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POUR L'EDUCATION, LA SCIENCE ET LA CULTURE

CONVENTION CONCERNANT LA PROTECTION DU PATRIMOINE MONDIAL, CULTUREL ET NATUREL

BUREAU DU COMITE DU PATRIMOINE MONDIAL

Vingt-quatrième session
Paris, Siège de l'UNESCO (Salle IV)
26 juin – 1er juillet 2000

Point 4.2 de l'ordre du jour provisoire : Etat de conservation de biens inscrits sur la Liste du patrimoine mondial - Engagements de l'Australie : ISP de l'ICSU– rapport n°2, mai 2000 (en anglais seulement) (Synthèse des points clés en français)

RESUME

S'agissant de l'état de conservation du Parc national de Kakadu (Australie), la troisième session extraordinaire du Comité du patrimoine mondial (12 juillet 1999), a décidé que:

Pour résoudre les questions scientifiques en suspens, telles que celles soulevées dans le rapport de l'ISP, le Comité demande à l'ICSU de poursuivre le travail de l'ISP (avec en plus tout membre supplémentaire) pour évaluer, en coopération avec le scientifique chargé de la supervision et l'UICN, la réponse du scientifique chargé de la supervision au rapport de l'ISP. Le rapport de l'évaluation de l'ISP devrait être présenté au Centre du patrimoine mondial **avant le 15 avril 2000** pour étude par la vingt-quatrième session du Bureau du Comité du patrimoine mondial en l'an 2000.

Ce document, soumis au Centre du patrimoine mondial par l'ISP de l'ISCU, est un rapport d'avancement faisant partie de leur évaluation des questions scientifiques relatives aux exploitations minières d'uranium à Jabiluka (une enclave du Parc National de Kakadu).

Ce document devra être lu conjointement avec les documents WHC-2000/CONF.202/5 et WHC-2000/CONF.202/INF.6.

Conseil international pour la science (ICSU) - Comité scientifique indépendant

Rapport n°2 – Mai 2000

Table des matières

Rappel

En avril 1999, le Conseil international pour la science créait, à la demande du Comité du patrimoine mondial de l'UNESCO, le Comité scientifique indépendant (ISP) chargé de passer en revue les problèmes scientifiques liés au projet de mine d'uranium à Jabiluka, par rapport à l'état de protection du Parc national de Kakadu (Australie), site classé au patrimoine mondial de l'UNESCO. L'ISP, composé de quatre scientifiques, a fondé son étude principalement sur le Rapport *Assessment of the Jabiluka Project* présenté par le Scientifique australien chargé de la supervision au Comité du patrimoine mondial.

L'ISP a effectué et soumis son étude pour le 13 mai 1999 afin de respecter le calendrier de l'UNESCO. Dans ses Recommandations, à la fois dans son rapport et lors de la présentation de ses constatations au Comité du patrimoine mondial, en juillet 1999 à Paris [Annexe 1], l'ISP a noté que son étude avait été limitée par le manque d'informations accessibles dans le temps imparti et par l'impossibilité de visiter le site. Néanmoins, l'ISP concluait que le rapport du Scientifique chargé de la supervision contenait de nouvelles informations et des analyses permettant d'effectuer l'évaluation scientifique de l'impact de la mine de Jabiluka sur les valeurs de patrimoine mondial de Kakadu avec plus de certitude qu'auparavant, mais qu'un certain nombre d'incertitudes graves subsistaient.

L'ISP a précisé clairement que son rapport concernait la proposition minière sur laquelle portait l'évaluation du rapport du Scientifique chargé de la supervision – c'est-à-dire l'extraction de minerai d'uranium à Jabiluka et le stockage des déchets en souterrain sur le site même. C'était la solution de remplacement Jabiluka, JMA (Jabiluka Mill Alternative). L'ISP ne s'est pas penché sur une proposition de transporter le minerai broyé de Jabiluka à la mine et aux installations Ranger et d'y stocker les déchets, la solution de remplacement Ranger RMA (Ranger Mill Alternative). La solution RMA nécessite l'approbation formelle des propriétaires traditionnels du terrain, qui n'a pas été donnée.

Avant la réunion du Comité du patrimoine mondial le 12 juillet 1999, le Scientifique chargé de la supervision avait préparé une " Réponse à l'étude ICSU du rapport du Scientifique australien chargé de la supervision au Comité du patrimoine mondial ". Toutefois, étant donné les contraintes de temps, l'ISP n'a pas pu étudier cette réponse avant la réunion de juillet.

Lors de sa réunion, le Comité du patrimoine mondial a noté qu'il " continue d'exprimer des réserves significatives en ce qui concerne les incertitudes scientifiques touchant l'exploitation minière et le

broyage à Jabiluka ", et " pour résoudre les questions scientifiques restantes ", a demandé " à l'ICSU la poursuite des travaux de l'ISP… " afin d'évaluer, en coopération avec le Scientifique chargé de la supervision et l'IUCN, la Réponse de ce Scientifique au rapport de l'ISP.

L'ICSU a renouvelé la mission de l'ISP qui doit poursuivre ses travaux en deux phases, à savoir :

1- Proposer des considérations préliminaires sur la Réponse du Scientifique chargé de la supervision au Premier rapport de l'ISP, et présenter ces considérations sous la forme d'un Rapport succinct d'avancement, qui sera examiné lors du 24ème séminaire du Bureau du patrimoine mondial, en juin 2000.

2- Envoyer des représentants de l'ISP en inspection sur le terrain, au Parc national de Kakadu et au site de Jabiluka, en juillet 2000, et préparer leur évaluation finale sous la forme d'un rapport qui sera examiné par le Bureau lors de sa 24ème session extraordinaire, en novembre/décembre 2000.

Le présent rapport succinct d'avancement (ISP of ICSU Report No.2 May 2000) achève la phase 1 des tâches de l'ISP.

Remarques générales

L'ISP juge utile la Réponse du Scientifique chargé de la supervision. Certains des soucis de l'ISP ont été amoindris et beaucoup de ses recommandations acceptées, quoique avec certaines restrictions mineures. Toutefois l'ISP a encore besoin d'informations additionnelles sur un vaste front. En particulier, les inquiétudes précédemment exprimées à propos d'une analyse holistique d'évaluation du risque pour l'écosystème demeurent. Une visite du site est la solution la plus appropriée pour résoudre ces inquiétudes.

L'ISP note l'utilisation de mots tels que significatif, minimum, réduit, etc. dans la Réponse du Scientifique chargé de la supervision, lorsqu'il s'agit d'impacts potentiels. Dans la mesure du possible, le Conseil scientifique indépendant souhaite que ces termes soient remplacés par des valeurs appropriées, des séries de valeurs ou des valeurs de seuil. Pour les déterminer, il faudra peut-être des avis détaillés et des discussions initiales. Dans certains cas, la technologie nécessaire pour réaliser les mesures pourrait ne pas être disponible. L'objectif doit cependant être de remplacer le " qualitatif " par du " quantitatif ", autant que faire se peut.

L'ISP a reçu récemment, avec satisfaction, le rapport d'avancement présenté au Bureau du Comité du patrimoine mondial le 15 avril 2000, intitulé " Australia's Commitments : Protecting Kakadu ". Bon nombre des points que l'ISP avait identifiés touchant à un engagement à long terme de surveillance, de protection et de réhabilitation de Jabiluka et de la zone du parc semblent avoir été abordés dans les procédures législatives qui doivent être mises en place. L'ISP souhaite être informé de ces arrangements de manière plus détaillée lors de sa visite du site.

Commentaires détaillés

L'ISP a estimé qu'au lieu de préparer un long commentaire général de la Réponse du Scientifique chargé de la supervision, il serait plus utile d'identifier des points spécifiques de ce document qui nécessitent une information complémentaire ou une clarification. Ces commentaires détaillés, identifiant avec précision les points du document, sont donnés en Annexe 2. La manière la plus rapide de les traiter serait une réunion de discussion avec le Scientifique chargé de la supervision, et d'autres personnes, en combinaison avec la visite du site.

Les commentaires détaillés de l'ISP peuvent sembler quelque peu critiques du document Réponse du Scientifique chargé de la supervision. Ce n'est pas l'intention de l'ISP. Le Conseil scientifique indépendant est satisfait de la plus grande part de cette Réponse, mais estime qu'il se doit d'adopter une approche particulièrement approfondie, et reste persuadé que le Scientifique chargé de la supervision et le gouvernement australien souhaitent qu'il procède ainsi. L'ISP n'attend pas une réponse immédiate du Scientifique chargé de la supervision, sinon pour la fourniture d'information, par exemple, sur :

- Un certain nombre de rapports non publiés ;
- Plus détails concernant l'équilibre des eaux, en termes de quantité comme de qualité ;
- Les plus récents détails d'implantation du site de Jabiluka dont dispose le Scientifique chargé de la supervision, etc.

Ces demandes sont indiquées par l'ISP dans l'Annexe 2. Il serait utile que le plus possible de cette information soit fourni à l'ISP avant sa visite du site. Le Comité scientifique indépendant estime que les discussions au cours de la visite du site permettront de résoudre une bonne part des questions qu'il a soulevées.

Visite du site

Les discussions sur la réalisation de la visite du site se poursuivent au moment où nous rédigeons ce rapport. Conformément à la demande du Comité du patrimoine mondial, cette visite sera centrée sur la solution JMA et n'abordera pas les problèmes touchant à la solution RMA.

Développements récents

L'annonce d'une fuite d'eau contaminée de la mine Ranger vient d'être portée à la connaissance de l'ISP. Si les activités de Ranger sont en dehors des compétences de l'ISP, ce qui se passe sur ce site est pertinent du fait que le rapport OSS fait référence aux normes élevées d'exploitation et de surveillance qui sont appliquées à Ranger depuis 20 ans et mentionne la valeur que cette expérience aurait pour Jabiluka. En conséquence, durant leur visite du site, les membres de l'ISP souhaitent en apprendre plus sur les circonstances qui entourent la fuite annoncée et son importance pour les activités de Jabiluka.

Professeur Gene Likens

Professeur Jane Plant

Dr. John Rodda

Professeur Brian Wilkinson

Mai 2000

ANNEX 1

Presentation by Professor Brian Wilkinson on behalf of the Independent Science Panel to WHC UNESCO 12 July 1999

Some parts of today's presentation were made last Wednesday, but I understand that there are some members present today who were not here on Wednesday. So it may be helpful to them if I repeat the background to the Independent Scientific Panel.

There were four members of the Independent Scientific Panel, which was established by ICSU:

- Dr John Rodda - President of the International Association of Hydrological Sciences and formerly Director of Water Resources at the World Meteorological Organisation;
- Professor Gene Likens -Director of the Institute of Ecosystem Studies in New York;
- Professor Jane Plant - Assistant Director, British Geological Survey: and myself
- Professor Brian Wilkinson - Professor at the University of Reading and formerly Director of the Centre for Ecology and Hydrology.

The Panel members were selected by ICSU and I was asked by ICSU, with the agreement of the Panel, to act as Team leader.

The Panel's work began on 22 April 1999 as soon as the first documentation became available, and our report was submitted on 14 May 1999 against a deadline of 15 May 1999.
Our brief was to make a scientific review of the report - « Assessment of the Jabiluka Project>> (WHC-99/CONF.204/INP.9C) from The Supervising Scientist – Environment, Australia. We have just had a presentation from Dr Johnston, The Supervising Scientist.
We also saw a number of other supporting documents - but in the time available there was a limitation on the information that was readily accessible. I regret that our insights may have been restricted by not having visited Jabiluka or the Kakadu World Heritage Site.

Panel members' comments were consolidated into the first draft. All Panel members approved the Final Report prior to its transmission to ICSU and UNESCO. Other than the presentation of its report to the Bureau, which I make today, the Panel has discharged its remit to ICSU on the delivery of its report on 14 May 1999. However, during June Dr Arthur Johnston, the Supervising Scientist, contacted me to say he would like some clarification on the Recommendations in the Independent Science Panel Report. I obtained agreement from the Panel members and from ICSU and UNESCO to hold a telephone conversation and this took place on 3 June 1999 with a subsequent approved conversation on 11 June 1999. There are agreed notes of these conversations available.

Towards the end of June I received a 62 page report giving the response of The Supervising Scientist to the Independent Scientific Panel Review. I forwarded this document to my fellow Panel members but they have had no time to make a formal assessment of this and furthermore believe such a consideration is outside their original brief from ICSU. I understand that this response document has been made available to the Bureau and that Dr Johnston will speak to it later this morning.

I was very concerned this morning to see reference in Doc. 205/INF.4 that a dialogue had started between the Australian Supervising Scientist and the Independent Science Panel to resolve some of the outstanding scientific issues and that this had began to show progress. Such a dialogue has not taken place. The telephone conversations were concerned with the Australian Supervising Scientist seeking insights into the Panel's Recommendations but a dialogue has not started. That is not to say that a dialogue is not necessary. ICSU would wish to see the record amended so that reference to this dialogue is removed.

Turning to the Independent Science Panel's Report - we considered that we could conveniently divide the work into four activity areas as follows:

- Hydrological modelling and the assessment of the retention pond design capacity
- Risk assessment for the ERA proposal
- Long-term storage of the mine tailings
- General environmental protection issues

However, there is strong interaction between these areas and the Panel took these interactions into account in making its 17 Recommendations, which are given at the end of the Panel's Report. If I can now take each of these areas in turn and give a brief overview of what the Panel considered to be the principle science issues:

1.Hydrological modelling and Assessment of Retention Pond Design Capacity

The design of the retention ponds at Jabiluka is crucially dependent on the records of rainfall and evaporation. It is fortunate that such a good (88)yr rainfall record exists at Oenpelli and that there is good correlation with the shorter Jabiru record. However, rain gauges often under record and the Panel considered it would be prudent to increase rainfall data by 5% and rerun the water balance calculations.

The rainfall records have been extended using synthetic data generation techniques. A study of evaporation based on evaporation pan records was also made and we consider that suitable rainfall and evaporation sequences have now been established for use in retention pond and water balance design. The rainfall and evaporation data were used in a run-off model and using a Monte Carlo approach, an acceptable method has been developed for determining design pond capacity against extreme weather events. It would, however, have been valuable to have seen such calculations undertaken for Ranger and compared with Ranger's operational performance.

The Australian Supervising Scientist's Report did not give a clear picture of the water balance between the various flows on the proposed Jabiluka Mine. We believe this information is needed. So while we considered that a suitable design approach has been developed, we have not seen a final design for the water management system and this is a cause for concern to us and has restricted our assessment.

The assumption in the rainfall analysis is one of stationarity i.e. the climate over the next 30 years will be the same as that represented by the past 88 years of record. However, we are all conscious of climate change issues. The appendix by Jones *et al* in the Supervising Scientist's Report analyses the climate change issue in a very comprehensive way, nevertheless this is an area of considerable uncertainty among the international scientific community .It is somewhat dismissed in the Supervising Scientist's Report but the Panel considers it must be kept under constant review, and if the mine proceeds new works may need to be introduced or operational methods modified as new information becomes available. Is there an appropriate mechanism to enable such modifications, if required, to be made during the life of the mine ?

2.Risk Assessment for the ERA Proposal.

To protect the environment against pollutants a policy of containment of mill and ore stockpile water in retention ponds is proposed. The Panel is in full agreement with this approach but there could be an impact on the aquatic ecosystem due to changing the water balance.

This Section of the Supervising Scientist's Report focussed on the concentration of contaminants in the ponds and the prospect of pond failure, which would release water into the environment.
We noted that the principle source of contaminants entering the ponds would be from the ore stockpile. We were uncertain as to whether any allowance had been made for the effects that evaporation may have in concentrating the contaminants in the ponds. We saw no reference to this potential issue. On

occasions the ponds may go dry but there was little reference to dust blow from the ponds, rock piles or elsewhere on the mine site.

The Ranger model for radiation exposure of members of the public had been applied to Jabiluka. We seek evidence that this transfer is appropriate. It is also important to include chemical toxicity in such models.

In the event of the water in the ponds escaping an assessment has been made of the impact on the aquatic ecosystem. This appeared to he based on the use of "surrogate species " for the whole aquatic ecosystem. We would seek justification that single species act as adequate indicators in this way.

3.Long Term Storage of Tailings.

The proposal to return the tailings to the mine void or into silos 100m below surface will remove a major source of potential environmental contamination in the short to medium term. The question is - how far will the contaminants move in the longer term as a result of groundwater transport? A number of mathematical models to predict the spread of uranium, radium and sulphate were described in the Supervising Scientist's Report. This modelling approach is welcomed by the Panel and it is appropriate providing the relevant hydrological and geochemical parameters are used. However, we had reservations in that:

- the modelling, as described, was not set within the overall groundwater flow pattern;
- no isotope measurements were quoted which may have enabled the age of the sub-surface water to be established;
- there is some uncertainty as to the permeability parameters used in the models;
- there is some uncertainty on the stability of the tailing/ cement mix and the geochemical interactions between the potential pollutants and the rock.

We understand that additional testing is being undertaken and new information is being obtained and this must be used in additional three dimensional groundwater models involving rock/ contaminant interaction and set in an overall groundwater flow context. Until such work is complete it is difficult to assess whether there is a long term problem arising from the sub-surface tailings or not.

4.General Environmental Protection Issues

We noted the prospect of the mine life being extended from 30 years to 40,50 or even 60 years. No consideration appeared to have been given as to how an extended mine life would change the impacts on the environment. The Panel considers that such assessments should be made now and not delayed. For example if the life is extended will future tailings be disposed of sub-surface or not? The mining and silo work will lead to sandstone rock piles. Sediment from these could have a major impact on the aquatic ecosystem but there was little or no information on this.
There are a series of related questions - Where will the rock be placed, what land form will it have; how will it rehabilitated?

In relation to a total landscape(catchment) analysis for Jabiluka mine - this appeared to have been dismissed in the Supervising Scientist's Report. The Panel considers such an analysis to be critical.

The Panel considered it necessary that a firm or binding commitment to long term (10O years) monitoring of surface, groundwater and the ecosystem of the Jabiluka site in relation to Kakadu National Park was necessary. It was also necessary to establish a binding commitment to reparation in the event of unforeseen impacts from mining activity.

The conclusions in our Report and the Recommendations can be placed in four broad categories - as follows:

- First category - some of the analyses in the Supervising Scientist's Report do lead to the assessment of impacts of the proposed Jabiluka mining operation being made with a higher degree of certainty than formerly;
- Secondly - there are some recommendations that we suggest should be followed out of prudence;
- Thirdly - there are some areas in the Supervising Scientist's Report where we were unable to make a judgement on ascertainable or potential impacts due to lack of information or data;
- Fourthly - there were some elements dealt with in an unsatisfactory manner in the Supervising Scientist's Report, and some important issues that were missing. Nine of our Recommendations are in this category. It may well be that some of our concerns are addressed by the Supervising Scientist's response to the Independent Science Panel Report - but this response would require detailed consideration by the Panel and as such it lies outside our brief. We are therefore unable to make appropriate comment on this document at this time.

Overall, our assessment of the ascertainable or potential risks were made more difficult by the fact that the design of the mine is still evolving. There are still, therefore, uncertainties e.g. how large will the footprint of the retention ponds and other works be? etc... Because of these uncertainties with respect to the final design there is a theme running through the Supervising Scientist's Report of "trust us" and we will ensure that final works fully meet the environmental requirements. Perhaps this approach is based on the Supervising Scientist's l8 years of operational experience at Ranger. However, Kakadu is such a rich and important site in terms of World Heritage values that we believe such assurances should be accompanied by firm and binding commitments, not just on the present administration but also on those in the future. These are particularly important for both long term monitoring and reparation in the event of this monitoring exposing some presently unforeseen event or threat. The Panel considers that there remain areas of scientific uncertainty in relation to quantifying potential impacts.

ANNEX 2

Points in the document *Response to the ICSU Review of the Supervising Scientist's Report to the World Heritage Committee* **on which the ISP seeks further information or clarification**

Page 2

- para 2 *'In particular ……decides.'*

Is it not the intention of the Australian government that the Jabiluka lease area will become part of the Park once mining is completed? If this is the case then what happens in the lease area is relevant.

- 2nd sentence

There is also an issue here concerning the broader landscape of Kakadu. ISP strongly disagrees with the idea that the impact of possible environmental changes within the lease area on the Park is not appropriate for its consideration.

- final sentence

Surely the OSS would not expect the ISP to consider that the EIS/PER are 'perfect. The ISP is attempting to undertake a 'thorough' review in the interests of protecting the values of the World Heritage property. The Panel feels certain that the OSS and the Australian government would not wish it to do otherwise.

– para 4 *'Some of the requirements……report'*

Will the requirements be incorporated in legislation?

– para 4 *' ERA must prepare……'*

Presumably the mine void includes silos and refers to Jabiluka?

– para 4 *'ERA must ensure…..'*

What does 'significant ' mean here and in the next point down the page?

– para 4 *'ERA must submit…'*

Does 'waste stockpiles' include waste from silos?

'significant' to be quantified. Assessment needs to be broader than just Swift Creek.

– para 5 *'ERA has not…..'*

To make an assessment the ISP does not need the detailed final design but the most recent plan, or an outline indicating the footprint of the retention ponds, waste rock piles, position of mill and other facilities.

Page 3

– 1st full sentence

ISP accepts that the final design has to be completed but a firm outline must be in place and is needed by ISP to make its assessment.

Pages 2 to 4

General comment - **Page 3 – para 4** *'It is within..'*

It is encouraging that there will be review and modifications through the life of the project but there is no reference here to long-term monitoring and reparation after mining has ended. If some unforeseen impact arises and is identified by a monitoring programme after mining activity has ceased, what would be the mechanism for reparation?

Page 5

- para 1 last sentence *'However to provide…'*

The 1 in 10 000 exceedence is the probability given on **Page 2**.

- para 5 last sentence *'The conclusion……..panel.'*

Agreed, but this is an area where the scenarios from the GCMs are being improved monthly and this has to be kept under constant and critical review.

Page 6
– para 1 last sentence *'Thus the Supervising scientist…….required.'*
It is encouraging to have this commitment but is it enshrined in legislation?

Pages 6, 7 and 8
There is still no clear diagram of water balance nor are the concentration of contaminants in the various flow paths given.

Page 9
– para 3 *'The assessment given…..'*
Martin [1999] paper is unpublished. Could a copy please be provided to the ISP.

Page 10
– para 2 - 1st sentence
The ISP would wish to consider the supporting data which led to the conclusion that 'direct chemical exposure was the dominant risk'.
- **final sentence**
Could a copy of the Finlayson et al 1986 paper please be made available to the ISP.
– para 5 *'If one makes…'*
Is this a 'conservative' assumption? Presumably the worst case is where the sediments from the site are not distributed uniformly but in patches. This would give rise to high local concentrations.

Page 11
– para 1 *' variation in floodplain……'* **last sentence**
ISP needs more information in relation to the impact of 'biotic recycling'.
- para 2 *'If one considers…'*
On what depth of sediment is this calculation based? This is not a 'conservative' approach. The sediment from the site may not be uniformly spread.
- **last sentence**
'significant effects due to recycling' not expected but has this been tested?
- para 4 *' In conclusion……'*
General comment – apparently no whole ecosystem risk assessment has been put in place or completed. This is regarded by the ISP as a deficiency.

Page 13
– para 1 point 1 *'The total flow…'*
What does 'significantly' mean? Was there some response in the boreholes?

- **point 2** *'Observation bores….'*
Isotopic analyses of the water samples in the boreholes and shaft should give an indication of age and recharge rates. Are these analyses being made?

Page 15
– Recommendation 12 *' As noted ….'* **– 2nd sentence**
Please quantify 'significant'.

Page 16
– para 2 *'The total amount…'*
What is the basis for the 1% and 10% estimates? If there is a groundwater model it should be possible to calculate the distribution of groundwater flow to the surface. Until a means is available to predict such flows the estimates as to how much uranium reaches the flood plain are at best a guess.

– para 6 *'In summary…'*
It is encouraging that there is recognition that the modelling needs to be extended. Until the ISP has a fuller understanding of the existing models and their boundary conditions the final sentence cannot be accepted.

Page 17
– para 1 *'As noted in the Introduction….'*
What does 'significantly' mean? There is a need to quantify.
Page 17 contd
- **para 2** *'The principal methods……'*
'progressive revegetation' - ISP has seen no details of this.
- **para 3** *'Estimates of the sediment…..'* **final sentence**
What are these 'landscape evolution models'? The Panel has no information on these nor has it seen the reports from Willgoose & Riley 1998 or Evans et al 1998. Could copies of these please be made available in view of the importance of sediment loss.
– para 4 *'As noted in Appendix 4..'*
It would be very helpful to see the detailed calculations in relation to all sources of sediment ie from retention ponds, embankments, spoil from silos etc
- **para 7** *' During the construction…'*
General comment – this is an encouraging statement but the ISP has seen no reports or data.

Page 18
- **para 5** *' A second way….."*
Could there also be ecosystem legacy effect ie interaction among ecosystem components, biomagnification of toxic elements, species changes, microbial response etc.

Page 19
– para 1 *'Evapoconcentration….'* **last sentence**
The basis of the ' simplified assumption of constant concentrations in the pond ' is not at all clear. It would be helpful to have estimates of concentrations of potential contaminants in all the flows throughout the site and to have seen the calculations on which this assumption is based.

– paras 1 2 & 3
General point – extending the mine life will mean that larger retention ponds are needed if the 1 in 10 000 year criterion is to be retained. It also implies more tailings therefore more rock to be landscaped on the surface. The footprint could thus be quite different from that of a mine with a 30 yr life. A greater volume of rock waste, even though vegetated, may lead to higher sediment loads.
- **Recommendation 15 - para 1** *'Note. We assume.'*
Jabiluka – yes, an oversight. General comment – the potential impact of the Jabiluka site on adjacent ecosystems in the landscape has already been noted [see comments on page 2]
- para 3 *'The Supervising Scientist agrees…..'*
2nd sentence needs clear and compelling justification.

Page 20
– para 2 *'The issues raised…'* **3rd sentence**
Is the bore field referred to here the water supply system to the west of Jabiru or is there another borehole well field to be used for the mine?
– para 5 *'The principal conclusions….'*
What is the 'haulroad' referred to here? Is it related to the RMA? If so, the ISP have given no consideration to its impact because the SSO Report focused on the JMA.

Page 21

– **Recommendation 16 – para 1** *'As stated in the Report…….'*

General comment – this is welcome but does it survive changes in government and the economy?

- para 2*'The approval for the development…'*

Is the requirement on the mine operator covered by legislation? What would be the position if there were changes in Government policy – would the legislative arrangements need to be amended?

General comment as above.

- **Recommendation 17** *'In addition to the provision…..'*

General comment as above

Is the long-term monitoring requirement covered by legislation? {see above] What is the position with respect to long-term reparation in the event of an adverse impact arising well into the future after mining has ceased?

Page 23

- **para 6** *'Nevertheless noting the significance…'*

General comment – Harris has made a useful summary report but he has not done a holistic ecological assessment. He makes this point in his report " such a full assessment is not possible at this time, but such a recommendation is warranted" [**p 54**]; " this present paper does not constitute a full ecological risk assessment" [**p 60**]; "while a formal risk assessment of the type proposed by the panel had not yet been carried out by ERISS or ERAES" [**p 60**] and "many of the issues ….(are) not addressed in the holistic and quantitative manner required in a formal ecological risk assessment; [**p 60**].

Page 24

– para 1 *' The report notes…'* **final sentence**

Clearly the waste and other rock structures will generate sediment that could present a major problem. The ISP would wish to see more evidence of the methods proposed to deal with this, supported by detailed calculations.

Page 24 contd

– para 2 *'Extension of the risk..'* **2nd sentence**

Reference has already been made above for the need to justify the 'simplified assumption' in relation to constant concentration of solutes in the ponds.

General comment – The SS response addresses some of the ecological and biochemical risks but it does not appear to consider these in a hydrological context ie the site [retention ponds etc] will have an effect on the hydrology of Swift Creek. There will undoubtedly be a change in the flow regime; the period of dry river bed will be longer. What impact will this have on the water quality and the ecology? Has this been considered?

Page 29

– para 4 *'Whilst there is some…..'*

The groundwater flow pattern is still uncertain. There is reference to deep groundwater flow but what drives this flow? Is it simply the recharge through the sandstone ridge or is the driving potential further to the east or south? If long-term predictions are to be made it is important to understand the system.

Page 30

– 2.4 2nd para

Where is the evidence to suggest that the deep groundwater flows to the sea and does not emerge in the flood plain?

Where does the 1% volume come from?

Page 31

– para 1 2nd point

It is particularly important to undertake isotope analyses on water samples collected in the decline.

Page 32
– para 2 *'Because the movement of….'* **2nd sentence**
Only if no convergence or divergence of flow.

Page 33
– para 4 *'The groundwater was dated..'*
Some useful comparisons here. It is a pity that [Darcy] groundwater velocities are used as a 'parameter'. They are not fundamental being dependent on gradient. Much better to use permeability. If $K=10^{-2}$ m/d with a gradient of 0.03 and a porosity of 1% [as appears to have been used in the calculations in Appendix B] then would the groundwater travel time not be 94 yrs/km?

Page 35
– para 2 *'The possible increases…'* **last sentence**
What is the basis of this 10% value?

Page 46
– para 1 *'In considering the potential..'*
Note that the ISP has given no consideration to the haul road as they assumed this was a feature of Ranger Mill Alternative. Is this the case?

Page 47
– para 3 *'The headwaters of Swift…..'*
Has any consideration been given to the change in the hydrology of the headwaters of Swift Creek due to the site works? How would this affect the ecosystems?

Page 50
'*ADDITIONAL BASELINE…'*
These are very welcome recommendations. ISP would be interested to know the date on which they were made.

Page 51
3rd point
What is 6.6.3? It does not appear in the Assessment Report.

Page 54
– para 4 *' This brief document …'*
Note that the recommendation from ISP for a full risk assessment up to 60 years is warranted Is this assessment being made?

Page 58
- **para 1** *'There are as yet…..'*

The first sentence is in contradiction to other statements in the report.