

4.1 Proposed Project (14)

D Farlam has raised a concern that the viability of the mine is subject to annual of market assessment and that it should be able to demonstrate how viable it is.

Table 4.1 in the draft EIS notes that the mine life of the existing underground operations is subject to annual review. Since the time the draft EIS was prepared the underground operations have ceased. The operation of the open cut project is not subject to annual review. MRM has committed to a mine life of 25 years for the open cut.

The project's viability is influenced by market demand and production costs. MRM's market analysis has indicated that the current world demand for zinc concentrate will continue to remain strong. Production costs for the open cut operation will improve by comparison to the cost of running the underground mine. Given this and the fact that the little change is required to the processing and transport facilities, Xstrata is confident that the proposed open cut operation will be viable.

4.2.1 Overview – Mine (3)

DNRETA has stated that there is no rationale in the draft EIS supporting the choice of alignment of the diverted river channel and consequently the size of the area enclosed within flood protection bunds. DNRETA considers that the position of the bund in the east is to excavate the channel of Bull Creek to accommodate the redirected flow of the McArthur River and to minimise the haul distance for excavated material.

The open cut project described in the EIS will not exhaust the ore body. The open cut project will remove 43 million tonnes of ore over the 25 year mine life. The mineralised ore body contains in excess of 180 million tonnes and this additional resource could potentially be mined in the future subject to revenue and cost sensitivities, development of downstream processing options, and obtaining all necessary environmental and other approvals. To enable additional ore to potentially be mined in the future, sufficient space has been left between the edge of the open cut and the toe of the flood protection bund. In this way a valuable mineral resource will not be sterilised.

The potential for future mining determined the location of the bund wall and it is the location of the bund wall that has determined the location of the river realignment. The realigned river channel parallels the southern section of the bund and it then runs in a relatively straight line back to the existing river. This alignment provides adequate protection for the bund wall, provides sufficient work space between the bund and the realignment, and provides a hydraulically efficient path for the diverted river flows. Bringing the river realignment closer to the eastern side of the bund wall would require two relatively sharp bends in the realigned channel which could generate additional erosion and stability issues.

4.2.3 Test Pit Project (5, 14)

MAGNT considers the test pit to be little else than an open cut mine, with approval gained from NT Government by just a 'modification' to MRM's mining plan. It considers that the open cut has begun and it will just be uneconomical to stop.

The Test Pit project is required to confirm the metallurgical properties of the ore that would be extracted from the open cut so that any processing modifications can be undertaken as necessary to accommodate the differences from the underground ore. The Test Pit is being used to determine the following:

- The depth and variability of the Base Of Partial Oxidation (BOPO) and Base Of Complete Oxidation (BOCO) surfaces.
- Identification of oxide, transition and primary (fresh) ore from the Hinge Zone (where no mining has occurred in the underground operation) across the full range of orebodies. Samples will be collected to enable metallurgical testing of the various orebodies from different weathering states.
- Rock properties of the range of orebodies.
- Dilution and ore loss associated with attempting to segregate multiple bedded ore and overburden bands.
- Structural data through the ore zone which can be used to confirm geotechnical parameters including:
 - Mapping of clay bands for stability modelling of a larger pit.
 - Rock mass properties for further assessment of tension cracking issues.
- Blast vibration monitoring.

The approval obtained from the NT Government is limited to the Test Pit Project only. The Test Pit Project was also referred to the federal Department of Environment and Heritage for consideration under the Environment Protection and Biodiversity Conservation Act (EPBC) Act 1999. The Department decided on 30 August 2005, that the action, pursuant to section 75 of the EPBC Act, was not a controlled action and therefore was only subject to the terms and conditions advised by the NT Government.

No further mining has been approved. If approval for the open cut project is not obtained, MRM will rehabilitate and close the whole site including the Test Pit Project area.

D Farlam has stated that the majority of the materials to be used to construct the test pit flood protection bund have the capacity to leach metals into the river system and groundwater.

Metals in the materials to be used to construct the flood protection bund for the test pit will be bound in with the overburden and are not readily available to mobilise into the environment. Metal solubility is strongly pH-dependent so that if overburden materials become acidic, leachate may contain elevated concentrations of dissolved metals. The flood protection bund for the test pit project will consist of NAF materials only. Any PAF material extracted as part of the test pit will be stored in the test pit OEF. In this way acidic conditions will not occur and metals will not mobilise or leach into the river and groundwater systems.

4.2.4 Pit Stability (2, 7)

DPIFM has stated that additional aspects of design considerations for open cut mining that should be considered include;

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- *Open pit and underground interface management, where voids, weak-ground, unstable support in underground workings need to be accurately identified and hazard remedied,*
 - *Appropriate blast pattern designed, charged and initiated with a view to protect high wall,*
 - *Appropriate monitoring systems to recognise and review decision process.*

Interface Management

The management of open cut operations in the vicinity of old underground workings will be undertaken with due care and attention to ensure the safety of personnel working in the pit. As the underground workings are all well recorded, the location of all the voids at the cessation of underground mining are known. These voids will be identified in mine plans, which will trigger Safe Work Procedures that must be followed when work is undertaken in these areas. Such practices can include:

- Restricted access to various levels to match the risk:
 - Lower risk areas may allow equipment with roll over protection fitted to access the area; and
 - Higher risk areas would be inaccessible to all vehicles and personnel.
- Geotechnical analysis of known structures, rock types and ground conditions to determine a safe crown pillar thickness.
- Probe drilling from safe ground to confirm the dimensions and location of the voids at that time.
- Risk assessment to determine the safest and most effective way to make the area safe, including;
 - Drilling of large diameter holes into the void, followed by filling with crushed material; and
 - Drilling of long holes through the crown pillar to enable it to be blasted into the void.

The procedures developed for the MRM open cut will be based on those employed successfully for many years at The Fimiston open cut (the 'Superpit') in Kalgoorlie.

Blasting

Drilling and blasting operations will be developed to address the needs of specific areas of the pit, including desired fragmentation, blast movement, and protection of walls. Trials of various wall blasting techniques are in progress and planned for the Test Pit which is currently being excavated. These include:

- Reduced burdens on back rows;
- Varying blasthole sizes in back rows;
- Lowering the explosive density in back rows; and
- Varying the angle of the holes in the back rows.

Monitoring

The wall performance will be closely monitored to ensure that recommended design slope geometry is updated with the latest knowledge of rock properties and structures. The wall in the south-west of the pit has been designed at a flat inter-ramp slope angle due to the presence of weak tuff beds in the core

samples. Pit designs and schedules are devised to enable this wall to be cut back to a flatter slope if required. Slope monitoring will be used in this portion of the pit to assess the stability of the wall.

DPIFM asked if consideration has been given to a contingency distance in the width of the haul ramp to allow the fleet variations / evolving equipment nature over the 25 years of operation.

Yes, consideration has been given to variable haul ramp widths to allow changing conditions over the life of the mine.

The deposit is to be mined in several pit stages. Each stage typically has a ramp on the eastern wall. The eastern wall of the stages is later mined out by subsequent pit stages. Thus, the ramp in each stage can be designed to suit the equipment in the mine plan at that time. The current mine plan is based on the use of trucks in the 90 t and 150 t class. A ramp width (including windrows and drains) of 27 m has been allowed in these eastern stages.

The footwall ramp on the western wall, and the eastern ramp in the final stage, will not be mined out. These ramps have been designed to a total width of 34 m. This will enable operation of trucks up to the 220 t size.

Some parts of the eastern haul ramps will also be mined wider than that needed to run the trucks. This is to allow room for a catch berm down the highwall side of the ramp to protect the roadway from any material dislodged from walls above the ramp. This can occur when one active bench is working above the haul road used by a lower work area. The extra width ensures that the travel way will be free of rill material, thereby ensuring safe two-way traffic.

With the large amount of groundwater set to accumulate in the pit, requiring dewatering at a rate of 6.3 million litres per day by year 17 of the mine, ECNT has major concerns that pit stability will be an ongoing and significant risk to workers and the environment. They consider that the issue requires much more study before any approval can even be contemplated for a move to open cut.

An extensive and detailed study was completed as part of the feasibility study into open pit mining at MRM. This addressed all aspects of pit stability, including local scale and slope scale failures. The study addressed issues such as the effects of groundwater and existing underground voids on the stability of the pit wall. Recommendations ranging from design guidelines to operational constraints and requirements were made to manage these issues. This enabled a pit design and mine schedule to be developed that would be stable over the operational life of the project.

Areas of higher risk of failures were specifically identified and modelled. Control strategies were devised to maintain a safe and efficient operation of the pit. Xstrata has confidence that the mine designs, schedules, and operational strategies devised in the feasibility study, and presented in the draft EIS, will provide a safe work environment over the life of the open cut mine.

A more detailed discussion of the pit stability issues is given in Appendix G.

4.2.5 Mining Activities (1, 2)

EPA has asked for an outline or inclusion of the ‘current site land disturbance procedures’ and the ‘permit to clear’ methodologies under which vegetation will be cleared.

A copy of the MRM Standard Operating Procedure “Permit to Clear” is attached in Appendix B.1. The Vegetation Clearance Plan that was used for the Test Pit project is also included in Appendix B.2. An additional Vegetation Clearance Plan will be developed for the open cut project which will be similar to that of the Test Pit, however on a larger scale.

DPIFM has asked if the proponent has obtained a security sensitive ammonium nitrate (SSAN) licence from NT WorkSafe including the submission of security plan.

MRM and its explosive supplier have not obtained a SSAN licence from NT WorkSafe at the time of writing (November 2005). NT WorkSafe has informed MRM that the SSAN license system will not be enacted until early in 2006. Orica and MRM have been in contact with NT WorkSafe to keep up to date with the impending legislative changes. All requirements under the new system will be complied with once they are implemented.

Until this system is operational, the explosives handling operations on site have been conducted to Australian Standards, as outlined in the amended 2005 Mine Management Plan that covers the Test Pit operations. MRM has worked with its explosives supplier to site the magazines, emulsion plant and blasting agents in safe locations and structures. Separation distances from infrastructure and work areas have been based on satisfying the Australian Standards. All areas are fenced off and locked at all times. The keys to these locks are kept in a locked box in the site office. The key to access this box is only issued to personnel approved to handle explosives on site. As well as the having the relevant explosives handling training, these personnel have been given security clearance from the Australian Federal Police.

A system of record keeping of all explosives movements into, out of, and around the site is kept up to date at all times to ensure all explosives are accounted for. The explosives supplier manages the safety and security of blasting products during transport to site.

4.2.7 Industrial Facilities (2)

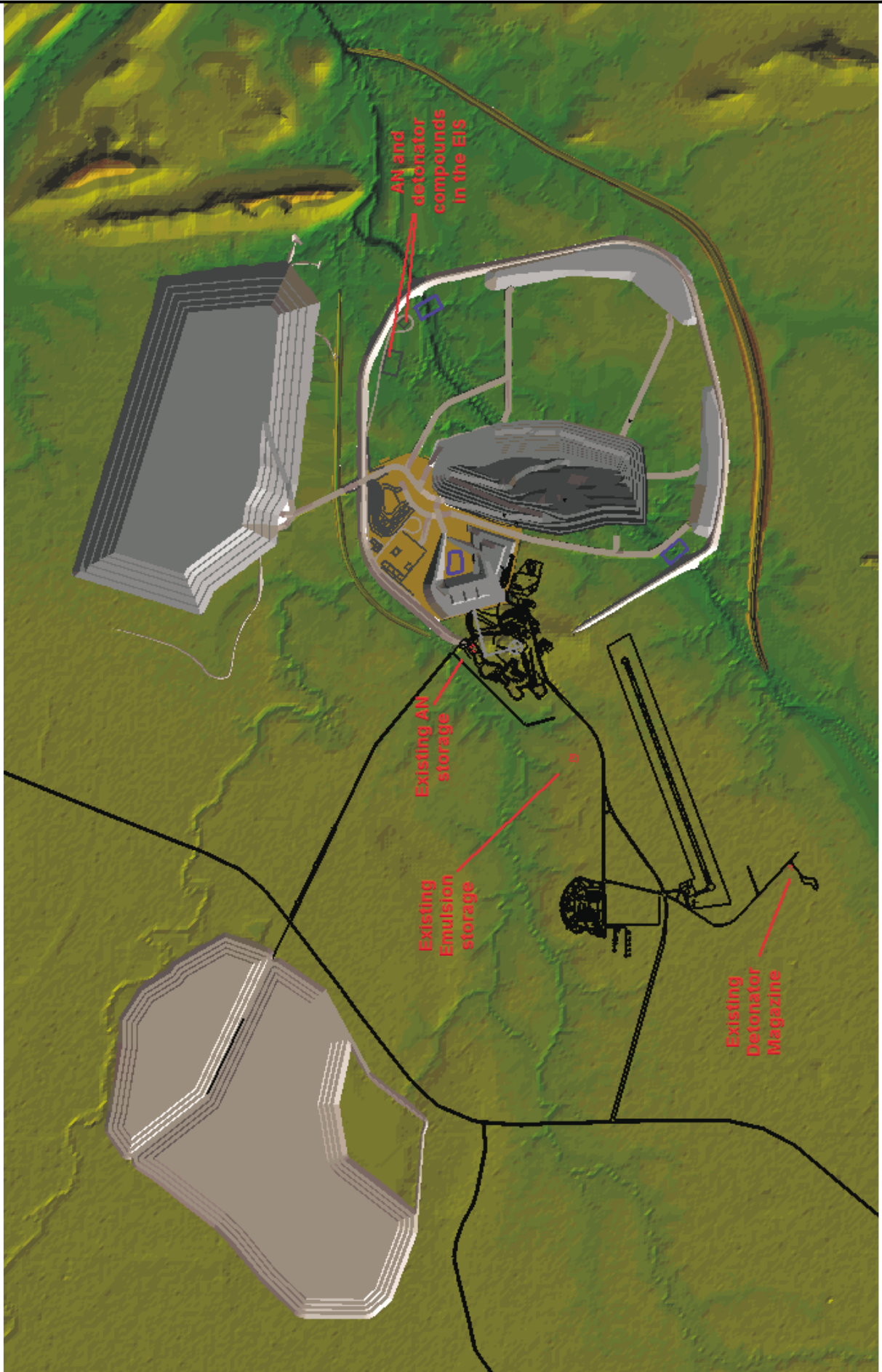
DPIFM has asked for a diagrammatic representation of the explosive storage facilities to assist in assessing the risks associated with the selected location.

The locations for explosives facilities on site are shown in Figure 1.

Figure 1 shows the recently constructed emulsion storage yard and surface magazines that were installed to service the Test Pit. The location of these items was devised to satisfy the following:

- Above the 1:500 year flood level;
- Adequate clearances from surrounding infrastructure and work areas in accordance with the relevant Australian Standards; and
- Safe access for transport vehicles.

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McARTHUR RIVER MINE
OPEN CUT PROJECT
ENVIRONMENTAL IMPACT STATEMENT SUPPLEMENT

LOCATION OF
EXPLOSIVES FACILITIES

Drawn: LL	Approved: CMP	Date: 28-11-05
Job No.: 42625552	File No. 42625552-g-155.cdr	

Figure: 1

Rev. A
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Figure 1 also shows the location for the explosives compounds as described in the draft EIS. These are in the north-east portion of the bunded area. The magazines were to be surrounded by suitably sized and constructed earthen walls. This area is well away from any work areas. However, now that alternative locations for the magazines and emulsion storage have been established for the Test Pit, the facilities, as described in the EIS, may remain in their present locations if the open pit operations were to continue rather than be relocated to the location shown in Figure 1.

4.3.2 Process Inputs (7)

Over 3 million tonnes/year of process and decant water will be used in the mining process as well as 6,635 tonnes/year of copper sulphate pentahydrate (see Table 4.9. for other inputs e.g. isopropyl xanthate, MIBC). ECNT has asked how toxic are these particular chemicals to humans and to aquatic ecosystems.

Appendix C contains Material Safety Data Sheets that are available for the chemicals listed in Table 4.9 of the EIS. These sheets contain information about the effects of the chemicals on humans and aquatic ecosystems.

4.3.3 Process Outputs (2, 14)

The DPIFM has asked how will lessons associated with historical issues and remediation requirements for site tailings management be incorporated into the design of future tailings dam aspects including;

- *Management of any neutral drainage issues,*
- *Contingencies such as use of geopolymers and recovery bores,*
- *Emergency water discharge management.*

The neutral drainage and runoff from the existing tailings storage facility (TSF) is pumped back to the plant settling pond for reuse in the process plant. This experience has demonstrated that the water can be reused in this way and hence a similar method of reuse is proposed for drainage from the TSF for the open cut project.

As discussed in Section 7.3.4, a trial of installing a geopolymer barrier wall around the existing TSF to minimise seepage is currently being undertaken. The lessons being learnt from this trial will be used to develop a seepage control system for the TSF for the open cut project. Should the trial be unsuccessful, alternative remedial works such as recovery bores will be considered.

At present, emergency water discharge is managed by a licensed discharge procedure that has been developed for the clean water dam in consultation with the Northern Territory Government. This procedure allows for variable flow discharges to ensure that the downstream concentration of zinc does not exceed the upstream concentration by more than 50 µg/L. Specific monitoring and reporting procedures are invoked for the emergency discharge procedure. Discharge is not permitted when river flows are below the 4 m level at the gauging station. The lesson learnt from this procedure is that this is a successful way to ensure large inventories of water do not build up at the mine which, if they needed to be discharged quickly or at a time when there were low flows in the river, could cause detrimental effects.

Due to the success of this procedure with the existing operations, a similar arrangement for emergency discharge will be maintained for the open cut project.

D Farlam has stated that only 90% of zinc and 70% of the lead is recovered in the current operation. HE considers that because there is a risk of material leaking from the tailings dam that 99% of all lead and zinc and other minerals should be processed or stored in a manner that prevents leakage and allows for future processing.

The ore deposit for both the existing mine and the proposed open cut mine is characterised by extremely fine grained ore. The lead and zinc sulfide bearing ores are predominantly of a size less than two microns. The current metallurgical process using the latest available technology grinds to eight microns. Whilst this liberates non-ore bearing waste rock, it does not physically separate the zinc and lead bearing sulfide ores. Thus MRM can only produce a bulk concentrate which contains physically bound zinc and lead sulfides. With current technology, MRM is unable to produce separate zinc and lead concentrates or extract any more metal than at present.

The TSF has been design to ensure that any seepage that does occur is collected by a network of recovery bores and does not impact on the downstream environment.

4.5 Bing Bong Port (9)

DLGHS has asked that since there will be a reduction in the tonnage shipped from Bing Bong each year, what will be the impact on the joint venture partnership between the Mawurli and Wirriwangkuma Aboriginal Corporation.

The conditions of the contract determine payment for services upon bracketed volumes of concentrate moved. Both the current 330,000 t/y and the proposed 320,000 t/y of shipped concentrate fall within the same bracket. Thus payment for concentrate shipping will remain unchanged.

4.6.3 Flood Protection Bund Construction (2, 5, 14)

DPIFM has requested that an “as built report” supported by testing of materials, interpretation of results and decision processes will be required to be submitted to their Minerals and Energy Group to ensure the construction is completed as per design.

MRM agrees to submit an “as built report” as requested.

DPIFM has recommended that the performance of the bund wall be reviewed periodically by an appropriately qualified professional and performance reports made available to regulatory agencies.

MRM will periodically review the performance of the bund wall by suitably qualified and experienced personnel as part of its continual environmental monitoring program. MRM agrees that these performance reports will be made available to regulatory agencies.

MAGNT has asked for information on any effects that the flood protection bund will have on shifting surface water drainage patterns and potential scouring during the wet season.

Construction work will be planned and documented in a Project Execution Plan that will include risk management strategies and monitoring. During construction, the flood protection bund will be partially built in strategically located sections. The objective will be to allow flood flows to pass safely along the existing river channel during the 2006/2007 wet season and to avoid adverse obstruction to floodplain flows should a large flood event occur. As part of construction planning and monitoring, the engineering designers will undertake flood modelling assessments to ensure that the scheduled partially completed works by the 2006/2007 wet season meet these objectives.

Small scale local drainage patterns (which do not hold water after rainfall events) will be affected during the bund construction. The Project Execution Plan will stipulate construction environmental management measures to include temporary drains (designed for 10 year ARI peak flows with non-scouring velocities) and temporary sediment traps (spillway capacity for 10 year ARI peak flows) to mitigate potential for adverse impacts from alterations to minor drainage patterns. All temporary drainage works will be monitored weekly and within 24 hours following 25 mm of rain or greater than 10 mm of rain in 10 minutes providing flooding conditions do not pose a significant safety hazard for access to works.

Temporary drainage works will be rehabilitated to blend with the finished landform and surrounding environment as soon as practicable.

D Farlam has stated that the materials to be used to construct the flood protection bund will leach metals and be eroded onto the river system and groundwater.

Geochemical test work on rock types proposed to be used in the flood protection bund has found that soluble (dissolved) metal concentrations were non-detectable in all water extract samples. In addition, all rock types to be used in the flood protection bund are non-acid forming (NAF) and will generate leachate with slightly alkaline pH and generally low salinity. Therefore, leachate derived from the flood protection bund will not contain metals in concentrations deleterious to the environment as these metals are not mobile under neutral conditions.

The flood protection bund will not be exposed to normal river flows. It will only be exposed to river flows in the event of a flood that is large enough to break the river banks and flow onto the floodplain (approximately a 1 in 5 year event). The outer layer of the bund will be a rockfill zone constructed from durable rock of a type and size that will be resistant to erosion from rainfall and flood velocities.

D Farlam has stated that placing a 1 m thick layer of durable rock material will be placed on the outer layer on the flood protection bund is likely to cause more erosion by creating more turbidity around the rocks.

As stated above, the flood protection bund will not be exposed to normal river flows. It will only be exposed to river flows in the event of a flood that is large enough to break the river banks and flow onto the floodplain (approximately a 1 in 5 year event). The outer layer of the bund will be a rockfill zone

constructed from durable rock of a type and size that will be resistant to erosion from rainfall and flood velocities. Modelling has shown that the velocities of flood flows around the bund will not be so high as to cause erosion.

D Farlam considers that waste material should not be stockpiled against the flood protection bund.

Any material placed against the flood protection bund will be placed on the inside of the bund and will not be exposed to flood flows. Furthermore, the only material placed in this location will be NAF and hence it will not generate any acidic runoff. Any sediment load in the runoff will be contained within the flood protection bund and will not be discharged to the surrounding environment.

5.2 Accommodation (4)

DHCS has stated that the construction camp and the existing permanent camp need to be registered as boarding houses in accordance with the Public Health Act and Regulations.

The existing MRM accommodation camp is registered under these regulations. Similarly, MRM intends to ensure the construction camp will be registered as boarding houses in accordance with the *Public Health Act* and Regulations.

DHCS has stated that the dry mess and wet mess of the permanent camp also need to be registered as food businesses under the Food Act 2004 and should comply with the requirements of the Food Act 2004 and Food Standards.

The dry mess and wet mess of the permanent camp are registered as food businesses under the Food Act 2004 and certificates of registration are on display. Annual inspections are carried out by the Health Department.

DHCS has stated that all building works must comply with NT Public Health Act and Regulations and the Building Code of Australia and be carried out to the satisfaction of the DHCS' Environmental Health Branch. Detailed plans, in relation to work proposed within the terms of the above legislation, must be submitted to DHCS Environmental Health Branch for assessment, prior to any works commencing.

MRM will ensure that all new building works will comply with *NT Public Health Act and Regulations* and the Building Code of Australia and be carried out to the satisfaction of the DHCS' Environmental Health Branch. Detailed plans, in relation to work proposed within the terms of the above legislation, will be submitted to DHCS Environmental Health Branch for assessment, prior to any works commencing.

5.3 Water Supply (4)

DCHS has stated that the potable water supply to the construction camp and the existing permanent camp must comply with the NH&MRC Australian Drinking Water Guidelines 1996. Bore setbacks to onsite wastewater disposal shall be in accordance with the Code of Practice for Small On-Site Sewage and Sullage Treatment Systems and the Disposal or Reuse of Sewage Effluent.

MRM's site potable water supplies comply with all statutory requirements of the NT Government. Under these requirements, water quality is checked daily. MRM agrees that any additional work on the potable water supply for the construction camp will be in accordance with the NH&MRC Australian Drinking Water Guidelines 1996.

5.4 Sewerage (4)

DCHS has stated that the package sewage treatment plant to be used in the construction camp must comply with the requirements of the Code of Practice for Small On-site Sewage and Sullage Treatment Systems and the Disposal and Reuse of Sewage Effluent.

MRM will ensure that the package sewage treatment plant to be used in the construction camp will comply with the requirements of the *Code of Practice for Small On-site Sewage and Sullage Treatment Systems and the Disposal and Reuse of Sewage Effluent*.

DCHS has stated that effluent from the package sewerage treatment plant should be disposed of in accordance with the Medical Entomology Branch guideline ‘The prevention of mosquito breeding in sewage treatment facilities’.

MRM agrees to incorporate the requirements of the Medical Entomology Branch guideline ‘*The prevention of mosquito breeding in sewage treatment facilities*’ when designing the effluent disposal system.

5.5 Roads (8)

DPI has noted that roads under its control affected by the proposal are the Carpentaria Highway, the mine access road intersection with the Highway, and the Bing Bong Road. DPI has commented that the EIS does not indicate any construction impacts on these roads as a result of the proposal. It notes that should any construction works impact on these roads, prior approval will be required from the Road Network Division of DPI.

Construction traffic will be mainly associated with the transport of earthworks equipment to and from the site at the beginning and end of the construction phase followed by the transport of construction materials, consumables and mining equipment during construction. As construction will occur over two dry seasons, some of the earthworks equipment may leave the site at the end of the first dry season and return at the beginning of the next.

The project’s original EIS in 1992 predicted an average of nine truck movements per day at the peak of the construction phase on the Carpentaria Highway from Daly Waters. As the construction of the open cut project will require less construction materials than the original mine construction which included the process plant and surface facilities, the average truck movements are estimated to be about six per day during the peak of the construction phase.

The existing annual average daily traffic volume on the Carpentaria Highway from Cape Crawford to Borroloola is approximately 60 vehicles per day of which approximately 9 are heavy vehicles. The impact of the project’s construction traffic will be to increase the existing average heavy traffic volumes to approximately 15 per day for a few months during the peak construction.

There will be minimal increase in light vehicle traffic during the construction phase as virtually all construction workers will be working under a fly-in/fly-out arrangement. There may be a small increase

in light vehicle traffic associated with any local residents employed on construction activities but this will not have any significant impact.

Should any construction works impact on these roads, prior approval will be sought from the Road Network Division of DPI.

DPI has noted that although recent road works on the Carpentaria Highway have reduced the potential for restrictions in some areas, load restrictions are likely to continue in extensive wet periods. Any strengthening works on the Carpentaria Highway and Bing Bong Road will be undertaken on a priority basis and the roads will continue to be subject to restrictions during wet periods.

As discussed in Section 4.4 of the draft EIS, the haulage rate on the Carpentaria Highway and Bing Bong Road will slightly decrease with the open cut project from 4,200 trips per year to 4,100 trips per year. The project's concentrate haulage schedule includes allowance for restrictions during wet periods.

MRM accepts that any strengthening works required will be undertaken by DPI on a priority basis.

DPI has noted that any subsequent proposed changes to the approved concentrate haul truck configuration will require a formal submission and subsequent approval.

MRM has no current plans to change the concentrate haul truck configuration. MRM acknowledges that any change would however, require a formal submission and subsequent approval.

DPI has noted that any required additional road strengthening as a result of increased loadings will require appropriate contributions from the proponent.

As discussed in Section 4.4 of the draft EIS, the loadings on the Carpentaria Highway and Bing Bong Road from concentrate haulage will slightly decrease with the open cut project as traffic volumes will reduce from the existing 4,200 trips per year to 4,100 trips per year.

5.6 Airstrip (2)

DPIFM has asked what are the estimates on increased flight activities during the construction phase.

The underground mine employed around 330 personnel. During the construction phase the maximum number of people employed on site with the Test Pit project and construction will be approximately 380. Working a 14-days-on/7-days-off roster, this equates to 20 people per crew, with one crew change per week. Only one additional flight per week over and above the levels required during the underground operations is required to transport the extra personnel. At the completion of the construction phase, the on-site workforce will reduce to 270 and the number of flights required will also reduce.

6.6 Overburden Emplacement Facility Location (3, 12, 14)

DNRETA has commented that the alternative northern, southern and western locations for the OEF are located over obvious drainage lines despite the draft EIS stating that watercourses are recognised as physical limitations to the selection of the OEF.

The presence of drainage lines was one of many factors taken into consideration when selecting the location of the overburden emplacement facility (OEF). While drainage lines are a consideration, their presence does not necessarily exclude the area as a potential OEF site. If a drainage line is present, alternative drainage arrangements (eg. new drainage channels, diversions) can be implemented if the site is to be used.

MARA note that there are eight OEF locations proposed over an extensive area around the mine, all located in the same floodplain that is inundated during flooding periods of the McArthur River. It has asked how can MRM guarantee that these mounds of acid forming sulfate waste will never leach into the catchment area in the long term future.

The eight OEF locations discussed in Section 6.6 of the draft EIS and shown on Figure 6.1 are alternative locations that were considered. Of those locations outside of the flood protection bund, only one will be used (Northern OEF).

Acid (at pH sufficient to impact on quality of receiving waters) will not leach from the OEF after rehabilitation because of the OEF design, rehabilitation trials and performance monitoring which are all intended to avoid production of acid leachate. The PAF pond will not be decommissioned until this objective is confirmed by water quality monitoring which will continue for as long as is necessary after the mine has closed. The detailed rehabilitation design will be developed using results from rehabilitation trials to ensure that this objective is achieved.

The Perimeter OEFs shown in Figure 6.6 that are located within the flood protection bund will be constructed of NAF/AC material only and hence there will be no potential for these OEFs to generate acidic runoff.

D Farlam has expressed concern that all the proposed/alternative OEF sites are close to water courses.

As discussed above, the proximity of water course does not necessarily exclude an area as a potential OEF site. If a drainage line is present, alternative drainage arrangements (eg. new drainage channels, diversions) can be implemented if the site is to be used. The OEF at the proposed location will be managed so that there will be no significant impact on the nearby watercourses.

6.12 Final Void (14)

D Farlam has stated that MRM should be able to give a definitive indication of the environmental impacts of the pit at the end of the mining operations.

Section 20.3.7 of the draft EIS provides an analysis of the environmental impacts of the four options considered for the pit at the end of the mining operations. The pit water quality resulting from the selected option will be similar to the background water quality of the river.

6.14 No Project (7)

ECNT has commented that there is no discussion of the environmental benefits of not proceeding with the open-cut project.

Should the open cut project not proceed, mining operations at McArthur River will cease. In that case all of the environmental impacts associated with the open cut project as described in the EIS will not occur. The mine would be closed in accordance with its Life of Mine Completion Plan (Section 20.3 of the EIS) with the objective of achieving long-term stability of the site and minimising off-site impacts.

7.2 Overburden Management – Open Cut Operations (2)

DPIFM has expressed concern regarding the identification of PAF as the only material requiring active management. It may be expected that NAF or even AC material will create neutral mine drainage with elevated sulphate and zinc levels if there is any mineralisation present at all. The material between the horizons may be expected to contain some minor amounts of metals.

DPIFM has asked for information on the following:

- *Control criteria on metals concentration in addition to sulfur.*
- *Action levels derived from NEPM guidelines for encapsulation should control criteria be exceeded as per the PAF material.*
- *Effective block modelling and appropriate positioning of material. This will also facilitate the diagnostic process if the waste dump's performance deviates from expectation and remedial measure required.*

All PAF materials will be encapsulated in the PAF cell within the OEF. The criteria for classifying materials as PAF will be based on their sulfur concentrations and NAG testing. Metal concentrations are not relevant in the identification of PAF.

The NAF and AC materials that will be used to construct the balance of the OEF will be categorised according to rock type as an indication of their suitability for use in the outside of the OEF. The rock types with lower metal concentrations will be used preferentially on the external OEF layers. These types will predominantly be W-Fold Shale, Teena Dolomite and Breccia in preference to the other NAF pyritic/dolomitic shale materials which may have higher metal concentrations.

Block modelling has been undertaken on the expected pit material that will report to the OEF. The block model will be updated as the project progresses and additional information becomes available.

Leach column testing will continue throughout the mine life to confirm waste rock characterisation and management strategies. The results from these tests will be used to further investigate the NAF material with a view to identifying the lowest risk material in terms of sodicity, salinity (low sulphur) and metal release, for the final lift and outer slopes.

7.2.1 Overburden Management Overview (1, 5, 7)

EPA has asked for clarification of the reasons for encapsulating potentially acid forming (PAF) material in the Stage 1 overburden emplacement facility (OEF) with 1m clay when only 0.6m encapsulation thickness is proposed for the Northern OEF.

The encapsulation of PAF materials at the Northern OEF has been developed using a “multiple lines of defence” strategy including:

- The thickness of NAF/AC materials overlying the PAF cell.
- The gradient to the outer surface of the OEF.
- The gradient to the PAF cell surface.

- The nature of the “barrier layer” above the PAF material. A 0.6 m thick compacted clay layer with a target permeability of 10^{-8} m/sec is considered to be acceptable.

The Test Pit OEF will have much less overlying NAF/NC material and hence there will not be as many “layers of defence” as there will be with the Northern OEF. To allow for this, an additional thickness (1 m) of the clay layer will be used for the Test Pit OEF.

MAGNT has stated that as there is potential for high acid-forming material to react, the overburden must remain separate from the outside environment with all safeguards. It considers that there is insufficient information as to how the overburden will behave. Further testing and modelling should be carried out before approval to proceed is granted.

The OEF will be designed and constructed to not leach acid, since potentially acid forming (PAF) material (11% of total waste mass) will be progressively encapsulated with clay within the centre of the OEF, surrounded by NAF and AC material (89% of total waste mass) and the OEF will be constructed to maximise water runoff. PAF material can only generate acid if it is exposed to oxidising conditions. Such conditions will be limited by the proposed progressive clay encapsulation of PAF materials, which will minimise the period of exposure time for PAF materials at the active face. While some degree of oxidation of PAF materials at the active face could occur, this is expected to be slow and the effects of oxidation will be mitigated by the surrounding NAF and AC material. This has been demonstrated through (ongoing) kinetic column leach testing on site and in laboratory experiments over a period of 26 months. Runoff from this face will not be discharged to the surrounding environment. It will flow to the PAF pond and then pumped to the water management dam at the TSF for reuse in the processing plant.

MAGNT has stated that a detailed rehabilitation strategy has not been developed. They are seeking reassurance that the OEF will be safe. It notes that sediment from the settling ponds can enter the creek.

Conceptual rehabilitation options / strategies have been developed for the OEF and MRM will prepare a detailed rehabilitation plan once operations begin. The plan will be designed to ensure that the rehabilitated OEF will be a stable self-sustaining landform with no downstream contamination from sediment or metals.

It would not be appropriate to prepare and “lock-in” a detailed rehabilitation strategy at this stage of the project. Current best practice across Australia and internationally (particularly in tropical climates) is to develop detailed rehabilitation plans with sound data and knowledge of performance characteristics of the relevant materials determined from site-specific rehabilitation trials. Detailed rehabilitation design for the OEF will be developed when conceptual strategies documented in the draft EIS and supporting studies have been confirmed with pilot rehabilitation trials.

Pilot rehabilitation trials will be undertaken when the OEF is sufficiently large and an appropriate mix of materials is available to trial the landform concept (particularly slope length, cover type, and durability) to evaluate erosion stability performance which is critical for sustainability of a rehabilitated OEF. This

approach recognises that erosion stability must be based on site-specific factors including climate, materials, hydrology, and vegetation. The erosion stability objective will be:

- Erosion is sufficiently self-limiting to prevent exposure of PAF materials;
- Sediment loads generated from erosion are sufficiently low such that there will be no appreciable impact on water quality in terms of total suspended solids, turbidity, and sediment bound contaminants;
- The land surface cover is sufficiently stable to support vegetation commensurate with the surrounding environment and/or defined vegetation type/density objectives of the rehabilitation criteria.

Results of pilot rehabilitation trials will be reported in statutory monitoring reports and the detailed rehabilitation design will be subject to approval through the Mine Management Plan process.

The detailed rehabilitation design will be defined by Year 7 of the project (or earlier if climatic conditions permit successful pilot trials) and updated as required during the mine life to be commensurate with best practice at the time.

ECNT notes that there are high metal concentrations present in the overburden rock types (arsenic, up to 800mg/kg; cadmium, up to 236 mg/kg; copper, up to 979 mg/kg; manganese, up to 15,700 mg/kg) and is concerned that these are all highly toxic materials.

Metals in overburden materials are commonly present at elevated concentrations. The enrichment of metals with respect to normal background concentrations is to be expected and reflects the natural geochemical enrichment that defines the mineral deposit. These metals are bound in with the overburden and are not readily available to mobilise into the environment. Metal solubility is strongly pH-dependent so that if overburden materials become acidic, leachate may contain elevated concentrations of dissolved metals. Testing has shown that soluble metal concentrations in runoff/seepage from the NAF/AC overburden will remain within ANZECC criteria for livestock drinking water under neutral or alkaline conditions.

The OEF has been designed to prevent the formation of acidic conditions by encapsulating all of the PAF materials in a clay cell. In this way oxygen and water, which are the two ingredients necessary before acidic conditions can develop, are excluded.

7.2.2 Geochemical Nature of Overburden (1, 2, 13)

EPA has asked if a procedure for waste rock management will be developed, which includes sampling, classification and handling of waste rock.

An operational methodology will be adopted for sampling, assaying and characterising the acid generating potential of waste rock during mining. The details of such a sampling program are under development, however are likely to include static testing of a 'suitable' number of samples from each blast. Information gathered from this process will be used to update the open pit block model.

DPIFM has recommended that a bench testing regime for ARD characteristics be the preferred characterisation option throughout the mining activities and that waste management plans detail management parameters, including sampling representation, number of samples per activity and cut-off criteria.

An operational methodology will be adopted for sampling, assaying and characterising the acid generating potential of waste rock during mining. The details of such a sampling program are under development, however are likely to include static testing of a 'suitable' number of samples from each blast. Information gathered from this process will be used to update the open pit block model.

DPIFM considers that the equation: acid producing potential (APP) minus ANC = NAPP is overly simplistic as it assumes that all of the neutralising ability is available, that it also will be available at the same rate that acid is produced, and that the neutralising material is homogeneously mixed with acid producing material. In the field none of these conditions generally occur.

The NAPP calculation is a standard calculation used in various forms worldwide to provide a 'first pass' indication of the potential for mine materials to generate acid. It is accepted that the NAPP calculation assumes that all of the neutralising capacity is available at the same rate as acid is produced and also assumes homogeneous mixing. However, it is also true that the NAPP calculation can overestimate the APP as total sulfur content is used in the calculation, which assumes that all sulfur is present as reactive sulfide. This is not the case at MRM where non-reactive sulfides (e.g. galena (PbS) and sphalerite (ZnS)) are also present, which are not acid producing. Hence, in this case, preliminary NAPP "screening" data were used in conjunction with NAG test and ongoing kinetic leach column test data to provide greater confidence in the accuracy of the data used to generate the initial open pit block model.

DPIFM has stated that if samples PAF & NAF have been done on the basis of the samples NAPP there is the possibility that the potential to produce acid under real conditions has been underestimated and it would be suggested that this is recognised in modelling and geochemical management.

To address the issue of geochemical characterisation using static NAPP and NAG test data alone, selected bulk samples of overburden underwent kinetic column leach tests to determine the actual availability and effectiveness of inherent neutralising material. The results of these tests are presented in the EIS and generally corroborate predictions made using the results of the static (NAPP and NAG) tests. The kinetic leach column tests are ongoing (both in the laboratory and on-site) and are reported internally to MRM on an annual basis. The column tests commenced in January 2003 and are expected to continue for a number of years.

DPIFM has asked for a copy of URS (2005a) Geochemical Assessment of Overburden and Tailings Material Including Conceptual Design of Overburden Emplacement Area.

URS (2005a) report was a stand-alone report generated as part of the environmental assessment. A copy of this will be forwarded to DPIFM. This report contains greater geochemical detail than presented in the EIS.

DPIFM has asked if kinetic testing of the waste rock been undertaken. If so how do the results compare with column leach testing?

Kinetic testing (which is the same as column leaching) has been undertaken and the results provided and discussed in the EIS and in URS (2005a).

NLC considers that the OEF will remain a long-term and significant point source for potential release of acid discharge (predominantly sulphuric acid) and hazardous substances (metals).

Acid generation (at pH sufficient to impact on quality of receiving waters) will be sufficiently reduced to ensure that there will be no acid drainage from the OEF after rehabilitation because the OEF design, rehabilitation trials and performance monitoring are all intended to avoid production of acid leachate. The PAF pond will not be decommissioned until this objective is confirmed by water quality monitoring which will continue for as long as is necessary after the mine has closed. The detailed rehabilitation design will be developed using results from rehabilitation trials to ensure that this objective is achieved.

7.2.3 Multi Element Nature of Overburden (1, 2, 7, 14)

EPA notes that the draft EIS concludes that the enrichment of some metals is simply a signature of natural mineralisation; however, no analysis of background geochemistry is provided to gauge the significance of elevated metals. The document says that background soil will be tested but infers that this is to assess any impacts that elevated metals may have on the success of establishing vegetation on the OEF.

MRM has committed to analysing background soil geochemistry in areas within and surrounding the proposed OEF. These data will be used to gauge the significance of any elevated metal concentrations, as a benchmark to measure any future changes in metal concentrations, and for assessing the potential constraints to successful revegetation.

EPA notes that there is no plan presented for what material will be used on the outer zones of the OEF. The W-fold shale & Teena Dolomite are described as most suitable geochemically, however these only comprise 8% of the waste rock and therefore may not be sufficient to cover the facility. The breccias are described as physically suitable and generally NAF but may be difficult to selectively handle. No geochemistry is presented for the breccias.

Conceptual outer batter treatments for the OEF have been developed for two options, as described in Figure 7.5 in the EIS as:

- Fine grained, non competent waste rock – this would include the W-fold shales and Teena Dolomite; and,
- Coarse graded, hard, durable waste rock – this would include the dolomitic breccia material that is present in layers up to 5m thick in some areas of the proposed open pit, which could be selectively mined.

Breccia within the lower pyritic shales has not been modelled as a separate geological domain and work is continuing to quantify the extent of the resource that may be available.

Geochemically, the information available indicates that the breccias are likely to be NAF, however may contain concentrations of some metals (Cd, Mn, Pb and Zn) that exceed ANZECC (1992) Environmental Investigation Level guideline concentrations. All samples with a predominantly breccia matrix are within NEPM (1999b) health-based investigation level guideline concentrations.

Shallow breccia material analysed as part of the diversion testwork also contained elevated Cd, Mn, Pb and Zn concentrations. Leachate from this breccia was below relevant ANZECC (2000) and NEPM (1999a) guideline levels. Therefore, the concentration of soluble metals in breccia from the lower pyritic shale may also be low, although this is yet to be tested and confirmed.

URS (2005a) provides greater geochemical detail than presented in the EIS, including geochemical information for the breccias. A copy of this will be forwarded to EPA.

Confirmation sampling of waste rock on the outer batters of the OEF will be conducted on an annual basis to confirm that the placement of material is being completed in accordance with design requirements.

EPA states that there are contradictory statements in the Leach Column Testing section that runoff/seepage may exceed and then will remain within livestock drinking water quality criteria.

The statement ‘*may exceed*’ is in reference to individual waste rock materials from each column, particularly Mn and SO₄. The statement ‘*will remain within*’ applies to the seepage from the OEF as a whole, but should read ‘*is likely to remain within*’ rather than ‘*will remain within*’.

The final paragraph should now read “The tests showed that soluble metals in runoff/seepage from overburden materials are likely to remain within ANZECC (2000) /NEPM (1999a) concentration guidelines criteria for livestock drinking water under neutral or alkaline pH conditions.”

EPA asks why the livestock category is used and not ANZECC levels of protection.

ANZECC (2000) provides criteria for both livestock drinking and aquatic ecosystems. Livestock drinking water criteria were used because the aquatic ecosystem objectives are more applicable as receiving water quality criteria. Nevertheless, runoff from the PAF side of the OEF will be managed so that there will be no discharge to receiving waters. As this water will be retained and reused on site, its compliance with either livestock or aquatic ecosystem objectives is not particularly relevant. Should there be an emergency discharge in an extreme storm event, the massive dilution would not result in measurable impact on contaminant concentrations downstream.

EPA has asked what are the implications of elevated metals and salinity for on-site and downstream environments and how will these be managed.

There will be no on-site “environments” or beneficial uses (other than mine water reuse) for waters within the defined water management system (containment dams and transfer systems) requiring water quality control for protection of environmental values and beneficial uses. Water quality implications for mine water recycling will be managed by monitoring and performance assessment. A wide range of water quality variations can be accommodated within the processing plant. Any pH control that is necessary will be managed by dosing with limestone.

The defined water management system will be designed to prevent discharge from the PAF pond at the OEF to receiving waters in downstream environments in all but extreme rainfall conditions. Regular monitoring of the system will be undertaken to assess the actual performance versus the design predictions and upgrades to the system will be carried out, if required. The probability of a discharge in extreme events will be very low and will be managed with regular risk assessments using OPSIM or equivalent modelling (refer Section 12.9.1 of the EIS) updated as necessary to reflect site conditions and water management system capacity during the mine life. With a low probability of a discharge (the PAF pond will be designed for 1 in 100 maximum probability of overflow), the small discharge quantity in such conditions, and the massive dilution that would be available (due to relative catchment size and flows in receiving waters), there will be no measurable impact on the quality of receiving waters from the discharge. With additional water quality and flow monitoring data obtained over the next three years, MRM will develop the salt/contaminant balance capabilities of the OPSIM modelling such that the quality of extremely rare discharges and impact on the receiving waters can be more accurately quantified.

DPIFM has asked if there is a breakdown of speciation in each of the geological formations to validate the statement that W-fold Shale and Teena Dolomite are “most suitable for outer wall construction”

Yes. This information is provided in URS (2005). A copy of this report will be forwarded to DPIFM.

DPIFM has asked for a discussion of the consequences should the leachate from the OEF turn acidic.

Static and kinetic leach column testing of NAF materials from the OEF indicates that these materials are pH neutral and, based on recent ongoing kinetic leach column results (October 2005) will remain pH neutral and generate excess alkalinity.

PAF material represents 11% of the total volume of the OEF and will be progressively clay encapsulated and surrounded by NAF and AC material. Therefore, leachate from the OEF will be overwhelmingly dominated by the geochemistry of the NAF and AC material and is unlikely to be acidic. Kinetic leach column testing to date indicates that when PAF material is combined with AC material, the pH remains neutral. If the leachate from the OEF was to become acidic then soluble metals concentrations in the leachate could increase. However, as stated, the likelihood of the OEF generating acidic leachate is extremely low. In any event, in line with the “multiple lines of defence” approach, any leachate from PAF material that is generated will flow to the PAF pond and be reused in the processing plant. It will not be discharged to the environment.

ECNT has asked if most of the samples whose analysis results are given in Table 7.3 of the draft EIS were towards the higher end of the range or the lower end.

The range of concentration values for metals in overburden materials, including average and median concentrations, are presented in the table below (Modified from Table 3.5, URS 2005a). The results indicate that median metal concentration in the overburden can be greater than ANZECC guideline criteria, but are generally below the NEPM guideline criteria. The main exceptions are median concentrations of As and Pb in Upper Pyritic Shale and Mn in W-Fold Shale and Teena Dolomite, which are marginally greater than the NEPM guideline concentration.

Rock Type	Statistical Criteria	As	Cd	Cu	Mn	Pb	Zn
		Concentration (mg/kg)					
Upper Pyritic Shale (36 samples)	Median	240	5.72	100	579	789	3,650
	Average	246	5.63	100	603	763	3,848
	Range	101 to 461	2.66 to 9.79	100 to 100	409 to 1,030	268 to 1,620	2,020 to 7,140
Lower Pyritic Shale + Bituminous Shale (285 + 24 samples)	Median	186	4.44	100	1,300	510	2,710
	Average	217	10.5	105	1,422	997	5,771
	Range	4.7 to 800	0.06 to 236	100 to 469	421 to 4,860	100 to 11,510	100 to 108,800
Lower Dolomitic Shale (50 samples)	Median	114	3.37	100	1,990	380	1,895
	Average	153	13.9	177	2,906	1,920	6,908
	Range	10.4 to 721	0.04 to 106	100 to 979	581 to 11,610	100 to 13,300	100 to 54,000
W-Fold Shale (231 samples)	Median	4.90	0.02	100	3,240	100	100
	Average	12.0	0.17	100	3,849	120	199
	Range	0.3 to 220	0.005 to 16.9	100 to 100	143 to 15,700	100 to 1,220	100 to 10,900
Teena Dolomite (30 samples)	Median	5.95	0.04	100	3,890	100	100
	Average	9.89	0.11	100	3,729	110	117
	Range	1.7 to 64	0.005 to 1.35	100 to 100	2,350 to 5,070	100 to 397	100 to 599
ANZECC ¹ Guideline Concentration		20	3	60	500	300	200
NEPM ² Guideline Concentration		200	40	2,000	3,000	600	14,000
Notes:							
1. Australian and New Zealand Environment and Conservation Council (ANZECC): National Health and Medical Research Council (NHMRC). Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites. January 1992 (Environmental Soil Quality Guidelines).							
2. National Environmental Protection (Assessment of Site Contamination) Measure (NEPM). Guideline on Investigation Levels for Soil and Groundwater. December 1999.							

ECNT is concerned that the effect of elevated metal concentrations in potential outer cover materials will have on rehabilitation of the OEF is not known and will require field trials.

MRM has committed to undertake a wide range of rehabilitation field trials to be undertaken over an extended period of time once adequate volumes of the relevant material are available for testing. The results of the field trials to be undertaken during the initial years of the open cut operations will then be available in subsequent years when the external face of the OEF is being developed. This long-term approach to rehabilitation trials is preferred to specifying cover materials during the design stage when fewer data are available.

D Farlam has stated that the metal concentrations in the OEF will be higher than the environmental standards and there is a great risk that the PAF material will leach into the river system and groundwater.

Multi-element tests indicate that some metals are commonly present in most overburden rock types at concentrations above guideline levels. The enrichment of these elements with respect to normal background concentrations is to be expected and simply reflects the natural geochemical enrichment that

defines a mineral deposit. These metals are bound in with the overburden and are not readily available to mobilise into the environment. Metal solubility is strongly pH dependent. Because a decrease in pH can significantly increase the solubility of these metals, the OEF has been designed to encapsulate the PAF materials that are capable of decreasing pH levels. In this way metals will not be mobilised and will not leach into the river system or the groundwater.

D Farlam has stated that the EIS does not adequately describe how much PAF material is expected to be exposed and whether there is enough NAF material to cover it and at what intervals.

As discussed in Section 7.2.2 of the draft EIS, 89% (162 million tonnes) of the overburden material will be NAF and only 11% (21 million tonnes) will be PAF. There will be more than enough NAF material available to encapsulate the PAF.

The clay lining on top of the active PAF cell will be placed on a continuous basis. As PAF material is placed and the active dumping face advances, the clay cover over the top of the PAF cell will also advance. In this way the only exposed PAF surface at any one time will be the active dumping face. Any drainage from this face will flow to the PAF pond and be retained on site.

D Farlam has stated that water naturally backs up into the PAF area and will settle there during a flood event.

The OEF has been designed so the water will drain away from the PAF area. It will not back up in this area. The bottom of the lowest PAF cell will be above the 1 in 100 year ARI flood level.

7.2.4 Overburden Emplacement Facility (1, 2, 3, 4, 6, 7, 13, 14)

EPA has asked what is the long term management plan for seepage from the OEFs, particularly the PAF pond.

The strategy for management of seepage from the OEF comprises a “multiple lines of defence” strategy that includes:

- Constructing a landform that reduces surface ponding.
- Utilising the wearing surface across each lift of the OEF to limit water ingress within the OEF and to divert water to the outer batter slopes, away from the PAF cell.
- Covering the clay encapsulated PAF cell with NAF/AC material.
- Constructing a low permeability clay layer around the PAF cell to limit infiltration.
- Providing a low permeability layer at the base of the PAF cell to reduce infiltration to the natural ground and to divert potential seepage to the PAF pond.
- The PAF pond will also incorporate a low permeability cut off below the containment bund to reduce seepage flows

During operation of the mine, seepage that is collected in the PAF pond will be monitored to measure both quality and quantity of seepage. Seepage collected in the PAF pond will be pumped to the water management dam at the TSF for subsequent reuse in the process plant. For low seepage flows, evaporation is expected to limit the stored volume of seepage. Groundwater monitoring of the areas surrounding the OEF will be undertaken to measure potential impacts from any OEF seepage. If monitoring detects seepage, measures will be implemented to reduce the seepage impacts such as pumping the seepage back to the PAF pond and pumping from there to the TSF on a more regular basis.

The results of the monitoring undertaken during the mine life will be used to design the closure strategy for the OEF. If necessary the need for a low permeability surface cover to reduce infiltration into the OEF could be considered. The monitoring program will be maintained for as long as is necessary to determine that there is no ongoing seepage from the OEF detrimentally affecting groundwater quality.

EPA has asked if the clay cap over the PAF cell will overlap the outer edges of the PAF cell walls to minimise the potential for rainfall seepage infiltration.

When the PAF cell is completed, the clay cap will overlap the PAF cell walls to minimise the potential for rainfall infiltration to contact PAF materials

EPA notes that mining surfaces on each lift of the OEF will direct any infiltration to the edges and that depending on the waste material used on the outer layers of the OEF, an outer bund may be constructed on each of the lifts. EPA has asked if any modelling work has been done on this waste rock dump design as they consider that in the long term the outer bunds are likely to fill with sediment and eventually overtop and fail. It has asked if there is any evidence that this design will be stable in the long term.

The concept of constructing bunds (or contours banks) to manage surface runoff at regular slope intervals has been proven in erosion control works extensively for agricultural land use and for mine rehabilitation where bunds have been properly designed and constructed. The potential for bunds to fill up with sediment and eventually overtop or fail is critically linked to success of rehabilitation revegetation cover. As such the risk cannot be modelled until monitoring data are obtained from pilot rehabilitation trials to evaluate optimum rehabilitation design relative to site specific conditions. From these pilot trials and assessments, the bunds or alternative surface water “drainage” strategies consistent with best practice will be designed to achieve erosion stability objectives.

When rehabilitation works are implemented, including the construction of surface water management systems and planting of vegetation, a monitoring and maintenance plan will be implemented. A key feature of this plan will be to demonstrate that vegetation has successfully been established over the OEF surface and that regular maintenance is undertaken to ensure that the designed surface water management system is functional. This would include desilting of drains, if required. As time elapses and the vegetation establishes and increases in density, the maintenance requirements for the drainage system diminish until a sustainable system is in place. Annual monitoring reports will be prepared to demonstrate that this has been achieved.

DPIFM has asked if the engineered rock chute would have a beneficial effect below the completed lifts of OEF during the operational phase. This gives an opportunity to test the performance of such structures, helps reduce the infiltration and eventually less environmental impact both in terms of contamination and erosion control. Performance of rock chutes at other NT mining operations for surface water control, suggest sides should be graded in rock size when abutting top layer material to minimise remedial management activities.

Rock chutes will be tested as part of rehabilitation trials and used strategically for erosion and sediment control during the operational phase when the OEF is being constructed. Grading of the rock size will be considered one of several critical factors for the success of rock chutes. The OEF strategy recognises the failures of past practices using “simple” rock engineered “drains” without due recognition of the additional erosion forces on steep slopes that should require engineered “chutes” which are based on more advanced engineering principles. Specific design measures such as bedding layers and geofabric under the rock chutes will be considered to protect the underlying substrate from erosive forces of flows down the chutes.

DPIFM has asked how thick the base layer of the OEF is. It suggests that even with a permeability of 10^{-8} m/sec (permeability is usually in cm/sec) this is meaningless if the base layer is only 1.5 cm thick. Evidence suggests that if a low permeability layer is required, permeabilities in the range 1×10^{-7} cm/s would be required. DPIFM suggests a better indicator would be to use nett percolation which is the result of thickness and permeability and has meaning.

The base treatment of the OEF includes:

- Stripping of surface vegetation and topsoil.
- Grading of the surface to eliminate isolated depressions and to provide a gradient to divert seepage flows.
- The base material will be scarified, moisture conditioned and compacted to achieve a target permeability of 10^{-8} m/sec. This treatment has been specified to a depth of 150 mm. However improvement in the soil is expected to a depth of at least 300 mm.
- Site investigation indicates that the natural subgrade soils comprise very stiff to hard clay soils (some alluvium) that grade to weathered rock at depth.

While permeability values of 10^{-9} m/sec (10^{-7} cm/s) as suggested by DPIFM are used in constructing engineered liners to landfills and similar structures as a “low permeability” layer, this requirement must be considered in the context of the overall design measures in place. The initial layer of rockfill placed across the OEF base will have a reasonably high permeability, possible two to three orders of magnitude greater than the base layer of the OEF. Therefore minimal head of seepage/ infiltration water is expected to pond above the base layer which should minimise infiltration to the natural soils below. Additional effort to improve the foundation soils beyond a target permeability of 10^{-8} m/sec is considered to be unwarranted.

DNRETA has asked that the OEF and flood protection bund be revegetated with the same range of species that is common in the existing low rises and river levees in the area and not just grasses.

The appropriate revegetation species mix and density for the OEF will be determined from pilot trials and take account of water quality monitoring data. This is will include trees and shrubs as well as grasses.

It is not appropriate to establish vegetation on the flood protection bund as the integrity of the bund for flood protection of the mine can be comprised by deep rooted vegetation. It is common best practice in Australia not to plant trees and shrubs on flood protection levees. For mine closure, revegetation of the bund may be considered if compatible with the final detailed closure strategy for the open cut.

DCHS has stated that the ponds for the collection of surface water and seepage from the OEF should be constructed in accordance with Section 1 of the Medical Entomology Branch guideline ‘Guidelines for Preventing Mosquito Breeding Sites associated with Mining Sites’.

All water collection ponds will be designed in accordance with the ‘Guidelines for Preventing Mosquito Breeding Sites associated with Mining Sites’ within the constraints that prevention of discharge to receiving waters remains the primary objective of the OEF PAF pond.

DCHS has asked that before the commencement of each wet season, the internal area of each collection pond could be slashed and burnt (if vegetation is present), to remove nutrient loads that could encourage mosquito breeding when the ponds flood. Any overflow points from the collection ponds would require erosion protection.

All stormwater collection ponds will be kept clear of vegetation to discourage mosquito breeding. All overflow points will be provided with erosion protection.

DCHS notes that the surface profiling on the top of the OEF will allow rainfall from small rain events to be captured and utilised to sustain vegetation. The captured water should not be allowed to pool for periods greater than five consecutive days, to prevent mosquito breeding.

The surface drainage of the OEF will be designed to prevent the long-term (greater than 5 days) storage of water. The OEF surface will be designed to shed most runoff to prevent increased seepage.

AFANT has stated that the lowest level that PAF cells are placed in the OEF should be above the 1 in 500 year flood level to ensure the integrity of the clay encapsulation. Also, the lower levels of the OEF should be constructed in such a way that they cannot be undermined by floodwaters over time. The storage of PAF must be done in such a way that it will be contained on site indefinitely ensuring no acid run off into the McArthur River in the future.

The base of the OEF PAF cell will be above the 1 in 100 year flood level (40 m AHD). For more extreme 1 in 500 year flood events, design flood hydrographs show that the flood inundation above 40 m AHD could occur for up to 60 hours before floodwaters recede below 40 m AHD. The target permeability of the PAF cell clay barrier is 10^{-8} m/s, and with 60 hours of exposure to floodwater in a 1 in 500 year event

the maximum penetration of floodwater infiltration into the clay barrier will be 2 mm (assuming rapid infiltration through the outer NAF/AC layers to the PAF cell barrier. This potential degree of penetration represents approximately 3% of the total barrier thickness (0.6 m) and hence the hazard from 1 in 500 year flood events in terms of penetration into the PAF cell is minimal. On this basis, there is no need to raise the base of the PAF Cell to above the 1 in 100 year flood level.

Flood modelling has determined that flood velocities immediately adjacent to the OEF are sufficiently low such that there is practically no risk of undermining in flood events.

The objective of the OEF design particularly the PAF cell and drainage system is to prevent acid runoff into receiving waters.

ECNT has asked about the concentrations of soluble metals in runoff/seepage from overburden materials under acid conditions.

Static and kinetic leach column testing of NAF/AC materials indicates that these materials are pH neutral and, based on recent ongoing long-term kinetic leach column results (October, 2005) will remain pH neutral and generate excess alkalinity.

PAF material represents a small proportion (11%) of the overburden material and will be clay encapsulated and surrounded by NAF/AC material in the OEF. Therefore, leachate from the OEF will be overwhelmingly dominated by the geochemistry of the NAF and AC material and is unlikely to be acidic. Kinetic leach column testing to date indicates that when PAF material is combined with NAF/AC material, the pH remains neutral. If the leachate from the OEF was to become acidic then metals concentrations in leachate could increase, however, as stated, the likelihood of the OEF generating acidic leachate is extremely low. In any event, in line with the “multiple lines of defence” approach to the OEF design, any potentially acidic leachate that is generated will flow to the PAF pond and be reused in the processing plant.

ECNT states that infiltration could saturate and ultimately penetrate the clay surround to the PAF cell within the western zone of the OEF. However, MRM admits to being unsure yet of the actual permeability characteristics of the clay.

The OEF design is intended to minimise water and oxygen penetration into the PAF cell and subsequently limit the risk of any contact with PAF materials. The clay protection barrier of the PAF cell will inevitably absorb moisture (up to a natural moisture content) but the passage of “flow” under saturated conditions through the clay to PAF materials (the ultimate determinant of potential for acidic seepage) will be minimal due to the relatively lower permeability of alternative more efficient flowpaths around the PAF cell. Furthermore, having the material being saturated is the most effective means of reducing oxygen diffusion.

While there is some uncertainty as to the actual permeability characteristics of the side walls of the PAF cell, additional thickness of clay material has been incorporated into the design. A program of laboratory testing will be undertaken during the detailed design phase to assess the permeability of the PAF wall cell

material. This will be supplemented by field trials to confirm the target permeability values have been met.

ECNT notes that whilst the PAF pond is designed to exclude a 1 in 100 year ARI flood, the pond will have an emergency spillway to discharge excess water in extreme rainfall conditions (which will go straight into Surprise Creek). It notes that the size of pond is not shown on Figure 7.3.

The crest level of the PAF pond spillway will be above the 100 year ARI flood level. The size of the pond will vary over the mine life relative to the size of the OEF and associated “dirty” water catchments. The pond size will always be based on maintaining the defined overflow risk objective and be determined from regular and up-to-date overflow risk assessment using the OPSIM mine water balance modelling.

Should the PAF pond overflow it would most likely occur during a 1 in 100 year ARI flood or greater. In this case the discharge would be into the passing flood flow which would be spread over the flood plain rather than into Surprise Creek.

ECNT notes that the draft EIS says that runoff from the surface of the OEF will encounter NAF and PAF materials and therefore should be of acceptable quality to be released into the environment. It presumes this is meant to say that runoff will encounter NAF/AC materials.

The draft EIS contained a typographical error and, as pointed out by ECNT, the first bullet point on p7-10 should refer to NAF/AC materials not NAF/PAF materials.

ECNT has asked how much water from the OEF will eventually end up in Barney Creek and will there be elevated heavy metal concentrations in the water. If so, what will the long term and downstream impacts be?

During operation and rehabilitation implementation, practically no water from the PAF zone of the OEF will reach Barney Creek because it will be captured in the PAF pond. When rehabilitation is completed and the quality of OEF runoff is acceptable for discharge, the PAF pond will be decommissioned and the runoff will discharge to Barney Creek.

Runoff from the NAF zone is not expected to contain concentrations of heavy metals which would exceed the relevant guideline values, and sediment will be removed in sediment ponds before pond overflow discharge reaches receiving waters. Once rehabilitation of the OEF is complete and the sediment load in runoff reduced due to surface stabilisation and revegetation, the sediment ponds will be decommissioned and the runoff will discharge to Barney Creek.

The long-term downstream water quality impacts would be minimal.

ECNT has stated that it is unacceptable that Section 7 of the EIS does not discuss the problem of ongoing acid leaching once the OEF has been rehabilitated.

Acid (at pH sufficient to impact on quality of receiving waters) will not leach from the OEF after rehabilitation because the OEF design, rehabilitation trials and performance monitoring are all intended to avoid production of acid leachate. The PAF pond will not be decommissioned until this objective is confirmed by water quality monitoring. The detailed rehabilitation design will be developed using results from rehabilitation trials to ensure that this objective is achieved.

NLC considers that long-term landscape stability does not appear to have been addressed by the draft EIS. It considers that despite plans to encapsulate potentially acid forming materials inside benign clays, continued erosion of the OEF would ultimately leave them exposed to the atmosphere and could result in significant contaminant and acid drainage into surrounding watercourses.

The PAF cells within the OEF will be covered by a minimum of 20 m of NAF/AC material which will be covered with an outer layer of sound, hard durable waste rock. Geochemical testing indicates that the W-fold Shale and Teena Dolomite overburden materials will be the most suitable for forming the outer layers of the OEF. The OEF will be engineered to ensure its long-term stability and resistance to erosion.

Pilot rehabilitation trials will be undertaken when the OEF is sufficiently large and an appropriate mix of materials is available to trial the landform concept (particularly slope length, cover type, and durability) to evaluate erosion stability performance which is critical for sustainability of the rehabilitated OEF. This approach recognises that erosion stability must be based on site-specific factors including climate, materials, hydrology, and vegetation. The erosion stability objective will be:

- Erosion is sufficiently self-limiting to prevent exposure of PAF materials;
- Sediment loads generated from erosion are sufficiently low such that there will be no appreciable impact on water quality in terms of total suspended solids, turbidity, and sediment bound contaminants; and
- The land surface cover is sufficiently stable to support vegetation commensurate with the surrounding environment and/or defined vegetation type/density objectives of the rehabilitation criteria.

The detailed rehabilitation design will be defined by Year 7 of the project (or earlier if climatic conditions permit successful pilot trials) and updated as required during the mine life to be commensurate with best practice at the time.

D Farlam has expressed concern that runoff from the OEF could leach minerals into Barney and Surprise Creeks and the McArthur River particularly during floods. He suggests that the OEF be moved as far away from water courses as possible.

The design of the OEF incorporates a “multiple lines of defence” strategy so that metals will not leach into the downstream drainage system. This strategy includes:

- Constructing a landform that reduces surface ponding.

-
- Utilising the wearing surface across each lift of the OEF to limit water ingress within the OEF and to divert water to the outer batter slopes, away from the PAF cell.
 - Covering the clay encapsulated PAF cell with NAF/AC material.
 - Constructing a low permeability clay layer around the PAF cell to limit infiltration.
 - Providing a low permeability layer at the base of the PAF cell to reduce infiltration to the natural ground and to divert potential seepage to the PAF pond.
 - The PAF pond will also incorporate a low permeability cut off below the containment bund to reduce seepage flows

During operation of the mine, seepage that is collected in the PAF pond will be monitored to measure both quality and quantity of seepage. Seepage collected in the PAF pond will be pumped to the water management dam at the TSF for subsequent reuse in the process plant. Groundwater monitoring of the areas surrounding the OEF will be undertaken to measure potential impacts from any OEF seepage. If monitoring detects seepage, measures will be implemented to reduce the seepage impacts such as pumping the seepage back to the PAF pond and pumping from there to the TSF on a more regular basis.

To limit the risk during floods the base of the OEF PAF cell will be above the 1 in 100 year flood level. In addition, flood modelling has determined that flood velocities immediately adjacent to the OEF are sufficiently low such that there is practically no risk of undermining in flood events.

7.2.6 In-Pit Overburden Emplacement Facility (6)

AFANT has stated that the handling of overburden and PAF material in the in-pit OEFs is not detailed. How are the two in-pit OEFs constructed, how is PAF to be stored in them and what happens to them when the pit is decommissioned and the main bund is breached?

The dumping of PAF material in the pit would only occur towards the end of the mine life when the final pit depth had been reached. At this stage all runoff from the PAF material would remain at the bottom of the pit and would not flow to the surrounding environment. This water would be reused in the processing plant. Any seepage would be collected by the pit dewatering system and pumped back into the site water management system.

When the pit is decommissioned, the PAF dumps will be flooded and remain permanently inundated (excluded from contact with air) and hence the potential to generate acid will be mitigated.

7.3.2 Tailings Decant management (2, 13)

DPIFM noted that Figure 7.7 was not included in the EIS as referenced and would provide useful information on the current structure of the tailings dam.

A copy of Figure 7.7 included on the following page.



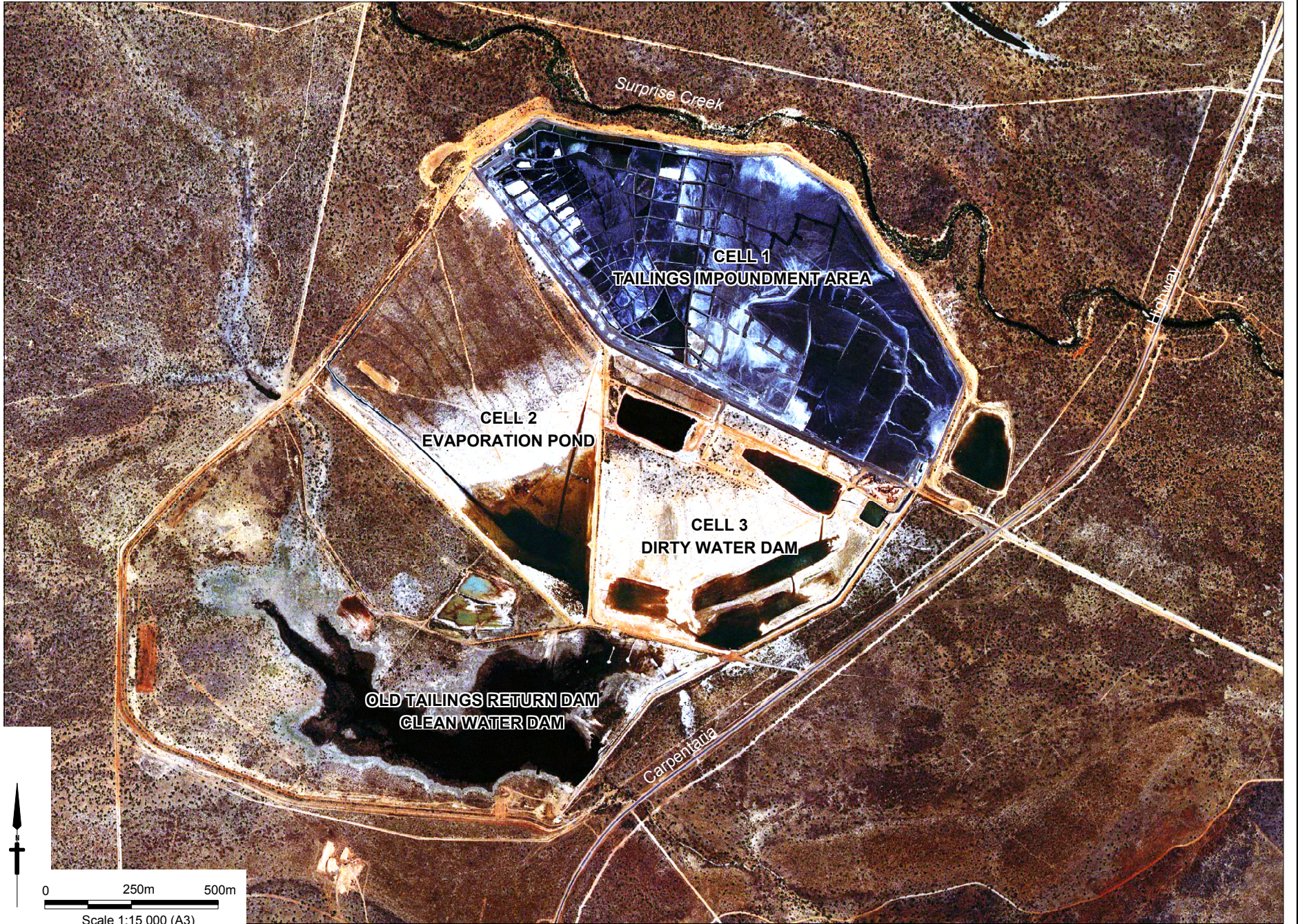
MCARTHUR RIVER MINE
OPEN CUT PROJECT
ENVIRONMENTAL IMPACT STATEMENT

Drawn: VH | Approved: CMP | Date: 12-07-05
Job No: 42625552 | File No: 42625552-9-041.wor

LAYOUT OF EXISTING
TAILINGS STORAGE FACILITY

Figure: 7.7

Rev: A
A4



NLC has raised concerns about the consolidation of tailings in the TSF. They consider the use of sub-aerial deposition may result in the development of inconsistent tailings density making it prone to localised subsidence in the future.

Consolidation of the deposited tailings will be an ongoing process during the operation of the TSF as the height of tailings placed in the TSF increases. Long term consolidation of the tailings is also expected. While some localised variation in tailings density could occur, this is not expected to generate local “subsidence” of the tailings surface.

Long-term settlement of the tailings will be a function of the depth of tailings, the strength of the tailings materials, and the rate of dissipation of pore pressures within the tailings. While long-term settlement of the tailings will generate deformation of the final landform surface, this has been allowed for in the design and is not expected to impact on the overall stability of the TSF.

NLC considers that subsidence may be a problem during periods when upstream lifts of the TSF are required. The draft EIS is considered to be unclear about how MRM intends to ensure that upstream lift walls do not sink or become distorted during their construction should subsidence occur.

Upstream lifting of tailings dams is an industry recognised approach that minimises the use of embankment materials. Testing of the placed tailings beach will be undertaken to confirm that adequate tailings strength has been obtained to enable the upstream embankment to be constructed.

In the unlikely event that the tailings beach has insufficient strength, then an alternative approach, such as the use of a downstream lift, would be considered. The downstream lift would be supported by the natural foundation downstream of the existing embankment and would not rely on the tailings for support.

NLC has asked for an indication of what protective covering is to be applied to the 10 m gap on the tailings surface between the successive embankments during upstream lifts to prevent erosion or loss of fines to the atmosphere.

The 10 m gap between successive embankments provides benefits to the management and performance of the tailings dam in that it:

- Allows for collection of seepage flows, if present.
- Reduces the hydraulic gradient to the outer slopes of the TSF, which improves the overall stability of the outer batters. This is also a benefit for the long-term landform.

During operation of the TSF, the 10 m gap is expected to be generally in a moist condition. However if dust generation becomes a problem, then a seal of clay or similar material could be placed across the surface.

In the long term, the gap between the successive embankments will be rehabilitated as per the outer surface of the TSF. Progressive rehabilitation of the outer batters to the TSF, including providing a surface water management system, will reduce the generation of dust and erosion from these outer slopes.

7.3.3 Tailings Characterisation (2, 7, 13)

DPIFM has asked that because of the acid forming nature uncertainty and increasing NAPP values, are there contingencies/ management plans should the materials trend towards PAF status.

Surface Water

The TSF will be managed as part of the site water balance, and runoff from the TSF will be contained within the water management system. To protect against any possible deterioration in water quality in TSF runoff, the TSF water management system has been designed to contain extreme rainfall conditions up to 1 in 500 years which minimises the risk of a spill to the environment.

Seepage Flows

Control measures will be implemented to manage seepage from the TSF and these measures are described in Section 7.0 of the Draft EIS. Seepage from the TSF is monitored through a series of groundwater bores adjacent to the TSF. The dolomitic siltstone foundation underlying the TSF is expected to provide significant neutralising capacity reducing pH levels in any seepage. However, given that the vast majority of the tailings will be stored under fully saturated conditions during operations, oxygen will be excluded from the bulk of the tailings materials and sulfide oxidation will be limited to near surface unsaturated materials. Hence, it is not expected that seepage from the TSF will be acidic during operations. The tailings also contain a significant neutralising capacity that will further mitigate any acid generation from near surface materials during operations.

Upon decommissioning, the TSF will be covered by a low permeability layer to:

- Reduce the potential for acid generation from oxidation of the tailings;
- Minimise the inflow of water into the tailings and hence reduce the amount of water available to seep into the surrounding environment; and
- Stabilise the surface of the TSF.

DIPFM has asked for a definition of 'significant period of time' in the statement 'Inhibit the onset of acid conditions for a significant period of time' as this implies that at some stage it is expected that there will be acid generated.

The geochemical testing undertaken to date indicates that some of the near surface tailings materials in the existing TSF have the potential to generate acid if exposed to unsaturated (oxidising) conditions. However the inherent acid neutralising capacity (ANC) of the tailings is likely to inhibit the onset of acid conditions for a significant period of time and certainly beyond life of mine, given the proposed operational management strategy for the TSF (*i.e.* the majority of the tailings will remain in a saturated condition). Hence, it is extremely unlikely that sulfide oxidation will be sufficient to lower the pH of the tailings during operations. Any acid generated by sulfide oxidation should be neutralised by the inherent available ANC of the tailings. Additionally, surface runoff from near surface tailings will be captured in the TSF water management system and recycled to the process plant.

Post-operation, the TSF cover system will inhibit the interaction of incident rainfall with underlying tailing materials, limiting the exposure of tailings materials to oxidising conditions and preventing capillary rise and evapo-concentration of salts.

The test work indicates that metals will be present in the leachate at elevated levels compared to drinking water guidelines. DPIFM has asked that as this may seep into a freshwater ecosystem, seepage management issues need to be examined more closely.

Seepage issues at the TSF have been closely examined.

Seepage from the existing TSF has been identified and a remedial program is currently underway. This program includes the installation of a geopolymer barrier wall around the perimeter of Cell 1 fronting Surprise Creek so that seepage is reduced. The effectiveness of this program will be confirmed by monitoring. Should further seepage be identified it is proposed to extract the seepage via a network of recovery bores so that the seepage does not reach any freshwater ecosystems.

Modelling has been undertaken for the expanded TSF to indicate the potential extent of seepage that could occur and to develop appropriate management strategies. Alternative control measures considered included the provision of a 1 m thick compact clay layer beneath the tailings as well as the installation of a network of recovery bores. Modelling demonstrated that recovery bores are the most effective means of seepage control. By recovering any seepage and returning it to the TSF, the movement of seepage to any freshwater ecosystems can be avoided.

DPIFM has asked how does the conclusion that at neutral pH most metals will remain within drinking water guidelines reconcile with Appendix G, where column leach test results indicate increasing metal levels with time.

The kinetic column leach test results reported in Appendix G of the EIS are for representative overburden materials analysed under unsaturated conditions with periodic flushing. There are no results presented in Appendix G for tailing materials. Details on tailing material testing are provided in a separate report (URS, 2005). As previously mentioned, a copy of this report will be forwarded to DPIFM.

ECNT has noted that tests on near-surface tailing samples at the TSF indicate that some near-surface tailing materials are likely to be PAF if exposed to oxidising conditions for a significant period of time. Table 7.6 in the EIS shows a high concentration of arsenic in the existing tailings - also lead, manganese and zinc. Leachate may contain elevated soluble levels of cadmium, manganese, lead and SO₄.

Some near-surface tailing materials may be PAF if unsaturated and exposed to oxidising conditions, However, such materials are contained within the TSF. All runoff water from the near-surface materials reports to the TSF water management dam and is recycled back to the process plant. This water management system has been designed to contain extreme rainfall conditions up to 1 in 500 years which minimises the risk of a spill to the environment.

NLC considers that the TSF will remain as a long-term and significant point source for potential discharge of the hazardous substances.

Any long-term seepage from the TSF will be managed by a long-term system of recovery bores designed to intercept any seepage from the base of the TSF. This system will operate for as long as is necessary after mine closure to ensure that sufficient seepage water has been removed from the TSF so that no further surface expressions would occur.

NLC states that once the pH drops to a value close to 6 or increases above 8, hazardous species (such as As, Cd, Pb and Zn) rapidly become more mobile in solution. It considers that the need to create and operate management strategies capable of maintaining water quality within this pH range would pose a challenge to this project.

It is because of the potential for pH values to affect the availability of hazardous species that MRM has designed the proposed waste storage and water management strategies specifically to manage this issue.

Waste that has the potential to lower pH in runoff water will be encapsulated in a clay cell within the OEF so that it does not come into contact with either seepage water or oxygen so that acidic runoff or seepage is not generated. To provide a further safeguard, if acidic runoff does occur, it will be collected and retained within the site's water management system for reused in the process plant. It will not be discharged.

The management of PAF waste and the site's water management system will be key components of MRM's environmental management system for the open cut operation.

7.3.4 Seepage (5, 7, 14)

MAGNT has asked, in the light of the seepage from the existing TSF, why have remedial bores not been installed as it considers that to be best practice.

Seepage from the existing TSF has been identified and a remedial program is currently underway. MRM has worked to eliminate seepage in a number of ways, including a trial involving injecting geopolymer fill along 750 m of the most affected area. The results of this trial were successful. On this basis, a \$2 million project to apply this treatment to the 1.5 km perimeter of Cell 1 fronting Surprise Creek was recently completed. The effectiveness of this program will be confirmed by monitoring. Should further seepage be identified, it is proposed to extract the seepage via a network of recovery bores.

Recovery bores are however proposed to be used for the extension of the TSF.

ECNT has noted that seepage was discovered in Surprise Creek adjacent to the TSF. It also notes that there are also significant areas of surface soils containing permeable sands and gravels and that the underlying siltstone is also relatively permeable and containing karst features.

It is because of the nature of the underlying ground conditions that seepage controls are proposed for the expanded TSF. The nature of the soils has been incorporated into the seepage model and their

permeability characteristics have been allowed for in the estimated possible future seepage rates. The proposed network of recovery bores will be designed to accommodate the seepage expected as a result of the in-situ conditions.

D Farlam has stated that the existing TSF is not adequate as it is leaking into Surprise Creek and that the success of the geopolymer barrier sued to contain seepage is yet to be shown.

As discussed above in the response to MAGNT the trial involving injecting geopolymer fill along part of the perimeter of the existing TSF was successful. On this basis, a \$2 million project to apply this treatment to the balance of the perimeter of Cell 1 fronting Surprise Creek was recently completed. The effectiveness of this program will be confirmed by monitoring. Should further seepage be identified, it is proposed to extract the seepage via a network of recovery bores.

7.3.5 Groundwater Quality (7)

ECNT has noted that there is evidence of elevated salinity levels and soluble sulfate concentrations in seepage from the existing TSF and that some metal concentrations in seepage/groundwater can be greater than ANZECC water quality guideline criteria for fresh water ecosystems.

As discussed above, it is because of this seepage that the current program for the installation of a geopolymer barrier wall around the perimeter of Cell 1 facing Surprise Creek is being implemented. This program has been designed to reduce the extent of seepage from the TSF. The effectiveness of this program will be confirmed by monitoring. Should further seepage be identified, it is proposed to extract the seepage via a network of recovery bores.

7.3.6 Cell 1 Closure Strategy (2, 7)

DPIFM has asked what is the target design for the Cell 1 cover ie. 100-200, 500yrs.

All TSF covers will be designed with an objective of “permanent” sustainability – not a specific limited design life.

ECNT has asked how much water is likely to run into Surprise Creek from the rehabilitated surface of Cell 1 and what the likely environmental impacts are. It also asked why this water will not be contained within the Water Management System.

The TSF covers will be designed so that runoff will not contact tailings materials that could contaminate runoff. Sediment loads from cover runoff will be reduced by the vegetation established on the rehabilitated surface of the TSF and the settling that will occur as runoff collects at the toe of the tailings slope around the perimeter of the cell. Once the sediment load has reduced, this runoff will be suitable for discharge without any significant environmental impacts.

The quantity of runoff to Surprise Creek will depend on the size of the relevant rainfall event.

TSF runoff quality will be monitored to confirm suitability for discharge to receiving waters and if unsuitable, the water management system will be adapted to capture the Cell 1 runoff. In this case the cover rehabilitation will be improved until acceptable runoff quality is achieved.

7.4.2 Tailings Disposal Method (13)

NLC considers that the single most important terrestrial impact related to the project arises from deposition of aerial transported dusts from around the TSF and that this is poorly addressed in the EIS. It states that dust generated from dried tailings should be considered highly toxic and represents a serious risk in the short to medium-term. It is concerned that wind blown dust from the surface of the TSF will not be controlled as maintaining adequate moisture levels will be difficult to achieve. It suggests it would be better to store the tailings under water.

Storing water across the surface of the tailings dam is not a desirable management practice for the following reasons:

- The placement of tailings would be sub-aqueous, not sub-aerial, which would reduce the density of the tailings and require additional tailings storage volume. This would require either a greater TSF footprint or an increase in the height of the TSF.
- Because of the lower density, the strength of the placed tailings beach is likely to be lower which could impact the ability to undertake upstream lifts.
- Storing water across the TSF is likely to increase the seepage from the TSF.
- Tailings dam embankments are typically not designed for storing water for extended periods.

The high in-situ moisture content of the placed tailings layers is the primary means of mitigating dust generation at the TSF. In addition, the fine nature of the tailings has been observed to form a thin crust across the tailings beach that will also help reduce the potential for dust generation. Should dust generation become a problem during operation of the tailings beach, the perimeter spigotted discharge system will allow for more regular tailings placement to selected areas of the tailings beach where dusting is a problem.

7.4.3 Design of Tailings Storage Facility (1, 6, 7)

EPA has asked if there will be monitoring undertaken of the TSF capping to make sure this is meeting expected performance and that post-closure seepage recovery is not significantly longer than 30 years.

Post-closure monitoring at the TSF will include the effectiveness of the surface rehabilitation and revegetation to ensure that no erosion of the cover material is occurring and that the vegetation is becoming established. Any areas identified as not meeting the agreed closure standards will be rectified as necessary. In addition, the quality of the runoff water from the rehabilitated TSF surface will be monitored to ensure that it is suitable for discharge. If it is not, the runoff water will be discharged to the pit void until such time as additional rehabilitation is undertaken at the TSF to improve runoff quality.

Based on the current modelling results, the post-closure seepage recovery is expected to be approximately 30 years. By that time it is expected that most of the seepage water will have been removed from the TSF and the cover treatment will have prevented the entry of additional water.

EPA has expressed concern that the disposal of tailings into the new cells could exacerbate seepage into Surprise Creek as the additional seepage may push the plume further in this direction and possibly widen the plume. The potential impacts and management of this should be considered.

MRM is aware of the potential for additional seepage generated by the expanded TSF. It is for this reason that a network of monitoring and recovery bores is proposed around the perimeter of the expanded TSF. The modelling indicates that any seepage that does occur will be downgradient towards the southern side of the TSF (away from Surprise Creek).

It is expected that any seepage to the north (towards Surprise Creek) will be intercepted by the geopolymer barrier around the perimeter of Cell 1. This will be confirmed by the monitoring bores in that area. If seepage to Surprise Creek does occur, the network of recovery bores will be extended to intercept it.

AFANT has some particular concerns about a possible escape of materials from the TSF. It is concerned that the outer tailings containment embankment will be at a level below the level of the upper lifts of tailings. It is not clear to AFANT if it has been designed with the weight of a number of lifts of tailings taken into account.

The TSF design of using upstream embankment lifts has taken account the weight of the number of lifts and strength of the in-situ tailings (with appropriate safety factors as defined in ANCOLD guidelines). A stability analysis was undertaken to confirm the geotechnical suitability of the proposed design. Stability modelling was carried out using the General Limit Equilibrium method which calculates a factor of safety against slope failure based on moment and force equilibrium. Slope stability analyses were completed using the SLOPE/W computer package with the Bishop Simplified method of analysis selected. The design included detailed consideration of all relevant parameters including material characteristics, hydrostatic conditions and seismic effects. The analysis results indicated that the adopted embankment configuration will be stable.

AFANT is concerned that there may not be sufficient freeboard at the top of the outer TSF cell embankments. The outer embankments will be built to RL 56 m but the top lifts of tailings will be as high as RL 68 m. This will leave only a relatively small area between the embankments and the bottom of the first tailings lifts to contain any rainfall run off.

The area between the outer embankment and the first upstream lift embankment is relatively small and will only need to accommodate the relatively small amount of rainfall that falls directly on it. This area will be provided with sufficient freeboard (between the top of the tailings and the top of the downstream embankment) to contain the runoff. Each embankment will be designed to discharge the runoff via a rock chute into the water management dam.

AFANT is concerned about heavy rainfall events. Although the TSF is located above a 1 in 500 flood level it has only been designed to cope with a 1 in 200 year wet season rainfall. An emergency spillway is to be put in place at crest level RL 55 m in TSF Cell 2 with an overflow at RL 54.5 m to allow Cell 1 to run into Cell 2 and thus utilise the spillway. AFANT is concerned that this spillway discharges into Surprise Creek (and into the McArthur River).

All runoff from rainfall falling onto the operational TSF cells will drain to and be captured in the mine water management system. The water management system will be designed such that spillway discharge from the TSF will be extremely unlikely (1 in 500 year probability) which is more stringent than ANCOLD guideline requirements which require containment for 1 in 200 year wet season rainfall. Hence, the possibility of discharges from the TSF to Surprise Creek will be extremely rare and in excess of the 1 in 500 year probability.

AFANT considers that the TSF should not be able to discharge to the river or wider environment under any circumstances and that some method needs to be found to retain the tailings on site under all but the most drastic conditions.

Tailings will be retained in the TSF and will not be discharged. Runoff from the TSF will be contained in the site's water management system and the possibility of the runoff discharging to Surprise Creek will be extremely rare and limited to extreme rainfall conditions (1 in 500 years).

The design of the TSF spillway is to incorporate the probable maximum flood on the highest pond level in a normal year; or the worst wet season on record less water returned to plant, plus 100-year average recurrence interval (ARI) storm plus waves. ECNT has asked why are there two design condition options given. Which one is MRM more likely to adopt? It is not entirely clear to ECNT how often Cell 2 water will spill into Surprise Creek.

The TSF spillway will be designed for the probable maximum flood with a very conservative assumption of initial storage level at spillway level and will take account of the joint-probability of concurrent waves.

The design standard for preventing discharges from the TSF to Surprise Creek will be a 1 in 500 year risk of discharge. In practical terms this means there will be no discharge to Surprise Creek in all but extremely drastic rainfall conditions.

The TSF will have only one emergency overflow spillway to external areas (from the water management dam) which is required to protect the integrity of the TSF in extreme flood conditions. Therefore if there is an overflow from the TSF it would occur from the existing discharge point for which MRM currently holds a licence. This discharge would not be directly into Surprise Creek.

All other TSF cells will have internal emergency spillways (with PMF design capacity).

7.4.7 Seepage Analysis (3, 5, 7, 13, 14)

DNRETA has raised concerns about the long-term seepage or erosion of the TSF. It suggests that the impact of various future scenarios be modelled to identify the risks, the resulting environmental impacts and management options.

Seepage from the existing and future TSF has been modelled considering a best case and worst case scenario and reported in Section 7.0 of the Draft EIS. Modelling of a range of seepage control measures was also undertaken. Key outcomes from this work are summarised as follows:

- Elevated groundwater levels are expected to develop under the TSF and seepage will express at the ground surface at the downstream toe of the perimeter embankment. The time for the seepage to express at the surface is dependent upon the sub-surface conditions and could be less than four years.
- As further lifts are added to the TSF, the area downgradient of the perimeter embankment that is impacted by the elevated groundwater levels will increase.
- The provision of a series of recovery bores along the downstream toe of the perimeter embankment prevents the surface groundwater levels from extending beyond the line of the recovery bores. However elevated groundwater levels will occur directly under the TSF footprint and the perimeter bund. The dewatering bores are equally as effective for either the best-case or worst-case sub-surface conditions.

The surface of the TSF will be rehabilitated to prevent erosion of the surface. The surface will be rehabilitated as follows:

- Re-profiling the surface to ensure incident rainfall runs off the TSF rather than seeps into the tailings.
- Placement of a capillary layer over the re-profiled surface to limit the capillary rise of salts into the cover layer.
- Placement of a low permeability cover over the capillary layer to prevent the oxidation of tailings, minimise the potential for seepage into the tailings, to stabilise the surface, and to provide a medium for vegetation growth.

Runoff from the rehabilitated surface will pass through sediment ponds until the revegetation has become established and reduces the sediment load in the runoff to the extent that the monitoring results demonstrate that the sediment ponds are no longer required. At that time the sediment ponds will be decommissioned.

MAGNT has asked for a statement that MRM will be responsible for running and maintaining the recovery bores at the TSF for at least 30 years after the mine has closed.

MRM will be responsible for managing any seepage from the TSF for as long as it occurs. Ongoing monitoring of groundwater bores will provide evidence of seepage and monitoring will continue whilst seepage is being detected.

ECNT is concerned that environmentally damaging seepage into surrounding creek and river systems will occur again with the new, expanded TSF. These concerns are based on the fact that the existing TSF is seeping and the groundwater recovery bores for the expanded TSF may need to be operated for 30 years or longer after decommissioning.

The footprint of the TSF is not expanding and will remain within the footprint established when the mine was approved in 1992. Seepage from the TSF will be managed as described above so that it will not cause environmental damage to the surrounding creek and river system.

NLC has stated that there is a risk from the encapsulation of PAF material in seemingly impermeable clays as the clay ultimately becomes saturated and permits transport of contaminants to groundwater aquifers which may express themselves in the McArthur River or Barney and Surprise Creeks.

The defensive design measures incorporated into the encapsulation of PAF materials have been developed as a “multiple lines of defence” strategy to minimise the risk of seepage. While clay encapsulation is one of the measures used to control seepage, other measures include the thickness of the surrounding NAF/AC material and the gradient of the final outer surface which is designed to shed runoff.

Kinetic column leach testwork over 26 months, and continuing, has shown that NAF materials and combined NAF/PAF materials produce leachate with neutral pH and low concentrations of metals. If it did occur, seepage from the OEF is expected to be pH neutral and contain concentrations of metals below the applied guideline values. In addition, the low permeability bedrock allows further water-rock interaction processes to take place during relatively long groundwater residence times between the OEF and the nearest groundwater receptors, such as Surprise Creek, McArthur River or Barney Creek.

D Farlam has stated that the new TSF has not been engineered to prevent seepage.

The management of seepage from the new TSF has been incorporated into its design. Modelling has shown that seepage from the TSF can be contained by the installation of a network of recovery bores downstream of the TSF. In this way there seepage will not flow to the downstream environment.

7.4.8 TSF Closure (1, 6)

EPA has asked how long will seepage from the TSF be pumped into the mine pit void after the plant is closed and what will be the power source.

As stated in the draft EIS, modelling has indicated that seepage will need to be pumped into the pit void for approximately 30 years. The exact length of time can only be confirmed by the monitoring that will be undertaken during that period.

As discussed in the draft EIS, the operation of the recovery bores for the period following site closure when power is no longer readily available will be undertaken using alternate energy sources that could include either solar or wind powered pumps. The groundwater monitoring data collected during the operation of the TSF will be used to evaluate which system is most suitable. The recovery well system will be designed to have a much greater pumping capacity than theoretically required and it may be

acceptable to have intermittent pumping from the bores particularly as the volume of seepage flows reduces with time. Monitoring of the performance of the recovery bores using alternate power sources will be undertaken to confirm that satisfactory performance can be provided.

AFANT has asked how long will MRM maintain the seepage recovery bores after mine decommissioning.

Modelling has indicated that seepage from the TSF could last for 30 years or longer. The seepage recovery system will be maintained by MRM for as long as is necessary to ensure that no further surface expression of seepage occurs.

AFANT has asked who will monitor seepage and ensure no polluted run off in the future.

Prior to the mine decommissioning, MRM will prepare a closure plan which will be approved by the NT Government. This plan will include strategies to ensure that the TSF seepage recovery system will be maintained for as long as is necessary to ensure that there will be no further surface expression of seepage. The plan will specify details of the ongoing management of the system.

7.5.2 Waste Management Strategies (2, 7)

DPIFM has noted that waste jet fuel is utilised in the cleaning of workshop floors and has asked if this waste water/fuel then reports to a collection point for cleaning purposes or does it report to the pollution pond through surface runoff.

Jet fuel is not used to clean the workshop floors. Small quantities are used for cleaning parts and equipment. The waste fuel from this cleaning process is disposed of with the site's waste oil.

ECNT has asked which section of the TSF will be used for the disposal of contaminated waste. Is MRM going to continue to use the area in the south-east of the TSF? What will the effects of this contaminated waste be on seepage water, or on any water that spills into Surprise Creek during extreme rainfall events?

The location currently used at the TSF for the disposal of contaminated waste will continue to be used until the capacity of the existing TSF is reached. After that, a location in Cell 1 will be used.

No effects from the disposal of contaminated waste on seepage have been detected to date. The tailings provide an ideal low permeability encasement for the contaminated wastes and no effects on TSF seepage or runoff water are expected.

7.5.3 On-Site Waste Management (2, 4)

DPIFM have noted that contaminated waste buried in TSF will include waste oils, xanthate, laboratory wastes and sewerage sludge. .DPIFM has asked for summary details on site procedure ENV SOP 0054 for management of waste disposal areas.

MRM's Waste Management Plan is attached in Appendix D. This plan is currently being reviewed and will be updated by December 2005.

DPIFM has asked if the TSF seepage monitoring program includes parameters appropriate for the contaminated materials which are disposed of there.

The TSF seepage monitoring program has been developed by MRM site personnel and approved by the NT Government as part of the annual Mining Management Plan process. The TSF seepage monitoring program will continue to monitor elements present in tailing materials which could potentially mobilise into seepage. The parameters included in the monitoring program are listed in Table 11.1 of the EIS.

Currently there are two main disposal methods on site, the trench method and area fill method. DPIFM has asked what wastes are disposed of by the trench method.

Putrescible wastes are disposed in a trench which is located at the southern end of the clean water dam. Waste is disposed on a daily basis and is burnt to reduce scavaging from birds, dingoes and feral cats.

DHCS has recommended that solid waste disposal comply with the Department of Infrastructure, Planning & Environment's Guidelines for the Siting, Design & Management of Solid Waste Disposal Sites in the NT.

Solid waste disposal on site currently complies with the Department of Infrastructure, Planning & Environment's Guidelines for the Siting, Design & Management of Solid Waste Disposal Sites in the NT. All future solid waste disposal will also comply.

7.5.5 Asbestos (4)

DCHS has stated that the removal and disposal of asbestos products must also comply with the Work Health (Occupational Health and Safety) Regulations.

Any removal and disposal of asbestos wastes at the site will comply with the *Work Health (Occupational Health and Safety) Regulations*.

7.6 Construction Waste (2)

DPIFM has asked how will construction wastes segregation be encouraged i.e. use of different coloured bins, education etc.

It will be a requirement of the construction contract that the contractor ensures that construction wastes are segregated in accordance with the requirements of the construction waste management plan. The means by which this is to be done will left to the discretion of the contractor who will select the most appropriate combination of measures suitable for the situation. While it is not possible to specify which measures will be used at this stage, it is envisaged that a combination of measures such as different coloured bins, education and others will be employed. MRM will be responsible for ensuring that construction wastes are segregated.

8.1.3 Extreme Events (7)

ECNT has stated that there is no discussion of the possible implications of climate change on extreme events.

Section 12.9.1 of the draft EIS includes a discussion on the implications of climate change on the site's water management system.

Research literature reports that Greenhouse effects on climate change are generally expected to cause a change in wet season rainfall in tropical Australia. It is not possible at this time to estimate the potential changes in the intensity of rainfall events, effects on rainfall event sequences (both inter-seasonal and inter-annual), typical wet season rainfall, evaporation, and the combined effects of these factors on runoff and floods. All of these factors (particularly rainfall event sequences), together with the capacities of the water management infrastructure are critical to the performance of the proposed MRM expansion water management system.

The recent report “*Climate Change in the Northern Territory*” prepared for NT Department of Infrastructure, Planning and Environment (Henessay et al), provides some indication of future climate change based on current best available climate modeling predictions. Although the predictions in this report are not sufficient at this stage to evaluate water management system performance for future climate change, some report findings suggest that climate change will likely produce a beneficial effect for water management required for the open cut project. The report suggests that average rainfall is likely to decrease by up to 20% and average evaporation is likely to increase by up to 100 mm/year (3%). Both these factors would reduce the potential to accumulate excessive mine water and reduce the probability of overflow from the proposed water management system.

8.4.1 McArthur River Mine (2, 7, 13)

DPIFM has asked for validation of the statement that dust monitoring sites D13 and D23 were selected “as typical sites to represent areas downwind of the tailings storage facility and process areas respectively”.

Figure 8.1 of the draft EIS shows that dry season winds are predominantly from the south-east. Most of the dust impacts are expected during the dry season. Sites D23 and D13 are generally downwind of the process areas and the TSF during the predominant dry season winds.

The dust deposition results measured at D13 and D23 are representative of dust deposition in the area if compared to dust deposition measured at all other locations. For example:

- Deposition results from D6, D7, D12 and D15 are similar to those presented for D13 (TSF).
- Deposition results from D24 and D22 are similar to those presented for D23 (process areas).

Dust deposition from sites D1 to D23 are given in Appendix F.

There are elevated levels of lead and zinc concentrations in soils at some sites close to Barney Hill. ECNT has stated that as no background data have been collected at these sites, it is not possible to say whether it is due to dust deposition. It has asked for more information.

Section 8.4.1 of the draft EIS states “However, no background data were collected at these sites, thus it is not possible to confirm whether the metals in soil are from natural sources or are the result of dust fallout from mining operations”.

As no background data are available, the objective is to measure the change in the concentrations of lead and zinc in soil as a function of time. If a change in the lead and zinc concentration in soils is detected, dust deposition from the change in mine operations is a possible source. Consequently MRM plans to monitor metal concentrations in soils surrounding the TSF and OEF on an annual basis.

NLC has noted that the air quality data in Figures 8.3 and 8.4 contain data up to 2002 thus precluding a comprehensive appraisal of existing environmental impacts in the period 2002 to 2005.

Where available, the data for the period 2002 to 2005 has been included in updated dust deposition graphs. These updated graphs are given in Appendix F.

8.5 Emissions from Open Cut Operations (1)

EPA has stated that the appendices do not contain any of the details of the air quality modelling undertaken.

All model input files are presented in the Appendix H. Output files have not been printed due to their length (typically greater than 100 pages per model run) but are available electronically if required.

EPA has requested that, rather than directing the reader to the National Pollutant Inventory, the proponent specifies each of the current emissions from the site and compares them to projected emissions from construction and ongoing operations.

Table 8.3 of the draft EIS shows the estimated fugitive emissions inventory for the open cut operations. In this table, emissions are compared to MRM’s existing emissions from the National Pollutant Inventory (NPI) web site (www.npi.gov.au). The NPI does not differentiate the source of emissions by process area, but rather the total of each substance emitted.

To respond to the EPA request, an estimate of the construction emissions is required. Such an estimate has been made based on the following assumptions:

- Construction activities will occur primarily over two dry seasons. Therefore the net construction time is likely to be approximately one year in the aggregate.
- The existing power station continues operation as normal during construction operations.
- That test-pit operations continue during the construction period. Currently the mine has ceased underground mining.

- Approximately 20 million tonnes of material is expected to be removed from the test pit (consisting of both overburden and ore).
- On average, there will be approximately 50% more vehicles used during construction than were on site during the 2003/2004 reporting period.

The following tables provide the estimated emissions from the open cut operations (presented in the draft EIS), the emissions for the existing underground operations (2003/2004 NPI report), and the estimate of construction emissions based on the above assumptions. Power station emissions are also included.

PM₁₀ Emissions (kg/yr) for the Open Cut Operations, Existing Operations and Construction Phase

PM ₁₀	Open Cut Operations	Existing Underground Operations	Construction Phase
Stack Sources	17,502	17,502	17,502
Wind Erosion of Exposed Areas	24,946	32,755	24,946
Drilling & Blasting	9,787	-	9,787
Un/Loading Pit, ROM, Waste Dump	46,870	-	46,870
Primary & Secondary Crushing	2,188	3,330	2,188
Stockpiles, Plant Handling	5,400	4,830	5,400
Haul Roads	75,925	34,923	52,385
Vehicles	11,803	10,767	16,151
Total	194,422	104,107	175,229

Zinc Emissions (kg/yr) for the Open Cut Operations, Existing Operations and Construction Phase

Zinc	Open Cut Operations	Existing Underground Operations	Construction Phase
Stack Sources	1	1	1
Wind Erosion of Exposed Areas	1,587	417	1,587
Drilling & Blasting	1,036	-	1,036
Un/Loading Pit, ROM, Waste Dump	342	-	342
Primary & Secondary Crushing	1,665	1,093	1,665
Stockpiles, Plant Handling	1,125	2,060	1,125
Haul Roads	79	10	15
Vehicles	-	-	-
Total	5,834	3,580	5,770

Lead Emissions (kg/yr) for the Open Cut Operations, Existing Operations and Construction Phase

Lead	Open Cut Operations	Existing Underground Operations	Construction Phase
Stack Sources	0	0	0
Wind Erosion of Exposed Areas	410	94	410
Drilling & Blasting	448	-	448
Un/Loading Pit, ROM, Waste Dump	136	-	136
Primary & Secondary Crushing	729	463	729
Stockpiles, Plant Handling	492	714	492
Haul Roads	12	4	6
Vehicles	-	-	-
Total	2,226	1,274	2,220

NO_x Emissions (kg/yr) for the Open Cut Operations, Existing Operations and Construction Phase

NO _x	Open Cut Operations	Existing Underground Operations	Construction Phase
Stack Sources	440,198	440,198	440,198
Wind Erosion of Exposed Areas	-	-	-
Drilling & Blasting	-	-	-
Un/Loading Pit, ROM, Waste Dump	-	-	-
Primary & Secondary Crushing	-	-	-
Stockpiles, Plant Handling	-	-	-
Haul Roads	-	-	-
Vehicles	176,744	143,584	215,376
Total	616,943	583,782	655,574

CO Emissions (kg/yr) for the Open Cut Operations, Existing Operations and Construction Phase

CO	Open Cut Operations	Existing Underground Operations	Construction Phase
Stack Sources	100,630	100,630	100,630
Wind Erosion of Exposed Areas	-	-	-
Drilling & Blasting	-	-	-
Un/Loading Pit, ROM, Waste	-	-	-

CO	Open Cut Operations	Existing Underground Operations	Construction Phase
Dump			
Primary & Secondary Crushing	-	-	-
Stockpiles, Plant Handling	-	-	-
Haul Roads	-	-	-
Vehicles	73,831	49,164	73,746
Total	174,461	149,794	174,376

SO₂ Emissions (kg/yr) for the Open Cut Operations, Existing Operations and Construction Phase

SO ₂	Open Cut Operations	Existing Underground Operations	Construction Phase
Stack Sources	4,037	4,037	4,037
Wind Erosion of Exposed Areas	-	-	-
Drilling & Blasting	-	-	-
Un/Loading Pit, ROM, Waste Dump	-	-	-
Primary & Secondary Crushing	-	-	-
Stockpiles, Plant Handling	-	-	-
Haul Roads	-	-	-
Vehicles	18,376	10,905	16,358
Total	22,413	14,942	20,395

VOC Emissions (kg/yr) for the Open Cut Operations, Existing Operations and Construction Phase

VOCs	Open Cut Operations	Existing Underground Operations	Construction Phase
Stack Sources	21,980	21,980	21,980
Wind Erosion of Exposed Areas	-		-
Drilling & Blasting	-		-
Un/Loading Pit, ROM, Waste Dump	-		-
Primary & Secondary Crushing	-		-
Stockpiles, Plant Handling	-		-
Haul Roads	-		-
Vehicles	10,113	14,138	21,207
Total	32,093	36,118	43,187

8.5.1 Fugitive Emissions (7)

ECNT has noted that 176,919 kg/annum of Total Suspended Particulates from the open cut operations will be less than 10 microns, compared to 87,000 kg/annum currently. Lead emissions will be 2,226 kg/annum, an increase of 926 kg/annum from current operations. It considers this to be an excessive increase.

The MRM operations are changing from an underground mine to an open cut mine and this is the primary reason for the increase in dust emissions. With the open cut mine there will be a significant increase in the area of disturbed land from the mining operation and also from the development of the OEF. The area of disturbed land is one of the significant factors contributing to total suspended particulate emissions.

These emissions have been estimated using the approved emission estimation techniques from the National Pollutant Inventory and are typical for an open cut operation of this type.

Fugitive dust generation will be managed by the implementation of the following controls:

- Dust control equipment will be installed on all major plant and equipment generating significant point sources of dust. The conveyor belts will be covered to minimise dust emissions.
- Water sprays will be used (as required) across work zones and unsealed areas to suppress dust. The water will be applied by water cart across ground surfaces whenever the surface has the potential to generate excessive levels of dust. Ore and rock, after firing, will be watered down.
- Other exposed surfaces and stockpiles will also be watered or sprayed as required.
- Any long-term stockpiles will be stabilised using fast-seeding, locally common grass species. Exposed areas will be minimised through progressive rehabilitation as soon as practicable.
- All major haul roads will be regularly watered and vehicle speeds on unsealed roads will be controlled to minimise dust.
- Spray systems will be installed at the new primary crusher and crushed ore stockpile.

8.9.2 PM₁₀ and PM_{2.5} (1)

EPA has stated that despite modelling having been undertaken for dust, modelling for smaller particulate matter such as PM₁₀ and PM_{2.5} should also be considered.

Dispersion of PM₁₀ and PM_{2.5} was modelled as described in the draft EIS in Section 8.9.2 and Table 8.10. Contours of maximum 24 hour and annual PM₁₀ concentrations are shown on Figure 8.7 of the draft EIS. The predicted concentrations are all well below the assessment criteria.

The lead and zinc component of the suspended particulates is described in Sections 8.9.6 and 8.9.7 and shown in Figure 8.9.

EPA has asked for details on the duration and design of the dust monitoring program. Lead monitoring should be undertaken in accordance with AS2800-2005.

The existing dust deposition monitoring program will be reviewed prior to the commencement of the open cut operations to determine appropriate monitoring locations in light of the proposed changes in site activities. The dust collected will continue to be analysed for lead and zinc concentrations.

A high-volume sampler (HiVol) will be installed at the eastern side of the mine camp to monitor for ambient concentrations of suspended particulates. The monitoring will be undertaken in accordance with Australian Standards AS/NZS 3580.9.6:2003, AS/NZS 3580.10.1:2003 or AS3580.9.7:1990. The filters collected from the sampler will be analysed for lead and zinc content to provide suitable data on emissions. AS/NZS 2800-2005 refers to the method used to analyse the HiVol filter paper for lead and this will be adhered to (if scientifically appropriate given the limitations expressed in the standard) for lead analysis.

8.9.6 Lead (1)

In view of the peak concentrations of lead in the vicinity of the McArthur River, EPA considers that the proponent should consider the impacts of high concentrations of lead as particulate matter entering the river system should a change in wind direction occur.

Figure 8.9 of the draft EIS shows the maximum annual average lead concentration from the mine operations. Because this is an annual calculation, the contribution of all wind directions has been accounted for. It is important to note when discussing concentrations of particulate matter in the air this relates to the amount that is suspended in the air. Suspended matter tends not to settle and hence very little of it would settle in or affect the water quality of the McArthur River.

However, heavier dust particles which are not suspended in the air are measured by deposition rates rather than by concentration rates. Hence modelling of the deposition rate of lead particulate was undertaken using Ausplume v 6.0 using all of the emission sources included in the air quality modelling presented in the EIS. Deposition was calculated for the closest point of the McArthur River to the mining operations after river realignment works have been completed.

Particle size distributions were estimated from guidance provided by the USEPA in their AP-42 compilation of emission factors, specifically "Appendix B.2 Generalized Particle Size Distributions" (1990).

The predicted annual average lead deposition at the nearest point in the McArthur River is 0.01 g/m²/month.

The existing deposition monitoring network is also used to determine lead deposition. The highest recorded monthly lead deposition between 1995 and 2001 was approximately 0.25 g/m²/month for site D23, with the mean for all sites shown on Figure 8.2 of the draft EIS being generally below 0.05 g/m²/month.

The concentration of lead in the river realignment due to dust deposition from the mine operations has been approximated on the basis of the following assumptions:

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- The predicted lead deposition of 0.01 g/m²/month applies equally throughout the deviation channel. This is a conservative assumption based on modelling.
 - The average width of the river at the end of the dry season (September) is approximately 5 m. This is a realistic assumption based on observation.
 - The chainage length of the river deviation is 5,400 m. This is a realistic assumption based on design data.
 - The average daily river flow during September is 23,000 kL. This is a realistic assumption based on measured flows.

Given these assumptions the concentration of lead in the river from dust generated by the mining operation would be approximately 0.4 µg/L. This is a low concentration when compared with either the ANZECC (2000) trigger value for lead of 3.4 µg/L or with existing upstream concentrations where the 20th to 80th percentile range is 1.4-9.4 µg/L. On this basis it can be seen that dust-borne lead will not have any significant effect on the river system

EPA has noted that although modelling shows that NSW and NEPM standards will not be exceeded at the accommodation village, concentrations of pollutants such as lead are 20 times the NSW standard in proximity to the pit. The EPA has said that this will need to be taken into consideration as a health and safety issue.

The NSW air quality standards applied at the accommodation village are based on public health criteria and are applied to the general public which includes elderly people and children. These standards are appropriate in residential areas. They are not appropriate for industrial situations such as in proximity to the pit where occupational health and safety standards apply. These standards are different because of the differences in the assumed time of exposure and the level of health of the workers. MRM will comply with all relevant occupational health and safety air quality standards in proximity to the pit.

8.14.3 Projected CHG Inventory to 2012 (1, 7)

EPA has stated that the draft EIS does not consider the greenhouse gas emissions associated with proposed land clearing for the open pit (53 hectares) and overburden emplacement facilities (255 hectares). The loss of low open woodland in these areas would generate greenhouse gas emissions and this should be considered in the Supplement.

Approximately 308 ha in total will be cleared for the open pit (53 ha) and overburden emplacement facility (255 ha). If we assume the following:

- a conservative carbon density of 5 tonnes C/ha for low open woodland; and
- the fraction of carbon that is oxidised to CO₂ is 75%;

then the predicted CO₂ emissions from the land clearance will be:

$$308[ha] \times 5 \left[\frac{tC}{ha} \right] \times 0.75 \times \frac{44}{12} \left[\frac{g/molCO_2}{g/molC} \right]$$

The result of this calculation is 4,235 t CO₂. For comparison, the projected GHG emissions are 117,900 t CO₂-e for 2004, and 124,100 t CO₂-e for 2008.

Clearing will occur in stages over the next 15 years to 2021. Therefore, estimated emissions of 4,325 t CO₂-e from clearing will be released in stages over the next 15 years but will be countered to some extent by the progressive rehabilitation to be undertaken during the life of the project.

ECNT has stated that there is no discussion of the life-cycle greenhouse gas emissions arising from the export of lead/zinc bulk concentrate.

There was no requirement in the EIS Guidelines for a life-cycle analysis of greenhouse gas emissions.

The boundaries for the greenhouse gas assessment presented in the EIS were the areas that are under direct management control of MRM. Activities that MRM cannot directly control or quantify such as the end-use of the exported lead or zinc concentrate have been excluded.

8.14.4 Management of Greenhouse Gas Emissions (1, 7)

EPA has said that MRM should commit to continuing their monitoring of greenhouse gas emissions and abatement measures. The NT Government has committed to introducing mandatory public reporting of greenhouse gas emissions by major industry and it is likely that MRM would meet the definition of ‘major industry’.

MRM undertakes to report to the Greenhouse Challenge Plus program and the NT Government’s program of mandatory greenhouse gas reporting by major industry. Further, MRM undertakes to estimate its Greenhouse Gas (GHG) performance including options for greenhouse gas abatement as discussed in Section 8.14.1 of the draft EIS.

EPA has stated that MRM should not rule out greenhouse offsets options and should commit to ongoing consideration of opportunities for offsetting greenhouse gas emissions from their operations.

MRM has committed to the following greenhouse gas abatement issues (Section 8.14.1 of the draft EIS):

- Continued use of natural gas for electricity generation;
- Ensuring that energy efficiency is a major consideration for the design and selection of equipment for the open cut project;
- Assessing opportunities for ongoing energy efficiency programs at the existing plant; and
- Progressive rehabilitation and revegetation during the life of the mine.

In light of these measures and the fact that there will be no significant change in the greenhouse gas emissions from the existing operations, the implementation of greenhouse gas offset strategies is not warranted and has not been planned at this time.

MRM will continue to assess opportunities to improve the mine's GHG performance in line with Greenhouse Challenge Plus targets.

The Draft EIS argues that because changing to open cut will have no significant effect on emissions, an offsets program is not warranted. ECNT considers that given that the mine would close if it does not change to open cut, and therefore zero emissions would occur, an offsets program is warranted.

See above response.