



Papua New Guinea

CONSTITUTIONAL & LAW REFORM COMMISSION

**Review of
Environmental and Mining
Laws Relating to
Management and Disposal
of Tailings**

ISSUES PAPER

You are invited to provide a
submission or comment on this
Issues Paper

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Terms of Reference

CLRC Reference No 6: Review of Environmental and Mining Laws Relating to the Management and Disposal of Tailings.

I, Bire Kimisopa, Minister for Justice, having regard to:

- the various concerns and comments raised by indigenous Papua New Guineans living within mine tailings disposal areas, including waterways and coastal areas over mining waste management and disposal into the environment and the consequential harm to the environment;
- recent concerns and reports on the high toxicity levels of hazardous chemicals and heavy metal traces which have been found to occur in the sample of population in mining waste disposal areas; and
- the need to systematically and properly consider these concerns and the need to take corrective measure should these concerns be found to be so;

by virtue of the power conferred on me by Section 12(2) of the *Constitutional and Law Reform Commission Act 2004* (the Act) refer and direct the Constitutional and Law Reform Commission (CLRC) as follows:

(1) Enquire into and report and recommend in accordance with Section 12(2) of the Act, on the systemic development and reform of laws relating to the management and disposal of tailings including containment and treatment of toxic chemicals and heavy metal traces consistent with industry and world best practice standards;

(2) In performing its functions in relation to this reference, the CLRC will consider:

(a) whether the *Environment Act 2000*; the *Mining Act 1992* and such other legislation provide effective mechanisms in their current form to offer and secure the health and wellbeing and lives of our people and the environment;

(b) whether the currently stated minimum allowable levels of all pollutants into the river systems, water ways, sea, and such other parts of the environment under all relevant legislation such as the *Environment Act 2000* offer adequate and effective levels of protection for the safety and well being of the natural environment and the people; and where necessary make appropriate recommendations and propose necessary reform;

- (c) for comparative purposes, any relevant regimes or systems of similar nature, including industry best practices endorsed by relevant professional bodies and such other international agencies – to inform this reference; and
- (d) any relevant research or developments, whether in this or other jurisdictions on the matters of enquiry.
- (3) The CLRC shall identify and consult with relevant stakeholders including but not limited to the Department of Environment and Conservation; the Department of Mining; the Department of Petroleum and Energy; the Chamber of Mines and such other industry groups; all mining and petroleum projects operating in the country; relevant technical experts within and outside the country; and such others.
- (4) The CLRC shall report to me within 15 months of the date of publication of this reference in the Government Gazette.
- (5) This reference shall be referred to as CLRC Reference No. 6: Review of Environmental and Mining Laws Relating to the Management and Disposal of Tailings.

Dated this 4th day of July 2007

HON. BIRE KIMISOPA, MP
Minister for Justice

Making a Submission

The CLRC seeks any form of submission from a broad cross-section of the community, as well as those with special interest in the inquiry.

Submissions are usually written, but there is no set format and they need not be formal documents. Where possible, submissions in electronic format are preferred.

It would be helpful if comments addressed specific proposals or numbered paragraphs in this Issues Paper.

Open inquiry policy

In the interests of informed public debate, the CLRC is committed to open access to information. As submissions provide important evidence to each inquiry, the CLRC may draw upon the contents of a submission and quote from them or refer to them in its publications.

Submissions should be sent to:

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The closing date for submissions in response to this Issues Paper is 30th September, 2013.

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1: Introduction to the Inquiry

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1.1 Introduction to the Reference

1.1.1 The Constitutional and Law Reform Commission

The Constitutional and Law Reform Commission (CLRC), was formerly the Constitutional Development Commission (CDC) and the Law Reform Commission (LRC). The CLRC was established on March 4, 2005 under Section 12 of its enabling legislation, the *Constitutional and Law Reform Commission Act 2004*.

The CLRC receives references from the Minister for Justice to conduct its review and propose legislative changes where appropriate, concerning laws other than constitutional laws; or receives references from the Head of State acting on advice from the National Executive Council to conduct its inquiry and review into any part of the *Constitution* and Organic Laws and propose appropriate constitutional law reform where and when considered appropriate.

1.1.2 Background of this Reference

This Reference was issued by the then Minister for Justice, Hon. Bire Kimisopa, in 2007, in response to the publicity given to various presentations by Sylvester Kotapu of his study of the alleged toxicity levels in the river system and surrounding environment of the Angabanga river owing to tailings waste disposal from the Tolokuma Gold Mine.¹

It is against this background that the Justice Minister, Hon. Bire Kimisopa, issued the reference.

¹ Sylvester Kotapu & Associates, *Heavy Metal Poisoning of the Indigenous People* (Powerpoint dated 12.03.2007, 2007)

1.1.3 Objectives of this Reference: CLRC Reference No 6: Mine Tailings

The primary objective of this Reference is to inquire into and review the systemic development and reform of laws relating to the management and disposal of mine tailings; including containment and treatment of toxic chemicals and heavy metals with the intention of making them consistent with the industry and world best practice standards. In performing its functions, the CLRC will consider:

- whether the *Environment Act 2000*; the *Mining Act 1992* and such other legislation provide effective mechanisms in their current form to offer and secure the health and well-being and lives of our people and the environment;
- whether the current stated minimum allowable level of all pollutants into the river systems, waterways, sea, and such other parts of the environment under all relevant legislation such as the *Environment Act 2000* offer adequate and effective levels of protection for the natural environment and safety and well-being of the people; and where necessary make appropriate recommendation and propose necessary reform;
- for comparative purposes; any relevant regimes or systems of similar nature, including industry best practices endorsed by relevant professional bodies and such other international agencies; and any relevant research or developments, whether in this or other jurisdictions on the matters of enquiry.

1.1.4 The CLRC Terms of Reference Process

The CLRC Terms of Reference (TOR) process is as indicated below:

- i. Reference issued by the Minister for Justice or the Head of State
- ii. Drafting of the Issues Paper
- iii. Launching of the Issues Paper
- iv. Formation of a Working Committee
- v. Public Consultation
- vi. Draft Report
- vii. Seminar
- viii. Final Report
- ix. Submission to the Minister for Justice

- x. Minister for Justice presents it to the Parliament

The TOR process begins with the issuance of a Reference from the Minister of Justice or a Directive from the Governor General. An Issues Paper, such as this, is then drafted by the Commission with the objective of establishing the issues that the Commission intends to consider relating to the review of relevant laws under the particular reference.

1.1.5 Purposes of this Issues Paper

The primary purpose of this Issues Paper is to provide background information and context on the subject matter of this Reference. It then asks a series of questions designed to stimulate discussions and responses from affected stakeholders and the general public. We caution that these questions should not be seen as dictating the issues falling within this Reference nor are they indicative of the final outcome of this Reference.

As indicated above, the Issues Paper also states the time frame for this review and invites submissions on any aspect or issue pertinent to this Reference. Accordingly, the CLRC welcomes submissions on the issues identified in this Paper and other issues or matters which stakeholders consider pertinent and fall within the subject-matter of this TOR.

1.1.6 Structure of this Paper

This Paper is structured as follows:

- Chapter 1 provides the background to this Reference and the general concerns that have led to it.
- Chapter 2 provides a background of the nature and composition of mine tailings and provides an overview of the riverine tailings disposal (RTD) and the deep-sea tailings placement (DSTP) methods and the general concerns relating to them.
- Chapter 3 provides a background of mine tailings disposal methods employed by past and present mines in PNG and provides a case study of the Lihir and Ok Tedi mines which employ DSTP and RTD methods respectively.
- Chapter 4 looks at the current law, policy and practice governing mine tailings disposal in PNG with consideration of international environmental law.
- Chapter 5 provides a comparative study of the laws governing mine tailings in other countries such as Australia, Canada and South Africa.

- Chapter 6 discusses the existing and new technologies and the possibility of alternate forms of tailings disposal or containment to that of RTD and DSTP.
- Chapter 7 sets out the preliminary issues for this Reference which the Commission considers relevant for the inquiry which will then be elaborated upon in the Draft Report after the process of public consultation.

2. Nature of Mine Tailings

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2.1. Introduction

There is a continuing urgent global need for countries, including PNG to implement sustainable development strategies, where economic, environment and livelihoods (social) are planned and implemented through a holistic approach. With particular regard to, mineral resources (economic), environmental and social issues associated with their extraction are receiving greater attention throughout the world. Mining is one of the most important economic sectors in PNG but although it contributes significantly to the people it also causes negative impacts to the environment and the health and well being of the people. It is essential for our livelihoods as well as the environment and the mining sector that the best mining practices and technologies are developed and adopted.²

Mining produces large volumes of waste, millions of tonnes, which includes overburden, waste rock and tailings (collectively referred to as “mine waste”).³ Tailings is the residual slurry that remains once ore is processed.⁴ What is an ore? An ore deposit is a mass of rock (or more correctly, portions of a mineral resource) from which a metal or mineral can be profitably produced.⁵ The process of

² The Scottish Association for Marine Science, “Independent Evaluation of Deep-Sea Mine Tailings Placement (DSTP) in PNG: Draft Guidelines for Deep-Sea Tailings Placement,” (Project Number: 8.ACP.PNG.18-B/15; SAMS Research Services Limited, 2010) 1. (Hereafter referred to as SAMS).

³ Ibid.

⁴ Martha Miranda, Philip Burris, Jessie Froy Binkang, Phil Shearman, Jose Oliver Briones, Antonio La Vina, Stephen Menard, “Mining and Critical Ecosystems: Mapping the risks” (*World Resources Institute*, 2003) 8 <<http://www.wri.org/publication/mining-and-critical-ecosystems>> accessed 25 June 2011.

⁵ “The 2004 Australasian Code for Reporting Exploration Results, Mineral Resources and Ore Reserves” (*Australian Joint Ore Reserves Committee (JORC) 2004*) para 28 <www.jorc.org> accessed 26 July 2011; Dr Willard Lacy, “An Introduction to Geology and Hard Rock Mining” (Science and Technology Series, *Rocky Mountain Mining Law Foundation*)

extracting minerals from an ore in open-pit or underground mine usually involves the use of explosives to cut into the ore and chemical reduction to separate the mineral from the ore.⁶ Once the mineral is extracted, the rest of the ore and chemical waste becomes tailings.

Mine waste poses an environmental threat because of both its volume and its toxicity. In terms of volume, around 99 tones of waste is produced for every ton of copper.⁷ This ratio is even higher for gold mining.⁸ The most toxic element of mine waste is contained in mine tailings. Mine tailings commonly contain sulphides as well as metals that occur naturally in the ore body, including cadmium, copper, iron, lead, manganese, mercury, silver, and zinc.⁹

Tailings disposal is considered one of the largest environmental risks associated with mining.¹⁰ Conventional on land impoundment is the most common way of storing tailings.¹¹ This involves the use of ponds or tailings dams to store the tailings and to retain water.¹² There are several other methods of storing or disposing tailings, including co-disposal, input storage, dry stacking and surface

<http://www.rmmlf.org/scitech/lacy/lacy.htm#TABLE OF CONTENTS> accessed 25 July 2011.

⁶ Leanne Farrell, Payal Sampat, Radhika Sarin and Keith Slack, “Dirty Metals: Mining, Community and the Environment” (*Earthworks and Oxfam America* 2004) 4-5 <www.nodirtygold.org/pubs/DirtyMetals_HR.pdf> accessed 25 July 2011.

⁷ Connie Sue M Martin, “The Implications of disposal of waste in international waters” (*Bullivant, Houser, Bailey Attorneys at Law* 2008) 2 <<http://www.bullivant.com/Implications-of-Disposal-of-Mining-Waste>> accessed 25 July 2011.

⁸ Ibid.

⁹ Catherine Coumans, “STD Toolkit: Submarine Tailings Disposal,” (MiningWatch Canada, 2002) <<http://www.miningwatch.ca/submarine-tailings-disposal-toolkit>> accessed 29 October 2012.

¹⁰ See n4 at p33; Extractive Industries Review, “Striking a better balance: Final Report of the Extractive Industries Review” (*World Banking Group* 2003), 31, <<http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2004/07/19/00001200920040719140227/Rendered/PDF/294540PNG0Eval10industries01public1.pdf>> accessed 20 June 2011. Note that for the purposes of this Paper, the terms “tailings storage” and “tailings disposal” will be used interchangeably.

¹¹ Andrew Ninkama Gunua, “Riverine and Deep Sea Tailings Disposal in Papua New Guinea: The Causes, Effects and Alternate Solutions,” (Masters in Science thesis, Curtin University of Technology 2010), 11. (*Used with the author's permission.*)

¹² Jon Engels, “Conventional Impoundment Storage- The Common Methods” (*Tailings.info*) <<http://www.tailings.info/conventional.htm>> accessed 25 July 2011. See also n6 at p5.

waste tailings disposal.¹³ There are environmental risks associated with all these methods, however, the most criticised and environmentally unfriendly method of tailings disposal are “offshore tailings disposal” which involve tailings discharged directly into rivers, lakes and seas.¹⁴ Riverine tailings disposal (RTD) and Deep-sea tailings disposal (DSTP) are off-shore methods of tailings disposal currently employed by most of the operating mines in PNG.

RTD involves releasing tailings directly into the river systems. It is regarded as so environmentally unfriendly that many developed nations such as Australia, Canada and the US have effectively banned it and the World Banking Group’s 2003 Extractive Industries Review consultation recommended that “no WBG-supported mining project should use riverine tailings disposal.”¹⁵ Since 2005 only four mines continue to employ this method, the Ok Tedi, Porgera and Tolokuma mines in PNG and the Grasberg mine in West Papua (Indonesia).¹⁶

DSTP involves discharging tailings into the sea at a minimum depth of 100m, below what is known as the euphotic zone. The euphotic zone is defined as, “the upper illuminated zone of the aquatic ecosystems, it is above the compensation level and therefore the zone of the effective photosynthesis.”¹⁷ It lies from about 30m in coastal waters to 100-200m in open ocean waters.¹⁸

Tailings disposal into the ocean is a concept that has been around for many years, however, the idea of “deep sea” tailings disposal, that is, of disposing of tailings between 800-1000m from the shore and at a depth below the euphotic zone, was suggested in literature published in 1994.¹⁹ Only a handful of mines around the world use DSTP, in 2002 only 7 mines practised DSTP, including the then operational Misima mine and the Lihir mine.²⁰ At the time there were 22 mines in the world proposing to use DSTP including Simberi, Ramu Nickel and Woodlark in PNG.²¹ Simberi began operations in 2006 and Ramu Nickel is to begin operation in 2013 and won a court battle in 2011 to use DSTP. Woodlark is yet to begin operations.

¹³ See n11 at pp 10-13.

¹⁴ See n6 at p6 also see Jon Engels, “Offshore Disposal- River, Lake and Sea Discharge” <<http://www.tailings.info/offshore.htm>> accessed 25 July 2011

¹⁵ See *World Banking Group*, n10 at p31.

¹⁶ *Ibid.* See n6 at p6 and n4 at p37.

¹⁷ European Environment Agency, “Environmental Terminology and Discovery Service,”

<http://glossary.eea.europa.eu/terminology/concept_html?term=euphotic%20zone> accessed 8 November 2012.

¹⁸ *Ibid.*

¹⁹ See n2 at p17.

²⁰ See n9 at p2.

²¹ *Ibid.*

This paper will provide detailed information about the nature and composition of mine tailings and the RTD and DSTP methods of mine tailings used in PNG as well as alternative technologies used by other countries for comparative purposes. The objective of this paper is to set out the pressing public concerns related to mine tailings disposal in PNG, especially the RTD and DSTP methods, and explore ways to address these concerns primarily through legislation.

2.2 Nature of Mine Tailings and General Environmental Concerns

One of the foremost online sources for information on mine tailings is the *Tailings.Info* website which was created as part of a PhD thesis regarding management of tailings waste by Jon Engels from the University of Leeds (United Kingdom).²² Engels provides clear definitions for the terminology related to mine tailings, as well as a definition of the nature and composition of mine tailings itself.

To understand the nature of mine tailings, an understanding of the process of extracting valuable minerals must first be obtained. There are two basic kinds of mining:

- Open-pit mines that can be many kilometres wide; and
- Underground mines that can extend kilometres below the surface of the earth.²³

The following five materials are found in open-pit mining operations and in some instances underground mines. Each is managed differently.

Overburden is made up of soil, gravel and other loose materials that cover the surface of a mine site. It is often used as a construction material during mine development or may be stored in large piles and used after mining is complete to restore natural conditions. (Found in open-pit and some underground mines)

Ore is rock that contains high concentrations of valuable or economic minerals- such as gold, copper, molybdenum, and silver. Once it is removed from an open-pit, it is crushed and processed/reduced at an on-site milling facility

Mine/waste rock is solid material removed from an open pit that does not contain enough minerals to be considered ore. It is stored on site and may be used to construct mine facilities- such as roads and tailings storage area. Some rock can be reactive, which means it produces a mild acid when exposed to air and water.

²² See n12.

²³ Scott Cardiff, Catherine Coumans, Ramsey Hart, Payal Sampat and Bill Walker, "Troubled Waters: how Mine Waste Dumping is Poisoning Our Oceans, Rivers and Lakes" (Earthworks and MiningWatch Canada, 2012) 6.

Mineral concentrate is a mixture of water and finely ground rock that usually contains about 80 to 90 percent of the economic value minerals present in ore. Once excess water is removed and sent to the tailings ponds, mineral concentrate is transported from the mine site for further refining.

Tailings are a mixture of water and finely ground rock that is left over once mineral concentrate is removed through reduction. They should be permanently stored in secure facility at the mine site. Tailings usually contain about 10 to 20 percent of the economic minerals that could not be recovered from the ore.²⁴

2.3 Composition of Tailings

Most mines operate on ore which is very low grade in terms of the contained valuables. Getting the valuable mineral out of the ore is a major exercise in chemical ingenuity. This process leaves behind mine/waste rock and tailings. To provide an indication of how much waste is produced, it is estimated that 99 tonnes of waste is produced for every ton of copper.²⁵ This ratio is even higher for gold mining.²⁶

All open pit mines (but not underground mines) have to remove overburden rock to clear the mine site and both types of mines produce mine/waste rock which is rock that does not contain enough valuable mineral to be ore. The waste left after the ore is processed is the tailings and it consists of finely ground and chemically leached sand or silt size reject material from the treatment plant, almost always in a thick muddy slurry with wash water.²⁷

The composition of tailings is directly dependent on the composition of the ore and the process of mineral extraction used on the ore. However mine tailings commonly contain sulphides as well as metals that occur naturally in the ore body, including cadmium, copper, iron, lead, manganese, mercury, silver, and zinc. An overview of all the past and present operating mines in PNG, and a case study on the Lihir and Ok Tedi mines in Chapter 3 will provide a comprehensive understanding of the exact composition of tailings waste that is being released into various river systems and oceans and the reasons this raises environmental concerns.

2.4 General concerns with Tailings Waste

Tailings waste is a concern because they are highly toxic, containing chemicals used in the extraction process. The extraction process involves chemicals such as cyanide and organic complexes which are applied to the ore to extract the valuable

²⁴ Jon Engels, "What Are Tailings?- Their nature and production" (*Tailings.info*) <<http://www.tailings.info/basics/tailings.htm>> accessed 1 November 2012.

²⁵ See n7 at p2.

²⁶ Ibid.

²⁷ See n24.

minerals within it.²⁸ The exact composition of tailings depends on the composition of the ore and the process of mineral extraction used on the ore as will be discussed in the next chapter.²⁹

As mentioned previously, tailings disposal is a major concern because of both its toxicity and volume. The main chemical/toxicity concerns that arise from DSTP and RTD are:

- Cyanide toxicity.
- Heavy metal contamination.
- Acid mine drainage.³⁰

The main concerns relating to the sheer volume of tailings (and waste rock) disposed through RTD and DSTP are:

- Alteration of the physical environment (due largely to the volume of waste).
- Changes in species composition/abundance and biodiversity.
- Increased metal bioaccumulation.³¹

The likely occurrence and extent of the effect of these toxicity and volume on the concerned environment can be assessed on an individual basis and depends on the particularities of the tailings treatment process, as well as the location of the processing site and final deposit area and the characteristics of the deposit site and the general surrounding area (ie., temperature and rainfall). Chapter 3 will take a look at some of the concerns surrounding the operations of Deep Sea Tailings Placement and Riverine Tailings Disposal mines in PNG.

²⁸ Robert Moran, "Riverine and sub-sea disposal of tailings and associated wastes from mining operations around the world: the need for detailed assessment and effective control" (Greenpeace International, 2008) 2 <<http://www.sjofartsverket.se/pages/15453/31-INF14.pdf>> accessed 9 November 2012.

²⁹ Department of Industry, Tourism and Resources (Australia), "Leading Practice Sustainable Development Program for the Mining Industry: Tailings Management" (2007) 1 <<http://www.ret.gov.au/resources/Documents/LPSDP/LPSDP-TailingsHandbook.pdf>> accessed 9 November 2012.

³⁰ SAMS, "Independent Evaluation of Deep Sea Mine Tailings Placement (DSTP) in PNG: A Review and Evaluation of Marine Environmental Information on Deep Sea Tailings Placement with Particular Reference to Lihir and Misima Mines, Papua New Guinea," (Project Number: 8 ACP PNG.18-B/15; SAMS Research Services Limited, 2010) 15-16.

³¹ *Ibid*, p25. Note although stated in reference to DSTP, it can arguably apply equally to RTD.

3. Mine Tailings Practice in PNG

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3.1 Introduction

This Chapter will provide a brief overview of some of the existing and closed mines in PNG that have employed DSTP and RTD. This will be followed by a case study of the Lihir and Ok Tedi mines which employ DSTP and RTD respectively. All existing mines operating and closed mines in PNG are open pit mines except for Tolukuma and Kainantu which are underground operations.

3.2 Past and present mines in PNG

3.2.1 Bougainville

The huge Panguna Copper mine on Bougainville operated from 1972 to 1988 and was forced to close in 1989 after continuous attacks by secessionist. It was operated by Australian company Rio Tinto. The mine operated under its own legislation, the *Mining (Bougainville Copper Agreement) Act 1967*.

Bougainville's mine tailings were discharged down the Jaba River and into the Empress Augusta Bay while the spoil and overburdens were piled up in waste dumps in the vicinity of Panguna. Leachate from waste dumps and mine tailings were concerns that continued to be raised together with royalty and equity issues that led to the Bougainville conflict in 1989 lasting a decade. In 1988-1989, a tailings pipeline was built to divert into the Empress Augusta Bay but because of the conflict this was not completed.³²

3.2.2 Ok Tedi

Ok Tedi is an open pit gold and copper mine that began operations in 1984 and expects to continue until 2022. Ok Tedi, as of February 2011, is a wholly PNG owned mine after Australian company BHP Billiton divested its shares to the Papua New Guinea Sustainable Development Program Limited (PNGSDPL). This occurred after long term environmental concerns were raised about the mine.³³ Ok Tedi's operations are regulated under its own legislation, the *Ok Tedi Mining (Safety) Act* and the nine Supplementary Agreements Acts.

Ok Tedi uses the RTD method of tailings disposal and has come under widespread criticism for this. The case study on the Ok Tedi mine later on in this chapter elaborates on the concerns surrounding RTD at the Ok Tedi mine.

In an environmental report commissioned by the Ok Tedi mine in 2006, it was found that the disposal of tailings into the Ok Tedi and Fly Rivers has caused environmental problems including more than 1,500 square kilometers of deforestation.³⁴ Deforestation is expected to increase to at least 3,000 square kilometers, and to last for more than 50 years along some parts of the river. Much

³² Ibid, pp20-21.

³³ "PNG Sustainable Development Ltd" Ok Tedi Mining <<http://www.oktedi.com/sustainable-development/png-sustainable-development-program-ltd>>15 June 2011.

³⁴ Alan Tingay, "The Ok Tedi Mine in Papua New Guinea: Report on Environmental and Health Issues," Community Mine Continuation Agreement Review 2006; Nancy Sullivan "Nineteen years and counting in Papua New Guinea: We Remember Dr Tingay's Ok Tedi Report", (Blog, 14 January 2013).

of this area will not return to tropical rain forest, but permanently transform into savannah grasslands.

Further that fish populations have declined by 95% in the Ok Tedi River, 85% in the upper middle Fly River and by 60% in the lower middle Fly. The number of fish species in the Ok Tedi and Fly River system, which included many endemic species, has also declined by 30%. In recent years the mine has suffered problems of Acid drainage allowing acidic waste and environmentally toxic metals to leach into the river. The ore body currently exploited by the mining operation is high in pyrites, which become acidic when exposed to oxygen. Acid drainage can render large areas inhospitable to organic life for decades or centuries.³⁵

As a result of this environmental damage, legal action was taken against BHP Biliton by the local population in 1994 (in Australia) which resulted in an out of court settlement to the tune of AUD\$ 110 million. The details and history of this case are noted in Annex 1 of this paper.

3.2.3 Mt Victor- Kainantu

Mt Victor situated near Kainantu was a small open pit gold mine that operated from 1987 to 1990 by Niugini Mining Limited, the mine operated under the repealed *Mines and Works Regulation Act 1935* and the *Environmental Planning Act 1978*.

In 1990, the mine pit was rehabilitated with important tree species identified by the local landowners as having a livelihood and timber usage. The mine tailings containing cyanide was placed in a tailings dam that was detoxified before being discharged into the Tutubiroa creek. Both the Department of Environmental and Conversation and Niugini Mining Limited monitor the site. However the current state of the tailings dam is unknown.³⁶

3.2.4 Misima

Misima was a large scale, open pit gold and silver mine located within the Louisiade Archipelago. Operations began in 1989 and the mine was operated by Placer Dome, a Canadian company.³⁷

Mining in Misima was an open pit operation where waste materials and overburden were placed in an eroding waste dump that released sedimentation into the ocean. Mine tailings were discharged through a submarine tailings disposal at a depth of 118 metres below sea level. The mine however closed in 2004 and rehabilitation of

³⁵ Ibid.

³⁶ Anthony Williamson and Graeme Hancock (eds), *The Geology and Mineral Potential of Papua New Guinea* (2005) 50
<<http://www.infomine.com/library/publications/docs/PapuaNewGuinea2005.pdf>>
accessed 20 January 2012.

³⁷ See n30 at pp31-32.

the mine site is continuing until the process of satisfying government regulations are achieved.³⁸

3.2.5 Tolukuma

Tolokuma began operations in 1995. Ownership changed over the decade and, by 2006, Tolukuma was owned and operated by Emperor Gold Mines Ltd and in 2008 was acquired by Petromin PNG Holdings Ltd. The mine is now 100% owned by the State. The estimated remaining mine life is four years.

Mining in Tolukuma is an underground operation, 100 km north of Port Moresby. The mine is a high-grade, low-capacity operation. The mine workings are processed through a closed circuit semi-autogenous mill and tailings from this are discharged into the upper reaches of the Angabunga River.³⁹ There have been two prominent incidents since the Tolukuma operation, where cyanide spillage and public health issues have arisen.⁴⁰

A report produced by Oxfam in 2005 details high levels of arsenic and other metals in the drinking water of those living downstream from the mine, near the Angabunga river.⁴¹

3.3.6 Porgera

Porgera Gold Mine is both an open pit and underground workings. Mining is regulated under the *Mining Act* and the former *Environmental Planning Act*. Mine tailings are detoxified where residual cyanide levels are reduced before being discharged into the Porgera River. Waste rock and overburden is dumped at the Anawe and Anjolek erodible dump sites where materials are eroded into the Porgera River.⁴² As per its Environmental Plan, Porgera monitors its sediment load into the Strickland River at designated stream gauging stations (SG) where compliance limit on sediment load and other parameters are to be checked regularly for compliance.⁴³

³⁸ Id, pp.30-38.

³⁹ Department of Environment and Conservation, "Environmental Policy and Planning Process in Relation to Mining in Papua New Guinea," (PNG Geology, Exploration and Mining Conference 1991) 240.

⁴⁰ See n1.

⁴¹ A & S.R Tingay Pty Ltd Environmental Scientists, "Arsenic and Selected Metal Levels in the Domestic Water Supplies of the Mekeo Villages near the Angabunga River, Papua New Guinea," (Oxfam Australia, 2006).

⁴² Porgera Joint Venture "Riverine Tailings and Waste Management" 3 <<http://www.barrick.com/files/porgera/Porgera-Riverine-Tailings-and-Waste-Rock-Management.pdf>> accessed 22 January 2013.

⁴³ Ibid.

Barrick (PNG) Ltd which now owns and operates the mine has also begun a thickened tailings waste disposal system since 2011. The plant process removes portions of the coarser content of the tailings mixture; cement is then added to these coarser solids and the mixture is used to fill the voids in the underground mine, a process known as “cemented paste backfill.” It aims to reduce the total quantity of the tailings solids discharged by approximately eight percent for permanent storage underground, and create a finer tailings mix in general, which tends not to settle onto the riverbed, and is more likely to be carried through the river system as wash load, rather than being retained in natural accretion zones.⁴⁴ The success of this system is still pending.

3.2.7 Lihir

The Lihir Gold Mine is an open-pit mine owned and operated by the Australian company, Newcrest Mining. It has been in operation since 1997. It practices DSTP and deposits an estimated 5 million tonnes of tailings waste a year into the Luise Harbour.⁴⁵ The tailings are deposited about 1.5km from the shore at a depth of 120m.⁴⁶

The concerns raised regarding Lihir will be looked at in the case study to follow later in this Chapter. However, it is interesting to note that an incident (tailings spill) happened in 2000 which resulted in five (5) tonnes of tailings solids containing treated cyanide being released into the Luise Harbour. The mine claimed that no significant environmental damage occurred.⁴⁷

3.2.8 Kainantu

Kainantu Gold Mine commenced operation in 2006 and after numerous project difficulties changed its ownership from Highlands Pacific to Barrick. Mining was underground along eight levels where ore was mined out and transported to the surface for processing. All mine tailings from the floatation process were placed in a tailings dam with a wall height of 22 metres and is designed to cater for tailings for a period of more than 15 years of operation.⁴⁸ The mine is currently under care and maintenance.

⁴⁴ Barrick Gold Corporation “Tailings Management at Pogera” 5-6 <<http://www.barrick.com/files/pogera/Tailings-Management.pdf>> accessed 18 January 2013.

⁴⁵ See n23 at p14.

⁴⁶ Ibid.

⁴⁷ “Cyanide spill at PNG's Lihir gold mine” (ABC Radio Australia, 29 June 2000) <www.radioaustralia.net.au/.../2000...spill-at...lihir-gold-mine/594906> accessed 22 January 2013.

⁴⁸ See n36 at pp90-92.

3.2.9 Ramu Nico

The Ramu Nickel Cobalt Mine is in the construction phase where nickel laterite ore will be processed and waste material will be rehabilitated on site while the mine tailings after processing through the floatation circuit will be discharged through a submarine tailings disposal that is said to flow into the ocean shelf. This disposal is attracting a lot of criticism about safety and environmental damage and in 2011, the Supreme Court declared its position in the controversial *Medaing v Ramu Nico Management Ltd (MCC) Ltd* (Ramu Nico case).⁴⁹

3.2.9.1 Ramu Nico case

The case was first brought at the National Court on 20 October 2010 by Louis Medaing and others without a proprietary interest in the mining site but potentially adversely affected by waste removal plans. At the trial, the National Court held that the plaintiffs had proper standing to bring their public and private nuisance claims due to their “close physical connection” and “genuine interest” in the land in question.

Medaing sought a permanent injunction against Ramu Nico’s Deep Sea Tailings Placement (DSTP) system, which proposed to deposit mining waste at sea levels where, allegedly, it would not harm marine life. At first instance, the National Court ruled that the DSTP system was both a public and private nuisance, since the plaintiffs successfully showed that the waste dumping would interfere with the use of their land, and furthermore cause inconvenience, damage, or harm to the general public. Perhaps most importantly, the National Court recognised the plaintiffs’ alleged breach of National Goal No. 4 of the *Constitution* as a justiciable claim of action. However, the trial judge refused to grant Medaing a permanent injunction against Ramu Nico to dispose the tailings through deep sea tailings placement because of the huge economical consequences of such a decision.

On appeal by Medaing (appellants), the Supreme Court in a 2:1 decision, upheld the trial judge’s decision not to grant a permanent injunction against Ramu Nico (respondents/cross appellant) but on different grounds. The Supreme Court found that the trial judge erred on several grounds. The primary issues the Supreme Court was concerned with was first, whether or not the appellants had established a cause of action in both private and public nuisance in respect of the disposal of mine tailings using the DSTP method, and, whether the DSTP method was contrary to National Goal No. 4 of the *Constitution*.

The Supreme Court held that the trial judge had erred in law on these primary issues. It held that the appellants failed to establish a cause of action in both private and public nuisance because the essential elements were not established. In respect

⁴⁹ *Medaing v Ramu Nico Management (MCC) Ltd* [2011] PGSC 45. On appeal from the National Court decision of WS No. 1192 of 2010 (22 October 2010).

of private nuisance, there must have been interference with the occupiers interest in the beneficial use of his land, and, for public nuisance there must be interference with a public or common right and the claimant must have incurred some particular or special loss over and above the ordinary inconvenience suffered by the public at large. The court concluded that as the mine was yet to operate and the DSTP process had not begun yet, the appellants claim was speculative and did not prove the elements of nuisance as apprehension of nuisance is not nuisance.

Furthermore, the Court also held that the DSTP method of mine tailings disposal is authorised by law and that National Goal No. 4 of the *Constitution* was not justiciable by operation of Section 25 of the *Constitution*.

3.2.10 Hidden Valley

Hidden Valley is an open pit gold and silver mine owned by Morobe Mining JV (a 50:50 joint venture between Newcrest Ltd, Australia, and Harmony Gold Ltd, South Africa). It began operations in 2010 and has an estimated 14 year life. The operations are at Hidden Valley and Hamata, near Wau, Morobe Province. Hidden Valley has two pits in production. These are about 5km apart and include the Hamata pit, which exploits the Hamata gold orebody, and the larger Hidden Valley pit, which exploits the Hidden Valley and Kaveroi gold and silver ore bodies. The mine uses conventional impoundment.

There have been news reports of concerns raised of Hidden Valley regarding chemical spills.⁵⁰ Many cases of mysterious health problems have been reported along the Watut or Markham River. As recently as 5 November 2012, the Post Courier reported that several women had died from “abnormal bleeding” and other people had developed large lumps and ulcers.¹³

3.2.11 Sinivit

This open-pit mine is in East New Britain Province south-west of Rabaul. It is owned and operated by Macmin PNG Ltd, a subsidiary of New Guinea Gold Corp of Canada. Mining began in 2007. Sinivit is a gold mine that uses the vat heap leach process and plans on installing a tailings dam at some later stage if required.⁵¹ Sinivit operates under the *Mining Act* 1992 and the *Environment Act* 2000.

In 2012, The National reported that the vats system at the Sinivit mine is leaking posing a health risk for communities along the river systems. The mine has many vats on the highest mountain peaks of the New Britain Island. It is reportedly a

⁵⁰ Ash Pemberton, “Resource colonialism bleeding people and nature” (Papua New Guinea Mine Watch, 10 December 2012) <<http://ramumine.wordpress.com/2012/12/10/resource-colonialism-bleeding-people-and-nature/>> accessed 18 January 2013.

⁵¹ Email from Paul Pora (Sinivit Community Relations Officer) to CLRC (24 November 2012).

concern to the community because a number of vats are outside the mining lease area and are “dangerously located.”⁵²

3.2.12 Simberi

Although mining only started in 2008, Simberi promises to be a much larger operation than Sinivit or Tolukuma. Located on Simberi Island in the Bismark Archipelago, New Ireland Province, the mine is owned and operated by Australia’s Allied Gold Ltd. Allied’s major shareholder is China’s Zijin Mining Group. Recovery is carried out by heap leach, carbon-in-leach methods. Tailings travel through a 528km-long pipeline to the sea, with a discharge point at 130m depth. From there, the tailings flow down a steep submarine slope and are finally deposited at 3km depth.⁵³

3.3 RTD and DSTP processes in PNG and environmental concerns: Case Study on the Ok Tedi and Lihir Mines

This section will discuss the RTD and DSTP processes employed by the Lihir and Ok Tedi mines and the composition of the tailings disposed into the concerned rivers and oceans. Concerns and issues arising relating to these mines and their tailings disposal methods and processes will also be discussed.

It is important to note that although this Paper attempts to provide an understanding of the tailings issue in a manner to be appreciated by the laymen and technical persons alike, unfortunately the very essence of this subject-matter makes it difficult to further clarify or simplify these various processes whilst maintaining accuracy. Thus, the interested stakeholder is advised to look at the source of the facts and figures that follow in the rest of this paper to gain an even broader understanding of the topic in question.

3.3.1 Lihir Gold Mine

In 2010 the Scottish Association of Maritime Science (SAMS) in association with the Mining Sector Support Program, an initiative of the European Development Fund, produced an “Independent Evaluation of Deep-Sea Mine Tailings Placement (DSTP) in PNG”(SAMS Review).⁵⁴ The SAMS Review had a particular focus on the Lihir and Misima mines and its objectives were firstly, “to critically evaluate the present environmental monitoring results of DSTP in PNG focussing on Lihir and Misima investigations, “and secondly, “to identify shortcomings and to identify tasks for a better understanding of the marine environmental impact of DSTP

⁵² “Sinivit mine leaks pose a threat” (Papua new Guinea Mine Watch, 5 January 2012) <<http://ramumine.wordpress.com/tag/sinivit>> accessed 22 January 2013.

⁵³ PNG Mining Sector Support Program, “Mining Journal Special Publication- Papua New Guinea” [2011] MJSP 7.

⁵⁴ See n30.

resulting in advanced strategies and guidelines for present environmental studies involving DSTP.”⁵⁵

The SAMS Review provides a detailed summary of the gold extraction process and the chemical equations that are involved.⁵⁶ As mentioned previously the Review concerned both Lihir and the now non-operational Misima Mines. Although the paper will only discuss the extractions/tailings process employed by Lihir, it will include a discussion of issues surrounding the DSTP process employed by Misima.

This next section is sourced directly from the SAMS report, and refers to the extraction process and subsequently the tailings waste composition of the Lihir and Misima mines.

3.3.1.1 The DSTP system at Lihir

Lihir processes ore to recover gold using whole-of-ore pressure oxidation. The whole-of-ore pressure oxidation process involves the production of pyrite, arsenopyrite, iron sulphate, potassium jarosite, ferric hydroxide and lime.⁵⁷ The minerals present in the ore itself include, zinc, zopper, arsenic, cadmium, mercury, lead, nickel, chromium, silver and the gold which is the object of the extraction.⁵⁸

The whole-of core pressure oxidation is followed by a carbon-in-pulp circuit which involves the addition of cyanide to the ore to extract the gold.⁵⁹ Cyanide is one of the few elements that can extract gold from an ore deposit. Thus, regardless of the deposit type (there are two main types) one of the major ways of extracting gold is by dissolving the ore in a cyanide solution.⁶⁰

Once the gold is extracted the leftover cyanide solution and the solution left-over from the whole-of-ore pressure oxidation, which is known as the “wash water” are combined and form the “tailings slurry.” The tailings slurry is treated in a detoxification plant in order to detoxify the cyanide before being de-aerated (to take out the air bubbles) and further diluted with sea water before being discharged into the ocean, at a depth of 128m, by the DSTP pipeline.⁶¹

3.3.1.2 Composition of Tailings from Lihir

According to the data used by the SAMS Review which was sourced from Australian company, NSR Environmental Consultants, the composition of Lihir’s tailings waste “comprise a mixture of tailings solids (5% clay, 93% slit, 2% fine

⁵⁵ Ibid, p5.

⁵⁶ Ibid, pp8-15.

⁵⁷ Ibid, p13.

⁵⁸ Ibid, p43.

⁵⁹ Ibid, p41.

⁶⁰ Ibid, p10.

⁶¹ Ibid, p41.

sand), freshwater, seawater, dissolved naturally occurring metals mentioned previously and process chemicals including lime and weak acid dissociable cyanide.⁶²

Statistics commissioned by the mine itself in 2005, state that the tailings discharge pH is about 2.3 and has a temperature of 34°C. These statistics are all within the Water Use Permit (WUP) 29/990 granted by the Water Resources Board of PNG. It should be noted, however, that no independent evaluation of these statistics have been made and there has been criticism of the work of NSR Consultants⁶³ who have produced Environmental Impact Assessments (EIA) for most of the RTD and DSTP projects both in PNG and abroad, in most cases presenting a positive picture.⁶⁴ NSR Consultants also underwent criticism in the 2011 *Ramu-Nico* court case for the EIA they produced for that mine.⁶⁵

3.3.1.3 Concerns at Lihir

Although the general concerns associated with DSTP at all mines are the same, this section will outline the specific concerns that have arisen at Lihir. The SAMS Review openly acknowledges that “there has been very little scientific research published in peer-reviewed journals on the geochemical processes occurring within the oceanic environment surrounding the two sites of interest, Misima and Lihir.”⁶⁶ Further, that “deep-ocean research is also expensive and technically challenging, and as a result there is very little information on the environmental impacts of DSTP.”⁶⁷ Thus, making it difficult to truly assess the effects of DSTP in these waters. In this regard, in its Review, SAMS draws on research done in the nearby waters of the Torres Strait and Gulf of Papua, recognising that not all characteristics of these waters are the same.⁶⁸

The SAMS Review lists a number of significant environmental concerns with the DTSP process at Lihir, noting that this was based on the little research that is available on the oceans in this area and are scientific estimations drawn from other studies:

- Meiofauna- generally Meiofauna at tailings-affected sites were significantly less abundant and diverse than at reference centres;

⁶² Ibid, p43.

⁶³ The company is today known as Coffey Natural Systems.

⁶⁴ See n9.

⁶⁵ Mohammed Hassan, “PNG’s Ramu-Nico mine: An environmental time bomb?” (*Pacific Media Centre*, 8 November 2012) <<http://www.pmc.aut.ac.nz/articles/pngs-ramu-nico-mine-environmental-time-bomb>> accessed 10 November 2012.

⁶⁶ See n30 at p56.

⁶⁷ Ibid, p65.

⁶⁸ Ibid, p56.

- Macrofauna- significant declines in total abundance and diversity in heavily impacted areas;
- Megafauna- There are only a few published studies on this. In Chile it was noted that there was high mortality of benthic invertebrates, fish and algae due to increased sedimentation, turbidity and light penetration

The SAMS Review stated that “the benthic environment and ecosystems of the deep Pacific are still very poorly known in comparison with the vast extent of the ocean.”⁶⁹ The review noted that, from Lihir’s own monitoring it was shown that there was significant decrease in coral cover on various impact zones due to sedimentation,⁷⁰ low density of shallow water fish in Luise Harbour,⁷¹ less coral fish,⁷² modified seabed⁷³ and inconclusive evidence as to change of current.⁷⁴

3.3.2 OK Tedi Gold and Copper Mine

3.3.2.1 The RTD process at Ok Tedi

Ok Tedi employs the RTD method of tailings disposal. In 1983 construction on a tailings dam began, however, a land slide in 1984 destroyed the foundations of the dam and resulted in Biliton, the then operator, abandoning conventional impoundment altogether. The PNG Government ultimately altered the *Mining (OK Tedi Agreement) Act* [1976] to permit RTD on a permanent basis.⁷⁵ The Government stated economic reasons as the overwhelming basis of its decision.⁷⁶

During the first four years of production, the Ok Tedi mine consisted of a closed circuit cyanide leach and carbon-in-pulp recovery system to extract the gold from the leached cap. The tailings were treated with hydrogen peroxide to destroy the residual cyanide. In 1997, copper processing began with the commissioning of a sulphide flotation and concentrator plant. Gold production ceased in 1988 and the

⁶⁹ Ibid, p66.

⁷⁰ Ibid, p87.

⁷¹ Ibid, p88.

⁷² Ibid.

⁷³ Ibid, p89.

⁷⁴ Ibid, pp93-94.

⁷⁵ Mining Minerals and Sustainable Development, “Mining for future- Appendix H: Ok Tedi Riverine Disposal Case Study” (Report No 68a, *International Institute for Environment and Development* 2002) H7-H8, < <http://www.iied.org/sustainable-markets/key-issues/business-and-sustainable-development/mmsd-working-papers> > accessed 2 May 2011.

⁷⁶ Kalinoe, L.K, “Water Law and the Nature of Customary Water Rights in Papua New Guinea” (Doctor of Philosophy thesis, University of Wollongong 1998, 278, < <http://ro.uow.edu.au/theses/1862> > accessed 29 April 2011.

gold now reports to the copper concentrate. The concentrator plant has a gold recovery of 70% and copper recovery of 80%.

After processing the concentrate, containing approximately 34% copper and 20 grams of gold per tonne, it is pumped through a pipeline to the river port of Kiunga. Here the concentrate is dried and loaded onto 3 000 tonnes river barges for transport to a silo vessel stationed in the Gulf of Papua. Approximately 50,000 tonnes of concentrate is loaded from the silo ship to export vessels each month.⁷⁷

Statistics from 1998 show that there was 22 860 tonnes of tailings alone discharged into the Fly River that year.⁷⁸ There was waste rock discharge of 42 378 tonnes. In total from 1984-1998 there was 300 148 tonnes of tailings plus 384 767.17 tonnes of waste rock discharged into the Fly River in order to extract 190.77 tonnes of gold.⁷⁹ Statistics from 2012 indicate tailings discharge from Ok Tedi to be approximately 90 000 tonnes per year and 44 0000 tonnes of waste rock.⁸⁰

3.3.2.2 Composition of mine tailings at Ok Tedi

Mineralogically the tailings are mainly comprised of varying amounts of silicates, calcite, magnetite and the sulfides, pyrite, chalcopyrite and chalcocite. Pyrite, the mineral of greatest interest because of its abundance and potential to generate acid, typically accounts for approximately 5 wt percent of the tailings.⁸¹

3.3.2.3 Concerns at Ok Tedi

The environmental impacts of the Ok Tedi mine are very visible and very controversial. PNG has become the focus of attention because of these impacts and legal claims by traditional landowners affected by the environmental changes. The risk assessment commissioned by Ok Tedi Mining Limited and undertaken in 1999 confirmed that the environmental impacts of the mine operation were significant and were far greater than initially anticipated. The major environmental impacts of

⁷⁷ See n 75 at ppH6-H7.

⁷⁸ Ibid.

⁷⁹ Ibid.

⁸⁰ Craig Vogt, "International Assessment of Marine and Riverine Tailings Disposal- Draft Report Presentation," (Presentation 1 November 2012, London Convention/London Protocol International Maritime Organisation, 2012) <http://www.imo.org/blast/blastDataHelper.asp?data_id=31104&filename=LCLPPresentationonMineTailingsVogtNov12012.pdf> 13 November 2012.

⁸¹ B.R Bolten et al, "Acid Rock Drainage Management of the Ok Tedi Mine, Papua New Guinea," (6th ICARD, 2003) 163, 164 <http://www.oktedi.com/attachments/209_ARD_BOLT.PDF> accessed 12 November 2012.

the mine included, increased sedimentation, degradation of the forest, toxicity, impacts on underground and surface water and decrease in fish communities⁸².

Since the beginning in 1984, when mining commenced, waste rock and tailings have been discharged into the headwaters of the Ok Tedi. Before the Ok Tedi mine, the Fly River carried about 100 ppm (parts per million) of natural sediment. Since mining began, the suspended sediment load of the river has risen to 450–500 ppm from disposal of mine waste. As well as the increased sediment load in the Ok Tedi, the disposal of waste rock and tailings has led to aggradation (the build-up of sediment in the river bed). By 1992 the total input of sediments associated with the mine was about 501 million tonnes. It was estimated that if the mine continued at the same rate, the total sediment introduced during the life of the mine up to 2010 would be 1,720 million tones.⁸³

The visual impact on the environment from increased sedimentary levels can be seen in Figure 1 below.



Figure 1: Effects of Ok Tedi Mine on the Ok Mani and Ok Tedi Rivers.

⁸² See n75 at pH15.

⁸³ Ibid.

There have been a number of changes in the Ok Tedi River due to the mine-derived sediment load. In the upper Ok Tedi, up to 5–6 metres of waste rock has been deposited in places, raising the level of the river bed. The forest floor on the adjoining banks, within the limits of the floodplain, has also been buried. In the lower Ok Tedi, aggradation has led to an increased frequency and duration of over-bank flooding resulting in the deposition of sediment on the floodplains. The flooding carries the sediments through the riverside rainforest with deposits of up to one metre, causing dieback in the vegetation. The process of overbank flooding and sediment deposition also occurs in the Fly River, but to a much lesser extent. There is a slight increase in the frequency of flooding and lower rates of deposition.

To minimise the effects of the dieback, OTML began a dredging program in 1998 which continues today. This involved excavating the riverbed and creating a slot of 800m long, 240m wide and 10 m deep. The waste material from the mine is collected in this slot from where it is then dredged. The dredged material is pumped into constructed storage cells on the east bank. The dredging operation was designed to remove about 20 million tonnes of sediment per year. However, the lighter silt continues to enter the river system.

The dredging trial was scheduled to terminate in March 2000 but is continuing at the request of the Government. The most obvious consequence of sedimentation in the river system is the destruction of vegetation. Sediment accumulation in the river beds of the Ok Mani, Ok Tedi and middle Fly reduces their in channel flow capacity and increases the incidents and severity of overbank flooding. Water logging and sedimentation reduces the oxygen levels in the soil thereby starving the roots of oxygen, stressing the vegetation and in the worst case killing it. This phenomenon is known as dieback (Figure 3.2).⁸⁴ Dieback not only reflects a loss of the floodplain ecosystem, but also loss of subsistence gardening/hunting land for people residing in downstream areas that may lead to the displacement of communities.

Figure 2: Dieback of vegetation in the Ok Tedi River Catchment, 1996

⁸⁴ Ibid.



Photo credit S. Kirsch

The main area of vegetation dieback is found on the lower Ok Tedi. The amount of dieback has increased steadily over the life of the mine and is predicted to continue long after the mine closes. It was noted by OTML's risk assessment that the area affected by dieback increased from about 18 square km in 1992 and to about 480 square km in 2000. According to the risk assessment carried out by OTML, the estimated area ultimately susceptible to dieback induced by mining operations (i.e. the Maximum Impact Area) ranges from 1,278 km² to 2,725 km².⁸⁵

Although copper, gold and silver are a natural component in the rocks in the Star Mountain, their presence in rivers has been minor. Before mining commenced, water in both the Ok Tedi and Fly Rivers was characterised by a moderately high content of alkaline minerals, reflecting the drainage from a predominantly limestone catchment. The 80,000 tonnes of tailings and 120,000 tonnes of waste rock discharged daily contain quantities of metals not recovered by the mining operation. The floatation process extracts about 80% copper and 70% gold and the rest is discharged into the river in the waste.⁸⁶

Most of the copper in the waste is in particulate form and very little is released to the dissolved phase because the river water is alkaline. Dissolved copper levels throughout the Ok Tedi and Fly River sometimes exceed 0.02 mg/l. This exceeds earlier predictions, on which the Acceptable Particulate Level was based.⁸⁷

Acid drainage another potential problem at the Ok Tedi mine and the river system. Due to the sulphide ore body, there is potential for acid generation in the failing waste dumps and the dredged material in the Ok Tedi. Acid drainage may

⁸⁵ Ibid.

⁸⁶ Ibid.

⁸⁷ Id, pH16.

accelerate the release of metals from the waste such as lead, zinc, copper, arsenic, selenium, mercury and cadmium, into ground and surface waters. The extent and long-term possible impacts of acid drainage from deposits of mine wastes at the Ok Tedi mine is unknown. This problem is controllable during mining because of the presence of limestone in the ore but these conditions will not continue after mine closure. It has been suggested that the predicted reduction in limestone content in the waste over the remaining life of the mine could be resolved by limestone additions that would help avert the very serious risk of major and widespread toxicity.

4. Current Law and Practice

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4.1 Introduction

The Laws of Papua New Guinea are enumerated under Section 9 of the *Constitution*. Firstly, the National Goals and Directive Principles and the Preamble to the *Constitution* declare that the natural resources and environment of the country are to be conserved and used for the collective benefit of the people, and to be replenished for the benefit of future generations.

The constitutional directive is to be promulgated by statute law and policy. The Vision 2050 and the Development Strategic Plan 2030 echo the same aspirations. The only policy that comes close to translating this constitutional directive is the 1976 Environment Policy which is entitled “Environment and Conservation Policy:

A Statement of Principles.”⁸⁸ Environmental and natural resources laws such as those which are mentioned in this Chapter must be designed to strengthen and give real meaning to this National Goal.

At the outset it is noteworthy that there is no specific legislation in PNG that regulates the management and disposal of tailings from mining activities and other industrial waste and pollution from the extractive industry to the waterways and the seas.

Nonetheless this paper will in broad terms examine the application of a myriad of legislation and practises in this jurisdiction that collectively provide the legal framework in the management and disposal of tailings from mining activities into the waterways and the subsequent effect on the ecosystem.

This paper will begin primarily with the examination of the following legislation which are the principal laws that collectively provide the legal regime in this jurisdiction for the management and control of the disposal of tailings including the containment and treatment of toxic chemicals and heavy metal traces. These are:

- *The Mining Act 1992*
- *Mining (Safety) Act 1977*
- *Mineral Resources Authority Act 2005*
- *The Mining (Bougainville Copper Agreement) Act 1967*
- *Mining (Ok Tedi Agreement) Act 1976* and Supplemental Agreements;
- *Water Quality Regulations 2002*; and
- *Environment Act 2000*

It must be noted that the primary enactments that are supposed to provide the legal framework for the regulation of the disposal of tailings is the *Environment Act* and the *Mining Act*. The *Environment Act* has undergone two significant amendments by Parliament with zero effect as the latter amendment in 2012 repealed the former amendment in 2010. The lesson deduced from the actions of the Parliament, as will be later discussed, clearly demonstrates the constantly competing forces of perceived economic gain on one hand and the environmental and social loss on the other.

⁸⁸ Eric Kwa and Alphonse Gelu, “National Policies and their impact on ABS” in Kwa, E, Kamene, S and Kokai, J(ed); *Access and Benefit Sharing: Policy and Legal Implications for Papua New Guinea* (Port Moresby: UPNG Press, 2011) 78.

4.2 Legislative Framework

4.2.1 Mining Act

The *Mining Act* regulates minerals and mining in PNG and outlines the provisions relevant to matters for this inquiry. Firstly, Section 17 empowers the State to enter into an agreement, not inconsistent with the Act, relating to a mining development contract or the financing of a mining development under a tenement. Secondly Section 18 provides for the circumstances under which the mining development contract shall be determined and the terms that it will conform to, whether it be a special mining lease or otherwise. Finally Section 19 determines the process that the mining development contract will follow and the process under which any conflict that may arise regarding the validity of the contract will be resolved.

It should be pointed out that whilst Section 5(1) states that ‘all minerals existing on, in or below the surface of any land in PNG, including any minerals contained in any water lying on any land in PNG, are the property of the State’ and Section 41 of the Act provides a proviso that once a developer has been granted a mining lease, this lease authorises the holder, in accordance with the *Mining (Safety) Act*⁸⁹ and subject to conditions on the mining lease to do the following:

enter and occupy the land over which the mining lease was granted for the purpose of mining the minerals on that land and carry on such operations and undertake such works as may be necessary or expedient for that purpose; and

construct a treatment plant on that land and treat any mineral derived from mining operations, whether on that land or elsewhere, and construct any other facilities required for treatment including waste dumps and tailings dams; and

take and remove rock, earth, soil and minerals from the land, with or without treatment; and

take and divert water situated on or flowing through such land and use it for any purpose necessary for his mining or treatment operations subject to and in accordance with the *Water Resources Act 1982*; and

do all other things necessary or expedient for the undertaking of mining or treatment operations on that land.

Subject to the Act, the holder of a mining lease:

is entitled to the exclusive occupancy for mining and mining purposes of the land in respect of which the mining lease was granted; and

owns all minerals lawfully mined from that land.

⁸⁹ No. 45 of 1977.

Section 41 removes ownership of the minerals from the State and transfers ownership to the developer as soon as a mining lease is granted. Thus it is up to the State to ensure that prior to the grant of the lease all conditions prescribed under Section 41 (a) to (e) have been complied with.

There are four different types of lease that are granted under the Act. These are:-

- A Mining Lease (ML) under Section 41;
- An Alluvial Mining Lease (AML) under Section 51;
- A Lease for Mining Purposes (LMP) under Section 69; and
- A Mining Easement (ME) under Section 84.

These respective leases confer certain mining rights to the leaseholder and also set certain conditions (listed above) under Section 41(1) that they must comply with. It is apparent, however, that Section 41(1) and the remainder of the *Mining Act* are silent on the planning and design of a tailings storage facility and the tailings discharge methods to be used. In addition, requirements relating to monitoring, evaluation and maintenance aspects of the tailings storage facility and tailings discharge methods are also non-existent.

Section 152 removes any responsibility or obligation on the lease holder for the removal of a mining plant, or, tailings, etcetera, on the expiry of tenement which is the subject of a mining development contract. It becomes the responsibility of the State. Here the obligation is placed on the State to ensure safe removal of any untreated and hazardous materials or substances on the land.

4.2.2 Mining (Safety) Act

The exercise of the rights come under the *Mining (Safety) Act* which provides for the regulation and inspection of mines and works, and for related purposes. The relevant provisions are Sections 42, 43 and 44.

Section 42 sets out a list of conditions relating to the construction or alterations of dams that are to be constructed on the site. It outlines the specification of the dam and the requirements for such plans and specifications to be lodged with the Chief Inspector of Mines and that all actions should be taken to ensure safety. Failing that, certain penalties will be imposed depending on the seriousness of that failure or breach.

Section 43(2) provides for the powers of the Chief Inspector to inspect and take appropriate action where he is of the opinion that a dam is dangerous to human life or property and this power entitles him to give written notice to the owner or the person in charge of the dam, requiring him promptly:

to empty the dam and keep it empty; or

to discontinue its use until it has been repaired or reconstructed to the satisfaction of the inspector; or

where he deems it advisable.

Section 43(3) goes on to state that where any repairs or reconstruction required under Subsection (2) have not been promptly carried out, the inspector may cause to be taken such measures for the repair of any defect in the dam as he considers necessary for safety, and the cost of the repair shall be a debt due from the owner of the dam to the State.

Section 44 relates to written notice to be given to the Chief Inspector by the owner of any dam used for mining within 14 days after abandoning the dam. Clearly there are no obligations placed on the owner of the dam to ensure that all necessary precautions are taken to avoid damage to both human health and the environment prior to abandoning the dam.

It is also important to note that the fines under the Act are inappropriate compared to the level of damage that are usually caused to human health and the environment as happened in the Jaba River in Autonomous Region of Bougainville and the Ok Tedi River in Western Province.

Both the *Mining Act* and the *Mining (Safety) Act* are inadequate in relation to the containment of mine tailings and responsibilities that a mining lease holder must be compelled to fulfill prior to the grant of a mining lease and upon expiry or abandonment of the mining lease for whatever reason.

4.2.3 The Mineral Resources Authority Act

This legislation was enacted in 2005 for purposes of establishing the Mineral Resources Authority (“the Authority”), a body corporate with perpetual succession and to give it powers to acquire, hold and dispose of property and is a legal entity. The Authority is an organ and instrument of the State and is entitled to the benefit of any immunity or privilege enjoyed by the State.

Section 5 sets out the various functions of the Authority, (subject to Section 8(6)) which are:

to advise the Minister on matters relating to mining and the management, exploitation and development of Papua New Guinea’s mineral resources; and

to promote the orderly exploitation for the development of the country’s mineral resources; and

to oversee the administration and enforcement of the *Mining Act*, the *Mining (Safety) Act*, the *Mining Development Act 1995*, the *Ok Tedi Acts* and the *Ok Tedi Agreement*, the *Mining (Bougainville Copper Agreement) Act* and the agreements that are scheduled to that Act, and any other legislation relating to mining or to the

management, exploitation or development of Papua New Guinea's mineral resources; and

to negotiate mining development contracts under the *Mining Act* as agent for the State; and

to act as agent for the State, as required, in relation to any international agreement relating to mining or to the management, exploitation or development of Papua New Guinea's mineral resources; and

to receive and collect, on its own account and on behalf of the State, any fee, levy, rent, security, deposit, compensation, royalty, cost, penalty, or other money or other account payable under the *Mining Act*, the *Mining (Safety) Act*, the *Mining Development Act*, the *Ok Tedi Acts* and the *Ok Tedi Agreement*, the *Mining (Bougainville Copper Agreement) Act* and the agreements that are scheduled to that Act, or any other Act the administration of which is the responsibility of the Authority from time to time; and

on behalf of the State, to receive and collect from persons to whom a tenement has been granted under the *Mining Act* the security for compliance with the person's obligations under the *Mining Act* which must be lodged with the Registrar, and to hold such security; and

on behalf of the State, to administer and be responsible for the administration of any public investment program relating to mining; and

to conduct systematic geo-scientific investigations into the distribution and characteristics of Papua New Guinea's mineral and geological resources, located on, within or beneath the country's land mass, soils, subsoil and the sea-bed; and

to provide small scale mining and hydro geological survey data services, and occupational health and safety and community awareness programs; and

to collect, analyse, store, archive, disseminate and publish (in appropriate maps and publications) on behalf of the State geo-scientific information about Papua New Guinea's mineral and geological resources; and

to carry out such functions as are given to the Authority by the Act or by any other law; and

generally to do such supplementary, incidental, or consequential acts and things as are necessary or convenient for the Authority to carry out its functions.

In addition to the above functions, Section 6 confers on the Authority power to do all things necessary or convenient to be done for or in connection with the performance of its functions.

Section 8 provides for the establishment of the Mineral Resources Authority Board and provides its powers and functions. Although the Act appears to state that the

Board has power to manage and direct the administrative affairs of the Authority, Subsections 3 and 4 state that the Board is subject to the direction of the Minister on general or specific matters as to mineral policy and the Board shall act in accordance with, and shall give effect to, any general or specific directions as to policy given to it from time to time by the Minister under Subsection (3) or the Government Policy Advisory Committee under Section 21.

These general or specific directions are however qualified under Section 8(5) which states that 'any direction as to policy given by the Minister under Subsection (3) or the Government Policy Advisory Committee under Section 21 may not be inconsistent with the provisions of this Act, the *Mining Act*, the *Mining (Safety) Act*, the *Mining Development Act*, the *Ok Tedi Acts and Ok Tedi Agreement*, the *Mining (Bougainville Copper Agreement) Act* and the agreements that are scheduled to that Act, or any other Act the administration of which is the responsibility of the Authority from time to time.

On the other hand, Subsection (6) of the same section again removes that power of supervision from the Board and gives this power to the Managing Director. Subsection 6 states:

Notwithstanding anything else in this Act, the Managing Director has the sole right and responsibility, to the exclusion of the Board, to supervise and direct the staff of the Authority in the exercise of all powers, functions and discretions in respect of the administration and enforcement of the *Mining Act*, the *Mining Act 1992*,⁹⁰ the *Mining Development Act*, the *Ok Tedi Acts* and the *Ok Tedi Agreement*, the *Mining (Bougainville Copper Agreement) Act 1967* and the agreements that are scheduled to those Acts, and any other legislation, regulation or national policy relating to mining or to the management, exploitation or development of Papua New Guinea's mineral resources.

Whilst this Act is meant to give direction as to government policy on the mining industry, Subsections 5 and 6 have inadvertently removed any powers that the Board is meant to have and placed it on the Managing Director of the Authority who is now the sole authority to oversee the administration and enforcement of the *Mining Act*, the *Mining Development Act*, the *Ok Tedi Acts* and the *Ok Tedi Agreement*, the *Mining (Bougainville Copper Agreement) Act* and the agreements that are scheduled to those Acts, and any other legislation, regulation or national policy relating to mining or to the management, exploitation or development of PNG's mineral resources.

⁹⁰ The 'Mining Act 1992' is repeated in this same provision twice.

Again this Act does not have any specific provisions relating to the requirements of maintaining operations that are of best international standards in dealing with mine tailings or hazardous waste and has not vested any powers on the Board to determine any issues of compliance or impose penalties for non-compliance.

4.2.4 The Mining (Bougainville Copper Agreement) Act

The *Mining (Bougainville Copper Agreement) Act* provided for the approval and enforcement of the agreement entered into between the Administration of the Territory of Papua and New Guinea and Bougainville Copper Pty Limited (BCL), for the development of certain mineral deposits in the Panguna mine and on Bougainville Island. This agreement was subject to a further amendment on 21 November 1974 between the Government of Papua New Guinea and BCL

Paragraph 15 of the Agreement is relevant to this inquiry as it relates to aspects of Overburden Tailings and Safety. Paragraph 15(a) placed a responsibility on BCL not to dispose of any overburden removed in the course of, or any tailings produced as a result of, its operation under this Agreement in an area or in a manner not previously approved for that purpose pursuant to the provisions of this Clause. It being intended that such overburden and tailings shall be disposed of in a manner which is reasonably safe and results in as little damage or disturbance (having regard always to the need for the Company to carry out its said operations efficiently and economically) as may reasonably be.

Paragraph 15(b) provided that BCL may from time to time submit to the administration of the Territory of Papua and New Guinea a proposal for the disposal of the overburden and tailings, with specifications of the area or areas and manner in which it is proposed to dispose of such overburden and tailings. The administration then had two months within which to either approve or submit an alternative approved proposal for the disposal of the overburden and tailings setting out the area or areas and manner in which the same were to be disposed.

Paragraph 15(c) provided for arbitration where the parties were not in agreement in relation to the proposals for the disposals of the overburden and tailings.

Paragraph 15(d) provided for any loss or damage caused by the disposal of the overburden and tailings (whether through an approved proposal or otherwise) BCL was to pay compensation for any loss suffered by any indigenous or other inhabitants of the said Bougainville Island or the other Islands adjacent thereto resulting from any damage done (whether to land, anything on land, water or otherwise) or any interference with any right to use land or water caused by the disposal by BCL of any overburden removed in the course of, or tailings produced as a result of its operations under the Agreement. Such compensation was subject to the provisions of Part VII of the *Mining Ordinance*.

It should be pointed out that although the above subparagraphs did provide for some safety measures to be carried out, the preceding subparagraphs (Paragraphs

(e) and (f) however, went as far as excluding responsibility and liability from BCL. Here BCL was indemnified from any liability for any loss, damage, disturbance or interference caused by the disposal of any of the said overburden or tailings except for liability in negligence.

In the 1974 Agreement, for some reason, paragraph 16A was inserted which provided for the Government to have access to the mine site for purposes of conducting study on the impact of the operations on the environment and related operations. This provision also allowed for the government upon request to BCL, to make available for its inspection any factual information in the possession of BCL relating to the impact on the environment of the said mining and related operations.

4.2.5 Mining (Ok Tedi Agreement) Act 1976

The *Mining (Ok Tedi Agreement) Act* is similar in nature to the BCL Agreement. The Act provides for the approval and implementation of the agreement entered into between the Government of Papua New Guinea and BHP Limited. The agreement has the full effect of law.

For the purposes of this inquiry, it is important to observe that initially a feasibility study for the Ok Tedi mine incorporated two stable facilities to contain about 80 percent of the waste rock: (1) a conventional tailings storage facility on the Ok Ma, a tributary of the Ok Tedi River; and (2) a hydroelectric dam on the Ok Menga. In 1983, prior to the commencement of gold production, construction of the tailings dam began on the Ok Ma, about 15 km south of the mine. It was planned that the tailings would be piped through a tunnel to this facility and that the decant water would then be discharged to the Ok Ma.⁹¹

During the early stages of construction, in early 1984, a massive landslide destroyed the foundations of the tailings dam. To keep production on schedule, an Interim Tailings Scheme was proposed by OTML, and accepted by the Government. This Scheme allowed OTML to commence mining and discharge tailings into the river after removal of the sand fraction (25%), which was stored in a stable dump in the Ok Ningi Valley. This was a temporary arrangement pending the construction of a permanent tailings storage facility. In 1988, the government withdrew the Interim Tailings Licence because the facility had reached maximum capacity.

However, during the period that the Interim Tailings Licence was in effect, the *Mining (Ok Tedi Agreement) Act* was modified with the Fifth and then the Sixth Supplemental Agreements. The *Sixth Supplemental Agreement*, which was signed in 1986, contained provisions for the management of waste from the mining and processing operations. One of the main features of the environmental provisions

⁹¹ See n75 at pH15.

was the deferral of the construction of permanent waste retention facilities until 1990, to enable the construction and commissioning of the copper plant.

This meant that all of the tailings and some of the waste rock from the failing dumps were discharged into the river system. OTML was required to conduct an environmental study to assess the impact of these discharges in order to enable the Government to establish an acceptable level of sediment, the Acceptable Particulate Level (APL), for the Fly River to ensure that the mining operations do not cause unacceptable environmental damage. In 1990, a maximum APL limit of 940 mg/l was set by the Government and a monitoring program introduced to check compliance. Under this program, OTML was required to monitor and report to the Government on a series of environmental parameters measuring the response of the entire system to the mine waste.⁹²

The construction of the tailings storage facility on the Ok Ma was abandoned because OTML's shareholders and the Government were concerned that any major dam constructed in the area would run the risk of being destroyed by future landslides or earthquakes. All mine waste (waste rock and tailings) is currently being placed into the headwaters of the Ok Tedi. This has had significant impacts on the Fly River system.⁹³

The Act affirmed that the responsibility for disposal of wastes or tailings was provided for under Clause 8.2 which required the Company responsible to make specific provisions as follows:

Damco shall in its proposals as to measures to be taken for the protection of the environment referred to in Clause 8.1 make specific provision for-

- the disposal of any overburden removed in the course of or any tailings produced as a result of the Company's operations;
- the disposal of all other wastes;
- the control of pollution arising from the industry;
- monitoring overburden, tailings and all other wastes produced as a result of the Company's operation; and
- any other matter arising from the environmental impact study required under Clause 5.1(k) or from the State's own environmental investigations which requires remedial action.

⁹² Ibid.

⁹³ Ibid.

4.2.5.1 Consideration and Approval of Proposal

Clause 9 of the Agreement provides for the consideration and approval process of the proposal for the disposal of any overburden or any tailings produced as a result of the Company's operations. The change, however, restricted the exercise of discretion by the State of the approval process. Here the onus is placed on the State to justify its approval process without qualification or reservation. Thus the State is placed in an awkward position where it has to approve the proposal as presented by Damco for purposes of the Agreement.

4.2.5.2 Environmental Management and Protection

Clause 29(2) of the Agreement deals with the management and protection processes. Here the emphasis is placed on compliance by the Company to implement all Approved Proposals relating to environmental management and protection and the Company in this case shall not dispose of the overburden, tailings or other waste otherwise than in a manner which is substantially as approved, provided that if the Company is of the opinion that circumstances have changed so that previously approved plans and proposals are no longer applicable or desirable, then it may give notice to the State of those circumstances together with alternative or revised plans and the State shall within two (2) months of that notice:

- approve the alternative or revised plans, or
- meet with the Company to discuss the alternative or revised plans.

Clause 29(3) places an obligation on the Company to install and maintain a suitable equipment of a standard approved by the State for purposes of measuring and analysing all waste discharges and deposits from the Company's operations. However, there is no requirement for the Company to keep a periodic reporting schedule and what amount of overburden or tailings would trigger a re-assessment of the reporting schedule or the upgrade of the technology used for storage of these wastes.

Clause 29(4) also places an obligation on the Company to take action as is necessary to carry out experiments for the determination of the suitability of vegetation to be established on the land area subject to dumping of waste. Clause 29(5) places an obligation on the Company to make sure that the area where the dumping of overburden, tailings or other waste has been carried out is in a condition such that it is possible to allow regeneration.

Clause 29(6) places again an obligation on the Company to at all times endeavour to overcome and minimise any deleterious effects resulting from its operations upon the physical environment, the streams, rivers, the inhabitants and the biota of the mining area or the land, streams and rivers flowing in the area. Clause 29(7)

deals with any failure by the Company to comply with any of the above provisions and the State's power to take appropriate action in dealing with that failure.

Clause 29(8) empowers the State to take reasonable steps including entering upon any land occupied by the Company as is necessary to prevent the continued or repeated contravention of such provisions and also provides that the Company shall indemnify the State for all costs and expenses incurred in connection with the exercise of these powers. Clause 29(9) deals with any issue of pollution and empowers the State to serve notice on the Company to take such reasonable steps as are necessary to remove, disperse, destroy or mitigate the pollution within the time specified in the notice. This clause also empowers the State to specify the particular method to be used to remove, disperse, destroy or mitigate the pollution. Compliance is mandatory.

Clause 29(10) provides that where the Company failed to comply with the requirements specified under Clause 29(9), the State is empowered to take reasonable steps including entering upon the land occupied by the Company as are necessary to remove, disperse, destroy or mitigate the pollution and the Company shall indemnify the State for all its costs and expenses incurred in connection with the breach. Clause 29(12) provides that where any person or persons has suffered any loss as a result of the Company's operations resulting from any damage (whether to land, anything on land, water or otherwise) or interference with any right to use land or water existing prior to the date when the damage occurred, the Company shall be responsible for the payment of compensation.

In spite of all the above limitations, Clause 29(13) provides a reprieve to the Company in that if it is shown that the Company has attempted to fulfill its obligations under Clause 29(2), and the State desires for the project to proceed and be economically viable acknowledging the effect the project will have on the environment, the Company's obligation will be to act reasonably to mitigate damage to the environment in these acknowledged circumstances.

Schedule II of the Act provides for the environment impact study to be carried out on the Ok Tedi River and catchment and the Fly River waterway and estuary. It provides that the analysis of the existing environment be undertaken into account the following:

- A photogrammetric evaluation of land classes on the basis of vegetative cover, slope and susceptibility to major soil movement taking into account climatic factors and mining development including the area designated for tailings disposal;
- Periodic recording of stream flow discharge and flood peaks above the town side, the Ok Tedi at Ningerum, the Ok Mani and the Ok Menga at their respective confluences with the Ok Tedi;

- A biogeochemical study of the catchment to measure the flow of elements from abiotic to abiotic and back to abiotic components of the ecosystem, including stream flow turbidity, biological oxygen demands, chemical oxygen demands;
- A description of the ecology of the Ok Tedi River and catchment area including species and population of terrestrial and aquatic organisms, habitat and communities, ecosystems and evaluation of heavy metal levels; and
- A sociographic survey of village communities in the area including population structure, population growth, settlement patterns, inter-clan and inter hamlet relations, traditional movements, land use patterns, water availability, natural resource use, nutritional and health status and cultural or archaeological sites of importance

4.2.6 Mining (Ok Tedi Supplemental Agreement) Act 1980

The *Mining (Ok Tedi Supplemental Agreement) Act* (Ok Tedi Supplemental Agreement Act) was enacted to address two matters: (1) any substantial modification, expansion or variation in the activities of the Company; (2) and environmental impact programs.

Clause 4 of the *Ok Tedi Supplemental Agreement Act* caters for any substantial modification, expansion or variation in the activities of the Company, either by undertaking any new activity or by a major expansion of activities specified in the Approved Proposals which is not covered by the conditions to the Approved Proposals under Clause 8.5 of the Principal Agreement; and Clause 9.1, 9.2 and 9.3 dealt with changes in the Approved Proposals relating to environmental management and protection under Clause 29.2 of the Principal Agreement

In addition, Clause 16 removed Schedule II and replaced it with Schedule B that provided for an environmental impact study with several objectives basically to ensure that baseline data are provided and evaluated to monitor and predict the effects of the project on the existing environment within the strategy proposed by the Consortium Feasibility Study (CFS – Consortium refers to the shareholders prior to the formation of the OTML) and these strategies are examined in relation to existing local land-use and the potential regional development of the area. It also allows interested public and the people in the area affected to participate in any consideration of the environmental effects.

4.2.7 Mining (Ok Tedi Fifth Supplemental Agreement) Act 1985

The *Mining (Ok Tedi Fifth Supplemental Agreement) Act* (Fifth Supplemental Agreement Act) was enacted on 28 November 1985. The relevant provisions for this discussion are clauses 5 and 29 of the Agreement.

Clause 5 of the *Fifth Supplemental Agreement* provides for procedures dealing with permanent tailings licence. This clause provided for an amendment to Clause 29 of the Principal Agreement by inserting an additional clause to Clause 29.

The additional clause is 29.14. This provision deals with the tender procedures and processes in relation to entering into a contract and issuance of a letter of award accepting a contractor's bid for the construction and timing of the construction of a tailings facility and the construction schedule. It also allows for the requirement for notice to be given to the State, should there be any delay in the progress of the construction schedule and for any modification or variation to be agreed upon between the parties on reasonable grounds.

4.2.8 Mining (Ok Tedi Sixth Supplemental Agreement) Act 1986

In February 1986, Parliament passed the *Mining (Ok Tedi Sixth Supplemental Agreement) Act* (Sixth Supplemental Agreement Act). This legislation legally bound the company to construct and operate a long-term copper mine, whereas the mine partners had initially preferred to mine only the gold cap, without any commitment to mining the copper, until the copper price improved. The legislation (and the Agreement it entailed) allowed for the suspension of the requirement for the construction of permanent tailings disposal facilities and stable waste dumps, pending the outcome of a detailed, three-year environmental study to be carried out by the Company. In the meantime, the Company was allowed to continue dumping tailings directly into the Fly River system.⁹⁴

It is important to note that Clause 29.14 was inserted into the Principal Agreement to provide an additional obligation on the Company to pay the cost of the environmental study referred to in the Change Notice No.32/4.2 and 14/29.2 delivered by the Company to the State on 28 February 1985 and approved by the State on the same date, with respect to the disposition of tailings including the maintenance of the existing interim tailings system or the application of any other appropriate manner of treating such tailings in compliance with the Approved Proposals.

⁹⁴ Lawrence Kalinoe, "Discussion Paper No. 105, The Ok Tedi Mine Continuation Agreements: A Case Study Dealing with Customary Landowners," *Compensation Claims* (The National Research Institute NRI, 2008) 12.

Clause 29.14 also provided for the Company to undertake, or cause to be undertaken a rigorous and detailed study on the acceptable levels of chemicals and heavy metals in the Fly River system and to provide these findings to the State to enable it to ascertain whether the findings are acceptable as per the criteria set out in the agreement between the State and the Company. The criteria is:

- the mining operations do not cause unacceptable environmental damage to the Fly River system;
- the State desire is for the Project to proceed and be economically viable, acknowledging and the effect the Project must necessarily have on the environment;
- waste disposal fall within the Acceptable Particulate Level at which significant environmental damage to the Fly River system will not occur.

Even after the examination and analysis of the environmental impacts and recommendations from the international community, the World Bank and NGOs for the closure of the mine, the Government was very reluctant to close the mine earlier than 2010. The Government and the people in the Ok Tedi region had welcomed the development of the mine because of its economic and social benefits. On the other hand, BHP, the majority owner expressed its wish to close the mine early after endorsing a statement that the company would refrain from the practice of riverine disposal in future projects.⁹⁵

The Ok Tedi case highlights conflicts between local interests and the international community. It also highlights the different perspectives of both the developed and developing world.⁹⁶ Whereas the Government was willing to accept the environmental impacts because the mine provides economic growth, employment and promotes regional development, the international community, most especially NGOs in the developed world, were advocating for its closure⁹⁷.

4.2.9 Mining (Ok Tedi Seventh Supplemental Agreement) Act 1996

The various lawsuits against BHP Minerals Ltd, BHP Billiton, OTML, and the State by the lower Ok Tedi and Fly River people within the impact area, in the Victorian Supreme Court, Australia, which was settled out of court led to various supplemental agreements relating to the mine. One such legislation is the *Mining (Ok Tedi Seventh Supplemental Agreement) Act* (Seventh Supplemental Agreement Act). The settlement also led to a new agreement referred to as the Community

⁹⁵ See n75 at pH17.

⁹⁶ Ibid.

⁹⁷ Ibid.

Mine Continuation Agreements (CMCAs) under the *Mining (Ok Tedi Mine Continuation (Ninth Supplemental) Agreement) Act 2001* (Ninth Supplemental Agreement Act) which is discussed later in this Chapter. The high profile lawsuits provided the only opportunity for landowners to pursue their compensation claims, which were, until then, either ignored or brushed aside by the Company and the State.⁹⁸

4.2.9.1 Compensation for Environmental Damage

Evidence shows that compensation claims for environmental damage in PNG are, by and large, made by customary landowners in the impact area; not the principal landowners. This highlights the importance of the amendment in particular Section 69B of the *Environment Act* which would have barred all civil causes of action for approved mining activities and vested excessive powers in the Director of the Department of Environment and Conservation.

When these landowners' compensation claims are made for environmental damages, experience shows that the project developers are initially uncooperative, sometimes become confrontational, and even push to take a highly moral defensive stand; despite overwhelming evidence otherwise. One such example is the study conducted by the Starnberg Institute, of Germany, which stated that the direct riverine tailings disposal system which the company was operating was causing significant damage to the two rivers, with fish stock in the upper reaches of the Ok Tedi river falling between 50 – 80 percent, but OTML continued to deny these claims.⁹⁹ However, in early 2000, there were strong evidence, that indicated a serious threat of copper and acid rock drainage into the Ok Tedi and Fly River systems and it was then that OTML began publicly recognizing the effect its operations had on the environment.¹⁰⁰

The story in Bougainville, preceding the blow-out, is similar. In 1989, Francis Ona, on behalf of the Panguna Landowners' Association, requested the National Government to conduct an independent investigation in order to ascertain the actual levels of environmental damage caused by the Bougainville Copper Mine. The Panguna Landowners' Association expressed concern that toxic chemicals which had been discharged from the mine were causing unknown diseases to trees and garden crops. They also said that a large number of people were suffering from unknown illnesses, which they suspected were caused by the release of toxic chemicals from the mine.

The preliminary results from the Government's investigation, '... found no significantly high level of chemical pollution. They described as unlikely the opinion held by many Bougainvillians that BCL was responsible for the decrease in

⁹⁸ See n94 at p4.

⁹⁹ Ibid.

¹⁰⁰ Id, p5.

wildlife and the decline in soil fertility (except in the pit and waste-dump area), for certain illness then prevalent in the lease area village.”¹⁰¹ These results angered many landowners, including Francis Ona, and some commentators have suggested that this may well have been the catalyst for the violent uprising on Bougainville, which resulted in the forced closure of the mine, and the consequential all-out civil war that gripped the island for more than a decade.¹⁰²

4.2.10 Mining (Ok Tedi Restated Eighth Supplemental Agreement) Act 1995

The *Mining (Ok Tedi Restated Eighth Supplemental Agreement)* bill was drafted in 1995 in an attempt to deal with the compensation claim by the landowners. However the proposed legislation did not comply with certain constitutional requirements and the Bill was subsequently ‘rearranged’. In the process, the original proposal became two separate, but related, pieces of legislation — the *Mining (Ok Tedi Restated Eighth Supplement Agreement) Act 1995* (Eighth Supplemental Agreement Act), and the *Compensation (Prohibition of Foreign Legal Proceedings) Act 1995*. The former Act came into effect on 2 February 1996 and the latter on 11 April 1996.¹⁰³

The Eighth Supplemental Agreement Act and the Compensation Act came into existence following an offer of a compensation package worth AUD\$113 million to the landowners in the hope of persuading the landowners to accept an out-of-court settlement by the Chan government.¹⁰⁴ The landowners initially refused to accept the settlement and continued to maintain their court action in the Victorian Supreme Court and the National Court.¹⁰⁵ However, six months later the landowners accepted a settlement package of AUD\$550 million and withdraw all legal proceedings on 11 June 1996.¹⁰⁶

When OTML and its shareholders offered the compensation package under the Eighth Supplemental Agreement Act, it did so without accepting full responsibility for the environmental damage it was causing to the Ok Tedi River and the Fly River system. Rather, OTML, through the State, initiated the compensation package to persuade the landowners who had taken out the lawsuits to accept an out-of-court settlement.¹⁰⁷

OTML and its shareholders succeeded, and the compensation package under the Eighth Supplemental Agreement Act was accepted. It is now administered by

¹⁰¹ Ibid.

¹⁰² Ibid

¹⁰³ Id, pp9-21.

¹⁰⁴ Ibid

¹⁰⁵ Ibid

¹⁰⁶ Ibid; see Annex 1 of this paper.

¹⁰⁷ Ibid

Heduru Trust which is managed by the Community Relations section of OTML, in Kiunga, and the North Fly trustees from the affected communities who were parties to the lawsuit. However, resistance to the operation continued and reference is made to a statement by a spokesperson for the then Wingti Government who said:

the government [did this] after giving much thought to the advantages and disadvantages of the project, [believing] at that time that the overall development advantage to the nation outweighed the environmental impact on the Fly River system, as it was not considered permanent.¹⁰⁸

In mid-June 1989, the new Minister for Environment and Conservation, Jim Yer Waim, was understood to have taken a firm stand against the pollution of the Fly River and delta areas. He reportedly threatened to advise Cabinet to close the mine, unless OTML was prepared to construct tailings treatment facilities to reduce environmental damage to acceptable levels.¹⁰⁹ In support of the Minister, the Department of Environment and Conservation released a statement to the effect that:

The pollution of the river system and delta has been compounded as the mine moved from the gold to the copper phase and the amounts of mine tailings and waste rock discharged into the river increased two to three times.¹¹⁰

In spite of these developments, on 28 September 1989, the Namaliu government decided not to force OTML to build a permanent tailings dam. Instead, it opted to allow the company to dispose of the mine waste directly into the river system, with the Government and the company being committed to compensate the people living along the length of the Fly River.¹¹¹ After the decision was taken, the Minister for Environment and Conservation stated that:

Everybody [Ministers] was concerned with the effects on the Fly River, and everybody was concerned with the welfare of the nation. We decided in favour of the people. It was the best decision any responsible government could take under the circumstances. In anything, there has got to be give and take. We risked our environment in favour of the people.¹¹²

¹⁰⁸ *Times of PNG*, 17 May 1989, 23.

¹⁰⁹ See n94 at p 9-21.

¹¹⁰ *Ibid.*

¹¹¹ *Post Courier*, 24 September 1989, 1.

¹¹² See n94 at pp9-21.

The Ok Tedi Mine was exempted from the application of the repealed *Environmental Planning Act 1978*.¹¹³ The then Minister for Justice, Bernard Narokobi, stated that:

After exhaustive briefings and careful questioning by Ministers, the Government has reached the view that the interest of all persons can be served by allowing the mine to operate without the tailings dam.¹¹⁴

4.2.11 The Mining (Ok Tedi Mine Continuation (Ninth Supplemental) Agreement) Act 2001 and the Community Mine Continuation Agreements

The *Mining (Ok Tedi Mine Continuation (Ninth Supplemental) Agreement) Act* in particular with the Community Mine Continuation Agreement (CMCA) is the current legal instrument under which the Ok Tedi Mine operates.

Section 8 of the Act confirms that environmental damage has been caused by the operations of the Ok Tedi Mine without admission of liability. Hence mining operations will continue and if any environmental damage occurs or will continue to be caused or is likely to be caused to the environment and any other environmental effects that follows as a result of the mining operation, OTML will compensate the customary landowners in the mine affected communities (a compensation package based on the magnitude of the environmental damage in their respective communities) as outlined under Schedule 2 of the various CMCAs to the Ninth Supplemental Agreement.¹¹⁵

The CMCA formulated under the *Ninth Supplemental Agreement Act*, is a mechanism which bars the customary landowners in affected communities from making an environmental claim for damages against the Mining Company and has a tailored compensation package which binds all persons from these affected communities to the compensation package. The CMCAs are the legal instruments through which the affected communities and OTML are bound, with specified duties and responsibilities. The people covered by a CMCA are barred from pursuing a damages claim for environmental damage against the mining company outside of the CMCA. On the other hand, the mining company undertakes to pay the agreed compensation payments, as specified under the respective CMCAs.¹¹⁶

In accordance with the Act, six separate CMCAs were executed by the people from the affected communities, within the mine area through to the impact areas and

¹¹³ See s.3(2)(b).

¹¹⁴ *Post Courier*, 16 October 1989, 1.

¹¹⁵ See n94 at pp9-21.

¹¹⁶ *Ibid.*

communities on the entire Ok Tedi River, the Tabubil-Kiunga Highway (along which the copper slurry is transported from the mine to Kiunga) the North Fly River area, and all the way down to the South Fly. For purposes of the CMCAs, these communities have been all given statutory status under the Ninth Supplemental Agreement Act. The Mine Continuation Agreement (MCA) is the First Schedule and the CMCAs are the Second Schedule to the Act.¹¹⁷

Section 4(1) and (2) give full legal effect to the MCA and the CMCAs and declare that these agreements apply, irrespective of any law to the contrary. Section 4(4) declares that:

The Community Mine Continuation Agreements represent the final and binding agreement between the parties hereto on compensation and benefits payable to such of them as are affected by the project.

Section 4(6) of the Act which came into effect on 25 September, 1998 ousts application of the *Fairness of Transaction 1993 Act*. This provision protects the MCA and the CMCAs from any legal action that may be available under the *Fairness of Transaction Act*.

Section 8 of the Act binds any person who purports to hold himself or herself as a community leader and who adequately demonstrates that he or she is a representative of the community, and is a signatory to the CMCAs, and all of the members of his or her community. This provision reads:

The signature or other execution of a Community Mine Continuation Agreement by a person representing, or purporting to represent, a community or clan, or that person's delegate, binds all of the members of that community or clan to that Community Mine Continuation Agreement notwithstanding-

that there is no express authority for that person to sign or execute the Community Mine Continuation Agreement on behalf of the members of the community or clan concerned; or *The Ok Tedi Mine Continuation Agreements*; or

that not all representatives of the relevant community or clan have signed or otherwise executed the Community Mine Continuation Agreements: or

that not all members of the community are parties of the Community Mine Continuation Agreement; or any requirements of the Underlying Law.

2) The Acts and deeds of a person described in Subsection (1) in respect of any matter referred to in the relevant Community Mine Continuation Agreement bind each person on behalf of whom that person purports to be acting, and where a

¹¹⁷ Ibid.

person purports to be acting on behalf of the whole of that person's acts and deeds bind each existing and future member of that person's community or clan, including, without limitation, children and persons who are subsequently born into, or who subsequently join, that community or clan.

It should be noted that Section 8(2) binds each and every existing and future members of the impacted community or clan, including without limitation, children and persons who are subsequently born into, or who subsequently join that community or clan. As long as this provision remains, generations of people in the affected communities will remain bound by the terms of the CMCA and its enabling legislation. In that context, it must also be pointed out that Section 4(6) of the Act bars the application of the *Fairness of Transaction Act*, hence, shielding the CMCA's from legal challenges, by future generations.¹¹⁸

The same trend is also cited in Clauses 9 – 13 of all the six CMCA's, under which a commitment made by a person purporting to hold a representative position in the impacted community binds that particular community to the CMCA, particularly under Clause 11.2:

that the persons signing this Agreement for and on behalf of each member of the Communities have the power and authority to do so and that this Agreement will be valid and binding on each member of the community.¹¹⁹

Clause 12 deals with a full indemnity statement where the communities participating under the six CMCA's sign an indemnity clause under which they each and severally release and discharge OTML, BHP, the company's shareholders, and their associated corporations, directors, officers, and agents from "all and any demands and claims arising directly or indirectly from the operation of the mine or any associated works."¹²⁰

Under Clause 13 of the CMCA, the communities, as parties to the six CMCA's, undertake to:

- take such steps as are necessary to ensure that on or before 7 January 2002, the communities, whether by the authorised representative or otherwise, execute and deliver opt-out notices in the Supreme Court proceeding (Clause 13.1); and
- release and discharge the company (OTML) and BHP from each and every claim made in the Supreme Court proceedings and the Dagi proceedings.

¹¹⁸ Ibid.

¹¹⁹ Ibid.

¹²⁰ Ibid.

- (Clause 3.2) as of March 2003, not all the members of the affected communities in the villages covered by the six CMCA had opted out and joined the CMCA. Elizabeth Matit and Tina Edwards, from Iogi and Atkambia Villages, respectively, Lower Ok Tedi, confirmed that their communities were divided into two groups — the lawsuit camp and the CMCA camp — and the situation remains. Rex Sale from Kivanga/Obo Village, Middle Fly, stated that, of the 10 000 people he represents as a trustee of the Middle Fly Development Foundation, 7 000 have signed up on the CMCA, but 3000 have not.

Clause 19 of the respective CMCA (all CMCA are standard in context, but differ in the schedules which set out the different set of compensation packages) addresses the effect of the payment of compensation under the MCA and the CMCA regimes, and all previous compensation regimes. It is a significant provision, as shown by the relevant parts:

...the payments to be made by the Company (OTML) pursuant to this agreement are, and shall be, in full compensation for all loss and damage contemplated by the environmental predictions suffered, or to be suffered, by the communities in respect of disturbance to the environment in the Lower Ok Tedi area of their use or enjoyment of the environment, including, where applicable and without limitation to the generality of the foregoing:

being deprived of the possession or use of the natural surface of the land area; damage to, or contamination of, the natural surface of the land;

- i. severance of the land or any part of it from other land owned or occupied by the communities; any loss or restriction of a right of way, easement, or other right;
- ii. any loss or damage to improvements;
- iii. in the case of land under cultivation, loss of earnings;
- iv. disruption of agriculture activities;
- v. social disruption;
- vi. garden damage and loss of economic trees;
- vii. loss or damage to any flora and fauna, on the land or in the water; and loss of use or contamination of water.

Overall the effects of Clause 12, 13, and 19 of the CMCAs are that they continue to bind all persons within and from the affected communities, for any loss or damage caused by the environmental effects due to the operation of the mine.

Although Section 5 of the Ninth Supplemental Agreement Act does not concern customary law holders and those in the affected communities covered in the various CMCAs, it provides “an absolute bar and defence” for BHP Billiton and its related companies in respect of any claim for environmental damage relating to, or arising out of, the operation of the mine.

In this regard, Section 5(1) of the Act states that:

neither the State nor any government agency may take, pursue, or in any way support proceedings against a BHP Billiton party in respect of any environmental claim relating to the operation of the project.

Basically, Section 5 of the Act prevents the National Government, the Governor of Western Province or the Western Provincial Government from making a claim or support any claim for environmental damages proceedings in a court of law. Section 5 of the Act offers absolute protection to the operator of the Ok Tedi Mine.

Under Clauses 15 and 16 of the CMCAs, OTML will have no obligation to continue to make the compensation payments under the CMCAs. In particular, Clause 15.2 states that, if the court orders:

the payment of damages by [OTML] or BHP to the communities or any member of them, then [the clauses on the payment of various compensation packages and cash payments under Clauses 17 and 18] from the date of any judgment or award of damages, and all payments made pursuant to Clauses 17 and 18, before that date, will be taken into account, and will be set off against those damages.

Clauses 15 and 16 in effect bar all future litigation against OTML for any claims for environmental damage.¹²¹

4.2.12 The Environmental Impact Assessments of the Ok Tedi Agreements

The *Ok Tedi (Mining) Act* of 1976 required the mine developer to conduct a program of environmental studies. In this era it is difficult to imagine how forward looking this requirement was, but at the time this was the most rigorous environmental standard for a mine in a developing country. Raymond Mikesell,

¹²¹ Ibid.

highly respected economist of the mining industry, at a conference in 1981 said of the Act, “[T]he most comprehensive environmental protection provisions in any mining agreement of which I am aware are found in the PNG-Ok Tedi agreement.” He was impressed that the requirements covered social as well as environmental impact, and that the environmental study was to be “taken fully into account in the detailed proposals for construction of the mine and infrastructure and the mode of operations, which proposals must be approved before the granting of the mining lease.”¹²²

The environmental impact statement (EIS) as a requirement of major developments had only been established in the United States from 1 January 1970. A similar legislation was enacted in Australia in 1974. One significant difference between the legislation in the U.S. and Australia is that in the U.S. it is government agencies that are responsible for Environmental Impact Assessment (EIA- with the costs carried by the private company) while in Australia it is the developer or the developer’s consultants that prepare the EIA, and it was the Australian precedent that was followed in PNG. Papua New Guinea’s *Constitution* was remarkable for the environmental principles it espoused, but these were only implemented in the 1980s. International lending agencies were even slower to require environmental impact statements of their projects. For instance, the World Bank did not require environmental assessments of all its projects until 1989.

The 1976 requirement that the Consortium (now OTML) produce an EIS was somewhat undercut by the agreement that no more than K150, 000 (US\$220,000) need be spent on environmental studies. This severely limited the fieldwork that would be done to establish a baseline against which to measure subsequent impact. The only data collected in the feasibility period was that related to hydrology, water chemistry, sediment transport, landslides, and bird life. On one of the major issues, the fate of soft (or “incompetent”) waste rock that would erode into the river system, the Consortium study, conducted by Vanoni and Henderson, optimistically assumed that the sediments would wash through the river system and end up in the Gulf of Papua without significantly altering the riverbed. This study predicted bed aggradation of only 23m in the Ok Tedi.

The Government commissioned its own environmental studies during the feasibility period. Indeed the government spent nearly four times as much as the company on environmental studies at this point. The government commissioned study to judge the effect of waste rock and sediments on the river system used computer modelling (then state-of-the-art techniques) and, unlike the consortium’s

¹²² Patricia K. Townsend and William H. Townsend, *Assessing an Assessment: The Ok Tedi Mine*, (UNEP Millennium Ecosystem Assessment) 4 < <http://www.unep.org/maweb/documents/bridging/papers/townsend.patricia.pdf>> accessed 14 December 2012.

study, considered four different waste disposal strategies to determine the range of potential impacts.

The Government's consultants from the Australian National University built on their experience with the Bougainville mine. They predicted that sediments would pass through the system as slugs of material that might raise bed levels in the order of 4 meters, vastly more than Vanoni and Henderson had predicted. This study was the basis for the government restriction of 60 million tonnes of waste rock in the Southern Dumps of the mine. Another technical consultant to the Government, Everett and Associates, studied the likely chemical impacts of mining on the river. These government reports were not made publicly available at the time they were made but the Consortium was required to make its studies public.¹²³

The Ok Tedi supplementary agreement of 1980 in its Schedule B described the format for a full Environmental Impact Study (EIS). This study was produced, at a cost of nearly US\$1 million by Maunsell and Partners as consultants and delivered in June 1982. The EIS was public and copies of all seven volumes are still available in libraries. The first volume was the main report. The other six volumes were a series of working papers. Volumes 2, 3, and 4 contained scientific and technical papers on water quality, waste rock, and sediment issues; Volume 5 was on the relationship between the people and plants and animals; Volume 6 on aquatic biology, and the biological effects of heavy metals, cyanide, and suspended solids; and Volume 7 primarily on the Port Moresby harbor. A short summary was translated into the trade languages Tok Pisin and Motu. However, there was no requirement that public input or peer review take place.¹²⁴

On the vexed issue of the effect of waste rock on the river system, the report was able to draw on both Consortium and Government studies, doing its best to reconcile them, compromising by suggesting that the bed aggradation might be in the order of 1 to 2 m from Tabubil to Ningerum and 2 to 5 m in the lower Ok Tedi. Maximum deposition of 3 m was expected on the lower Middle Fly because of the backwater effect of the junction of the Strickland River. One thing that is made strikingly clear in the EIS is that the impact of the mine on the river will be very long term. It was suggested that in the lower Ok Tedi, for example, bed aggradation could reach its maximum of 1.5 m fifty years after the mine closed. This time-scale has largely been ignored in most discussions of the mine.¹²⁵

In comparison with the boiler-plate environmental impact statements that have become common nowadays, the Maunsell EIS was unique, drawing upon the expertise of almost everyone who had done any environmental work in the area whether as a hydrologist, anthropologist, or biologist. The terms of reference

¹²³ *Ibid.*

¹²⁴ *Id.*, p5.

¹²⁵ *Id.*, p6.

encouraged them to focus on species of importance to the people living in the Fly watershed. Their ethno scientific approach allowed them to incorporate the rich local knowledge of several language groups of people indigenous to the area.¹²⁶

The Government was responsible for completing the Social Impact Study just as the Consortium was responsible for the EIS. The main social impact study was completed for the Department of Minerals and Energy in July 1980. The study dealt largely with the economic impact of the project, both its expected macroeconomic impact at national level and the prospects for economic benefits to local people through employment and small business development.¹²⁷

4.2.13 Environment Act

The *Environment Act* was enacted in 2000. It repealed and replaced the *Environment Planning Act* 1978, the *Environmental Contaminants Act* 1978 and the *Water Resources Act* 1982. This Act is meant to be a one-stop-shop for all matters dealing with environmental planning and management in PNG. The legislative scheme of the Act is designed to promote the development of natural resources but within approved environmental parameters as outlined in the legislation.

In the absence of specific legislation in the area of tailings disposal, the tenor of the *Environment Act* provides in general terms the legal mechanism necessary to manage and control pollution and environmental harm caused by economic activity such as mining and resources development. It is observed that, the tenor of the Act is premised on the traditional “command and control” regulatory methods of pollution control.

In its preamble the Act recognises the fact that while it is inevitable for humans to exploit the environment, it must be done in a responsible and sustainable manner. This is consistent with the fourth of the National Goals and Directive Principles of the *Constitution*.

The objective of the Act is more or less an attempt to provide the mechanisms to efficiently and effectively manage and control such activity through a prescribed licensing process. In Part 5, the Act provides for the different levels of environment permits. A permit can be issued to a proponent of an economic activity by the relevant authority, in this case the Director, upon preparation of an Environment Impact Assessment (EIA). In order to qualify for a permit to be issued it is mandatory for the proponent to carry out an EIA on an economic activity that, amongst other issues, poses a threat of serious environmental harm.

¹²⁶ Id, p4.

¹²⁷ Id, p8.

Under the EIA process established in Sections 51-59 of the Act, companies engaged in mining developments must inform the Government of their plans and manner in which they will carry out the mine tailings disposals. Since the enactment of this legislation all current mining operations now are required to comply with the provisions of the *Environment Act* in terms of mine tailings.

This procedure is a step away from the previous government policy as seen in the Bougainville and Ok Tedi mining operations whose activities were regulated by their specific legislations.

4.2.14 Environment (Water Quality Criteria) Regulation 2002

The *Environment (Water Quality Criteria) Regulation* sets out the minimum standards of water quality that is safe for protection of aquatic life. This applies to any discharges into freshwater or sea. The water quality standards adopted by the Regulations are based on the World Health Organisation's water quality standards acceptable at the relevant period. It is noted that water quality is subject to weather patterns and other natural and human-made occurrences. The criterion used for the standard of water quality is flexible to allow for a revision of the standard based on new scientific evidence.

4.3 International Environmental Law

International environmental law principles include; sovereignty over natural resources; obligation not to cause damage; sustainable development; equitable utilization; polluter pays; and preventive action and precaution.¹²⁸

For the purpose of this inquiry, the two key principles are preventive action and precaution. These principles basically place an emphasis on the importance of being proactive and employing measures that can be used to minimise or prevent the environmental impacts of mining or any activity that pose a high likelihood of environmental damage and pollution, particularly in relation to the manner with which their business is carried on or the way waste is disposed.

The principle of precaution and preventative action provide that actions on environmental matters should be taken even if there is a lack of total scientific certainty, often reversing the burden of proof and placing it on those who claim that an activity is not damaging.¹²⁹ That is to say despite evidence proving otherwise the burden of proof lies on those who assert that no pollution or environmental damage will ensue from a particular mining activity.

¹²⁸ Elli, Louka, *International Environmental Law: Fairness, Effectiveness, and World Order* (Cambridge University Press, 2006).

¹²⁹ *Id.*, p50.

The *Ramu Nico* case gives examples of sections in the *Environment Act* that give effect to the principles, namely Sections 44(3) and 129(4).¹³⁰ Section 44(3) provides that an environmental permit confers on the holder the right to carry out the activities specified in the permit in accordance with the conditions imposed under the permit. The permit in other words enables and creates an opportunity for *preventative* measures or precautionary conditions to be included in the permits when issued so that holder of such permits will not only carry on their activities but also have due regard of the conditions set out under the permit either precautionary, preventative or both.

However, an analysis of the Supreme Court decision in *Ramu Nico* illustrates that beyond the Department of Environment and Conservation's discretion to consider environmental law principles in assessing environment impact statements and issuing permits, there is no underlying policy or legislation that supports the precautionary and preventative action principle. If such underlying legislation or legislative provision existed then it is highly probable that the Supreme Court decision in *Ramu Nico* would have been different.

¹³⁰ See n49 at 84.

5. Mine Tailings Practices

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5.1 Introduction

Although the practice of mine tailings and mining in general are regulated by legislation in most countries around the world, the regulatory framework of tailings disposal in mining countries such as Australia, Canada and South Africa play a dominant role. These countries are heavily involved in that they invest substantially in terms of their time and money into studies about tailings management. Included in all these studies are the regulatory requirements, weather conditions, soil type, surface waters, ground water and geochemistry of the soil and properties of the tailings.

This Chapter will basically discuss the practices being applied in the mining countries of Australia, Canada and South Africa as well as other parts of the world with similar conditions to PNG. The material for this Chapter is largely sourced from the innovative work of Engels and Dixon-Hardy on tailings storage guidelines and standards, which is a contemporary issue not just in PNG but the rest of the mining world.¹³¹

5.2 Tailings Waste Management in Selected Countries

5.2.1 Australia

Australia's mining industry is controlled by individual states. For example in Western Australia, the Department of Minerals and Energy (DME), through administering the *Mining Act* 1978, *Mining Act Regulations* 1981, *Mines Safety and Inspection Act* 1994 and *Mine Safety and Inspection Regulations* 1995, regulates safety and environmental aspects of tailings disposal in Western Australia. Whereas

¹³¹ J Engels & D Dixon-Hardy, "Tailings Storage Guidelines and Standards" (Tailings.info) <<http://www.tailings.info/guidelines.htm>> accessed 25 July 2011.

in Victoria, the Minerals and Petroleum Division (MPD) of the Victorian Department of Primary Industries regulates the minerals, petroleum and extractive industries within Victoria and its offshore waters, including Commonwealth waters. The MPD, manages the administration of the *Mineral Resources Development Act* 1990 and the *Extractive Industry Development Act* 1995. In Queensland, tailings storage facilities are regulated under the *Environmental Protection Act* 1994.¹³²

Despite the different regulatory bodies, Australia is ardent in promoting the best environmental practices in all aspects of the mining industry. In its effort it has set up the Environmental Protection Agency (EPA), an agency of the Australian Environment Department which has been active in promoting the concept of Best Practice Environmental Management in Mining (BPEM) that involves consultation with communities and involving them in environment auditing through the environmental impact assessment and tailing containment.

5.2.1.1 Ministerial Council and Business Cooperation

In 2003, a document entitled, *Strategic Framework for Tailings Management* was produced by the Ministerial Council on Mineral and Petroleum Resources (MCMPR) and the Minerals Council of Australia. The document was primarily focused on the topics of stewardship, stakeholder engagement, risk management, implementation and the closure aspects of tailings storage and compliments tailings regulations and other tailings guidance manuals which are implemented across Australia. Principally, the aim of this document is to establish regulatory and industrial input to develop more consistent guidelines for tailings storage within Australia.

Although mine tailings practices within Australia predominantly falls within the jurisdiction and responsibility of each state and territory by its legislation and regulations, the Commonwealth does have overlying responsibilities and jurisdiction dealing with Australian offshore areas.

5.2.2 Canada

Like Australia, mining in Canada is controlled by the individual provinces. In 1998 the Mining Association of Canada (MAC) published a document titled *A Guide to the Management of Tailings Facilities*. The purpose of framing such a guide was to provide the basic information on safe and environmentally responsible management of tailings facilities, to assist mine operators develop tailings management systems that met the environmental and safety criteria and at the same time improve the consistency of application of sound engineering and management principles to tailings facilities. The guide therefore was purposely framed to assist mine operators in developing a successful management system for their tailings facilities.

¹³² See n75 at pH15.

In an effort to include tailings dams the Canadian Dam Association (CDA) revised its Dam Safety Guidelines in 1999. As a result, MAC and other contributors assisted in developing and incorporating tailings facilities into CDA's guidelines thus they now have the same level of respect as conventional dams.

Then in 2003, the MAC followed up and published as a compliment to the 1998 guide another manual titled, *Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities*. Basically the manual emphasised on sound industrial practice and procedures. Importantly though, the mining companies adopted and implemented the tailings management systems.

The whole aim for the MAC guide and manual and the CDA guidelines were to compliment government regulation in the mining industry and ensure that the mine operators are diligent in carrying out their mining activities to ensure protection of the environment and the public from the hazards associated with tailings storage.

5.2.3 South Africa

Mining in South Africa is generally regulated by three (3) main pieces of legislation, namely; the *Water Act* 1998, the *Minerals Act* 1991 and the *Mine Health and Safety Act* 1996. The responsibility for the implementation of these pieces of legislation is vested in the Department of Minerals and Energy (DME).

The "Code of Practice for Mine Residue Deposits", published by the South African Bureau of Standards in 1998 is the guide for tailing facilities. The standard does not address the environmental issues or health and safety concerns of tailings storage, although it places more emphasis on the need for management throughout the life cycle of a Tailings Management Facility.

The standard contained fundamental objectives, principles and minimum requirements for best practice, all directed towards ensuring that no inevitable risks and problems are left to future generations. The key principles on which the SABS standard is based are:

- i. Continual management – stressing the importance of ongoing management attention.
- ii. The minimization of waste and the impacts of waste – the steps that should be taken to reduce the amount of waste produced and the impact of its disposal.
- iii. Precautionary principle – a conservative approach where there is risk to human health, property or the environment exists.
- iv. Internalization of costs – detailing the full cost of satisfying the requirements of the standard reiterating that this should

not be avoided by neglecting safety, health or the environment.

- v. Assessment of the full life cycle implications – stressing that waste disposal should be seen in the context of the entire mining process, and the need to rehabilitate for sustainable land use after it has ceased.

In 2000 DME as declared law that tailings management in South Africa be regulated by the “Guideline for the Compilation of a Mandatory Code of Practice on Mine Residue Deposits” issued by the DME in 2000. The code of practice that resulted from this is known as the *SANS 10286, Code of Practice for Mine Residue Deposit*. The SANS 10286 code of practice is mandatory for each tailings facility and requires strict adherence.

5.2.4 Other countries

In 1996 a strong earthquake caused the failure of several tailings facilities in Peru. As a consequence, the government enforced legislation requiring mining companies to conduct stability analysis of both active and decommissioned tailings facilities. Peru now has seventeen protocols and guidelines addressing environmental monitoring and design specifications to protect the environment. Topography in Peru is extreme, as such tailings dams are constructed to great heights as earthquakes are frequent and hydrology is also not well understood.

The challenges associated with tailings storage in Peru are perhaps more complex than those in countries with suitable tailings management guidance and regulations, such as Canada. However, countries without suitable guidance and regulation, such as Peru and Papua New Guinea would benefit as a result of worldwide standardisation of tailings management.

5.2.5 Organisations providing tailings management guidance

The universal frameworks for managing a tailings facility are made up of guidelines and manuals that were largely developed in Canada, Australia and South Africa. These rules are accompanied by various guidelines developed by independent organisations such as the United Nations Environmental Program (UNEP) and the International Council on Metals and the Environment (ICME) which have attempted to address tailings safety independently to regulators.

5.3 Developing Best Practice

Mine tailing practices are regulated by legislation varying from country to country. The practices within Australia, New Zealand, Canada and South Africa incorporate Best Practice Environmental Management in mining which have had international acceptance.

However in PNG, mine tailings practices vary greatly from a riverine tailing disposal, deep sea tailing disposal and tailing impoundments. While riverine tailing disposal and deep sea tailings may fall within PNG law, the mine tailings issues from a global perspective suggest that containment measures are preferred and that there needs to be comprehensive containment migration, maintenance and surveillance management undertaken.

6. Alternatives to Riverine Tailings Disposal and Deep Sea Tailings Placement

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6.1 Introduction

This Chapter discusses the available alternatives to riverine tailings disposal and deep sea tailings placement. A large part of this Chapter is sourced from the work of Andrew Gunua, in his 2010 MSc thesis, “Riverine and Deep Sea Tailings Disposal in Papua New Guinea: The Causes, Effect and Alternate Solutions.”¹³³

Technology in containing mine tailings is classified into two categories: (i) storage or containment and (ii) disposal of tailings. A discussion of current storage and

¹³³ See n11.

disposal methods will be followed by a discussion as to whether these alternatives are valid options for use in PNG.

6.2 Tailings storage and disposal techniques

There are advanced tailings storage techniques and disposal techniques practices around the world. The tailings data website, Tailings Info (www.tailings.info.com) provides information on the tailings storage techniques and tailings disposal techniques. The tailings storage techniques are underground backfill, co-disposal, conventional impoundment, inpit storage, and water management. The tailings disposal techniques are dry stacking, surface paste tailings disposal, and thickened tailings storage.¹³⁴

The following section discusses these tailing storage and disposal techniques.

6.3 Tailings Storage Technique

6.3.1 Underground Backfill

For underground backfill disposal, the tailings are generally mixed with cement or other forms of binder, and discharged in pumps to fill voids which assist in stabilizing underground mines. In the case of an underground room and pillar mining operation, backfill is used to extract the insitu pillars containing ore. This is because the cemented backfill acts as a support and prevents heading collapse and subsidence. After backfill tailings are mixed from the surface, they are piped down into the area of the mine that requires backfilling either by method of decline, shaft or surface borehole.

6.3.2 Co-disposal

Co-disposal is the mixing of fine tailings with coarse waste material to form a single waste stream. The empty void space primarily associated with coarse waste streams is reduced when mixing the fine and coarse waste. Also, it increases the strength of the fines and stabilises the waste. This reduces the environmental risks and allows access onto the tailings for rehabilitation.

6.3.3 Conventional impoundment

Conventional impoundment is aimed at reclaiming the water for use in the processing plant and at the same time storing tailings. The surface impoundments can be a water retention type dam, and a raised embankment in a form of upstream, downstream or centre line embankment. The main difference is raised embankment dams are built higher as they required to store more tailings and process water or storm water, and the water retention dam is constructed to its maximum height before any impoundment discharge.

¹³⁴ See n131.

6.3.4 Inpit Storage

In-pit tailings storage involves backfilling of tailings in abandoned open pit surface mines. This method involves very low cost and is very attractive to mines as worked out voids can be filled. It does not require designing, constructing and operating a conventional, thickened, paste or dry stack facility. Also retaining walls are not required for tailings, thus this eliminates the risks associated with embankment instability.

6.4 The tailings disposal techniques

6.4.1 Dry Stacking

Dry stacking involves dewatering of tailings to higher degrees to lower its moisture content, which can no longer be transported by pipeline but by conveyor or truck. The truck or conveyor then dispose of them and are spread and compacted to form an unsaturated tailings deposit. A stable deposit is produced from this type of tailings storage. Thus, this does not require any form of retention building and is referred to as 'dry stack'.

6.4.2 Surface paste tailings disposal

Paste tailings are tailings which are significantly dewatered to a point where they have no critical flow velocity when pumped. When deposited they do not segregate, and when discharged from a pipe they produce minimal bleed water. Displacement pumps are required in this process to transport the paste due to increased viscosity of the tailings as a result of high dewatering. The distance at which the paste can be economically transported can be limited.

6.4.3 Thickened tailings storage

Thickened tailings require a mechanical process whereby low solids concentrated slurry is dewatered. The compression thickeners or a combination of thickeners and filter presses are used to achieve this. Thickened tailings are tailings that are dewatered to form a homogeneous non-segregated mass when discharged from a pipe. To prevent the possibility of liquefaction, the thickened tailings, when placed layer-by-layer, will dry to near its shrinkage limit and become dilative under dynamic shaking.

6.5 Alternate solutions of tailings storage and disposal in PNG

In his thesis, Gunua used a qualitative ranking system to make an assessment as to whether the tailings disposal and containment methods discussed above could be viable options within PNG.

Gunua created the table below in Table 2 and made a number of preliminary conclusions as to alternative tailings disposal methods that can be considered by mining operations within PNG.

Gunua's table was based on the work of Murray, Thompson and Lane titled, "Obstacles to On-Land Mine Tailings Disposal in Papua New Guinea" and the table created by them in Table 1.¹³⁵

Murray's table in Table 1 highlights the factors that deter on-land tailings disposal and compares these factors in PNG against Canada, Peru, Chile, Australia and West Papua. A 5 level scale is used to make the comparison, with 5 being the least favourable and 1 being the most favourable.

The ranking for PNG in the table is not made using specific mine sites but is a general assessment made by Murray, Thompson and Lane as a result of 50 years of combined working experience with various mining operations within PNG. Thus, it provides only a general indication of the difficulties faced by mines in PNG in pursuing on-land tailings disposal methods and individual mine sites could have either a higher or lower grading/level than those indicated in the table in Table 1.

Table 1: Tailings Disposal Methods Grading by Murray, Thompson and Lane

Factor	Variable	Assigned Qualitative Ranking									
		Construction/Operating					Closure				
Mining Area	Country and/or Location	PNG	BC Canada	Ontario Canada	West Australia	Arid Peru and Chile	PNG	BC Canada	Ontario Canada	West Australia	Arid Peru and Chile
Climate	Rainfall	4	3	2	2	1	4	3	3	3	1
	Temperature	1	1	3	1	1	1	1	3	1	1
Topography/ Geomorphology	Slope Stability Natural disasters	4	3	1	1	3	4	3	1	1	3
Tectonics	Earthquake	4	3	2	1	5	4	2	1	1	3
Geology / Geotechnical	Low strength materials	4	3	2	2	3	3	2	1	1	2
Social	Including regulatory issues	3	1	1	1	2	4	1	1	1	2
Floral/Fauna	Impacts	1	1	1	2	1	3	4	4	2	1
Constructability	Ability to construct	3	2	1	1	1	0	0	0	0	0
Logistics	Ability to respond	4	2	1	1	1	5	4	3	2	3
Qualitative Comparison	Total Rank	28	19	14	12	18	28	20	17	12	16
	Number of 4 ^s	5	0	0	0	0	4	1	1	0	0
	Number of 5 ^s	0	0	0	0	1	1	0	0	0	0

Qualitative Ranking Legend: 1 – very favourable, 2 – favourable, 3 – neutral, 4 – unfavourable, 5 – very unfavourable

Murray, Thompson and Lane's table gives PNG an overall rating of 28. Based on this ranking and the qualitative ranking system employed to obtain the ranking,

¹³⁵ Len Murray, Mark Thompson and Malcolm Lane, "Obstacles to On-Land Mine Tailings Disposal in Papua New Guinea," (Klohn Crippen Berger Ltd) 17 <<http://www.infomine.com/library/publications/docs/Murray.pdf>> 18 December 2012.

Gunua created a comparative analysis shown in Table 2. Gunua's table assess the alternative forms of tailings disposal against PNG's ranking and draws preliminary conclusions as to appropriate alternate forms of tailings disposal/containment that can be used in PNG. Again, it must be noted that this table is formed on generalisations and not on assessments of specific mine sites.

Table 2: Tailings Disposal Methods Grading by Gunua

Factor	Variable	Country	Assigned Qualitative Ranking						
			Storage			Disposal			
Mining Area	Country and/or Location	PNG	Underground backfill*	Co-disposal	Conventional impoundment**	Inpit storage	Dry sacking	Surface paste tailings	Thickened tailings storage
Climate	Rainfall	4	4	4	4	4	5	5	5
	Temperature	1	3	2	1	2	3	3	3
Topography/ Geomorphology	Slope Stability/Natural disasters	4	4	3	4	2	4	3	3
Tectonics	Earthquake	4	4	2	5	3	4	4	4
Geology/ Geotechnical	Low strength materials	4	4	3	3	2	3	3	3
Social	Including regulatory issues	3	2	2	3	4	5	5	5
Flora/Fauna	Impacts	1	2	2	3	4	4	4	4
Constructability	Ability to construct	3	3	4	4	3	3	3	3
Logistics	Ability to respond	4	3	4	4	3	3	3	3
	Total Rank	28	29	26	31	27	34	33	33
Qualitative Comparison	Number of 4s	5	3	2	3	3	3	3	2
	Number of 5s	0	5	0	1	0	5	2	2

Note: * Refer to underground mines

Qualitative Ranking Legend: 1 - very favourable, 2 - favourable, 3 - neutral, 4 - unfavourable, 5 - very unfavourable

**covers centline, down and upstream impoundment

6.6 Analysis

This section provides an analysis of the findings in Table 2.

6.6.1 Storage technique

6.6.1.1 Underground backfill

High rainfall is unfavourable for this technique. High rainfall will increase the water table underground and it is likely that the tailings effluents may seep into ground water and cause contamination. It involves the high cost of tailings dewatering, extra manpower and equipment. It is not favourable for flora and fauna above the surface as well as mining communities using the surrounding land.

6.6.1.2 Co-disposal

This method is unfavourable to high rainfall, but conducive to earthquake prone areas due to its increasing strength from mixing of fine and coarse waste material. It has a high constructability cost as it would require two feeds i.e., coarse and fine,

both will be pumped together for blending. However, the high logistics cost is also unfavourable.

6.6.1.3 Conventional Impoundment

This technique may come in the form of water retention design, downstream design or upstream design. However, these designs are not favourable to high rainfall and earthquake areas. It involves high cost of constructability and logistics. Only mines operating in stable areas with low rainfall can use this storage method. Two examples are the Kainantu and Hidden Valley mines.

6.6.1.4 Inpit storage

This method is unfavourable for high rainfall and earthquake areas. The flora and fauna may be impacted due to contamination caused by ground water seepage. However, it does not require construction of facilities and no logistics are required. Thus, this is a low cost method.

6.6.2 Disposal technique

6.6.2.1 Dry stacking

This technique requires high construction and logistics costs. It is unfavourable for high rainfall and requires large spaces to stack up the dry stacks. Requiring large spaces or land may require further negotiations for land.

6.6.2.2 Surface paste tailings

This is very unfavourable for storage on land due to restrictions by the country's regulations in relation to land ownership. It is unfavourable for high rainfall. The flora and fauna are endangered by this method, thus, it is not favourable. It is also not favourable for earthquake areas.

6.6.2.3 Thickened tailings storage

This is very unfavourable for high rainfall areas and for storage on traditional land a number of restrictions are imposed by law. It is unfavourable for earthquake areas, and flora and fauna. This method is neutral for temperature and stability. It may require high construction and logistic costs.

6.6.3 Discussion

The analysis shows that the storage technique of co-disposal has a ranking of 26, which is less than PNG's 28, as ranked by Murray, Thompson and Lane, in comparison with other countries. Thus, it could be a viable alternative storage technique for use in PNG. The others that follow are inpit storage, underground backfill and conventional impoundments. The inpit storage will be only applicable to abandoned mines or any empty crater close to operating mines.

The disposal techniques include surface paste tailings (33), thickened tailings storage (33) and dry stacking (34), which are all above PNG's ranking of 28. These techniques require open and barren land, which not all mine sites in PNG have. Thus, these disposal techniques are not practical for PNG's more mountainous mine sites but could be considered for lowland mines.

6.6.4 Issues concerning storage alternatives

Gunua at the completion of his analysis suggests co-disposal, in-pit storage, underground back-fill and conventional impoundment as alternatives. All of these are storage as opposed to disposal methods.

There are several issues that arise with these storage methods that need to be taken into account when considering these alternatives. The first issue in relation to tailings management is to ensure that tailings storage areas are located away from environmentally sensitive areas. Secondly the tailings must be kept as environmentally friendly as possible. This can be achieved through a milling process that ensures the chemical levels in the tailings are kept to a minimum. Thirdly, storage methods need to be kept safe and secure to not only prevent accidents induced by natural phenomena such as earthquakes, but also technical failure and sabotage.¹³⁶

With the third concern comes associated concerns specific to PNG, of land ownership and security of the storage area. As the law stands, once the mining lease expires, the ownership of the land reverts back to the customary landowners. Therefore, the issue becomes who is responsible for the maintenance and security of the storage site at this point, and what kind of arrangements can be made to ensure the responsibility does not fall back onto the customary land owners who in most cases would not have the expertise or funds to appropriately maintain and secure the site.

¹³⁶ See Engels n12.

7. Issues

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7.1 Introduction

This term of reference came about because of “concerns and comments raised by indigenous Papua New Guineans living within mine tailings disposal areas, including waterways and coastal areas over mining waste management and disposals into the environment and the consequential harm to the environment.”¹³⁷ This illustrates that the foremost issue with this TOR is the concern for environmental damage caused by tailings disposal.

The TOR goes on to further state that the CLRC must recommend corrective measures that have to be taken to address these concerns against the backdrop of the *Environment Act*, the *Mining Act* and other related legislation.

¹³⁷ See Chapter 1 of this Paper.

The TOR calls for the above to be addressed through consideration of comparative industry best practises, any relevant research or developments, and consultation with relevant stakeholders.

Hence there are three main issues concerned with this TOR:

To what extent is the environment affected by mine tailings disposal?

Does the current stated minimum allowable levels of pollutants offer adequate protection for the environment and well-being of people?

Does the current legislative regime adequately address the issue of tailings waste disposal and its effect on the environment and the well-being of people?

This Chapter will discuss the specific issues that fall under these three main areas of inquiry.

7.2 To what extent is the environment affected by mine tailings disposal?

The previous chapters provided an insight as to the general concerns associated with largely riverine tailings disposal and deep-sea tailings placement. Chapter 2 looked at the nature of RTD and DSTP and the environmental issues associated with them and Chapter 3 briefly discussed the tailings disposal system at all the operating mines in PNG, with specific case studies on Ok Tedi and Lihir's RTD and DSTP systems respectively.

This section will re-visit the identified environmental concerns and highlight the associated issues.

7.2.1 The environmental effects of RTD

As discussed in Chapter 2 and 3, PNG is one of only two countries in the world which continue to use RTD, as a method of tailings waste disposal. It is considered so environmentally unfriendly that the World Banking Group has made it a policy not to support projects proposing to employ the RTD. More significantly, BHP Biliton which operated Ok Tedi, having witnessed the destruction of the environment around Ok Tedi due to their employment of RTD, and after various out of court settlements, have instilled a company policy against the future use of RTD.

The main environmental concerns that surround RTD are sedimentation, acid drainage, high levels of water toxicity and dieback.

The Oxfam funded Report on “Pollution from the Tolokuma Gold Mine in the Auga-Angabanga River System Papua New Guinea,”¹³⁸ is one of the few, if not, the only independent study of the direct effects of RTD in PNG.

The Oxfam Study revealed several matters of concern, including the high levels of arsenic, copper, lead, mercury and zinc found in tailings samples, that in several instances were above the Australian Water Quality guidelines for the protection of 80-95% of aquatic organisms.¹³⁹ Since 2002, PNG has set (WHO-level) standards for water quality for aquatic life protection through the *Environment (Water Quality Criteria) Regulation*. However, how the Department of Environment and Conservation (DEC) applies this through the Environmental Impact Assessment (EIA) environmental permit process (for individual mines) is not clear. The Oxfam Report also reported concerns with high levels of turbidity and sedimentation. Both concerns do not seem to be regulated by the DEC through legislation or policy.¹⁴⁰

Given the consideration above, the very real question to be asked is, whether RTD should be banned in PNG?

There are several obvious issues that surround the question of a ban on RTD. Firstly, consideration has to be given to the reasons why RTD has been employed in PNG in the first place. These reasons were discussed in Chapter 3, and include the geographical location of PNG which makes it susceptible to earthquakes and heavy rainfall which can lead to flooding, therefore, rendering the traditional impoundment method untenable. This is, however, countered by discussions in Chapter 6 which point to alternatives apart from traditional impoundment as possibilities within PNG, and also to observation of the fact that several mines in PNG have already employed alternative methods to RTD and DSTP. It must be noted that a conclusion as to the success of the latter is still pending.

Another reason mine operators have opted to use RTD is the relative cost compared to alternative methods, which due to PNG’s harsh terrain and known logistical difficulties, pose a very large cost and may significantly cut into the profits of mining companies. Especially when considering the wasterock/tailings ratio to the very little valuable mineral that is eventually extracted. Thus, consideration needs to be given to the question of whether mining operators, especially foreign companies, will be deterred from mining in PNG by the high costs. Again, counterbalancing this, is the fact that there are several mining companies in PNG already using alternative methods to RTD and DSTP, apparently with sufficient profit to continue.

¹³⁸ Different Report by same author: A&SR Tingay Pty Ltd Environmental Scientists, “Pollution from the Tolokuma Gold Mine in Anga-Angabanga River System, Papua New Guinea” (Oxfam Australia, 2006)

¹³⁹ Ibid.

¹⁴⁰ Id, pp13-14.

In the event that a ban on RTD was implemented, would the ban be retrospective, in the sense that all mines currently employing the RTD method would need to cease this method and propose alternative forms of tailings disposal/storage? Or would the ban on RTD only apply to future mine developments in PNG? If a ban was implemented retrospectively than, the Ok Tedi, Porgera and Tolokuma mines would need to implement alternative forms of tailings disposal/containment.

In addition, if such a ban was implemented and the three operating mines could not successfully propose and implement an alternative form of tailings disposal, then a significant consideration would need to be given to the closure of these mines. This is of particular concern to the Ok Tedi mine, whose closure has been recommended by both the World Bank and its previous operator, BHP Billiton.

In 2000, the World Bank was commissioned by the Government of PNG to review the environmental issues associated with the Ok Tedi mine, the World Bank suggested that the mine be shut-down. The mine itself conducted a review in 1999 and there were four options discussed: (1) continuation of trial dredging to minimise sediment and dieback; (2) cease dredging; (3) continue RTD as it is; and (4) shut down the mine.¹⁴¹ BHP, then the mine operator, decided that the best option was to shut down the mine. However, the Government decided to: (1) continue the mine which led to BHP divesting its shares to the PNG Sustainable Development Program (PNGSDP); (2) continuation of dredging; and (3) RTD to continue at Ok Tedi. These decisions mean that the environmental damage still continues despite the dredging which has had minimal impact.

If RTD is to continue, then serious thought needs to be given to the safest method in which to conduct this waste disposal method. Questions to be considered in relation to this are: should a set of guidelines be created either through MRA policy or legislation establishing a uniform set of rules which should be as environmentally safe as possible? Should a comprehensive study of the effects of RTD on the environment be carried out in order to fully understand and address the effects of RTD? Who should carry out such a study?

Issue 1

Should Riverine Tailings Disposal be banned in PNG?

¹⁴¹ See n75 at pH10.

7.2.2 The environmental effects of DSTP

Deep-sea tailings placement is a more widely used form of tailing's disposal than riverine tailings disposal. However, it is still used in very few places. Currently, there are only an estimated 13 mines, in the world which use DSTP and this is also largely due to its effects on the environment.¹⁴²

In 2010 the Scottish Association of Maritime Science (SAMS) in association with the EU funded Mining Sector Support Program conducted a study on the use of DSTP in PNG, with a particular focus on the Lihir and Misima mines as discussed in Chapter 3. It came up with a set of guidelines for the use of DSTP in PNG. Unfortunately, the report and guidelines have not been made widely available to the public.

The report made several major statements about DSTP in PNG. Firstly, it noted that there were very few studies on the oceans around Lihir and Misima where the tailings were discharged. Instead the study drew on experience from similar waters in the Torres Strait and Gulf of Papua. Thus, the real impact of DSTP is not quantitatively known, and conclusions are drawn on scientific estimations. The main reason behind the absence of such an indepth study, is the cost associated with undertaking such studies. For example, the information on the marine environment in the EIA submitted by Lihir's consultants was based on observations and statistics from the Torres Strait ocean area. The SAMS report is critical of the Misima EIA, which it stated provided very little accurate information on the marine site of the tailings disposal.¹⁴³

Secondly, again based on studies of nearby or similar marine environments, SAMS notes several significant changes to the Lihir marine environment relating to its meiofauna, macrofauna and megafauna due to DSTP.¹⁴⁴

Thirdly, when SAMS submitted its report, it also produced a set of guidelines pertaining to use of DSTP, noting, however, that "the decision as to whether the use of DSTP is deemed acceptable should be based on a good understanding of the relevant environmental and social systems affected, but this is ultimately a political decision made by the government."¹⁴⁵ Thus, the SAMS review does not make any comment on whether DSTP should continue or not in PNG, rather it only makes comment as to how DSTP should continue in order to reduce environmental risk.

These statements by the SAMS reveal tangible environmental damage being caused by DSTP, the full effect of which cannot be estimated due to the lack of scientific studies in affected marine waters, largely due to cost and technicality. SAMS,

¹⁴² See n9 at pp2-3.

¹⁴³ See n30 at pp56 and 65.

¹⁴⁴ Ibid, pp 62-67.

¹⁴⁵ See n2 at p1.

however was not prepared to comment on the acceptability of DSTP, recognising it as a political decision.

This final statement by SAMS is significant, in that, the process it refers to is the aim of this very paper. This paper is formulated to highlight the environmental and social issues surrounding DSTP and RTD which followed by a consultation process, should result in a final report that will assist the Government in making an informed decision about the acceptability of either or both RTD and DSTP in PNG.

Given the findings of SAMS and considering international environmental law principles, particularly that of precaution and preventive action, could a ban on DSTP be a legitimate possibility?

Ultimately, in addressing whether there should be a ban on either or both RTD and DSTP, a balance needs to be drawn between the economic benefits of RTD and DSTP and the negative social and environmental aspects.

Issue 2

Should Deep Sea Tailings Placement be banned in PNG?

7.3 Does the current stated minimum allowable levels of pollutants offer adequate protection for the environment and well-being of people?

In addition to the environmental concerns, there is the added concern on human health and wellbeing of those individuals living downstream from the mine. Part of the social concern regarding tailings disposal which led to this Terms of Reference, was the work by Dr. Kotapu and the 2005 report funded by Oxfam which carried out a survey of levels of arsenic and other metals in the domestic water supply of people living along the Auga-Angabanga river system associated with the Tolokuma gold mine.¹⁴⁶

7.3.1 Best practice standards

With regards to standards for minimum allowable levels of pollutants for the protection of aquatic life, the *Environment (Water Quality Criteria) Regulation 2002* sets WHO standard criteria for pollutants released into freshwater and sea (this will be discussed as a separate issue in the next part of this Chapter). It is the water quality standards pertaining to human health which is of high concern.

Although in scientific measurement, the samples surveyed in the Oxfam study were small, the results indicate an area of grave concern as the samples illustrated high

¹⁴⁶ See n41.

levels of arsenic and other metals which could be attributed to the Tolokuma mine waste.¹⁴⁷ The study showed that the level of lead in the Angabanga river exceeded the WHO drinking water standards and that the level of arsenic and mercury of some of the samples collected in 2004 were also above WHO standards.

The study noted that although all levels of arsenic, lead and mercury in the river samples remained within PNG drinking water standards as per the *Public Health (Drinking Water) Regulation 1984*, those standards were based on the WHO standards of 1971 and are now out of date¹⁴⁸ especially when taking into consideration advances in knowledge of the toxicology of these elements. For example, the PNG standard for arsenic is 5 times higher than the current WHO standard, and the PNG lead standard is 10 times higher than the current WHO standard.¹⁴⁹

It must be noted that the *Public Health (Drinking Water) Regulation* only applies to water suppliers and hence does not apply to mine operators. However, it does provide an indication of acceptable drinking water standards in general, whether from a supplier or from natural sources. Mine operators should make some kind of consideration for the potential effect of their tailings disposal on the drinking water sources of nearby communities.

No other similar study to the Oxfam Study is known to have been conducted in PNG by either government agencies or non-governmental organisations. Thus, the extent to which RTD or DSTP may affect the health of individuals living in areas downstream from RTD mines, or living subsistence based life-styles in the marine areas surrounding DSTP locations is relatively unknown.

Issue 3

- (i) **Should the current minimum allowable levels of pollutants in the *Public Health (Drinking Water) Regulation 1984* be changed to meet world standards, specially the WHO standards?**
- (ii) **Should such standards be applied to drinking water sources potentially affected by a mine's tailings disposal?**

¹⁴⁷ Ibid, p1.

¹⁴⁸ Ibid.

¹⁴⁹ Ibid.

7.3.1.1 Regulation of mixing zones

Although not discussed previously in this paper, the water quality of a “mixing zone” is also an issue. A “mixing zone” is defined by the Australian and New Zealand Environment and Conservation Council (ANZECC) as an “explicitly defined area around an effluent discharge where certain environmental values are not protected” provided that the effects are contained within the mixing zone and do not affect the entire water body.¹⁵⁰

According to ANZECC standards, a mixing zone should have:

Effective discharge controls that consider both the concentration and the total mass of contaminants, combined with in situ dilution and waste treatment, should ensure that the area of a mixing zone is limited and the values of the waterbody as a whole are not jeopardized. If mixing zones are to be applied, then management should ensure that impacts are effectively contained within the mixing zone, that the combined size of these zones is small and, most importantly, that the agreed and designated values and uses of the broader ecosystem are not compromised.¹⁵¹

In PNG, water quality in the “mixing zones” of all mines are not legislatively required to be monitored.¹⁵² Further, the Ok Tedi and Porgera’s mixing zones have been criticised as being too large and of having adverse effects that go beyond the designated areas.¹⁵³ Ok Tedi and Porgera’s mixing zones extend 200km and 160km

¹⁵⁰ “Australia and New Zealand Guidelines for Fresh and Marine Water Quality 2000” (ANZECC, 2000) 2-17<<http://www.mfe.govt.nz/publications/water/anzecc-water-quality-guide-02/anzecc-water-quality-guide-02-pdfs.html>> accessed 12 August 2011. See also “A Case Study on Indigenous People, Extractive Industries and the World Bank. Papua New Guinea” (*Forest Peoples’ Program*, 5 April 2003) 8<<http://www.forestpeoples.org/sites/fpp/files/publication/2010/08/eirinternatwshoppngcaseapr03eng.pdf>> accessed 16 August 2011.

¹⁵¹ ANZECC Ibid, pp2-17. It is interesting to observe that the Australian and New Zealand Environment and Conservation Council (ANZECC) has established authoritative water quality standards that provide guidelines for the protection of aquatic ecosystems in areas such as the tropics, which are relevant in this case.

¹⁵² See n41 at p1.

¹⁵³ Council of Ethics, “Recommendation of February 14 August 2008 on Exclusion of the Barrick Gold Corporation” (*The Government Pension Fund- Global*, 14 August 2008) 8<http://www.regjeringen.no/upload/FIN/etikk/recommendation_barrick.pdf> accessed 15 August 2011; *Forest People’s Program* See n150 at p8.

respectively down the Fly and Strickland rivers.¹⁵⁴ It is estimated that more than 37 000 people live within five kilometres of these mixing zones.¹⁵⁵

Issue 4

Should mixing zones be required by law to satisfy international best practice standards?

7.3.2 Consideration of social impact

There has been no substantive study on the impact of mine tailings on the livelihoods of individuals within the mine impacted areas. However, looking at the environmental effect of tailings disposal on the river and ocean environments around the tailings disposal areas, it can be assumed that the livelihoods of subsistence-based locals in that area may well be impacted. It is the exact or quantified extent that needs further study and analysis.

It should be noted that (especially) with DSTP, the social effects may go beyond the traditional communities around the tailings site to affect commercial industries operating in the area such as fisheries. In particular, in the case of the Ramu-Nico mine, consideration needs to be given to the potential impact of its DSTP process upon the fisheries industry, especially where fish is prepared for export to the European Union with its strict regulations.¹⁵⁶ In this regard, a review published by the PNG National Fisheries Authority (NFA) in 1999 should be considered. In that report the NFA found that the Ramu Nico project is “unsustainable socially, economically and environmentally and cannot be allowed to proceed.”¹⁵⁷

In fact, Section 4, Schedule 9.1.1 of the PNG NFA “Fish Quality Control (Export) Standards” states that, “Fish shall not be harvested from areas where the presence of potential harmful agents such as pesticides, fungicides, pathogenic bacteria, biotoxins or heavy metals could lead to an unacceptable level of such substances in

¹⁵⁴ Ibid.

¹⁵⁵ See n4 at p38.

¹⁵⁶ The EU accredited “country of origin” process, describes PNG’s tuna as the “environmentally clean caught tuna, Bismarck Sea.” See: Alex Harris, “Paradise at risk: The politics of submarine tailings,” (*Keith Jackson and Friends: PNG ATTITUDE*, 14 February 2012) <http://asopa.typepad.com/asopa_people/2012/02/paradise-at-risk-the-politics-of-submarine-tailings.html> accessed 7 December 2012.

¹⁵⁷ Harris Ibid.

the food.”¹⁵⁸ The wording of this provision alone, means that fish cannot be harvested from the Bismarck Sea surrounding Ramu Nico’s DSTP point, because the area has “the presence of *potential* harmful agents,” and “*could* lead to an unacceptable level of such substances in the food.”

Issue 5

Should Social Impact Assessments be required under the Mining Act or Environment Act on the possible impact upon the livelihoods of individuals, communities and industries in the vicinity of RTD and DSTP sites prior to mining leases being granted?

7.4 Does the current legislative regime adequately address the issue of tailings waste disposal and its effect on the environment and the well-being of people?

There is no specific legislation or provisions regarding the management of tailings in PNG. This leaves the management of tailings to be assessed within the EIA process under the *Environment Act*.

Clearly there are concerns that surround this process as can be seen in the *Ramu Nickel* case, where although the mining company had fulfilled all the apparent legislative and regulatory requirements, the local population remained concerned about the environmental, health and social impact of the proposed DSTP on their lives. The argument, put forward by the mining company that because all legislative and regulatory requirements were satisfied, the mine and the DSTP should continue was in the end accepted by the Supreme Court. The question posed is whether the current legislative and regulatory framework for the management of mine tailings gives confidence to Papua New Guineans, in that it operates to effectively balance their health, environmental and social interests as well as the country’s economical interests.

7.4.1 The Operation of the Environmental Impact Assessment

Part 5 of the *Environment Act* provides for the different levels of Environment Permits. A permit can be issued to a proponent of an economic activity by the

¹⁵⁸National Fisheries Authority, “Fish Quality Control (Export) Standards” <<http://www.fisheries.gov.pg/LinkClick.aspx?fileticket=%2bcmHz%2bBp9Mg%3d&tabid=161>>

relevant authority, in this case the Director, upon preparation of an EIA. In order to qualify for a permit, it is mandatory for the proponent to carry out an EIA on an economic activity that, may poses a threat of serious environmental harm.

7.4.1.1 Issues with the Environmental Impact Assessment

The *Environment Act* attempts to provide a process of licensing and authorisation to the proponent of an activity such as mining but does not provide the mechanism to address the inherent limitations and shortcomings posed by the operation of the law itself. Currently, the *Environment Act* confers upon the proponent of an economic activity to lead or drive the EIA process. Critical to the commencement of any economic activity by the proponent is the preparation of the EIA. It is sometimes argued that when the EIA is prepared by the proponent or his agent in the form of an engineering or environmental consultant they would naturally be inclined to assess the environmental impact of the proposal in terms which favours the interest of the proponent.

7.4.1.1 Lack of Financial Capability and Capacity within Government

The EIA process is premised on the basis that the Director and the instrumentalities of the State are well versed in the area of economic activity such as mining and further assumes that they have the capacity to make an assessment within the timeframe provided by the *Environment Act*.

Like everywhere else in any public institution, the Department is inundated with mundane administrative matters to highly specialised matters that they lack the capacity and capability to adequately attend to an EIA process with due care and professionalism. The Department usually lacks industry expertise to adequately assess the statement proposal made by the proponent.

Issue 6

Should Environment Impact Assessments be prepared by the Department of Environment and Conservation with funding from the proponent of the mining activity?

7.4.1.2 Material falsehood and misleading information as an offence

The Act provides the procedure for the proponent to prepare an EIA and deems that the proponent is trustworthy. However, the Act does not impose any obligation or duty upon the proponent to provide an unqualified statement attesting to the

truthfulness of the EIA and, also there are no penalties for any material falsehood or misleading information.

As it is, the penalties for offences under Section 73 of the Act do not account for inflation, nor the seriousness of the specific offence (breach of permit). Thus a review of the penalties should also be considered.

Issue 7

Should Section 73 of the *Environment Act* be amended to include the provision of misleading information and material falsehoods in the EIA as an offence?

7.4.1.3 Independent Audits

Under Section 74 of the *Environment Act*, the current EIA process allows for the Department of Environment and Conservation to conduct an audit or investigation if it is alerted to discrepancies in the periodic environmental reports provided to it by the proponent or, in practice, at the behest of local communities, subject to sufficient pressure. Whilst the Act provides for ongoing audit of the activities, the limitations of technical capacity and capability and inadequate penalties renders enforcement and accountability difficult. In most situations, the Department of Environment and Conservation contracts independent auditors which is not only an expensive process but means that the Department of Environment and Conservation is less likely to follow up on what are seen as minor infringements.

There is no requirement in the Act for a Department of Environment and Conservation officer to be present at the mine sites for monitoring purposes. Thus, again, the Department of Environment and Conservation relies totally on the honesty of the proponent. Part III, Division 1, of the *Mining (Safety) Act*, provides for the role of investigators and wardens but does not require an on-site liaison officer, although in some mines this is the case in practice.

In 2000, the European Union funded a Department of Environment and Conservation-led monitoring body responsible for monitoring mines within PNG. This was a trial project and once the trial period ended, the program did not continue. The results and effectiveness of the program are not publicly known. However, such a body may require some consideration.

7.4.2 Developing a systematic approach to the environment and tailings management

What can be clearly discerned is that there is no systematic approach to mine tailings waste and its effects. The Department of Environment and Conservation, Mineral Resources Authority and the Department of Mineral Policy and Geo-

Hazard Management (DMPGM) have their respective responsibilities, however, their interaction may be described as ad hoc at this stage.

International best practice provides the considerations in the table below in developing a comprehensive tailings management system.¹⁵⁹ The table also provides a comparative analysis of PNG's current practice with international best practice, indicating any deficiencies that need to be addressed. The third column of the table calls for comments, which will be sourced during the consultative phase of this working process.

Table 3: Requirements for Internal Best Practice of Tailings Management.

No.	REQUIREMENTS FOR INTERNATIONAL BEST PRACTICE	CURRENT STATUS AND PRACTICE	COMMENTS
1	Specific regulations for the operation and maintenance of Tailings Placement System	Nil	
2	Competent regulatory authorities to monitor discharge quality and its environmental effects.	MRA, DEC	
3	Standardised methods for assessment of risk associated with the Tailings Placement System.	Currently each mine is given individual guidelines, monitoring requirements and standards as per their environmental permit issued by the DEC. These guidelines do not include uniform standards. They also have not included, in past practice, monitoring requirements for sedimentation and turbidity of waters.	
4	Establishment of a transparent EIA process where the environmental	As the law stands, the mining proponent provides an EIA to the	

¹⁵⁹ See n2 at p1.

	<p>protection outcomes and the most hazardous aspects of the tailings placement activity are identified and appropriate mitigation measures are identified; and where the interests of all stakeholders are identified and considered.</p>	<p>DEC which assesses and decides on it with the issuance of an environmental permit within 60 days. The process is not transparent, nor the principles/policy/guideline upon which the DEC makes its decision. For example, is there a consideration of the preventative and precautionary environmental law principles?</p>	
5	<p>A permitting/licensing process that details the site specific requirements that are needed to protect the marine environment and achieve the identified environmental protection outcomes in terms of the discharge system specification and operation, and includes appropriate environmental monitoring informed by the identified protection outcomes and the risk analysis.</p>	<p>Currently the EIA process is a proponent-led process and there seems to be no policy/guideline setting the requirements that the EIA must meet and the assessment that it undergoes in order for an environmental permit to be issued.</p> <p>Section 38 of the <i>Environment Act</i> makes provision for an environmental code of practice to be formulated in consultation with other stakeholders. Such a code, particularly pertaining to tailings waste, is not in existence at the moment.</p>	
6	<p>Scientifically robust and transparent methodology for setting sediment and water column environmental quality Standards (EQS) for potentially ecotoxic</p>	<p>This standard is absent from the current practice surrounding mine tailings management. There is no transparency in the methodology and public</p>	

	discharge components.	inquiries to obtain approved EIAs and specificities of tailings management systems can be fraught with difficulty.	
7	A clear process for reviewing all the information gathered through the EIA process showing how this has been assessed in coming to a decision, and confirming that all required procedures have been followed must be implemented.	Nil.	

The DMPGM has been in the process of developing a mine tailings waste management process for several years, however, it is yet to be finalised and made public. Whether policy is sufficient or there is a need for legislative reform is one to be determined in the process being kick-started by this Paper.

Issue 8

Should a specific legislation be enacted or should the Mining Act or the Environment Act or the Mining Safety Regulation be amended to address mine tailings waste management?

7.4.3 Sustainable mining

In October 2011, the Mining Journal produced a special publication on Mining in PNG. The map in Annex 2 identifies granted, pending and renewed exploration licenses in PNG and the map in Annex 3 identifies current and pending mine site. The abundance of these licenses are of particular concern as there was no zoning or long-term plan for a sustainable pace of mining. Zoning and controlling exploration license, will assist in sustainably mining in PNG as it regulates where and when mine operations can take place.

There are forest management plans for the forestry industry in PNG, however, such plans are non-existent in the mining industry. Sustainable mining could, not only, limit the social and environmental effects of mining, but also ensure that the pace

of mining activities progresses at a rate that the monitoring and regulatory bodies could keep pace with.

Issue 9

Should a long-term mineral resources management plan with zoning considerations be created to ensure sustainable mining?

7.5 Conclusion

This paper has highlighted some of the issues surrounding the effective management of mine tailings in PNG. The paper is not conclusive of all the issues. It only serves to highlight the issues the CLRC has identified at this stage of the legislative reform process. Hopefully, though the public consultation and feedback from affected stakeholders, more issues are identified and progress can be made towards producing strong recommendations for the Government, whether in the form of legislative reform or otherwise.

Annex 1: Litigation History of the Ok Tedi Mine

1976

BHP buys rights to Ok Tedi (sells 30% to German company, 30% to AMOCO, and gives 20% to PNG government).

1983

Tailings dam constructed as per agreement with PNG government.

1984

Dam collapses; BHP gets permission to dump 90,000 tons of waste each day into Ok Tedi River.

1984

Series of accidental cyanide releases into river.

1987

German and US interests withdraw. Landowners serve a petition demanding recognition of the damage.

1990

Mine briefly closes as 2000 protest damage to river and demand compensation.

1994

May 5

Writs filed against BHP and Ok Tedi Mining Ltd in the Supreme Court of Victoria.

1994:

June 16

Court awards judgement in favour of Ok Tedi landowners after BHP's lawyers fail to lodge their defence by the 30-day deadline.

1994:

June 20

BHP seeks leave to file their defence; this is granted a week later.

1994:

July 5

BHP seeks to have the case struck out; in November the Supreme Court of Victoria rules that the case can go ahead.

1994:

September

Slater & Gordon's PNG lawyer Rimbink Pato quits after being threatened; Dair Gabara becomes the firm's PNG representative and files 1056 writs in Port Moresby before the Statute of Limitations expires.

1994

November

Supreme Court rejects BHP's contempt proceedings against Slater & Gordon's Nick Styant-Browne and John Gordon for commenting on the case in two radio interviews; Justice Byrne also rejects BHP application that the PNG landowners should deposit an estimated \$2 million with the court to cover legal costs if they lose.

1995

February

Court rejects BHP application that the Victorian Supreme Court had no jurisdiction to hear the case.

1995

April

Inconclusive private meeting in Melbourne between Slater & Gordon and PNG Mines Minister John Giheno.

1995

August

After BHP offers \$110 million in compensation, its lawyers are exposed for helping draft PNG legislation to impose huge fines on anyone initiating foreign litigation against BHP.

1995

September

BHP begins a TV, radio and newspaper advertising campaign with claims that the tailings released into the Ok Tedi River were “virtually identical” to natural materials that found their way into the river; that only 20 km of the river’s 1000 km were affected; that fish “seem to be increasing again”; and of the social benefits from the mine.

1995

September 19

Justice Cummins of Supreme Court of Victoria finds BHP in contempt of court for interfering with the administration of justice in Victoria by co-operating with the PNG government in drafting the Ok Tedi Eighth Supplemental Agreement legislation, which would make criminal in PNG of anyone suing BHP in Victoria.

1995

September 20

BHP advised the court that, under 1994 changes to Victorian law, only the Attorney General could authorise proceedings for contempt of court.

1995

September 22

Justice Cummins ruled that the changes were unconstitutional and that BHP was still guilty of contempt.

1995

December 15

BHP’s first victory: the Appeal Court ruled by a margin of 3-2 that the 1994 law was valid, that only Attorney-General Jan Wade could prosecute for contempt of court.

1996

March 4

Mrs Wade announces that, on the advice of Solicitor-General Douglas Graham, she will not prosecute BHP; Parliament is later told, in October 1996, that Mrs Wade holds BHP shares and Mr Graham is a director of companies which hold BHP shares.

1995

October 11

Solicitor John Gordon arrested on arrival at Port Moresby; detained then deported. PNG Court finds Immigration officials in contempt of the court's habeas corpus order.

1995:

Oct-Nov

Supreme Court of Victoria warns BHP that its advertising could be in contempt; also rules that the case can proceed but that the court did not have the power to order BHP to build a new tailings dam.

1995

December 15

PNG Parliament passes the Compensation (Prohibition of Foreign Legal Proceedings) Act 1995. PNG villagers have 60 days to withdraw their legal action against BHP or face arrest. Gazettal is delayed after an appeal by Australia Foreign Minister, Gareth Evans.

1996

April

The PNG legislation became law. BHP began modest payments to villagers. But by the end of the month clan leaders representing 31,488 Ok Tedi and Fly people had opted out of the BHP compensation plan.

1996

June 7

BHP, its subsidiary OTML, plaintiffs and their lawyers reach agreement.

1996

June 11

Settlement announced. This includes:

- \$110 Million
- a further \$40 million to the worst affected areas
- a commitment to put an end to tailings from the mine polluting the river
- legal costs
- the withdrawal of court action in Victoria and PNG
- environmental measures, including dredging the river and a proposed 130 km pipeline, which were expected to cost \$400 million.

1999

June

OTML reacts to preliminary results from environmental studies on waste from the mine. The results predict the environmental impact of the mine will be significantly greater than previously expected. OTML flags the early closure of the mine as option for dealing with the problem.

1999

August

OTML releases scientific reports on the environmental effects of the Ok Tedi mine. BHP says the mine is not compatible with its environmental values and company should not have become involved in the mine.

2000

March

The World Bank says the Ok Tedi mine should be closed without delay. The Bank expresses concern at delays by BHP and the PNG government to deal with the environmental problems caused by the mine.

2000

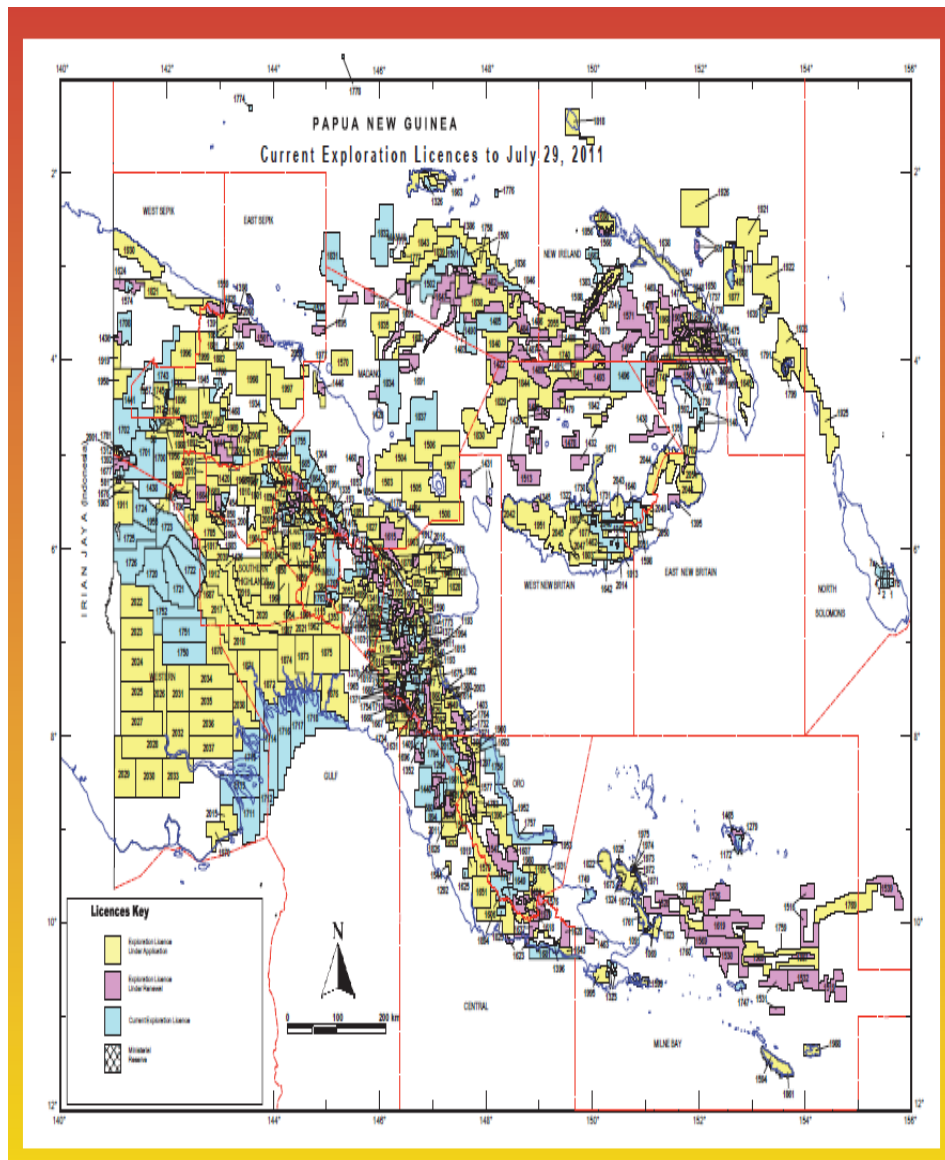
April 11

Ok Tedi 2: Legal action seeks compensation and reasonable tailings mitigation.

2001

The Ok Tedi Ninth Supplemental Agreement is passed, allowing for the continuation of the mine and the end to all future legal action.

Source: Slater & Gordon

Annex 2: Current Exploration Licenses

Source: Mining Journal

Annex 3: Current Mine Projects

