

3.0 Alternatives

3.1 Summary

A discussion of the project alternatives is given in Section 6 of the Draft EIS (URS, 2005a). This section provides additional discussion of the alternatives considered for a number of major project components. Table 3.1 lists those components and summarises the beneficial and adverse impacts of each.

Table 3.1
Summary of Alternatives

Project Component	Beneficial Impacts	Adverse Impacts
Continuation of underground mining	Avoids the need to divert the McArthur River and Barney Creek Avoids the need for above-ground disposal of overburden.	Results in unsafe working conditions Some ore remains un-mined Results in significantly more overburden and tailings per tonne of ore mined Additional backfill quarry, crushing plant and cemented aggregate fill plant required Not economically viable.
Open pit mining	Can be mined in a safe manner All of the targeted orebody can be fully extracted Results in increased efficiencies and is economically viable.	Requires the diversion of the McArthur River and Barney Creek Requires above-ground disposal of overburden The open cut remains in the flood plain following mine closure and the flood protection bund will alter the flood hydrology.
Mining without affecting the McArthur River – East Pit	Avoids the need to divert the McArthur River and Barney Creek.	No further mining is possible beyond the extent of the existing Test Pit Southern Extension Mining would cease in 2007.
Mining without affecting the McArthur River – West Pit	Avoids the need to divert the McArthur River and Barney Creek.	Would enable mining of only a small portion of the orebody Due to the large volume of overburden to be moved, this alternative would not be economically viable.
Out-of-pit overburden disposal	Enables all of the overburden generated to be disposed of Provides a flexible disposal system which facilitates ongoing mine operations.	Results in the disturbance of 255 ha of land Risk of contamination of runoff and seepage from PAF material Visually dominant feature Requires extensive rehabilitation.

Project Component	Beneficial Impacts	Adverse Impacts
In-pit overburden disposal	Reduces the area disturbed by out-or pit disposal Reduces the risk from potentially contaminated runoff or seepage Reduces visual impact and rehabilitation requirements.	Would not enable the disposal of all overburden generated Out-of-pit disposal would still be required Introduces additional safety risks for operators in the pit.
Re-alignment of flood protection bund closer to proposed Open Cut Project outline	Disturbs less area than is required for the proposed Open Cut Project.	Effectively sterilises future mining potential of outer areas of the orebody.
Re-alignment of McArthur River diversion channel closer to the bund	Less area of land between the bund and the diversion channel.	Greater disturbance footprint in area of high ground east of the flood protection bund Less sinuosity and length compared with existing river channel and proposed diversion.
Alter alignment of Barney Creek diversion to between bund and OEF	Shorter diversion length.	Less sinuosity and length increases flow velocities and threatens diversion stability.
No project option	None of the disturbance associated with the Open Cut Project will occur. Reduces risk of environmental impact to the surrounding environment will reduce No diversion of the McArthur River or Barney Creek required.	Loss of direct and indirect employment opportunities Loss of royalties Loss of community support programs Loss of opportunities for local businesses Closure of support businesses at the mine and Darwin.

3.2 Continuation of Underground Mining

A detailed feasibility study was conducted to examine safe and economic ways to continue operations at the MRM mine. This included investigating alternative mining methods including the viability of continuing to mine the deposit by underground methods.

The study concluded that there is potential for more underground mining in the following areas:

- More bulk stopes between 2- and 4-Orebody in the Main Zone
- Room-and-pillar and stoping of areas of the upper orebodies (5- to 8-Orebody)
- Bulk stoping in the Woyzbun South block, which is a block of ore that has been faulted off the southern end of the ore package, and thrust deeper by around 150 m.

Several factors were considered in the analyses of these options including:

- Almost all of the high grade 2-Orebody has been mined, so the lower grade orebodies and areas would need to form the basis of production

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- The geotechnical investigations indicated that further stope extraction without substantial backfilling of existing and future voids would result in major instability throughout the mine. The stability of the main declines, which are the means of entry and exit from the mine, would be compromised. This presents an unacceptable risk to personnel working in the mine.
 - Extraction of the orebodies above the mined areas also requires the existing voids to be backfilled
 - The substantial backfilling necessary would require a separate backfill quarry, crushing plant and cemented aggregate fill plant, which would increase the disturbance footprint of the mine
 - The fine grinding required to liberate the ore would result in very fine particles in the tailings. Only a small proportion of the tailings could be utilised in backfill.
 - Deteriorating ground conditions in old areas has made access back into them for backfilling and further extraction unsafe.

On the basis of this assessment it was determined that continuation of underground mining beyond that previously undertaken could potentially be unsafe, and expose workers to unacceptable risks. Additionally, the mined grade would be lower, so more tonnes of rock would need to be processed and hence greater volumes of tailings would be generated to produce each tonne of metal, and so the cost per tonne of contained metal would be very high. For these reasons, underground mining at McArthur River has now ceased.

3.3 Open Pit Mining

3.3.1 Benefits of Open Pit Mining

Mining of the deposit by open cut methods was also investigated as part of the feasibility study described above. The study examined numerous variations to develop the best mine plan, including:

- Conventional open pit mining and waste rock placement
- In-pit dumping of waste rock
- Alternative pit staging and final pit sizes for a variety of economic assumptions.

The benefits of open pit mining over underground mining at MRM include the following:

- Open pit mining method is safer for personnel as the method is more mechanised and excludes the inherent risks of working in the confined spaces of underground mines
- All the orebodies can be fully extracted to their economic limits, with no need to leave ore in pillars
- No requirement for a backfill quarry, crushing plant and cemented aggregate fill plant
- Due to the higher recovery of ore and the higher productivity of the large machines, the mining costs per tonne of contained metal are lower than underground mining
- Backfilling of the voids can be undertaken with crushed or blasted rock rather than use of cemented aggregate fill.

3.3.2 Mining Without Affecting the McArthur River

A part of the economic portions of the orebody comes close to the ground surface to the west of the McArthur River. This is the site of the Test Pit operations mined in 2005, and the Southern Extension currently being mined. However, this is the largest pit that can be mined on the western side of the river whilst allowing room for a flood protection bund and without diverting the river.

Most of the economic portions of the MRM deposit are located under or to the east of the McArthur River. An investigation into mining on both sides of the river was made whilst leaving the river in its current location. Figure 3.1 shows a cross section of how a possible west pit and east pit could develop whilst leaving the McArthur River channel unaffected.

The cross-section clearly illustrates that the east pit fails to reach deep enough to reach the ore zone to allow for the recovery of economic quantities of ore. Thus, it is not feasible for the Open Cut Project to proceed by separately mining both sides of the McArthur River. The pit must either remain as a very small strip to the west of the river, or the river must be diverted to allow a larger pit to be excavated.

3.4 Overburden Disposal

3.4.1 Out-of-Pit Disposal

The proposed Open Cut Project mining method is based on mining the open pit in a series of stages, starting with the shallowest ore in the west, and progressing to the east to mine the deeper ore. The overburden excavated from the pit would be hauled to the OEF located to the north of the mine. The OEF would also be constructed in stages over the mine life.

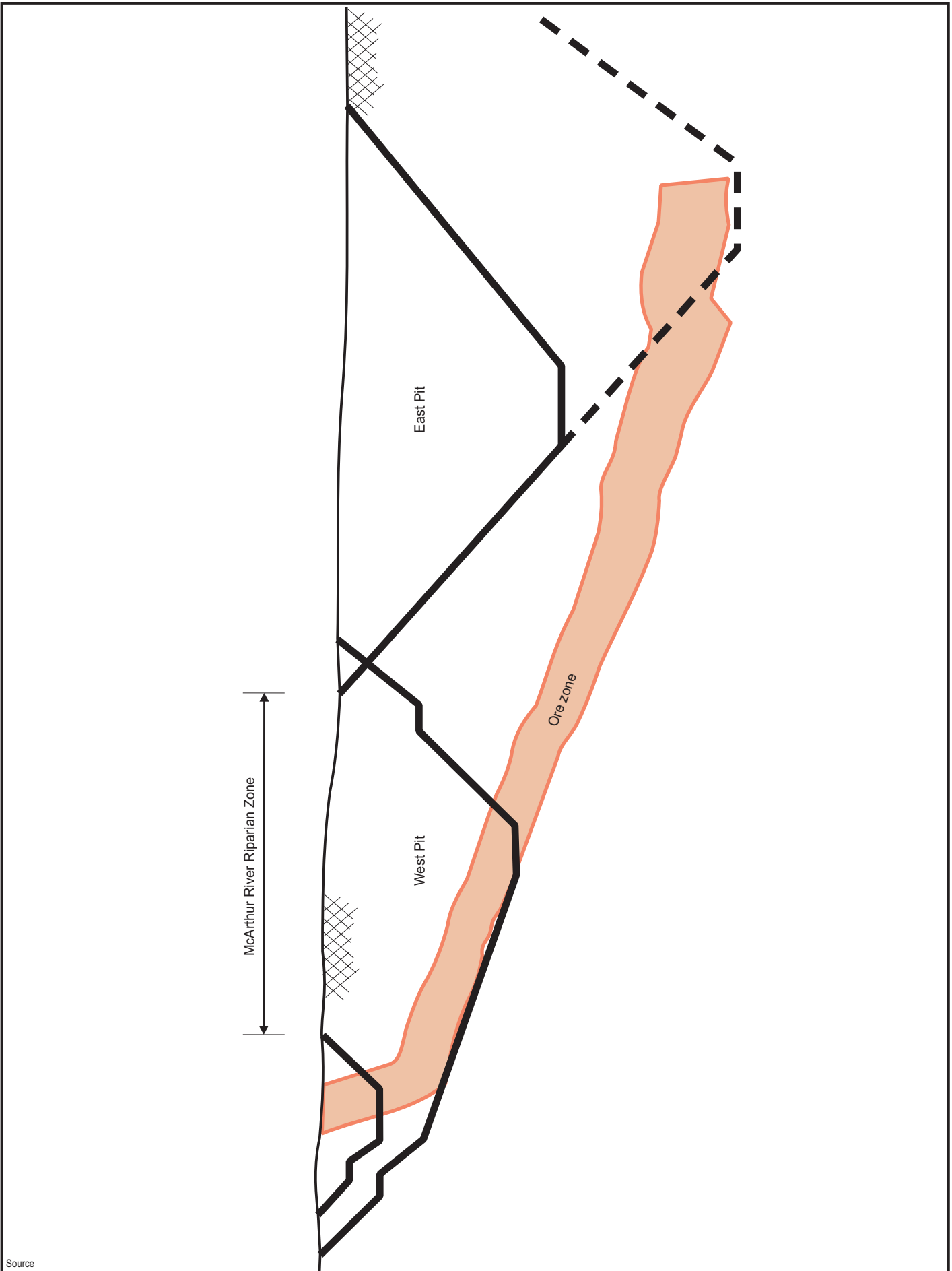
This proposal for out-of-pit disposal was chosen due to its flexibility as well as its ease of planning and management. The mine plan and OEF design can be fine-tuned as more information becomes available over the life of the project. Also, it provides an overburden management system with the capacity to handle all of the overburden generated by the mine.

Alternative locations considered for the out-of-pit OEF are discussed in Section 6.6 of the Draft EIS (URS, 2005a).

3.4.2 In-Pit Disposal

Once the mine pit is far enough advanced, an alternative to out-of-pit disposal of overburden is for disposal at the end of the pit where mining has already been completed. This has the following advantages:

- Mining costs are lower, as the overburden is not hauled as far
- Reduced equipment and manning requirements
- Smaller external OEF, which results in less rehabilitation and land disturbance.



Source



McARTHUR RIVER MINE
OPEN CUT PROJECT
PUBLIC ENVIRONMENTAL REPORT

CROSS SECTION
OF EAST PIT OPTION

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Figure: 3.1

Detailed design, scheduling and cost estimate were undertaken to investigate this alternative. However the study concluded that the geometry of the MRM pit did not suit this strategy. In-pit disposal of overburden would require mining to be undertaken in stages across the orebody, from one end to the other. The extra costs of mining in stages across the pit would far outweigh any savings in hauling overburden.

The depth of the proposed open cut pit requires a considerable initial excavation before any overburden can be returned to the pit. The study estimated that approximately 75-80% of the overburden would need to be mined before there is sufficient room for overburden to be safely returned to the pit and not interfere with ongoing mining operations.

Limited in-pit disposal of overburden is proposed towards the end of the mine life, when the dip of the pit floor flattens off enough to allow safe operations. The preferred material to be disposed of in the pit will be PAF overburden.

3.5 Alignment of Flood Protection Bund

The alignment of the flood protection bund has been chosen to surround the entire McArthur River orebody. The current economic and technological constraints limit the proposed Open Cut Project to mining 43 million tonnes of ore. It is not proposed to mine the balance of the orebody at this time.

However the flood protection bund has been located in such a way that it would be possible to recover the balance of the orebody in the future, without having to move the bund. The alternative of placing the bund closer to the proposed open cut pit outline would potentially sterilise a future mineral resource.

3.6 Alignment of McArthur River Diversion Channel

The alignment of the first half of the McArthur River diversion channel has been positioned as close as is reasonably practicable to the outside of the flood protection bund. The second half of the diversion channel moves further away from the bund.

This alignment has been selected to avoid high ground immediately to the east of the bund, and also to take advantage of the existing local drainage channels. To keep the diversion closer to the bund would result in the introduction of significant bends and increased sinuosity, compared to the existing river channel.

3.7 Design of Barney Creek Diversion Channel

There are few options available with respect to the alignment of the Barney Creek diversion channel. The only feasible location is between the northern side of the flood protection bund and the southern side of the OEF.

Initial designs of the diversion channel were relatively straight with a uniform slope. However hydraulic modelling indicated that under the unlikely condition of flood flows in the Barney/Surprise Creek system,

but no flow in the McArthur River, this design would generate high flow velocities, which could threaten the stability of the lower sections of the diversion channel.

Consequently the alignment was changed by increasing its sinuosity (and hence its length), by including an energy dissipating riffle structure in the slightly weathered (high strength) rock section capable of withstanding higher velocities, and by reducing the slope in the extremely weathered (low strength) lower section of the channel. In this way the channel will remain stable in the case of flood flows in the Barney/Surprise Creek system, but no flow in the McArthur River

3.8 No Project Alternative

Should the Open Cut Project not proceed, mining at McArthur River will cease. This will result in a loss of economic production for the Northern Territory, the loss of employment for the existing workforce, loss of indirect employment, loss of business for suppliers and local businesses, and detrimental socio-economic impacts in the region. Furthermore, the project benefits described in Section 13.3 will not be realised.

The no-project alternative would result in none of the disturbance to the biophysical environment associated with the Open Cut Project occurring. The risk of environmental impact to the surrounding environment would reduce and there would be no diversion of the McArthur River or Barney Creek