



ASSESSMENT REPORT NO 33

MAUD CREEK OXIDE PROJECT

ENVIRONMENTAL ASSESSMENT REPORT AND RECOMMENDATIONS

by the

**ENVIRONMENT AND HERITAGE DIVISION
DEPARTMENT OF LANDS, PLANNING AND ENVIRONMENT**

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EXECUTIVE SUMMARY

This report assesses the proposal by Katherine Mining NL to mine gold ore at Maud Creek and to haul the ore to Union Reef Gold Mine north of Pine Creek for processing.

It reviews the Public Environmental Report (PER) submitted by the proponent and information, comments and advice provided by Northern Territory Government agencies and in public submissions. Reference has also been made to the draft Environmental Impact Statement (EIS) and related studies for the Maud Creek Gold Project submitted in 1998.

Environmental Assessment is the process of determining those elements of the environment which may be affected by a development proposal and of determining the significance, risk and consequences of the potential impacts of the proposal.

Major issues

The principal environmental issues identified by the proponent and this assessment report are:

- Water management;
- Haulage; and
- Rehabilitation.

Conclusion

It is considered that the environmental issues associated with the project have been adequately identified. Most of the issues have been resolved through this assessment process, while the remainder will be addressed through the Mine and Environmental Management Plan required under the *Mining Act*.

Provided that the environmental commitments and safeguards detailed in the PER are implemented, the recommendations in this Assessment Report are adopted and regular reviews and reporting are undertaken, long term environmental impacts should be minimised.

SUMMARY OF RECOMMENDATIONS

Recommendation 1

Katherine Mining NL and AngloGold shall ensure that the proposal is implemented in accordance with the environmental commitments and safeguards identified in the Maud Creek Oxide Project Public Environmental Report (summarised in Section 7 of the PER) and as recommended in this assessment report. All safeguards and mitigation measures outlined in the PER are considered to be commitments by Katherine Mining NL and AngloGold.

Recommendation 2

Katherine Mining and AngloGold shall liaise and develop an agreed traffic management strategy with the Department of Transport and Works regarding the use of Bicentennial Road for northbound road trains and the Ross Road/Stuart Highway intersection upgrade and signage requirements.

Recommendation 3

AngloGold and Katherine Mining shall clearly define the responsibilities for environmental management, decommissioning and rehabilitation during and after mining.

Recommendation 4

A program shall be in place for the ongoing monitoring of the mine site, including the access road after mine closure. The program shall set out the matters to be monitored, the frequency of monitoring and who is responsible for the monitoring. A contingency plan shall be prepared outlining the measures to be taken if the monitoring indicates corrective action is required.

Recommendation 5

Katherine Mining approach the Katherine Landcare Group for advice and other assistance in the rehabilitation and ongoing monitoring of the mine site.

Recommendation 6

The proponent shall ensure that mosquito breeding does not become a problem by implementing the relevant sections of the MEB guidelines (Appendix 2).

Recommendation 7

The proponent shall obtain the necessary consents under the *Heritage Conservation Act* to disturb or destroy any site that may be affected by the mining operation.

Recommendation 8

Katherine Mining shall consider means of informing the local community about how the project and its environmental management are progressing.

Recommendation 9

The Department of Mines and Energy shall consider the need for a bond as a condition of any lease issued for the Maud Creek Oxide Project.

1 INTRODUCTION

1.1 Background

This report assesses the proposal by Katherine Mining NL to mine gold ore at Maud Creek and to haul the ore to Union Reef Gold Mine north of Pine Creek for processing.

The proposed gold mine at Maud Creek, about 20 km east of the town of Katherine has a long history. A Notice of Intent (NOI) was lodged in early 1996 to mine, both by open cut and underground, and process gold ore at the Maud Creek site. At the time it was determined that assessment would be required under the *Environmental Assessment Act* at the level of an Environmental Impact Statement. The main reason being the location of the mine site within the catchment of the town's water supply and the potential impacts from mining and processing of ore on that water supply.

An EIS was submitted and placed on public review for eight weeks between September and November 1998. A public meeting attended by more than 100 residents of Katherine was held during the public review period and 11 public submissions were received. These together with a consolidated NT Government submission and notes from the public meeting were forwarded to the proponent, Kilkenny Gold NL. The issues raised in the submissions were to be addressed by the proponent in a supplement to the EIS. Low gold prices forced the proponent to reassess the project strategy and, as a consequence, the supplement has not been completed.

Recently there have been some changes to the corporate structure and activities of Kilkenny Gold NL with the result that all Kilkenny's gold tenements are now held by Katherine Mining NL.

1.2 Assessment of new proposal

In March 2000 Katherine Mining NL wrote to the Minister for Lands, Planning and Environment advising of substantial changes to the project and the changes to Kilkenny's corporate structure. Accompanying the letter was a NOI for the new Maud Creek Oxide Project.

The advice from Katherine Mining was in accordance with clause 14A of the Administrative Procedures of the *Environmental Assessment Act*. The alterations to the project substantially change the environmental significance of the project.

It is a much smaller project with a shorter project life. It is essentially a quarry operation, extracting overburden/waste rock and oxide ore from a small open cut. The ore will be transported by road to the Union Reef Gold Mine north of Pine Creek for processing.

Taking into account the scale of the project, the location within the water catchment, haulage of ore through Katherine and the public interest in the project the Minister determined that it should be assessed under the *Environmental Assessment Act* at the level of a Public Environmental Report (PER).

Guidelines for the PER, based on the guidelines issued for the previous EIS, were issued to the proponent together with a direction to prepare the PER. The PER was submitted in early April and placed on public review for two weeks until 28 April 2000. The proponent held a public meeting in Katherine during the public review period. 17 people attended the meeting including representatives from the Government and the proponent. The proponent also provided copies of the PER to those individuals and groups that made submissions on the original EIS in 1998. Two public submissions were received. The PER was also circulated to NT Government agencies for review and comments.

2 THE PROPOSAL

AngloGold Pine Creek will undertake the mining, under an agreement in which AngloGold Australasia Ltd. has purchased the right to mine the Maud Creek oxide resource.

The Maud Creek Oxide Project will involve approximately 6 months of mining, using open cut methods. Approximately 400,000 bcm of material will be mined during the project life and 56,000 bcm of this will be ore. The pit maximum depth will be 35-40 meters. Expected grade for this open cut resource will be 4.5 g/t. Road trains will haul ore from the project to the AngloGold Union Reef Gold Mine, for processing.

The project will be established on freehold land owned by Katherine Mining. The development area is presently used for grazing cattle from the nearby Maud Creek Station (NT Portion 4192, a subdivision of NT Portion 4159).

The project area is located on Gold Creek, a tributary of Maud Creek, which flows into the Katherine River below the Katherine Gorge and upstream of the Katherine Township. Both Maud and Gold Creeks are ephemeral and do not generally flow in the dry season.

Ore mined from the open-cut pit will be hauled via road trains to the Union Reef Gold Mine mill for processing. Waste rock mined from the operation will be stockpiled in a waste dump adjacent to the pit. A rock sampling program will be established to provide early identification of problematic rock. If any problematic rock is mined, it will be placed in a temporary stockpile and returned into the pit at the end of the mining program. It should be noted that previous geochemical tests indicated that there should not be any acid producing material in the oxide zone.

Vegetation and topsoil will be stripped from footprint areas and stockpiled for reuse in rehabilitation. Clearing will be kept within the designated areas already assigned to the project by Katherine Mining.

Ore hauled to the Union Reef Gold Mine Run of Mine (ROM) stockpile will be processed at a rate 2.8 Mtpa by the Carbon in Pulp process (CIP), to produce gold bullion. Maud Creek oxide ore will displace marginal ore currently processed from Crosscourse pit. Therefore, throughput rate will not change. Resultant tailings will be discharged into the existing Tailings Storage facility at Union Reef Gold Mine.

Rehabilitation of the Maud Creek site will be undertaken on a progressive basis. Rehabilitation will be consistent with current best practices implemented at Union Reef Gold Mine.

All personnel will be accommodated in the township of Katherine and commute to the site daily. Temporary on-site facilities will include crib, administration, workshop and storage areas.

3 ENVIRONMENTAL IMPACT ASSESSMENT

3.1 Introduction

The information provided in the PER has been assessed and then used, along with submissions from advisory bodies and public comment on the PER, to determine the adequacy of the information provided by the proponent and the accuracy and acceptability of predicted impacts and safeguards. Comments and recommendations, based on submissions and comments from Government advisory bodies, are then made.

It is acknowledged that during implementation, flexibility is necessary and desirable to allow for minor and non-substantial changes the proposals outlined in the PER and examined as part of this assessment. It is considered that subsequent statutory approvals for this project could make provisions for such changes, where it can be shown that the changes are not likely to have a significant effect on the environment.

It is important for interpretation purposes that the recommendations (in bold) are not considered in isolation, as the text identifies concerns, suggestions and undertakings associated with the project.

Safeguards and mitigation measures undertaken by the proponent in the PER are summarised in Section 7 of the PER (pages 35-37). All safeguards and mitigation measures outlined in the PER are considered to be commitments by the proponent.

Subject to decisions that permit the project to proceed, the primary recommendation of this assessment is:

Recommendation 1

Katherine Mining NL and AngloGold shall ensure that the proposal is implemented in accordance with the environmental commitments and safeguards identified in the Maud Creek Oxide Project Public Environmental Report (summarised in Section 7 of the PER) and as recommended in this assessment report. All safeguards and mitigation measures outlined in the PER are considered to be commitments by Katherine Mining NL and AngloGold.

3.2 Major Environmental Issues

The principal environmental issues identified by the proponent and this assessment report are:

- Water management;
- Haulage; and
- Rehabilitation.

3.2.1 Water management

As the Maud Creek mine site is located in the catchment of Donkey Camp Pool, from which Katherine's water supply is sourced the potential for the mine to contaminate the water is a major concern. Possible sources of water contamination are groundwater dewatering for the open cut pit, the waste rock dump, fuel storage and other disturbed areas on the mine site.

Groundwater dewatering is required for the pit. Preliminary testing of groundwater at the shallow depths of the pit (35-40 m) in 1999 showed that the groundwater is suitable for irrigation purposes and would meet drinking water quality except for high arsenic levels. Testing of water from greater depths for the original proposal showed high levels of arsenic, selenium, barium and lead. The groundwater will in the first instance be used for dust suppression on the site and the haul road leading to the Stuart Highway. Excess water will be spray irrigated to allow for maximum evaporation in an area of black soils (2:1 montmorillonite clays) that have the ability to attenuate heavy metals in the water. Surface runoff from this disposal method into Gold and Maud Creeks is not expected. The proposed method of managing the dewatering is acceptable.

However, the water from the dewatering bores should be monitored through the life of the mine to ensure that the water quality is as shown by the preliminary tests and therefore is acceptable for continual dust suppression and irrigation. The proponent has undertaken to carry out further water quality tests. If the water quality is within acceptable limits it may be permitted to discharge excess groundwater directly to Gold Creek via an armoured flume.

If pyrite is present in the waste rock there is potential to acid rock drainage and thus contamination of surface water. Waste rock characterisation carried out for the previous EIS indicated low pyrite content and high carbonates in the weathered zone and fresh zone with little potential for acid formation. As the current proposal is to mine only the oxide (weathered) zone and the upper level of the transition zone acid formation is not considered to be a problem.

Nevertheless, the operator, AngloGold, will carry out a waste rock characterisation program during mining operations similar to that carried out at the Union Reef Gold Mine. Any "problematic" waste rock, either with Net Acid Generating (NAG) potential > 1 and/or arsenic > 1000 ppm, will be placed in a temporary stockpile. Upon completion of mining the problematic waste rock will be placed back in the pit and covered by water and thus prevent the generation of acid.

Non problematic waste rock will be placed in a waste rock dump about 10 m high and covering an area of 4.7 ha adjacent to the open pit. The dump is located outside the 1:100 year flood zone. The sides will be contour ripped and the top paddock dumped to control erosion. (See 3.2.3 below regarding some concerns about paddock dumping.)

The proposed handling of waste rock in general and the problematic waste rock in particular is acceptable.

Upon completion of mining the pit will be left open with groundwater allowed to fill the void. A bund will be constructed around the pit and waste rock dump. Surface water will thus be diverted away from the mine site. Drainage from within the bund and the waste rock dump will be directed to the pit.

The fuel storage and handling has the potential to cause surface water contamination if not constructed and operated to prevent spillage. The storage area will be bunded in accordance with the relevant Australian Standard and should also be handled in accordance with this Standard. The bunded area should have sufficient capacity to accommodate the combined storage capacity of all tanks within the area. Waste oils and hydraulic fluids will be collected in drums for treatment or disposal off site. Collection should be carried out in a bunded area and the waste oil treated for reuse or recycling rather than disposal. Disposal should be by an approved method and to an approved site.

Provided water management is carried out in accordance with the undertakings set out in the PER the risk to the Katherine water supply is minimal.

3.2.2 Haulage

The haulage of ore from the Maud Creek site to Union Reef Gold Mine using road trains will add significantly to heavy vehicle traffic through Katherine. This also increases the potential for traffic related incidents. It is preferable that northbound road trains use the Bicentennial Road and Victoria Highway and southbound road trains use the Stuart Highway/Katherine Terrace through the town. However, there are concerns about the pavement of Bicentennial Road, which the Department of Transport and Works (DTW) are currently assessing. The Department is also investigating the diversion of all northbound road train traffic off Katherine Terrace onto Bicentennial Road. The proponent should therefore liaise with the DTW on the use of Bicentennial Road.

The proponent has undertaken to upgrade the Ross Road/Stuart Highway intersection to a "B" intersection in accordance with the DTW's requirements. Signage will be required at the intersection to warn of slow traffic entering the Stuart Highway.

Recommendation 2

Katherine Mining and AngloGold shall liaise and develop an agreed traffic management strategy with the Department of Transport and Works regarding the use of Bicentennial Road for northbound road trains and the Ross Road/Stuart Highway intersection upgrade and signage requirements.

The proponent should consider scheduling the road trains to avoid travelling through the town in the morning and afternoon when the schools commence and close for the day.

On the mine access road scour and erosion are potential problems if the drainage offlets are inappropriately located. Table drains and offlet drains must be appropriately designed and constructed especially where the access road crosses Gold Creek. Advice can be obtained from the Department of Transport and Works and the Katherine office of the Department of Lands, Planning and Environment.

3.2.3 Rehabilitation

The proposed rehabilitation and decommissioning of the various elements of the mine site at Maud Creek as described in the PER is generally acceptable. Some concern has been expressed about the paddock dumping of the top of the waste rock dump as this could lead to erosion rather than controlling erosion. Contour ripping may be more appropriate. The proponent should liaise with the Department of Lands, Planning and Environment in Katherine on this matter.

It appears from the PER that AngloGold will be responsible for the rehabilitation and decommissioning until the closure of the mine as well as environmental management during the mining operation. Responsibility will then be taken over by Katherine Mining. The time and extent of Katherine Mining's responsibilities are not stated in the PER.

Ongoing monitoring needs to include more than the revegetation. The integrity of the bund walls around the pit void, the toe drains and capping of the waste rock dump should also be included in a continuing monitoring program. Water quality in the pit void and possible flows into Gold Creek or Maud Creek must also be monitored.

If the access road is to remain open after mine closure ongoing monitoring and maintenance should be part of the rehabilitation monitoring program.

Recommendation 3

AngloGold and Katherine Mining shall clearly define the responsibilities for environmental management, decommissioning and rehabilitation during and after mining.

Recommendation 4

A program shall be in place for the ongoing monitoring of the mine site, including the access road after mine closure. The program shall set out the matters to be monitored, the frequency of monitoring and who is responsible for the monitoring. A contingency plan shall be prepared outlining the measures to be taken if the monitoring indicates corrective action is required.

The Katherine Landcare Group has offered to be involved in the design, implementation and long term monitoring of the site. The Group would like to provide practical assistance in the rehabilitation of the site, such as seed collection. Appendix 1 is a list of suitable species provided by the Group. It is also of the opinion that 5 kg/ha of seeds should be used rather than 2.5 kg/ha.

Recommendation 5

Katherine Mining approach the Katherine Landcare Group for advice and other assistance in the rehabilitation and ongoing monitoring of the mine site.

3.3 Other Issues

Other issues raised relate to public health matters and mosquito breeding, weed management, heritage matters, reporting and the requirement for a bond.

3.3.1 Public health

The Territory Health Services advises that raw water from the dewatering shall not be used in ablution facilities if it comes into direct body contact unless it can be shown that the water is not detrimental to human health. The results from the analysis of potable water shall be forwarded to the Services' Environmental Health Officer in Katherine. The sewerage system shall be approved and installed before mining operations commences. The *Public Health Act* is also relevant to the project.

3.3.2 Mosquito breeding

The Medical Entomology Branch (MEB) of the Territory Health Services has prepared guidelines to prevent the creation of mosquito breeding at mine sites. These guidelines are attached as Appendix 2.

The MEB endorses the land application of excess water but if the water pools for more than five days these pools are likely to become productive mosquito breeding sites. Regular checks should be carried out for ponding and mosquito breeding. Any silt traps and drainage structures should be designed to be free draining within a period of five days.

The mining operation should not create or exacerbate existing mosquito breeding sites. The dengue mosquito, *Aedes aegypti*, occurs in North Queensland but is absent from the NT. No used tyres, machinery or other containers that have previously held rain water should be brought to the NT from Queensland unless the containers or machinery has been treated to remove the possibility of the introduction of drought resistant eggs of exotic *Aedes* mosquito species. Machinery tyres, drums, disused tyres, tanks, pots, etc. should be stored under cover, be provided with drainage holes or emptied on a weekly basis until collection by the waste disposal contractor (see Section 9 of Appendix 2).

Recommendation 6

The proponent shall ensure that mosquito breeding does not become a problem by implementing the relevant sections of the MEB guidelines (Appendix 2).

3.3.3 Weed management

Wash down facilities for machinery moving on to and off the site should be part of the weed management to minimise the spread of weeds into the greater Katherine River catchment.

3.3.4 Heritage matters

As regards sacred and significant sites it should be noted that no such sites have been identified under the NT *Aboriginal Sacred Sites Act*. This distinction is needed to avoid confusion with archaeological and/or historic sites.

Of the sites recorded by the two archaeological surveys carried out in the area only one, MC1 is likely to be affected by the mine. Under the *Heritage Conservation Act* Ministerial consent is required prior to undertaking any work that may disturb a site. Appropriate advice can be obtained from the Heritage Conservation Branch of the Department of Lands, Planning and Environment.

In addition to signage and induction of employees fencing may also be required to protect some of the sites recorded by the archaeological surveys.

Recommendation 7

The proponent shall obtain the necessary consents under the *Heritage Conservation Act* to disturb or destroy any site that may be affected by the mining operation.

3.3.5 Reporting

Both the public submissions raised the issue of regular reporting on monitoring and testing carried out both during mining and subsequent to mining. This reflects a wish by the local community to be kept informed about progress of the project and its environmental management. The Katherine Landcare Group suggests the proponent set up an Internet site to achieve this.

Recommendation 8

Katherine Mining shall consider means of informing the local community about how the project and its environmental management are progressing.

3.3.6 Bond

Both the public meeting and the public submissions raised the matter of a bond to ensure that the site is rehabilitated and that the rehabilitation is maintained for a number of years after the mine closes. There is merit in this suggestion and the Department of Mines and Energy should consider the requirement of a suitable bond as a condition of any approval to mine.

Recommendation 9

The Department of Mines and Energy shall consider the need for a bond as a condition of any lease issued for the Maud Creek Oxide Project.

4 CONCLUSION

It is considered that the environmental issues associated with the project have been adequately identified. Most of the issues have been resolved through this assessment process, while the remainder will be addressed through the Mine and Environmental Management Plan required under the *Mining Act*.

Provided that the environmental commitments and safeguards detailed in the PER are implemented, the recommendations in this Assessment Report are adopted and regular reviews and reporting are undertaken, long term environmental impacts should be minimised.

APPENDIX 1

Maud Creek Area Species List	
Scientific Name	Common Name
Grasses	
<i>Brachyachne convergens</i>	
<i>Setaria apiculata</i>	Pigeon Grass
<i>Alloteropsis semilata</i>	Cockatoo Grass
<i>Chrysopogon latifolius</i>	Ribbon Grass
<i>Chrysopogon fallax</i>	Golden Beard Ribbon Grass?
<i>Themeda triandra</i>	Kangaroo Grass
<i>Sorghum intrans</i>	Spear Grass
<i>Heteropogon contortus</i>	Black Spear Grass
Legumes	
<i>Indigofera linifolia</i>	Native Indigo
<i>Alysicarpus vaginalis</i>	Buffalo Clover
<i>Tephrosia rosea</i>	Flinders River Poison
<i>Rhynchosia minima</i>	Native Pea
Herbs	
<i>Gomphrena canescens</i>	Batchelor Button
<i>Neptunia dimorphantha</i>	Sensitive Plant
Shrubs	
<i>Acacia holosericea</i>	Soap Bush
<i>Acacia dunnii</i>	
<i>Acacia platycarpa</i>	
<i>Acacia gonocarpa</i>	
<i>Acacia dimidiata</i>	
<i>Acacia umbellata</i>	
<i>Acacia exstipulata</i>	
<i>Calytrix exstipulata</i>	
<i>Planchonia careya</i>	
<i>Petalostigma pubescens</i>	
<i>Cochlospermum fraseri</i>	Kapok Bush
Trees	
<i>Brachychiton diversifolius</i>	
<i>Brachychoton paradoxum</i>	
<i>Erythrophleum chlorostchys</i>	Ironwood
<i>Eucalyptus alba</i>	
<i>Eucalyptus bigelerita</i>	
<i>Eucalyptus bleeseri</i>	
<i>Eucalyptus confertiflora</i>	
<i>Eucalyptus foelscheana</i>	
<i>Eucalyptus latifolia</i>	
<i>Eucalyptus miniata</i>	
<i>Eucalyptus pruinosa</i>	
<i>Eucalyptus tectifera</i>	
<i>Grevillea pteridifolia</i>	
<i>Terminalia ferdinandiana</i>	
<i>Terminalia platyphylla</i>	

GUIDELINES FOR PREVENTING MOSQUITO BREEDING SITES ASSOCIATED WITH MINING SITES

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Medical Entomology Branch
Territory Health Services

General Comments

All mining operations need to include in an Environmental Management Plan a section for the monitoring and control of mosquitoes. This is necessary due to the potential of mine sites to provide extensive breeding sites for mosquitoes of pest and disease significance. Mine sites also provide the potential for the introduction into the NT of mosquito species and mosquito borne diseases that are either exotic or that have previously been eliminated.

The monitoring of adult mosquitoes in any new mine may be restricted to trapping once a month for the initial 12 months baseline mosquito monitoring program. The baseline mosquito monitoring program provides an indication of the seasonal distribution of the mosquito species present and the relative potential impact of mosquito borne disease to mine personnel.

The monitoring and control of mosquito larvae should be an ongoing operation for the life of the mine. Mosquito larvae must be controlled with an approved mosquito larvicide (*Bacillus thuringiensis* var. *israelensis* or temephos) as part of an organised monitoring and control program.

Accommodation for personnel should be sited as far as possible from the most important biting insect breeding sites and is adequately insect screened.

The potential for artificially created mosquito breeding sites can be minimised with the appropriate design of water holding facilities and water management procedures.

1. WATER DAMS

- All dams should be constructed with relatively steep sides (45° slope minimum) to discourage the establishment of semi-aquatic vegetation (eg. *Typha* and *Eleocharis* reeds) that will provide suitable habitats for mosquito breeding.
- Dam margins should be as straight as possible to minimise the linear area available for the establishment of semi-aquatic vegetation.
- Where possible, any closely grouped dams should be joined together to minimise the linear margin of vegetation.

- The bottom of any dam should be graded as level as possible, with a slight slope to one end to form a deeper section for periods of low water. This will remove the potential for the formation of isolated pools as the water level recedes in the dry season.
- Areas surrounding any dam that will be flooded during the wet season should be graded to enable water to drain freely into the dam as the water level recedes, without the formation of isolated pools that are capable of retaining water for a period greater than 5 days.
- There must be no islands formed within any dam. All areas of impounded water should have a relatively deep (2 m) wet season stabilised water level to prevent the emergence of semi-aquatic vegetation.
- Any drainage line directed into a dam must be fitted with a sediment trap or erosion prevention structures just upstream from the dam. This is necessary to prevent the formation of “alluvial fans” that will promote the establishment of semi-aquatic vegetation in the area of the fan where silt will be progressively deposited.
- Local native fish should be introduced or have access into any dams where the water quality is suitable for their survival, to provide natural predators for the control of mosquito larvae.

2. WET LAND FILTERS

- Wetland filters have the potential to provide prolific breeding sites for mosquito species of pest and disease significance. If no other alternative is available for the treatment and disposal of waste water, a wetland filter should incorporate the ability to annually reduce the build up of any dead vegetation. Plans for wetland filter design and siting should be forwarded to the Territory Health Services (Medical Entomology Branch) at the planning stage to ensure that their potential impact on the health of mine site personnel is minimised.
- Annual maintenance could be achieved by dividing a wetland filter into separate sections. A dual pond system will enable water to be directed into one side of the filter while vegetation is burnt or otherwise reduced in the other side. An ability to manipulate the water level in the filter to strand or drown vegetation would be beneficial for the management of vegetation and mosquito numbers.
- Stocking the wetland filter with local native fish will provide a significant measure for controlling mosquito larvae. The provision of fish however will not remove the need for annual maintenance of the wetland filter.
- Where appropriate, consideration should be given to the provision of a fish ladder on any overflow facility to enable the dispersal of fish into and upstream of the filter.
- Wetland filters may need to be removed after mining operations are completed to enable the development of adjacent land.

3. WEIRS

- Any spillways must be fitted with erosion prevention structures to prevent scouring and siltation of creek lines during periods of overflow.
- Fish ladders should be constructed where appropriate to enable the upstream dispersal of fish following periods of dam overflow.

4. MINE WASTE DUMPS

- The final surface of mine waste dumps should be contoured so that the surface area is free draining and has no surface depressions.
- Any runoff from a waste dump should be directed to a silt trap to prevent any siltation of natural creek lines. Siltation in creek lines can promote the formation of isolated pools or disrupt fish ecology and may lead to the subsequent establishment of mosquito breeding sites.

5. SEDIMENT TRAPS

- Sediment traps need to be designed so that they are free draining within a period of 5 days after flooding.
- Sediment traps should be maintained by silt and vegetation removal on an annual basis.

6. BORROW PITS

Borrow pits, costeans or scrapes must be rehabilitated such that they do not hold water for a period greater than 5 days. These sites can be rectified either by filling or rendering them to be free draining.

7. DRAINAGE PATHS

- Natural drainage patterns should be maintained where possible. Culverts must be fitted to access roads to prevent the unnecessary retention of water which could cause the formation of mosquito breeding sites following periods of rain.
- Any disruption to surface drainage should be removed at the end of the mining operations.

8. WASTE WATER DISPOSAL

- Septic tanks must be installed to THS guidelines and should be inspected on an annual basis by the Environmental Officer to ensure that tanks and their effluents do not breed mosquitoes.

- Overflow or excess effluent from sewage treatment systems must be disposed of in a manner approved by THS. A sprinkler disposal system is suitable under most situations. The discharge of excess effluent into ephemeral creek lines is not acceptable.
- Sewage ponds should be constructed with steep sides with an impervious lining and be regularly maintained to prevent vegetative growth at the margins (see *“Mosquito Breeding and Sewage Treatment in the Northern Territory”*, available from the Medical Entomology Branch). Surface debris and algal scum should be removed on a regular basis. Monitoring of mosquito larvae should be conducted in sewage ponds on a regular basis and control treatments conducted when necessary.
- Disposal of water into “Application areas” must ensure that water does not pool for a period greater than 5 days.

9. ARTIFICIAL CONTAINERS

- Rainwater tanks must be adequately screened to prevent the entry of mosquitoes.
- Any container capable of holding water, eg. machinery tyres, drums, disused tyres, tanks, pots, etc. should be stored under cover, be provided with drainage holes, emptied on a weekly basis or disposed of in an appropriate dump site to prevent the formation of mosquito breeding sites.
- No used tyres, machinery or other containers that have previously held rain water should be brought to the NT from Queensland unless the containers or machinery has been thoroughly treated to remove the possibility of the introduction of drought resistant eggs of exotic *Aedes* mosquito species.

10. RUBBISH AND GARBAGE DUMPS

- Rubbish and garbage dumps must be operated in such a manner that there is no pooling of water for a period greater than 5 days, to prevent the formation of mosquito breeding sites.
- Rubbish and garbage dumps must be rehabilitated by filling and surface contouring to ensure they are free draining and have no surface depressions.

23 May 1997

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