

## ENVIRONMENTAL AND SOCIAL IMPACT OF URANIUM MINING IN AUSTRALIA

A. JOHNSTON

Supervising Scientist, Environment Australia  
GPO Box 461, Darwin, Northern Territory, Australia, 0801.



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### Abstract

The mining of uranium at the Ranger and Jabiluka mines in Australia's Northern Territory has been assessed as a case study for the environmental and social impact of uranium mining in Australia. The level of environmental protection achieved has been very high. However, a number of social indicators reveal that the social impact of development in the region, including the mining of uranium, has been significant. A program is now underway to redress these social issues. Links between social and environmental impact have been identified. In today's world, the standards and practices in environmental protection are as much determined by social attitudes as they are by scientific and technical assessment.

### 1. INTRODUCTION

The mining of uranium has been the subject of environmental and social concerns in the Australian community since the mid - 1970s. Following the discovery of a number of major uranium deposits in what is known as the Alligator Rivers Region (fig. 1) of the Northern Territory, a major public inquiry, the Ranger Uranium Environmental Inquiry (RUEI), was held. This inquiry not only addressed the potential environmental impact that could arise from the development of the uranium resources. It also assessed the likely social impact on the Aboriginal people of this remote region of Australia.

The RUEI concluded [1] that mining of the Ranger deposit could proceed without having significant impact on the environment provided that a comprehensive system of environmental protection was implemented. Importantly, it also concluded that the clearly expressed opposition to mining by the traditional Aboriginal land owners should not be allowed to prevent the development. The Australian Government accepted the recommendations of the RUEI and approval was given in 1977 for mining of uranium at Ranger to commence.

Following the government's decision on Ranger, approval was also subsequently given for mining of uranium at Nabarlek in the Alligator Rivers Region and at Roxby Downs in South Australia. However, when the Australian Labor Party came to power in 1983, the implementation of its "three mines policy" prevented the development of the Jabiluka and Koongarra uranium deposits in the Alligator Rivers Region as well as a number of other potential developments at other sites in Australia.

The Ranger and Roxby Downs mines are currently the only two fully operational uranium mines in Australia. However, following a further change in government in 1996, a number of other mines are being developed. These include Jabiluka near Ranger in the Northern Territory, and Beverley and Honeymoon in South Australia. In this paper, we explore the issues of environmental and social impact arising from uranium mining in Australia using the Ranger and Jabiluka mines as a case study. This choice has been made because two defining characteristics of the region highlight the significance of both environmental and social issues at Ranger and Jabiluka. First, the Ranger and Jabiluka leases are surrounded by Kakadu National Park which has been inscribed on the World Heritage List. Second, the land on which these deposits were found is Aboriginal land and the owners of the land have opposed the development of both mines.

## Alligator Rivers Region

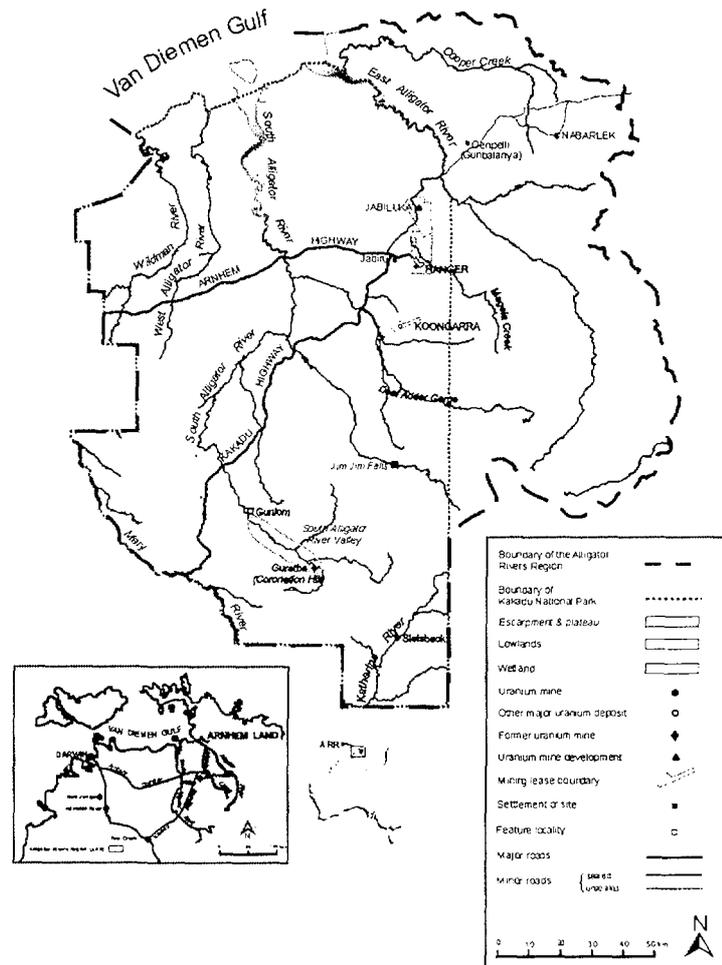


FIG. 1. Location map of the Alligator Rivers Region in the Northern Territory of Australia

### 2. THE ALLIGATOR RIVERS REGION

The Alligator Rivers Region, comprising an area of approximately 28 000 km<sup>2</sup>, is broadly defined by the catchments of the East, South and West Alligator Rivers (fig 1). It is of outstanding heritage value for its unusual combination of largely uninhabited areas with attractive wild scenery, is highly biodiverse, and has a very large concentration of Aboriginal rock art of world significance. Its national and international importance is recognised by the inclusion of Kakadu National Park on the Register of the National Estate and its inscription on the World Heritage List. The flood plain areas within Kakadu are recognised as one of Australia's Wetlands of International Importance listed under the Convention on Wetlands of International Importance. The region is rich in natural resources, having a variety of terrestrial and aquatic ecosystems including sandstone heathlands, open woodland, monsoon rainforest, flood plains, large rivers, seasonal water courses and permanent billabongs, as well as large mineral reserves including uranium, gold and platinum group metals.

The region is within an ancient geological basin called the Pine Creek Geosyncline which has a long history of mineral production. Uranium exploration in the Geosyncline was stimulated

by the discovery in 1949 of secondary uranium mineralisation near Rum Jungle, south of Darwin. This was followed by a decade of intense exploration activity resulting in the discoveries of economic uranium orebodies at Rum Jungle and in the upper reaches of the South Alligator River valley.

All the known major uranium deposits of the East Alligator River uranium field have been discovered since 1969. Energy Resources of Australia Ltd (ERA) operates the Ranger Mine, eight kilometres east of the township of Jabiru. The mine lies within the 78 square kilometre Ranger Project Area (RPA) and is near the Magela Creek, a tributary of the East Alligator River. Following successive declaration in stages, the RPA is now surrounded by, but does not presently form part of, Kakadu National Park. Mining and commercial production of uranium concentrate have been underway since 1981. Mining of orebody No 1 was completed in 1994 while mining of orebody No 3 commenced in May 1997. (The smaller No 2 orebody is close to Mount Brockman, an Aboriginal sacred site, and will not be mined.)

Other orebodies discovered in the East Alligator uranium field were located at Nabarlek, about 30 kms east of Oenpelli in Arnhem Land, Jabiluka about 20 kms north of Ranger and Koongarra about 25 kms south-west of Ranger. The ore at Nabarlek was mined and stockpiled in 1979 and milling took place between 1980 and 1988. The site has been rehabilitated. The ERA proposal to mine Jabiluka has recently been the subject of environmental assessment and preliminary construction work has begun. There are no immediate plans for mining of the Koongarra orebody.

### **3. THE RECORD ON ENVIRONMENTAL PROTECTION**

The extent to which the environment of the region has been protected from the effects of mining at Ranger has been summarised in Ref [2] and is the subject of a summary presentation at this Symposium [3]. Only the briefest of summaries is presented here.

An extensive program of chemical monitoring has been in place throughout the period of mining. The chemical measurements made in the Magela Creek downstream from the mining operation but upstream from the point at which the creek enters Kakadu National Park have shown that, for all constituents, concentrations have been lower than the standards recommended by the Supervising Scientist by more than a factor of ten.

A program of biological monitoring has been implemented since 1992 following an extensive research program on the development of suitable site-specific techniques. The program incorporates creekside toxicological tests that have the potential to provide early warning of potential biological impact and measurements on the structure of communities of fish and macroinvertebrates.

An example of the results of biological monitoring is given in figure 2. The figure shows the egg production rate for freshwater snails exposed to waters both upstream and downstream of the mine over a number of years. While there is a significant natural variability in egg production rates, the variation at the downstream site is matched very well to that at the upstream site and the difference between the two sites is not statistically significant. The triangles on the graph indicate when water was being discharged from a pond that stores runoff from waste rock stockpiles at the mine site. The discharge of these waters clearly had no impact on the snail egg production rate.

An extensive radiological monitoring program is also in place at the Ranger mine site to measure the radiation exposure of people living close to the mine. This program measures radionuclides dispersed by the surface water, ground water and atmospheric pathways and

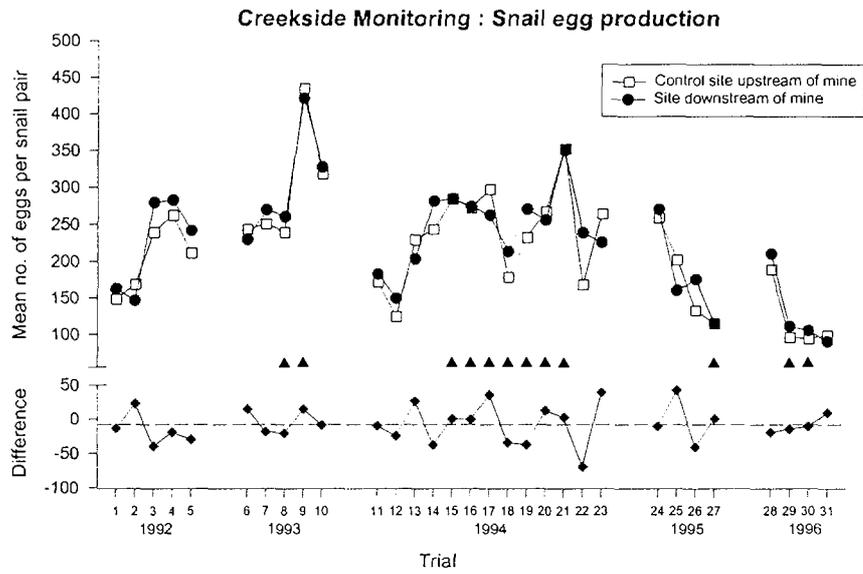


FIG. 2. Biological monitoring of the impact of mining at Ranger, freshwater snail reproduction. Data are shown for animals exposed to water from sites upstream and downstream of the Ranger Mine. Differences between upstream and downstream responses are also shown. Periods of water release are indicated by triangles.

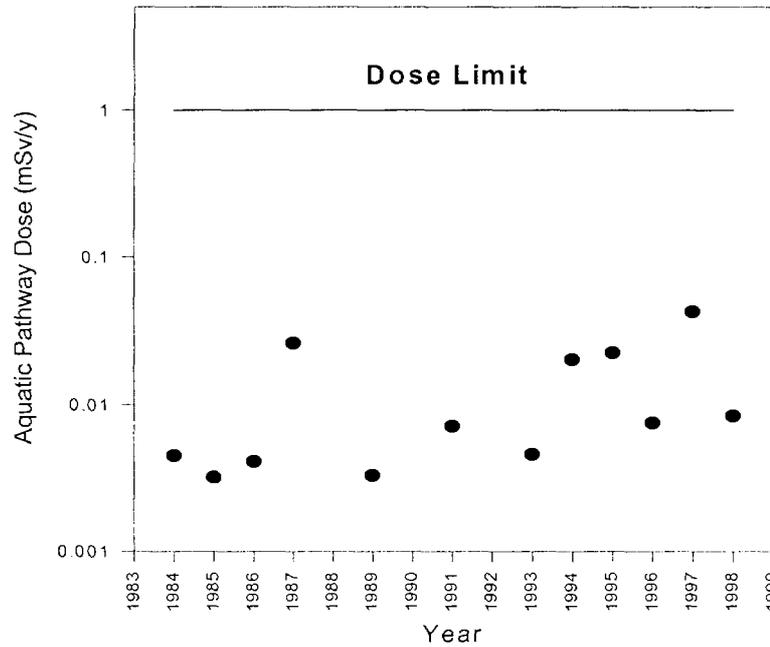


FIG. 3. Radiation exposure of members of the public resulting from operation of the Ranger Mine via the aquatic pathway.

converts these measurements into radiation exposure estimates. An example of the results obtained for the surface water pathway is shown in figure 3. In this case, annual radiation dose estimates have been lower than the public dose limit, 1 mSv per annum, by more than a factor of ten throughout the period of mine operation.

The conclusion that has been drawn by the Supervising Scientist from the results of the extensive chemical, biological and radiological monitoring programs in place at Ranger is that mining and milling operations have been carried out in a manner that has enabled a very high level of environmental protection to be achieved for the people and the ecosystems of Kakadu National Park.

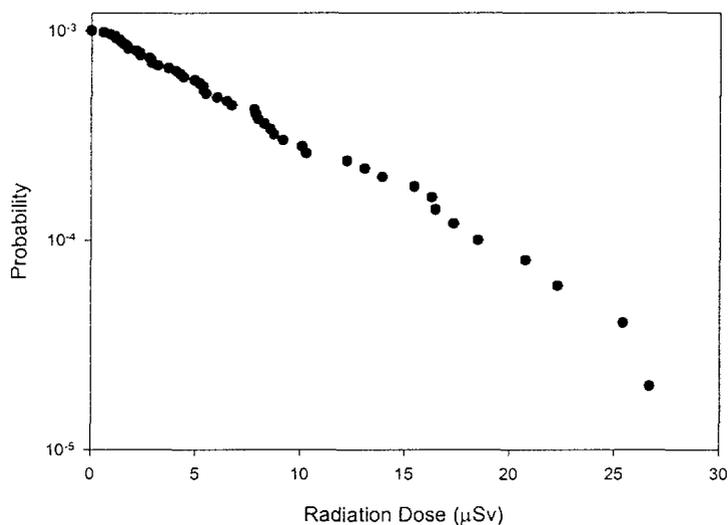


FIG. 4. Probability versus radiation exposure of members of the public resulting from the discharge of excess water from the Jabiluka mine site for the water management system proposed by ERA

While the Jabiluka mine has not commenced operations, it has been the subject of an extensive environmental impact assessment process. Recently, the Supervising Scientist prepared a report [4] for the World Heritage Committee that addressed a number of environmental protection issues raised by the Committee. The report reviewed the hydrology of the area, assessed the potential significance of severe weather events and climate change, and presented quantitative assessments of the risks associated with the storage of uranium at the surface and of tailings underground.

For example, figure 4 shows the risk of radiation exposure to members of the public arising from the occurrence of a sequence of extreme wet seasons resulting in the capacity of the water storage dam at Jabiluka being exceeded with the resulting discharge of water to the surrounding environment. The results show that the probability that any member of the public would receive a radiation dose of 20 µSv, one fiftieth of the public dose limit, on one occasion during the 30 year mine life would be less than 1 in 10,000.

Similarly, figure 5 shows the probability with which an area of the Magela floodplain, downstream from the mine, would be subject to adverse ecological effects following the occurrence of a severe earthquake. At the 1 in 10,000 level of probability, the area that would be subject to definite adverse effects would be about 0.5 km<sup>2</sup>, which is less than 0.3% of the total floodplain area. At the same level of probability, residual effects may occur for some species of invertebrates out to an area of about 5 km<sup>2</sup>, but the system would recover following flushing by the natural waters of the Magela system.

The report to the World Heritage Committee concluded that the natural World Heritage values of Kakadu National Park are not threatened by the proposed development of the Jabiluka project.

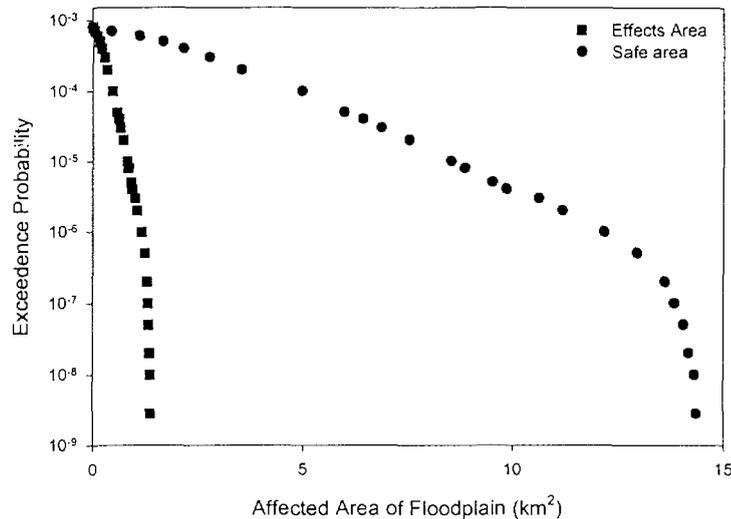


FIG.5. Probability versus the affected area of the Magela floodplain for a severe earthquake. Beyond the safe area, no adverse effects are expected. Adverse effects on invertebrates are expected inside the effects area. Between the two areas, some residual effects may occur.

#### 4. THE RECORD ON SOCIAL IMPACT

While the record on environmental protection at the Ranger mine has been excellent and the risk assessment for Jabiluka indicates that a similar high degree of environmental protection should be achieved if the Jabiluka mine is fully developed, the record on social impact is much less impressive. A more extensive description of the social impact issue will be presented [5] at this symposium. Only the key issues are summarised here.

As noted above, in the late 1970s the Australian Government approved uranium mining in the Kakadu region despite Aboriginal opposition. Recognising this, the government put in place a series of safeguards and offsets intended to minimise the risk to Aboriginal people as well as to protect the unique environment of the region. As the Ranger Uranium Environmental Inquiry intended, Aboriginal people in Kakadu would have employment opportunities and business development concessions that do not exist elsewhere. Educational opportunities would be provided and capital for development would be available (from mining royalties). It was anticipated that Kakadu National Park would act as a buffer zone, with traditional owners having the option of residing on their land away from the planned township of Jabiru and away from high visitation areas and utilising the rich environment for subsistence.

In addition, it was intended that the social impact of mining on the Aboriginal people of the region would be the subject of ongoing monitoring. Such a monitoring program was carried out in the early years (1979–1984) by the Australian Institute of Aboriginal Studies (AIAS) under contract to the then Department of Aboriginal Affairs. The report submitted at the end of the AIAS study in 1984 [6] contained a number of recommendations to address issues that had been identified. From 1984 until 1996, however, no progress was made and the issue of the social impact of uranium mining was virtually ignored.

In mid – 1996, in response to a request from traditional owners in the Kakadu Region, the Australian Commonwealth Government, the Northern Territory Government, the Northern Land Council (NLC) and Energy Resources of Australia Ltd (ERA), the operating company at the Ranger uranium mine, agreed to sponsor the Kakadu Region Social Impact Study (KRSIS). The request of the traditional owners arose following a change in the national government and the abandonment of the previous

“three mines policy”, a decision that led to a proposal by ERA to develop a mine at Jabiluka. The KRSIS study ran in parallel with the Environmental Impact Assessment process for Jabiluka.

The organisational structure of the KRSIS study was, we believe, unique. It consisted of an Aboriginal Project Committee (APC) and a Study Advisory Group (SAG). The APC members, senior representatives of the various Aboriginal communities of Kakadu, were to determine the issues, the aspirations, the ideas and the expectations of Aboriginal people. The APC was provided with funds to enable the committee to engage consultants of their choice working under terms of reference determined only by the APC. The APC then provided its report [7] to the SAG. The SAG, consisting of senior representatives of the institutions and agencies influential in decision-making for and about Kakadu, was to bring forward its collective knowledge and generate plans. It was to interact with the APC to transform the issues, aspirations, ideas and expectations of the Aboriginal people into actions that would make a difference; actions that would assist the move towards harmony for the parties. The SAG produced a Community Action Plan [8] that was considered by the Commonwealth and Northern Territory governments.

The KRSIS project found that there had been a number of positive social outcomes arising from development in the Kakadu region, most notably the highly successful management of Kakadu National Park under joint management arrangements between the traditional Aboriginal owners and the Commonwealth government. On the whole, however, the SAG concluded that the worst fears of the Aboriginal people of the 1970s had come to pass. Among the key findings were:

- While the conditions are neither demonstrably better nor worse than other Aboriginal communities in the rest of the Northern Territory, the living conditions of some of the Aboriginal communities in Kakadu are of a third world standard.
- Key social indicators for education, health and employment are as bad as any community in Australia.
- Alcohol misuse is chronically debilitating to individuals and social interaction.
- Competition among Aboriginal factions in the region over access to royalty money has been quite destructive.
- There is a lack of effective communication and understanding between the various co-habitants of Kakadu.
- Institutional arrangements, once intended to protect Aboriginal people from the pressures of negotiations, have unintentionally grown to become impediments to mutual interaction, appreciation and co-operative action.

The Kakadu Region Social Impact Study gave rise to an extensive range of recommendations to the Commonwealth and Northern Territory Governments. These recommendations fall into four broad categories:

- Improvements in social conditions
  - The provision of improved housing, the provision of employment and training opportunities, the improvement of education and health services, measures to reduce the alcohol problem, and the improvement in sport and recreational facilities.
- Addressing cultural issues
  - The provision of a Women’s Resource Centre, measures to enhance the participation in cultural ceremonies, measures to improve communication between parties in the region.
- Promoting economic development

- The production of an economic development plan for the region, measures to assist Aboriginal people in the establishment of Aboriginal owned businesses, measures to remove the anomalies in the distribution of mining and tourism royalties, and measures to address the issue of funding substitution.
- Recognition of the rights of Aboriginal people as the land owners and empowerment
  - Addressing the issue of Aboriginal ownership of the Jabiru township, measures to involve the Aboriginal community in the governance of Jabiru, measures to improve the provision of services to Aboriginal communities, action to resolve current disputes between various Aboriginal communities, the implementation of a comprehensive social impact monitoring program.

The respective governments accepted most of the recommendations of the KRSIS reports and established a KRSIS Implementation Team in November 1998 to ensure that positive action was taken to address the issues raised in the reports. The Chair of the Implementation Team presented his first progress report to the Commonwealth Minister for the Environment in June 2000 [9].

In many areas progress of the Implementation Team has been outstanding in the short period since the establishment of the Team. Progress has been greatest in measures to improve social conditions, to address cultural issues and to promote economic development. Total funding secured in these areas is about \$8 million and a further \$2.7 million in funding is pending approval. It will, of course, be some years before the impact of these commitments is seen in the social indicators for education, health, employment etc.

The area where least progress has been achieved to date is in recognition and empowerment. It is in this area that the most intractable problems exist; for example, the issue of the ownership of the town of Jabiru. It is also in this area that current arrangements have been established under law or under binding legal agreements. Time will be needed to enable substantial progress to be made.

Overall, however, positive action in the field of social impact is now underway and this action has brought about a spirit of co-operation between many of the Aboriginal communities of the region and the agencies responsible for service provision and government. There is an optimism that the deficiencies of the past will be rectified.

## **5. LINKS BETWEEN SOCIAL IMPACT AND ENVIRONMENTAL PROTECTION**

In the above discussion, the issues of environmental impact and social impact have been presented as if they are quite distinct issues. This has been the traditional approach adopted in most societies where environmental protection is seen as being governed by science and engineering and social impact is seen as a political issue.

The experience of uranium mining in the Alligator Rivers Region has, however, demonstrated that the two issues are inextricably linked and that the environmental protection standards and practices adopted today are as much determined by social attitudes as they are by the biological and physical sciences.

From the outset of mining at Ranger, it had always been anticipated that water contained within what was called the Restricted Release Zone (essentially water that had come in contact with ore, but not tailings water) would need to be released to the environment in unusually intense wet seasons. For this reason, the Supervising Scientist had conducted an extensive research program on the dispersal of radionuclides in the surface water system, their uptake in local species of flora and fauna, the toxicological effects of the constituents of the water on local fauna, methods for biological monitoring etc. On the basis of this research, the Supervising Scientist had designed a control regime of standards and practices under which water could be discharged without causing harm to people of the region or

aquatic ecosystems. He also had developed an extensive monitoring program designed to demonstrate that people and ecosystems had been protected.

In 1995, a sequence of unusually intense wet seasons culminated in the need to discharge water from the Restricted Release Zone and the authorities gave approval for this to occur. However, the local Aboriginal people strongly objected to the release of this water and the Northern Land Council, acting on their behalf, sought a court injunction to prevent the release. The legal application for the injunction failed but the operating company, in recognition of Aboriginal concerns, did not proceed with the release and gave an undertaking not to release such waters in future. As a result, the only method now regularly available to the company to solve water balance problems is to use land irrigation on the mine site. The latter method is considered scientifically inferior to direct discharge and it is a method that will increase rehabilitation costs to the operating company.

A minor incident at the Ranger mine during the 1999–2000 wet season resulted in the discharge of a small volume (estimated at 80 m<sup>3</sup>) of tailings water from the physical containment structures and, after passing through constructed wetland filters, the water reached the main water-course near the mine. The public reaction to this incident was intense, particularly among local Aboriginal people. The Supervising Scientist was required to submit a detailed report [10] to Commonwealth Ministers on the incident and it was tabled in the Australian Parliament. The report demonstrated that there had been no harm to downstream ecosystems and that radiation exposure of people living in the region was totally insignificant. Indeed, it was estimated that the volume of water discharged would need to have been 200 times greater before it would have been detectable downstream from the mine. Nevertheless, an outcome of this incident has been that the operational procedures at the mine will, in future, need to be adjusted to ensure that not only are incidents that could cause harm be avoided, but incidents that could be *perceived* to cause harm are also avoided.

Currently, the Jabiluka mine is, following initial development of the portal and decline, being managed on an environmental care and maintenance basis pending negotiations between ERA and the Aboriginal traditional owners on ERA's preferred option for development of the mine. The background is too complicated to describe in detail here but the outcome is that the interim water management system, which was only designed for one year, is likely to be in place for a number of years. To adjust the interim water management system to meet long term environmental protection objectives, it will be necessary to discharge some water from the system in the coming year. A suitable solution from a purely technical perspective would be to use land irrigation on currently disturbed parts of the mine site. Because of objections from the local Aboriginal community, the company is being required to install a reverse osmosis plant to treat the water prior to irrigation.

These examples illustrate that, in today's world, the standards that apply to environmental protection, particularly in contentious areas such as uranium mining, are being determined, at least in Australia, as much by social concerns as by scientific and technical assessment. The reasons for this could be the subject of intense debate. However, in the case of uranium mining in the Alligator Rivers Region, several prime reasons are to be found in the above discussion on the social impact of mining.

First, it was noted that when approval was given for uranium mining to proceed in the region, the decision was made contrary to the clearly expressed wishes of the Aboriginal traditional owners. Second, apart from the successful inclusion of Aboriginal people in the management of the Park, the concerns and aspirations of Aboriginal people in the region were largely ignored for almost twenty years. Third, throughout that period, attempts to convey to Aboriginal people the nature of the scientific research that was being carried out and the meaning of the results of the research for the protection of the land and the people themselves were feeble and ineffective. The consequence has been that opposition to mining has become more entrenched (as the debate over the development of Jabiluka has demonstrated) and the assurances of scientists mean little or nothing to Aboriginal

people. Thus, the social impact of development in the region has had a direct impact on the standards and practices adopted to protect the environment from the effects of mining.

## 6. CONCLUSIONS

The mining of uranium at the Ranger and Jabiluka mines in Australia's Northern Territory has been assessed as a case study for the environmental and social impact of uranium mining in Australia. It has been established that the mining and milling of uranium at Ranger have been conducted in a manner that has led to a very high level of environmental protection and that a similar high level of protection is expected if the Jabiluka mine proceeds.

However, the record on social impact has not been impressive. Major deficiencies have been identified in living conditions of the Aboriginal people of the region, in their health and education and in employment opportunities. Alcohol misuse is a significant problem, communication between Aboriginal and non-Aboriginal communities is poor, and institutional arrangements have tended to disempower rather than empower Aboriginal people. A program is now underway to redress these issues.

Links between social and environmental impact have been identified. In today's world, the standards and practices in environmental protection are as much determined by social attitudes as they are by scientific and technical assessment.

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