rehabilitation, in an area that has become infamous for its mining related environmental problems. The mayor believes (Sayer 2004, p. 14) that the region needs to:

> …perfect remediation and recovery programs in the region and then patent these to be used on a worldwide basis.

The mayor controversially suggested that funding for this strategy could come from mining royalties or from a levy on mining operations. According to the Sayer (2004) there is approximately $8 million in bond money to fund remediation work at Mount Lyell, the King and Queen Rivers and Macquarie Harbour and it is some of this money the mayor is suggesting be used for establishing the centre for excellence.

The Minister for resources in the Tasmanian government, Mr Bryan Green claimed that rehabilitation at Mount Lyell was the priority for the Tasmanian government, however, he did acknowledge the merits of the idea for establishing such a centre and the flow on effects it could have for the Tasmanian mining industry, as well as assisting to change perceptions about the mining industry in the state.

The executive director of the Tasmanian Minerals Council, Mr Terry Long agreed with the idea of establishing a centre of excellence and wanted further investigation into the idea, and did not in theory oppose the concept of a levy. Mr Long stated that (Sayer 2004, p. 14):

> …along with safety, remediation (rehabilitation) is front and centre in mining these days and is now built into the mine plans from day one. Such a centre would need the cooperation of both governments and universities in order to work…

He went on to say that: '…if achieved, its research would attract national and international interest'.

The centre is still only a concept and has not been developed at the site. In addition to this, the research has failed to uncover any further evidence of Sayers (2004) claim that $8 million is available for rehabilitation at the site and given the slow progress of the remediation at the site to date and the Governments claim that money for the site is limited, it is doubtful that the $8 million is accessible for the rehabilitation of the site.

As a sidenote to this section, Mount Lyell is often held up as a poster for poor rehabilitation and closure practices (and this thesis is no exception in this process), however, as noted above the people that live in the area may not necessarily view the poor rehabilitation standards of the past as abhorrent, as stated to some in the community, the site provides a unique tourism product for the Queenstown region and is something to celebrate in the state's mining history. Looking at the Mount Lyell site purely from an environmental perspective it is a disaster of huge proportions, however, to some of the residents thus viewpoint does not hold sway and to some extent they may well resent outsiders viewing their town from such a narrow perspective.

It is something that mining companies, regulatory bodies and researchers need to consider when engaging with local communities. The viewpoints held by community members are disparate and based on their experiences, history, self-interest and role in the community. Rehabilitation and closure outcomes will not always conform to the expectations of all parties and it is sometimes necessary to be pragmatic when determining what is 'best' for a local community.

A1.9.7 Summary

Mount Lyell and the Queenstown region of Tasmania have become associated with poor rehabilitation practices associated with more than a century of mining in the region. It is true that mining has not been solely responsible for the environmental problems experienced in the Queenstown, the smelters in the township and the region's heavy rainfall and geological composition have also played a role, however, mining helped contribute to the environmental degradation experienced in the region. The bare hills surrounding the town were a result of the smelter that operated at the site for a number of years, producing acid rain in the area. The mine has directly caused the leaching of heavy metals into waterways surrounding the region, affecting the local ecology and causing problems in nearby Macquarie harbour.

The town has actually become a tourist attraction due to the bare hills surrounding it, causing a lunar like landscape to form. Opposition from locals at attempts to rehabilitate the site are unusual in the mining industry and definitely do not represent 'world's best closure practice'. As has been demonstrated, however, the lack of rehabilitation at the site has actually led to environmental problems elsewhere in the region and although it is understandable that locals would wish to preserve the town's unique tourist attraction, this does not mean that the mine site should not be rehabilitated.

Queenstown is not a traditional mine void site, but is representative of what can occur with poor closure practice. The town and its history represent a good case study into why closure is such an important part of the mining process. It would be hoped that both the industry and regulators have learnt from mistakes made at sites such as Queenstown and that such environmental and indeed social and economic disasters do not occur again in the future. Queenstown presents a good example of why sustainable development guidelines need to be put into practice across the mining industry and by regulators.

A1.10 Windimurra Mine – Mt Magnet, Western Australia – Vanadium

The Windimurra vanadium (vanadium is a ductile transition metal and has a number of uses including increasing the strength of steel and the high temperature performance of steel, it is also used for alloys in the aerospace industry) mine near Mt Magnet in the centre of Western Australia has been notable for its unusual history during times that have been classified as boom times for mining in Australia, but in particular in Western Australia. The site opened in 1998 and began operations in 1999 with assistance from the Western Australian Government and claimed that due to the demand for steel from China and India in particular, the Windimurra vanadium mine would be a profitable undertaking, creating thousands of jobs during construction and operation. Similarly, it was claimed that much needed infrastructure would be provided in a remote and isolated region of the country.

Unfortunately the reality never quite lived up to the promises and by 2004 the mine was permanently closed, causing regulators a major headache and providing the original owners of the site Xstrata Plc (who were in a joint venture partnership with PMA), with some bad publicity surrounding the manner of the mine closure and the cost to the local economy. The mine was brought out by Windimurra Vanadium Ltd, who set about trying to reopen the site in 2009, however, they went into receivership and the site did not open. Midwest Vanadium then took over control of the site from Windimurra Vanadium Ltd and they too also failed to open the site. In 2010, Atlantic Ltd brought into the site Acquiring Midwest Vanadium Ltd stake in the project. The mine is a good example of mining dependant Governments sometimes being too eager to develop mines, without exploring the full ramifications of early, unplanned closures.

Figure A 1.15: Windimurra Mine

Source:ABC online (18/02/2009)

A1.10.1 The location of the mine

The Windimurra vanadium mine is located 600 kilometres northeast of Perth and 80 kilometres southeast of Mt Magnet, in the Murchison region of Western Australia (Windimurra Vanadium Limited 2008). The area is characterised by high temperatures and low rainfall (280 mm per annum), with a high evaporation rate. Most of the region is used for grazing cattle, sheep and goats, with much of the area being low-lying plains covered with mulga, native herbaceous layers and annual and perennial grasses (Bolton and Alexander 2004)

It is also a sparsely populated region, with large distances between centres and a lack of modern infrastructure in some parts of the region. The Windimurra mine was at the time of its construction seen as a major boost to the region, not only for the employment it would provide, but also upgrades in infrastructure (notably roads, gas and electricity) provided by both the government and the company.

Figure A 1.16: Windimurra Vanadium mine location

Source: WindimurraVanadium Limited (2010)

A1.10.2 Size and profitability of the mine

The initial mine lease covered an area of 300ha and the tenements are part of the Windimurra Pastoral Station (Windimurra Vanadium Limited 2010). The mining at the site was done by open cut method to a depth of approximately 40 metres however mining did not occur below the water table. The Windimurra site is reputedly the largest known Vanadium deposit in the world, according to Precious Metals Australia (2010), with demand forecast to grow by 7.8% annually until 2015 (Windimurra Vanadium Limited 2010).

According to reports from resource experts quoted in the *West Australian Newspaper*, the Windimurra mine was one of the lowest-cost vanadium sites in the world (The West Australian May 11th 2004), despite this, however, the mine according to its owners Xstrata plc needed substantial new investment to operate effectively (The Sydney Morning Herald, January 4th 2008). The mine commenced production in 1999, officially opening in May 2000, with the mine operating at 75% of output capacity by September of that year (Australian Stock Exchange Online, March 2005). It was estimated that at full production the mine would supply 10% of the world's vanadium supply (Economics and Industry Standing Committee, November 2004, p13).

Vanadium has many uses and its value as a commodity soared with the increasing demand for steel (particularly from China), over the latter parts of 2003 into 2004/2005. It is used in making rust-resistant springs and steel in tool making, the substance also has some nuclear applications. It is used to help build superconductive magnets, with vanadium foil used as a bonding agent to bond Titanium to Steel. Vanadium compounds are used in the dyeing and printing of fabrics (Chemistry Department, University of Sheffield 2005).

Xstrata (the owners of the mine) suspended the operations at Windimurra in February 2003, with the company basing the decision on low worldwide vanadium prices. The permanent closure of Xstrata's Windimurra operation was announced in May 2004. The company based its decision on a number of other factors, as well as low commodity prices, these included an uncompetitive exchange rate and what the company claimed were high production costs associated with running the mine. The company stated the following in relation to their decision (Reuters News Service, March 2, 2005):

> The decision to close the plant was taken following a thorough assessment of the operations ongoing financial viability, taking into account the estimated cost and timeframe of returning the plant to operation, the expected cost of production and Xstrata's assumptions regarding the long-run vanadium price and the Australian dollar exchange rate.

The joint venture partner with Xstrata, PMA announced in August 2004 that it would initiate legal proceedings against Xstrata over the loss of royalties from the premature closure of the Windimurra mine site (Metal Bulletin, August 2004, p1). PMA claimed that given the rapid rise in vanadium prices shortly after the mine closed (the Director of PMA claims that the mine would have made $71 million profit in 2004, based on vanadium prices at the time, however this figure is strongly disputed by Xstrata), and that Xstrata should have consulted with the state government before it closed the mine. The director of PMA (The West Australian, September 23rd 2004, p8) said in relation to the closure of the mine that:

> …Xstrata should have consulted other stakeholders, most notably the state, which pumped $30 million into associated regional infrastructure and retains all mineral rights…the fundamental point is it is not their (Xstrata's) vanadium, it is yours (the state of Western Australia's)…

Xstrata claimed, however, that it had invested and lost $186 million (Metal Bulletin, August 2004, p1) at the Windimurra mine site by closing the plant prematurely and claimed that it would not sell the site at a discount to another producer, hence the reason it had decided to just close the mine and shut production, rather than attempt to sell the mine. This claim by Xstrata raises issues about the involvement of government in private industry and also the right of a mining company to decide whether or not a mine is profitable and hence a viable, ongoing operation.

A1.10.3 The size of the community where the mine is situated

Windimurra is located in the Shire of Mount Magnet in Western Australia, approximately 571 kilometres from the capital city of Perth (Main Roads WA 2010). The Mount Magnet Shire had an estimated resident population of 642 people in 2008, (ABS, National Regional Profile – Mt Magnet 2004-2008) a decline of approximately 14% from the 2006 Census. The shire has a land area of 13,888 km^2, with much of the area devoted to pastoral and mining activities with these two industries being key contributors to the local economy (ABS, National Regional Profile – Mt Magnet 2004-2008). The sheer size of the area means that infrastructure is difficult to deliver effectively, as many parts of the region are inaccessible other than by 4WD or in some cases helicopters and light planes.

Any negative impacts on these industries (such as mine closures) have ramifications for the local economy and will impact not just on the affected industry it will have flow on effects to other industries in the region. A region as sparsely populated as Mount Magnet, relying on just a couple of industry sectors, including Tourism and the pastoral industry, will be adversely affected by an event such as an unexpected mine closure. In such a small population with few employment alternatives, as reflected in the census data, many people will be forced to relocate to find suitable work.

Figure A 1.17: Mount Magnet Main Street

Source: Shire of Mount Magnet, (2010)

A1.10.4 The ownership of the mine

The mine was initially a joint venture operation between Xstrata plc (a mining company that was headquartered in Switzerland) that held a 60% interest, and Precious Metals Australia (PMA), a local Western Australian based mining company that held the remaining 40% interest (Australian Stock Exchange Online, March 2005). In October 2000, PMA sold its 40% interest in the joint venture to Xstrata for $29 million (ABC news online January 7 2005). The company PMA managed to maintain an interest in the project through a royalty paying 15% of earnings before interest and tax, or $500 000, whichever amount is greatest (Reuters News Service, March 2, 2005). PMA will continue to receive royalty payments from the mine until the environmental rehabilitation of the site is completed.

The West Australian government has since 1998, provided assistance to the site, providing $30 million in infrastructure (The West Australian May 11, 2004) to assist the mine into its operational phase. The government was also committed to paying $800 000 a year in interest for a loan that was taken out by Western Power for work associated with the mine (The

Sydney Morning Herald, November 12th 2004). The Shire of Mt Magnet was also responsible for investing money into infrastructure for the mine, mainly in the upgrading and opening of new roads to the mine.

The site was due to reopen for mining in 2009, however, this stalled as the company Windimurra Vanadium Ltd (that took over the lease of the site for redevelopment) went into receivership and work at the site ceased. A new company Midwest Vanadium Pty Ltd was formed to develop the site however that too was plagued by difficulties, and it too ceased to develop the site. Atlantic Ltd, a resources company based in Perth has now brought into the site, acquiring a 100% stake in the site as of October 2010 (Proactive Investors, August 13, 2010).

According to Atlantic Ltd (2010) (who originally had a 90% stake in Midwest Vanadium Pty Ltd), the site will be ready for production in mid 2011. The company has also stated that the site will be profitable due to high overseas demand for vanadium and the high grade value of the Windimurra deposit. In addition to this, the lease area for the mine site has nearly doubled in size, with the new lease for the site requiring an additional 300ha of cleared land for development at the site (Windimurra Vanadium Limited 2008). The open pit will also increase in size from around 40 metres to near 90 metres, although the report to the Environmental Protection Agency outlining the increased mining activity claimed that the increased pit depth would be below the water table.

A1.10.5 When the mine closure was planned

The closure at Windimurra was not an example of a well planned, coordinated closure, instead it highlighted faults from both the company and regulators in dealing with early mine closure. The mine closure was unexpected and premature and as it was unplanned did not meet the original expectations outlined in the original rehabilitation plan for the site (ABC News, January 7th 2005).

The new mine plan prepared for the State Government in 2008 (preparing for the reopening of the mine by Windimurra Vanadium Ltd) outlined a revised rehabilitation and closure plan for the site. The revised plan promises best practice closure outcomes in accordance with the Australia and New Zealand Minerals Energy Council/ Minerals Council of Australia *Strategic Framework for mine closure* and the Chamber of Minerals and Energy *Mine Closure Guidelines for Mineral Operations in Western Australia* (Windimurra Vanadium Ltd 2008). The objectives of the revised mine closure plan (Windimurra Vanadium Ltd 2008 for the site were to minimise:

- The potential for erosion
- Impacts on natural drainage; and

- Potential for contamination of surface and groundwater systems.

The disturbed area of land, within the context of the mine lease will be rehabilitated with native species to a point where it will be '...a stable, productive land surface that requires minimal ongoing maintenance and management' (Windimurra Vanadium 2008, p. 11). The pit will be contoured and shaped to reduce the slope of the pit and if necessary will have fencing, safety barriers and signs erected around the pit to keep it safe.

The document is significant in its mention of mine closure and adherence to the ANZMEC and Chamber of Minerals and Energy guidelines on mine closure. This will not however, prevent premature mine closure and no mention has been made what precautionary measures have been put in place should premature mine closure occur (to prevent economic and environmental damage to the community). Given the history of mining at this site and its cost to taxpayers it is surprising that no mention has been made of this by the new owners of the site, or regulators and local community who are still dealing with the effects of the original premature closure by Xstrata.

How the mine closure was planned and conducted

It was in mid-December 2004 that Xstrata announced that the mine site would never re-open (The West Australian December 12th, 2004). The company also on-sold the processing plant to a rival development that effectively ensured that the mine would not be re-opened. The closure of the mine has meant that the state of Western Australia has effectively lost $30 million invested in the project and is still owned power utility) undertook related to the project (The West Australian, December 12th 2004). Xstrata, at the time of closure believed and indeed claimed that it was meeting its rehabilitation requirements as outlined in the *Mining Act 1978,* however early in 2005 the Western Australian Department of Environment disputed this.

According to the Department of Environment, Xstrata failed to produce a closure plan for the Windimurra mine, and hence had breached the conditions of its mining lease. A spokesperson for the department speaking to the ABC said in relation to this alleged breach that (ABC news, January 7th 2005):

> The mine near Mt Magnet in the mid-west of Western Australia was closed in May (2004), but the department believes that in a recent audit it was discovered that Xstrata did not provide the necessary decommissioning plan six months before closure.

The concerns surrounding the mine centred on the potential contamination from mineral stockpiles and tailings. A department spokesperson said (ABC news, January 7th 2005):

The main issues will be stockpiles of minerals, tailings and any waste products from their processing to make sure that they're encapsulated, left in a stable condition, so that they don't leach into the environment.

Figure A 1.18: Tailings dam at Windimurra

Source: Atlantic Ltd, (23/10/2010)

Xstrata was forced into admitting to ABC news that it too was concerned about the progress of rehabilitation at the site, with the company eventually sacking the consultant that was initially employed to undertake rehabilitation at the site. Rehabilitation was still ongoing, with an expectation that it would be completed by March 2005. The rehabilitation of the site was eventually expected to cost Xstrata over $11 million (Economics and Industry Standing Committee, November 2004, p67). A new closure team was established by Xstrata that guaranteed a timely and fully compliant closure of its Windimurra mine. The company claimed that it would work in close consultation with the relevant government departments and key stakeholders in the mine site (Reuters News Service, March 2nd 2005). Leases for the site were to be relinquished to the Western Australian Government once the rehabilitation process was completed. The rehabilitation of the site that Xstrata was undertaking was never completed by the company and is now the concern of Atlantic Ltd as the new owners of the lease. The case though highlights the issues that can occur when companies fail to deliver their rehabilitation plans, particularly when ownership of a mine passes to another company.

The Mt Magnet shire invested money in the project through infrastructure related to the mine, notably roads, and stated their wish to have former mine sites, such as Windimurra made available for tourism uses after they had closed. The council in a submission to the

Economics and Industry Standing Committee noted in relation to these mines that (Economics and Industry Standing Committee, November 2004, p. 72)

> A number of these mines have adequate sporting/recreational facilities and camping areas…and mine sites should be retained for tourist inspection and development at a later date. This could be done in cooperation with the mine (owner), the shire and the Department (of Industry and Resources).

What alternative closure options were considered

There were no alternative closure options planned for this site due to the sudden, unplanned nature of its closure by Xstrata. The unplanned, early closure of the Windimurra mine provides an argument for companies and regulators ensuring that the mine planning phase incorporates a mandatory detailed closure and rehabilitation plan that also covers potential early and unplanned closures. This is imperative on regulators as it is not normally the mining company that deals with unplanned and early closures, it is the local community and governments that bear the economic, environmental and social costs associated with it.

Figure A 1.19: Plant and equipment left idle at the closed plant

Source: Dowling, (25/11/2009)

The legislation under which the closure was conducted

The Western Australian government has no legal right to take back the Windimurra mine, as Xstrata were meeting the minimum spending requirements under the *Mining Act 1978.* The view from both within government circles and from the state opposition, however, is that there may be changes required to the *Mining Act 1978* to prevent a similar situation from occurring in the future (Business Editor, Sydney Morning Herald, November 12th 2004). According to the then State Development Minister, Clive Brown (The West Australian, December 12th 2004):

> As long as Xstrata kept up its minimum spending obligations under the *Mining Act*, the government did not have the power to seize control of the Windimurra leases…
>
> …however, Xstrata did have a strong moral obligation to re-open the mine or sell it intact if viable, and a regulatory response could not be ruled out in the future.

The parliament of Western Australia established a parliamentary review committee in mid-2004 to examine the early closure of the Windimurra vanadium mine. The Economics and Industry Committee (EIC) as it was known outlined a number of recommendations in a report released in November 2004 that if they had been adopted as regulatory requirements could have had quite significant ramifications for mining in Western Australia and the issue of closure, in particular. The report recommended that the government have a greater say in mine closures, following the circumstances that surrounded the closure of the Windimurra mine.

In regards to increased government involvement, the report stated that (Engineers Australia, January 2005, p. 42):

> The circumstances surrounding the closure of Windimurra provided an opportunity to assess the capacity of the state government to protect the public interest in its dealings with the mining industry.

The EIC report also stated that the government should have more information relating to the feasibility of a site, to allow other operators to assume the operation of a site when an existing mine owner no longer wishes to operate the site. The report went even further by suggesting that governments become mortgagees over assets disposed by operators who close a mine site earlier than anticipated (Engineers Australia, January 2005, p. 42):

> …the government should have access to technical and operational information relating to the project and the ability to call for expressions of interest to purchase a mine of the existing owner no longer wants to operate…the government could also assume the status of first mortgage over project assets that may be dispersed of by the operator.

The EIC concurred with the remarks made by the Director of Precious Metals Australia that given the overall upward movement of vanadium prices, and in particular the prices being offered at the time of closure, the mine would likely have been able to make a profit (Engineers Australia, January 2005).

The Economics and Industry Standing Committee has recommended four changes to the Western Australian mining legislation, which will impact on mining companies that decide to close their operations prematurely. The recommendations are as follows (The West Australian, September 23rd 2004):

1. Mine operators must accept a duty of disclosure to the government detailing technical and financial information relating to a mining project, either on a regular basis, or on request.
2. In the event that a company no longer wishes to operate a resource project, the state government should have discretion to call for expressions of interest to purchase the project before the established lease is relinquished.
3. The state government assumes the status of first mortgagee over assets that may be sold, or otherwise disposed of by the operator, and/or
4. A proportion of the state's financial investment in supporting infrastructure to a project should be considered to be a conditional loan convertible to a grant after a specified period and subject to agreed performance criteria.

The committee also recommended other legislative changes that may have negative repercussions for the mining industry in Western Australia. These included (Economic and Industry Standing Committee, November 2004, p. 72):

1. Legislation forcing companies to prove projects are uneconomic before they are closed
2. Measures to be adopted requiring ministerial approval for any closure that is supported by a detailed economic assessment of the project's outlook (this is similar to that which already occurs in New South Wales and Queensland)
3. A 'fail-safe' mechanism be established that allows the closure of any operating mine to be challenged

The owners of the Windimurra lease Xstrata plc were criticised by both the state government and the opposition for dismantling and selling equipment at the site to other mining operators and leaving the Windimurra mine, virtually worthless to any other operator that wished to take over the operation of the site, once Xstrata had met its lease conditions. The Economics and Industry Standing Committee findings support the argument that (Sydney Morning Herald, November 12th 2004):

> …the leaseholder should not be free to obstruct future mining or mineral processing at the site by dismantling, or removing equipment or infrastructure without the written consent of the minister.

A1.10.6 Engagement with stakeholders

The Windimurra mine is located in a remote corner of Western Australia and is 80 kilometres from the nearest township of any size, Mt Magnet. The mining lease is part of a pastoral station and the mine has little interference with human habitation. There appeared to be no engagement with stakeholders regarding the closure of the Windimurra mine and like the regulators, the community of the region appeared to be taken by surprise at the closure of the site. The only community contact that was conducted by the company appeared to be the initial consultation with stakeholders as required under the *Mining Act 1978* to outline the proposed plan to mine at the site.

The Economics and Industry Committee (2004) noted the feelings of powerlessness and inability to influence the final outcome of the mine closure at Windimurra by the local community. The Committee believes that it is the right of the local community to become more involved in the development of mining projects that fall within their region (Economics and Industry Standing Committee, November 2004, p. 72):

> The Committee draws particular attention to the local community's sense of helplessness and distance from Xstrata's eventual decision to permanently close the mine and considers that local government should have more involvement in the development of mining projects within its jurisdiction.

An executive spokesperson for Xstrata, however, claimed that the company considered itself to be a good corporate citizen and that the company worked hard to ensure harmonious relationships with local communities (Engineers Australia, January 2005, p. 1):

> I believe we take those community relationships seriously…I would like to think the investments we have made and the good neighbour that we have been to the shire have been documented…obviously we will look carefully at what was done and not done, and whether we could have done it better. I am sure in many of these instances; we could have done it better.

The community of the region had a right to feel some anger towards Xstrata, however a degree of that anger could have been directed at regulators who in many respects failed the local community, in their inability to ensure that premature closure of the site would not result in the site sitting idle for so many years, costing the local community economically in terms of promised, but undelivered infrastructure and environmentally in a site that was not rehabilitated to worlds best practice. The closure also provided a salient lesson on the need for local communities to become more engaged in mining approvals and through that process become more involved in mine closure outcomes.

A1.10.7 Summary

The Economics and Industry Committee proposals if they were to be adopted by the State Government would imply a quite significant increase in the amount of government involvement in the mining industry. The proposals that have been put forward by the parliamentary committee may be met with some resistance by the mining industry as it could be seen as an impulsive reaction by parliament, in the face of what many in the industry would describe as an aberration in mining practice. This does not mean that the legislation surrounding mining operations and closure in Western Australia (or anywhere else in the country, for that matter) do not require any changes, but rather that any changes would require involvement from operators in the mining industry. The legislation perhaps needs to become more flexible and may need to take into account the needs of each specific mining site.

The proposed changes have not yet been adopted (as at 2011) and there may still be no need for the State Government to adopt the proposed changes to the legislation as recommended by the EIC, as the Western Australian government has the power to more closely monitor major developments through State Agreements. These are agreements that are entered into voluntarily by governments and a proponent to facilitate developments in the natural resources sector. Once they have been enacted, they have the force of law. The agreements are ratified by parliament and outline the obligations of both parties during the life of the project (Economics and Industry Standing Committee, November 2004).

Major project developments are often established under state agreements when requiring long-term certainty, land tenure and complex approvals, often in remote areas, hence one could have been used in the Windimurra case. The agreements can actually provide greater security to a project as the agreement provisions can only be changed by mutual consent and parliamentary approval. They promote security of land tenure and reduce sovereign risk for both the developer and the government itself. As yet, no known state agreement has been signed by the State Government and the new owners of Windimurra Mine, Atlantic Ltd.

A1.11 Desktop case studies of best practice mine closure

These mine sites were classed as best practice as they meet the mine closure criteria that the research has deemed is necessary in order to demonstrate what this thesis is proposing as best closure practice. The site's range from mines in the New South Wales, Western Australia and a former mine in Wisconsin in the United States in which the local government and community were able to provide input into both the mining operations and the mine closure process. Each of the sites share common characteristics including good closure planning, urban locations with medium to large populations (or being close to large urban areas), strong demand for commodities, consistent mine ownership during the course of the mine's life, sound legislation and continuous regulatory involvement regarding mine site rehabilitation and hence closure, and in nearly all cases strong community consultation and engagement.

Each of the case studies provides strong evidence for involvement from both local communities and local governments during the whole of a mine's life in order to influence the outcomes at the end of the mining process. In addition to this the evidence appears to indicate that the more profitable a company and the larger their operations are, will have an impact on their ability to rehabilitate and close mine sites in a timely and effective manner. The mining companies studied in these case studies also were actively involved in the local communities in which they operated and appeared to include the local community (this includes the local government) in the decision making process surrounding the mine closure.

Each case study represents best practice in mine closure and each has lessons that can be learned and practices that can be adopted by regulators, communities and other organisations involved in the minerals industry. It is hoped that over time these case studies will come to be seen as minimum examples of best practice closure and that the mistakes of the past are confined to the annals of mining history.

A1.12 Flambeau Mine – Wisconsin USA – Gold/Copper

The Flambeau mine located in Wisconsin in the Great Lakes region of the United States. It has provided a good example of best closure practice, as it was the first and only example in Wisconsin of a metallic mineral mine that was planned, operational, rehabilitated and closed under the State's existing regulatory framework. The mine did not require additional regulatory approvals or government support and is a rare example, not only in the United States, but around the world of a mine site that has closed under existing regulatory conditions.

The mine was located close to the Flambeau River and was unpopular with some in the local community due to its proximity to the river and the potential for environmental problems if leakage were to occur from the site into the river. Mining taxes and royalties from the mine were also redistributed back to the local community and used for a variety of civic projects that assisted in gaining community and government support for the mine.

A1.12.1 The location of the mine

The Flambeau mine is located only 1.7 miles (2.7km's) from the City of Ladysmith in Wisconsin USA and is only 140 feet (42.7metres) from the Flambeau River, the area covered by the mine also includes Rusk County and the Town of Grant (Wisconsin Department of Natural Resources 2006). The owners of the mine are the Kennecott mining company, which is a wholly owned subsidiary of Rio Tinto (Fox 2007, p1). Due to its location the mine had the potential to be both an environmental and social disaster if the mine operation and closure phases were not handled in a sustainable manner. The company owners Rio Tinto plc are one of the leaders in the mining industry in adopting sustainable development and the initiatives outlined by the Global Mining Initiative (GMI). Rio Tinto was , placed by the Dow Jones Sustainability Index as the top ranked mining company in its 2002 report on sustainability practices by global organisations (Fox 2007, p1).

The region experiences moderate to high precipitation with 850mm of precipitation on average each year and 125cm of snowfall (Wisconsin State Climate Office 2010). The area has four distinct seasons with heavy snowfall from November to March during which many of the streams and lakes are frozen. During the spring melt and rains in April flooding is common in areas surrounding streams and lakes as the ice melts, causing water levels to rise. As Flambeau mine, was being situated so close to the Flambeau River, this was a serious concern from both regulators and the community due to possible acid drainage from the mine.

Figure A 1.20: Location of Ladysmith in Wisconsin

Source: Rusk County (2010)

A1.12.2 Size and profitability of the mine

The ore body of Flambeau was discovered in 1968, with planning for a mine in the area beginning in the early 1970’s. The initial plan called for a mine life of 11 years and an open void approximately 300 feet (91.44metres) deep, with the rehabilitation plan calling for a recreational lake as the end use (Fox 2007). The local community, however, reacted unfavourably to the proposal and the company chose not to proceed with that particular development. This placed Kennecott in a strong position within the local community, as they were seen as a company that was inclusive and would listen to the needs of the local community.

Figure A 1.21: The centre of the Flambeau mine open pit

Source: University of Wisconsin Extension (2010)

Kennecott Mining Company began planning for the mine again during the mid 1980's, but changed the criteria for the site. The plan this time allowed for a smaller pit, with backfilling of the pit and contouring of the site back to its original condition upon closure and rehabilitation. The Flambeau River that runs near the mine site is an important part of the community, in terms of its usage for recreational fishing, tourism, and a wildlife habitat and just for its aesthetic appeal (Kennecott Minerals 2003). The mining company needed to take into account the Flambeau River in its planning criteria, as the protection of the river was the cornerstone to gaining community approval and acceptance for the new development. The ability to listen to and take local concerns into account assisted Kennecott in ultimately gaining local approval for the mine development.

The area covered by mining at the site ultimately covered 181 acres (approximately 73 ha), with the open pit measuring 793 metres in length by 167 metres in width and reached a depth of around 67 metres (Wisconsin Department of Natural Resources 2006).

The mining project due to its profitability for the company also provided economic benefits in the form of the taxes paid by the mining company to the State of Wisconsin. The Wisconsin State government received approximately US$16 million in taxes from Kennecott Mining Company (Fox 2007, p4); this money could then be redistributed back to the local communities. The local Communities received approximately US$10 million of this (Fox 2007, p4) that they were able to use to assist in offsetting some of the negative impacts of the mine closure and to assist in attracting and developing new industries to the region. According to Fox, Rusk County have been able to add US$6.5 million to their tax base as a result of these funds used to attract new industries to the region (2007, p4).

In addition to economic development, Kennecott assisted in the development of the community through various projects, such as the contribution of US$500 000 towards a new library, US$30 000 towards playground equipment for the local primary school, a new visitor centre, fire truck and a scholarship program for the local High School (Fox 2007 p4). The company also turned former gravel pits that were located near the Flambeau River into Wetland reserves as part of their community development program.

A1.12.3 The size of the community where the mine is situated

The City of Ladysmith had a population of 3,392 at the 2000 census (no later data was available) (US Census Bureau, Ladysmith City 2008) and is part of Rusk County with a population of 15,347 (US Census Bureau, Rusk County 2008). The City of Ladysmith is located approximately 370 kilometres from Milwaukee, the major city of Wisconsin, with the area around the City of Ladysmith being mainly rural, consisting of small farming communities. The Town of Grant also adjoins the mine and has an estimated population of 1008 (Town of Grant 2010) and alongside Rusk County and the City of Ladysmith was instrumental in granting Kennecott permission to mine at the site near the Flambeau River.

Mining in Wisconsin is generally small scale and it is only a small industry sector in the state, employing only 3,514 people, compared to the largest industry sector in Wisconsin, manufacturing which employs 487,573 people (US Census Bureau, Economic fact sheet, Wisconsin 2006-2008). In the City of Ladysmith, however, the mine during its operational phase was a major source of employment (both directly and indirectly) in an area that has experienced high unemployment and low participation rates, compared to the rest if the State and the Country (Northwest Regional Planning Commission 2005) and was an important source of revenue for both the State and Local governments.

A1.12.4 The ownership of the mine

The Flambeau mine is a fully owned subsidiary of Kennecott Minerals Company which is headquartered in Salt Lake City in Utah. The copper and gold mine had an operational life of five years, with mining commencing in 1991 and ending in 1996. During its operational phase, the mine produced 1.8 million tonnes of copper and gold (Rio Tinto 2006), and was a highly profitable mine, earning Net Sales Revenue US$341 million for Kennecott during its operational life, with a Net Income of US$126 million after operating costs and taxes (O’Brien 2008).

Rio Tinto as part of proving its commitment to the notion of sustainable development established a sustainable development policy that has been implemented across the whole organisation (including its subsidiaries). This policy states the following in relation to sustainable development at Rio Tinto (Rio Tinto 2003):

> To ensure our businesses, operations, and products contribute to the global transition to sustainable development…
>
> …We contribute to sustainable development by helping to satisfy global and community needs and aspirations, whether economic, social or environmental. This means making sustainable development considerations an integral part of our business plans and decision-making processes.
>
> …By focussing on people, the environment, resource stewardship and management systems, we can better manage risk, create business options, reduce costs, attract the best employees, gain access to new markets and resources and deliver a better product to our customers.
>
> …In practice, this depends on the active awareness of and support for Rio Tinto's principles and policies by each of us as individuals.

In addition to this overall company objective, the Rio Tinto subsidiary Kennecott Mining Company developed its own Sustainable Development Framework that 'integrates the principles of economic activity with social responsibility, environmental integrity and effective governance systems' (Fox 2003, p. 1). According to Fox (2003) the Kennecott Mining Company has encouraged stakeholder involvement in the four sustainable development principles (Economic, Social, Environmental and Governance) at the operational level of its mining activities. This is an important consideration if a mining company is to adopt sustainable development policies and it meets the guidelines laid out in the MMSD report. It is also vital if mining companies are to become more inclusive in their mining operations.

The mining operations operated under the principles of sustainable development from the outset. The operation incorporated the following procedures (Fox 2003, p. 2):

- Mining in as small a footprint as possible covering only 181 acres;
- Utilisation of a state-of-the-art water treatment facility which produced over 600 million gallons (2,280 million litres) of high quality water (less than drinking water standards) discharged to the Flambeau River;
- Minimising environmental impacts through use of high density polyethylene liners, leachate collection systems, treatment of contact water and sorting waste rock;
- Controlling the formation of Acid Rock Drainage (ARD) from high sulphide waste rock and backfill material; and
- Backfilling the open pit in the same geological sequence and establishing on site native plant communities for wildlife habitat and trails for passive recreation.

A1.12.5 When the mine closure was planned

Kennecott Minerals Company initially commenced planning for mining at the Flambeau site in 1974 under a new act in Wisconsin, the *Metallic Mining Reclamation Act.* Initial plans for the site consisted of 11 years of open pit mining, followed by 11 years of underground mining. The initial rehabilitation plans for the site called for the pit to be allowed to fill with water, whilst the remainder of the site would be revegetated to its pre-mining state. This was deemed to be acceptable to the regulators at the time. Mining never commenced however, due to some opposition in the community and the Rusk County governments refusal to grant zoning permission for the mine, due to concerns about the project and the State's new mining laws.

The project lay dormant until 1986 when the company revised plans for the site that included a smaller open pit mining operation that would be backfilled with waste rock blended with limestone (to neutralise acidity). The actual mining operations commenced in 1991, with the last shipment going out in 1997. The site began to be rehabilitated during autumn of 1996, with the backfilling of the void, which was completed the following year. The site was then contoured back to its approximate original state, along with the construction of wetlands for a wildlife sanctuary. By the end of 1999, the last of the rehabilitation was completed.

How the mine closure was planned and conducted

After the community and local government opposition to the initial mine operation and closure plans for Flambeau, Kennecott Mining Company redesigned the mine project, and changed the closure plans for the site in order to address community concerns about the initial mine closure proposal. There was also some concern from the local government and the company about the State's then new mining law and their impact on the proposed Flambeau mine (Wisconsin Department of Natural Resources 2010).

The company went back to the local community and government with some significant changes to their original mining proposal which included a smaller mining footprint and significant changes to their closure plans for the site, including a decision not to turn the open pit into a freshwater lake, but instead to backfill the pit (a more costly option) and return the site as near as possible to its pre-mining state.

The company engaged the local community in the revised mining project from the outset, with a deliberate strategy to include the local community in the mine's rehabilitation and closure outcomes. The mining company entered into a Conditional Land Use permit and a legally binding contract with the local community (namely Rusk County, The City of Ladysmith and the Town of Grant), known as *The Local Agreement (1988).* This agreement provided a contract that documented all of the promises made by the mining company and made a number of binding guarantees to the local community (these are discussed in the Community Engagement section).

The rehabilitation of the site began in 1996, with the open pit being progressively backfilled and contoured to match the surrounding landscape. The remainder of the mine site was rehabilitated with the replacement of topsoil, revegetation and the construction of wetlands and four mile (6.4 kilometres) nature trails (Fox 2007). The company also established an industrial park at the site, using the physical facilities (such as buildings) and infrastructure (such as roads and a rail spur) operated by Kennecott during their tenure at the site.

The rehabilitation was complete by the end of 1999, with the company submitting a Certificate of Completion in 2001 to the Wisconsin Department of Natural Resources. The Certificate was granted by the Department in 2007 (after a mandatory four year monitoring period of vegetation at the site). Under Wisconsin law the groundwater on and around the site will be monitored for a period of 40 years, even with the granting of the Certificate of Completion (Wisconsin Department of Natural Resources 2010). A Certificate of Completion was not granted for the industrial park at the time (as the park was still in the development phase) (the Industrial Park has since been completed and is one of two such parks in the County.

In addition to the Certificate of Completion, the company was also granted a reduction to 20% of their original US$11 million rehabilitation bond (which is the maximum amount allowed under Wisconsin law) (Flambeau Mining Company 2009). The total cost of rehabilitating the Flambeau mine site was US$20 million with the rehabilitation standards exceeding the regulatory requirements of Wisconsin law (Fox 2007, p2).

Figure A 1.22: Flambeau before mining commenced

Source: Rio Tinto, Rio Tinto in North America(2006), P.4

Figure A 1.23: Wisconsin, before rehabilitation

Source: Rio Tinto, Rio Tinto in North America, 2006, P.4.

Figure A 1.24: Flambeau, Wisconsin, after rehabilitation

Source: -Rio Tinto, Rio Tinto in North America, 2006, P.4

What alternative closure options were considered

When the mine was originally proposed in the mid 1970's, the initial mining plan called for a 91metre open pit with a life of 11 years and the processing of the ore on site. The pit was to be rehabilitated as a freshwater lake, with the area surrounding the lake to be rehabilitated as close as possible to its pre-mining state. The open pit was to be situated close to the Flambeau River (42 metres away); hence possible issues with leakage from the pit were a concern to both residents and local government officials (Wisconsin Department of Natural Resources 2010).

The company shelved the original plans for the site after the concern from local residents and the local government and left the site in its natural state until 1986 when the company reintroduced a scaled back version of the project. The new mining plans called for a smaller operation with an open pit that was around half the size of the original pit and with all processing for the mine to be carried out off site. In addition to this, the open pit was to be backfilled with waste rock and acid neutralising limestone rock, with the remainder of the disturbed site to be returned to its pre-mining state.

The revised rehabilitation (or reclamation plan as it is known in the United States), outlined plans for a series of recreational trails at the site, passing through wetlands, grasslands and woodlands that were to be incorporated into the rehabilitation plan (Fox 2007). This revised plan for rehabilitation and closure was met with much less opposition from both the local community and local and state regulators, yet still made the mine economically viable for Kennecott.

In addition to this, in 1998 Kennecott submitted a request to the Wisconsin Department of Natural Resources to modify the Mining Permit and Reclamation Plan (Kennecott Mining Company 2009). The modifications were to allow the on-site buildings and facilities, a railroad spur and some of the waste rock pile to be used for alternative uses once mining had ceased. The site was to be used as an industrial outlet by the Ladysmith Community Industrial Development Corporation who eventually leased parts of the site to other businesses, including a branch office of the Department of Natural Resources and the use of part of the area as a trailhead for a local equestrian club (Northwest Regional Planning Commission 2005).

The legislation under which the closure was conducted

The initial mine permit for the Flambeau mine was granted under the then newly instituted *Metallic Mining Reclamation Act 1973,* however, due to concerns from both the local government and Kennecott Mining Company about the new laws, mining at the site did not commence. In 1977 the mining laws in Wisconsin were rewritten and it was under this new regime that Kennecott recommenced their application to mine at the Flambeau site in 1986 (Wisconsin Briefs 2000). As a result Flambeau was the first and to this day only example of a metallic mineral mine that was '...permitted, constructed, operated and reclaimed under the State's existing regulatory framework' (Wisconsin Department of Natural Resources 2010).

The Flambeau mine was also the first mine in Wisconsin to be regulated under the *National Environmental Policy Act 1969* and the *Wisconsin Environmental Policy Act 1972*. These acts along with the 1973 *Metallic Mining Reclamation Act* were designed to 'provide that the air, lands, waters, plants, fish, and wildlife affected by prospecting and mining in the state will receive the greatest practicable degree of protection and reclamation' (Wisconsin Briefs from the Legislative Reference Bureau 2000, p3). The *Act* specifically focused on the reclamation of mining sites, authorising the Department of Natural Resources to establish environmental standards and procedures for mining. The *Act* also developed a revenue sharing system with the county and municipal governments from the proceeds of mining taxes.

The *Metallic Mine and Reclamation Act* requires three public hearings during the mine permit phase, with the public invited to comment at any of these hearings. The Act also provides legislated power for local communities to influence the mine permit process through the establishment of local impact committees that have the power to negotiate legally binding contractual agreements with mining companies (Wisconsin Briefs from the Legislative Reference Bureau 2000).

In addition to this the legislation allows for local areas where mining operations occur to receive '...first dollar payments and additional payments...for mining related purposes defined as activities...directly in response to construction, operation, cessation, or curtailment of operation, or closure of a metalliferous mine site. It also included activities which anticipated the economic and social consequences of the cessation of mining...' (Fox 2007, p3).

In 1986, Kennecott Minerals decided to pursue the mine lease at Flambeau and approached regulators with a revised, smaller plan for the mine site. The Wisconsin State Government in an attempt to circumvent opposition to the mine, arranged to have the three local government areas that abutted the mine (City of Ladysmith, Town Grant and Rusk County) to sit down with Kennecott Minerals and determine whether or not the mine could be a feasible option for the region. A task force was established by the State Government to find a resolution to the impasse, eventually resulting in the establishment of a negotiating committee that took over ten months to broker a deal on the mine.

The result was the *Local Agreement* and the *Conditional Land Use Permit* that were signed on August 1, 1988 by the three local government areas and Kennecott Minerals (Northwest Regional Planning Commission 2005). The Local Agreement established economic and environmental guarantees that covered everything from mine planning through to closure. It is a legally binding contract between the parties that would result in prosecution for any party that fails to abide by the terms of the agreement. The Agreement exceeds Wisconsin's regulatory requirements for mine operation and closure and it is unique in that the agreement is between local government authorities and the mining company, rather than State, or Federal Governments and mining companied (which traditionally has been the norm in mining operations).

In addition to this, the Agreement provided for the development of alternative economic activities (although it does not specifically state what these alternative activities would be), via direct tax payments to the three local government authorities, regardless of whether or not the mine made a profit (Local Agreement, Flambeau Mine 1988). The Local Agreement Committee focussed on five major points that were of concern to local residents (Northwest Regional Planning Commission 2005, p. 54):

1. The mine would have to meet all of Wisconsin's ...environmental and mining requirements so that the Flambeau River, the wetlands, the groundwater, and the fish and wildlife would not be harmed.
2. Jobs for local people and if for some reason the mine did not make a profit, what would happen to the surrounding communities' share of the mining taxes.
3. What would local residents do if for some reason their wells were affected.
4. Concerns about safety and noise from the mining operations affecting people at night.
5. A guarantee that the value of the property in the area would be protected.

The Local agreement addressed each of these concerns and ensured that the local communities would benefit by the distribution of funds back into the local community via a number of economic development programs across the three local government areas. According to Fox (2007, p. 2), Kennecott paid US$16 million in taxes to the government of Wisconsin during its mine life and of this US$11 million was made available to the three local government authorities, with this amount increasing to US$28 million in total from private and public investments in the local economy (Fox 2007, p. 3).

Sustainable development was integrated into the Kennecott operations as part of the Local Agreement that was signed with the local government regions and became formalised company policy in 2001. The key components of the Flambeau project were (Fox 2007, pp. 6-7):

- Mining in as small a footprint as possible, covering only 181 acres;
- Utilisation of a state-of-the-art water treatment facility which produced 600 million gallons of high quality water (less than drinking water standards) discharged to the Flambeau River;
- Minimising environmental impacts through use of high density polyethylene liners, leachate collection systems, treatment of contact water and sorting waste rock;
- Controlling the formation of Acid Rock Drainage (ARD) from high sulphide waste rock and backfill material;
- Backfilling the open pit in the same geological sequence and establishing on site native plant communities and wetlands for wildlife habitat;
- Constructing over four miles of public trails on the reclaimed mine site to complement a city-wide trail system being planned in partnership with the City of Ladysmith; and

- Providing numerous contributions to the local communities, including major funding for a new US$1.4 million library, and creating a number of opportunities to develop and retain non-mining related businesses in the area.

The development of a legally binding agreement between Kennecott and the three local government areas, City of Ladysmith, Rusk County and the Town of Grant provided an additional degree of assurance for the local communities in their dealings with the mining company. The local government authorities were able to control the outcome of the mining development and deliver a project that was acceptable to their local constituents. It also provided the local government authorities with a voice in the project, something that was lacking in the case of poor practice mine closure and meant less control from bureaucrats located in the state or federal capitals, often many kilometres from the mine sites and generally removed from the circumstances of the local communities. In addition to this, Flambeau was unique in that a substantial portion of the revenues received from the mine site were redirected back to the local community to assist in post-mining economic development.

A1.12.6 Engagement with stakeholders

The mining company established a Local Agreement and Conditional Land Use Permit with the three local government areas responsible for the development – City of Ladysmith, Rusk County and the Town of Grant (Fox 2007). The agreement gave guarantees to the local communities in a number of areas, some of which were (Fox 2007, p. 4):

- Hiring of employees – Flambeau and its contractors committed to hire at least 75 percent of employees from within ten miles of the Rusk County border. Flambeau averaged over 80 percent local hire during the project.
- Visitor's observation area – Flambeau agreed to provide an area to allow visitors to park and observe the mining operation. The Flambeau Visitors Centre was located on the topsoil stockpile providing a clear view of the operation and site reclamation. Over 125 000 visitors observed the operation and reclamation of the Flambeau mine over five years.
- Hours of operation – Blasting, crushing and rail shipping were limited only to daylight hours, Monday through Saturday only.
- Guarantee of private Off-Site wells – Flambeau agreed to test potable wells within a Well Guarantee Area. During the project, there were no wells within the guarantee area that failed to be suitable for human use.
- Right of first refusal – The local governments have the right of first refusal based on the highest bid received on any property being sold by Flambeau.

- Revenues to Local Government – One time construction payments of US$100 000 were paid to the local governments. Additionally, there were annual ‘first dollar’ payments of US$100 000 to all three governments and additional payment guarantees to Rusk County. Payments were indexed according to the inflation indicator. Net proceeds taxes from the operation of the Flambeau mine also returned to the local governments.

These were important factors in the success of the Flambeau mine, as it developed local support for the project from the planning stages of the mining operation. The local community had their needs addressed and were listened to in matters concerning the mine and its impact on the community. Importantly for the operation, the closure of the mine was given priority from the initial planning stages, providing the local community with a sense of security with regards to the cessation of mining. It also provided the community with time to plan the development of alternative industries to provide employment when the mine closed.

According to Fox the local community saw the mining experience in Flambeau as overwhelmingly positive and the community views mining in a more positive light as a result (Fox 2007, p. 4):

> Current opinion within the local communities is that the operation of the Flambeau Mine was a positive experience and the communities would be glad to see Kennecott return to the area with another project in the future…Flambeau, together with the local communities of Rusk County, the City of Ladysmith and the Town of Grant, worked cooperatively to ensure area communities made the most of the economic and environmental opportunities available before, during and after mining. Flambeau’s ability to build strong community partnerships and working relationships with the local communities through sustainable development will be of great benefit for future generations, and should go a long way towards improving industry-wide social and environmental performance.

The Kennecott Mining Company also entered into an agreement with the City of Ladysmith to establish a series of hiking trails on the mine site. A public walking trail was established in 2001 that demonstrates the rehabilitation of the site, passing through various wetlands, grasslands and wooded areas (Kennecott Mining Company 2003).

Kennecott mining developed an industrial park on part of the mining site in conjunction with the Ladysmith Community Industrial Development Corporation. The site used infrastructure developed by the mining company, including a rail line to service the park.

Kennecott Mining Company continued to engage local communities after mining had ceased at the site and in 2004 formed the Flambeau Community Advisory Group whose purpose is to develop a land use management plan for the 2177 acres (881 ha) that is still owned by Kennecott (Kennecott Minerals 2005). The group is still in operation today.

A report was released in 2005 by the Northwest Regional Planning Commission that investigated the socioeconomic impacts of the mine on the local community. The report consisted of a detailed survey from the population of the three local government areas, in addition to various social and economic analysis of the impact of the mine. The report estimated that the three local government authorities received approximately US$11 million in revenue either directly or indirectly from the Flambeau mine and nearly treble that amount in public and private investment in various economic development projects in the three regions (Northwest Regional Planning Commission 2005).The findings from the report indicated that the money was used to develop and retain businesses in the region and had resulted in the creation of approximately 500 jobs in the Rusk County area and increased the County's incremental tax base by US$170,000 annually (Fox 2007, p3). Some of the industries developed in the region included building trades (such as cabinet makers and carpenters), automotive supply companies, and transport companies.

From a community engagement point viewpoint the report found that a majority of respondents (90.3%) believed that Kennecott kept their promise to rehabilitate the mine site, with 77.3% claiming that the mine kept its promise in providing economic benefits to the town. Most tellingly from a community engagement point of view when asked the question 'If another ore deposit were found in the vicinity of your community, would you welcome Flambeau Mining Company back to mine it?', 75.2% of respondents replied that they would welcome them back (Northwest Regional Planning Commission 2005).

A1.12.7 Summary

The Flambeau experience provides a good example of 'world's best practice' in both mining operation and closure. Importantly, for the local community, the closure of the mine was decided during the planning phase, giving the community time to absorb the closure impact and begin developing alternative industries, to assist in providing employment and income when mining ceased. The local community was actively engaged in the entire mining process, from the original mining development that was knocked back by the community, through to the final mining operation that commenced in 1991. This engagement provided the local community with a sense of empowerment and as Fox stated probably led to the harmonious relations that characterised the Flambeau operations.

The idea of active involvement in the local community and the funding of development projects for the local community also did the company no harm and assisted in the generally positive light in which Kennecott mining is seen in the areas of Rusk County, Town of Grant and the City of Ladysmith. One of the positive features in this study is the idea of the

Wisconsin State Government handing back some of the mining taxes to the local communities, for them to use in development projects.

World’s best practice in mining and closure should aim to redistribute some of the funds received by governments in the form of mining royalties and taxes, back to the local mining communities, so that it can be used for future development programmes. How this would be achieved is open to debate, but the idea of a ‘committee for closure’, is not without merit, particularly if the committee drew its members from a wide cross-section of the community. The committee members could be drawn from the local community, mining and other industries, government regulators and academia.

A1.13 Ridgeway Mine - South Carolina, USA – Gold/Silver

Ridgeway Mine was a gold and silver mine owned by Kennecott Mining Company, a wholly owned subsidiary of Rio Tinto plc. The mine is located in South Carolina in the Southeastern corner of the United States in a rural area that is known for its natural beauty, rather than its mine sites. When the mine was first proposed in the mid 1980’s it faced signifcant opposition from locals who were concerned about the impact the mine would have on the local community and the surrounding environment.

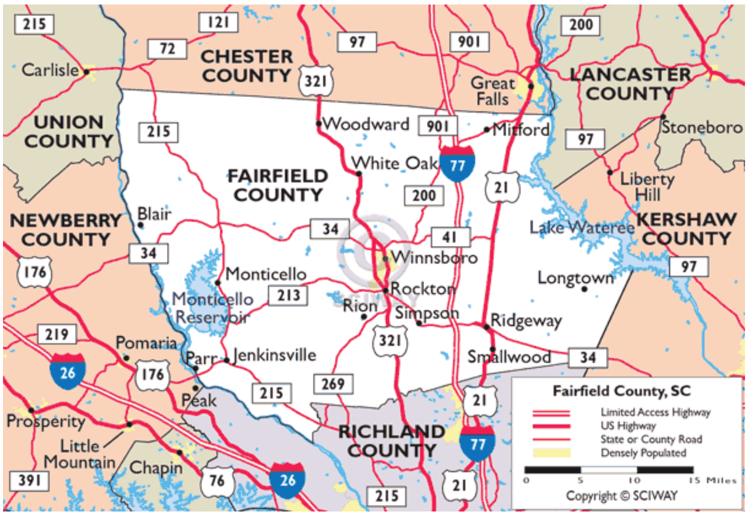
Kennecott Mining Company was forced to actively engage the local community in the mine development process in order to overcome the local resistance (in the form of litigation) to the proposed mine. Community oppostion to the mine was eventually swayed in favour of the project after the company was able to demonstrate that the rehabilitation and closure program at the mine would ensure that the area disturbed by the mine would be retuned to a standard that was higher than what existed prior to mining.

A1.13.1 The location of the mine

The Ridgeway mine is located approximately 8 kilometres from the town of Ridgeway in Fairfield County, South Carolina. The region is mainly rural residential, focussing on its natural beauty and with many of its homes and buildings dating back to before the Revolutionary War. The mine itself faced substantial opposition when it was first proposed, due to concerns about its impact on the surrounding environment and the possibility of contamination from the mine into surrounding waterways.

The climate of the region is classified as humid, sub-tropical characterised by cool to cold, dry winters and wet humid summers, with occasional heavy rainfall events in the form of hurricanes, as an example Hurricane Earl in 1998 produced over 200mm of rain during a 24 hour period in the region (South Carolina State Climatology Office 2010). These extreme rainfall events, although rare can cause problems associated with water runoff from the pit lakes, particularly in the form of reduced alkalinity and pH levels.

Figure A 1.25: Overview map of Fairfield County, with Ridgeway in the Southeastern corner of the State



Source: South Carolina Information Highway (2010)

The town of Ridgeway is located approximately 44 kilometres from the State Capital of South Carolina, Columbia. The region around Ridgeway is characterised by farmland, forests and inland waterways with the town of Ridgeway selling itself as a lifestyle destination, due to its historical buildings and rural surroundings. Its rural countryside, historical significance and lack of heavy industry were also part if the reason there was significant opposition to the initial mine proposal by Kennecott Mining.

A1.13.2 Size and profitability of the mine

The mine covered an area of 234 ha and consisted of two open pits, each with depths of approximately 100 metres. Each open pit covers an area of 40 hectares, with the tailings storage area for the mine covering an area of 153 hectares (Duckett and Fox 2007). The ore recovered at the Ridgeway mine was of a low grade, however, low production costs and the large ore deposits (15,000 tons of ore a day were mined during the mine's peak production phase) made the mine a highly profitable one for Kennecott Mining (Dorey et al 1999).

The Ridgeway mine commenced operations in 1988, closing in 1999, after producing 60 million tons of ore during its operational phase (Fretwell 2004, p. 1). The Ridgeway mine was a profitable mine for the Kennecott Mining Company becoming the largest gold producing mine in South Carolina and the 10th largest gold producing mine in the United States, with one of the lowest production costs for gold mines in the world (the United States has the second lowest gold production costs in the world) (Virginia Department of Mines, Minerals and Energy 1991). At its peak the mine employed 180 people directly at the mine site, providing stable employment and income for workers employed at the mine (Dorey et al 1999). At the peak of its operations the mine experienced annual sales of US $23 million and was the most profitable mine in South Carolina and the second largest mining employer in the state (Dorey et al. 1999).

A1.13.3 The size of the community where the mine is situated

Ridgeway is a small rural town located in Fairfield County South Carolina, the population in 2009 was estimated to be 461 (US Census Bureau 2010). The town covers an area of just 1.2 km^2 all of which is classified as land according to the United States Census Bureau (2010). The Ridgeway mine at its peak production capacity employed 180 people directly (not all of whom resided in Ridgeway Township) and was a significant industry sector to the town of Ridgeway and the county of Fairfield. The town is part of the Columbia Metropolitan Statistical Division, with Columbia being the State Capital and largest metropolitan area in South Carolina.

The County of Fairfield covers an area of 1,838 km^2 has an estimated 2009 total population of 23,482 (US Census Bureau 2010). The county consists of small rural towns, with the major industry sectors (by employment) being the retail, accommodation and food, and health care and social assistance sectors (US Census Bureau 2007). Mining is not an industry that is statistically significant enough to be counted in the 2007 Industry Census for the county, however, in terms of the town of Ridgeway its population declined between the closure of the mine in 1999 and the 2000 (Fretwell 2004) census, however, it has since recovered according to the last population estimate in 2009.

A1.13.4 The ownership of the mine

The Ridgeway mine is wholly owned by Kennecott Minerals who are located in Salt Lake City in Utah, and who in turn is a wholly owned subsidiary of London based Rio Tinto plc. As part of the Rio Tinto group of companies, Kennecott Minerals has access to substantial resources (both financial and human) and an entrenched culture of sustainable mining, with Rio Tinto being one of the key signatories to the Minerals Mining and Sustainable Development Report (2002) which developed a set of guidelines designed to assist mining companies in developing best practice across all aspects of mining from planning to closure.

Kennecott Minerals had sales of US$23 million per annum at the Ridgeway mine, employing 180 people directly at the mine during the operational phase of the mine 9Doery et al. 1999). Kennecott Minerals is a wholly owned subsidiary of Rio Tinto plc ensuring that the organisation has access to large capital resources and an entrenched sustainable development policy within the company with a good recent history on mine closures, particularly in their North American operations. Rio Tinto had a market capitalisation in 2010 of US $125 billion, making the company the world's third largest mining company after BHP Billiton and Vale (Rio Tinto Chartbook 2010). The company employs 105,785 people worldwide (Rio Tinto Chartbook 2010) in over 50 countries across the globe and is one of the world's most diverse mining companies with a production base that includes cooper, Aluminium, Diamonds and Minerals, Energy (including coal and uranium), Iron ore and Copper (Rio Tinto Annual Report 2009).

Kennecott Minerals along with the Rio Tinto Group have integrated the International Council of Mining and Metals Sustainable Development Framework into their business units with the organisation designing a closure standard for all mine closures. This mine closure standard is implemented from the mine planning stages to ensure that a mine project '...must integrate closure considerations to minimise financial, social and environmental risk from the outset...' (Rio Tinto, 2010).

The sheer size of the organisation, the company's recent history of delivering positive outcomes from mine closures and the internal focus on sustainable development policies from its mine projects have enabled Rio Tinto and its subsidiaries to achieve best practice closure outcomes at many of its mine sites across the globe)).

A1.13.5 When the mine closure was planned

The Ridgeway mine was initially opposed by a section of the local community who were concerned about the impact of the mine on the local ecosystem and surrounding environment. In order to alleviate the concerns of those opposed to the mine development, Kennecott developed a strategy of engaging with the local community throughout the life of the mine project, including developing a closure plan for the mine site that incorporated the requirements of locals that the area be returned to its pre-mining state (Fox 2007). The company began the mine closure preparation for the site during the planning phase of the mine and as is company policy reviewed the closure plans every four years (Fox 2007) to ensure that the plans were being implemented and make any necessary changes.

Kennecott Minerals adopted a number of measures that were designed to listen to the apprehension that locals displayed regarding the mine operation. Some of the measures adopted by Kennecott included providing a Wildlife Management Plan, providing a financial guarantee for the owners of local wells should their water become contaminated from the mine site, in order to monitor this an independent groundwater consultant was employed (Rio Tinto 2010). The company also employed of a full-time Department of Natural Resources wildlife technician to monitor wildlife habitats at the site, it also increased the amount of noise and visual buffer land at the site in order to reduce the physical impact of the site. Kennecott has consistently gone beyond its regulatory requirements regarding mine closure at the Ridgeway mine site, however mine closure procedures are a company policy that have now been standardised across all Rio Tinto businesses (Rio Tinto 2010).

The Ridgeway mine closure provides an interesting case study on the costs associated with mine closure and how even in best practice closure, with continual rehabilitation and regular planning reviews, costs can escalate beyond initial estimates. The mine closure at the Ridgeway mine site was estimated by Kennecott Mining Company at US $9.53 million in 1994, however, by the time the mine ceased operations in 1999 Kennecott had spent US $28.84 million on the rehabilitation and closure of the site (Fox 2007).

A1.13.6 How the mine closure was planned and conducted

The main priority for Kennecott was to rehabilitate the site to a level that would be of use recreationally to the local community and to a higher standard than existed prior to mining. The standards that Kennecott set for its mining operations are based on the concept of sustainability as outlined by the Minerals Mining and Sustainable Development (MMSD) guidelines and their own company guidelines on sustainable development. Kennecott Minerals Company Sustainable Development Framework provides for the following (Fox 2003, p. 1):

> …a basic organisational structure for continued advancement in sustainable development…addressing its four 'pillars'; Economic, Social, Environment and Governance. The Sustainable Development Guidelines were developed with stakeholder involvement for each of the four pillars…The guidelines will be utilised by all KMC operating and closed properties to further incorporate a consistent approach to implementing sustainability concepts.

Figure A 1.26: Ridgeway rehabilitation in 2003

Source: Kennecott Mining Company, (2003)

Figure A 1.27: Ridgeway rehabilitation in 2006

Source: Fox, 2007, p6

Kennecott instituted a Settlement Agreement in 1989 with the local community after a law suit was filed against Kennecott in the late 1980's by a group opposing mining at the site. The group known as GOLD CAMOUFLAGE (Citizens Against Mining Operations Unsafe For Land And Good Environment) launched a concerted campaign to have mining stopped at the site during the late 1980's (Kennecott Minerals Company 2003). The Settlement Agreement circumvented the litigation and provided the local community with a number of guarantees regarding the mine closure that Kennecott were legally bound to honour. The agreement forced Kennecott to alter their original closure plans for the site however it provided the local community with a mining operation that was sustainable and that suited their needs after mining ceased.

The following outlines the process that Kennecott follows with regards to its sustainable development practice. The Kennecott Mining Company claims that the process used for the closure of its Ridgeway Mine sites, yielded a number of positive insights that it claims will assist it for future mine closures and that it hopes will lead eventually to an industry-wide closure process. The process is as follows (Fox 2003, pp. 7-8):

- There is a need to develop best practice principles and reporting criteria (indicators) well in advance of project implementation with which to measure the progress of implementing sustainable development principles.
- Informed, transparent, inclusive and equitable decision-making processes with all known stakeholders are needed well in advance of deciding project scope, budget and schedule, along with reclamation and closure objectives. This can be accomplished by establishing advisory committees for specific areas.

- The difference between short-term local community contributions and resultant benefits versus long-term sustainable development opportunities for local and regional communities are distinct and should be understood. Both bring good will and benefits to the communities, each having different objectives and outcomes.
- Regular active engagement with key stakeholders and information sharing is a key to community respect, trust, and ultimate acceptance of a project and company. There are many ways to accomplish this needed communication, including regular project updates and scheduled site tours.
- Traditional and cultural values of local communities need to be thoroughly understood and respected to be able to improve the well being of people in the area of operations. Specific studies will be required that focus on the socio-economic and cultural values, including governance within local communities.
- Institutional arrangements are preferred (e.g. formal agreements) to improve the processes associated with stakeholder engagement, documentation and sign-off, and the capacity of the local communities and government to address the consequences of a project.
- Alternatives regarding sustainable uses of facility infrastructure should be evaluated with stakeholder involvement early on and included as options for post closure development. A well-planned project from the start will result in community acceptance of post closure facility use and reduced costs in utilisation of infrastructure.

Further to this according to Fox (Fox 2003, p. 8):

> These valuable lessons learned should become something of the past as KMC moves forward in implementing its recently developed Framework for Sustainable Development and each site integrates the concepts of sustainable development into core business practices using a consistent set of Sustainable Development Guidelines.

Figure A 1.28: Rehabilitated Tailings embankment in 2002

Source: Kennecott Minerals Company, 2003, p4

In 2005, Kennecott Minerals was awarded the Hardrock Mineral Environmental Award by the Bureau of Land Management (Eastern States Division) for its rehabilitation and closure work at the Ridgeway Mine. The award is designed to recognise environmental stewardship in the mining industry and is awarded to organisations that consistently exceed regulatory requirements with minimal need for intervention from regulators (Bureau of Land Management 2006). The award is important in that it recognises sustainable development in mining that takes into account not just environmental, but also the economic and social considerations when planning for mine site rehabilitation and closure. The then Director of the Bureau of Land Management (Eastern States) had the following to say in relation to the Ridgeway Mine (PR Newswire Association LLC, 2005); 'Kennecott Ridgeway Mine illustrates the BLM's concept of sustainable development – maintaining current standards of living while providing for future needs'.

In addition to the Bureau of Land Management Award, the Ridgeway Mine in 2006 also received two other awards, the South Carolina Mined Land Reclamation Award and the Interstate Mining Compact Annual Reclamation Award (Interstate Mining Compact Commission 2010). As with the Bureau of Land Management Awards, the two awards recognised the environmental work that was conducted at the Ridgeway Mine, along with the social and economic benefits that were considered as part of the mine closure program that was undertaken by Kennecott Minerals.

The final rehabilitated site at the Ridgeway mine now includes two 41 ha lakes, a number of wetland habitats and the 154 ha tailings storage area that have been transformed into prairie grassland (The Mining Journal, April 25, 2007). The former mine void has also become an established centre for environmental education and research on balancing economic growth with environmental protection, with Kennecott Mining providing funding for the programs being conducted by the Southeastern Natural Sciences Academy's Centre for Ecological Restoration.

A1.13.7 What alternative closure options were considered

The initial closure plans for the mine site centred on stabilising the long-term physical, chemical and ecological stability of the site (Fox 2003). Kennecott Mining was also mindful of the need to stabilise the site to make it safe for possible future recreational use. Part of this included the creation of wetlands to control the surface water runoff from the site and to act as a filtration system helping to prevent drainage into local waterways. The wetlands were linked to the two lakes that were created from the open pits and according to Fox, were used to 'enhance the overall aesthetics and biodiversity of the site' (Fox 2003, p. 5).

The company initially wanted to establish a business park within the boundaries of the site, but due to the close location of an existing business park (that was itself struggling to attract businesses), Kennecott in tandem with the local council decided not to proceed with this development.

During the rehabilitation process a group of educators developed an idea that would help shape the future direction of the site. Their idea focussed on turning the site into a facility for students centred on extracurricular activities such as fitness, health, environmental and scientific education and Indigenous cultural education (Fox 2003). The group that developed this idea established a non-profit organisation to further this program. The aim of the organisation with regards to the facility was as follows (Fox 2003, p. 6):

> Through active engagement with Ridgeway management this group of educators formed a non-profit organisation to further develop these concepts for the Ridgeway Mine reclaimed site. This organisation brought forth a post mine land use sustainable development strategy appealing to Kennecott management…

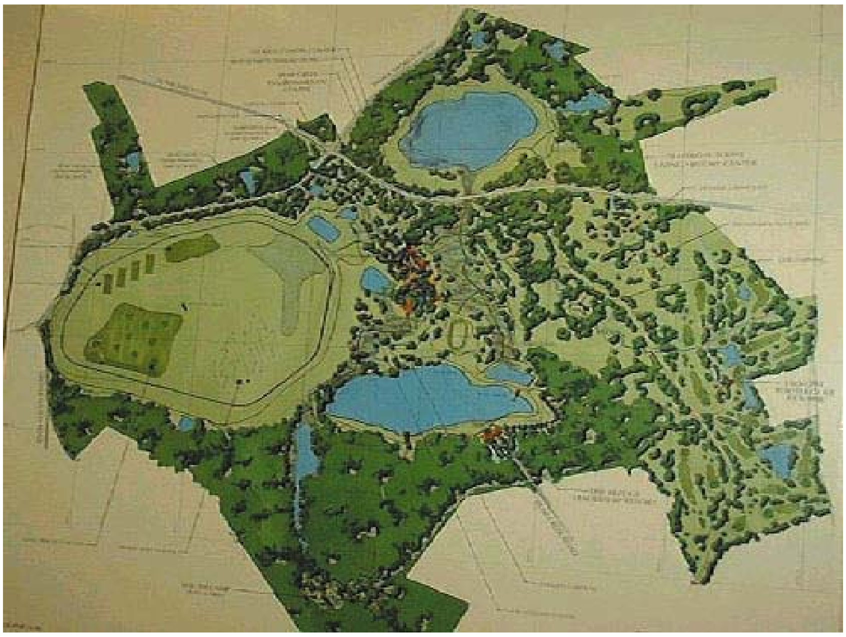
In addition to this plan, an environmental consulting group that was researching and monitoring water characteristics for the long-term management of the pit lakes found a further use for the site. The group was affiliated with the Southeastern Natural Sciences Academy with whom together they were protecting disappearing habitats and teaching the importance of natural resource management (Fox 2003). The aim of the group was to establish a world-class educational facility and environmental research centre. The objectives of the centre are to (Fox 2003, p. 7):

> …promote a sustainable program for economic growth at the site, balanced with environmental protection and education, achieved by a transfer of knowledge through workshops and seminars coupled with general public interaction. The Memorandum of Understanding (MOU) creates a Community Advisory Committee intended to assist and advise an Operations Committee in guiding future decisions and programs of the centre. The early focus would be partnering with a local university to establish certified curricula on the graduate-postgraduate level, and offer a variety of specialised environmental science courses having applied research requirements. The long-term educational opportunities would involve the local school districts and offer K-12 courses and science field trips covering ecology and the environment…

Kennecott Mining Company acknowledges that it may take some time for the education facility to reach its full potential, particularly while the site stabilises and matures (Fox 2003). As a short term measure, however, Kennecott, along with the stakeholders and local community groups have decided to use 'buffer lands' that surround the mine site, to bring the education facility to fruition.

The Southeastern Natural Sciences Academy is still conducting research and education tours at the mine site through the Centre for Ecological Restoration, however, at the time of the research for this thesis the proposed Education Centre had not yet come to fruition and appears unlikely in the short-term, as there is no longer a mention of the proposed centre by the Centre for Ecological Restoration. It is possible that the building of a physical education facility at the site however, is not the best option for research at the former mine site and that it would be better if the mine continued to be utilised as a practicum centre on best practice mine rehabilitation and closure.

Figure A 1.29: Final closure plans, including planned recreational, commercial and educational facilities, Ridgeway Mine



Source: Kennecott Mining Company, 2003

A1.13.8 The legislation under which the closure was conducted

In South Carolina, the *South Carolina Mining Act (1974)* through the Department of Health and Environmental Control covers all aspect of mining in the state including mine closure. Mine closure, however is not specifically addressed in the legislation, rather the restoration (rehabilitation) of mines is the main focus of the legislation, which is standard legislative practice in most jurisdictions around the world. In best practice case studies such as the Ridgeway mine closure the research indicates that the onus is on mining companies to go beyond the legislative requirements for mine closure and for local communities to be proactive and work in partnership with mining companies in determining closure options for their community.

The Act describes reclamation as (South Carolina Mining Act (1974), section 48-20-40 Definitions):

> ...the reasonable rehabilitation of the affected land for useful purposes and the protection of the natural resources of the surrounding area...the basic objective is to establish on a continuing basis, the vegetative cover, soil stability, water conditions, and safety conditions appropriate to the area. Closure activities are part of reclamation...

The *South Carolina Mining Act (1974)* requires that mining companies submit their reclamation (rehabilitation) plans when they submit the operating permit plans. The *Mining Act (1974)* requires that reclamation be carried out continuously only to control erosion at a site, and all reclamation must be completed two years after mining has been completed (unless specified otherwise by the South Carolina Department of Health and Environmental Control) (South Carolina Mining Act 1974, Section 48-20-90). It is a requirement of the *South Carolina Mining Act (1974)* that a site be monitored for a period of 30 years after closure (Fox 2003) in order to mitigate any negative environmental impacts that may have been associated with mining.

The *South Carolina Mining Act (1974)* does not make any mention of the need for companies to consider the social or economic consequences of mine closure (the Act only mentions the need to remediate the environmental impacts associated with mining). Mine closures that are considered best practice (and Ridgeway is no exception), operate in legislative environments that neglect the social and economic considerations of mine closure. The research has found that the socio-economic effects of mine closure in best practice examples are being addressed by local communities and the mining companies directly at a local level (normally with some assistance from State or National Governments), rather than through legislative provisions. Just as the environmental provisions in mining legislation have become the norm, it will be necessary in the future for mine closure legislation to become an accepted part of mining legislation, notably the impacts of the economic and social effects of mine closure on communities. The socio-economic effects of mine closure on local communities are currently inadequately addressed by Governments (at all levels) and although the success stories demonstrate how local communities and mining companies can deal with the impact of mine closures, likewise poor closures demonstrate how high the cost of failure to adequately deal with mine closures can be.

Figure A 1.30:Wetlands created to enhance biodiversity at the Ridgeway site

A1.13.9 Source: Kennecott Minerals Company, 2003Engagement with stakeholders

The initial community response to the mine operation was sceptical and in some cases hostile, particularly during the early phases of the planning and mine operation when litigation was launched by a group opposed to mining at the site. This required Kennecott to develop a positive and proactive approach towards the local community, in order to stem any potential conflicts with the local community. This was achieved over a period of time, according to Fox, during which the local communities' attitudes changed from one of opposition to the mining operations to acceptance and eventually support of the mine. Kennecott was able to achieve this through (Fox 2003, p. 4):

> "…active engagement of mine opponents and local community groups in the form of information sharing and regular site meetings to discuss plans and issues of concern."

Kennecott Mining's response to the court action that was threatened by the activist group CAMOUFLAGE, who were opposed to mining at the site, was to alter their approach to the development at the site and actively engage the local community in the mining process, including them in the mine planning process. The company formed a community advisory committee that met on regularly (every couple of months) to discuss and review Kennecott's rehabilitation and closure plans for the site. As part of this process, Kennecott allowed the local community to determine the final end-uses for the site once mining had ceased and it was through this process that Kennecott was able to determine the final design for the Ridgeway mine site.

Kennecott provided a US$ 300,000 fund to the local community for a three year period to assist the local community with various projects to counter the effects of the mine closure. The funding was used in a number of areas in the community including, providing assistance to local schools in the form of scholarships and awards for teachers. The company purchased items for the local health services, including a new ambulance for the town. Kennecott believe that their active participation in the community, along with community participation in the mining process is vital in order to develop a constructive two-way dialogue with the community (Fox 2007).

According to Fox (2003), the company was able to gain the trust of the local community by delivering on the commitments it made to the community during the operation of Ridgeway; this was particularly the case with regards to the closure options for the site with the community advisory committee determining the end-use design of the site. One of the more substantive developments from the mine site was the construction of a 6.4 kilometre water pipeline from the mine to the Town of Ridgeway which allowed the residents to connect to a communal water supply, rather than relying on the use of individual groundwater supplies as had previously been the case.

During one of the community presentations regarding possible end-use option for the site, a group of local teachers saw an opportunity to use the site for extracurricular outdoor activities for schoolchildren. The educators have since utilised the former mine site for a range of physical pursuits for local schoolchildren including activities promoting fitness and health, such as running, walking and orienteering. In addition to using the site for extracurricular education activities that range from environmental education to teaching traditional cultural (Indigenous American) values regarding environmental stewardship are also being run at the former mine void as a way of demonstrating how humans can repair the environment provided they work in a united manner to achieve their aims.

The Ridgeway site demonstrates what can be achieved when mining companies engage with the communities in which they plan to operate. Ridgeway demonstrates that positive outcomes can be achieved, despite initial opposition, or in the case of Ridgeway outright hostility towards a mine. The engagement process however, will only work when communities are actually engaged and making decisions on the future of a mine site and its possible end uses. The Ridgeway mine site proved that companies can turn around negative attitudes towards a mine, if they engage with the community and most importantly listen to what outcomes the community wants for a mine site upon its closure.

A1.13.10 Summary

The Ridgeway mining site is developing a beneficial end-use for the site, that will take a while to develop, but is attempting to provide a post-mining land use that is economically viable. The site will take a number of years to reach its full post-mining use potential, but the process has proven that constructive, two-way dialogue can benefit both the mining industry and local community. The idea of world's best practice in mine closure does not mean that a former mine void must be used for either altruistic or economic purposes. It involves a process of determining what the best possible end-use for that particular site could be and how the site can be sustainable to the local community over the long term. It will often be a long, sometimes painstaking process, but each site is different and flexibility (from all involved in the process) is the key to its success. As Fox (2003, p. 7) said in relation to Ridgeway:

> Some form of a new, non-mining sustainable development will undoubtedly occur at the former Ridgeway Mine site during the next few years. This will result in jobs for the local community and utilising the site as a platform for environmental research and education. This sustainable development will showcase the ability of a primary resource industry to successfully reclaim a mine site, providing environmental protection and economic growth and benefits to local communities for future generations.

In the end it is the community that is left with the legacy of a mine site (whether it is good or bad) and companies' reputation (and future licenses to mine) can be built, or destroyed based on their approach to mine closure. The Ridgeway mine site won a number of awards not just on the positive environmental outcomes from the mine rehabilitation and closure, but also for the approach that was taken to make the former mine sustainable by providing long-term uses for the site, so that it can become an asset for future generations.

The cost however, for Kennecott Mining was more than three times their original estimate for rehabilitating and closing the site, proving that best practice mine closure can be an expensive process whose final outcome and therefore cost may not always be readily quantifiable at the start of the mining process. Ridgeway provides a good example of why it is imperative that companies set aside a sufficient reserves for the inevitable mine closure process. The changing cost structure of the Ridgeway mine closure also provides a timely lesson to regulators on the need to be vigilant about an organisation's capacity to meet their mine closure plans.

A1.14 Elliot Lake – Ontario, Canada – Uranium

Elliot Lake was an entirely planned mining community located in the north of Lake Huron in the Canadian province of Ontario. Like Rum Jungle in the Northern Territory, Elliot Lake consisted of a series of Uranium mines that were developed at a time when demand for uranium was strong and prices for the material high. Elliot Lake however, unlike Rum Jungle managed to successfully rehabilitate and close the former mine sites and assist in making Elliot Lake a viable community post mining.

Elliot Lake, like Rum Jungle, operated as a series of mill processing facilities and underground and open pit operations and has been included in this analysis due to the positive rehabilitation and closure practices that were implemented and the contrast that the site provides with the poor closure practices of Rum Jungle. The rehabilitation and closure efforts at Elliot Lake were designed to create a sustainable outcome that focussed on the triple bottom line, taking into account environmental, economic and social needs of the community. Elliot Lake has managed to elude the negative images traditionally associated with uranium mining and has started to market itself as a retirement and vacation destination, moving away from its mining past.

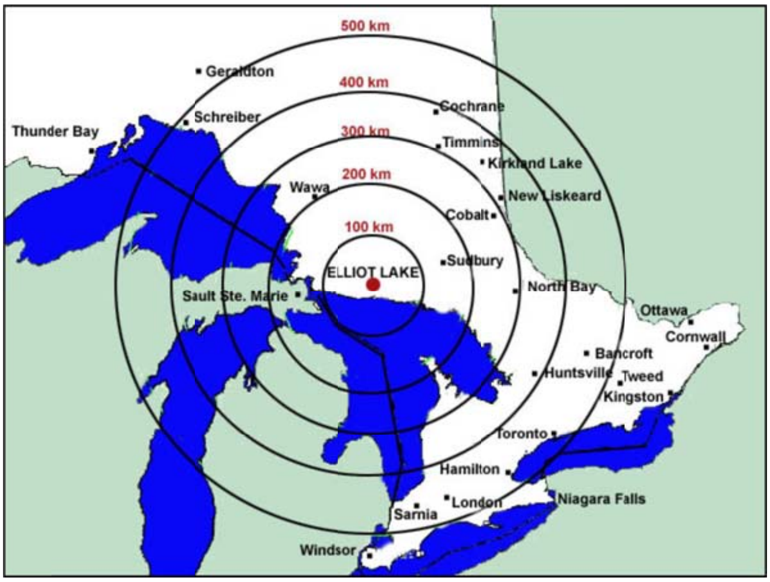
Figure A 1.31: The City of Elliot Lake from the air

Source: City of Elliot Lake, 2011

A1.14.1 The location of the mine

Elliot Lake is located in Northern Ontario, a sparsely populated area near Lake Huron in the Eastern half of Canada. The town is located 160 kilometres from the largest city in Northern Ontario, Sudbury which has a population of 160,000 (City of Greater Sudbury 2010). Sudbury is a major mining and mine service town for the northern regions of Canada and is a source of visitors and residents retiring from the area to Elliot Lake.

Figure A 1.32: Location of Elliot Lake



Source: City of Elliot Lake, 23/08/2008

Elliot Lake is situated in an area known as the Canadian Shield a geological shield covered by a thin soil layer that is composed of mostly igneous rock (rock formed through the cooling and solidifcation of lava, or magma) that was formed by high levels of volcanic activity (Natural Resources Canada 2010, Geological Provinces). The Shield covers approximately half of Canada stretching from the Great Lakes region to the Artic Ocean, reaching into the Northern half of the United States. The area that forms the Shield has some of the most extensive metal and mineral deposits in the world, enabling Canada to become one of the world's major mining centres, with Ontario placed firmly in the centre of this region. Due to the influence of its volcanic past, Elliot Lake (and indeed Northern Canada) is surrounded by extensive river and lake systems as well as being rich in flora and fauna, hence making the area important from an environmental perspective. It is the dichotomous nature of the area that places pressure on area such as Elliot Lake to maintain a sustainable balance between mining activity and environmental conservation.

The climate of Elliot Lake is typical of the southern section of Northern Ontario which is classified as a humid continental climate with warm humid summers and cold, snowy winters (The Weather Channel, The Climate of Ontario, 2010). The annual precipitation for Elliot Lake is 941mm pa (The Weather Channel, Statistics: Elliot Lake, Ontario, 2010), with temporary flooding occurring each year around the lakes with the spring melt, which has been a factor that warranted consideration in the mine site rehabilitation in Lake Elliot, as it was important that spring melt runoff did not enter contaminated tailings and mine areas and make its way back into local waterways.

A1.14.2 Size and profitability of the mine

Elliot Lake was a major uranium mine centre from 1955 until 1996 when the last mine ceased production. The area came into being due to high demand for uranium associated with the post World War II boom in nuclear energy production. The Elliot Lake region extracted large quantities of the metal; however the ore bodies of the region were of low grade and over the 45 year life of the mines, increased supply and suppressed demand for the metal saw the mines of Elliot Lake lose their commercial viability.

In Elliot Lake there were twelve mines in operation during the life of uranium mining in the region (there are thirteen listed in the table below, this is due to the fact that the Stanrock mine was a joint venture). The mines were profitable during the 1950's and 1960's when demand for uranium was strong and supply was limited to a few major suppliers (of which Elliot Lake was one of the most important), however, during the 1970's and 1980's higher grade ore bodies were found in other regions of the world, increasing the supply of uranium and in addition to this, demand for uranium declined causing the closure of many of the mines in the area. The mines at Elliot Lake are listed in Table A 1.2 and Table A 1.3 outlining the year of operation and closure and the amount of uranium that each mine produced.

Table A 1.2: Rio Algom Limited mines at Elliot Lake

Mine	Production ('000 Tonnes)	Operation/Closure (Year)
Buckles	276	1956/1960
Lake Nordic	3,400	1956/1960
Milliken	6.3 million	1957/1964
Nordic	13 million	1956/1970
Panel	15 million	1957/1961 and 1978/1990
Pronto	2.3 million	1955/1970
Quirke	44 million	1955/1961 and 1965/1990
Spanish-American	430,000	1957/1959
Stanleigh	14 million	1956/1960 and 1982/1996
Stanrock	6.4 million	1958/1960 and 1964/1985

Source: International Atomic Energy Agency, 2008, p5

Table A 1.3: Denison Mining Ltd mines at Elliot Lake

Mine	Production (Tonnes)	Operation/Closure (Year)
Can-Met	2.6 million	1957/1960
Denison	69 million	1957/1992
Stanrock	6.4 million	1958/1960 and 1964/1985

Source: International Atomic Energy Agency, 2008, P6

At the height of the mining boom in Elliot Lake in 1960 the population of the town peaked at 24,887, with the mines employing 7,400 people in the town (BHP Billiton 2001). In the space of six years, however, the population of the town had fallen to just 6.664 (BHP Billiton 2001) after the closure of five mines between 1960 and 1966 (after the United States ceased buying uranium from Canada) leaving a large number of mines in care and maintenance, some of which recommenced mining during the 1970's and 1980's as demand for uranium increased due to increases in the use of nuclear energy (Sabourin M, 2008)

A1.14.3 The size of the community where the mine is situated

Elliot Lake was a town established from scratch in the early 1950's to mine for uranium. A number of mines were established around the town, with most being situated near the lake itself, hence there was always the potential for environmental problems to arise both in and around the lake. The Government of Ontario in 1955 created the Improvement District of Elliot Lake to oversee the uranium industry in the town. There was Canadian $40 million invested in the town in residential, commercial and industrial projects and Canadian $340 million invested in mining projects in the town (BHP Billiton 2001).

The town’s fortunes varied with the industry and the demand for uranium, with the population of the town fluctuating from high’s of approximately 25,000, to just 6,000 by the late 1960’s into the 1970’s (Payne 2000, p. 53). With the increasing demand for uranium during the 1970’s during the oil crisis, the town re-opened closed mines and was able to stabilise its population to around 14,000 by 1996 (Statistics Canada, Elliot Lake Community Profile 2006). The town’s population decreased further after the closure of the last mine in 1996, with population stabilising over the decade to 2006 at 11,500 people (Statistics Canada, Elliot Lake Community Profile 2006).

Elliot Lake was incorporated as a city in 1990 (City of Elliot Lake 2008) and covers an area of 698 km^2, with a population density of 16.5 people per square kilometre (Statistics Canada, Elliot Lake Community Profile 2006). The city’s low population density has been one of the factors that have contributed to its popularity as a retirement and holiday destination and has been one of the promotional tools used to sell the area since mining ceased.

A1.14.4 The ownership of the mine

There were two mine operators based at Elliot Lake, they were Rio Algom Limited (now a subsidiary of BHP Billiton) and Denison Mines. Rio Algom was the major operator of mines in the Elliot Lake region owning nine of the twelve mines, with the remaining three being controlled by Denison Mining.

Rio Algom Limited was the largest miner and major employer in Elliot Lake during the life of uranium mining in the area. The company is a Canadian based metal and minerals company with headquarters in Toronto and a presence in the Elliot Lake region through a Rehabilitation Manager who is overseeing the ongoing monitoring of the company’s rehabilitation and closure operations in the area. Rio Algom Limited was acquired by Billiton in 2000, who themselves merged with BHP in 2001 to form BHP Billiton (BHP Billiton 2001). Rio Algom has diversified since the closure of its Elliot Lake mines and is now a major producer of copper and gold, although the company still has an active interest in Uranium mining through mines owned by the company in the United States (BHP Billiton 2001).

Denison Mines Corp is an intermediate uranium producer with uranium production in Canada and the United States and currently has a number of development projects in Zambia and Mongolia (Denison Mines Annual Report 2009). In addition to its uranium interests Denison Mines also produces vanadium as a by product of some of its mines in the United States. The company employs 340 people worldwide and has a market capitalisation of $1.1 billion in Canada and $1.1 billion in the United States and as December 2010 had debt free working capital of Canadian $78 million (Denison Mines Corp. Update, December 2010).

Both companies have extensive market capitalisation and sound balance sheets that have enabled them to fund their rehabilitation efforts at the sites in Elliot Lake. In addition to this, both organisations have employed full time managers to oversee the rehabilitation and closure of the mine sites, with both organisations working in partnership in the ongoing closure and maintenance at Elliot Lake. Elliot Lake has been an unusual mine rehabilitation and closure success story as it has involved not just one mine, but a number of mines owned by two different companies operating in the region since the early 1950's. The companies were fortunate to operate mines that were profitable and low cost and that were at the time the world's largest uranium producers (Payne 2000). The companies began their operations during a period when demand for uranium was high and the number of reliable uranium producers was quite limited. The Canadian and Ontario governments were also proactive in their desire to ensure that the mine sites were rehabilitated to a benchmark that was as high as their pre-mining state. These factors all contributed to the eventual successful rehabilitation and closure of the Elliot Lake mines and contrast starkly with the Rum Jungle mine in Australia.

A1.14.5 When the mine closure was planned

Elliot Lake saw the closure of not just one, but over a 45 year period the rehabilitation and closure of twelve mines in the region. Both Rio Algom and Denison Mines began commencing the plans for closure of their respective mine sites during the 1980's. The major issues facing both companies (and one that all uranium mines face) is the prospect of how to dispose of the acid generating and radioactive tailings waste that is produced when mining for uranium. This is in addition to the decommissioning and reclamation of the mine sites themselves, which pose their own problems, however none as severe as the disposal of tailings.

During the 1960's and 1970's Federal regulatory attention began to address the issue of mine closure in the uranium mines of Elliot Lake. The key issue was the waste associated with uranium mine tailings and its disposal, which at the time consisted of what has been described as a form of 'modified dumping' (Martin, 2005). The lack of a comprehensive process for mine rehabilitation and closure prompted the mining companies and regulatory authorities to begin the development of a rehabilitation program to guide the closure of uranium mines (Martin, D, 2005). The result was the commencement of the mine rehabilitation and closure programs undertaken at Elliot Lake, one of the largest such programs in North America.

It was 1990 when Rio Algom, the largest of the mine owners in Elliot Lake, had three recently operating mines and six older, non-producing mines when the company began its assessment of each of the mine sites, commenced closure and decommissioning planning, and commenced its rehabilitation programs (BHP Billiton 2001). In an unusual move for the mining industry, Rio Algom began the rehabilitation of all nine of its mine sites at once, using a different method for the older non productive mine sites and the more recent mines that were still operating (at that stage).

Denison Mines operated the largest uranium in Elliot Lake from 1956 until 1992, which over that time produced 63 million tonnes of low level radioactive, acid generating tailings (Laliberté et al. 2002). In addition to this mine, Denison also operated two other uranium mines in the Elliot Lake region both of which were placed under care and maintenance until the company commenced its rehabilitation programs. Like Rio Algom, Denison began determining closure options for its mine sites during the 1980's after evaluating rehabilitation possibilities for the sites. The company began the process of planning for closure and decommissioning and commenced the rehabilitation programs of the sites in 1992 after the cessation of operations at Denison (Laliberté et al. 2002).

Neither Rio Algom, or Denison Mines commenced their planning for closure during the mine planning phase of their operations, in part because of the lack of regulatory controls with regard to uranium mining at the time and also in part because they expected some of the closed mines to re-open as the drops in uranium prices at the time were considered temporary. Despite the lack of early mine closure planning, both companies were comprehensive in their mine closure plans after taking a number of years to determine the best options for the rehabilitation and closure of their mine sites. The most noticeable aspect of the closure planning at Elliot Lake was the wide-ranging research that the companies undertook to decide on the best practice closure options for their mines.

Much of this research involved developing monitoring and evaluation programs to determine the effects of mining on the surrounding environment. Some examples included annual inspection of the sites by independent geotechnical engineers, the monitoring of the tailings basins to measure biological and ecological data on each of the tailings management areas in order to understand how the ecosystem was recovering post mining. There was also monitoring by Laurentian University examining the diversity of plant species that have developed since the rehabilitation of the mines. Monitoring of the waterways surrounding the mines was also conducted to monitor the impact that water released from the tailings wetlands was having on the biodiversity of the waterways.

A1.14.6 How the mine closure was planned and conducted

In terms of the actual closure process, in what was a unique event at the time, the Canadian government, under the Atomic Energy Control Board (now known as the Canadian Nuclear

Safety Commission) established a Joint Review Group that led a coordinated group of what were normally separate departments to oversee the closure process. The departments included Environment Canada, Fisheries and Oceans, Natural Resources Canada, Health Canada, Ministry of Environment, Ministry of Natural Resources, Ministry of Northern Development and Mines and the Ministry of Labour (it was a combination of both Federal and the Ontario Provincial Government Departments) (Payne 2000, p. 55). All of the departments maintained their regulatory authority, but it was processed through just one main body, the Atomic Energy Control Board. In other words, what would have normally been a bureaucratic approach to closure with different bodies all separately involved became a streamlined process, with just one main regulator.

In the decommissioning and closure of three of its former mine sites (Quirke, Panel and Stanleigh,) Rio Algom's main environmental priority was to ensure that the radioactive and acid generating tailings areas of the three sites were controlled to prevent contamination of surrounding water bodies. In order to achieve this, Rio Algom constructed a series of dams and dykes creating ponds submerging the tailings. Rio Algom found that the lack of exposure to air limited the formation of acid, with the water acting as a barrier to the release of radiation (BHP Billiton 2001). The water runoff from these dams is treated via a series of wetlands and specially engineered soil and sludge designed to clean the water before being released into local waterways and it will continue to be monitored until water leaving the site meets regulatory guidelines (Denison Environmental Services 2010).

In addition to the tailings lakes that have been formed as part of the rehabilitation at Elliot Lake, a number of gravel pits (that supplied building and construction materials to the mines) were rehabilitated into pit lakes. These gravel lakes have not had any issues regarding acidity or potential radiation leakage and have been able to form part of the native ecosystem, with only minimal monitoring compared to the tailings lakes (Denison Community Report 2009).

In the older mine sites, Rio Algom found that the geography did not always allow for the tailings areas to be flooded to create lake systems and wetlands. These sites were rehabilitated by revegetating the sites in order to control dust and surface run-off (which was collected and treated before being allowed into waterways), and recontoured as much as possible to match the surrounding landscape. All of the former mine sites are monitored on an ongoing basis by both Federal and Provincial government regulatory agencies (such as the Canadian Nuclear Safety Commission, the Federal Environmental Assessment Review Office and the Ontario Ministry of Natural Resources), with annual inspections of the sites by geo-technical engineers (BHP Billiton 2001).

Rio Algom was able to clear the physical structures of their mine sites (such as buildings, mills, conveyer belts, and storage tanks) during the early 1990's, leaving the sites clear of visible structures. The company then set about recontouring this land to its natural state and then revegetated the landscape to that which existed prior to mining.

According to Rio Algom in their 2001 report outlining the key issues surrounding their rehabilitation program at Elliot Lake, there were nine that were taken into account in decommissioning and closing Elliot Lake. These issues included (BHP Billiton 2001, p. 16):

- The objectives of the Decommissioning Plans
- The Regulatory Process
- The Timeframe for Decommissioning
- Site Specific Issues
- Selection of Contractors and Contractor Employee Training
- Public Information Needs and Consultation Processes
- Financial Assurances
- The Long-Term Requirements
    - Care and maintenance of sites
    - Environmental monitoring issues
- Site Management
    - Regulatory and public involvement issues
    - Proposed land use once decommissioned
- Risk (associated with long-term structural stability)
- Institutional burden (care and maintenance)

Rio Algom set about addressing these issues through a number of measures including the development of comprehensive studies designed to provide solutions (or alternatives) to the issues facing the company. Some of these studies included (BHP Billiton 2001, p.16):

- Determining the risk and probability of failure
- Determining the environmental consequences of failure
- Developing a care and maintenance program
- Determining the present-day-cost (net present value) of care and maintenance

Rio Algom is still involved in an ongoing monitoring program of its mine sites at Elliot Lake and has a full-time Reclamation Manager and closure team based in the town. The team will be based at Elliot Lake until the Federal and Provincial governments allow the mine leases to be relinquished and the former mine sites handed back to the City.

Denison Mines operated the largest mine in the Elliot Lake region, which ceased operations in 1992, during which time the mine produced 63 million tonnes of low level radioactive and acid generating tailings (Laliberté et al. 2002). The tailings were placed into specifically engineered lake basins and valleys that were named by the company as TMA 1 and TMA 2. The company also constructed a similar lake and basin (TMA 3) for its smaller Stanrock mine, which contained 5.7 million tonnes of radioactive and acid generating waste (Laliberté et al. 2002). The company's smaller mine Can-Met was rehabilitated as part of the Stanrock mine rehabilitation program.

In addition to the creation of the tailings lakes, the company also rehabilitated the sites containing the physical structures of the mine sites such as buildings, mills, conveyer belts, roads. The rehabilitation of the mine sites involved recontouring the sites to their original land form and revegetating through the use of native plants and tree species, with the aim of returning the former mine sites as much as possible to their natural state.

Denison Mines (along with Rio Algom) undertook extensive research into the rehabilitation of uranium mines, particularly on the effects of acidification of local waterways from mine runoff. The Federal Environmental Assessment Review Office who needed to approve rehabilitation plans for Elliot Lake concurred with the rehabilitation plans for the Denison mine sites to form a series of lakes and wetlands to deal with the mine tailings and waste. The rehabilitation plans (the same process was undertaken for Rio Algom) were the subject of a number of public hearings and displays, with input on the plans invited from the public. The key concerns from locals surrounding the closure plans included controlling acid generation, the long term management of the sites and the risk of catastrophic failure, mitigation measures, the long-term responsibility and ownership of the sites and possible land-uses of the sites (Denison Environmental Services, 2010). Therefore, it was these issues that required addressing when the former mine sites were finally rehabilitated.

The lake known as TMA 1 was rehabilitated by dredging the tailings, creating a flat surface and then flooding the area to create a 240 ha lake. TMA 2, a 40 ha lake had half of its tailings placed into TMA 1, whilst the other half was relocated to a former underground mine, essentially creating a freshwater lake and wetlands area in the process. At the Stanrock (and Can-Met) mines new dams were created from the tailings, with the surface being graded, covered with soil and revegetated, this along with the water acted to prevent the water from becoming contaminated when it entered the surrounding ecosystem(Laliberte et al. 2002).

Figure A 1.33: Part of TMA 2 post closure 1997

Source: Laliberté et al. 2002, p. 6

Figure A 1.34: Same section of TMA 2 in 2002

Source: Laliberté et al. 2002, p. 6

As with Rio Algom's former mine sites, the Dension mine sites require ongoing inspection by various regulatory agencies, in addition to monitoring by the mining companies. Some of these general programs to ensure the ongoing safe rehabilitation, care and maintenance of the mine sites include: Site security, radiation protection programs, health and safety programs, inspection programs, tailings management operating programs, monitoring programs, reporting programs and contingency response programs (Laliberté et al. 2002).

The closure costs associated with Elliot Lake (across all of the former mine sites) include Canadian $140 million capital costs from the initial phase of the project, Canadian $5 million annually in the transitional phase of the closure, which has since decreased to Canadian $1 million annually and a perpetual care and maintenance cost of Canadian $15 million (Net

Present Value – based on the regulatory requirement of a 50 year maintenance period) (Payne et al. 2002). The 50 year maintenance program that is required by the Canadian Nuclear Safety Commission at Elliot Lake is longer than the operating life of the mines in the region and demonstrates how companies that fail to adequately plan for, or miscalculate the costs associated with mine closure can find themsleves in financial trouble, even if the mine were profitable during its operational phase. This of course then has inevitable negative consequences for communities and regulators faced with mine closures that are not adequately financed, such as a loss of jobs and therefore income in the local community, loss of royalties for governments, and the potential costs of the government paying to rehabilitate the site if the mining comapny is unable to do so.

A1.14.7 What alternative closure options were considered

The only option considered for the closure of the Elliot Lake sites was to return the sites to their pre-mining condition as the nature of uranium mining (with its radioactive and acid generating waste) precludes many closure options that may be considered with other ore bodies such as their usage for recreational lakes. In addition to this, the then Atomic Energy Control Board along with the mining companies and the local community wanted the sites returned to their pre-mining state, or to an equivalent standard (through the formation of new lakes, or wetlands in the mined areas) in order to preserve the natural beauty of the region (Payne 2000).

A1.14.8 The legislation under which the closure was conducted

The early mine rehabilitation and closures at Elliot Lake conducted at the former Rio Algom mine sites (Spanish American, Lacnor, Nordic, Buckles, Pronto and Milliken) were undertaken 30 years prior to the development of the legal framework that now covers uranium mine rehabilitation and closures in Canada (*Uranium Mines and Mills Regulations* and *the Nuclear Safety and Control Act (1997)*. As a result, the company was required to obtain a licence from the Canadian Nuclear Safety Committee to control radioactive materials from these former sites (International Atomic Energy Agency 2002). Rio Algom has still continued the process of monitoring these sites and where necessary improving the earlier rehabilitation efforts to meet current regulatory requirements.

The actual decommissioning process commenced in 1991 and was finished in 1997, nearly seven years after the initial closures. Due to a comprehensive assessment process required by the Canadian Environmental Assessment Act (CEAA), this process also required by law a public consultation period, to demonstrate what steps the company were undertaking to rehabilitate the site and also to invite input from the public on these plans. (Payne 2000).

Uranium mining in Canada is regulated separately to other mining operations, in that its regulation does not come under the sole control of the provincial governments. Instead, the *Nuclear Safety and Control Act (1946)* regulates all uranium mines in Canada and is overseen by the Canadian Nuclear Safety Commission (known as the Atomic Energy Control Board when Elliot Lake mines first went into production), which is a publicly appointed body that administers the Act and Regulations (Laliberté et al. 2002). The Nuclear Safety Commission is responsible for issuing licenses to both operate (Mining Facility Operating Licenses) and close (Mining Facility Decommissioning Licenses) uranium mines throughout Canada. The licensing and compliance regulation is undertaken in conjunction with various other federal and provincial government agencies including the Ministry of Labour, the Ministry of Natural Resources, Environment Canada, Ontario Ministry of the Environment and the Ministry of Northern Development and Mines (Laliberté et al. 2002). All of the former mines in Elliot Lake have remained compliant since 1992 (Canadian Nuclear Safety Commission 2010).

In the case of Elliot Lake, the mining companies although bound by the provisions of federal legislation chose to also work closely with the Provincial legislators by following some of the requirements of the revised Ontario *Mining Act (1989)* including undertaking progressive rehabilitation at the Elliot Lake sites, the development of a trust fund to provide adequate financial assurance for the mine closure and placing the onus of closure on the mining companies who need to certify and audit their mine closure plans in order to meet the requirements of the *Mining Act (1989)* (Cowan and Robertson 1999). This was done on a wholly voluntary basis by the two companies, Rio Algom Limited and Denison Mines Limited and demonstrates why part of best practice mine closure involves exceeding the regulatory requirements demonstrating a strong commitment to ensuring optimum results from the closure process.

The regulatory decommissioning and closure process at Elliot Lake involved the establishment of a series of public hearings during the early 1990’s organised by the Canadian Environmental Assessment Agency to determine the final designs of the rehabilitated mine sites. At the end of these public hearings a Joint Review Group was formed to oversee the rehabilitation and closure process. This Group consisted of employees from the Canadian Nuclear Safety Commission and the two mining companies, Rio Algom Limited and Denison Mines Limited (Payne et al. 2006). The idea behind the Joint Review Group was to streamline the closure process at Elliot Lake by providing one regulatory body (the Canadian Nuclear Safety Commission) that oversaw the whole regulatory process, whilst at the same time working in conjunction with Rio Algom Limited and Denison Limited. This differed from the usual practice of mine closure in which mining companies deal with numerous regulatory bodies, all of whom usually operate as separate entities with differing regulatory agendas, which was unique to this process and not used in other mine closures today.(Laliberté et al. 2002).

In 1994 both Denison and Rio Algom entered into an agreement with the Canadian and Ontario governments to establish a long-term trust fund, the Reclamation Funding Agreement to be used as a guaranteed source of funding for the rehabilitation of the former mines in Elliot Lake. This agreement requires funds in the trust to be (Denison Annual Report 2009, p. 37) ‘equal to estimated reclamation spending for the succeeding six calendar years, less interest expected to accrue on the funds during the period’. Withdrawals from this trust can only be made to fund Elliot Lake monitoring and rehabilitation costs and requires approval from the Canadian and Ontario governments.

Both Rio Algom and Denison won an award each in 1996 from the Prospectors and Developers Association Canada for their rehabilitation work at Elliot Lake and the regulatory model for uranium mine closure is frequently referenced as a best practice closure example by the International Atomic Energy Agency (Cowan and Robertson 1999). Elliot Lake demonstrates how a strong regulatory regime can assist the mine closure process; particularly when the mining companies are prepared to work with the regulators who also need to work with the local community to ensure that best practice closure takes into account the needs and wishes of the local community.

A1.14.9 Engagement with stakeholders

During the 1980’s demand for uranium had declined and supply pressures from the newly opened former Eastern Bloc countries with their cheap, plentiful supplies of uranium, saw the main uranium mining company in Elliot Lake (Rio Algom) close two of its three sites. The impact of these closures could have had a much more dramatic impact on the community than they did, according to Payne (2000) and this was mainly due to the closure plans enacted by the mining company, the Provincial Government and the local community. These three groups all worked in close consultation with one another several years prior to the mine closure, in order to help minimise its impact. Part of this process involved developing the area as a retirement location and tourism destination through the use of the former mine infrastructure (such as houses and buildings) as part of the development process.

Rio Algom was a strong supporter of community programs and encouraged employees to join voluntary organisations. They also established facilities such as ski areas, an equestrian centre, a golf club, and supported nature and conservation programs (Payne 2000). The company is still active in supporting many of these ventures today, according to Payne et al.

(2006), claiming it recognises the need to keep strong cultural/social institutions, particularly after closure. This is not often a consideration in the closure process, but social institutions are just as important as economic considerations in maintaining the vitality of a community. It is important that closure considerations take this into account, as was discovered in Elliot Lake the strong social institutions that existed after mining had ceased, helped the town to market its strong lifestyle attributes and this in turn, helped retain the town's population base and attracted new residents to the town.

The company kept its employees closely informed of the closure details and elicited their involvement in the process. Rio Algom also provided assistance to employees to help with the transition to other employment by assisting with retraining the workers, paying relocation costs, and finding alternative employment for former employees, or through retirement incentives. The company prior to the closure process instigated a programme that allowed employees to purchase company rental properties – to provide some financial independence to employees and also to prevent the company from being left with a large number of dwellings once mining had ceased. It was the success of this program that an unexpected event occurred that has helped to ensure that Elliot Lake has thrived post closure.

Even with employees purchasing former company owned houses, the company was still left with over 2,000 dwellings that would have to have been demolished. Instead, the company chose to advertise the dwellings as retirement homes for seniors. What had started virtually by accident, turned into a success story, with Elliot Lake now a highly sought after retirement area (International Atomic Energy Agency 2002).

Both mining companies engaged with the local community through a series of public meetings held over a two year period that were used to refine the closure plans for their Elliot Lake mine sites. The meetings were organised through the federal government's Environmental Assessment Agency with the aim of eliciting views from the community as to the final design and look of the rehabilitated site (Laliberté et al. 2002). The overwhelming majority of residents wanted the mine sites returned as much as possible to their pre-mining state, however, there were (and still remain) (Laliberté et al. 2002) a number of concerns from the local community regarding the closure of the sites. The major concerns are (MacDonald 2002, p. 108):

- The impact of early mine waste management practices on the watershed and fisheries
- Difficulties in obtaining compensation for workers (those affected by radiation in the early days of mining in Elliot Lake)

- The need to filter radium from drinking water in the town of Serpent River (near Elliot Lake) and the standards of drinking water for the people of the Serpent River First Nation
- Radium levels in fish and moose meat
- Deaths from Cancer
- Loss of land.

The companies along with the Canadian government regulators took these community concerns into account and in 1998 initially established a Decommissioning Review and Advisory Committee to further review and refine the closure plans. This Committee was scrapped after two years, however, when members of the committee felt that an independent organisation with a broader mandate was required, which they felt would have more credibility with the community. As a result of this a standing committee was formed (known as the Standing Environmental Committee), which consisted of two members each from the City of Elliot Lake, the Township of the North Shore and the Serpent River First Nation (International Atomic Energy Agency 2002).

The Standing Environmental Committee was responsible for liaising with the mining companies on developing solutions to the major concerns raised by the community surrounding the closure of the mines in Elliot Lake. In addition to this, the Standing Environmental Committee worked with the mining companies and the City of Elliot Lake to develop a sustainable economic base for the area. The committee was in part responsible for diversification of the city’s economic base, including the area’s development as a research centre on mine waste management, and the development of the area as a destination for retirees (MacDonald, 2002).

The Standing Environmental Committee process has still been the subject of some criticism from the community, although the concerns raised are the responsibility of the mining company and regulators, rather than issues that can be addressed by the Committee. Some of the criticisms directed at the process include (MacDonald, 2002, p. 109-110):

- Loss of mining company personnel and their expertise
- Changes in the areas focus towards retirement living, tourism and cottage industry development
- Changes in land use to former mine sites for increased recreational activities such as camping, trail bike riding and hiking
- The production of highly detailed and technical reports that are not easily understood by those without the technical expertise

- Competition from other regions for limited resources to assist with economic diversification
- High residential rate costs to compensate for falling tax base after mines closed
- Infrastructure costs, as the city was built for a population twice the size
- The burden of a retirement population on local health infrastructure.

These are issues that arise at any mine closure in any jurisdiction around the world and are not always easily dealt with by either mining companies, or Governments at all levels. The issues raised by the community highlight the difficulty in pleasing the entire community, no matter how well planned and implemented the mine closure is. This does not mean that companies or regulators ignore negative feedback, however, it pertinent that community expectations about an impending mine closure are not unrealistic and that communication from the companies and regulators does sets realistic and achievable goals for the community post-closure.

The City of Elliot Lake worked with the local community and the mining companies to facilitate the move away from mining and diversify the economic base of the region. The city developed an Economic Diversification Strategy to turn the area into a retirement centre and all-seasons tourism region. In addition to this, the town attracted a research centre from Laurentian University, a drug and alcohol treatment centre and developed 4,500 cottage housing lots from federal and provincial government grant funds (Local Government, Resiliency and Recovery Project Committee 2005).

A regional centre for business development, Discovery North worked with the City and assisted 100 small businesses to start and expand in the region, developed the White Mountain Academy of the Arts and attracted a call centre and fibre optics company (Local Government, Resiliency and Recovery Project Committee 2005). The city also attracted industry grant funding of Canadian $3.5 million from the Ontario government for the city’s development priorities (Local Government, Resiliency and Recovery Project Committee 2005). The city has managed to diversify its economic base away from a dependence on mining and it has done this by working with the local community, mining companies and provincial and federal government agencies and in the process ensuring that the town has not only survived, but has managed to halt a population slide that occurred post mining.

Figure A 1.35: Elliot Lake, Denison Mill Site, during operating phase

Source: Ontario Government 2004 www.mndm.gov.au.ca/mndm/mines/mg/rehab/rehabexmp_e.asp

Figure A 1.36: Elliot Lake, Denison Mill Site, after rehabilitation and closure

Source: Ontario Government (2004)

A1.14.10 Summary

The idea of a streamlined process for closure by regulators throughout the world is one that has merit. The use of one main regulating body provides all people involved in the closure process with a single point of reference, rather than a number of different bodies, as occurs in most mine closures throughout the world at present. This should enable the limiting of time spent on regulatory matters by those involved in the closure process and therefore limit some of the costs involved. This approach should be easier for regulators, as they are better able to coordinate the closure process and should have a better understanding of what is occurring at each site, as there is less potential for confusion, as each department is reporting to one main body that should be able to maintain each site. It is important that this regulating authority draws its members from a wide range of backgrounds, including local community members.

The closure process at Elliot Lake has been by world standards an overwhelming success, but Payne (2000) argues that more rigorous debate is needed surrounding issues such as environmental monitoring post-closure, site care and maintenance after closure for issues such as road access, fencing, dams and water management. Payne (2000) also argues that there exists a need to determine the extent and level of involvement and responsibility in the closure process by government and local communities. It also imperative that mining companies and regulators do not to raise community expectations on post mine closure options, but to set and meet realistic and achievable goals post closure.

Elliot Lake is unique in that a series of Uranium mines existed around the township, which in itself could have been enough to ensure continuous protest from various interest groups opposed to its operation. The site is also unique in that a former Uranium town has become a popular retirement and year round tourism destination in Ontario. The success of the site was due to strong commitment to the closure process by the company, regulators and the local community. The company continued to support a range of social infrastructure initiatives, even after mining had ceased, recognising that social cohesion can be just as vital as economic development in ensuring the continued viability of a region.

A1.15 Golden Cross – Waihi – New Zealand – Gold

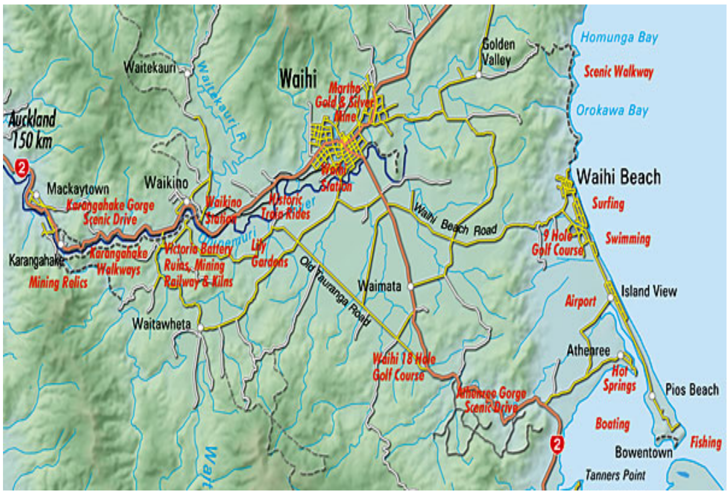
The history of Golden Cross dates back to the last part of the 19th Century, with the mine initially operating between 1895 and 1920 as an underground mine. The mine closed in 1920 and the area reverted to farmland. Initial licensing and exploration for the current site began in 1977, with exploration commencing during the early 1980's, followed by Environmental Impact Reports, mining and water licenses (Wilson and Barker 2003), with mining commencing in 1991 and ceasing production in 1997.

A1.15.1 The location of the mine

Golden Cross is located in Waihi in the North Island of New Zealand. The site is located approximately eight kilometres from the township of Waihi. The mine site is located in the Coromandel Ranges near the mouth of the Waitekauri River in New Zealand's North Island. The mine site rises from 270 metres to 480 metres above sea level (Department of Environment and Heritage, 2003) and is surrounded by farmland, native forests and a pine plantation. Annual rainfall is around 2.9 metres, but it can be as high as 4.0 metres (Department of Environment and Heritage 2003), therefore, water quality is an issue due to the dangers from cyanide leakage from the mine into local water supplies. Wilson and Barker (2003, p. 1) noted with relation to the site that:

> Faced with rugged terrain, some of the highest rainfall in the country, and complex geology, the Golden Cross mine has endured cyclones, a major land movement, and anti-mining misinformation to become a productive operation, and the first modern mine in New Zealand to successfully move into planned closure and final rehabilitation.

Figure A 1.37: Location of Golden Cross Mine in Waihi, New Zealand



Source: Tourism Coromandel, (2010)

Waihi is located approximately 151 kilometers from New Zealand's largest city Auckland (Tourism Coromandel 2010) and is located in the Waikato region in what is known as the Coromandel Peninsula on the east coast of New Zealand's North Island. The town has traditionally been a gold mining town and still promotes itself as a gold mining town in its tourism promotion with tours being offered of the former Golden Cross mine site as both a recreational area and also an example of how a former open pit mine site has been rehabilitated without scarring the landscape of the area (Tourism Coromandel 2010). The town also promotes tours of the still operational open pit Martha Mine which is located on the edge of the town and at one stage was one of the largest operating gold mines in the world (Newmont Mining 2011) and is one of the few mines in the world that operate within a residential community.

The town of Waihi proudly boasts of its mining heritage and is keen for visitors to see past mining activities of the town (Golden Cross) and its current mining operations (Martha mine). Waihi is part of an important tourist destination, the Coromandel region of New Zealand, which is consistently one of New Zealand's top tourism destinations (by visitor numbers) due to its proximity to Auckland (Statistics New Zealand 2011). Tourism is one of the region's major economies, with mining also playing a major role in the local economy, estimated to have New Zealand $60 million into the local economy in 2008 (Hauraki District Council 2009). Waihi is still dependent on mining for its local economy (through the Martha mine) however; it is using the success of the rehabilitation program at Golden Cross to actively promote the town as a recreational tourism area with a difference.

A1.15.2 Size and profitability of the mine

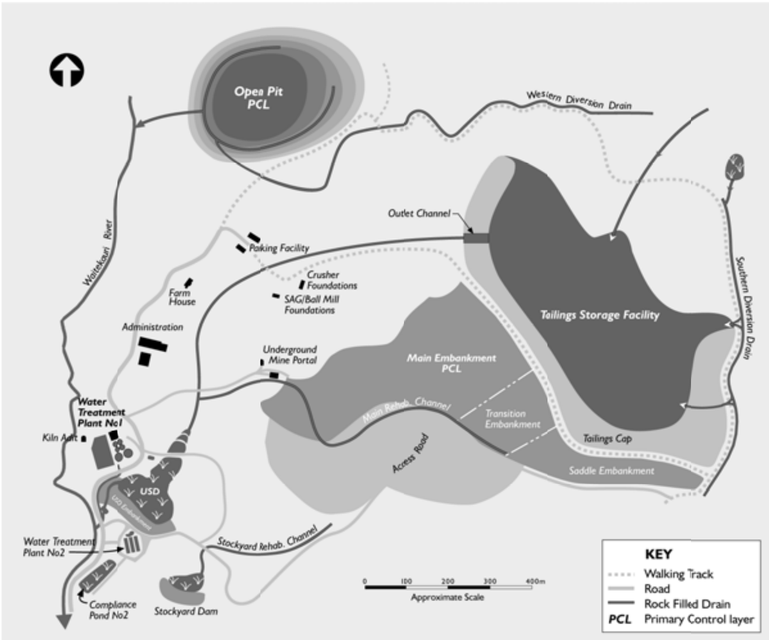
The mine is located approximately 8 kilometres northwest from the township of Waihi and is surrounded by rural farmland and wilderness (Hauraki District Council 2009). The area was first mined between 1895 and 1920 commencing life as an underground mine before closing and being returned as farmland (New Zealand Minerals Industry Association 2002). Exploration of the site commenced again in 1977, with the application for a mining licence being submitted in 1987, with final approval for the mine being granted in 1990 (the licence was the subject of an appeal by a local group over concerns about the impact of the mine on the local ecosystem) and mining commencing at the site in 1991. The mine approval process required that the mining company pay a rehabilitation bond of New Zealand $12.1 million in order to allay fears raised by some in the community concerning the impact that mining would have on the local area (New Zealand Minerals Industry Association 2002).

Mining at the site began in 1991 and ended in 1998, with the mine producing 20.5 tonnes of gold and 52 tonnes of silver during its lifetime (Hauraki District Council 2009). Revenue from the mine during its life amounted to New Zealand $430 million, making it one of the most profitable mines in New Zealand (Wilson and Barker 2006, p. 8). The mine was a significant employer in the town, with an annual payroll in excess of New Zealand $10 million, employing 243 people directly at the mine and an additional 750 people in mining related industries in the town (New Zealand Minerals Council 2002). In addition to this, the company ensured that the people employed at the mines were predominantly locals, who were trained by the company, increasing the skills set of the local population and generating substantial income into the local economy.

The mining at the site was undertaken by using both underground and open pit mining methods, with the site covering an area of approximately 240 ha, with the open pit extending to 70 metres in depth (Fitzgerald 1998). The open pit covered an area of 8ha, making the pit a substantial size, however most of the metal that was recovered came from the underground workings of the mine which extended to a depth of 300 metres (Fitzgerald 1998). The open pit was the biggest problem that faced the operators of the mine, however as the community expressed a desire to see the area returned as much as possible to its original state with the open pit backfilled and recontoured to fit in with the existing landscape.

Golden Cross was a successful and profitable New Zealand mine and an important employer in the town of Waihi, bringing substantial income into the region. The closure of the mine left the town with a skilled local workforce that was able to be absorbed into the larger Martha mine in the town and left the town with a well planned rehabilitated former mine area that has now become something of a tourist attraction for the town.

Figure A 1.38: The site plan for the Golden Cross mine site



Source: MacGillivray (2000)

A1.15.3 The size of the community where the mine is situated

The town of Waihi with a population of 4,503 (Statistics New Zealand, Quick Stats Waihi 2011) is a township located in the boundaries of the Hauraki District Council which has a population of 17,190 (Statistics New Zealand, Quick Stats Hauraki 2011). The region is counted as part of the wider Waikato region, with a population of 382,716 (Statistics New Zealand, Quick Stats Waikato 2011) giving the area a substantial wider population base. In addition to this, being 1.5 hours from Auckland, New Zealand's largest city and located in the popular Coromandel tourism district, has provided Waihi with a substantial tourism base and the ability to offer alternative employment opportunities for workers displaced from the Golden Cross mine when it ceased operating in 1998. The population of the area decreased by 0.5% between 2001 and 2006 which has been partially attributed to the closure of the Golden Cross Mine, according to the local council (Hauraki District Council 2009).

A1.15.4 The ownership of the mine

Golden Cross mine site was originally mined from 1895 until 1920 where a small township developed around the mine. The mine produced 155,000 tonnes of ore during its life and when it closed the small township went with it and the area reverted to farmland for the next 60 years (MacGillivray et al. 2000). The site was brought by Cyprus Gold in the early 1980's who began the process of applying for a mining licence to mine the site. After securing a mining licence in 1990, the company began operational mining at the site in 1991. In 1993 Couer D' Alene Mines Corporation acquired the assets of Cyprus Gold in New Zealand and took over ownership of the mine (MacGillivray et al. 2000) establishing a joint venture partnership with Viking Mining Ltd. The mine ore-body consisted of both gold and silver production from an open-pit and underground mine operation (Department of Environment and Heritage 2003). Production began in 1991 and ended in 1998, upon which rehabilitation of the site commenced, with the process taking approximately 3 years (Department of Environment and Heritage 2003).

Couer D' Alene is a United States based mining company with head offices in Couer D' Alene, Idaho. It is the largest US based primary silver producer and is also a strong gold producer with mining operations currently in North America, Central and South America and Australia. The company had equity market capitalisation of US$1.9 billion and revenue earnings of US$118.6 million (Couer D' Alene 2010). The company employs 1,294 people across its mines, making it a small to medium sized mining company by world mining standards. Although it is only a medium sized mining company in terms of market capitalisation, its relatively strong financial position, ensured that there was sufficient capital to meet the company's rehabilitation obligations.

Viking Mining Ltd was a wholly owned subsidiary of the Todd Corporation, a New Zealand based privately owned holding company that operates through a number of subsidiary companies (Bloomberg Businessweek 2010). The Todd Corporation was formerly known as the Todd Brothers Limited and has been operating in New Zealand since 1885 (Bloomberg Businessweek 2010) always involved in the business of providing equity to companies to assist in restructuring, consolidation and expansion. The company currently has investments across a number of portfolios in industry sectors ranging from oil and gas exploration, electricity generation, telecommunications, healthcare, property development and agriculture (Todd Capital 2011). As it is a private company, there is little public information available on the company; however, it is estimated to be worth New Zealand $2.6 billion, with the Todd family claiming the title of New Zealand's wealthiest family (New Zealand Herald, February 16, 2011).

This provided Viking Mining Ltd at the time with substantial capital investment and the ability to fund the rehabilitation required at the mine site. Viking Mining Ltd was only a minor partner in the joint venture partnership (controlling just 20% of the partnership) and played only a minor role in the rehabilitation and closure of the Golden Cross Mine. Viking Mining Ltd no longer exists and has been transformed into the Viking Group Ltd (a subsidiary of the Tiri Group Ltd) which comprises four businesses each providing various applications for use in industry, particularly mining, oil and gas and construction (Viking Group Limited 2011).

A1.15.5 When the mine closure was planned

Upon its closure in 1998, Golden Cross mine became the first New Zealand mine to move into planned rehabilitation and closure. The rehabilitation and closure planning for the site began three years prior to the closure of the mine, with community involvement in the closure plans commencing during the planning phases of the mine. The final rehabilitation has seen the mine become a wetland and native habitat, as well as being used for grazing and recreational purposes, such as tramping (bushwalking), bike and horse riding, with facilities also being made available for picnics.

Through the *Resources Management Act* (1991) Environment Waikato was responsible for monitoring the environment during all phases of the mine's life, with the Hauraki District Council providing the second tier of regulation for the mine site (New Zealand Minerals Industry Association 2002). Water management was the key environmental issue for the mine and was identified as a potential problem during the planning phase due to the steep terrain and high rainfall of the region. A number of diversion management programs were instigated by the Joint Venture Partnership to mitigate any potential toxic water entering local waterways. Some of these programs included water diversion systems, and the construction of a water treatment plant on the site to collect water runoff and treat it before allowing it to be discharged into the Waitekauri River (Wilson and Barker 2003).

Coeur Gold and Viking Mining also undertook rehabilitation and enhancement programs that went beyond regulatory requirements. These programs were carried out during the operating phase of the mining process as part of an ongoing rehabilitation program at Golden Cross. Some of the initiatives the Joint Venture undertook included (Wilson and Barker 2003, p. 7):

- Recognised stands of native trees were extended to establish local corridors with similar stands and enhance wildlife habitats
- Riparian habitat enhancement programs were instituted to protect stream banks from erosion and increase habitat quality both in-stream and on riparian boundaries. This has involved cooperating with local farmers to exclude stock from riparian areas
- Over 100 000 native trees and shrubs have been planted on and around the mine site
- Swamp areas located away from the riverbed were fenced and planted with native species to encourage wetlands establishment and enhancement.

The planning for rehabilitation and closure at Golden Cross began during the planning phase of the mine operation and continued during the operational phase of mining as part of a progressive rehabilitation program. The regulators along with the mine owners recognised early in the process the issues that would affect the mine and sought to address them during the planning phase in order to prevent problems in the future. Golden Cross provides a good example of how strong regulatory processes along with a commitment by mining companies to best practice closure outcomes and strong community involvement can result in a closure outcome that is sustainable over the long term.

Figure A 1.39: Golden Cross mine, New Zealand, before mining, during mining, and after closure and rehabilitation

Source: Minerals Council of New Zealand (2002)

A1.15.6 How the mine closure was planned and conducted

The Department of Environment and Heritage (2003, p. ??) (now known as the Department of Sustainability, Environment, Water, Population and Communities) said in relation to the mine completion process at Golden Cross mine that:

> Building confidence and support for a project's closure plan begins with a commitment to genuine peer review and community consultation. Consultation should begin during the construction phase and continue through the operational and closure phases. The key design features that underpinned the successful operation and closure at Golden Cross in an area characterised by 3-metre plus rainfall included:

- Strict engineering rules for the classification, placement and compaction of mine waste material;
- Installation and revegetation of an oxygen diffusion control layer over the waste rock;
- Robust design of diversion drains to protect the capping; and
- Manipulation of process tailings to reduce and re-use the entrained cyanide, stabilise contained metals and accelerate improvement in water quality for direct discharge to the sensitive receiving environment.

The closure and rehabilitation of the works centred on stabilising the site works around the mine, and ensuring water quality was of a high standard, in order to provide for the possible use of an aquaculture industry based on recreational and possibly commercial trout fishing. This is an ongoing process at the site. Interestingly, for other sites around the world that are attempting to convert former mine sites into use as recreational/commercial fishing facilities there are many issues that need to be dealt with before aquaculture becomes an established industry at the site (not the least of which being its commercial viability). This is an important aspect of successful mine closure, namely that it will take time to realise the full potential of a site.. While some communities may prefer rehabilitated mines to be commercially successful for economic reasons, the aesthetic appeal of a well rehabilitated mine site can be just as important as any commercial appeal. At Golden Cross, it was this aesthetic appeal that was given first consideration during the rehabilitation of the site (New Zealand Minerals Industry Association 2002, p2)

> Site works for closure focussed on the issues of handling the site stormwater, compacting and sealing acid-generating waste, and creating long-term stable structures. The most extensive site works comprised the controlled placement of acid-generating waste rock into engineered disposal sites, the design and placement of sealing layers over the waste rock disposal sites, establishing a vegetative cover to protect the sealing layer, the design and construction of diversion drains, and the partial capping of the tailings impoundment. An important part of the closure process was the procedures and practices adopted through the construction period and mining operation to provide a sound basis for the closure works."

The Department of Environment and Heritage (2003) from Australia who have conducted research into the closure outcomes of Golden Cross, noted in relation to the closure program that it (Department of Environment and Heritage 2003, p 5)

> … resulted in a world-class rehabilitation program for the first modern metal, mine closure in New Zealand. The work done at Golden Cross sets a new standard for successful environmental protection during mine operation and closure in the extraction Industry.

Coeur Gold and Viking Mining established a treatment system during the operational phase of mining, whereby cyanide was removed from tailings for reuse in the site. Cyanide is one of the key process chemicals associated with mining in tailings waste, and can potentially contaminate tailings material in the long term if not dealt with correctly. Coeur Gold and Viking Mining established a (Department of Environment and Heritage 2003, p 6)):

> Sophisticated water management system and a peroxide oxidation/metals coagulation and removal treatment system on the final discharge, to deal with this issue.

The result was a new cyanide recovery system that was developed at Golden Cross (the Cyanisorb System), in order to recover the cyanide from the discharge prior to it going into the tailings impoundment. The tailings from the processing plant were pumped via a series of pipelines into the processing plant. Any excess water during this process was decanted and piped into a treatment centre, before being discharged into the dam. The dam itself contains over 5 million tonnes of tailings (Wilson and Barker 2003). During closure a cap of topsoil was placed over the tailings and around the perimeter of the dam, then this perimeter was revegetated and contoured. The central area of the dam was left as a body of water that drains clean water through a channel and out into the Waitekauri River (Wilson and Barker 2003).

The tailings pile, was , upon closure landscaped to blend with the surrounding terrain and also provide a habitat for wildlife. The area has since been used to build walking and interpretive trails for visitors and has become a popular place for picnics, and recreational activities.

The Joint Venture Company identified 6 key features essential to the rehabilitation program (Department of Environment and Heritage 2003, p 6)):

1. The controlled placement of acid-generating waste rock into engineered disposal sites.
2. The design and placement of sealing layers over the waste rock disposal sites.
3. The design and construction of diversion drains.'
4. The establishment and management of vegetation to protect the rehabilitated layers
5. A partial capping of the tailings to accelerate consolidation adjacent to the tailings then embankment, and
6. The implementation of a recovery circuit to recycle cyanide from the tailings prior to disposal.

The Joint Venture and Consultation Task Force established one of the Key Performance Indicators for the site as being 'post-closure chemistry of the water draining from the site' (New Zealand Minerals Industry Association 2002). The Joint Venture wanted to have either at closure, or as soon as possible, post-closure water drainage from the mine site that could be filtered into the nearby river, without causing environmental damage. This outcome was achieved by the Joint Venture with the result that (Department of Environment and Heritage 2003):

> Surface water draining from the site can now be discharged directly into receiving water in a high quality stream environment which supports a diverse aquatic community and a small trout fishery without the need for further treatment.

The three key elements to meet this desired outcome (of mine drainage water being able to meet receiving water) were (Department of Environment and Heritage 2003, p 7):

- Management of waste rock disposal operations
- The use of geo-technical and geo-chemical controls, and
- Appropriate design principals

The area around the mine is characterised by steep terrain and high rainfall, therefore water quality is an issue. A diversion system was established during the operational life of the mine that was designed to capture rainfall runoff and divert it away from the mine into local streams. Water or seepage from the tailings impoundment area was diverted into the water treatment facility via a series of underground drains. Any water used from underground aquifers was pumped into the water treatment facility before it was discharged into the Waitekauri River (Wilson and Barker 2003).

The water was monitored to ensure that water quality was to a set standard with a testing program designed to establish the water quality being discharged from the mine site. The tests were conducted as follows (Wilson and Barker 2003, p. 7):

> … in addition to a comprehensive water monitoring system, juvenile rainbow trout were used to establish a real-world, real-time bio-monitoring system to monitor the potential effects of discharge water on the receiving stream ecology. Three test aquaria were set up; one contained 100% river water as a control, another 20% water treatment discharge and 80% river water, and another 100% water treatment plant discharge. Water was continuously pumped through the aquaria. Treatment water was taken from the retention pond 6-12 hours before planned discharge. If fish appeared distressed the discharge to the river could be stopped prior to that water entering the discharge pipe and the water treatment plant put into recycle so that potential problems could be identified and rectified.

It was not just the mining companies, but also the regulatory agencies that conducted monitoring, in order to provide independent analysis of the data. The water treatment plant is still in operation and will continue to operate until all the water at the site meets discharge criteria (under the Resources Management Act), and can be safely released into the Waitekauri River, without the use of any intervention mechanisms. Once the Joint Venture team, the regulatory authorities, the Peer Review Panel and the Community Consultation

Group are satisfied that discharge water from the former mine site is safe, the wetland areas that have been established will act as passive water treatment systems.

Underneath the tailings dam and mound was a slip surface approximately 100 metres thick that was slowly moving down the slope of the mountain, and hence the Joint Venture Company had to employ a landslide expert to monitor the problem and ensure it did not cause problems after closure (Fitzgerald 1998). The company notified regulatory authorities and kept the local community up-to-date with regular meetings, informing them of how the issue was being resolved.

As part of the consultation process, the Joint Venture Company produced an 18-minute video presentation explaining how the problem would be resolved. This process was also undertaken in order to counteract what the company saw as the false representations about what was occurring at the site, by media outlets, which included reports that the site would be unsafe for recreational use when completed and that the site would be more prone to landslips, particularly given the high levels of rainfall that the area experiences.

The problem of the slip surface was undertaken by use of the following methods, described in greater detail by Wilson and Barker. Below is a simplified explanation of the method (Wilson and Barker 2003, p. 6):

> … to reduce groundwater pressure and lubrication of the slip surface where movement was occurring, a series of horizontal drainage holes were drilled at numerous sites. A drainage tunnel between 4 and 5 metres in diameter was driven through the rock some 15 metres below the slip surface. Holes bored upwards into the slip surface drained more water. Water volumes in the tailings impoundment were reduced. A soluble filter buttress was constructed of rock quarried nearby to add strength to the tailings impoundment structure …

The extra cost to the rehabilitation program of Coeur Gold and Viking Mining for undertaking this project was NZ$27 million, however, the extra cost appeared to be worth it from a long-term perspective, due to savings on potential costly, extra rehabilitation work (not to mention the potential environmental damage and hence unfavourable publicity), that would have occurred had the problem not been identified and dealt with in a prompt manner. Wilson and Barker (2003, p. 6) go on to say with regards to the slip surface issue that:

> By 1997 the problem had been generally controlled, and by 2000 the annual rate of movement detected was less than the annual uprising of the Southern Alps…throughout all of this time the structural integrity of the tailings impoundment was maintained.

Along with the features listed above, other features of the rehabilitation process include contouring of the open pit; this has been achieved by use of low permeable overburden allowing the pit to be revegetated. The area around the perimeter of the tailings impoundment has also been revegetated and a freshwater pond/wetlands area has been established near the tailings impoundment. Drainage channels have been built to maintain the level of the pond/wetlands area (New Zealand Minerals Industry Association 2002).

Areas surrounding the mine site that previously had been cleared for farming were revegetated with native species. Alongside this, bush areas surrounding the Coromandel forest were fenced to act as a buffer zone, excluding livestock and other non-native species. As well as this Wilson and Barker (2003, p. 8) note that a:

> "…comprehensive monitoring programme keeps track of landform stability, vegetation, rehabilitation, surface water quality, groundwater quality and flora and fauna."

The rehabilitated mine site area now has walking trails, picnic facilities, footbridges and information panels along the walking trail that discuss the history of the Golden Cross Mine.

Figure A 1.40: The tailings dam at Golden Cross, which features walking trails, picnic facilities and interpretive signage

Source: New Zealand Minerals Industry Association (2002)

A1.15.7 What alternative closure options were considered

The Golden Cross site was always designed to be rehabilitated and closed back to the original landform that existed prior to mining. The community expressed a desire for the site to be returned to the landform that existed prior to mining, basically following the requirements of the Resource Consents and Mining Licence (New Zealand Minerals Industry Association 2001). The community did request that the site be open to the public as a recreational area and the end-use of the site was designed to meet the community needs. From the outset, the communities' expectations were high. The standard of rehabilitation the community expected on the site was nothing other than a return to its pre-mining state.

A1.15.8 The legislation under which the closure was conducted

In New Zealand all gold, silver, uranium and petroleum is owned by the government, with permits to mine granted by the Ministry of Commerce under the Crown Minerals Act (1991) (New Zealand Minerals Industry Association 2010). When the Crown is deemed to be the owner of the minerals, the following permits and consents are required to commence mining (Ministry of Economic Development 2010):

- A permit granted under the Crown Minerals Act
- An access arrangement negotiated with all landowners and occupiers
- If the Department of Conservation owns the land an access arrangement with the Department is required
- Resource consents to use land and water may be required by District and Regional Councils.

The other main piece of legislation that covers mining in New Zealand is the Resources Management Act (1991) that sets out restrictions on the use of land, lakes and rivers, water usage and contaminant discharges into the environment. The RMA is similar to the legislation in the Environmental Protection Act of Australia in that it focuses mainly on issues of environmental importance, with little direction on the economic and social issues surrounding mine operation and closure. There is also only one act in New Zealand, as opposed to Australia, which has separate acts for each of the States and Territories. The aim of the New Zealand Resources Management Act is to (from section 2, part 5 of the Act) (New Zealand Minerals Industry Association 2004,)

> … promote the sustainable management of natural and physical resources…providing for the wellbeing of people while protecting the life supporting capacity of the environment, the needs of future generations and minimising or avoiding the adverse effects of activities on the environment.

The Golden Cross Mine should never be a burden to New Zealand taxpayers, according to Wilson and Barker, due to the best practice rehabilitation standards adopted at the site, but also, in part due to the bonding mechanism required by regulators (Wilson and Barker 2003, p. 9):

> Bonding provisions ensure that no ratepayer funds are required to successfully rehabilitate the site, or cope with any future maintenance.

Under the Crown Minerals Act (1991) it is a requirement that a company's rehabilitation and closure plan will be administered and the land will be managed over the long-term even if the company walks away from a site and the mine is forced to close prematurely. The bonding mechanism necessitates enough money is set aside in a bonding trust fund (established specifically for each mine) to rehabilitate and close the mine in the event of a sudden, unforeseen closure (Newmont Mining Corporation 2010).

In addition to this, the Crown Minerals Act (1991) legislates that mine rehabilitation and closure plans are submitted in two parts, one part being an annual report covering the progressive rehabilitation that was being undertaken at Golden Cross and a second part that covered the methodology that would be used to cover rehabilitation and closure of the site had the mine closed unexpectedly. The two parts to a mine closure and rehabilitation plan are designed to ensure that all possibilities are covered in relation to mine closure and along with the bonding mechanism ensure that enough funds are set aside to mitigate any potential negative environmental effects associated with premature mien closure (Fitzgerald 1998). The idea is also to put in place a plan so that an unexpected mine closure does not mean an unplanned mine closure, as has been the case in many of the poor practice mine closures discussed previously.

A1.15.9 Engagement with stakeholders

During the history of the Golden Cross mine, the Joint Venture developed a strong relationship with the local community through the establishment of two community based consultative groups, a peer review panel and a community consultation group (known as the Joint Task Force). These bodies commenced operations during the operational phase of the mining process and continued to operate during the rehabilitation and closure phase of mining. According to McGillivray these bodies provided confidence in the local community regarding the mine closure plans and were particularly important during the closure phase when the company’s reduced personnel at the mine site (McGillivray 1998, p.8):

> The ongoing review and liaison afforded by these bodies was essential in maintaining confidence in the progress of the closure works during the later periods when the company’s presence onsite became minimal...

Coeur Gold and Viking Mining established a Peer Review Panel and the Joint Task Force (also known as the Community Consultation Group – CCG), during the operational phase of the mining project, in order to undertake an analysis of the closure/rehabilitation process.

The joint venture operation established a ‘Joint Task Force’ to examine sustainable post-mining land uses for the site, with the process involving community engagement both prior to, and during closure. One of the major issues for the site was cyanide contamination; therefore, the rehabilitation required thorough planning and engagement with the local community.

The Joint Task Force that was established to participate in the closure process consisted of a number of members drawn from the wider community in order to assist with the closure of the mine. Members of the Consultative Task Force included (Department of Environment and Heritage 2003, p 2)

- Regional and District Councillors and Staff members
- Professional peer reviewers

- Environmental groups
- Local residents of the Valley; and
- Iwi (Maori) People

The Peer Review Panel of experts consisted initially of a geo-technical engineer and an environmental scientist who specialised in land rehabilitation. These were later joined by geo-chemists specialising in water quality and acid-mine drainage and a post-closure specialist in landslides, a mine closure specialist also joined the team prior to closure (Department of Environment and Heritage 2003). These experts monitored the whole process from initial planning stages through to actual closure and advised both the company and regulators of any changes they deemed necessary to enhance the rehabilitation process. Wilso and Barker noted in relation to the use of these specialists that they (2003, p. 8):

> … removed the problems that the industry sometimes experiences when trying to present complex technical material to council staff, while at the same time providing council staff with a degree of comfort that their decisions were based on expert recommendation.

In order to encourage interaction with the local community, Coeur Gold and Viking Mining encouraged regular visits to the site by members of the Community Consultation Group and the local community (this was open to anyone from the local community who wished to attend).

The Community Consultation Group and Peer Review Panel met regularly (not always in combination), from 1997 (one year before closure) through to the completion of the rehabilitation process. The participation in these groups was voluntary, but according to records obtained by the Department of Environment and Heritage from meetings by the groups, attendance from all representatives was strong through to the mine closure completion (2003). This group met regularly with the peer review panel – broadening the consultation process and providing better, more informed communication in the process. The Department of Environment and Heritage stated with regard to this process that (Department of Environment and Heritage 2003, p.11):

> The direct interaction between the Peer Review Panel and the CCG (Community Consultation Group) and routine site visits were very important in effectively communicating the proposed concepts to the group. This transparent planning strategy, with the help of the regulatory staff members, transformed community concern into informed neutrality and support from those who participated in the ongoing community consultation.

According to Needham (2005) it is important that the community is engaged in the mine closure process from the initial construction phase and that the members of the community that are involved in the engagement phase come from a wide variety of backgrounds in order to be able to actively contribute to the mine closure (Needham 2002, p. 6):

> Building confidence and support for a project's Closure Plan begins with a commitment to genuine peer review and community consultation. Consultation should begin during the construction phase and continue through the operational and closure phases.

A1.15.10 Summary

According to Wilson and Barker (2003, p. 5) in order for mine closure to be effective it must involve the following. The closure process must:

> … meet all regulatory requirements as laid down in the conditions on the mining License and Resource Consents. In addition, Human Resource Management and community involvement and consultation add a social facet to the procedure…rehabilitation activities at a modern gold mine include: decommissioning the mine, providing surface drainage and erosion protection across the entire site, establishing self-sustaining vegetation cover, meeting water quality standards and maximising post-closure maintenance requirements.

Golden Cross represents world's best closure practice and was New Zealand's first mine to initiate a successful planned closure and final rehabilitation. Despite the successful initial plans for closure of the site, the final concept cost many millions more than had been allowed for in the original closure plan, which demonstrates the high costs sometimes associated with closure. The Joint Venture Company in this case, however, decided that it was wiser to bear the extra rehabilitation costs, rather than risk future environmental problems and the potential negative publicity associated with it.

The consultation process involved a number of positive features that enabled the Joint Venture partners to make Golden Cross a success from a social perspective, as well as an environmental one. The decision to establish a peer review committee and community consultation group provided the two companies, regulators and the local community with strong technical information on closure issues and also allowed members of the local community to be kept fully informed of the closure process at every step.

A1.16 Rother Valley Country Park – Rotherham, United Kingdom – Coal Mining

The Rother Valley Country Park was first suggested during the 1960's. The Sheffield City Council began to determine the feasibility of the park in 1972 after the National Coal Board announced that they intended to establish open cast coal mining in the region. The mine was named Meadowgate with mining commencing at the site in 1976 and ceasing production by 1982 after producing 1.7 million tonnes of coal during its life, making it one of the largest mines in the United Kingdom.

The area of the proposed park covered the local council areas of Rotherham, Sheffield, North and East Derbyshire and the South Yorkshire county councils (Rotherham Metropolitan Borough Council 2004). These councils in the initial phases of the planning for the park established the rehabilitation criteria and working with the National Coal Board ensured that these criteria were met during the rehabilitation of the mine site. The development of the Rotherham site was at the time one of the most comprehensive mine rehabilitation projects undertaken in the United Kingdom and was planned well in advance of the mine closure allowing time for extensive community involvement in the process and say in the design of the final form of the park.

A1.16.1 The location of the mine

The mine was located in the town of Rotherham, in South Yorkshire located in the centre of England, just 12 kilometres from the major UK city of Sheffield (which has a population of 534,000) (Office for National Statistics, 2008). The region has traditionally been known for being a heavy manufacturing and coal mining centre, with a strong emphasis on the steel industry (Rotherham Investment and Development Office, 2011). The closure of many of the area's s during the early 1980's left the region economically depressed for a long period of time and left the area with high unemployment rates for much of the 1980's and early 1990's. (Office for National Statistics, 2008).

During the last decade, the region has been able to diversify its economy and expand its industrial base with industries such as aerospace, vehicle manufacturing, food technology and ICT (Rotherham Investment and Development Office, 2011). The region has also benefitted from increased tourism to the South Yorkshire region, with Rother Valley Country Park now one of South Yorkshire's main tourist attractions, attracting 800,000 visitors annually that is particularly noted for its water based activities (Yorkshire Tourist Board, 2011).

The area is classified as having a temperate maritime climate (as with the United Kingdom as a whole) with cold damp winters and cool summers, with the area averaging 600mm of rainfall per year, however this is spread over a large number of days (up to 45 days during the winter months) (Met Office, 2011). The area has a mean annual temperature of 9.5°C, with temperatures ranging from 13°C to 21°C during July/August and 1°C to 6°C during December/January (Met Office, 2011). The region only averages 1600 hours of sunshine per year which is the average for the United Kingdom (Met Office, 2011). The region is not known as a sunny, warm vacation destination and so the decision to turn the former mine voids into recreational lakes was something of a calculated risk on the part of authorities when deciding on end-uses for the former mine site.

Figure A3.22 Location of Rotherham in the United Kingdom

Source Communitas UK, 2011

A1.16.2 Size and profitability of the mine

The name of the operating mine that existed prior to the opening of the Rother Valley Country Park was Meadowgate. The open cast mining of the Meadowgate site began in 1976, ending in 1982. The site produced over 1.7 million tonnes of coal over this period (Rotherham Metropolitan Borough Council 2004), with over 23 million tonnes of overburden being produced during the operational life of the mine. The mine site produced nearly 10% of the country's coal output at its peak and was one of the largest, most productive s in the Unites Kingdom (Rother Valley Country Park, 2011), with the mine employing 150 people directly during the life of the mine, however nearly ten times that number were estimated to be indirectly involved with the mine (Horne, G, 1990). The site covered an area of 367 hectares on what prior to mining had become a derelict grazing area and nature reserve, that was bounded by a large former coal mining and agricultural town turned residential area known as Killamarsh.

The area of the mine site is situated on a flood plain and was traditionally used as a floodwater storage area during times of excessive rainfall and this was an ongoing requirement during the operational phase of mining. The National Coal Board put in place a series of measures (mostly involving contouring the site to enable it to continue to act as a floodplain) that enabled the site to continue to act as a floodwater storage locale whilst mining activities were being carried out at the site. In addition to this, the Rother River was also diverted from its original path in order for the coal seams that lay under the river to be mined. The diversion was eventually made permanent by the mining company working with the Yorkshire Water Authority and incorporated into the final rehabilitated landscape at the Meadowgate site. The rerouting of the river enabled the Coal Board and the Water Authority to clean the Rother River which had become heavily polluted through past mining practices that had used the River as a dumping ground for mine waste.

A3.23 Rother Valley, United Kingdom, after rehabilitation and closure,

Source: Rotherham Metropolitan Borough Council, 2004

A1.16.3 The size of the community where the mine is situated

Rotherham is located almost in the geographic centre of England in the South Yorkshire region. Rotherham has a population of 254,000, whilst the South Yorkshire region has a population of 2 million (Office of National Statistics, 2008) providing a large population base for the Country Park. The Rotherham metropolitan borough covers an area of 28,278 hectares and is bounded by three other metropolitan boroughs (Barnsley, Doncaster and Sheffield) that together make up the region of South Yorkshire (Rotherham Metropolitan Borough Council, 2010; p1).

The economy of Rotherham has moved away from its traditional reliance on industry sectors such as coal mining and steel manufacturing with 19% of the region's workforce now being employed in areas such as Advanced Manufacturing (aerospace, food production, automotive components, healthcare), and Information and Communication Technologies (ICT).

The population of Rotherham is largely rural based, with 52% of the population living rurally in towns and villages, rather than in the metropolitan area (Rotherham Investment Development Office, 2011). The borough's economy is also now increasingly intertwined with the City of Sheffield, with the town acting as a feeder community to the City of Sheffield, which has added to the diversity of the Rotherham economy enabling employment growth rates that were double those of the fellow Yorkshire conurbation of Leeds (Rotherham Investment Development Office, 2011). The change in the dynamics of the Rotherham economy since the closure of Meadowgate and other s in the region have allowed

Rotherham to withstand the negative social and economic effects that are often associated with mine closures in smaller mining dependent communities. In addition to this, the detailed closure plans for the Meadowgate site and the decision to turn the site into a series of recreational lakes and a country park, provided the Borough with an added attraction not just for tourists, but also for residents and the ability to market the region as a lifestyle destination located close to the major city of Sheffield.

A1.16.4 The ownership of the mine

The Meadowgate mine was one of the most profitable mines in the United Kingdom during its operational phase, in addition to this it was one of the largest mines in the England at the time. The mine employed 150 people directly during its operational phase, along with numerous subcontractors who were employed indirectly in various roles associated with the mine (including the rehabilitation of the mine). The mine was not the largest employer in the region during its life, however due to the large number of people associated with the mine on an indirect basis and its importance to the British energy industry, alongside the fact that a number of other s were in operation in the region, the mine played an important part in the economic structure of the South Yorkshire economy (Horne, G, 2010).

The Meadowgate mine was owned by the National Coal Board's Opencast Executive, who were a Statutory Organisation established in 1947 as part of the nationalisation of the British coal industry after World War II (Durham Mining Museum, 2009). The National Coal Board was a major employer, employing over 700,000 people during the peak of its operations in the 1960's, however, this number fell to less than 600,000 by the time mining commenced at Meadowgate in 1976 (Durham Mining Museum, 2009). The National Coal Board was producing just over 15 million tonnes of coal at the time of the Meadowgate closure in 1981, however, the 1980's was the start of the demise of the coal industry in the United Kingdom as cheap coal from overseas mines (notably France, Germany, Australia and the United States) made many British mines uncompetitive.

The National Coal Board became the British Coal Corporation in 1987 and eventually ceased to exist as a Statutory Body as of 1997. In 1994 the *Coal Industry Act 1994* established the Coal Authority which took over responsibility from British Coal Corporation and also administered the privatisation of the economic assets of the British Coal Corporation (British National Archives, 2007). By the time of the privatisation of the British Coal Corporation, the number of s in the United Kingdom had fallen to fifteen open cast pits and the number of workers employed in the industry in the United Kingdom had fallen to 18,000 (British National Archives, 2007).

Meadowbank was one of the largest opencast pits in the United Kingdom at the time and was also one of the most profitable in the country, due to the large reserves of coal and the relatively low production costs. The mine was responsible for producing 10% of the country's coal output during its years of operation from 1976 to 1981 and was a key supplier of coal to the electricity generators in the United Kingdom (Horne, G, 1990).

The closure of the Meadowbank mine in Rotherham coincided with a number of issues that altered the face of coal mining in Britain, including the miners strikes during the mid 1980's and the closure of many mines leading to a large number of job losses. In addition to this, the importation of cheap coal from overseas caused further destabilisation to the British coal industry as imported coal became cheaper relative to locally mined coal. The closure of Meadowbank had the potential to cause social and economic upheaval for the Borough of Rotherham but the well planned closure of the mine, along with the local councils and public involvement in the mine closure process prevented the mine closure from causing social and economic dislocation for residents of the region. This involvement ranged from the planning and funding of the park (Local Councils), to the input from the local community in determining the final design of the park.

A1.16.5 When the mine closure was planned

Rother Valley Park was planned long before mining actually commenced. The idea of the park began in the early 1970's, but mining did not commence until the mid 1970's, however, from the outset it was envisaged that the site would be rehabilitated in such a manner that it would become a recreational facility that would attract tourists to the region. The rehabilitation of the site is unique in that the local councils used council funds to help develop the park and incorporate the mine site into what was essentially became a public park. Local councils effectively became involved in the rehabilitation process, with the overall aim being a public park that incorporated the rehabilitated mine site into its design.

The Joint Committee throughout this period established a community consultation program. In 1977 they produced a *Development Options Report* that allowed for significant community input into the final design of the park, enabling them to determine what recreational facilities the park would contain and how the park would be laid out. By 1978 the *Final Report* was published and this was used as the basis for the final rehabilitation design (Rotherham Metropolitan Borough Council 2004), importantly in terms of the rehabilitation and closure of the site, the report was published four years before the mine closed and formed the basis for the final design of the mine site. The open nature of this process and the fact that was a former overrun country field was rehabilitated into a local Country Park, explain why there was little opposition to the final plans for the former .

Figure A3.24 Rotherham County Park, after rehabilitation, with one of the former pits, now a recreational lake,

(Source: Rotherham Metropolitan Borough Council, 2004)

A1.16.6 How the mine closure was planned and conducted

The Joint Committee, formed by the five county councils stated the following as its corporate objective regarding the park (Rotherham Metropolitan Borough Council 2004)

"To create an easily accessible park offering a safe and attractive land and water based environment which will cater for a wide range of countryside and recreation activities, available to a broad cross-section of the community at both the local and regional level and the conservation of such resources for present and future generations."

The Joint Committee of the councils oversaw the funding for development and running of the park, although the rehabilitation of the former mine site was conducted by the National Coal Board, who undertook the rehabilitation on a progressive basis. The Rotherham and Sheffield Councils each provided 40% of the funding, with the other three councils providing the remaining 20%, until South Yorkshire was abolished in 1986, leaving just four councils in the Joint Committee (Rotherham Metropolitan Borough Council 2004).

In 1992, Sheffield City Council cut its share of the funding by half, before withdrawing completely in 1994. In 1995, the Joint Committee was abolished altogether, as the Derbyshire councils also withdrew. This left the Rotherham Metropolitan Borough Council as the sole entity responsible for the funding and maintenance of the park, a position it continues to hold (Rotherham Metropolitan Borough Council 2004).

The first process of the mining operation consisted of diverting the Rother River (which ran through the middle of the mine site); away from the mine pits allowing the National Coal Board to access the coal seams that ran under the River. The Rother River was heavily polluted at the time (due to past mining practices which had seen the river used as a dumping ground for mine waste) and was not able to support fish life of any kind, and as a result one of the programs of the diversion involved a clean-up of the river and its tributaries (Horne, G, 1990). At the end of the rehabilitation, the river was used to supply water to the lakes and ponds that were created as part of the closure program.

Mining first began in the northern section of the site, whilst the Rotherham River was being diverted. This section of the mine was then recontoured, reshaped and landscaped, at which time mining commenced in the southern section of the mine.

The rehabilitation program consisted of three main objectives (Rotherham Metropolitan Borough Council, 2004):

1. “Create four main lakes and open land to provide a wide variety of recreational pursuits both water and land based.
2. Provide several different habitats for the many different plants and animals that inhabit or migrate through Rother Valley.
3. Create an efficient flood control system to protect areas of housing and industry downstream”.

The lakes were lined with compacted mudstone, a metre thick, with water from the lake pumped from Moss Brook 2.5 kilometres away (Rotherham Metropolitan Borough Council 2004). The deepest pit in the mine was 46 metres deep, with the shallowest pit being just 8 metres deep, however all of the pits were reshaped during rehabilitation, so that when the final lakes were created the deepest was only 3.5 metres (Horne, G, 2010). The park saw a total of 480 000 trees and shrubs planted on the site. An historic mill that was located on the site was restored and opened to the public as a tourist attraction and Visitor Information Centre.

Figure A3.25 one of the former pits rehabilitated as a recreational lake and wetland

Source BBC, 2010

The overburden and material excavated to create the recreational lakes, ponds and divert the Rother River were used to create the slopes and hills that have become part of the recreational area. Topsoil and subsoil were used to create the recreational area, and then planted with ryegrass to hold the soil together and form the foundation for the new recreational area (Horne, G, 2010). An impermeable blanket of compacted clay was used to line the lakes, wetlands and the new course of the Rother River in order to prevent water leakage, but also to assist with controlling acid mine leakage (Horne, G, 1990).

The water to fill the lakes was pumped from Moss Brook, which was located two kilometres away from the site. This was done to ensure that the water entering the lakes was pollution free and as clean as possible, over time, however, the diverted Rother River has been the source of water for the lakes as the water from the river eventually became pollution free as part of the mine rehabilitation process (Rotherham Metropolitan Borough Council, 2004). The main lake of the park (Rother Valley Lake) covers an area of 43ha, is 1km long, 300 meters wide and has an average depth of 3.5 metres. The other lakes at the site were used for a number of uses including a fishing lake, a nature reservation and a lake for rowing and model boating (Rother Valley Country Park, 2011).

In addition to the lakes, the rehabilitation of the mine site included the construction of car parks, access roads and guided walks and nature trails. Other recreational facilities developed at the mine site included (Rother Valley Country Park, 2011):

- “18 hole golf course
- Four soccer pitches
- Riding trail
- Camping and caravan facility
- Education centre
- A grass skiing slope
- Visitor Information Centre at a 17th Century mill that was redeveloped as part of the mine rehabilitation

Figure A3.26 Aerial overview of the former mine site, now Country Park

Source: -Rother Valley Country Park, 2011

The former open pit coalmine site has been turned into a successful recreational park that attracts over 800,000 visitors per year. The planning for a recreational area commenced nearly 20 years prior to mining at the site and the development of the site into a Country Park was actually assisted by the decision to commence mining at the site. Rother Valley Country Park has been able to capitalise on its location in the heavily populated Northeast of England and hence is not necessarily an option for all mine closures. The former coalmine does represent however, best practice closure and importantly occurred at a time when mine rehabilitation and closure were not at the forefront of mine planning and often was not considered until just before the mine ceased production.

A1.16.7 What alternative closure options were considered

No alternative closure options were considered for the Rother Valley site, as the development of the Rother Valley Country Park had been planned since the 1960's with the aim of developing what was essentially an underutilised and somewhat derelict area of land. The idea of the park had broad support through input from the community and had been canvassed by the local government areas through numerous public meetings during its planning stages. The decision by the National Coal Board to mine the site enabled the local councils to gain assistance from the National Coal Board to rehabilitate the site into a series of recreational lakes and wetlands, generally broadening the original layout of the park to encompass more recreational uses (Rotherham Metropolitan Borough Council, 2004).

A1.16.8 The legislation under which the closure was conducted

The Meadowgate rehabilitation and closure was rare at the time in that it exceeded its legislative requirements for mine rehabilitation and closure and went some way to addressing the economic and social impacts of closure by the decision to turn the mine into a recreational and tourism facility, hence providing a facility for locals and also generating additional income for the region through the provision of an extensive visitor attraction and in turn also providing alternative employment for some displaced former mine workers, reducing the need for welfare after the mine closed. The mine closure was also distinctive at the time by the financial involvement of the local government authorities in the rehabilitation and closure of the site, again a process that exceeded legislative requirements.

In the United Kingdom Opencast coal operations did not require a formal planning consent until the passing of the *Opencast Coal Act 1958* and the *Town and Country Planning Act 1962* both of which provided the Department of Environment with the authorisation to make planning decisions with regards to s specifically (Minerals UK, 2009). The idea behind the development of these acts was to remove the authorisation and control for mine development away from local government authorities. The Opencast Coal Act was designed to address previous problems associated with coal mining legislation in the United Kingdom that did not properly deal with the rights of surface owners and compensating for loss of land (Minerals UK, 2009).

No early mine legislation in the United Kingdom addressed the issues of mine rehabilitation, in the coal industry this process was at the discretion of the National Coal Board and local government authorities. The *Mines and Quarries (Tips) Act 1969* was the first act to specifically deal with environmental issues relating to mines (this act covered all mine types) and the environment, specifically addressing disused mines and ensuring that they did not constitute a danger to the public after closure (Minerals UK, 2009).

The rehabilitation and closure of the Meadowgate mine site was undertaken under the guidance of the National Coal Board and the five local councils (Rotherham, Sheffield, East and North Derbyshire and South Yorkshire) under the *Town and Country Planning Act* which specified how land should be developed after mining had ceased. The act provided statutory definitions as to what was meant by certain rehabilitation terms, an example of three of these are (Department of Communities and Local Government, 1996; p10-11):

“Reclamation – Includes both restoration and aftercare...it also includes events which take place before and during mineral extraction...and may also include operations after extraction such as filling and contouring or the creation of planned water areas”.

> Aftercare Condition
>
> “A condition requiring that such steps shall be taken as necessary to bring land to the required standard for whichever of the following uses is specified in the (after-use) condition, namely;”
>
> Use for agriculture
>
> Use for forestry
>
> Use for amenity
>
> After-use is used to mean:
>
> “The ultimate use after mineral working for agriculture, forestry, amenity (including nature conservation), industrial, or other development.”

These were only definitions of terms for mining companies and regulators to follow when implementing rehabilitation projects and were by no means a comprehensive closure checklist. Mine rehabilitation and closure projects on a scale as substantial as Rother Valley Country Park were the exception rather than the norm during this time and most mine closures were undertaken in an ad hoc manner rather than through the early development of a comprehensive mine closure plan such as the one developed for the Meadowgate mine.

Engagement with stakeholders

The councils sought local community input into the final design plan of the park and this input formed the basis for the final design of the park. This process occurred during the 1970's and was among the first mine closures that incorporated community involvement into the closure process and was conducted at a time when community consultation, let alone in involvement in mining rehabilitation and closure was almost unheard of in the United Kingdom.

The Meadowgate mine saw the formation of a Community Liaison Committee at the commencement of the mining process, with the committee continuing to operate throughout the life of the mine being actively involved in the mine rehabilitation and closure process. The Committee consisted of National Coal Board executives, Council representatives from each of the Councils involved in the development of the park (Rotherham, Sheffield, North and East Derbyshire and South Yorkshire) and local residents who met every two to three months to discuss what was occurring at the site and also review the planning for the rehabilitation and closure of the site, including regular site tours to examine the progressive rehabilitation process at the site (Horne, G, 1990).

The most important aspect of the community engagement process at the Meadowgate mine site came not from the National Coal Board, but rather from the Local Council Authorities who were responsible for the original planning and development of the Rother Valley Country Park concept. The Rotherham Borough Metropolitan Council and the Sheffield City Council actually began the process of planning the development of the park during the 1960's. Sheffield City Council undertook a feasibility study to determine the viability of developing the park. It was during this feasibility study that the National Coal Board announced plans to extensively mine the area that was under consideration for the park (Rotherham Metropolitan Borough Council, 2004).

The plans by the National Coal Board to mine the site provided the impetus for the project to proceed as the rehabilitation of the mine site would enable the development of the Country Park. As the proposed bordered five Local Government Areas, the Joint Committee was established to guide both the mine development and the rehabilitation of the site (Horne, G, 1990). Throughout this process the community were actively involved in the development of the mine with regular public meetings and displays on the proposed plans for the mine and the rehabilitation of the site.

The Joint Committee met on a regular basis and developed the final plans for the rehabilitation of the site after extensive public consultation and involvement. In 1977 the Committee released a Development Options report on different closure options for the mine site and in 1978 after public involvement in this process the Committee released the

Development Proposal Plan from which the final design for Rother Valley Country Park emerged (Rotherham Metropolitan Council, 2004).

Alongside the Joint Committee, the Yorkshire Water Authority and the Countryside Commission (a statutory body designed to coordinate government activity in the English countryside) worked in the development of plans for the rehabilitated mine site. The Countryside Commission provided £1 million towards the rehabilitation of the former mine site as part of its commitment to the development of the Rother Valley Country Park and to ensure that it met the statutory requirements for the development of such a park (Select Committee on Environment, Transport and Regional Affairs, 1999). The Sports Council provided a grant of £50,000 towards the rehabilitation program, with the Joint Committee Councils contributing £2.5 million and the National Coal Board £4 million towards the total cost of £8 million pounds that were expended in the rehabilitation of the site and the development of the Country Park (Rotherham Metropolitan Borough Council, 2004).

By 1992 the management of Rother Valley Country Park was handed over totally to Rotherham Metropolitan Borough Council, due to changes in the boundaries of South Yorkshire Councils and the decision by other Councils involved in the management of the park to cease their funding commitments for the park. Despite this, the development of the former mine site into a large recreational park was successful due the engagement and commitment by so many local government authorities to work with the local community and invite their input into the final design. The community was able to take ownership of the former Meadowgate site and saw the park as an asset for future generations and a positive new feature for the region.

A1.16.9 Summary

Rother Valley Country Park provides a good example of a beneficial end-use that has developed strong commercial outcomes through tourism-based activities. The park is again not a typical mine void closure, and has more in common with the Penrith lakes development, with one notable departure, Rother Valley was a former coal mining site and hence experienced the environmental problems that are associated with s, such Acid Mine Drainage. Rother Valley provides a good case study analysis however, as it incorporates many of the features of world’s best practice rehabilitation such as early planning, community involvement, strong local council involvement, a long time frame for the development and commitment from all of the parties involved in the closure process.

The rehabilitation and closure of the former Meadowgate into the Rother Valley Country Park was a unique early example of a mine closure that was planned well before mining actually commenced at the site. It was the decision to mine the site that ironically allowed the Meadowgate mine site to be rehabilitated and turned into a country park as it provided the local councils involved in the planning of the park the financial and human resources (through the National Coal Board and the Countryside Commission) to complete the design and implementation of the park that had been planned since the 1960's. In addition to this, the rehabilitation of the mine greatly exceeded the legislative requirements for mine closure at the time (and indeed would still exceed such requirements)

The rehabilitation and closure of the Meadowgate mine site also involved a great degree of public involvement in the development of the Country Park. The development of the Country Park only proceeded once the public had been able to comment and suggest changes on the proposed park. This was a unique feature of the mine rehabilitation and closure process at the time, particularly given the long term nature of the proposed development and the decision to turn the former mine into a tourist attraction. Rother Valley Country Park was also unusual in mine rehabilitation and closure in that the local community through the local councils funded part of the rehabilitation program, essentially taking ownership of the closed mine and providing a long-term asset for the region.

Appendix 2: Australian best practice desktop case studies

A2.1 Introduction

The review of the literature surrounding mine decommissioning and closure found that there were both inferior and best practice mine closures, both of which were influenced by a number of common factors. As a result of these factors, the thesis will explore both inferior and best practice mine closure by examining a number of case studies at mine sites around the world where both poor and best practice mine decommissioning and closure practices were undertaken.

The case studies were categorised as either inferior or best practice closure based on their ability to meet the key mine closure criteria that this research is arguing should be regularly used during mine decommissioning and closure. In addition to this, in order to determine best practice closure practice, the desktop case studies include information and discussion on mine site closures from around the world, as this will assist in determining if there were issues surrounding mine closures that were common and or any unique features that could assist in shaping best practice closure.

The desktop studies examining poor closure practices included the following mines, with each being detailed in the following order in Appendix 1:

A2.1.1 Inferior Mine Closure:

- Run Jungle and South Alligator River mine in the Northern Territory
- Mount Todd mine in the Northern Territory
- Summitville mine in Colorado in the United States
- Mount Lyell mine in Queenstown, Tasmania
- Windimurra Mine at Mt Magnet, Western Australia

A2.1.2 Best Practice Mine Closure

- Flambeau mine in Wisconsin, United States
- Ridgeway Mine, South Carolina, United States
- Elliot Lake, Ontario, Canada
- Golden Cross, Waihi, New Zealand
- Rother Valley Country Park, Rotherham, United Kingdom

In addition to the desktop case studies, field visits were made to four mine sites in Australia that were determined to have undertaken best practice closure, in accordance with the mine closure criteria. These four sites have also been included as they were accessible due to their locations and their ability to fit within the scope of the resources (both financial and human) available to the researcher on this topic.

Interviews were conducted at the mine sites with personnel from the mining companies involved with the closure, Local Council personnel that were involved with the mine and community members that were involved with the mine closures. The interviews were conducted in order to verify the findings from the desktop analysis, and to provide further insight and information on the mine decommissioning and closure process. The interviews also provide further depth to the desktop research and primary data on the decommissioning and closure process, to either corroborate the research findings or impart new information on the closure process.

The case studies that were used for this section of the research were:

- Penrith Lakes, Penrith, New South Wales
- Candia Hill mine, Orange, New South Wales
- Jarrahdale mine, Jarrahdale, Western Australia
- Lake Kepwari, Collie, Western Australia

A2.2 Mine closure criteria

The closure of a mine will not have the same economic impact in every community that has met with this issue. Rather, there will be a range of factors that will influence the actual closure of the mine and the effect it has on each community. There are a number of drivers that influence the mine closure procedure and therefore the success or otherwise of the mine closure process. It is these factors that have been the main criteria in influencing selection of the case studies for review in this thesis and that will assist in the development of the framework for best closure practice.

The literature search and desktop case study analysis, highlight that there were a number of key factors that played a role in the success or otherwise of a mine closure. These include (Chapter 6, p3)

- The location of the mine
- The size and profitability of the mine
- The size of the community where the mine is situated
- The ownership of the mine
- When the mine closure was planned
- How the mine closure was planned and conducted

- Alternative closure options – Partly determined by above, but also by type of mine factors (for example water quality, public safety hazards and risks, community expectations
- The legislation under which the closure was conducted
- Engagement with stakeholders.

Each of these will be outlined in brief detail below.

A2.2.1 The location of the mine

The location of the mine was found to determine the successful closure, or otherwise of a mine. The location of the mine is a significant determinant in the extensiveness of the rehabilitation program. It suggests that a mining company is more likely to go above rehabilitation standards if a mine site is located in close proximity to an urban locality. Mine sites that are located in more remote communities will exhibit different characteristics and have different closure requirements to mines that are located near urban areas.

Mining companies that operate mines near urban areas will also come under closer scrutiny from regulators and the local communities, some of whom may well be opposed to mining from the outset. The desktop case studies has shown that even in the case of successful mine closures, those mines located near urban areas often came under intense opposition from local residents who were opposed to mining in their communities. This places more pressure on mining companies to get their mine closure right and is different to the scrutiny that companies will face in more remote locations. This does not mean that all mining companies that operate in remote locations will abrogate their closure responsibilities; however, poor mine closure practices tend to occur more often in remote locations where the level of scrutiny may be less noticeable.

A2.2.2 The size and profitability of the mine

These two factors are often linked, as generally a large mine is indicative of a rich ore body and suggests a mine that has been operational for a number of years and that has been able to grow accordingly. Mining companies attempt to extract the largest possible amount of high grade ore at the lowest possible cost, this is generally achieved via high capital and operating costs on areas such as high wages, which attract well qualified staff and the use of expensive capital equipment all aimed at boosting the productive capacity of a mine. Increased productive capacity generally results in improvements to the bottom line.

A profitable mine can provide a company with the resources to rehabilitate a mine and in all surveyed case studies of successful mine closure the mine was operating from a profitable basis. There may be many factors associated with this that cause a company to engage in successful rehabilitation, but the key factor appears to be the ability of the mining company to draw on its capital reserves and put this into a robust rehabilitation program. Mines that have not been successfully rehabilitated have not been profitable and hence the companies do not have the resources at their disposal to take on the often-expensive process of rehabilitation. It is then the government and the local community that are left to deal with problems associated with poor closure practices. Although mining legislation throughout Australia's States and Territories requires that company rehabilitate mines to a standard that existed prior to mining, the reality is that in the case of mines that are not profitable, or where the mining company is facing financial difficulties rehabilitation and closure may simply not be a viable option. Rehabilitation bonds are not always sufficient to cover the costs associated with rehabilitation and closure, often leaving governments and local communities with a burden that may take many years to rectify.

Profitability is also associated with the prices of commodities and the evidence from the case studies is that poor closure practices are often associated with low commodity prices, which directly affects the viability of a mine. A mine that is not financially feasible will struggle to develop sufficient capital reserves to implement a successful rehabilitation program. This is not to advocate that government regulation and the collection of rehabilitation bonds does not work (they are after all designed for this very means), however, it does raise questions about the size of rehabilitation bonds and the ramifications for the wider community when it has to pay (both directly and indirectly) for poor closure practices.

A2.2.3 The size of the community where the mine is situated

The size of the community where the mine is situated is closely related to the location of the mine, as the size of the community is generally dictated by its location. Communities with larger populations often have a more diversified industrial base, where the closure of a mine may not have the same economic and social impact as smaller communities that may be more mining dependent. This will affect the end-use of the mine site, as communities that are more reliant on mining may have requirements for the mining site that include an economic focus, for example the development of tourist facilities. For communities that are larger and more diversified, the end-use may need to be only aesthetic, for example rehabilitation of a mine site to its pre-mining status.

Whatever the size of the community, however, the research indicates that the mine closure and the end-use of the mine site need to be included in the strategic plans of the local council and that mine closure planning should commence with the initial planning phases of the mine. Further, communities of all sizes need to work with mining companies from the outset of mine planning, if the end-use is going to be beneficial to the community

A2.2.4 The ownership of the mine

Ownership of the mine will have a significant impact on the end-use and rehabilitation of a mine void. A larger organisation will have greater access to capital reserves that it can use to develop a strong rehabilitation program. Large organisations will also be able to employ more resources to work on rehabilitation programs and are more likely to be actively involved in research and development projects on end-uses for mining voids.

The research from the literature review, notably the Minerals Mining and Sustainable Development Report (2003) found that for mine closure to be sustainable it is necessary for sustainable development practices to be reflected throughout all levels of the organisation. The case study reviews have found that Alcoa is devoting a large amount of resources to mine closure through the development of a research and development team specialising in mine rehabilitation. The case study review on Alcoa's Jarrahdale mine site found that Alcoa senior management actively promote sustainable mining practices across the organisation, including a provision that rehabilitation practices need to be embedded in the company culture and practiced across all levels of the organisation as referred to in the Alcoa case study (Appendix 2)

Limited financial resources does not preclude small organisations from engaging in successful mine closure, however, the more resources an organisation has at its disposal, the more likely it will be that those resources will be used in the rehabilitation process. A large organisation is also more likely to be the subject of public scrutiny and particularly in the case of large multi-national companies who will be trying to publish their credentials as 'good corporate citizens'.

A2.2.5 When the mine closure was planned

The findings from the desktop case studies have invariably indicated that successful mine closure requires a strategic level of planning, normally carried out at the start of the mining process during the early planning phases. Even before they commence operations, mining companies should be planning for the closure of the mine, no matter how long it is estimated that the resource reserves will last. This is a difficult undertaking for both companies and regulators, as currently most mining leases require only a basic closure plan with the guarantee that a site will be returned to a pre-mining state. As the case studies have shown, however, this does not always occur even in today's more stringent regulatory environment, as governments are powerless to prevent companies from going bankrupt for example and not meeting their regulatory obligations in relation to mine closure. Rehabilitation bonds are designed to cover such events, but they are not always adequate enough to cover rehabilitation costs, particularly when there are negative externalities such as extreme pollution affecting a site.

Planning of a mine closure must also be evolutionary, as changes in technology may occur during the mining process that will affect the final design of a rehabilitated mine. This occurred during the rehabilitation process of Alcoa's Jarrahdale mine in Western Australia where changes were made to the actual rehabilitation process during the 30 plus year life of the mine as research found that initial rehabilitation techniques did not meet the company's own rehabilitation guidelines during the latter stages of the rehabilitation process. The company voluntarily rehabilitated older areas of the mine site in order to meet the newer standards of rehabilitation and bring consistency to the end-use design.

Much of the literature reviewed and the findings from the case studies indicate that most mine closure is commenced when a mine nears the end of its useful life and not at the outset of the initial planning phases. This has included mine closures that have been classified as being successful, the issue for the communities in which these mines operate however, is that this does not always allow them to plan properly for the closure of a mine and in most instances such a lack of forward planning brings with it the potential for disaster, an example of which occurred in the Northern Territory at Rum Jungle where the East Finnis River continues to be heavily polluted by acids and metals from a poorly planned and regulated mine closure upon the cessation of mining in 1971 (Appendix 1). Planning for early closure is still not accepted practice in the mining industry (with the exception of the large companies), despite evidence suggesting that early planning actually results in lower long-run average costs in rehabilitation and closure (Chapter 4).

A2.2.6 How the mine closure was planned and conducted

How the mine closure was planned and conducted in part relates to previous sections, as it is asking what strategy went into the closure process. Was the closure and rehabilitation of the mine considered during the mine planning process, or was it left until the last few years of the mine's operational phase? Was the rehabilitation of the mine carried out on a progressive basis during the operational life of the mine? In addition to this, what if any of the rehabilitation and closure process was funded through the operational budget of the mine.

Many of the major mining companies in Australia reviewed for this thesis (including Rio Tinto, BHP Billiton, Wesfarmers Coal Division, Alcoa) Australia plan for mine rehabilitation and closure during the initial planning phases of the mine (legislation in all Australian jurisdictions requires that a rehabilitation plan be submitted (Chapter 5: p28), however, closure of a mine involves more than just the rehabilitation of a mine. Despite evidence demonstrating that early closure planning results in better social and economic outcomes for mining dependent communities and their workers in particular, there are many mining companies that still only see mine closure as an afterthought, something that they only need to worry about once the productive resources of the mine have been exhausted.

Mine closure that is not conducted in a planned and effective manner can result in an area that becomes a danger and a source of pollution, often for many years after the last reserves of the ore body have been removed. Mining companies that adopt best practice mine closure will consider a number of factors before decommissioning and closing a site including the climate of the area, the hydrogeological features of the area, the landform associated with the mine, the flora and fauna associated with the mine site and the land uses associated with the mine site.

The Australian New Zealand Minerals Energy Council/ Minerals Council of Australia /MCA (2007) guidelines for planning and conducting mine decommissioning and closure are defined by the following:

Mine closure should be integral to the whole of life mine plan:

- A risk-based approach to planning should reduce both cost and uncertainty
- Closure planning is required to ensure that closure is technically, economically and socially feasible
- Closure plans should be developed to reflect the status of the project or operation
- The dynamic nature of closure planning requires regular and critical reviews to reflect changing circumstances.

Mine closure planning is a whole of life process and needs to be undertaken progressively during the life of a mine. Planning for closure is an integral part of the mining process and will assist not just mining companies, but also communities in the structural adjustment process that occurs after a mine is closed. Companies that have developed sound rehabilitation and closure plans for a mine site will generally be better placed to gain approval from local communities for mine site developments. This approach also enables communities to factor future mine closure plans into their broader economic development strategic plans.

A2.2.7 Alternative closure options

Alternative closure options are partly determined by the issues discussed but also by factors such as the type of mine and water quality. Mining companies can consider a number of alternatives when determining options for a mine site once mining is completed. There are a number of factors that are important in the closure of a mine (Environment Australia 2002, p. 2):

- Public safety hazards and risks
- Ecological compatibility
- Potential as an ongoing source of pollution
- Community expectations
- Future land use and resource development

It was established that there are three broad, but basic mine void closure strategies, or options that companies can undertake:

1. **Waste Storage** – where a former mine void is used for storing waste from the mining process through either the storing of waste rock, or tailings. This is only an option for companies when the volume of ore extracted is less than the volume of material extracted. It is generally not considered a best practice closure option, as there have been cases where local groundwater supplies have been contaminated through this practice (Johnson and Wright 2003).
2. **Water Storage** – this process involves allowing water surface runoff to fill a mine void. The process allows mining companies to reopen a mine at a later date, as they only need to dewater the mine. The void is also used, as an additional source of water for the mine site, which is the key reason mining companies, will consider this option. The research has found that issues associated with salinity (particularly an issue in areas that have high rates of evaporation), and acidity are the biggest factors that need to be overcome if companies use this as their preferred method of mine void closure. This option is more likely to be a cost effective use of former mine voids (for both companies and the broader community) and will allow for a more sustainable approach to mine closure.
3. **Open Void** – This option allows an open void to fill with water with the aim of using the void for a future recreational, or commercial use. This is similar to the second option of water storage; however, using a void for water storage is designed primarily to allow a mining company to use the water for the mine site. The option of an open void allows companies to consider a variety of uses for the voids, including recreational uses such as diving, sailing, swimming, fishing, and irrigation supply, the capture of floodwater in areas of high rainfall, use for industry or other mines in the region, or possibly use of the void as a reservoir for town water supplies (it should be noted that this option would probably face considerable community resistance and there is no record of former mine voids being used for this purpose anywhere in the world). This option is generally considered the best option for large mining voids, as it is less expensive than backfilling a mine void and may also provide a cost-effective beneficial end-use for the local community.

There are a number of other factors in addition to the above that need to be considered when determining mine closure and rehabilitation. These include:

- **Climate** – The climate of a region is an important determinant in mine closure decisions. Areas of low rainfall and high evaporation rates are likely to cause hypersaline conditions to develop in open voids, whereas in areas of high rainfall and low evaporation this is less likely to be an issue for open voids and may broaden the closure options for mining companies and communities. As many of Australia's major mines are located in either arid or semi-arid zones of the country the climate will play an important part in the options for mine closure and any ensuing legislation from government and policy development from the mining companies.
- **Site geology** – The geology of a site and the impact that mining will have on that site during the life of a mine impact on the type of closure options that are available. Mining companies need to consider what impact mining will have on native flora and fauna during the life of the mine, how any impacts on them can be addressed and what steps will need to be taken to restore native flora and fauna during the rehabilitation and closure process. If rehabilitation is undertaken in a progressive manner this process can be monitored and if necessary changes can be made to the rehabilitation method if it is found that rehabilitation has not been effective. This approach occurred at the Jarrahdale mine site in Western Australia, where the rehabilitation process was altered during the operational life of the mine, as the company discovered more effective rehabilitation techniques that enabled the establishment of native flora and fauna similar to that which existed prior to mining.
- **Economic Diversity** – the main issue that is considered here is whether or not the region is wholly dependent on mining. If this is not the case and the region has a more diverse industrial base then the impact of a mine closure may be less severe. The research has also found that the location of a mine site plays an important part in the closure process – the more remote the mine, the fewer the closure options available to the mining company and the local community. In addition to this, access to infrastructure also plays an important role in the closure process. Again, in more remote communities infrastructure may be limited and will preclude some closure options that will be available to larger communities that are located close to urban populations.

All of these factors need to be considered in the mine closure process and that no one method of closure is correct. Mine rehabilitation and closure needs to be adapted to suit the needs of each local community and the site-specific circumstances of each mine site. A holistic approach needs to be taken to mine closure with governments, mining companies and local communities working together in the mine closure process. The most successful mine closures have been ones that adopt a holistic approach and are inclusive, as local communities are better equipped to cope with mine closure if they are part of the closure process.

A2.2.8 The legislation under which the closure was conducted

Legislation relating to mine closure in Australia (and indeed across much of the developed world) is limited. All aspects of the legislative requirements in Australia are concerned with rehabilitation of a mine site and do not specifically address mine closure, other than through rehabilitation requirements Across all states and territories in Australia, the legislative requirements of rehabilitation are quite comprehensive, however, closure is about more than the rehabilitation of a mine site, as there are many other concerns that need to be addressed when a mine is closed and much of this is left to the discretion of mining companies which only works when mining companies, are proactive in their approach to closure.

There is no Commonwealth legislation for mine rehabilitation or closure in Australia, it is all state based, hence there is a lack of uniformity in rehabilitation and closure requirements across the country, with some state legislation more comprehensive than others. As an example the legislation in New South Wales (the Mining Act, 1992) places greater emphasis on community consultation in the rehabilitation process, using the rehabilitation and Community Consultation guidelines established in the Australian Minerals and Energy Environment Foundation Report (2003). The only time that federal legislation will be utilized during mine closure of rehabilitation is if there has been a severe impact on the environment, at which point the *Environmental Protection and Bio-Diversity Act 1999* is employed to pursue offenders.

The desktop case studies provide examples of cases where mine closure was successful and the mining companies went well beyond their legislative requirements for both the rehabilitation and closure and in all instances took into consideration the impact that closure would have on the local community. In addition to this, the mining companies also engaged with the local communities on mine closure ensuring that the community was behind them in their closure plans.

The issue with mine closure legislation (or a lack thereof), however, is not those companies that exceed their closure obligations; it is those companies that do not meet their duties, either ethical or legislated, with regards to closure. In the case study chapter discussing best practice closure the companies provided as examples are meeting and exceeding their legislative requirements for mine closure and in all instances have at the very least consulted their respective communities in the closure process from the outset and enabled these communities to have ownership of the mine closure. Successful mine closure as measured by whether or not a mining company meets its legislated rehabilitation requirements is not necessarily an accurate measure of the outcome of mine closure. Legislation across Australia at present does however the success or otherwise of mine site rehabilitation to be used as the measurement of successful mine closure; however, in terms of best practice mine closure, meeting legislative requirements is only one aspect. Legislation in Australia does not currently adequately address mine closure and is not sufficiently equipped to deal with those companies that ignore their social closure obligations to local communities.

A2.2.9 Engagement with stakeholders

Traditionally mining companies have tended to use the term ‘community consultation’ when discussing the idea of engagement with communities, indeed some companies still use this term to describe their involvement with local communities. The reality is however far more complex, as there are varying degrees to which local communities can become involved in the mine closure process. As an example in the case of Penrith Lakes mine closure the community was required through the New South Legislative process to be consulted in the rehabilitation and closure practice. To meet these requirements the Penrith Lakes Development Corporation established a Community Consultative Committee working alongside the CSIRO to determine optimum end uses for the rehabilitated site. One of the outcomes from this process was a strategy to use the former mine site as a mixed recreational and urban area once mining had ceased, the outcome of which has been realised with the final use of the site as both a recreational and urban development site (Appendix 2) .

At the other end of the spectrum, Alcoa’s Jarrahdale mine in Western Australia ceased production in 1998 after being progressively rehabilitated since 1963 to a standard that constituted best practice closure (Alcoa was recognised by the United Nations Global 500 Roll of Honour for its mine rehabilitation at the site) (Alcoa, 2009), however, the consultation process was all but non-existent as the rehabilitation commenced at a time when the idea of community consultation was not a requirement of either regulatory authorities or mining companies.

The examination of the Jarrahdale mine site closure process (Appendix 2) found that Alcoa used the rehabilitation and closure process at the site to undertake a review of its community consultation process, with the result being that the company now undertakes annual reviews of its community consultation processes at each of its mine sites (Appendix 2)

The literature review established that the terms consultation, participation, involvement and engagement tend to be used interchangeably by many companies (and indeed the same can be said of many government agencies), the reality, however, is that they are quite distinct terms. Mining companies may consult with local communities, they seek involvement and even participation from local communities, however, they may not actually engage (engagement means that post closure development plans are developed for local communities, with the input from local communities in order to mitigate the negative effects often associated with mine closure, such as a lack of alternative employment options once mining ceases) local communities in the mine closure process.

An example from the Case Studies can illustrate this point, notably the Cadia Hill Mine site in New South Wales which has been included as a best practice closure example and where the community has certainly been consulted on a regular basis on the rehabilitation and closure options for the site, however that consultation has been with local government authorities who by proxy speak for the community interests, but who are not necessarily representative of the wider community.

It is important to define the difference between participation and consultation, as one implies actual involvement by stakeholders, whilst the other may only imply involvement on a superficial level, with decisions being made by those outside the process. The distinction becomes important in the mine closure process, as one method provides communities with empowerment, whilst the other could leave the community feeling powerless. In the literature review, research conducted by the CSIRO (Chapter 4) on engagement demonstrated that communities that are engaged will feel more empowered, these communities are then more likely to find a positive outcome from the closure process, this is particularly so if communities are engaged from the outset of the mining process during the initial mine planning phase.

Actual engagement in the mine closure process is not something that even the most committed of mining companies have done well, particularly in the past. Even in the best practice examples outlined below, much of the process of dealing with local communities was likely to be of a consultative nature rather than actually engaging with local communities. In the case studies that are reviewed for this section of the research all of the mining companies engaged to a degree with their local communities (hence the reason they were chosen for this section of the research), however, it was not necessarily the degree of engagement that the literature would recommend as 'world's best practice. This is not solely the fault of the mining companies and is to a degree an issue that governments, particularly at a local level need to address as more often than not in the past they have been happy just to have any form of dialogue with mining companies and have not necessarily been concerned as to whether or not this dialogue has been engaging. It is also true that in years gone by, mining companies have not necessarily seen a need to involve local communities in the closure process, as rehabilitation and closure have been an afterthought rather than an important feature of the mining process.

In order to become more engaged in the closure process, it is important that local government areas ensure that part of their economic development strategic plan includes the development of alternative industries before mine closure is to be undertaken or indeed that such plans start to take place during the mines planning stages, thus remaining proactive.. It is in this area that local governments can work with their state and federal counterparts and the mining companies in diversifying their economic base and mitigating some of the negative effects that are often associated with mine closure.

A2.3 Summary

The above issues are key factors that determine the success, or otherwise of a mine closure and it will be argued are critical issues that need to be addressed in order for mines to close with no cost to the community. These aspects will be addressed in a series of Australian best practice closure case studies that will examine where successful mine closure has occurred, or in the case of two studies will demonstrate how progressive rehabilitation by mining companies and early planning for closure is leading to a more positive outlook for mine closure and importantly has the support of the wider community.

A2.4 Australian best practice case studies

A2.5 Jarrahdale Mine Closure – Jarrahdale Western Australia

Jarrahdale bauxite mine was a mine located in the Peel region of Western Australia, one hour south of the state capital, Perth. Mining at the site commenced in the 1960’s at a time when planning for mine closure was not undertaken until just before the closure of a site (and in some cases not undertaken at all). Alcoa began the mining process at Jarrahdale with the aim of returning the post-mining landscape to its pre-mining state. When Alcoa commenced rehabilitation at its Jarrahdale site, the area around the site was sparsely populated and heavily vegetated, with little previous human interference. The mining was undertaken in what is now classified as one of the world’s bio-diversity hot-spots, however, the company’s initial rehabilitation practices reflected little consideration of this unique attribute.

The company admits that its early rehabilitation practices were below what is considered best practice rehabilitation and closure by today’s standards, however, the company was unique in the industry at the time, in that it undertook rehabilitation progressively and conducted research into the company’s rehabilitation practices. Part of the rehabilitation at the mine created Langford Park, a recreational park that is now a popular destination for families in the Southern suburbs of Perth and came about as part of the long-term planning that was commissioned for the closure of the Jarrahdale site.

A2.5.1 Location of the mine

The Jarrahdale mine was Western Australia's first bauxite mine with mining commencing in 1963 and production ending in 1998 (Paczkuta and Chapman, 2000). The Jarrahdale mine is located in the shire of Serpentine-Jarrahdale, Western Australia approximately 45 kilometres, or one hour south of Perth (Serpentine-Jarrahdale Shire, 2009). The region has a Mediterranean climate characterised by hot, dry summers and cool, wet winters with an annual rainfall average of 1236 mm (BOM, 2012). In this jarrah forest it is estimated that 79% of species are endemic to the South West region and there are estimated to be >780 species of flora in the area (Paczkowska and Chapman, 2000).

Alcoa still has two other operating mines in the area, Huntly and Willowdale mines, both of which are undergoing progressive rehabilitation, much of which is based on techniques learned from the rehabilitation work undertaken at Jarrahdale. These mines, along with Jarrahdale are located in the South Western botanical district, which is one of the world's bio-diversity hotspots (Grant and Koch, 2007). This placed further pressure on Alcoa in terms of the standards that were expected of the rehabilitation at Jarrahdale.

A2.5.2 The size of the community where the mine is situated

The mine is located in the Shire of Serpentine-Jarrahdale, located to the south of Perth, Western Australia. The shire itself has a population of 12,900, spread over an area of 921km^2; however, the wider area known as the Peel Region has a population of over 100,000 with a five-year annual population growth rate of 3.7% (Peel Development Commission, 2009:2). The population of the area at them time of mining, however, was substantially less than it is now and the area was largely a rural area characterised by vast tracts of jarrah forest.

A2.5.3 Size and profitability of the mine

The Jarrahdale mine occupied an area of 4090 ha, mining 168 million tonnes of bauxite during the 35-year life of the mine (Alcoa, 2009: 5). The mine produced 44.6 million tonnes of alumina for the Alcoa refinery in Kwinana (Alcoa, 2009: 5). The mine was a very profitable one for Alcoa, due to a number of factors, including the ability to control both the supply of bauxite and the refining of alumina, the prices for bauxite and improvements over time in the mining extraction process as it became more capital and less labour intensive and hence the company was able to boost productivity levels and decrease production costs (Grant and Koch, 2007).

Figure A 2.1: Jarrahdale mine site upon early 1960's

Alcoa, 2009

Figure A 2.2: Jarrahdale after rehabilitation program

Alcoa, 2009

A2.5.4 The ownership of the mine

Alcoa Australia is part of the larger conglomerate known as Alcoa Inc, which is headquartered in Pittsburgh in the United States. The company is the largest in the world in the production and management of primary aluminium, fabricated aluminium, and aluminium combined and is involved in all stages of the production of aluminium from mining to refinery. The company had a revenue turnover in the 2011 financial year of US$26.9 billion dollars, with assets of $40 billion, realising a profit of $611 million and employed 67,000 people in its worldwide operations (Alcoa, 2011).

Alcoa Australia is part of the worldwide conglomerate of Alcoa Inc. a business with a large revenue base and strong profit margins. The company has a proven track record in good rehabilitation practices and is committed to the triple bottom line across all of its business operations (Grant and Gardner, 2005). The culture of the company is such that sustainability is embedded across all departments in the organisation and is part of the company's annual reporting system. This culture enables the company to develop mine rehabilitation and closure practices that are best practice and that take into account the long-term future of the communities in which a mine operates (Grant and Koch, 2005).

In addition to this, Alcoa is a large, highly profitable organisation that has the resources (both physical and financial) to be able to commit to the process of mine rehabilitation and closure. These resources provide the company with options for dealing with mine rehabilitation and closure that may not be as readily available to smaller organisations and may prevent these organisations from undertaking the extensive mine rehabilitation research that was carried out at Jarrahdale by Alcoa.

A2.5.5 When the mine closure was planned

Alcoa's Jarrahdale provides an interesting study in the evolving techniques of rehabilitation over time. Alcoa was fairly unique in the mining industry during the 1960's as rehabilitation was undertaken progressively and was something that was considered during the planning and operational phases rather than as an afterthought as occurred in many other mine closures at the time (and still continues in varying degrees today). During the 1960's rehabilitation at the Jarrahdale mine consisted of using exotic pine species and non-native eucalypts as there was concern that the native Jarrah would be susceptible to the dieback disease caused by phytophthora cinnamomi (Grant and Koch, 2007: 96) which would impact on the success of the rehabilitation.

Research and evolving rehabilitation techniques caused major changes to Alcoa's rehabilitation practices at Jarrahdale over time demonstrated that Jarrah would survive in rehabilitated mine areas even if dieback disease was prevalent. The findings of this research enabled Alcoa after 1988 to use only native over storey species including Jarrah in its rehabilitation of the Jarrahdale mine. After this Alcoa split its rehabilitation of the mine into pre and post 1988 rehabilitation eras with different completion criteria established for each era.

According to Grant and Koch (2007) it was the ability of the organisation to instigate adaptive management techniques to its rehabilitation practices that led to improvements at the mine site over time. The areas of the mine that were rehabilitated prior to 1988 were reviewed by Alcoa and officials from state government regulatory agencies to determine whether they met the post 1988 completion criteria guidelines. Those areas deemed not to have met these criteria were repaired to post 1988 completion criteria standards; this included some pit faces that required further rehabilitation work. Alcoa have admitted that even in these reworked areas the standard of the rehabilitation was sometimes lower than in those areas that used the post 1988 completion criteria prescriptions (Grant and Koch 2007). How the mine closure was planned and conducted

The Jarrahdale mine site was heavily forested before mining commenced and hence a large amount of the site was cleared before the commencement of mining at the site. This meant that rehabilitation of the site would require extensive planting if the site were to be returned to a pre-mining state. Alcoa worked with various state government agencies in determining the completion criteria for the site.

The company commenced mining at the site in 1963 (Grant and Koch, 2007) and began progressively rehabilitating the site soon after mining commenced. This was unusual at the time in the mining industry and in many respects Alcoa led the way in mining rehabilitation practices in Australia. The initial rehabilitation at the site focussed on the introduction of exotic tree and plant species, including non-native eucalyptus species, rather than the native jarrah trees. This was standard practice in the industry at the time (and to a certain extent continues today in some sections of the industry), however, due to the company’s progressive rehabilitation practices these exotic and non-native species were eventually replaced and in their place native vegetation and jarrah were planted in these rehabilitated areas.

Alcoa admits that the initial rehabilitation practices at the Jarrahdale site were not as comprehensive as later rehabilitation standards and the company acknowledges that it could have done better (Alcoa, 2009). The area of the mine in particular that the company is referring to is what is now known as Langford Park, a popular recreational park in Jarrahdale, near Perth, Western Australia.

The rehabilitation that was conducted at Langford Park is an interesting study in the evolution of rehabilitation and closure practices. Alcoa accepts that the rehabilitation at Langford Park, although considered best practice at the time, was not repeated in later phases of the rehabilitation. The organisation used practices that at the time were considered best practice, however the rehabilitation did not involve the use of species that were native to the area, instead relying on the use of non-native pine trees and blue gums that were resistant to dieback (Alcoa, 2009).

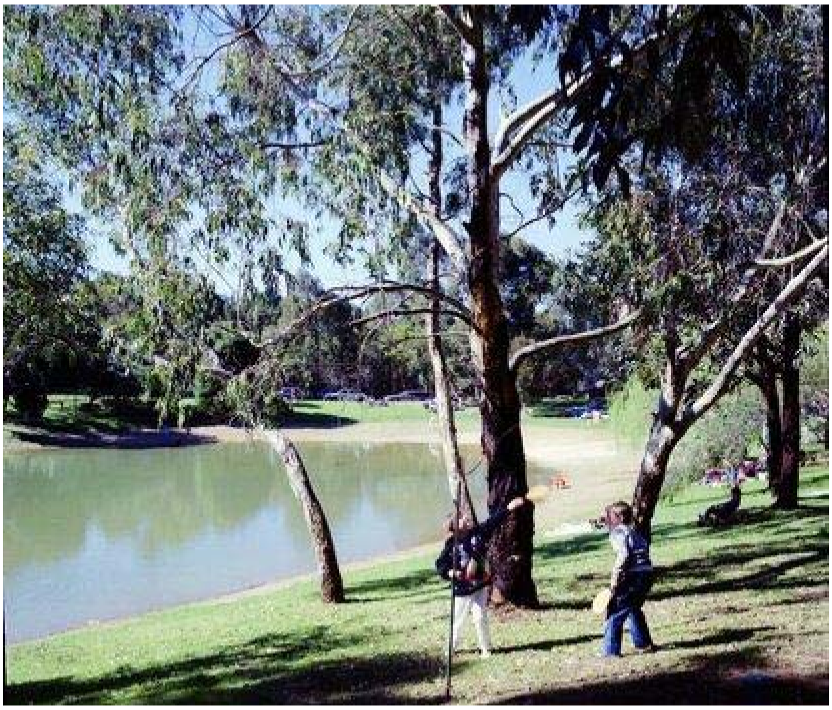
Further to this, the company did not use topsoil in the rehabilitation practices, it did not alter mine pit faces, or use understory natives as part of the rehabilitation program at the site, altering the landscape of the site from its original state. The company admitted that the site was an important learning exercise in later rehabilitation and closure techniques at its other mine sites and that the site was allowed the company to develop a greater understanding of the development of environmental techniques in relation to mine rehabilitation and closure (Alcoa, 2009; Grant and Koch, 2007)

Alcoa saw the rehabilitation of what is now the Langford park site as an important step in moving towards an understanding of the process of rehabilitation and closure. The company used mistakes it made in their initial rehabilitation at Jarrahdale to implement changes to their rehabilitation practices and closure plans for the site. As Alcoa noted in relation to the site, the rehabilitation practices of the company have come a long way since the rehabilitation and closure of the Jarrahdale site and the company since 1988 is now committed to developing a self-sustaining jarrah forest ecosystem at the site (Garner and Stoneman, 2006).

Figure A 2.3: Jarrahdale mine site pit 1965

Alcoa, 2009

Figure A 2.4: The same site post rehabilitation



Alcoa, 2009

The experience at Alcoa is important as it highlighted an important aspect of world's best practice mine closure, namely that companies need to be continually adapting their rehabilitation practices as new strategies are identified. In the mining industry Alcoa is recognised as a world leader in rehabilitation and closure and has been the recipient of a variety of awards for its rehabilitation practices, including a 'Golden Gecko' award in 2002 for the Jarrahdale mine site (Alcoa, 2008). In addition to this, Alcoa has been the recipient of a United Nations Environmental Program Global 500 Roll of Honour for their mine rehabilitation, the first mining company in the world to be recognised for such an award (Alcoa, 2008).

The Alcoa Jarrahdale site was a well planned closure in that planning for closure commenced early in the mining process which was not usual practice when mining commenced at the site in the 1960's. However, the site suffered from the use of rehabilitation planning techniques that did not recognise the value of using native plant species at the site, instead adopting non-native species that did not necessarily take to the native ecosystem of the region. The site was rehabilitated extensively again after 1988, using native species with the company applying the rehabilitation techniques at the site as learning tools for its other mine sites.

A2.5.6 Alternative closure options

Alcoa did not consider alternative options for the closure of the Jarrahdale site; perhaps due to the period of time when the rehabilitation process was undertaken (the first stage of rehabilitation at Jarrahdale began in the 1960's). Alcoa followed the legislative requirements for closure during this period, which were limited to ensuring that the area was rehabilitated with little or no concern as to what species of flora the area was rehabilitated with, early rehabilitation at the mine site used non-native eucalypts and exotic pine trees.

Alcoa admitted that their initial rehabilitation practices were not replicated during later phases, as the company was able to learn from past errors. The company also acknowledged that that they did not use the native jarrah trees in their early rehabilitation practices as they were concerned that it would be susceptible to phytophthora dieback disease (Grant and Koch 2007). The use of exotic plant species in the rehabilitation of mine sites was standard practice during the middle part of last century, mostly due to a lack of research on mine site rehabilitation at the time and little concern from both mining companies, regulatory authorities and the wider community about the impact that mining can have on a region.

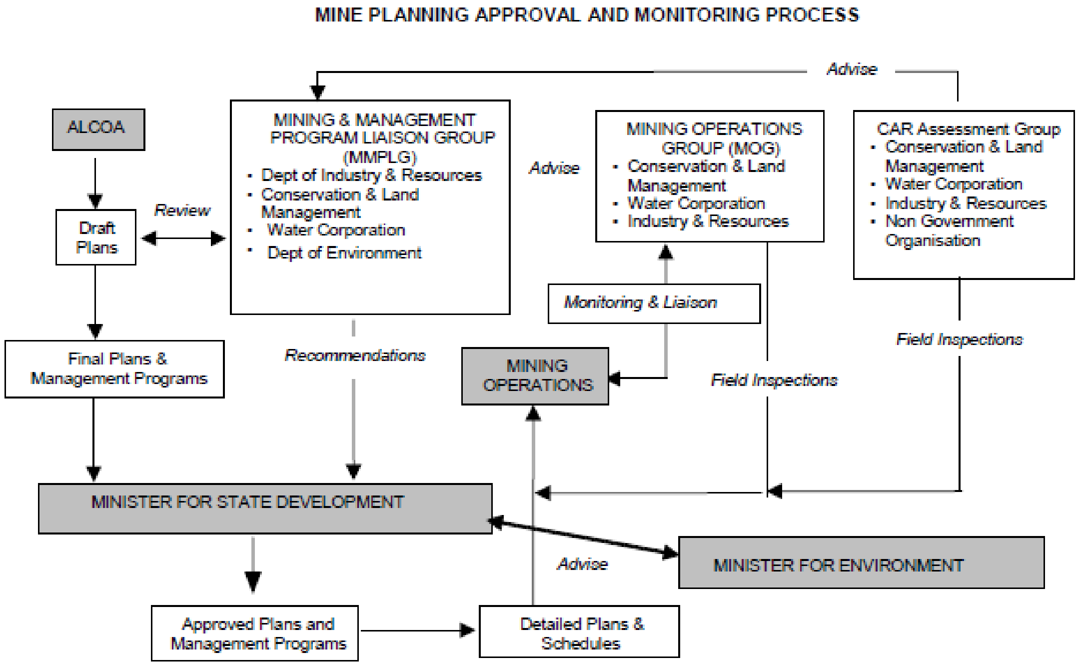
Alcoa simply did not consider alternative closure options at its Jarrahdale site, as it did not have to consider them. Rehabilitation was only conducted with the aim of replanting a mined area; there was little concern (or understanding) about what was planted and little concern about the long-term future of a site (Gardner and Stoneman, 2006). There was little research at the time surrounding mine site rehabilitation and most mining companies were happy to leave behind a landscape that was not scarred (and meet their regulatory requirements), regardless of the long-term consequences of the rehabilitation (Mallet and Mark, 1995).

A2.5.7 The legislation under which the closure was conducted

The Jarrahdale mine (and the Kwinana alumina refinery) was commissioned under an Agreement between Alcoa and the State Government of Western Australia in 1961 (Grant and Gardner, 2005). This Agreement was given statutory effect with the introduction of the Alumina Refinery Agreement Act in 1961. This agreement was amended in 1969 and again in 1978 to allow for the Pinjarra and Wagerup refineries and their bauxite mines at Del Park, Huntly and Willowdale. The 1978 Wagerup agreement required Alcoa to undertake an environmental review and management program that required approval by the State before construction could commence and then implement an approved environmental management program. The Environmental Review and Management Program undertaken by Alcoa gave specific commitments in relation to the submission of mine plans for agreement with the State. The agreement decided on how mined areas would meet designated land use priorities, safeguarding of water catchments, ensuring the control of dieback disease, ensuring that land adjacent to a mined area was rehabilitated and a formal research reporting and monitoring program. From a legal standpoint, Wagerup agreement applied only to the Wagerup site, however, the company used the environmental and planning guidelines of the agreement and applied them at all of their Western Australian operations (Alcoa, 2009, Grant and Gardner, 2005).

Alcoa submits on an annual basis, a five-year rolling mine plan to a committee known as the Mining and Management Program Liaison Group. This committee consists of a number of representatives from across a range of government agencies that have responsibility for mining (namely the Department of Industry and Resources, CALM Water Corporation and the Department of the Environment) as part of the rehabilitation and closure process at all of their sites, including the Jarrahdale site (Alcoa, 2009). These advanced plans allow for the integration of Alcoa's activities with those of other forest uses such as forest silviculture, logging and prescribed fuel reduction burning (Grant and Gardner, 2005). This process is outlined diagrammatically below:

Figure A 2.5: Alcoa mine rehabilitation planning process



Grant and Gardner, 2005

According to Grant and Gardner (2005), this process of annual evaluation of Alcoa's mine plan allows the company to alter their mine plans on an annual basis if required, enabling more flexibility in the mining plans, particularly in regards to rehabilitation.

The legislative requirements under which the Jarrahdale site was rehabilitated and closed were part of an Agreement between the State Government and Alcoa that was given statutory effect. This Agreement required that only basic rehabilitation be undertaken by the company, namely to return the site to an acceptable state, as determined by the regulators and Alcoa. Alcoa, however, went beyond these obligations and progressively rehabilitated the site to its pre-mining state and conducted research programs that examined the company's rehabilitation and closure methods that over time have enabled the company to develop best practice closure outcomes for its mine sites. Later amendments to this Agreement required more stringent outcomes for the company's mine sites and encouraged more involvement from local communities in the mining process.

A2.5.8 Engagement with stakeholders

Initial community consultation and engagement at the Jarrahdale site by Alcoa was limited, however, this was standard practice at the time, with regulators also responsible for a lack of direction in this area. The company was meeting its regulatory requirements as outlined under the Agreement and this combined with the fact that the mine site operated in a largely uninhabited environment, meant that there was little pressure (and probably need) for community engagement in the initial phases of the rehabilitation and closure phases. The company, however, did learn from the mistakes it made in relation to this initial lack of consultation and engagement in the mine closure process at Jarrahdale.

Alcoa has established an annual review of its mining operations that incorporates input from the local community and engages them in the closure process, by encouraging their contribution to the rehabilitation and closure process. The company recognises that engaged communities are empowered communities and that they are more likely to be accepting of the mining process (Grant and Koch, 2009). The company also acknowledged that even the best practice rehabilitation and closure of a mine site is seen to be of little benefit to communities if they have not been engaged in the process. Public perception is the key to best practice closure and communities will judge companies based on this perception, regardless of whether or not the physical outcome is measured as a success (Vines, 2005).

The closure of the Jarrahdale mine was notable for a number of reasons; firstly the rehabilitation was staged progressively (an unusual occurrence at the time in the mining industry); secondly the rehabilitation process began whilst the mine was still operational (again unusual at the time); third the company went beyond its regulatory requirements for rehabilitation (this is still not standard practice by many in the industry); fourth despite little engagement with community stakeholders at the time, Alcoa managed to gain community acceptance of its rehabilitation at the Jarrahdale site (Grant and Koch, 2007).

This may have in part been due to community expectations at the time (mine site rehabilitation standards did not generate a lot of mainstream publicity until the late 1970's) (NSW Minerals Council, 2011). Rehabilitation was also not a top priority for mining companies, particularly during the 1960's and any rehabilitation that was undertaken tended to be prescriptive normally using non-native and exotic plant species. Alcoa was unusual in the industry at the time by undertaking progressive rehabilitation at its Jarrahdale site and in its desire to study the effect of its rehabilitation practices on its mine site (Gardner and Stoneman, 2006).

Although Alcoa did not engage directly with the local community, it did engage with the regulatory authorities on a regular basis. The company was also notable for its research into rehabilitation standards at its site and also the stance the company took on altering earlier rehabilitation at its Jarrahdale site during the 1980's, when the company realised that the rehabilitation did not meet its revised rehabilitation standards (Alcoa 2009). Despite the company's lack of initial community engagement, Alcoa was mindful that community expectations would eventually force the company to exceed its regulatory requirements if it was to gain community acceptance of its mining practices.

The former Executive Director of Alcoa's Western Australian operations Roger Vines said in relations to community expectations on mine site rehabilitation, that it is ultimately public perception that defines the success of a rehabilitation and closure program regardless of the actual effort that a company puts into the rehabilitation program. In addition to this it does not matter what the actual data demonstrates in relation to a rehabilitation program i.e. through flora and fauna species adaptation to a rehabilitated site, it is humans that measure the success of rehabilitation outcomes not just at a regulatory level, but at the local community level (Vines, 2005).

The decommissioning and closure of the Jarrahdale enabled Alcoa to examine its community engagement practices bringing about a cultural change in the organization. The company now places community engagement at the forefront of its mining operations, particularly in Western Australia where the company actively involves local communities throughout the whole of life of its mining operations. The company has established a community consultation program that covers a five-year time frame overseeing all aspects of the mining operation and is reviewed on an annual basis. Alcoa invites all key stakeholders to participate in this review, including current and future neighbours and local government (Alcoa, 2009).

Alcoa states that local government engagement is important in gaining support for Alcoa's operations and also assists the company in understanding community concerns about their operations. According to the Alcoa community consultation website, the purpose of the consultations is to (Alcoa, 2009):

- Assist the Councillors and Shire staff to understand Alcoa's mining operations and future mining plans, and any impacts that these mining plans may have on local communities and residents within the Shire;
- Provide the Councillors and Shire staff with a contact at Alcoa to discuss any questions or concerns they have about Alcoa's operations; and
- Enable Alcoa to gain an understanding of any concerns that the Councillors or Shire staff may have about Alcoa's operations.

Stakeholders can take many forms, for Alcoa in their initial mining operations at Jarrahdale, the stakeholders were the regulatory authorities and in effect the local communities that the regulatory authorities represented on their behalf (Vines, 2005). When Alcoa began their rehabilitation at the Jarrahdale site local communities did not necessarily have a voice on what form the rehabilitation took and in some instances may not have been aware of what was occurring at the site. This lack of interest and cohesion changed from the late 1970's as communities became more active and coordinated in their approach to environmental issues and were able to exert an influence over mine development (Vines, 2005). Alcoa recognised that this community pressure would have an impact on their operations and decided that the best way forward was for the company to engage local communities directly in order to obtain continued support for mining operations.

A2.5.9 Summary

Alcoa's Jarrahdale mine is considered best practice due to the rehabilitation and closure outcomes at the site as measured by the company meeting regulatory outcomes. However, its consideration of best practice closure can also be measured through the company's commitment to ongoing research at the site and the continuous improvement processes it established at the Jarrahdale site as part of this research. Forty years after mining commenced at the site, the former open cut mine is now fully rehabilitated to a state that as much as possible is reflective of its pre-mining state. The site is also home to a popular recreational park that includes a lake that was once part of the open-cut pit at the site. The community of the Jarrahdale-Serpentine shire have been left with an asset, rather than a liability and an asset that Alcoa can now use as an example of their commitment to sustainable mining practices. The site is unique in both the scope of the rehabilitation work and the research that was undertaken into this rehabilitation and in the fact that at the time that rehabilitation commenced, few mining companies were considering closure at the start of the mining process, it was normally left to the end of the mine's useful life (or in some instances never undertaken).

The Jarrahdale mine site rehabilitation met the requirements for world's best practice mine closure as outlined by this thesis. The rehabilitation was undertaken progressively, with the company exceeding its regulatory requirements for the decommissioning of the site. Alcoa engaged the community in the closure process (although initially this was done through the regulatory agencies) and due to lessons learned from Jarrahdale have now made this part of the company's closure process. Most importantly, Alcoa was able to provide the community with a positive feature that has proved to be of long-term benefit to the community and has provided the company with a positive image in the community and with the regulators who the company kept regularly informed throughout the rehabilitation and closure process.

A2.6 Cadia Hill Progressive Rehabilitation – Orange, New South Wales

Cadia Hill's location just outside of Orange, a major service and tourist centre in the Central Tablelands of New South Wales placed some pressure on the mining company Newcrest Mining to deliver a mining operation that did leave an adverse impact on the surrounding environment. The area surrounding the mine is largely rural, surrounded by farmland and grassland, with little in the way of urban development. Newcrest did purchase some surrounding properties during the mine planning phase, in order to mitigate issues with noise and dust from the site. Orange is an area that promotes itself as a food and lifestyle destination, so the mine owners were required to ensure that the mine did not leave permanent physical scar on the landscape that could have potentially negative ramifications on the region's green image.

The Cadia Hill mine site was granted a lease extension in 2011 by the NSW State government that has extended the life of the mine for another 20 years. The mine extension involves the development of an underground mine that will replace the existing open cut operations, which is still slated for rehabilitation and closure (Blayney Council, 2011).

A2.6.1 Location of the mine

The Cadia Hill mine operates in the central west of New South Wales and is located approximately 25 kilometres from the town of Orange. Orange is located around 250 kilometres, three and a half hours from the state capital, Sydney (Orange City Council, 2009). Newcrest Mining Ltd wholly owns the mine, with operations commencing in 1998 and a projected mine operating life of 12 years (Orange City Council, 2009). The area around the mine site is predominantly rural and consisted of rural properties, prior to mining, which Newcrest was required to purchased prior to opening the mine to limit issues associated with noise from the mine and to allow it to operate on a round-the-clock basis (Orange City Council, 2009).

The area is characterised by cool to cold winters and warm summers with a year round mean temperature of 17.9° Celsius, with median rainfall of 935mm of rain per annum (BOM, 2011). The town sits at an elevation of 922 metres above sea level and is located in a part of

New South Wales known as a gourmet food and wine region (Orange City Council, 2011). The importance of agriculture to the region was an important factor in determining the rehabilitation outcomes at the Cadia Hill site.

A2.6.2 The size of the community where the mine is situated

The Cadia Hill mine is located approximately 25 km's from the city of Orange in the Central Slopes region of New South Wales. Orange has a population of 37,991 (Orange City Community Profile, 2009). The city is located 260 km's from Sydney and 270 km's from Canberra and is a popular weekend getaway for tourists from the two cities, particularly as the area is increasingly becoming noted for its cool climate wines and has developed a reputation as a gourmet food producer and dining destination.

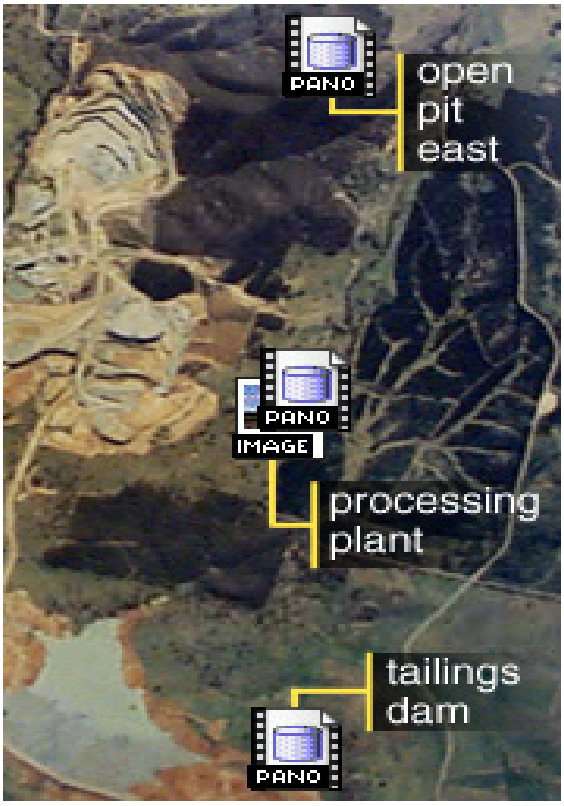
The city is predominantly rural, however, recent population growth (an annual average of 1.24%) (Orange City Council, 2009) has seen an expansion of residential areas. The city also has some industrial and commercial land development, however much of the industrial development in the region is based around the rural sector, particularly forestry, crops, orchards, viticulture, sheep and cattle grazing, and in the last few years the mining industry has again become a major employer in the region.

A2.6.3 Size and profitability of the mine

The mine operates 24 hours a day, 7 days a week on a year round basis and has an expected life of 14 years. The open cut operations consists of a pit which is 132 ha in size and runs to a depth of 460m, the waste dump will cover an area if 360ha, whilst the tailings area will be over 100ha (UNSW, 2006). The mine is a very profitable one for Newcrest, being the second largest Australian gold producing mine, with 645 kilo ounces per year. In addition to this, the mine produced 40 kilo tonnes of Copper (UNSW, 2006). The Cadia Hill mine is an open pit gold mine that upon completion is projected to be 510 metres deep with a surface area of 86 ha (Department of Minerals New South Wales, 2004).

The capital investment in the mine totalled over $900 m and provided 756 direct jobs at the site. The mine is estimated to generate $47 million pa to the local economy and the company donates over $300,000pa in sponsorships and donations (UNSW, 2006).

Figure A 2.6: An overview of the Cadia Hill site



University of New South Wales, 2006

A2.6.4 The ownership of the mine

Newcrest Mining as part of the larger BHP Gold Ltd is the largest gold producer in the country and is a highly profitable company with access to substantial capital reserves. This access to capital and being a producer of the highly profitable commodity that is gold provide the company with substantial cash flow and also enable the company to invest in its rehabilitation program at Cadia Hill (ASX, 2009). The company's links with BHP-Billiton to some degree plays an important role in the rehabilitation and closure program for Cadia Hill. Newcrest's parent company can ill afford the negative publicity associated with poor mining practice, as it has the potential to affect share prices and future mining operations that the company may wish to undertake (Newcrest Mining Ltd, 2009).

The Cadia Hill open cut mine is owned by Newcrest Ltd, which is the largest gold producer in Australia and one of the top ten gold producers in the world. The company has a market capitalisation of $13.3 billion, and in the last financial year had a turnover of $1,801 million and a profit in the 2008 financial year of $493.9 million. The company employs approximately 4700 employees across the world (Newcrest Mining Ltd, 2009, retrieved from The company is an Australian based firm and is one of the top 20 listed companies by market capitalisation on the ASX (ASX, 2009). The company began operations in 1966 as a subsidiary of the US based Newmont Mining Limited, known as Newmont Australia Limited until 1990 when it bought out Australmin Holdings Ltd. The company then merged with

BHP Gold Ltd in the late 1990's and became known as Newcrest Mining Limited (Newcrest Mining Limited Profile, 2009).

A2.6.5 When the mine closure was planned

As part of its progressive closure plan, Newcrest has developed a closure plan in conjunction with the local community. The company has also established a Community Consultative Committee to deal with any issues surrounding the rehabilitation and closure of the site. The rehabilitation and closure plans of the site aim to return the site to its pre-mining state, which consisted mostly of native forest and grassland. The local community indicated that their preference for the site was to return it its natural state, rather than the development of the site for commercial purposes.

Closure of the mine was planned at the outset of the mine planning process, with a plan for progressive rehabilitation of the site. Newcrest submitted a conceptual closure plan of the mine and engaged with local stakeholders on the closure process. Newcrest has committed itself to regular engagement with the local community (not just on closure, but any issues surrounding the mine site), by establishing a Community Consultative Committee and hosting regular residents meetings and instigated the development of a 24hr community complaints hotline (UNSW, 2006).

The Environmental department also works with the New South Wales Department of Minerals on revegetation issues such as topsoil replacement, stockpiling and stripping of topsoil. The company along with the department and Newcrest is responsible for planting between 10 and 20000 trees per annum as part of the progressive rehabilitation of the site (Newcrest, 2004).

Also monitored by the department are the water quality in the creeks and stream flows (19 stream gauging stations, 26 water sampling points and 10 pluviometers); the ground water quality and levels (24 groundwater quality bores, 91 groundwater level bores, 2 weather stations and 10 pluviometers); the soil, vegetation and aquatic biology; the blast, vibration and dust (22 dust deposition gauges and 3 permanent blast monitoring stations (Department of Minerals New South Wales, 2004)

Rehabilitation at the site is progressive and is carried out as mining in a particular area is completed. The revegetation is undertaken firstly with native grasses. This is then followed up by tree planting, creating a mixture of tree and grassland areas similar to that, which existed prior to mining (Newcrest Mining Limited, 2004).

Figure A 2.7: Cadia Hill mine with rehabilitated land in the foreground

Blayney Council, 2011

The tailings dam will be left to dry out, once the mine is decommissioned and a cover of topsoil will be placed on the dam, with the site being revegetated into a woodland and grassland area, similar to that which existed prior to mining (Department of Minerals New South Wales, 2004). This was the plan for the rehabilitated site from the commencement of mining, with the community desiring a site that was not used for commercial purposes after mining ceased (NSW Minerals Council, 2008).

A2.6.6 How the mine closure was planned and conducted

The Cadia Hill site is undergoing progressive rehabilitation and has been chosen for the company's commitment to open dialogue with the local community and for the company's rehabilitation efforts. The Cadia Hill mine is an open pit mine site, however, the mining lease also covers an underground operation, and the Ridgeway underground mine. The total area of the mining lease is 9000 ha, with only a portion of the land used for mining, the remainder being used for grazing and as a conservation area. (Newcrest Mining, 2009).

The company planned the closure of the site from the commencement of its mining operations, as per New South Wales State Government requirements with the sole aim of returning the land to its natural state. The company submits annual plans for review of its operations and to detail any changes to its rehabilitation practices (these are known as the Annual Environmental Management Plans). Newcrest has established a range of objectives that it uses as part of its Land Management Program when submitting its rehabilitation plan. The objectives for Cadia Hill are (Newcrest Mining Limited, 2009):

- Meet all related conditions of consent and to implement sustainable land management practices across all Newcrest owned land at Cadia.

- Meet the Cadia Hill and Ridgeway Consent (and other) requirements for the development and implementation of a
    - Rehabilitation plan
    - Landscape plan
    - Weed Management plan
    - Vegetation Management plan
    - Soil Management plan
    - Biosolids Management plan
- Minimise the removal of existing vegetation to those areas required for construction, operations or fire control
- Prevent land degradation and to rehabilitate disturbed land as soon as practicable to a level equal to or better than the original landscape.
- Manage existing pastures to and remnant vegetation to ensure the minimal degradation to these areas.
- Control noxious weeds within the mining lease area.
- Sustain and enhance the agricultural value of lands in a manner consistent with the mining plans.
- To maximise soil stripping opportunities and implement sound soil management practices.

Newcrest has worked closely with the New South Wales regulatory agencies in developing a detailed rehabilitation and closure plan for the Cadia Hill site. The company has undertaken progressive rehabilitation in line with government regulations, however, it has also worked closely with the local community in determining the future design of the rehabilitated mine site (Heritage NSW, 2004).

A2.6.7 Alternative closure options

Newcrest did not consider alternative closure options for this site, as the overwhelming preference from the local community and the regulators has been for the site to be returned to its pre-mining land use. Prior to mining the site currently under mining lease consisted of open pasture and native vegetation and forest and all rehabilitation efforts have been directed towards returning the land to a state that improves bio-diversity and encourages the restoration of the land for use by future generations. (Newcrest Mining, 2009)

Newcrest’s Cadia Hill mine operates in an area that has a diverse regional economy that is not heavily dependent on the mining sector. The mine site is located only 25 km’s from Orange, which is itself a busy regional centre with a strong tourism industry, hence turning the open void into a recreational lake was not necessarily an option and it would compete with nearby Lake Canobolas a recreational freshwater lake that is already a very popular venue with locals and tourists alike (Orange City Council, 2009). Basically for the people of Orange, the mine, although an important part of the local economy represents only a small percentage of the regions economic base and the mine's aesthetic value was of more importance to locals than alternative uses that may have been found for the mine (NSW Minerals Council, 2008).

A2.6.8 The legislation under which the closure was conducted

The company's mining lease is overseen by the Department of Primary Industries with regular monitoring of the site a requirement of the mining lease. The company has exceeded its regulatory requirements at the site, through the progressive rehabilitation of the site and the engagement with the local community through the Consultative Committee who have assisted the company with their vision for the rehabilitated site (NSW Department of Minerals, 2004).

The mining lease for the Cadia Hill site was granted in October 1996 by the Department of Primary Industries (Minerals and Petroleum division), then known as the Department of

Minerals, along with the Department of Environment Climate Change and Water (known as the Department of the Environment when the lease was granted). This department oversaw overseeing the rehabilitation of the site and ensuring that the Cadia Valley Operations complies with its regulatory requirements (NSW Department of Minerals, 2004). The NSW *Minerals Act (1992)* requires that all mine sites in NSW undertake either ongoing rehabilitation, or progressive site rehabilitation as part of their mine lease conditions under state legislation (NSW Department of Minerals, 2004).

In addition to this, the Cadia Valley minesite operates under a number of other consents that were granted by numerous regulatory authorities in New South Wales including (NSW Minerals Council, 2008):

- The Department of Planning
- National Parks and Wildlife Service
- Department of Primary Industries – Fishery
- New South Wales Heritage Council
- Local Government Areas
- New South Wales Dam Safety Committee
- Mid-Western Area Health Service (New South Wales Minerals Council, 2008)

In NSW, the *NSW Environmental Planning and Assessment Act 1979 Part 3A* attempts to encourage ecologically sustainable development particularly where development of mineral resources provides significant benefits to NSW from both a social and economic perspective (NSW Mining Act, 1992). The key principles of this act are ecological requirements with *Part 3A* outlining the requirements for effective rehabilitation where land and or water have been disturbed. Notably, it identifies the need for the development of mineral resources in a way that minimizes environmental impact (NSW Mining Act, 1992).

The Cadia Hill site was required to submit a Mine Operational Plan which detailed the rehabilitation plans for the site and is submitted every 2-3 years, or as changes to the mining operations occur (NSW Mining Act, 1992). The *New South Wales Mining Act 1992* requires that mining companies involve stakeholders in the MOP rehabilitation plan, with the plan needing to be revised on an ongoing basis and altered according to changes in the mine operations (McGlynn, 2002).

The influences on the *NSW Mining Act (1992)* regarding mine rehabilitation have come from the *Strategic Framework for Mine Closure* published jointly by the Australia New Zealand Minerals and Energy Council and the Minerals Council of Australia (1996/2000). The rehabilitation and closure requirements in New South Wales (along with Western Australian legislation) are the most comprehensive in the country (McGlynn, 2002). They do not however have any requirements regarding minimising the socio-economic effects of a mine closure, despite the ANZMEC guidelines published in 2000 recommending that these factors be taken into consideration in determining mine rehabilitation and closure outcomes (ANZMEC/ANZMEC/MCA, 2000).

A2.6.9 Engagement with stakeholders

Newcrest actively engages with the local community on an ongoing basis using its environmental standards policy. Through this policy, Newcrest consults and engages with the community on all aspects of its operations. This site had significance to the local community due to a number of historical features that Newcrest preserved and restored as part of their early engagement with the local community and Heritage NSW. The company's efforts in this process saw them receive recognition from Heritage NSW and generated a large amount of goodwill in the local community towards the company and their operations (Heritage NSW, 2004).

The company also holds annual open days that demonstrate the operational aspects of the company's environmental management plan, by showcasing the progressive rehabilitation that is being undertaken at the Cadia Hill site. In addition to this, the company also works with the NSW Education Department and Minerals NSW in the development of a curriculum based program for students, one module of which is designed to teach students about rehabilitation practices, using Cadia Hill as an example of best practice rehabilitation (NSW Minerals Council, 2008).

Newcrest minerals conducted extensive consultation with the local community in the region as required by the consent of their Development Application, as lodged with the New South Wales Department of Planning (NSW Department of Minerals, 2004). The Cadia Hill site was a site of historical significance to the local community, due to its former significance as a mining site in the 19th Century where a number of heritage sites were located. The company was required to undertake its mining operations with the location of these sites an important factor in determining the final layout of the site. In addition to this, the company also had to relocate a 19th century cemetery that was located near the proposed mine site. This required extensive engagement with the local community and the New South Wales Heritage Office as the gravesites required exhumation and relocation (NSW Heritage Office, 2004).

The company's work on the site enabled it to win praise from the New South Wales Heritage Office, which noted the company's success in engaging the local community:

"…Mining and conservation are thought to be at opposite ends of the spectrum…an innovative approach to by a mining company (Newcrest) to the conservation of an historic landscape has won plaudits from both heritage professionals and the local community…" (New South Wales Heritage Office 2004)

The project involved both conservation and involvement with the local community and the descendents of people buried at Cadia, in the design and location of the new cemetery and a Garden of Remembrance above the heritage listed Engine Room of the old minesite. The remains of part of the old mining site have been restored and preserved by the mining company, in cooperation with the New South Wales State Heritage Office. In the words of the State Heritage Office, the project received wide support from the local community, with the company undertaking a successful engagement program that saw the descendants of those buried at Cadia involved in the process of relocating their ancestors to a new heritage listed and protected location within the mine site lease (NSW Heritage Office, 2004).

The New South Wales State Heritage office has stated that work undertaken by Newcrest at the site has been taken as an example of best practice and will be used in their dealings with other mining companies and projects across New South Wales (NSW Heritage Office, 2004).

Newcrest Mining has developed a set of environmental standards that it integrates into all aspects of the company's business activities and that the company claims are an important facet of its dealings with local communities. These standards (paraphrased below) indicate that Newcrest will adhere to the following standards in respect to its dealings with local communities (Newcrest Mining, 2006):

- Integrate environmental management into all facets of our business.
- Ensure that its employees and contractors are informed about this Policy and made aware of their environmental responsibilities in relation to the company's activities.
- Inform the community of the company's activities and consult with the community in relation to the company's projects.
- Manage environmental risks on a site-specific basis to achieve planned environmental outcomes.
- Comply with all applicable environmental laws and regulations as a minimum standard,
- Continually strive to improve its environmental performance through the Company's Environment Management Systems and periodically review performance to identify areas for improvement.
- Rehabilitate sites or areas disturbed by company activities to comply with the applicable Environmental Management Plan.
- Report annually to shareholders and the community on the company's environmental performance.

Newcrest mining has also been actively engaging the local community in a number of ways in order to demonstrate how the mine site is meeting its rehabilitation objectives. These include an annual open day designed to showcase not only the operational aspect of the mine, but also the environmental aspects including the rehabilitation practices being undertaken at the site (NSW Minerals Council, 2008).

The company has also developed a Community Consultative Committee and regularly holds residents meetings to keep surrounding residents and the local community informed of the company's activities at the site. In addition to this, the company has established a 24-hour community complaints hotline designed to handle any complaints that may arise from the mining company's activities, in a timely manner (UNSW, 2006).

Newcrest as part of its community engagement strategy also contributes to the local community through a student scholarship program for local school students and through its involvement in a number of sponsorship and donation programs through which the company contributes over $300,000 p.a. (UNSW, 2006)

The company through Minerals NSW and the NSW Department of Education is also engaged in the education curriculum, offering a range of curriculum units, one of which is focussed on demonstrating to students the key role that rehabilitation plays in the mining process. The educational programs are offered to both primary and secondary students with teachers and students encouraged to visit the site in order to reinforce what has been learnt in the class (NSW Minerals Council, 2008). The aim of the education program is to demonstrate how the mining industry is adapting sustainability into its everyday operations and to show that mining does not just leave a scar on the landscape in the form of a large hole in the ground, but that the industry is committed to returning these sites to at the very least, the condition they were in before mining commenced NSW Minerals Council, 2008).

Each of these aspects of community engagement demonstrates a commitment to the mine site and the local community by Newcrest Minerals. They highlight the importance of working closely with the local community in order to gain acceptance of mining and in the case of Newcrest they have demonstrated through a number of initiatives that they are able to put into practice their environmental standards. It will also assist the company when it comes to the eventual closure of the mine site, as the company have listened to the local communities concerns and decided to rehabilitate the mine site to its natural state, something that locals were adamant was a necessary precondition to the closure of the mine.

A2.6.10 Summary

Cadia Hill is an example of best practice closure, even though the mine is not yet closed. This thesis is arguing that part of best practice closure involves the progressive rehabilitation of a mine site, as this option has been shown to be more cost-effective for companies and local communities. It also demonstrates a company’s commitment to the mine and can be a good exercise in public relations as companies are seen to be proactive in their stance towards the environment and sustainability. Newcrest Minerals Ltd actively engaged the local community throughout the mining process from the planning phases through to the operational phase of mining. The company has also worked with the local community to ensure that the mine rehabilitation and closure are done in accordance with community expectations with overall community satisfaction with the company seemingly high.

A2.7 Penrith Lakes Mine Closure – Penrith, New South Wales

Penrith Lakes is a unique case study, given the size of the mine (the largest construction materials quarry in Australia) and the fact that it is situated in Australia’s largest urban area. The site itself is large, at over 1935 ha and has become a significant tourist attraction for the Penrith area, with over 500,000 visitors a year (Penrith Lakes Development Corporation, 2004).

The development of the site a recreational lake occurred through a progressive development program that commenced once mining began at the site. The formation of the Penrith Lakes

Development Corporation to oversee the closure of the site enabled the former mine site to develop into a comprehensive recreational lake area.

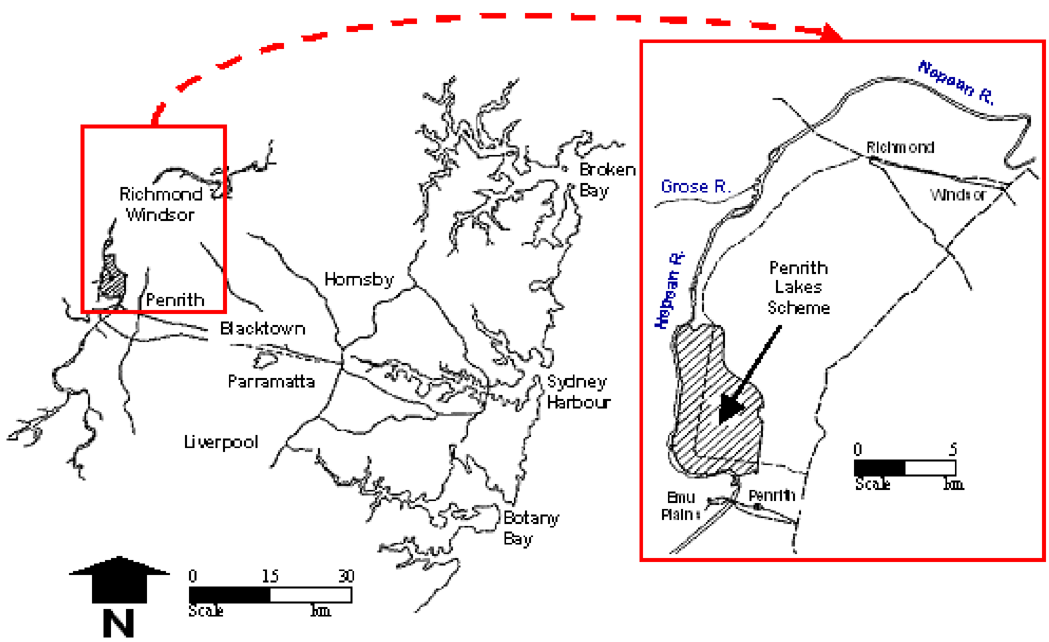
Due to the progressive nature of the rehabilitation strategy, the company was able to add new developments to the site as the need arose. These included the Indigenous Interpretive Centre and the Environmental Education Centre which were not part of the initial closure plans, but became projects as the need for them arose and they were shown to be viable.

A2.7.1 Location of the mine

The Penrith Lakes is built on a former sand and gravel quarry mine site in the Penrith region of Western Sydney. The site is situated in a region with a population of nearly 5 million people and is a large drawcard for its recreational and educational facilities that have been developed as part of the mine site's rehabilitation (Penrith City Council, 2010).

The mine site is located in the most densely populated urban area in Australia, the Greater Sydney Basin and is near residential areas, as well as being part of the Nepean river system and being nestled at the base of the Blue Mountains, it forms part of that regions world heritage listed eco-system (Penrith City Council, 2010).

Figure A 2.8: Location of Penrith Lakes in relation to Sydney Metropolitan region



Baker, 2002: 8

The Penrith Lakes Development attracts more than 500 000 visitors a year (Boral News 2004, p4). Activities are organised at the site on a regular basis, including fishing activities during school holidays, sailing programs and the development has become a major attraction in Western Sydney for the Australia Day celebrations (Penrith City Council, 2010).

The current use of the Penrith Lakes system includes a rowing course, white water rafting course (the only man made course of its kind in the Southern Hemisphere) and a 5 km walking/cycling track, as well as picnic/barbeque facilities (Penrith Lakes Development Corporation 2000). The walking/cycling track has also become a venue for regular triathlons, adding to the number of commercial opportunities available to the site since its rehabilitation. The Penrith White-water Stadium hosted the 2000 Olympic canoeing and kayaking events. The facility is now open to the public for White-water rafting, canoeing, kayaking, beach volleyball, as well as guided tours (Penrith Lakes Development Corporation 2000).

A2.7.2 The size of the community where the mine is situated

The Penrith City area has an estimated population of approximately 180,000 and has been growing at around 1-1.5% pa over the last two decades (Penrith City Council, 2009). The city is located approximately 54 km's from the centre of Sydney and is a major transport hub for Western Sydney, with a series of motorways, rail lines and bus routes running through the city's boundaries. The city consists mostly of residential areas; however it is also bounded by some rural-residential areas and rural areas where agriculture is a major industry (Penrith City Council, 2009).

The Penrith City area is classed as one of the Sydney Metropolitan growth areas and , a number of areas within the city boundaries are earmarked for residential subdivision. One of the areas that is earmarked is the Penrith Lakes area; with up to 400ha of the site planned for residential and commercial facilities (some parts of the site already have a residential component) (Penrith Lakes Development Corporation, 2004).

Due to the sites proximity to a major urban area and the ability to attract a large number of visitors the site was not as constrained as some former mine sites, in terms of the types of commercial end-uses that could be considered. The location, however, did mean that the company was under far greater pressure from both regulators and the local community regarding the rehabilitation of the site.

A2.7.3 Size and Profitability of the Mine

The site of the Penrith Lakes is the largest construction materials quarry in Australia, currently supplying 75% of the sand and gravel requirements for Sydney. The quarry provides 450 jobs and is worth approximately AUS$50 million to the Western Sydney economy (Penrith Lakes Development Corporation 2000).

Due to the sheer size of the site and the quantity of the materials being mined, the site was a highly profitable site for the companies involved with the site, (Boral, Readymix and Pioneer). The site is over 2000 hectares and consisted of a number of open-cut pits that have been progressively developed into a series of lakes and wetlands, in addition to a series of parklands (Mulligan, 1999).

Figure A 2.9: Overview of the Penrith Lakes site

Penrith Lakes Development Corporation, 2004

A2.7.4 The ownership of the mine

The mine was originally owned by three joint operators, Boral, Readymix and Pioneer; however, in recent years the joint ownership has changed to Boral, CEMEX and Hanson. In 1979 Boral, Readymix and Pioneer in order to oversee the rehabilitation of the site and develop it into a world-class recreational, residential and commercial area formed the Penrith Lakes Development Corporation.

Boral is the main company in the joint venture; it is a construction and building company with operations in Australia, Asia and the US. The company has a current market capitalisation of $2,402million; it had an annual turnover of $5.2 billion in 2008, with a profit of $243 million. The company employs nearly 16,000 people worldwide (Boral Limited, 2009).

Readymix was acquired by CEMEX, a global building company that operates in 50 countries around the globe. It had a turnover US$21,695 million in 2008, with a gross profit of US$6,868 million in the same period. The company employs over 57,000 people across its operations (CEMEX, 2009).

Hanson is a subsidiary of the Heidelberg Cement Group, which has over 65,000 people working for it across the globe. Heidelberg Cement Group had a turnover in 2008 of EUR$14,187 million in 2009, with a profit of EUR$1,920 million (Heidelberg Cement Group, 2009,). The company has a market capitalisation of EUR$3.83 billion (Financial Times Market Data, 2009).

The mine's owners were able to use their extensive resources to assist in the rehabilitation and closure of the site and this in no small part contributed to the overall success of the mine closure. The company also realised that by working in conjunction with the local community they could develop the site into a recreational area (and future housing development) that would meet community expectations for the site.

A2.7.5 When the mine closure was planned

In 1979 Boral, Readymix and Pioneer in order to oversee the rehabilitation of the site and develop it into a world-class recreational, residential and commercial area formed the Penrith Lakes Development Corporation. The Corporation was also responsible for planning and managing the removal of overburden from the site. This overburden was then used to replace the material excavated from the site to create landforms that were used in the development of parklands, lakes and urban development at the site. The lakes themselves were filled using a variety of methods including rainwater, urban runoff, and groundwater from the mine site (Boral, 2004).

The closure plans for the site began a number of years before the actual site was due to be closed (nearly 30 years before closure), with rehabilitation an ongoing process that is set to continue until the site finally closes in 2010. The closure of the mine site was a collaborative effort that involved people from the various companies that operated the quarry, the state government and representatives from the local community (Mulligan, 1999).

The reason for the success of the site is that it has incorporated a number of features into the final design process of the site, which have enabled a wide range of end-uses (Penrith Lakes Development Corporation, 2009). These end-uses have allowed the Penrith Lakes site to become an asset to the Penrith Council and wider community and the prominent profile of the rowing facility during the Sydney Olympics gave Penrith Lakes a boost to their tourism numbers. Listed below is an overview of the important rehabilitation features of the Penrith Lakes site (Penrith Lakes Development Corporation, 2004):

- Mine site is used for sand and gravel for building industry in Greater Sydney Area (supplies 75% of the sand and gravel for building industry)
- Rehabilitation program being overseen by Penrith Lakes Development Corporation (established by Boral, Readymix and Pioneer)
- The lakes system when complete will be one third the size of Sydney harbour
- More than 40 000 native trees have been planted, with another 200 000 planted up to 2010
- Rehabilitation completed by 2010
- Rehabilitation includes restoration of heritage buildings in the area
- The building of the Olympic rowing and white water rafting course for the 2000 Olympic games
- Water quality has been brought to swimming standard

- The introduction of native fish into the lakes
- The establishment of wetlands and ecosystems within the park
- Construction of an Environmental Education Centre, used to educate primary through to tertiary students about flora and fauna in the park and the relationship between people and the environment
- Muru Mittigar – an Aboriginal Culture Centre designed to showcase local culture and art

The closure of the site has been successful in part due to the long time frame of the closure, planning and commencement of which began 30 years prior. Rehabilitation was progressive and the companies worked with the local council to ensure that the project was part of their economic development strategy. The Penrith Lakes Development Corporation has representation on its Board from the Penrith City Council, which further reinforces a link between the mine and the local community (Penrith City Council, 2009).

A2.7.6 How the mine closure was planned and conducted

The closure of the Penrith Lakes site began nearly thirty years before the mine site was due to be closed, with the rehabilitation of the site commencing as soon as mining at the site began. This rehabilitation process was ongoing throughout the life of the mine site and importantly was flexible in its approach, enabling changes to be made as rehabilitation practices altered during this long time frame (Mulligan, 1999).

The planning process was from the outset undertaken with a view to developing the site as a planned mixed use development that combined urban, commercial and residential components (Penrith Lakes Development Corporation, 2004). The site did not have as many environmental issues associated with it as many other mine sites, as the mine site was a sand and gravel quarry and did not have to address issues such as high acidity levels, or high levels of heavy metals that are typically associated with many other mine developments. In addition to this, the local council (Penrith City Council) had included the development of the site as part of their long-term planning for closure of the site (Penrith City Council, 2010).

Due to the site’s proximity to such a large urban environment, the owners of the mine (initially three owners – Boral, Readymix and Pioneer) all realised that there would be pressure placed on them to develop the site in a responsible manner that took into account the mine’s proximity to the nation’s largest urban area. The rehabilitation of the site was also undertaken at a time when mine site rehabilitation was becoming an important issue, although it was still largely confined to the fringes of the environmental movement (Mulligan, 1999).

The sheer size of the site also necessitated a development that was sympathetic to the concerns of locals and the local council. The site covers an area of 1935 ha, and is surrounded by suburbia and is located just 3 km's from the centre of Penrith (Penrith Lakes Development Corporation 2009). In 1980 the three companies then involved with the mine formed the Penrith Lakes Development Corporation in association with the Local council, to drive the rehabilitation and development of the site. Below is a diagram of the site showing the final design and layout of the site (Penrith Lakes Development Corporation, 2009).

Figure A 2.10: Layout and design of the Penrith Lakes site

Penrith Lakes Development Corporation, 2009

As the mine is still operating as a sand and gravel quarry (operations are now forecast to cease in 2013), the rehabilitation process had to be undertaken progressively, with operations still continuing on part of the site, whilst other sections were given over to the public for use as a recreational area (Penrith Lakes Development Corporation, 2009). The site was also used extensively during the 2000 Olympics, as it was the main venue for rowing and White-water rafting for the Olympics and was used extensively by large volumes of people during the event, whilst still continuing to operate. This aspect of the rehabilitation and closure process is important, as it required detailed planning to ensure that development could proceed without disruption to the mining operations and without affecting the safety of those using the site for recreational purposes (Department of Planning NSW, 2005).

When the site is finally completed, the planning process will have overseen the development of a series of parklands, recreational lakes, wetlands, parks and gardens, an Environmental Education Centre, and Indigenous Interpretive Centre and Nursery and the development of residential housing and commercial development (Department of Planning NSW, 2005). This development has required detailed long-term planning by both the mining companies and regulatory authorities working alongside the local community to ensure a development that met not only regulatory requirements, but also met the needs of locals.

A2.7.7 Alternative closure options

The site was not considered for alternative uses other than what was planned by the Penrith Lakes Development Corporation back in 1980. The site planning did not initially consider the development of an Environmental Education Centre, or an Indigenous Interpretive, however, these came later as the need for them arose, due to interest in the site development from the State and Catholic Education Departments and the University of Western Sydney (all of whom have been involved with the development of the Environmental Education Centre) (Penrith Lakes Development Corporation, 2005).

The owners of the site had planned this development from the formation of the Penrith Lakes Development Corporation in 1980 working in consultation with the Local Government Authority in the development of the site. The site is unusual in Australia, in that a former mine site is being developed into a commercially oriented venture, with the money from the venture being returned to the Penrith Lakes Development Corporation for further development at the site (Boral, 2004).

The type of end-uses that have been developed at Penrith Lakes are not going to be viable for every mine site, but that is the issue – each site closure needs to be assessed on its own merit. The legislation for the site only covered rehabilitation requirements as per the mining lease of the site, the company has gone beyond its regulatory requirements for rehabilitating the site, however, the result has been a development that is now visited by more than 500,000 people annually and is accepted by the local community as an asset to their region (Penrith Lakes Development Corporation 2009).

A2.7.8 The legislation under which the closure was conducted

Any type of comprehensive legislation did not initially cover the Penrith lakes mine site when mining first commenced at the site in the 1960's. The New South Wales government did not initially have detailed legislation covering the quarrying industries and rehabilitation practices until 1971 when the government established a working party to investigate the extraction being undertaken at the Penrith site and determine the feasibility of rehabilitating this site for use as a major recreational water facility for Western Sydney.

The legislative requirements for the site were developed only when the site was earmarked for development as a sand and gravel quarry during the late 1960's, early 1970's. The Sydney Regional Environmental Plan that covered the site allowed for the development of the site into a series of recreational lakes and open-space areas, in addition to urban development if demand necessitated such a development (Baker, 2002).

Following series of technical and financial studies to determine what would be an acceptable (and achievable) scheme, the New South Wales government gazetted a statutory planning instrument that covered the Penrith Lakes site. From this, the Penrith Lakes Scheme was implemented in 1986 (Mulligan, 1999). The Plan was amended in 1989 to allow for the construction of an Olympic size rowing and canoeing facility at the site, this was the course that was ultimately used for the 2000 Olympics.

The scheme is covered by a statutory plan, the Sydney Regional Environment Plan No. 11, with an overview of the objectives being (Mulligan, 1999):

- To provide a development control process establishing environmental and technical matters which must be taken into account in implementation of the Penrith Lakes Scheme in order to protect the environment;
- To identify and protect items of the environmental heritage;
- To identify land which may be rezoned for urban purposes;
- To permit interim development in order to prevent the sterilisation of land to which the Plan applies during implementation of the Penrith Lakes Scheme.

The Structure Plan of the lake flows from the Regional Environmental Plan, which outlines the following in relation to the rehabilitation of the site:

- The Penrith Lakes Scheme is the creation of a regional recreational lake system….for the benefit of the public as a result of (Mulligan, 1999; p610)
  a. The staged optimum extraction of sand and gravel
  b. The staged rehabilitation, reconstruction and landscaping of the land, and
  c. The staged formation of a series of interconnected lakes, and includes the identification of land for possible future urban purposes as a result of the works referred to in paragraphs (a) and (b).

The Penrith Lakes rehabilitation was in many ways a success in spite of the lack of legislative requirements in the early days of the mine’s operation. It took the government 10 years into the mine’s operation before they developed a coordinated response to the rehabilitation of sand and gravel mines in New South Wales (Mulligan, 1999). The three companies that controlled the lease of the site were in many ways farsighted in their approach to the redevelopment of the site and have demonstrated what can be achieved when companies exceed their obligated requirements and provide an asset that can be used for generations to come.

A2.7.9 Engagement with stakeholders

The Penrith Lakes Development Corporation, which was formed in 1980, has consistently worked with the local community in developing the final plans for the Penrith Lakes site. The Corporation has also worked with the Penrith City Council and the State government regulatory authorities in determining outcomes for the development (Baker, 2002).

In 2007 the Penrith Lakes Development Corporation established the Community Advisory Committee to assist in driving development at the site for the remaining years of the rehabilitation program. The corporation established used an independent facilitator to assist the Advisory Committee and ensure that the rehabilitation and closure process were as open and transparent as possible. The Committee was comprised of people from across a range of industries and from various sections within the local community in order to obtain a cross-section of opinion on the final stage of the closure process. These included specialists in areas such as community engagement and development, recreation, leisure and tourism, economic development, education, environment and heritage, the key criteria being that they were able to demonstrate an interest or connection to the future development of Penrith Lakes (Penrith Lakes Development Corporation, 2009).

Long before the establishment of the Community Advisory Committee, the Penrith Lakes Development Corporation engaged the CSIRO to undertake a series of community engagement forums to deliver a sustainable end-use for the Penrith facility. The CSIRO through a program that it has termed ‘Sustainable Ecosystems’ was able to assist in developing the framework that has been used to underpin the rehabilitation and closure process at Penrith Lakes (Baker, 2002).

From the perspective of the CSIRO, this study enabled their organisation to study the links that exist between economic, social and ecological considerations during mine site rehabilitation and closure (Baker, 2002). The approach that the CSIRO used was a systems approach that examined what forces shape urban ecosystems and how these can be developed in an integrated manner that is essential if urban areas are to find new opportunities for their future (Penrith Lakes Development Corporation, 2009).

The CISRO working alongside the PLDC developed a series of workshops and on-site meetings during which they found a number of synergies between the operational side of the mine site and the rehabilitation that was being progressively undertaken at the site. Their research found that these could be used to drive innovation at the site and take a more balanced approach to development and it could be undertaken by the following methods (Baker, 2002; p2) :

- increasing intergenerational economic development following the end of quarrying in successive areas of the Penrith Lakes site;
- enhancing community involvement through recreational, educational and cultural linkages with the surrounding region and its history;
- applying ecological knowledge in the planning and design of the water management system, built environment, sewage treatment and waste management processes, and
- integrating the principles of ecosystem function into the rehabilitation of landforms, construction of flora and fauna habitat and human use of urban and recreational areas. (Baker, 2002, retrieved

From the identification of these inputs the Sustainable Ecosystems Strategy was developed. The key outcomes of this strategy included: an opportunity to make a substantial contribution at the planning stage for a major urban and recreational development; design principles which guide design actions towards achieving set balanced urban development goals; interactive documents that transfer a systemic way of thinking; learning from the application of ecological knowledge to the design and construction of sustainable human habitat; balancing economic, social and environmental issues to achieve a healthy urban ecosystem for the future Penrith Lakes community; identification of, and monitoring methods for, critical factors for achieving balanced development. (Baker et al, 2000).

The CSIRO research found that capacity was best built in the Penrith community through an adaptive management approach, as this resulted in a more resilient and empowered community. This systems approach to mine closure at Penrith has assisted the local community in a number of ways according to Baker (2002) including:

- Developing Partnerships — Building partnerships with community, government and industry groups captures diverse perspectives and ensures that an understanding of the region and key issues are identified and addressed. Together, the partners explore synergies with existing investments, and map desired options for the future.
- Creating the Foundation — as culture and history influences communities' response to change, an assessment of the historical events and contextual factors that have helped shape the region is undertaken. Lessons from the past are identified. Past trends, existing research and baseline information are collated into a searchable inventory to be used as a community resource.
- Opportunities for Change — a community will identify the way the region works as a system: the drivers of change, the interconnections between economic, social and environmental issues, and the flow-on consequences of investment decisions. This

'systems understanding' of the region is central to identifying where (and why) strategic investments for the future can be made.

- Building Resilient Futures — provide a process for evidence-based decision-making concerning future development pathways. A learning organisation approach underpins the process for charting pathways for the future, for monitoring and adapting economic, social and ecological investment strategies and for realising strategies that are resilient in the long term.

The key strengths of the approach taken by the Penrith Lakes Development Corporation working with the CSIRO were in the areas of community engagement and ownership of the site, and the sustainable manner in which the site has been rehabilitated and developed. The approach taken at the site: engages community groups; enables development options to be quantitatively and qualitatively compared; identifies the range of changes a community may be seeking and why; is based on a holistic approach and on Systems Thinking concepts. These approaches are totally consistent with 'whole-of-government' and 'whole-of-community' approaches; teaches adaptive management and continual learning, particularly through systems workshops and scenario evaluation; is a structured and phased approach with each phase having clearly identified objectives, inputs and outputs. This offers communities the flexibility to phase a project contingent on local circumstances (e.g. timing, commitment, budget etc.); and provides local government and communities with the capacity for ongoing implementation and monitoring, realised through a sustainable data system (Baker et al., 2000).

Community engagement has been the key to successful rehabilitation and sustainable development at the Penrith Lakes site. The Penrith Lakes Development Corporation has ensured from the outset that the local community has been engaged in the process and that development at the former mine site has been sympathetic with the vision that the community has for the site (Penrith Lakes Development Corporation, 2009). The success of the rehabilitation program can be measured by the visitation to the site and the range of activities that have accompanied this development (Mulligan, 1999).

The Penrith Lakes Development Corporation has consistently sought to engage the local community, the local government and state regulators in the rehabilitation and closure of the Penrith Lakes site. In addition to this, early community engagement undertaken by the Penrith Lakes Development Corporation and the CSIRO found that it was necessary to drive economic development at the site in the future, that took into account the needs if future generations. The approach used a Systems Approach that encourages ownership of the site and approaches closure in a sustainable manner that ensures the longevity of the site in the future.

A2.7.10 Summary

Penrith Lakes is best practice closure for a number of reasons. Firstly, the closure of the site was planned during the planning phases of the mining process, with the rehabilitation and closure being conducted in a progressive manner. Secondly, the mining companies ensured that the closure process was well funded and well resourced. Thirdly, the company worked closely with the local community, the local government and regulators in the closure of the site through the Penrith Lakes Development Corporation, a company established to oversee the site. In addition to this, the site's location in a major metropolitan area assisted in the final development plans for the site, and to a degree are the reason for the site's success as a recreational site and a tourism destination, largely due to the access to a substantial population base.

The outcome and final design of the Penrith Lakes site would not necessarily be possible in other areas, however, the nature of best practice closure is such that it needs to be site specific and there can be no one size fits all policy. Best practice mine closure involves a number of processes that must take into account many factors and requires a long-term, unified approach from key players in the mining operations.

A2.8 Lake Kepwari Mine Closure – Collie, Western Australia

Lake Kepwari will be unique to Australia once this former void commences its life as a recreational lake. The former mine void was a highly profitable mine for the Wesfarmers subsidiary Premier Coal and was a major producer of coal for the state's major power station Muja. The location of the mine in Western Australia's main regional tourism region, the Southwest provides the potential for the lake to benefit from a substantial tourism base. In addition to this, the proximity of Collie to Perth provides the lake with a prospective day-tripping base, as the lake is less than 90 minutes drive from the city. The town is also beginning to be sold as an affordable tree change destination and is becoming a 'life-style' destination for former city dwellers.

Collie being heavily dependent on the mining industry has traditionally not had to worry about a diversified industrial base, as employment in the town tended to be intergenerational. As the mining industry has become more capital and less labour intensive and mining industries have increasingly become more skilled, the town has needed to diversify its industrial base. Tourism provides the opportunity to diversify the town's base and there are often fewer entry barriers for people to enter the industry compared with other industries. Lake Kepwari provides such an opportunity for workers in the mining industry that become displaced, or for younger workers who may find employment in the mines less easy to enter than their forebears did.

A2.8.1 Location of the mine

Lake Kepwari, a former coalmine void operated by Wesfarmers Premier Coal is located in the Collie region of Western Australia, 202 kilometres from the centre of Perth (Main Roads WA, 2005). The Lake Kepwari site is a 15-minute drive from the centre of Collie (APP Project Management 2003). Collie has a Mediterranean climate of dry summers and wet winters with an average annual rainfall of 943 mm, and is situated 204 metres above sea level (Bureau of Meteorology 2005). The town has a population of 8829 (South West Development Commission, 2006), the population of Collie, however, has declined since 1986 when the town had a population of 9077 (ABS 1986), this has been due mainly to job losses in the mining and timber industries over the last 15 years.

Figure A 2.11: Location of Collie, Western Australia

Western Australian Electoral Commission, 2005

Collie is in a unique position for a mining community as it is located in Western Australia's second largest tourism region the South West and is within a day trip's drive from the capital city of Perth, hence it is able to capitalise on a large population base, in addition to a large tourism base (WATC, 2006). However, not all mining communities have the same benefits, for some communities the mine may be the only reason for the town's existence and they may not have the luxury of being able to use a former mine void for recreational tourism purposes, it may be that the only use for such a void is one of passive tourism. In the case of Collie, the process of transforming a former mine void into a recreational lake is well under way and along with it the potential to diversify the industrial base of the region.

A2.8.2 The size of the community where the mine is located

The Collie River Valley as it is known has a population of approximately 9000 people, located approximately 200 km's south of Perth and approximately 60 km's inland from the Port of Bunbury (Collie River Valley, 2009). The town is primarily a coal-mining town, with the mining industry both historically and even today being the largest employer in town. There are two mining companies operating at what is the only coal-mining region in Western Australia, those companies are Wesfarmers Premier Coal and Griffin Coal. The town itself is surrounded by a number of abandoned mines, a number of which are used by locals for swimming in the summer months (this is not sanctioned by regulators, however) (Lund, 2001).

The mines are only a few kilometres from the centre of town hence their influence pervades the town, with some rural properties adjoining the coalmines. The town is also surrounded by rural-residential and rural properties, with many parts of the shire being National and State Forests, or conservation parks (Collie River Valley, 2009).

The town has traditionally been seen as a working class town, particularly given the nature of the mining industry that has been so prevalent on the region since the late 1800's. This is changing, however, as a new mix of people move to the region attracted by affordable housing, close proximity to the coast and Perth. The region is also starting to capture the tourist dollar, as it is located in the middle of Western Australia's number one regional tourism destination, the South West. These changes are beginning to alter the town (albeit slowly), and may have an influence on how the town progresses in the future, which is a similar story to that of Cessnock in the Hunter Valley in New South Wales, also a traditional coal mining town where tourism has now surpassed coal mining as the major employer in the region.

A2.8.3 The size and profitability of the mine

Premier Coal was part of the much larger Wesfarmers Resources division when the Collie rehabilitation and closure was undertaken and was one of a number of mining companies that Wesfarmers either owns, or is a joint venture partner in. This provided Premier Coal with a substantial capital and resource base and in addition to this; Premier Coal had the distinction of being one of only two coal mining companies in Western Australia, located in the State's only coal producing area, enabling the company to generate substantial revenue from the site (Natural Resources Review, 2004).

One of Wesfarmers Premier Coal's former mine voids is in the process of being turned into a recreational lake to be known as Lake Kepwari. The lake was formed after the closure of the Western No.5 mine site that was mined from 1970-1997 (APP Project Management, 2003).

The site left a series of mine voids, with a surface area covering 188ha, and with nearly 20 million tonnes of coal extracted from the site, after closure (Ashton and Evans, n.d.). One of the voids Western 5B was chosen as the site for the development of a recreational lake, due to its size and the depth of the pit at 75m with a potential water volume of 32Mm3 (Ashton and Evans, n.d., p4). The name Kepwari comes from the Aboriginal name for the river in the area, meaning ‘water playground’, or ‘playing in water’ (SWDC 2006).

The company undertook a rigorous evaluation of the site before determining that the best option for the site would be as a recreational lake. The number of abandoned mine lakes in the area also prompted Premier Coal to recognise that best practice closure of the Lake Kepwari site would involve value-adding to the site and addressing community concerns about safety at mine voids (Lund, 2001).

A2.8.4 The ownership of the mine

Premier Coal is a subsidiary of Wesfarmers, with a head office in Perth, Western Australia and is the leading coal producer in the State. The company was part of the Wesfarmers Energy Group and is one of only two coal-mining companies in Western Australia, supplying coal for the State’s power plants. Wesfarmers is a large Australian based conglomerate with diversified interests in mining, retail, energy, and chemicals. Wesfarmers is Australia’s largest private employer with over 200,000 employees employed in a range of industries from mining, electricity generation, manufacturing and retail. The company had total assets in 2011 of $42,199.0 (millions) and equity of $24,479.0 (millions) (Wesfarmers, 2011).

Due to the nature of being one of only two coal producers in the State, Premier Coal’s mine was a very profitable mine for the organisation. The revenue for the Energy division as a whole in 2009 was $1,310.8 million (the breakdown of individual divisions was not available) (Wesfarmers, 2009). Premier Coal was sold in 2011 to Chinese company Austar and is no longer part of the Wesfarmers group.

The size of Wesfarmers enabled Premier Coal to have access to a substantial pool of resources in terms of manpower and resources to undertake the rehabilitation and closure of the site. The ability to be able to fund rehabilitation and closure programs is a necessary component of best practice closure, as this can be the most neglected part of the mining process and many companies do not adequately fund closure programs either through a lack of forward planning, or finance, or a combination of both. Premier Coal did not have these issues, as they planned the mine’s closure well before the operational life of the mine ceased and they had the ability to be able to fund a substantial rehabilitation program

A2.8.5 When the mine closure was planned

Lake Kepwari, formerly known as Western 5B began mining in 1969, and was a major coal producer for Wesfarmers during its operational life, producing over 20 million tonnes of coal during its 30-year operational life (Wesfarmers Premier Coal, 2004). The closure of the mine in 1996 enabled the company to examine the closure plans for the site and determine what options were available to the company in the rehabilitation of the site.

The company had the choice of just meeting its legislated rehabilitation requirements and returning the mine void surrounds to their natural state (with an open void as part of the environment), however, this would have required the company to close part of the site off, as the open void would have legal issues associated with it. As part of the closure process, the company developed a series of conceptual plans designed to find alternative value adding uses for the site (Natural Resources Review, 2004).

Wesfarmers Premier Coal received the Banksia Award for Sustainable Development Leadership in the Minerals Industry in 2004 in recognition of its rehabilitation efforts at their former open-pit coalmine, now known as Lake Kepwari. Wesfarmers Premier Coal decommissioned Lake Kepwari in 1996; the company then began the process of revegetating and reshaping the former open pit mine, in order to enable the site to become accessible as a recreational lake (Natural Resources Review, 2004, p10). The company also began a water quality control program to make the lake safe for recreational use this process has been ongoing since the decommissioning of the site in 1996.

The planning for rehabilitation and closure of the site was relatively straightforward for the local community and was brought about partly due to the large number of previously abandoned mine voids in the area that were used by locals to swim despite the dangers associated with this. Planning for the development of Lake Kepwari was done partly in response to locals concern about swimming in these former mine voids and litigation that occurred against the State Government that was successfully fought by a person who seriously injured themselves after swimming in a former mine void in Collie (Lund, 2001).

A2.8.6 How the mine closure was planned and conducted

The final design for the Lake Kepwari site was arrived at by deciding that a variety of recreational uses could be found for the site, however, this would require additional expenditure beyond what was planned and required. Wesfarmers believe that closure of a mine site requires more than just rehabilitation, as there is more to a mine site at the end of its operational life than just a mine void and barren landscape. The company also stated that it was aware of community concerns regarding rehabilitation and closure of mine sites and that it should deliver outcomes that prevent or minimise adverse long-term effects to the environment. The aim being to develop a self-sustaining ecosystem, or an agreed alternative land-use (Wesfarmers Premier Coal, 2004).

Figure A 2.12: Lake Kepwari post rehabilitation

Wesfarmers Premier Coal, 2005

The company working in conjunction with a range of stakeholders began the process of determining a value-added end-use for the site. The options that were considered as part of the closure process included wetland habitats, 4wd and bike trails, walking trails (to link in with the Bibbulmun track that runs through Collie), picnic facilities, camping, aquaculture and water based recreation (Wesfarmers Premier Coal, 2004).

The company decided to alter the shape of the mine void by reshaping the perimeters to 10 degrees to five meters below the final water level as this would allow for a variety of safe recreational use at the site. This brought with it additional costs for the company in its rehabilitation program, adding an extra $2 million more to the program cost (Wesfarmers Premier Coal, 2004). The change in the degree of the slope, also had another positive effect for the mine void, as it allowed plant growth to occur below the water level, hence acting as a stabilizing force and allowing nutrients to be fed into the lake, acting as a buffer to the low pH levels and it also allows for some aquatic life in the shallow areas of the lake (Wesfarmers Premier Coal, 2004).

The company, with the approvals of regulators and the support of locals decided not to let the lake fill naturally (which would have taken up to 100 years given the size and depth of the lake), but to divert a branch of the Collie river and let the lake fill through this measure (Natural Resources Review, 2004).

Figure A 2.13: Collie River diversion into Lake Kepwari

Wesfarmers Premier Coal, 2004, p. 2

The diversion of the river allowed the lake to fill within four years and was done with only a minimal amount of water from the Collie River. The company installed a gate valve in the lake in order to control the flow of water, ensuring that water was only used for six weeks during the peak winter rainfall (Wesfarmers Premier Coal, 2004).

In order to ensure that the lake would be suitable for recreational activities, the company collaborated with the Centre for Excellence for Sustainable Mine Lakes to monitor the water quality of the lake, research low-cost, self-sustaining ecosystems and determine various end-use options for the lake (Ashton and Evans, n.d). This research during its existence provided Wesfarmers Premier Coal, regulators and the local community with information on rehabilitation techniques and also provided valuable research on the ability of post-mining rehabilitation to cope with value-added end-uses (Ashton and Evans, n.d.).

The company worked closely with the local community, local government and regulators in designing a mine void that would be safe for recreational purposes and would become a self-sustaining eco-system in the long term. The changes that were made to the final design of the site were costly, adding an extra $2 million to the cost of rehabilitation at the site (Ashton and Evans, n.d.). The establishment of a CRC to conduct research into the issues surrounding value-adding rehabilitation provided further detailed research into mine void rehabilitation and closure.

A2.8.7 Alternative closure options

When the closure of the mine site occurred in 1996, Wesfarmers was faced with the possibility of just complying with its legislated rehabilitation and closure requirements, or adding value to the site by rehabilitating the site to allow for other uses post closure. The company after consultation with the local community and regulators decided that the best way forward for the site was to close the site by adding value to the site. In part this may have been driven by the fact that the company had no alternative other than to develop the site with a mine void, as the option of backfilling was not open to the company (Wesfarmers Premier Coal, 2005).

The company investigated a range of alternatives including wetlands habitat, 4wd and motorbike trail park, hiking trails, aquaculture facility and water recreational lake. The company engaged a business consultancy company that determined that the best option for the site would be its use as a recreational lake, with additional business activities to be developed when the lake had a critical mass to support their existence (APP, 2003).

Figure A 2.14: Lake Kepwari overview

West Australian Regional Newspapers, 2010, p 4

The development of the lake for recreational purposes was a more costly exercise for Wesfarmers Premier Coal, however, the company decided that community expectations necessitated an end-use for the site that would add value and have the potential to diversify the town’s industrial base (Wesfarmers Premier Coal, 2005).

In part it was a concern about community reactions to the closure that drove Wesfarmers Premier Coal to undertake a more rigorous approach to the closure of the mine site. The company recognised that in many ways the mine site would be a legacy for the company and would deliver for the community a positive bequest, the benefits of which would outweigh any additional short-term costs to the rehabilitation project (APP, 2003).

This project in many ways has set new benchmarks for mine closure in Western Australia, in particular, but the ramifications may reach further beyond the borders of the state. Wesfarmers Premier Coal have provided the community of Collie with a long-term asset with the potential to diversify the town’s economy and will leave a positive statement about the role the mining industry can play in a regional economy.

A2.8.8 The legislation under which the closure was conducted

In Western Australia, legislation covering the environmental aspects of closing (or decommissioning) mine sites is a multi-layered approach whereby some sites are covered by the Mining Act, others by State Agreement Acts (which are covered by the Mining Act) and others that are covered by the Environmental Protection Act (in cases where the State does not own the access to the minerals. All mining operations are subject to the State's Environmental Protection Act, in addition to being covered by the Mining Act and Agreement Acts (Jones, H, 1998).

The *Mines Safety and Inspection Act (1995)* also covers all mine operations in the state, namely in those areas associated with aspect of public safety issues once mine sites operations finally cease. This Act is designed to prevent mining companies leaving mining sites in a condition that is unsafe and subject to public liability. An issue with mine safety arose in Collie during the 1980's when a young person suffered tetraplegia after jumping into Black Diamond mine lake (a former mine void that is used by the local community as a recreational lake, despite it being illegal). This accident although occurring in an area that was advertised as being unsafe for swimming, cost the State Government $1.8 million in damages (Ashton, 2004) and provided a good example of why best practice mine closure is important, particularly from a regulators perspective.

Through the Mining Act, companies submit a Notice of Intent prior to commencing mining, stating the condition that the site will be left in once mining ceases (notably the rehabilitation of the site). The requirement for this Notice of Intent is as follows (Jones, 1997: 27):

> "…that companies remove all man-made structures, or otherwise make them safe in the long-term, that all disturbed land is put in a condition whereby revegetation can be affected, except those areas where this is deemed to be impracticable, such as the solid rock-face of an abandoned pit, or the outcropping of rock in the floor of that pit. Man made structures such as waste dumps, tailings disposal areas, roads, airstrips; plant sites, etc are to be treated so that revegetation is actively promoted."

Under the Agreement Act (under which the Lake Kepwari site operated), the closure of the site has to be approved by the Minister responsible for the Agreement Act. The advice that the Minister receives regarding this closure comes from The Department of Minerals and Energy and the Department of Environmental Protection. There is a flaw in this legislation in that it does not allow the State Government to have recourse to funding to rectify any breaches to the Act (Jones, 1997). The State government can however have this recourse through the Environmental Protection Act, which allows the Government the power to order companies to address issues of environmental concern at mine sites (Western Australian Government, 2011).

As the Mining Agreement Act covered Collie, Wesfarmers Premier Coal had to meet regularly with the Department of Minerals and Energy and the Department of Environmental Protection prior to the closure of the Lake Kepwari site and then had to liaise with these organisations on an ongoing basis. In addition to this, due to the diversion of the Collie River through part of the rainy season; the company was required to meet guidelines for water quality as established by the then Water Authority (Jones, 1997). The company is not totally relinquishing its rights to the entire site, only the area immediately surrounding the mine void, as the company will still hold rights to any future reserves that may be found in the area surrounding the mining lease (Wesfarmers Premier Coal, 2005).

Wesfarmers Premier Coal went beyond their legislative requirements as the culture of the company values sustainability and their mining operations adopt best practice outcomes as addressed through the ANZMEC guidelines. The company believes that in order to continue operating with a degree of goodwill in a community they need to consider public opinion in relation to mine closure and leave behind an asset for future generations. As Ashton (2004, p3) stated in relation to this:

> "After establishment in 1950, our company operated three underground and four open cut mines in the Cardiff Sub basin. The total land disturbed was nearly 1,000ha, mainly due to open cut mining. Final landform not only includes new hills but eight voids, with an aggregate surface area of 188ha, ranging from 5ha to 103ha. The voids vary in depth up to 75m. The fact that we are producing assets during rehabilitation that will last well after mining ceases is having a marked impact on community perceptions of our industry".

The company adhered to all of its legislative requirements and exceeded its legislative requirements for rehabilitation and closure at the site. The decision to turn the mine void into a recreational lake was actually the main reason the company went further than the legislation required. The company views the redevelopment at Lake Kepwari as not only providing a long term asset for the community, but also developing goodwill within the local community towards the mining industry.

A2.8.9 Engagement with stakeholders

The cessation of mining and the planned closure of the Western 5B void (Lake Kepwari) involved the engagement of the local community and the local development body for the region, known as the South West Development Commission. The process of deciding on end-use options for the lake was progressed via working group that was established consisting of representatives from the community, the South West Development Commission, the Local Council, the Centre for Sustainable Mine Lakes, Wesfarmers Premier Coal and State Government regulatory authorities (CALM and Department of Environment) (Ashton and Evans, 2004)

This working group was given the responsibility of researching end-use options for the site and through the Centre for Excellence assessing the issues surrounding water quality, geotechnical requirements and the requirements for granting a lease for development. The working group decided that the best outcome for the former mine void was a recreational lake that offered a diverse range of options in order to maximise the added value at the site. Ashton stated in relation to this process that (Ashton, 2006: p4):

> "Following cessation of mining, rehabilitation continued and the community engagement process commenced with the formation of a stakeholder working group, the Lake Kepwari Working Group. It was envisaged that this group would oversee the development of the recreational lake and ensure that regulatory requirements were either met, or re-examined in the light of experience gained in the relinquishment process."

A committee was formed which was chaired by the South West Development Commission consisting of members from a broad spectrum of industry, government, the local community, the Chamber of Commerce, Premier Coal and the Centre for Sustainable Mine Lakes a cooperative research centre developed by all four Western Australian public universities one of whose projects was to provide advice on aspects relating to the prediction of water quality at Lake Kepwari (Evans and Ashton, 2006).

This working group, with the aid of consultants, undertook assessment of the best end-use options for the lake area. The SWDC provided funding of $25,000 for a scoping development plan and a further $13,000 for development of a business proposal. The scoping development plan explored many key issues required in such a proposal including the following examples: land and water tenure; land and water management requirements; infrastructure requirements; private versus public sector involvement; features of area to be included in development; consultation with all stakeholders; approvals processes and hurdles; market assessments (Evans and Ashton, 2006).

The Business Proposal took these one step further and detailed factors such as: existing services; details of markets to be targeted; tenure requirements; facilities, accommodation, parking, fire management; options for development partnerships; a development process; and financial requirements." (Evans and Ashton, 2006))

As part of the company's commitment to the community engagement process and due to the nature of the closure process at Lake Kepwari, Wesfarmers Premier Coal began to invest enhance its R&D expenditure. This increase in R&D expenditure resulted in the company assisting in the establishment of the Centre for Sustainable Mine Lakes, a collaborative effort between the four public Universities in Western Australia. The centre used Lake Kepwari as the basis for much of their research into mine closure and at the time was one of only two such centres in Australia. The Centre focussed on three broad research areas relating to mine void closure (Ashton and Evans, 2004, p5):

- development of science and modeling tools to underpin decision making — for legislation, relinquishment, remediation and end uses of former mining areas;
- development of amelioration techniques — with an underlying theme of utilising or establishing natural biological processes to provide self-sustaining, eco-systems; and
- assessment of various end-use options and their sustainability.

Lake Kepwari is seen as important by not only the company, but through the community engagement process, the company was able to ascertain that the local community also saw the Lake as beneficial to the long-term future of the town (Ashton and Evans, 2004). The Lake would be unique in the fact that it would be the first void in Australia that had been developed as a recreational lake, it would also be one of the few freshwater lakes in Western Australia and hence had the potential for various recreational pursuits, the likes of which are currently limited in the state. The development of the void into a recreational mine lake would also provide the town with a unique talking point and provide a positive image for a town often associated with a 'dirty' coal mining town image (Evans and Ashton, 2006).

The initial business study conducted by APP Project Management found that the Lake would generate additional employment and boost business in the town through increased visitation to the region. The study found that the lake also had the potential to be used as a training facility due to its proximity to Perth, the depth of the lake and the clear, calm waters of the water body (APP, 2003). The business research into the potential economic benefits found that the lake would provide the following: 30 primary business beneficiaries; 74 other potential business beneficiaries; a total of 37% of Collie businesses being beneficiaries; an expected extra 25 jobs in tourism in Collie; an additional $1.5M of indirect flow-on in economic benefit from construction; 59,000 visitors per annum to the site Estimated visitor expenditure on accommodation, food and fuel in excess of $2 million per year (APP, 2003)

In addition to engagement with the broader local community, Wesfarmers Premier Coal also engaged with the local Indigenous community. The Nglang Boodja Nursery, the first accredited Indigenous Nursery in Australia were used to supply services to the former mine void such as, seedling propagation and planting, and weed control as part of the rehabilitation process at the mine (Premier Coal, 2005) . This assisted in building links between the local Indigenous community and the mining company and provided valuable employment and experience for the local Indigenous community.

From this project, the Nglang Boodja Nursery was able to harvest native grass trees during clearing operations for mining operations conducted by Wesfarmers Premier Coal. These trees are then being sold through the Bunning's chain (owned by Wesfarmers Ltd) and due to the premium prices the trees are able to fetch, have provided a strong additional source of incomeforthenursery(EvansandAshton,2006).

Identifying and then developing closure options for former mine sites is an essential feature of sustainable mine closure. The closure options available to mining companies are many and varied, with each site offering unique challenges and opportunities for value adding to the mine closure process (Morrey, 1999). Wesfarmers Premier Coal partnered with the local community in determining the beneficial closure outcomes for the Lake Kepwari mine site. The approach taken by Wesfarmers is an example of best practice closure, as it considered the needs and wishes of the local community and worked with them (and the regulators) to achieve the best possible outcome from the mine closure (Centre for Sustainable Mine Lakes, 2005).

Premier Coal engaged with the local community, local government and state regulators in addition to the local development board, the South West Development Corporation and the four public Universities during the planning of the rehabilitation and closure phases of the mining process. The formation of the Lake Kepwari Working group provided local residents, businesses and Council representatives with a voice in determining the final shape and design of the mine void. In addition to these groups, Premier Coal also engaged with the local Indigenous community, by assisting them with the development of a commercial venture that was established as part of the rehabilitation phase.

A2.8.10 Summary

Lake Kepwari is an example of best practice rehabilitation as it was a planned and progressive process of mine closure that incorporated a whole of community approach to the closure process. The company engaged the regulators and local government officials during the rehabilitation and closure planning phases and again during the actual implementation of these phases. The company exceeded its legislative requirements for mine void closure and ensured that the rehabilitation and closure of the site were financially viable before proceeding. Premier Coal also had at its disposal a strong balance sheet and a corporate culture that valued sustainability and corporate social responsibility. This was an expensive undertaking from Premier Coal and would not have been possible had the company not had a culture that encouraged sustainable development practices.

Appendix 3: Financial Analysis Lake Kepwari

A3.1 Lake Development financial analysis

Table A3.1 shows the financial analysis results for the lake development only. The cafe and watersports developments can only proceed if the lake development occurs, so it is assumed that this development would commence independently of the commercial developments.

Table A 3.1: Financial results for Lake Kepwari development for discount rate of 7 per cent

Criteria:	Lake
Net Present Value @	-$2,680,860
Internal Rate of Return	-1.8%
Benefit cost Ratio @	0.58

In table A3.2 below a sensitivity analysis of the lake development was undertaken, using a number of different variables to demonstrate the effect on the Net Present Value. The table demonstrates that changing the variables by only small increments can have a profound effect on the Net Present Value. However, what the table shows is the significant costs associated with the lake development impact on the revenue stream, as even substantial changes to the variables do not allow the lake development to generate a positive revenue stream. The best options for the lake development to operate at a minimum loss are to have a discount rate of 3%, for 27,000 vehicles to enter the lake and for the lake to charge a $16 entry fee. However, as a fee to enter national parks does not occur in Western Australia and this type of mine use option is unknown in Australia, then such an entry fee seems an unlikely proposition.

Table A 3.2: Sensitivity analysis lake development (Net Present Value)

Number of Cars	19,000	21,000	23,000	25,000	27,000
NPV	-3,272,222	-2,976,541	-2,680,860	-2,385,178	-2,089,497
Discount Rate	3%	5%	7%	9%	11%
NPV	-1,919,292	-2,359,273	-2,680,860	-2,919,943	-3,100,761
Park Entry Fee (per car)	$8	$10	$12	$14	$16
	-3,814,305	-3,247,582	-2,680,860	-2,114,137	-1,547,414

Table A3.3 below provides the break even analysis of the lake development. Both the number of cars and the entry fee per car would need to increase significantly in order for the lake development to break even. In Western Australia, entry to National Parks is free, so a break even entry price of $21.46 is unlikely to be achieved, at least until entry fees to National Parks are legislated. The break even figure for the number of cars entering the park is similarly unlikely to be achieved, at least until the development becomes known and builds a reputation.

The table below illustrates the number of cars, ideal discount rate and park entry fee which would be necessary to break even at the Lake Kepwari development. The increase required in the number of cars is significant, a further 18,133 needing to be attracted to the facility for the lake to break even at an entry price of $12. The table also illustrates that an unattainable -2% discount rate would need to be achieved to break even with 23,000 cars and an entry price of $12. The figure with the most flexibility would appear to be the entry price to the lake development shifting from $12 to $21.46 however, currently in WA, there is no entry fee to national parks and hence an entry fee of $21.46 would be unrealistic.

Table A 3.3: Break even analysis lake development

	Current Cars	**Current NPV**	**Break Even Cars**
Change no of cars	23,000	-$2,680,860	41,133
	Current DR	**Current NPV**	**Break Even Rate**
Change discount rate	7%	-$2,680,860	-2%
	Current Fee	**Current NPV**	**Break Even Fee**
Change park entry	$12	-$2,680,860	$21.46

Table A3.5 below is a summation of the capital costs associated with the lake development and has been taken from a number of sources. These include APP Project Management who provided much of the capital costing for the site development in their original report in 2003. The costs were adjusted for inflation, due to the timeframe of the original report, which was released in 2003.

The table also includes the lifespan of the capital costs, which were calculated using the useful life estimates from the Australian Taxation Office (2011). The salvage values have been calculated using the formula of the remaining life dividing it by the life span and multiplying this by the establishment cost (Australian Taxation Office (2011).

Table A 3.4: Summary capital costs/ salvage value lake development

Capital Investments	Cost	Life span	SV	Assumptions
Walking/Hiking Trail Establishment	$320,000	25	$64,000	APP Project Management (2003) and ATO (2011)
Car Park	$ 65,000	25	$13,000	APP Project Management (2003) and ATO (2011)
Beach/Swimming Area	$ 40,000	25	$8,000	APP Project Management (2003) and ATO (2011)
Amenities Building	$220,000	25	$44,000	ATO (2011)
Sewerage Costs	$220,000	25	$44,000	APP Project Management (2003) and ATO (2011)
Potable Water	$ 140,000	25	$28,000	APP Project Management (2003) and ATO (2011)
Power	$190,000	25	$38,000	APP Project Management (2003) and ATO (2011)
Roads and Drainage	$ 350,000	25	$70,000	APP Project Management (2003) and ATO (2011)
Phone Lines	$27,500	25	$5,500	APP Project Management (2003) and ATO (2011)
Lookout Area	$ 37,000	25	$7,400	APP Project Management (2003) and ATO (2011)
Car Park - Watersports	$ 430,000	25	$86,000	APP Project Management (2003) and ATO (2011)
Boat Ramp	$ 290,000	25	$58,000	APP Project Management (2003) and ATO (2011)
Playground	$ 265,000	8	$132,500	APP Project Management (2003) and ATO (2011)
Trail Bike Tracks	$155,000	25	$31,000	APP Project Management (2003) and ATO (2011)
Wetland Areas	$ 35,000	30	$11,667	APP Project Management (2003) and ATO (2011)
Recreation Areas - Day use	$ 430,000	25	$86,000	APP Project Management (2003) and ATO (2011)
Jetties	$76,000	25	$15,200	APP Project Management (2003) and ATO (2011)
Signage	$76,000	12	$25,333	APP Project Management (2003) and ATO (2011)
Motorsport Link Upgrade	$130,000	25	$26,000	APP Project Management (2003) and ATO (2011)
Landscaping and Grassed Areas	$265,000	25	$53,000	APP Project Management (2003) and ATO (2011)
Footbridges	$ 55,000	25	$11,000	APP Project Management (2003) and ATO (2011)
Hall Facility	$300,000	25	$60,000	APP Project Management (2003) and ATO (2011)
Motor Vehicle	$20,990	8	$10,495	APP Project Management (2003) and ATO (2011)

The table A3.6 below provides a summary of the operating costs that would be incurred at the Lake Kepwari development. The costs have been taken from a number of sources including Telstra (2011), the CCH Small Business Guide (2009) and the Water Corporation (2011). All costs are assumed to occur at the end of the year.

Table A 3.5: Summary of operating costs* lake development

Operating Costs	Number	Price per unit	Total Cost	Assumptions
Staff	2	$59,000	$118,000	WA Department of Training (2011).
Telephone Costs				Telstra,(2009)
Local Calls	8,320	$0.15	$1,248	
STD Calls	5,850	$0.16	$936	
Mobile Calls	8,190	$0.40	$3,276	
Business line plus fax/phone plan	1	$491	$491	
Electricity Costs				Western Power, (November 2009)
Supply Charge	1	$96.71	$97	
Running Costs	365	$10.65	$3,887	
Stationary	1	$8,597	$8,597	CCH Small Business Guides, (2006)
Motor Vehicle	1	$4,620	$4,620	CCH Small Business Guides, (2006)
Water Rates	365	$16.68	$6,088	Water Corporation, (2008)

* Operating costs assumed to occur at end of year.

A3.2 Cafe financial analysis

Table A3.7 provides an overview of the cafe development at the lake. While the cafe can only proceed in the lake development proceeds, it is the most profitable development of the ventures discussed.

Table A 3.6: Cafe financial results for a discount rate of 7 per cent

Criteria:	Cafe
Net Present Value @	$1,309,086
Internal Rate of Return	37.9%
Benefit Cost Ratio @	1.41

In table A3.8 a sensitivity analysis of the Cafe venture at Lake Kepwari was undertaken, using a number of different variables to demonstrate the effect on the Net Present Value. The table demonstrates that changing the variables by only small increments can have a profound effect on the Net Present Value. However, the table also illustrates the need to procure a large number of visitors or capture a significant spend per capita to ensure that cafe generates a positive revenue stream, to remain commercial viable and achieve longevity.

Table A 3.7: Sensitivity analysis cafe development (Net Present Value)

Visitors	19,000	21,000	22,724	25,000	27,000
NPV	575,007	969,249	1,309,086	1,757,733	2,151,975
$ Spend per Capita	$12	$14	$16	$18	$20
NPV	189,242	749,164	1,309,086	1,869,008	2,428,930

The table below outlines the number of visitors required to patronise the cafe in order to break even in conjunction with the spend per customer required to achieve the same break even figure. As the table demonstrates, the cafe is the most viable project and does not require either large spend per capita, or a substantial number of visitors to break even.

Table A 3.8: Break even analysis cafe development

Change visitors	**Current Visitors**	**Current NPV**	**Break Even Visitors**
	22,724	$1,309,086	16083
Change spend	**Current Spend Per Capita**	**Current NPV**	**Break Even Spend**
	$16.00	$1,309,086	$11.32

Table A3.10 is a summary of the capital costs and salvage values for the cafe. The costs were drawn from a variety of sources, using figures from the CCH Small Business Guide (2009) and sourcing figures from hospitality industry suppliers including Sydney Commercial Kitchens (2009) and QCC hospitality (2009).

The table also includes the lifespan of the capital costs, which were calculated using the useful life estimates from the Australian Taxation Office (2011). The salvage values have been calculated using the formula of the remaining life dividing it by the life span and multiplying this by the establishment cost (Australian Taxation Office (2011).

Table A 3.9: Summary Capital Costs/ Salvage Value Cafe

Capital Investments	Cost	Life Span	SV	Assumptions
Building and Site Costs	$350,000	25	$70,000	APP Project Management (2003), ABS (2006)
Electricity				Western Power (2009)
Account Establishment Fee	$28			
Connection Fee	$28			
Three Phase Meter New	$240			
Water				Water Corporation of Western Australia (2006)
Service Charge - Water 25mm meter	$722			
Service Charge - Sewerage	$1,283			
Telephone Connection and Fee				
Fixed line connection	$209			
Commercial Coffee Machine	$5,500	8	$2,750	Supreme Coffee Machines (2009)
Commercial Oven	$5,530	10	$0	Sydney Commercial Kitchens (2009)
Commercial Fridges	$4,158	10	$0	Sydney Commercial Kitchens (2009)
Cake Display	$4,741	10	$0	Sydney Commercial Kitchens (2009)
Commercial Deep Fryer	$2,771	5	$0	Sydney Commercial Kitchens (2009)
Commercial Dish Washer	$3,703	8	$1,852	Sydney Commercial Kitchens (2009)
Cash Register	$1,188	10	$0	Sydney Commercial Kitchens (2009)
Commercial Rangehood (Exhaust Fan)	$2,658	8	$1,329	Retravision Australia (2009)
Café furniture				Hillcross Commercial Furniture (2009)
Tables	$2,000	10	$0	
Chairs	$7,000	10	$0	
Cutlery	$2,500	10	$0	
Glassware, Cups,				
Glassware	$356	1	$0	QCC Hospitality, Perth WA (2009)
Cups	$356	1	$0	
Miscellaneous	$5,752	10	$0	QCC Hospitality, Perth WA (2009)

Table A3.11 is a summary of the operating costs of the cafe over the twenty year analysis period of the development. The operating costs have been arrived at using a variety of sources in order to provide a scenario that is as close as possible to market-based realities. As an example marketing costs were arrived at using industry average costs for marketing and advertising which is around 3% of total sales (CCH, 2009), wages costs were based around two employees and the associated costs from the *Liquor and Allied Industries Catering, Cafe and Restaurant Award (1998).* All operating costs were assumed to occur at the end of the year.

Table A 3.10: Summary of operating costs* and assumptions cafe

Operating Costs	**Year 1**	**Year 2**	**Year 3**	**Year 4-18**	**Year 19**	**Year 20**	**Assumptions**
Insurance Costs	$905	$928	$951	*	$1,412	$1,447	National Insurance Brokers Association (July 2006)
Telephone Costs							ABS (2006)
Local Calls	$1,638	$1,679	$1,721	*	$2,555	$2,619	
STD Calls	$582	$597	$612	*	$908	$931	
Mobile Calls	$2,912	$2,985	$3,059	*	$4,542	$4,655	
Electricity Costs							Western Power (2009)
Supply Charge	$97	$99	$102	*	$151	$155	
Running Costs	$5,890	$6,037	$6,188	*	$9,186	$9,415	
Water Costs	$2,030	$2,081	$2,133	*	$3,166	$3,245	CSIRO (2001), Gehrish (2005)
Wages	$93,735	$96,078	$98,480	*	$146,195	$149,849	Liquor and Allied Industries Award (1998)
Marketing Costs	$11,393	$11,678	$11,970	*	$17,769	$18,213	Hales (2005)
Food Costs	$94,938	$97,311	$99,744	*	$148,071	$151,773	Hales (2005)
Business line plus fax/phone plan	$491	$503	$516	*	$766	$785	Telstra (2009)
Total Operating Costs	$214,611	$219,976	$225,475	*	$334,719	$343,087	

* Operating costs assumed to occur at end of year.

A3.3 Watersports financial analysis

The table below outlines the financial impact of using a discount rate of 7 per cent in the watersports development. The table highlights that the facility is marginally profitable over the period of the analysis, however the discount rate is a conservative one and it is more likely that the discount rate used would be higher if it were to be run by a private operator, as they would be requiring higher rates of return for their business.

Table A 3.11: Watersports financial results for discount rate of 7 per cent

Criteria:	
Net Present Value @	$146,296
Internal Rate of Return	14.6%
Benefit Cost Ratio @	1.09

In table below a sensitivity analysis of the watersports venture at Lake Kepwari was undertaken, using a number of different variables to demonstrate the effect on the Net Present Value. The table demonstrates that the entry price to this facility would need to be $30 per vehicle or above to make the business profitable. The higher the entry price, the greater the returns generated over the analysis period. Further, the number of participants needs to be close to 5000 people to have a positive impact on the NPV figures. Clearly, when the facility establishes a reputation and is able to attract a higher number of participants, greater profit can be achieved but should it not be successful and for example attract only 1,000 participants there will be a significant loss, with a NPV of -$1,252,277.

Table A 3.12: Sensitivity analysis watersports (Net Present Value)

Entry price	$20	$25	$30	$35	$40
NPV	-443,096	-148,400	146,296	440,992	735,688
Watersports participants	1,000	3,000	4,784	7,000	9,000
NPV	-1,252,277	-513,074	146,296	965,333	1,704,537

Table A3.14 below details the entry price and number of visitors that would be required for the watersports facility to break even. The variables used for the break even analysis were the price charged to use the facility and the number of visitors to the facility. The break even analysis shows that the breakeven entry price is lower and likewise the number of participants lower than the initial analysis figures.

Table A 3.13: Break even analysis watersports

	Current Entry Price	Current NPV	Break even Entry Price
Change entry price	$30.00	$146,296	$27.52
	Current Visitors	**Current NPV**	**Break Even Visitors**
Change number of visitors	4,784	$146,296	4678

The table below summarises the capital costs at salvage values that would occur at the watersports development at Lake Kepwari. The costs were arrived at using a variety of sources, including watersports sales operators, Telstra and the Water Corporation in order to provide an accurate assessment of capital costs.

The table also includes the lifespan of the capital costs, which were calculated using the useful life estimates from the Australian Taxation Office (2011). The salvage values have been calculated using the formula of the remaining life dividing it by the life span and multiplying this by the establishment cost (Australian Taxation Office (2011).

Table A 3.14: Summary capital costs/ salvage value watersports

Capital Investments	Number	Price	Cost	Life Span	Salvage Value	Assumptions
Hire Shed	1	$52,000	$52,000	25	$10,400	APP Project Management (2003), WA Department of Sport and Tourism (2009)
Jet Ski Purchase	5	$15,000	$75,000	5	$0	APP Project Management (2003), WA Department of Sport and Tourism (2009)
Catamaran Purchase	5	$8,690	$43,450	10	$0	APP Project Management (2003), WA Department of Sport and Tourism (2009)
Windsurfer' s Purchase						
Board	10	$1,296	$12,960	10	$0	APP Project Management (2003), WA Department of Sport and Tourism (2009)
Sail	10	$590	$5,900	3	$0	APP Project Management (2003), WA Department of Sport and Tourism (2009)
Canoe Purchase						
Canoe	10	$ 980	$9,800	15	$6,533	APP Project Management (2003), WA Department of Sport and Tourism (2009)
Surfski	10	$540	$5,400	15	$3,600	APP Project Management (2003), WA Department of Sport and Tourism (2009)
Inflatables Purchase	10	$159	$1,590	3	$0	APP Project Management (2003), WA Department of Sport and Tourism (2009)
Ski Purchase	5	$479	$2,395	3	$0	APP Project Management (2003), WA Department of Sport and Tourism (2009)
Electricity						Western Power (2005)
Account Establishment Fee	1	$28	$ 28			
Connection Fee	1	$28	$ 28			
Three Phase Meter	1	$240	$240			Telstra (2005, 2009)
Telephone Connection and Fee						
Fixed line connection	1	$209	$ 209			
Water						Water Corporation of Western Australia (2006)
Service Charge - Water 25mm	1	$722	$722			
Service Charge - Sewerage	1	$1,283	$1,283			
Cash Register	1	$1,188	$1,188	10	$0	Sydney Commercial Kitchens (2009)
Motor Vehicle	1	$20,990	$20,990	8	$10,495	CCH Small Business Guide (2006)

The table below summarises the operating costs incurred at the watersports development, Lake Kepwari. The operating costs have been arrived at using a range of sources in order to generate market based assumptions in the provision of these costs. Sources included CCH small Business Guide (2009), Telstra (2009) and electricity charges from Western Power (2009). All operating costs are assumed to occur at the end of the year.

Table A 3.15: Summary of operating costs* watersports

Operating Costs	**Year 1**	**Year 2**	**Year 3**	**Year 4-18**	**Year 19**	**Year 20**	**Assumptions**
Insurance Costs	$1,481	$1,518	$1,556	*	$2,310	$2,368	National Insurance Brokers Association (July 2006)
Telephone Costs							Telstra (2005)
Local Calls	$1,664	$1,706	$1,748	*	$2,595	$2,660	
STD Calls	$936	$959	$983	*	$1,460	$1,496	
Mobile Calls	$4,368	$4,477	$4,589	*	$6,813	$6,983	
Electricity Costs							Western Power (2005)
Supply Charge	$97	$99	$102	*	$151	$155	
Running Costs	$3,887	$3,984	$4,084	*	$6,063	$6,214	
Maintenance Costs	$5,500	$5,638	$5,778	*	$8,578	$8,793	
Water Costs	$2,029	$2,080	$2,132	*	$3,165	$3,244	Western Australia Water Corporation (2005)
Wages	$32,747	$33,566	$34,405	*	$51,074	$52,351	Minimum Conditions of Employment Act (1993)
Fuel Costs	$31,200	$31,980	$32,780	*	$48,661	$49,878	Based on Petrol Averages (2006)
Business line plus fax/phone plan	$491	$504	$516	*	$766	$786	
Motor Vehicle Costs	$9,388	$9,623	$9,863	*	$14,642	$15,008	CCH Small Business Guide (2006)
Total operating costs	$93,789	$96,133	$98,537	*	$146,278	$149,935	

* Operating costs assumed to occur at end of year

A3.4 Combined lake development financial analysis

Table A3.17 below provides an overview of the combined development options for the lake, presenting the total outcomes if all three options were undertaken at once. The end result is a project that would still prove costly for any government or community attempting to undertake it without any form of partnership.

Table A 3.16: Overall financial results for combined developments at Lake Kepwari for discount rate of 7 percent

Criteria	Lake	Cafe	Water	Total
Net Present Value @	-$2,680,860	$1,309,086	$146,296	-$1,225,478
Internal Rate of Return	-1.8%	37.9%	14.6%	3.8%
Benefit Cost Ratio @	0.58	1.41	1.09	0.89

Table A3.18 is a sensitivity analysis of the combined lake development using a number of variables in the process of delivering a number of different results.

Table A 3.17: Sensitivity analysis overall results for combined developments at Lake Kepwari (Net Present Value)

Discount rate	3%	5%	7%	9%	11%
NPV	431,642	-516,090	-1,22,5478	-1,765,176	-2,182,406
Lake entry price	$8	$10	$12	$14	$16
NPV	-2,358,923	-1,792,201	-1,225,478	-658,755	-92,032
Visitors to development	19,000	21,000	23,000	25,000	27,000
NPV	-2,903,371	-2,064,425	-1,225,478	-386,531	452,416
Average cafe spend	$8	$12	$16	$20	$24
NPV	-3,465,166	-2,345,322	-1,225,478	-105,634	1,014,210

Different discount rates were chosen to demonstrate their effect on the Net Present Value results. It was decided to use 3% as the lowest discount rate, down 4% from the original discount rate of 7% . The table illustrates the effect of a change in the discount rate plus or minus 2%, up to 11% and down to 3%. The higher rates demonstrate how vulnerable the development would be to higher discount rates and the effect this would have on the bottom line.

The park entry price likewise was changed using a figures that whereas $2 plus or minus the base price, the lowest figure being $8 and the highest being $16. Although the $16 entry price comes close to breaking even, it is clear that an entry of between $18=$20 would be required to achieve a positive NPV. A similar approach was adopted for the visitor cars to the lake and the average cafe spend, as the different variables reflect how minor changes to either vehicle numbers or cafe spend can impact on the Net Present Value result, assuming all other variables remain constant.

Table A3.18 below provides the break even analysis of the combined lake development as a way of providing an idea of what entry price would be required, the number of cars required to visit the lake and the average cost per person required at the cafe for the combined development to break even.

Table A 3.18: Break even analysis – overall results for combined developments at Lake Kepwari

	Current entry price	**Current NPV**	**Break even entry price**
Entry price	$12.00	-1,225,478	$22.47
	Current visitors (cars)	**Current NPV**	**Break even visitors (cars)**
Visitor numbers	23,000	-$1,225,478	30,825
	Current spend per capita	**Current NPV**	**Break even spend**
Cafe spend	$16.00	-$1,225,478	$26.60