WMC (Olympic Dam Corporation) Pty Ltd

OLYMPIC DAM EXPANSION PROJECT

ENVIRONMENTAL IMPACT STATEMENT

S U M M A R Y

KINHILL

SUMMARY
ISBN 0 949397 82 2 (set)
ISBN 0 949397 87 3 (summary)

Printed by Finsbury Press, Adelaide

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ENVIRONMENTAL IMPACT STATEMENT

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May 1997


OLYMPIC DAM
MINE AND
PROCESSING PLANT
OLYMPIC DAM
VILLAGE
ROXBY DOWNS
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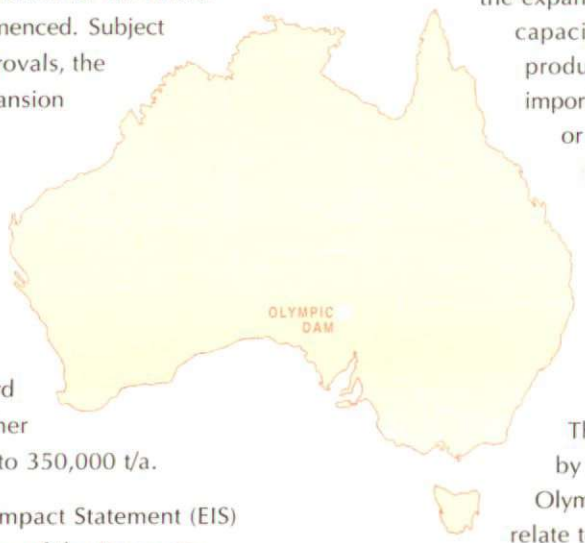
2 km
Photo date: 4-10-95

INTRODUCTION

This booklet summarises the information contained in the Environmental Impact Statement prepared for the Olympic Dam Expansion Project and published as two separate volumes: the main report and the technical appendices.

WMC Limited (WMC) proposes to undertake a two-phase expansion of production at its Olympic Dam operations in northern South Australia. The first phase of the expansion will initially increase the production rate from the current 85,000 t/a copper and associated products to the already approved rate of 150,000 t/a. Construction for this initial step has already commenced. Subject to the necessary approvals, the first phase of the expansion will enable copper production to be increased to a nominal rate of 200,000 t/a. The second phase of the expansion, which is subject to WMC Board approval, would further increase production to 350,000 t/a.



The Environmental Impact Statement (EIS) considers both phases of the Expansion Project above the already approved rate of 150,000 t/a to 200,000 t/a and then 350,000 t/a copper.

The operations at Olympic Dam are based on one of the world's largest polymetallic orebodies, with known mineral reserves of 11.4 Mt of copper, 0.34 Mt of uranium (as uranium oxide), 400 t of gold and 2,790 t silver.

At a nominal copper production rate of 200,000 t/a, the corresponding rate of production for associated products would average approximately 4,630 t/a uranium oxide, 2,050 kg/a gold and 23,000 kg/a silver. However, owing to the variability in the ore grade, the peak production rates in any year could be up to 210,000 t/a copper, 5,000 t/a uranium oxide, 2,110 kg/a gold and 28,350 kg/a silver.

In the second expansion phase to a nominal production rate of 350,000 t/a copper, the corresponding production rate for associated products would average approximately 7,730 t/a uranium oxide, 3,630 kg/a gold and 49,600 kg/a silver.

Following completion of the first phase of the expansion, surplus smelting capacity could be used to produce copper from imported copper concentrates or other ores. If both the new and existing smelters were fully utilised, the overall copper production after the year 2000 would be up to 285,000 t/a.

The major issues raised by this proposal to expand Olympic Dam operations relate to:

- the sustainable supply of water
- the containment of tailings
- the management of radiation exposures.

In the proposed expansion, the mining method and metallurgical processes would remain essentially unchanged, and are thus well understood. The expansion also offers the opportunity to incorporate recent advances in technology and productivity that would lead to improved environmental performance, waste minimisation, energy and water conservation, and better occupational health and safety standards.

The Olympic Dam Expansion Project EIS demonstrates how all of the environmental, social and pollution control issues for the proposed two-phase expansion would be managed.

Tapping copper

WMC began exploring South Australia for copper deposits in 1961. In 1972, a review of historical geological data combined with various geological models led WMC geologists to focus on the region to the west of Lake Torrens. Large-scale surveys indicated a number of coincident gravity and magnetic anomalies, suggesting that the Olympic Dam area warranted further exploration, and in 1977 WMC's Chairman reported to the Annual General Meeting that drilling had outlined a large prospective ore position.

Because of the likely size of the project, WMC sought partners to assist with its development, resulting in the formation of a joint venture with the BP Group in July 1979. In May 1980, the decision was made to sink an exploration shaft (the Whenan Shaft) to a depth of approximately 500 m. Feasibility studies into the metallurgical processing were conducted, and preliminary design work was undertaken. Environmental baseline studies began later that year.

Production at Olympic Dam commenced in 1988 at a rate of 45,000 t/a of refined copper and associated products. Between 1989 and 1995, the production rate was increased to the present levels in two optimisation programmes, ultimately raising the ore mining rate to 3 Mt/a and the copper production rate to 85,000 t/a.

In 1993, WMC acquired full ownership of Olympic Dam. The facilities are now operated by WMC (Olympic Dam Corporation) Pty Ltd, a wholly owned subsidiary of WMC Limited.

The regulatory framework and approvals process

The operations at Olympic Dam are regulated by the *Roxby Downs (Indenture Ratification) Act 1982,* which was ratified by the South Australian Parliament in June 1982 and amended in 1996. The original Indenture applied to the development of an operation recovering up to 150,000 t/a copper and associated products. The amended Indenture provides for the development of an operation recovering up to 350,000 t/a copper and associated products.

Environmental assessment at Olympic Dam has been comprehensive from the project's inception. It began with the preparation of the Draft EIS and Supplement which was based on a mining and processing operation capable of producing 150,000 t/a of refined copper and associated products. The project as defined in these documents was assessed and approved by the South Australian and Commonwealth governments in 1983.

The environmental management and assessment process since that time has included licence approvals, a waste management plan, environmental monitoring programmes updated every three years, and annual environmental and radiation monitoring reports. Also required have been an environmental review of the existing operations, and detailed environmental and Aboriginal heritage assessments for the progressive development of water and power supply infrastructure.

In addition, WMC has provided the State Government with Project Notices setting out details of all operational changes, and has complied since project commencement with all applicable Acts, Regulations and codes of practice.

For the proposed Expansion Project, the environmental impact assessment process entails:

- preparation of an EIS according to guidelines approved by both the State and Commonwealth governments;
- submission of comments by the public and by government departments;
- preparation of a response (or 'Supplement') document by WMC;
- review of all documents by both governments, leading to a decision on whether the Expansion Project will be allowed to proceed and, if so, under what conditions.

Structure of this booklet

The structure of this summary booklet parallels the structure of the EIS, which was shaped by two key considerations: the need to describe the scale and physical characteristics of the Expansion Project in the most effective way, and the need to examine those environmental factors that have been identified in the EIS guidelines and by WMC's environmental consultants as being the most relevant in assessing the effects of the proposal.

The existing operations at Olympic Dam comprise an underground mine, mineral processing plant and associated infrastructure located within the Special Mining Lease area of approximately 29,000 ha. WMC has systems in place—covering environmental as well as occupational health and safety procedures—for managing all these facilities.

In December 1996, the Olympic Dam operations employed 449 people in mining activities and 514 people in mineral processing.

Mining and processing

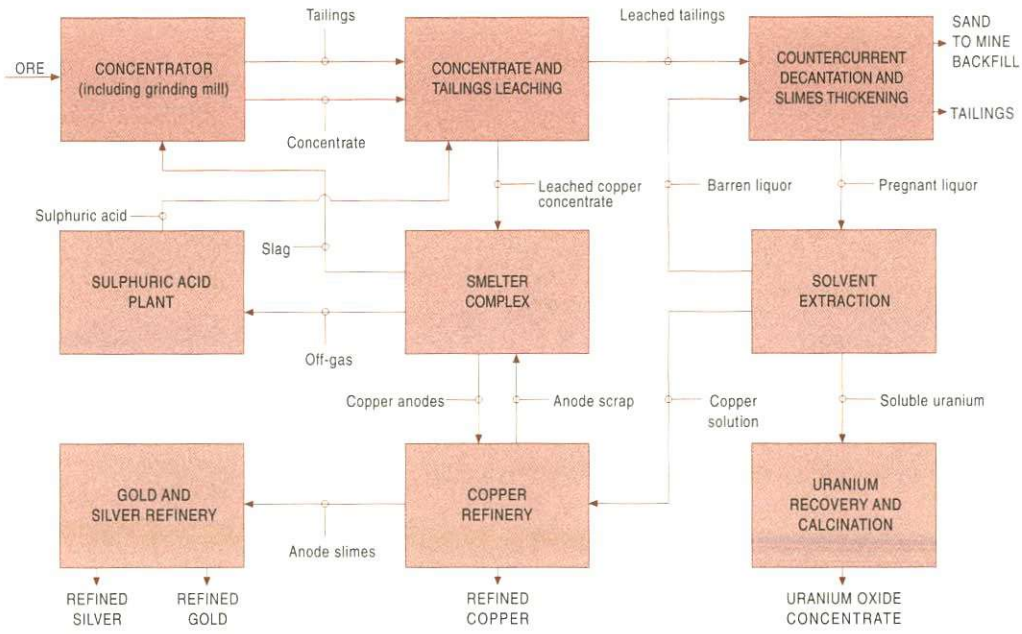
Access to the mine is through the vertical Whenan and Robinson shafts and the inclined service tunnel. Since mining commenced in 1988, more than 100 km of underground development has taken place, producing 17 Mt of mined ore.

The ore minerals consist mainly of fine-grained copper sulphide, uranium, gold, silver and rare earths, located beneath some 350 m of unmineralised sedimentary rocks. The primary extraction method is a variant of sub-level (underground) open stoping, in which blocks of mineralised ore are systematically blasted and the ore recovered for crushing below ground. The crushed ore is then hoisted up one of the shafts to the surface stockpile.

Following extraction, stopes are backfilled with a cemented aggregate of crushed mullock (waste rock), deslimed mill tailings, cement and pulverised fuel ash. Twenty-one mine-to-surface airways are used to ventilate the underground workings.

Above ground, the processing facilities (collectively referred to as the metallurgical plant) comprise a copper concentrator (including a grinding mill), hydrometallurgical plant, copper smelter, sulphuric acid plant, copper refinery, and gold and silver refinery. The plant currently produces 85,000 t/a copper, 1,500 t/a uranium oxide, 850 kg/a gold and 13,000 kg/a silver.

Copper is recovered primarily by flotation of copper sulphide from a slurry of finely crushed ore, after which the copper concentrate is smelted to produce blister copper, and is converted by electrorefining to high purity copper. Wastes generated during electrorefining are treated to recover gold and silver. After treatment by flotation, the finely crushed ore is leached with sulphuric acid to dissolve the uranium and any remaining copper. The leach liquor is then processed in the solvent extraction plant to separate the

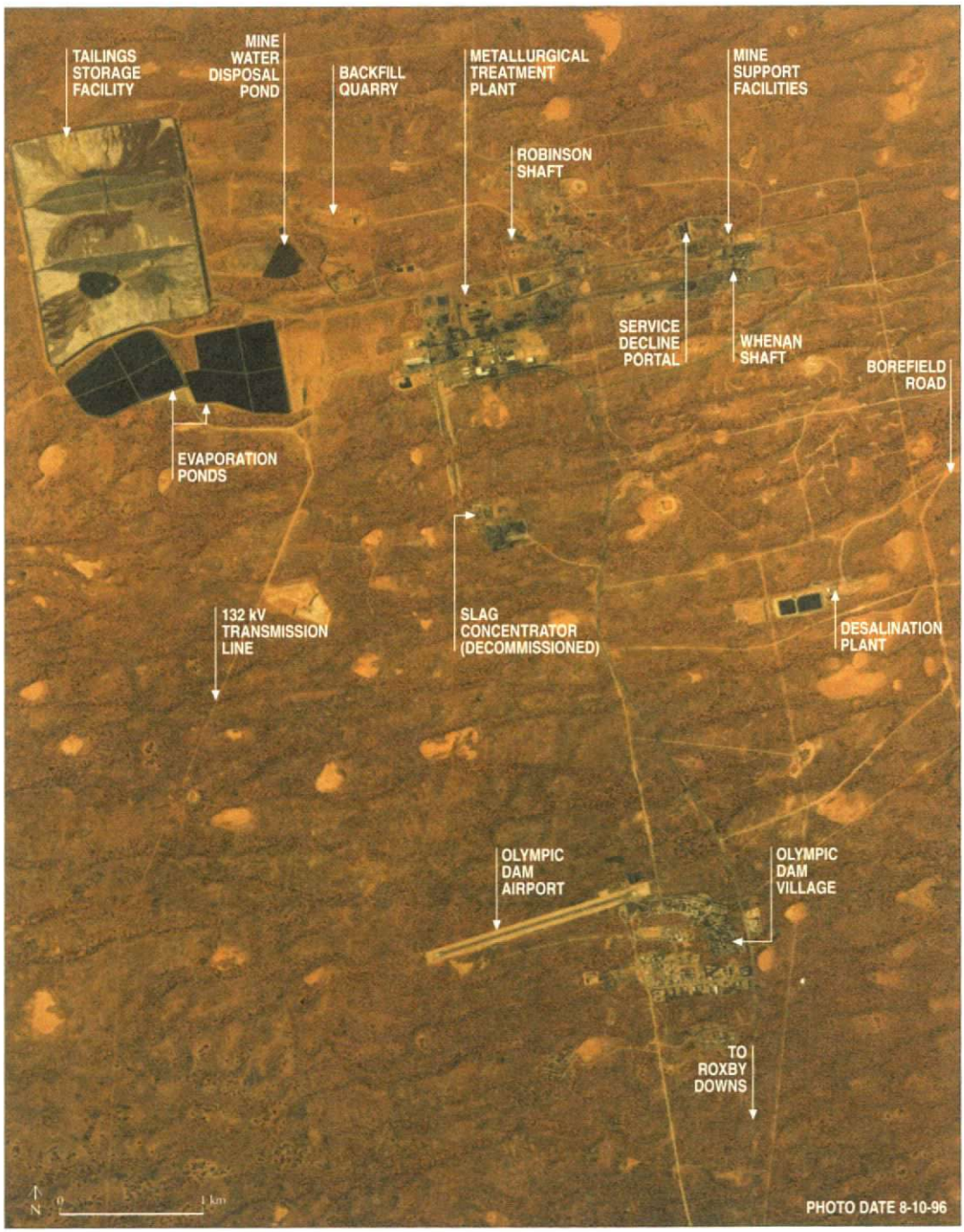


Simplified process flowsheet

residual copper and the uranium streams. This residual copper is recovered by electrowinning, and the uranium is converted to yellowcake and then calcined to produce uranium oxide.

The mine and processing operations produce a series of waste streams which are managed in separate dedicated facilities. These include a storage facility for the tailings solids, evaporation ponds for tailings liquor, a disposal pond for mine drainage water, a recycling centre and solids landfill, and sewage treatment facilities. The plant has been designed so that any spillage of ore, concentrate or process slurries can be readily returned to the process circuit.

The plant also includes comprehensive air pollution control equipment, and air emissions and noise are monitored and kept within statutory requirements.



Layout of existing facilities—Olympic Dam

Existing infrastructure

Electrical power is supplied by a 132 kV transmission line to Olympic Dam via Pimba from the Port Augusta power station. With the current demand reaching 40 MW average load, the transmission line is approaching capacity.

Water is supplied from two borefields which abstract water from the Great Artesian Basin. The total water use is about 15 ML/d, of which some 1.6 ML/d is used by the township.

Roxby Downs and the Olympic Dam operations are accessed by sealed bitumen road from the Stuart Highway, and by a regular air passenger service from Adelaide.

The workforce is accommodated in the Roxby Downs township and at the village. The township was established in 1988 and houses the plant workforce and government and service industry employees. The Olympic Dam Village is located about 5 km south of the process plant, and 9 km north of the town, and comprises the construction workforce camps, the industrial area and the airport.

At present, some 2,500 people live in the township and approximately 200 people at the village. The township has been developed in accordance with the parameters set out in the Indenture, and has a very well developed infrastructure. The town's population enjoys a high level of community amenities and has a very positive attitude towards involvement in community activities.

Environmental management

An environmental management and monitoring plan has been formulated covering all Olympic Dam operations, to ensure that the requirements of WMC's Environment Policy and the legally required management obligations are fulfilled. The current plan consolidates and updates the previous environmental monitoring programme and waste management plan, and covers the period from 1 March 1996 to 28 February 1999.

Annual environmental management reports are made available to the public by Mines and Energy South Australia, and copies are held by the State Library of South Australia.

All aspects of the Olympic Dam operations are regulated by comprehensive occupational health and safety procedures, with a major focus on radiation safety. At the commencement of operations in 1988, WMC initiated stringent radiation safety practices to protect all personnel and the environment. The results of monitoring programmes have shown that radiation exposure levels to employees, members of the public and the environment have been maintained well within statutory limits and international guidelines. WMC has also implemented formal programmes that continually seek to improve the safety of the workplace.

WMC is continuing a consultation programme with the Roxby Downs community, local pastoralists, Aboriginal groups and other community groups, in order to consult with and inform them about the operation's activities.

Ethnographic and archaeological sites are identified in consultation with the Aboriginal community, and recorded and managed.

Copper concentrate flotation

The first phase of the proposed Expansion Project would increase copper production to the already approved rate of 150,000 t/a by the year 1999, with a further increase, if approved, to 200,000 t/a to be achieved by the year 2000. However, an accelerated construction programme is being implemented and these production rates may be achieved at earlier dates.

The WMC Board has made no formal decision on implementation of the possible second phase expansion to a copper production rate of 350,000 t/a. However, for the purposes of hydrogeological and economic modelling, it has been assumed in the EIS that the second phase would be operational in the year 2010, and construction would start in the year 2008.

In planning for both phases of the Expansion Project, it has been assumed that ore would be supplied exclusively by the mine. However, there may be times when feed for copper production may be supplemented by ore imported from other mines in South Australia, or by copper concentrates imported from other mines in Australia or overseas. The use of imported copper concentrate or ore would be largely determined by economics and by the availability of surplus capacity in the metallurgical plant. The importation and treatment of ores or concentrates for the recovery of uranium is not proposed.

Geology and mineralisation of the deposit

The Olympic Dam deposit, located in the Stuart Shelf geological province in the far north of South Australia, lies beneath approximately 350 m of barren, flat-lying sedimentary rocks within a formation known as the Olympic Dam Breccia Complex (breccias consist of rock fragments cemented by finer material). The core of the complex comprises barren quartz–haematite breccias, flanked to the west and east by a broad zone containing abundant haematite-rich breccias intermingled with altered granite breccias. The known copper–uranium mineralisation occurs within these zones.

The mineralisation of the deposit can be broadly categorised as follows:

- copper–uranium (with some gold and silver) ore: This ore comprises most of the resource, and is primarily contained within haematite breccias;
- gold ore: This ore type generally occurs as small zones hosted by either granite-rich or haematite-rich breccias. There are some rare, but significant, extremely high-grade concentrations of free gold, especially around the margins of the quartz–haematite core.

Proved and probable total ore reserves as at 30 June 1996 are 73 Mt and 496 Mt respectively, yielding an average of 2% copper, 0.6 kg/t uranium oxide, 0.7 g/t gold and 4.9 g/t silver.

Mining

In most respects, mining operations for the Expansion Project would remain unaltered. The most significant changes proposed to

Electrorefinery

achieve the target production rates are the construction of a new vertical haulage shaft and the replacement of diesel trucks by an automated electric rail system for ore haulage underground.

A coarse ore blending stockpile would be installed on the surface to achieve a more consistent ore grade at the metallurgical plant. This blending stockpile would allow mining to proceed in the most efficient manner by maximising the productive use of mining equipment. It would also optimise the recovery of metal from ore in the processing plant by minimising grade variations.

For the processing plant to achieve a sustained production rate of 200,000 t/a copper, the mine would need to supply 8.7–9.2 Mt/a of ore, depending on the grade of ore processed. At least thirty stopes would need to be operated in any one year for this rate of production. At any one time, the number of stopes in operation would vary from an average of thirteen to about twenty-three.

In the proposed expansion, the main ore haulage level would be established approximately 740 m below ground level. The new vertical shaft, referred to as the No. 3 shaft, would be sunk from the surface to minimise interference with other operations. Underground development associated with the No. 3 shaft would include a new crusher station and ore handling system.

The ventilation system for the proposed expansion would be similar to that currently in use, with approximately one new ventilation shaft being installed each year. A new backfill system would be designed to maximise the use of deslimed tailings in addition to using other backfill material from an expanded quarry. Expanded mine services would include additional pumping facilities, water supply, power, communications and control equipment, workshops, explosives magazine, and amenities.

Mineral processing

The principal modifications to the metallurgical plant for a nominal capacity of 200,000 t/a refined copper would include the following:

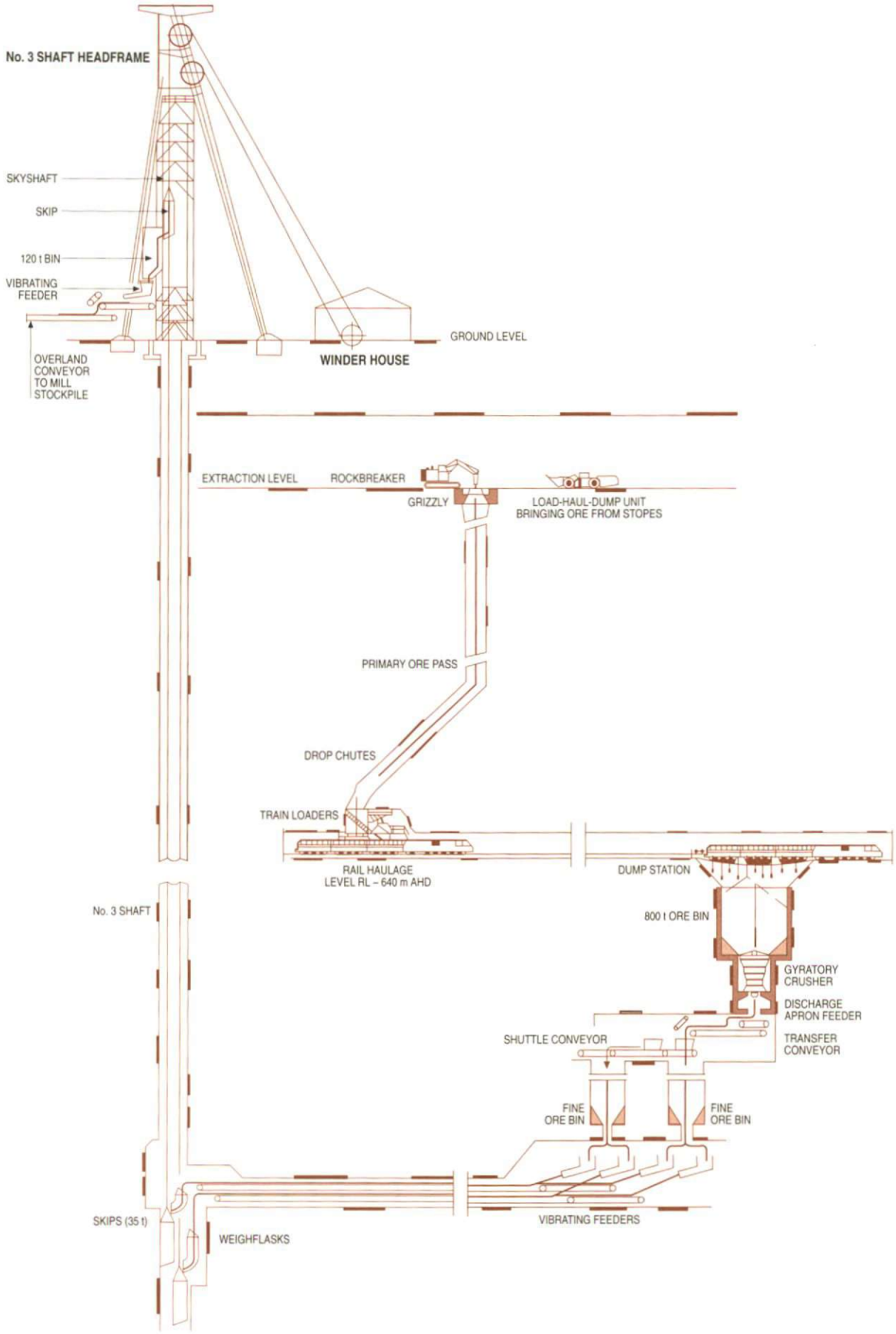
- a new ore stockpile, a new autogenous mill and additional flotation cells added to the copper concentrator section of the plant;
- expansion of the hydrometallurgical plant, including expansion of the tailings leach area and expansion of the copper–uranium solvent extraction area;
- construction of a new smelter complex with a nominal capacity of 180,000 t/a copper, and an associated acid plant of capacity 1,640 t/d sulphuric acid;
- expansion of the copper refinery to a nominal capacity of 179,000 t/a electrorefined copper, and 23,750 t/a electrowon copper;
- construction of a new gold and silver refinery;
- relocation and expansion of buildings, laboratories and site services.

The modifications to the tailings retention system for the expansion to 200,000 t/a, assuming the current paddock system for tailings disposal is continued, would include the construction of another two tailings storage cells of 100 ha each, increasing the overall storage area to 390 ha. Another lined four-cell evaporation pond of 50 ha, to increase the overall evaporation pond area to 118 ha, would also be provided. An alternative to the paddock system of tailings storage—central thickened discharge—is being considered. The mine water disposal pond would be relocated and enlarged to 30 ha.

Modifications for the possible second phase expansion to 350,000 t/a would include:

- further expansion of the copper concentrator and hydrometallurgical sections of the plant;
- construction of a new copper matte smelter and associated acid plant;
- duplication of the copper refinery.

Modifications to the tailings retention system for this phase, based on the paddock method, would include provision of a further three tailings storage cells of 110 ha each, increasing the overall storage area to 720 ha.



Proposed ore handling system

Future rates of water abstraction from the Great Artesian Basin, including amounts required for expansion up to a copper production rate of 350,000 t/a, will be maintained within the requirements of the special water licences that apply to the borefields.

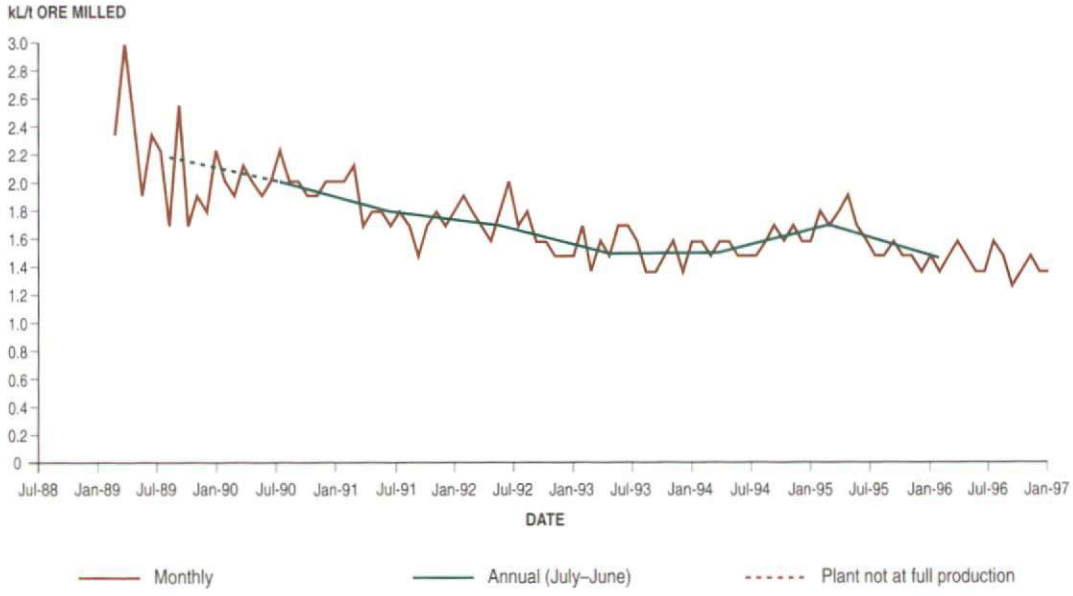
At present, of the approximately 425 ML/d of water flowing into the South Australian sector of the Great Artesian Basin, pastoral use is estimated to be 132 ML/d; mound spring flows—66 ML/d; flows associated with gas and oil production—22 ML/d; Olympic Dam and Roxby Downs use—15 ML/d; and vertical leakage—190 ML/d. As part of the Expansion Project, Olympic Dam water use is expected to increase to 34 ML/d for 200,000 t/a copper production, and then to 42 ML/d for 350,000 t/a.

The cost of water at Olympic Dam is high owing to the extensive infrastructure required to source the water and the cost of treatment to achieve potable water quality. At a copper production rate of 200,000 t/a, the cost of process and potable water at Olympic Dam would be some 1.8 and 2.7 times greater, respectively, than the cost of potable water to Adelaide consumers.

The high cost has been an incentive for WMC to design the plant to be water efficient and to investigate and implement water use minimisation programmes. Since the first full year of production, process and potable water use at Olympic Dam has reduced from 2.10 kL per tonne of ore milled to the current rate of 1.57 kL per tonne. A further reduction to 1.24 kL per tonne is planned as part of the expansion to a copper production rate of 200,000 t/a.

Numerical modelling of the future borefield operation, over a planning period of twenty years to the year 2016, was undertaken using an updated hydrogeological model and recently acquired data to assess compliance with requirements of the special water licences. The modelling was also used to update predictions on the effects of borefield operation on mound springs and pastoral bores.

The results of the numerical modelling show that the drawdown limits of the special water licences over the twenty-year planning period would continue to be met. The predicted reductions in flows from current levels would be less than 16.5% for all mound springs and less than 2% for those springs that are considered to be ecologically significant.

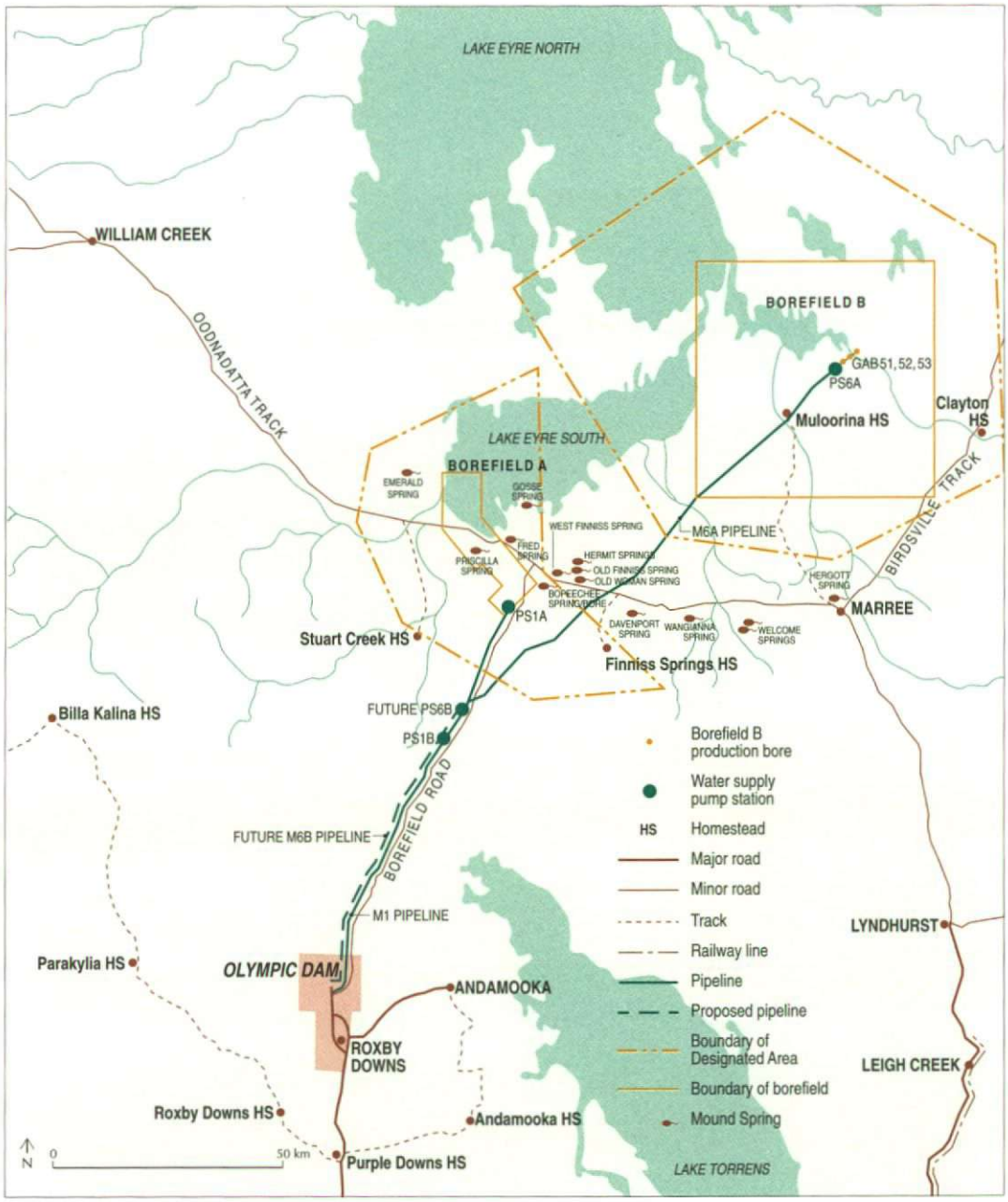


Historical rate of water consumption per tonne of ore milled

An increase in flow is predicted at a number of mound springs near Borefield A, with these springs having shown the greatest flow reduction from the previous Borefield A operations.

The numerical modelling also shows that the pastoral bores closest to the WMC borefields would be most affected by reductions in aquifer pressure. Two pastoral bores currently having low artesian pressure are predicted to cease flowing. However, water would continue to be available at these and all other existing pastoral bores, and current flow rates could, if necessary, be maintained by pumping. Arrangements in this regard would be in accordance with the Indenture, which contains provisions for the maintenance of existing pastoral water supplies.

Options exist for the provision of water supplies beyond the twenty-year planning horizon adopted for the EIS. These options include the continued use of the existing



Location of borefields

borefields together with the development of further water conservation measures. In addition, it is expected that estimates of the obtainable long-term water supply will increase. Such increases could result from the use in future modelling of additional measured data to replace assumptions made previously. The current modelling uses precautionary principles in the selection of assumptions, thereby resulting in conservatively low estimates of the available long-term supply.

The development of a borefield further into the Great Artesian Basin may also be necessary to meet long-term water supply needs. If required, this borefield would be the subject of further environmental evaluation. Although research indicates that water outflows from the basin currently equal inflows, it is considered feasible that the basin could be further developed by providing strategically positioned bores which harvest groundwater that would otherwise be lost to evaporation via vertical leakage from the aquifer.

Groundwater below the Olympic Dam site generally occurs at a depth of 50 m, is highly saline (with total dissolved solids in the range 20,000–40,000 mg/L) and contains detectable levels of naturally occurring metals including uranium and radium. Owing to its salinity, this groundwater is not currently used as a water supply, with the exception of some minor use for dust suppression and drilling at the operations.

The direction of regional groundwater flows was reviewed as part of the EIS. While not totally conclusive, the review indicated that groundwater under Olympic Dam flows to the north-east and then probably to the east, to the saline aquifers under the northern end of Lake Torrens.

The impact of the underground mining operations at Olympic Dam on the regional aquifer is substantial but localised, with little if any effect distinguishable beyond a distance of approximately 5–10 km. However, this localised aquifer drawdown does dominate the groundwater regime of the mine area, with groundwater flowing towards the mine from all adjacent areas, including the area beneath the tailings retention system.

Due to the slow rate of regional groundwater flow, water levels would be expected to take a long time, perhaps centuries, after the cessation of mining to recover to a point where the pre-mining groundwater flow system was re-established.

Seepage to groundwater is known to occur from the mine water disposal pond, which receives groundwater that drains into the mine. This seepage, however, essentially constitutes natural groundwater. Seepage also occurred previously from the tailings storage facility and associated evaporation ponds, but the design and operation of these has been changed substantially in recent years to ensure seepage is minimised. Investigations into this seepage have concluded that it has had no adverse impact on the environment or the health of employees or members of the public. In addition, groundwater monitoring around the area indicates that the new measures are successfully meeting their objective of minimising seepage.

As part of the Expansion Project, the tailings retention system would be expanded, with the design of the new facilities incorporating features to ensure seepage continues to be minimised. The extensive groundwater monitoring system in this area would also be extended. In addition, the mine water disposal pond would be relocated so that seepage from this facility would not interfere with groundwater monitoring near the tailings retention system.

Stormwater management for the expanded project would continue to use the same approach as the existing plant and would include the provision of impervious bunding around process equipment, enabling spillages, wash water and stormwater to be collected and returned for use as process water.

ABORIGINAL CULTURE AND RELATIONSHIPS

There are currently three registered claimant Applications for a Native Title Determination over the Olympic Dam Project Area, which comprises the Special Mining Lease and Municipal Lease areas. There are also several other applications over all or part of the borefields and pipeline and power line corridors.

WMC has contributed to, and continues to participate in, statutory conferences and meetings convened by the National Native Title Tribunal. In accordance with its Indigenous Peoples Policy, WMC is committed to the continued protection of sites of Aboriginal heritage significance, and has appointed community relations officers who are responsible for ongoing consultation with Aboriginal groups in all of WMC's Australian operations areas, including Olympic Dam.

Aboriginal heritage studies and consultation with Aboriginal groups have been ongoing since the 1983 EIS, and have produced considerable additional information about the archaeological and ethnographic aspects of Aboriginal heritage in the Project Area, the borefields, the pipeline and power line corridors, and the Stuart Shelf Exploration Area. For development in these areas, a strategy of site avoidance has been adopted for all ethnographic sites and, where possible, archaeological sites.

Owing to the ubiquitous nature of the archaeological record in the Olympic Dam Project Area, avoidance of archaeological sites is not always feasible. Prior to any new development, Aboriginal people are consulted and surveys undertaken with consulting archaeologists and anthropologists. A sign-off procedure is part of the surveys. Measures for the protection of sites during construction are included in project-specific environmental codes of practice.

In addition to fulfilling its obligations for Aboriginal heritage assessments, WMC is also active in general support of broader Aboriginal cultural processes. The company has funded and provided logistic support to a recent women's ceremony near Roxby Downs; supported an archaeological site excavation and surface artefact collection by the Royal Geographical Society of South Australia and the Andamooka Land Council; initiated discussions with Aboriginal groups in relation to community development programmes; and developed strategies to facilitate greater employment opportunities for Aboriginal people.

Photograph: D. Nerjul.ze

Western myall plant community

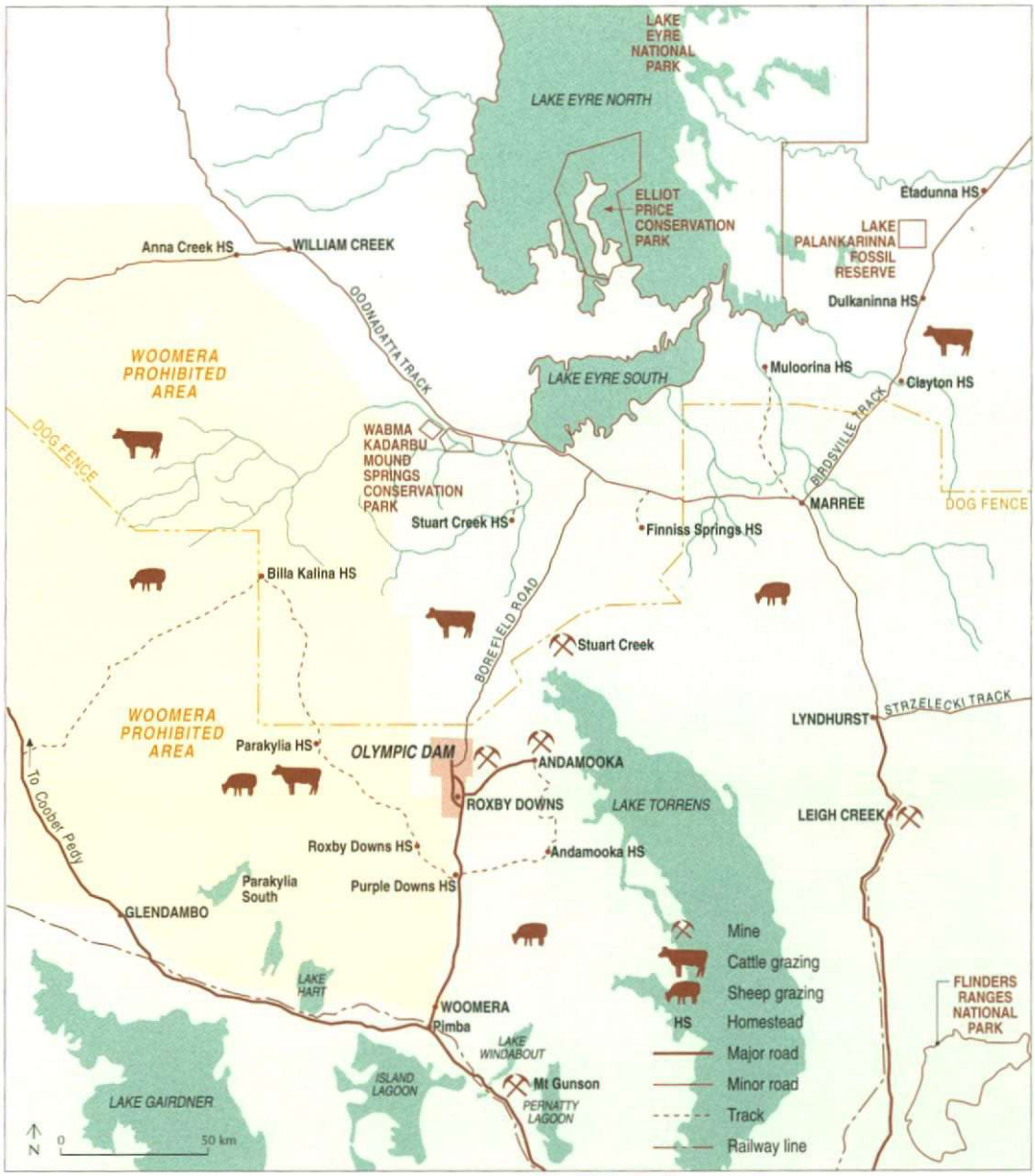
Regional environmental, heritage and recreational features

Although its viability has always been dependent on the region's erratic rainfall, pastoralism remains the most extensive land use in the region. Mining activities are also undertaken and these include Olympic Dam (copper, uranium, gold and silver); Coober Pedy and Andamooka (opal); Mt Gunson (copper); and intensive minerals exploration in the wider area.

Other land uses include defence-related activities at Woomera; tourism, particularly in the Lake Eyre and mound springs areas; and conservation parks. Settlements are dispersed, with Roxby Downs being one of only two major regional centres in South Australia north of Port Augusta, the other being Coober Pedy.

Pastoralists in the region have benefited from the existing operation which has brought improved access to town facilities and potentially more reliable stockwater supplies via the Olympic Dam water supply pipelines.

Additional stock and fauna losses may result from increased vehicle traffic between Olympic Dam and Woomera, particularly during the construction period. In the operational phase there would be an increased risk to stock and pastoral property from the larger population. There would be no direct impacts from the proposed expansion on other land uses or features of European heritage value in the region.



Regional land use

WMC's Environment Policy establishes the company's corporate commitment to the National Strategy for Ecologically Sustainable Development. WMC has effective environmental management programmes for all its operations, and has implemented a comprehensive government-approved environmental management and monitoring programme (EMMP) at Olympic Dam. In addition, WMC staff undertake a wide range of biological research programmes beyond the EMMP or legislative requirements, and this has led to a better understanding of regional biodiversity and conservation issues.

Flora

The vegetation of the Project Area and region is characterised by low density arid zone vegetation that has been degraded for over a century by past land use and introduced herbivores, particularly the European rabbit. Within the Project Area, this type of degradation has slowed since the more recent removal of domestic stock and the release in 1996 of Rabbit Calicivirus Disease.

The Project Area and region are dominated by three vegetation communities that occur repeatedly and are associated with the two major landform types: dunefields and stony tablelands. There are no species recorded in the Project Area or region that are classified as rare or endangered under Australian or South Australian legislation.

The dunefields are generally dominated by Acacia woodland and tall shrubland vegetation on the dune ridges, merging into low chenopod shrubland vegetation in the dune swales.

Photograph: D. Ninjalke

Salt pipewort (Eriocaulon carsonii)

The Project Area contains relatively large areas of white cypress pine and western myall communities that are biologically important and poorly preserved elsewhere in formal conservation areas. The impact of the proposed expansion on these vegetation communities is expected to be negligible.

Vegetation associated with water drainage occurs where water collects in swales between some dunes. These areas are generally dominated by swamp cane-grass (sometimes with lignum), chenopod low shrubland and short perennial grasses.

The vegetation present in areas of stony tableland is dominated by low chenopod shrubland. Other significant vegetation communities associated with areas of stony tableland, such as bladder saltbush/stalked Ixiolaena low shrubland and cane-grass tussock grassland, are not expected to be affected during the proposed expansion. There are no plant species recorded in the Project Area or region that are classified as threatened under Australian or South Australian legislation.

In comparison with many other settled areas in Australia, relatively few introduced plants are present. The majority of the sixty-three introduced species recorded are annuals and do not pose a threat to native vegetation. In the past, three proclaimed pest plant species have been recorded in the Project Area and twelve in the region. The activities by WMC have not increased the number or distribution of proclaimed introduced plant species in the region, and the proposed Expansion Project is expected to have a minimal effect in this respect.

Past land clearing in the Project Area as a result of mining and associated activities has been minimal (approximately 3.5% of the total area) although there have been adverse impacts to some small areas of vegetation due to some air emissions and activities such as off-road driving. However, these impacts have been mitigated through environmental management actions and community education.

Predicted impacts of the proposed Expansion Project include clearance of some dunefield vegetation communities, particularly tall shrubland and low chenopod shrubland. Land clearance is expected to be between 632 ha and 1,082 ha for the 200,000 t/a expansion, and between 1,008 ha and 1,628 ha for the 350,000 t/a expansion. However, vegetation and communities of habitat and local conservation significance will be preserved wherever possible (for example, in reserves in the municipal expansion area).

WMC has developed and implemented effective vegetation retention and rehabilitation programmes during past development phases at both the operations area and township. Strategies that retain vegetation and promote rehabilitation will be part of the EMMP and the environmental code of practice for the Expansion Project.

Fauna

Species of particular conservation significance in the region and the Project Area include five mammal species, twenty-one bird species and five reptile species. The plains rat, plains-wanderer and possibly the woma python (if additional animals are found) are of conservation significance either nationally or internationally. It should be noted that most vertebrate species are naturally low in abundance in this arid environment.

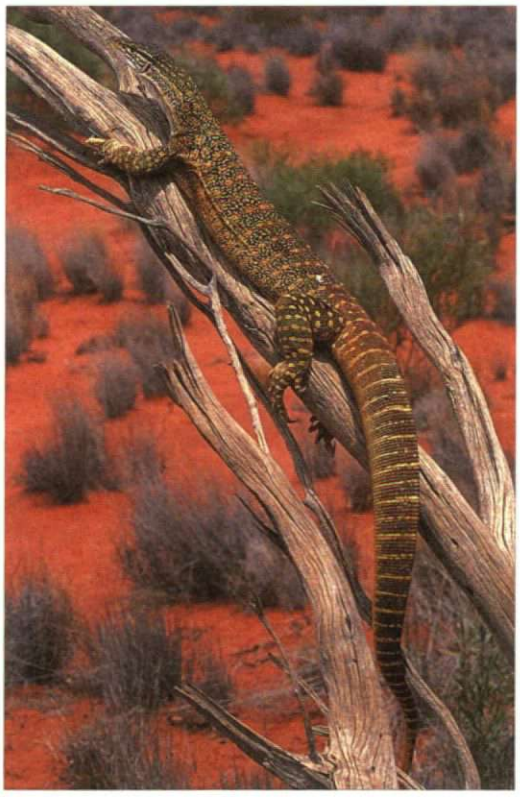
Large mammals such as kangaroos have benefited from the removal of domestic stock and the provision of fresh water and increased food resources. Eighteen bird species have also benefited from the project as it has increased their water and food supply and nesting sites. Past and current activities associated with mining in the region have not had an adverse impact on small mammal populations in the Project Area.

All vertebrate species recorded before the 1983 EIS are still present. Detailed research programmes by WMC have expanded knowledge of the distribution, abundance and ecology of these and an additional number of species.

Some loss and modification of habitats as a result of the proposed expansion is unavoidable. However, the habitats expected to be changed are not essential to the survival of any animal species, and the total modified area is expected to increase from approximately 3.5% to less than 10% of the total Project Area. Since the Project Area comprises less than 2% of the dominant environmental association of the region, the overall disturbance to the association is expected to be about 0.2%. Any adverse impacts to animals are expected to be localised and short-term while animals shift to alternative habitats.

To guard against potential impacts to animals, WMC has implemented various management procedures. These include fencing evaporation ponds and using deterrents to keep animals, particularly birds, away from the evaporation and tailings retention ponds.

WMC will continue to monitor the presence and abundance of native and introduced animals and, in addition, will continue to control the abundance of the rabbit, cat and fox, as part of the EMMP. Control of these introduced species will continue to have a



Photograph: D. Nicjalke

Gould's goanna (Varanus gouldii)

positive impact on the abundance and diversity of native animal species in the Project Area.

Mound springs

The artesian (mound) springs present along the margins of the Great Artesian Basin, including those located in the region of Borefields A and B, are important habitats for endemic and relict plant and animal species, especially macroinvertebrate groups. The springs and their habitats are important scientifically, historically and culturally.

Degradation of the mound springs has been occurring since European settlement, and has been exacerbated by the uncontrolled use of artesian water and the continued use of the mound springs habitat by introduced animals.

Plant species of conservation significance that are present in mound springs include salt pipewort, twigrush, cutting grass and sea rush. Animal species of conservation significance are also present, notably the fish species Dalhousie goby and Dalhousie hardyhead; the endemic macroinvertebrate groups hydrobiids, ostracods, amphipods and isopods; and probably a number of biogeographically significant spider species. Each of these taxa relies on the habitat provided by mound springs for its survival.

The taxonomy and ecology of the invertebrates endemic to the mound springs are of great interest to numerous researchers. Of particular interest is the isolation of endemic invertebrate populations from each other, and the genetic variation and species divergence that have occurred and are continuing to occur as a result of this isolation. WMC personnel are currently involved in research of this type.

Recently, water abstraction by WMC has been identified as the probable cause of an adverse habitat change at the Bopeechee and Hermit Springs spring groups. This impact has been remedied by the reinjection of water adjacent to these spring groups and a reduction since November 1996 in water abstraction in Borefield A from 15 ML/d to 6 ML/d.

The majority (up to about 85%) of water required for the proposed expansion will be abstracted from Borefield B, with the abstraction rate from Borefield A remaining at 6 ML/d. This scenario, as predicted by groundwater modelling to the year 2016, is expected to have a significant, positive impact on water discharge rates and the ecology of mound springs in the vicinity of Borefield A. Minor to moderate negative impacts to mound springs are expected as a result of pumping from Borefield B.

The greatest impact is predicted to occur to springs within the Wangianna spring group. This spring group is composed of several spring vents, the largest of which has been highly modified for pastoral use. The springs in this group lack plant species of conservation significance and have only small populations of endemic mound springs fauna.

WMC will continue monitoring mound springs water flow rates, vegetation and endemic invertebrate populations as part of the EMMP. The company is also in the process of conducting additional sole and collaborative research on significant mound springs plant and animal species and is considering further research options to assist in the understanding and management of the mound springs.

Photograph: R. Anderson

Mound spring

The principal components of the existing tailings retention system at Olympic Dam are:

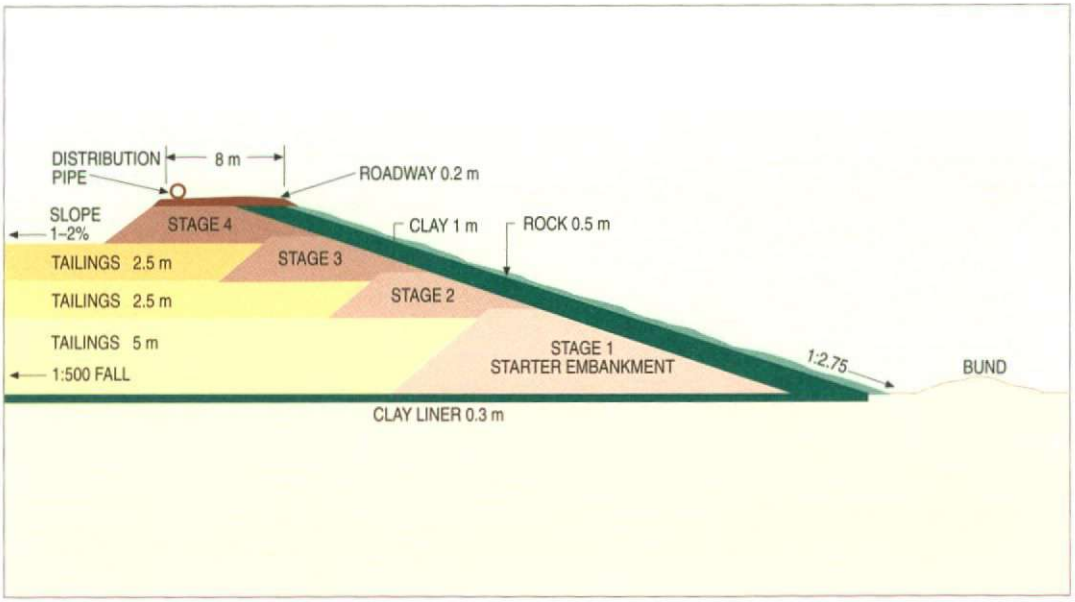
- a 'paddock method' tailings storage facility, comprising three storage cells of approximately 190 ha total area, tailings distribution pipelines contained within a bunded pipeline corridor and decant facilities for supernatant tailings liquor;
- two liquor evaporation ponds, each divided into four cells with a combined evaporative area of 68 ha, which are used to dispose of supernatant tailings liquor and excess acidic process liquor by evaporation;
- a mine water disposal pond used for the disposal of groundwater that drains into the mine, partly by evaporation and partly by seepage.

In the current operation, some of the tailings from the metallurgical plant are treated to remove the sand fraction for use as mine backfill. The remaining fine fraction and the remainder of the tailings are thickened and pumped to the tailings storage facility via two above-ground pipelines. The pipeline route is bunded for the entire length, with transverse bunds at regular intervals to contain any spillage.

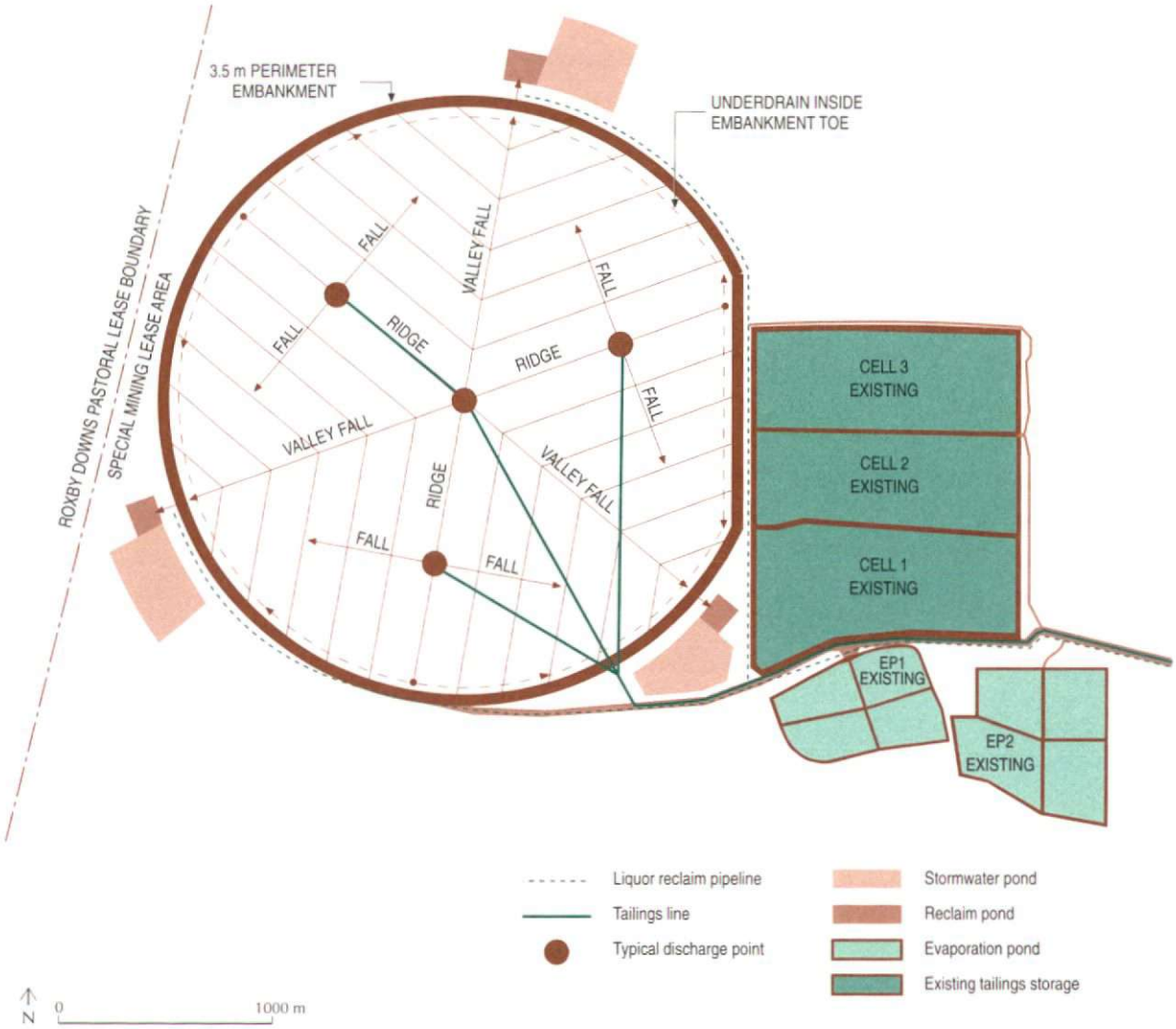
Other minor waste streams from processing are also directed to the tailings retention system. Excess acidic liquor resulting from tailings thickening passes to the liquor evaporation ponds, as does supernatant liquor decanted from the tailings storage facility.

The present tailings production rate varies depending on the quantity of ore milled and whether or not the sand plant is in operation. The amount of tailings expected to be delivered to the tailings storage cells during 1996–97 is approximately 2.7 Mt. About 4% of the tailings produced is presently used as mine backfill, with an objective of the Expansion Project being to increase this proportion to approximately 20%. On this basis, the rate of tailings delivery would increase to about 6.6 Mt/a at 200,000 t/a copper production and 12.5 Mt/a at 350,000 t/a copper.

The operation of the tailings retention system was changed in 1994 and 1995 to its present arrangement following the discovery of a localised elevation in the water table, which was attributed to seepage from the system. The results of all investigations concluded that the seepage had no adverse impact on the environment or on the health of employees or members of the public. This conclusion was supported by the findings of the Environment, Resources and Development Committee of the Parliament of South Australia.



Paddock method—cross-section of typical embankment construction



Example of central thickened discharge system for 136 Mt of tailings

Management and monitoring systems

Management and monitoring systems for the existing tailings retention system are well established and would be extended to meet the needs of the Expansion Project. Management of the system involves the collection and assessment of operational data, and planning for future development of the tailings system. It also involves operational staff checking the system several times a day, and making adjustments where necessary.

The operational data collected are used in liquor balance calculations to identify any apparent loss of liquor before the loss begins to have any environmental effects. The existing groundwater monitoring system would also be extended to cover the expanded facilities.

For the Expansion Project, two tailings storage options are being considered. One is to continue the existing paddock method, constructing additional similar cells. The other is to adopt a new tailings storage method for the site, which would involve further thickening the tailings slurry and discharging it from elevated outlets to form a final tailings profile resembling a series of intersecting flattened cones. The feasibility of using the new central thickened discharge method on the Olympic Dam tailings is the subject of current pilot trials.

Among other important design criteria, the design of the expanded tailings facilities for both options would include measures to ensure that seepage is minimised. Features of the design to minimise seepage would include:

- site preparation to provide a low permeability floor lining;
- use of perimeter embankments that incorporate a low permeability clay zone;
- deposition of the tailings in thin layers, allowing the tailings to dry and consolidate prior to the deposition of subsequent layers;
- use of decant structures to remove supernatant liquor for disposal by evaporation in lined ponds.

Hydrology

The expanded facility would be designed to handle run-off from extreme rainfall events.

The paddock method currently used would achieve this by storing the run-off on the tailings surface, allowing removal by the decant facilities for use in the process or disposal by evaporation. The central thickened discharge method would require the provision of stormwater ponds, sized to store the run-off resulting from a 1-in-100-year average return interval storm.

As discussed above, the focus of the design and future operation of the expanded tailings retention system would be to minimise seepage. It is relevant, however, to assess the likely impacts if seepage were to occur. In this regard, monitoring results and other test work conducted on the existing facilities provide a sound basis for making predictions.

The Andamooka Limestone which underlies the entire site, including the tailings retention system, has been shown by experience to offer both advantages and disadvantages as a foundation. The obvious disadvantage is the limestone's inherent permeability, requiring the proposed floor preparation and lining systems to minimise seepage. However, the limestone has the ability to neutralise acidic liquors and to remove metals (including radionuclides) from solution, thereby providing a natural safeguard to minimise pollution.

Another safeguard for the control of groundwater pollution is the presence of the cone of groundwater depression associated with the underground mining operation. This dominates the local groundwater regime, resulting in groundwater flow within about 5–10 km towards the mine. This effect would continue to develop as the mine expands and is expected to persist for a long time, perhaps centuries, after the cessation of mining.

Tailings radiation control

The tailings at Olympic Dam contain approximately 80% of the radioactivity associated with the original ore. The operation and final rehabilitation of the tailings storage facility would therefore be determined by the need to ensure that doses to people from the radiation remaining in the tailings are as low as reasonably achievable and less than levels considered acceptable.

Measurements of radon and radon decay products in air near the tailings storage facility during operations have shown that natural ventilation is sufficient to disperse and dilute radon and radon decay products to very low levels within quite short distances.

Similarly, dust monitoring has shown that the tailings storage facility is not a major dust emission source. This is because the smooth, flat, even grain size and moist surface of the tailings limit the processes that could lead to dust lift-off. Although the potential for dust increases during mechanical working of the tailings, particularly during successive lifts of the storage cell walls, water sprays are effective in limiting dust release.

A final rehabilitation plan for the tailings storage facility is subject to ongoing trials. However, preliminary calculations indicate that provision of 1 m of cover over the tailings surface, overlain by rock armour, would be sufficient to achieve an acceptable reduction in the long-term release of radon.

Air quality

Airborne process emissions at Olympic Dam include sulphur dioxide, sulphur trioxide and sulphuric acid mist, oxides of nitrogen, hydrogen fluoride, carbon monoxide, carbon dioxide, particulate matter and dust. The principal sources of gaseous emissions are the acid plant, the copper smelter and fuel burning equipment. Process particulate emissions arise mainly from the smelter. Dust is also produced in plant operations, quarrying and traffic movements.

Meteorology, including wind patterns and thermal structure, is the major factor governing the transport and dispersion of airborne emissions. Weather information has been recorded for several years at weather stations near the Olympic Dam operations, and the data collected have been used to predict the impact of the emissions from the proposed Expansion Project. Results from dispersion modelling studies and assessment of gaseous emission controls for individual process units indicate that the Expansion Project will conform to existing and anticipated national and State air quality goals and emission limits.

Dust arises mainly from the handling and storage of process chemicals in stockpiles, from quarry operations and from unsealed roads. Dust control measures currently include the use of covered and underfeed conveyors, water sprays and road wetting. The control equipment and techniques already in use on the site have kept occupational concentrations below levels recommended and these measures would continue to be employed for the Expansion Project. Environmental dust levels outside the Special Mining Lease are well within State and national guideline figures.

Noise

The expanded operations would involve the addition of a new range of operating machinery, and hence new noise sources. The existing plant operations were used as a baseline in the assessment of potential noise impacts from the proposed expansion on residents of Roxby Downs township and the Olympic Dam Village. Predicted noise levels, including maximum operating sound power, were calculated for each phase of development. These predicted levels were then compared with environmental requirements.

It was calculated that noise levels for the Expansion Project would remain generally less than 62 dBA at the security fence, with a maximum of 67 dBA, following possible future expansion to 350,000 t/a copper production. Predicted noise levels at the Olympic Dam Village, adjacent to the Special Mining Lease boundary, would be up to 34 dBA. These levels are below the criterion limit of 70 dBA for an industrial zone. The predicted noise levels at Roxby Downs and Olympic Dam Village would increase by 1–2 dBA, but would be some 5–10 dBA below the existing minimum background noise levels in Roxby Downs and would therefore not be audible at most times.

Within the operations area, occupational noise levels would continue to be at sufficient levels in some areas to require control measures. The contracts for new equipment would include noise specifications to limit occupational noise exposure as much as practicable. Other occupational control measures, which include hearing protection equipment, noise monitoring, signage and employee training, would continue.

Radiation is associated with the mining, processing and disposal of wastes from the Olympic Dam operation.

In making predictions about the likely impacts of the proposed Expansion Project, there is a wealth of data available from the previous operation upon which to draw. The radiation studies conducted for the EIS have also made use of the most recent recommendations by national and international expert bodies charged with researching scientific evidence relating radiation exposure to health effects. Where data from years past have been used, the radiation exposures have been recalculated in order to provide a consistent method of comparing recent and past exposures.

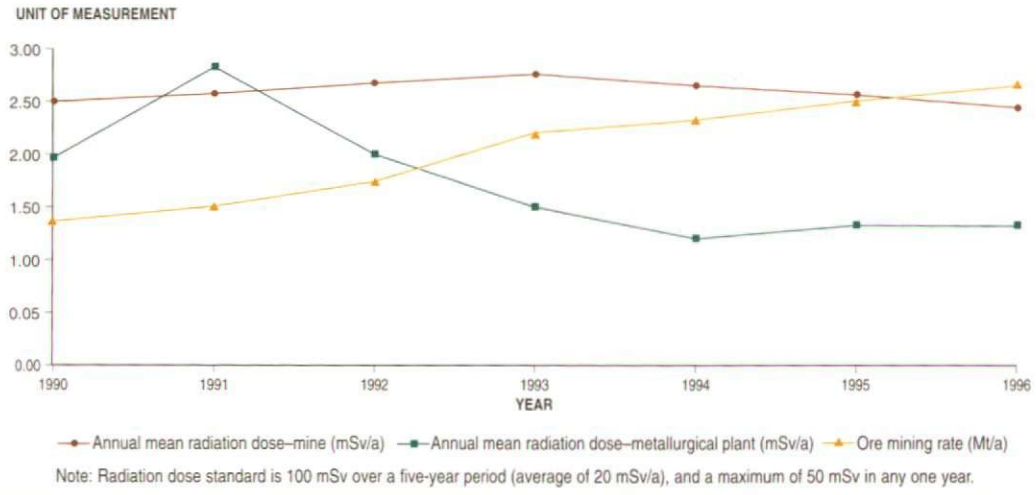
The occupational and environmental radiation data that have been generated during the operation of the current mining, processing and waste disposal facilities at Olympic Dam have been analysed and used to determine the impacts of operating the facilities at the current copper production rate of 85,000 t/a. Where it has been possible to identify causal links between production and radiation levels, the relationships have been used to predict the likely impacts associated with copper production rates of 200,000 t/a and 350,000 t/a.

Individual radiation exposures to underground mining personnel are unlikely to be greatly changed by an increase in production rates, the reason being that the ventilation system, local ventilation control and mining methods would remain largely unchanged, and these are the three factors that have the greatest influence on the exposure rate. The analyses of past data show a relatively constant rate of exposure from year to year. The effects of the proposed automated electric train haulage system on radiation exposure would be the subject of investigations once the system was operational. However, it is likely that any effect would be to reduce individual exposures.

Proposals for the expanded surface facilities are largely extensions of existing facilities and methods. The major exceptions are that a new smelter and a new calciner will be constructed. Analysis identified the existing smelter as the source of the greatest individual radiation exposures. The design of the new smelter incorporates features to reduce the radiation doses, and hence reduce these exposures.

The analyses of past exposures in the metallurgical treatment plant show a relatively unchanging annual rate. Predictions based on the monitoring of current exposure rates show that future exposures would be maintained well within currently recommended limits.

As part of Olympic Dam's monitoring programme, pathways along which radionuclides travel following release into the environment have been examined to determine the geographical extent of dispersion. In general, radionuclides attributable to operations can be found at distances up to 5 km from the site. Beyond this they are difficult to distinguish from background radiation. As a consequence, radiation doses to the public are unlikely to change significantly following the Expansion Project and are expected to remain at only a small proportion of international radiation standards.



Relationship between mining rate and radiation doses

Water supply

Water is drawn from Borefield A and Borefield B in the south-west of the Great Artesian Basin, and pumped via buried pipelines to Olympic Dam. Borefield A was approved in the 1983 EIS, and Borefield B was approved in November 1995 following further hydrogeological and environmental assessments.

Borefield B is being developed in two stages. The initial stage, for which commissioning commenced in November 1996, involved the installation of three production bores (only one of which is currently in operation), seven observation bores, approximately 110 km of buried pipeline to connect with the existing Borefield A (M1) pipeline, and a forward pump station. Stage 2 will include the construction of an additional pipeline to Olympic Dam beside the M1 pipeline, connection of the other two production bores, and the decommissioning of an existing pump station.

The Borefield B pipeline route was selected after consideration of environmental constraints, engineering requirements and cost optimisation factors. All work was confined to a disturbance corridor of minimum practicable width within an overall easement of 100 m. Particular care was taken to avoid and protect sites that were significant in terms of flora and fauna habitat and Aboriginal heritage.

A specific environmental code of practice was prepared for the construction of Stage 1. All aspects of the work were subject to environmental clearance and assessment of work methods before commencement. Compliance with the code of practice was regularly audited, and monitoring has continued to assess the environmental effects of construction.

A similar process will be implemented for Stage 2.

Electricity supply

Electricity is currently supplied to Olympic Dam via a 132 kV transmission line from the Davenport substation at Port Augusta. A new 275 kV transmission line, which had been foreshadowed in the 1983 EIS, is presently being constructed. The new line will parallel the existing line for most of its length with minor deviations near Port Augusta, to comply with the revised Port Augusta Development Plan, and east of Woomera to avoid an area of Aboriginal heritage significance.

The corridor for the dual lines will be approximately 130 m wide (an increase of 30 m over that originally predicted), providing a separation of 80–90 m between the two lines. With the exception of those areas where the new transmission line deviates from the existing easement, the present service road will be used for construction and line

Photograph: M. Roberts

Construction of the Borefield B pipeline

maintenance. Disturbance will be confined to the new transmission tower sites, and to some limited vegetation clearance in order to maintain statutory conductor clearances.

For the possible expansion phase to 350,000 t/a copper, the existing 132 kV line is proposed to be replaced with a second 275 kV line (in addition to the one presently under construction) in order to ensure security of power supply. This additional new line would follow the same alignment as the existing 132 kV line, apart from the two minor deviations for the 275 kV line under construction. Any additional environmental disturbance caused by construction of the additional 275 kV line would be minimal.

As with Borefield B, a specific environmental code of practice has been prepared for the transmission line under construction. The code of practice will be updated prior to the construction of the future additional 275 kV line.

Other infrastructure

The existing road network is suitable for the Expansion Project, during both construction and operation. No additional roads would be required, other than minor roads in the plant area and in Roxby Downs township. The construction of a railway line to Olympic Dam is not included in the current proposal, although it is a future option. It would be subject to separate technical and economic review.

The products from Olympic Dam would continue to be exported through Port Adelaide. Should the option of importation of copper concentrates be pursued, the port facilities at Whyalla, Port Pirie or Port Adelaide could be used for this purpose. The possible importation of copper concentrates through Whyalla would require an upgrade of the wharf facilities and infrastructure.

Olympic Dam is serviced by a licensed all-weather airport, capable of handling turboprop and small jet aircraft. During the construction period, additional flight services may be needed. The use of larger aircraft would require an upgrade of the runway and terminal facilities; a decision to increase capacity in this way has not yet been made.

Olympic Dam is connected by optical fibre cable with the national telephone grid. Telecommunications planning provides for an increase to the capacity of the existing service in response to project demands. Telstra has recently installed a digital mobile telephone service to cover the operations and Roxby Downs township.

Township development

The first phase of the Expansion Project requires the provision of up to 130 new dwellings for the increased permanent workforce, and the development of two self-contained construction villages with a combined capacity of 1,200 people and provision for expansion to 1,600. The South Australian Government has announced funding for the construction of a medical centre in Roxby Downs, which is expected to be opened in early 1998.

Town planning provides for an additional 200 residential allotments if required, increased open space, pedestrian and cycle pathways, and additional recreation facilities, particularly for teenagers. A new caravan park is also proposed. The town planning also provides for future development of the town to the south, for the possible future second phase of the Expansion Project.

Water supply, sewerage and sewage treatment infrastructure and electricity services would be expanded or replaced as appropriate.

In the conceptual design for the township expansion, particular attention has been paid to the effects of climate, the preservation of vegetation and sand dunes, and the avoidance of Aboriginal heritage sites.

SOCIAL IMPACTS

The principal feature of the social environment for the Olympic Dam operations personnel is the town of Roxby Downs, which was established in 1986 to accommodate Olympic Dam personnel, their families, and the associated commercial and community facilities.

The Roxby Downs Statistical Local Area, which includes the town of Roxby Downs and the Olympic Dam Village, is markedly different in its social characteristics from the surrounding Northern Statistical Division and South Australia as a whole. Population and employment have been declining in the Northern Statistical Division while increasing in the Roxby Downs Statistical Local Area. The population of the latter is younger and better educated, has a higher income and rate of employment, and is characterised by predominantly two-parent families and far fewer single-parent families.

The fundamental social effect of the Expansion Project would be an increase in the number of permanent jobs that are likely to be generated locally. This increase derives from both direct and indirect employment—'direct' referring to employment on the project site and 'indirect' to the non-project workforce employed by the public and private sectors in supporting the project, its workforce and the town.

It is estimated that the direct operational workforce at Olympic Dam will need to increase from 895 to 1,076 by the year 2000. This increase of 181 persons is predicted to consist of 159 new jobs in the mine (120 staff and 39 contractors) and 22 in the process plant (11 each of staff and contractors).

It is also estimated that in 1996 there were between 269 and 358 persons in the indirect operational workforce and that this is likely to increase to between 323 and 430 by the year 2000. This would represent the generation of between 54 and 72 new positions in the indirect operational workforce.

It is expected that an average direct employment of 1,300 construction personnel including management will be required on site, over a two-year period, to expand the mining and processing facilities to enable production to reach 200,000 t/a copper by the year 2000. In addition, between 200 and 300 personnel are likely to be required on a short-term basis from January to April 1998.

It is further estimated that between 130 and 260 indirect jobs based at Olympic Dam will be required to support the two-year construction workforce of 1,300. It is expected that most of these additional indirect jobs will be casual and filled by existing residents of Roxby Downs and Andamooka.

A model was developed for estimating the likely size and social characteristics of the increased population of Roxby Downs resulting from the increased direct and indirect local workforce. From this model, the 1996 population of Roxby Downs of 2,500 is estimated to increase to 3,100 by the year 2000 and to 4,500 by the year 2010.

An assessment was made of the implications of the increased population for the town and its services, including housing, child care and education, community health and medical services, community welfare and support services, recreation and cultural facilities, policing and emergency services, and retail and commercial facilities. The results of the assessment showed that the increase in population resulting from the expansion to 200,000 t/a copper production would have a minimal impact on existing services and facilities.

As part of the EIS process, consultations were held with the communities of upper Spencer Gulf, Roxby Downs and Andamooka. The municipal councils and economic development boards of Whyalla, Port Augusta and Port Pirie expressed a generally positive view of current Olympic Dam operations and of the proposed expansion, which are seen as a source of economic and social benefits to local communities.

In the main, the residents of Roxby Downs liked living there, referring to the town as 'an

oasis in the desert'. Residents generally had a high level of satisfaction but were keen to see a range of specific improvements in the design and functioning of the town. These views have been taken into account by WMC in designing the southern expansion of Roxby Downs.

Overall, apart from reservations about the influx of the construction workforce, the proposed expansion is viewed positively by Roxby Downs residents, with potential benefits including the creation of employment opportunities, with associated social and economic benefits, and a sufficient increase in the population of Roxby Downs to permit a viable expansion of commercial facilities as well as justify an expansion of community services.

Concept plan for future development of Roxby Downs

The impacts on the South Australian and Australian economies of increasing production at Olympic Dam were modelled using a computable general equilibrium (CGE) model which provided estimates of changes in employment, gross state product (GSP) and gross national product (GNP) and a number of other economic indicators.

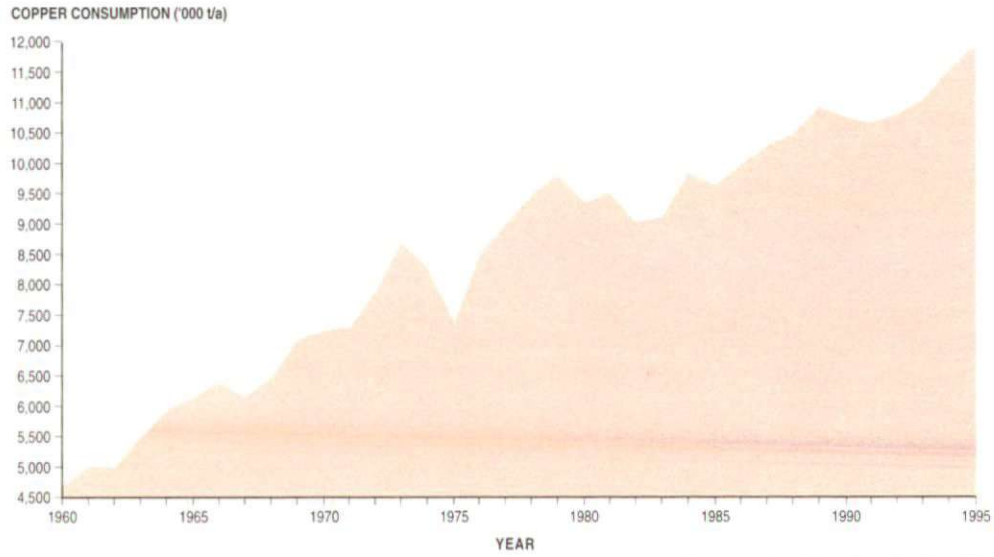
Two phases of expansion were modelled, the first being expansion to production of 200,000 t/a copper, and the second phase being possible future expansion to a production rate of 350,000 t/a. Each phase consisted of a construction period and an operational period, modelled separately.

The construction periods, commencing in the years 1997 and 2008, are relatively short term, generate activity and employment in the construction and service sectors of the economy, and require imports of equipment.

The operational phases, commencing in the years 2000 and 2010, generate employment in mining and processing, and produce metals for domestic use and export. The 'base case' for modelling the expansion to 200,000 t/a is production in 1996–97 of 85,000 t/a, and the base case for expansion to 350,000 t/a is production in 2006–07 of 200,000 t/a. The results reported are changes from the base case for a 'typical year' of construction or operation.

Construction for the first phase of expansion to 200,000 t/a is planned to last for two and a half years. Direct employment at Olympic Dam is estimated at 1,300 jobs. Total employment generated in South Australia is estimated at between 1,750 and 2,500 jobs, with up to 3,000 additional jobs in Australia. (This was the only phase for which employment in the rest of Australia was estimated; all subsequent estimates are the 'low estimate' of employment generation.) It is predicted that the GSP for South Australia would increase by between 0.4% ($120 million) and 0.5% ($150 million), with a negligible increase in GDP.

The operational phase of expansion to 200,000 t/a is expected to employ directly up to 181 people additional to the base case. Total additional employment in South Australia is estimated at 1,100. It is predicted that the South Australian GSP would increase by 0.4% ($115 million) and the GDP would increase by 0.1% ($340 million). Annual royalty payments to the South Australian Government are expected to increase by $12 million, depending on metal prices.



Historical trends in world copper consumption

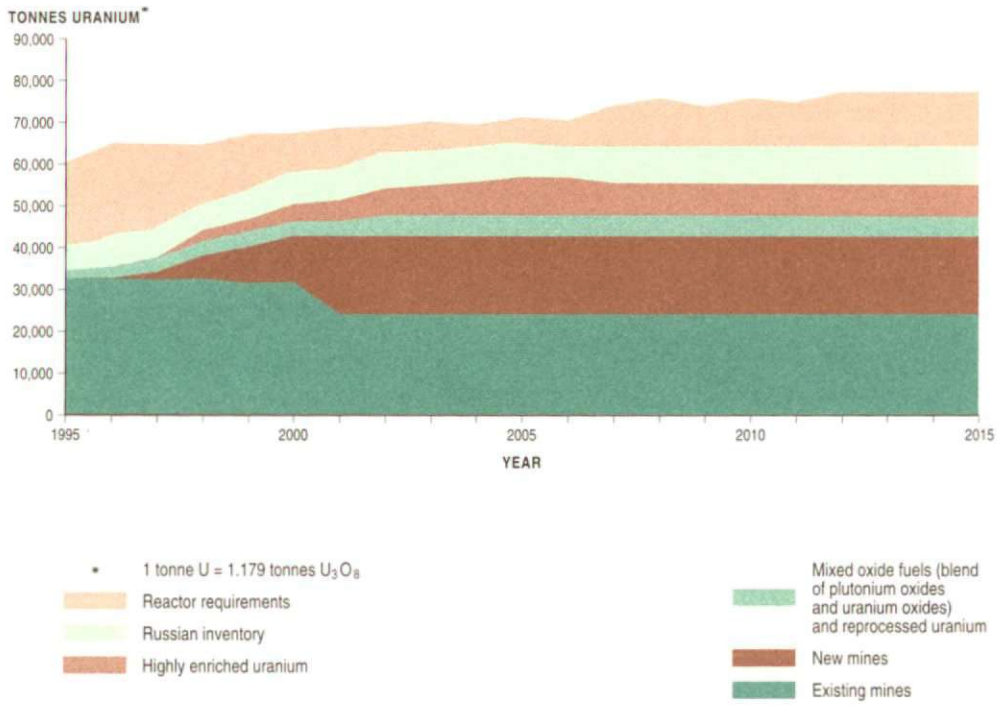
The future possible expansion to 350,000 t/a has been modelled on the basis of a construction phase that would last for two and a quarter years. The construction workforce is estimated to be 1,100 people and total employment in South Australia is estimated at 1,240. The GSP for South Australia is predicted to increase by 0.3% ($87 million) with no change in the GDP.

The employment generated in the operational phase of expansion from 200,000 t/a to 350,000 t/a is predicted to be up to 510 additional jobs at Olympic Dam and a total of 1,190 additional jobs in South Australia. The GSP is expected to increase by almost 0.5% ($135 million) and the GDP by 0.1% ($468 million). The South Australian Government is expected to collect $17 million in royalties each year.

The CGE model was used to estimate impacts of the expansion on other sectors of the economy in investment and output from mining and processing. A minor contraction in some sectors is predicted, particularly in agriculture (and mining during the construction phases) owing to price and exchange rate effects. In all cases, these would be offset in South Australia by the Olympic Dam project and GSP increases. National effects are negligible; however, these contractions lead to slight decreases in GSP in other States, in some of the phases modelled.

A slight increase in the consumer price index is estimated, and this flows through to a need for increased borrowings by the Commonwealth Government to make indexed welfare and other payments. In the construction periods there are short-term negative effects on the balance of trade owing to the importation of equipment. In the operational phases, the impact on the national balance of trade is positive, and predicted to be $96 million annually for 200,000 t/a copper and $124 million annually for 350,000 t/a.

The impacts of the Expansion Project on the South Australian economy would be positive in terms of employment created, revenue raised by the State and contributions to the GSP. Production at a future possible rate of 350,000 t/a would support an additional 2,290 jobs in South Australia, compared with the base case in 1996–97. The estimated increase in GSP of more than 0.5% when operations are at 350,000 t/a is significant in terms of the State's annual total increase in GSP, which has ranged between 1.0% and 5.7% since the beginning of the 1990s.



Forecast uranium supply and demand

REHABILITATION AND DECOMMISSIONING

Olympic Dam has an existing rehabilitation programme to reinstate and revegetate disturbed areas using local indigenous plant species and ensure the long-term viability of rehabilitated areas. Achieving these objectives involves progressively rehabilitating areas disturbed by operational activities and conducting a monitoring programme to assess the effectiveness of rehabilitation, and modifying the programme if needed.

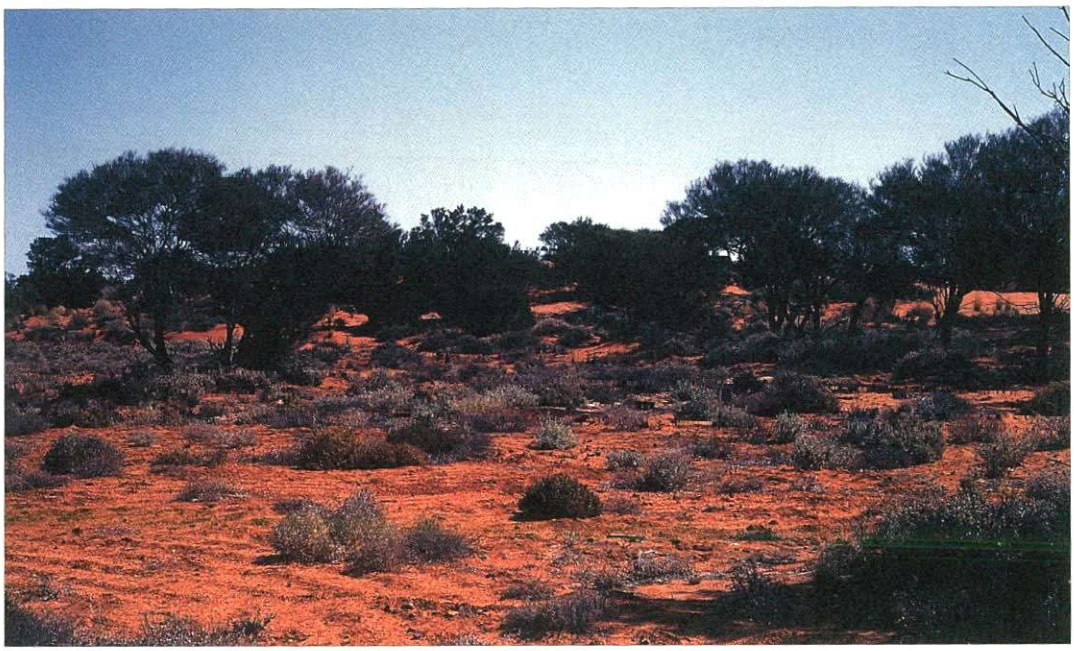
Before land disturbance or construction can begin, a signed environmental clearance form must be obtained from the Environmental Superintendent. The clearance sets conditions that minimise the impact of disturbance and thereby facilitate rehabilitation. All areas disturbed in any significant, adverse way by the Expansion Project would be rehabilitated according to the existing rehabilitation methods and monitored to ensure the completion criteria are met before finalisation of the project.

Rehabilitation planning begins before areas are disturbed and is an integral part of the existing clearance procedure. The existing rehabilitation programme uses passive methods for small areas, which essentially involve leaving them to regenerate naturally, and active methods for larger areas, which require earthworks as well as additional sources of locally collected seed.

Successful rehabilitation programmes undertaken since 1984 include those on drill pad sites, disused access roads and tracks, borrow pits and, most recently, the Borefield B pipeline corridor. Further development of rehabilitation procedures and the continued application of environmental codes of practice will ensure that standards of rehabilitation are either maintained or improved.

The decommissioning of the areas managed by WMC would be to a best practice standard, with rehabilitation success measured by the development of a self-sustaining state in rehabilitated areas compared with undisturbed communities. Final rehabilitation procedures and completion criteria would be included in a decommissioning plan that would be submitted to the South Australian Government for approval prior to implementation. Due to the acidic nature of the tailings, the type and extent of rehabilitation for the tailings storage cells will be determined by the results obtained from ongoing rehabilitation trials.

The rehabilitation procedures and completion criteria contained within the plan would generally focus on such parameters as vegetation species composition, vegetation density, vegetation cover, likely fauna species composition and abundance, water quality, erosion rates, visual quality and land capability.



Photograph: Z. Bowen

Rehabilitated drill pad

Environmental management at Olympic Dam is guided by the EMMP. In addition, the site's Statement of Environmental Commitment requires all employees and contractors to be responsible for implementing environmental management guidelines. Specific personnel, however, are responsible for monitoring, auditing and reporting environmental performance as well as providing specific environmental advice to management, other employees and contractors.

There are environmental management and monitoring programmes undertaken at Olympic Dam covering meteorology, waste management, hydrogeology, airborne emissions, environmental radiation, vegetation, rehabilitation, fauna, borefields (including the mound springs), and community consultation and heritage issues. Reviews of the management and monitoring activities are provided to regulatory authorities in quarterly and annual reports.

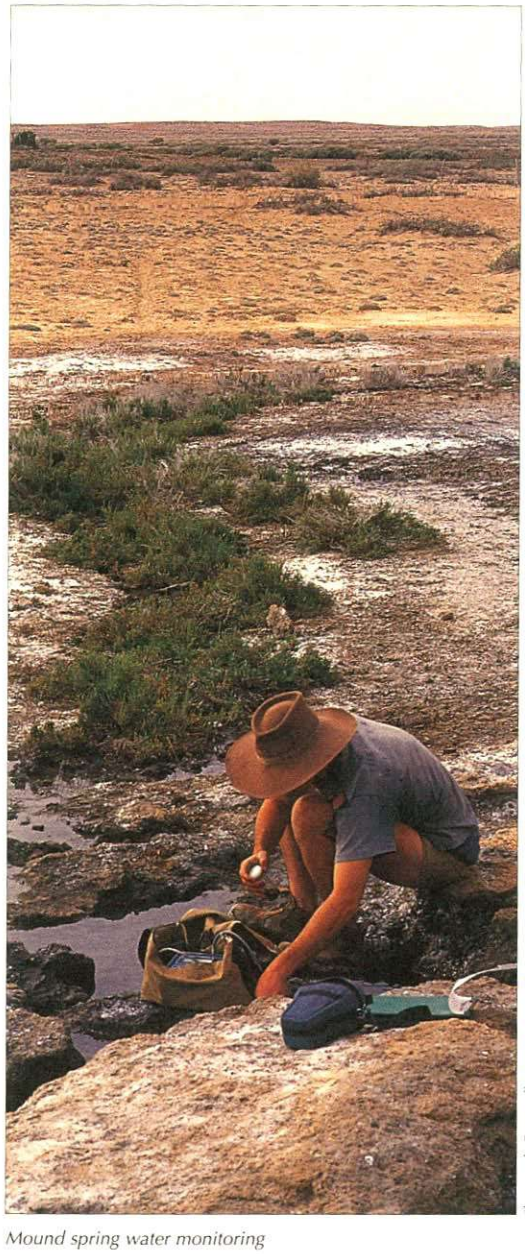
In addition to the statutory requirements placed on WMC, employees are undertaking research programmes in the Olympic Dam area and the surrounding environs which are increasing knowledge of the region's environment to an exceptionally high level.

Environmental management during construction of the Expansion Project would be guided by an environmental code of practice. This code describes the procedures to be followed to minimise environmental impacts and the monitoring and audit process that would be undertaken to verify compliance. The environmental code of practice would be incorporated into construction contracts and issued to all contractors and new personnel as part of the site induction process.

Olympic Dam also has in place a workplace hazard management system, which would continue to be used. A review of existing workplace hazards has been undertaken to provide information for the design of the Expansion Project.

Following the Expansion Project, Olympic Dam would continue to use and store minor quantities of hazardous chemicals. The small inventories of these chemicals, together with established safety procedures and the remoteness of the site, would result in negligible off-site individual and societal risk.

The safeguards that would be adopted for the construction and operation of the Expansion Project are important elements of the proposed overall environmental management. The table overleaf summarises these safeguards together with outcomes that have been predicted based on experience with the existing facilities.



Photograph: D. Niejalke

Mound spring water monitoring

Summary of environmental safeguards

Issue	Environmental safeguard	Predicted outcome
Erosion	Environmental clearance would be required prior to constructing any new works. Progressive rehabilitation would be undertaken.	Experience has shown erosion is controlled effectively by safeguards.
Vegetation disturbance	Environmental clearance would be required prior to constructing any new works. Progressive rehabilitation would be undertaken.	The Expansion Project would result in further clearing for the construction of new facilities. Some amelioration would be provided by progressive rehabilitation. Experience has shown safeguards to be effective in minimising clearance.
Bushfires and other fires	Natural safeguard is provided by characteristics of regional vegetation. Further protection is provided by roads and tracks and the site fire-fighting service.	Bushfires are not expected from site activities. There is a high level of confidence in the site fire-fighting service's ability to contain and control fires.
Changes to groundwater	Design of the tailings storage facilities and evaporation ponds has been based on ensuring seepage is minimal. As a further safety factor, the tailings retention system is also located within the cone of groundwater depression caused by dewatering of mining operations. The existing extensive groundwater monitoring system would be extended to include the new facilities.	Changes in groundwater systems under the Special Mining Lease would be dominated by dewatering of mining operations and the associated mine water disposal pond. No significant or detrimental change in groundwater quality is expected.
Air pollution	Expanded facilities would incorporate additional air cleaning equipment and higher discharge stacks. Improved ventilation of work areas would also be provided.	There would be overall improvement in ambient and workplace air quality.
Water pollution	Processing areas would be sealed and bunded to enable spillages to be collected and returned to the process.	No pollution of surface or groundwater is expected.
Exposure to radiation	A comprehensive range of safeguards is already in place. These include management of working conditions (ventilation), limitation of access, use of protective clothing and equipment, and monitoring.	No significant increases are expected in individual or combined exposure levels. Exposure levels would remain well within current guidelines. There would be a probable reduction in maximum exposure resulting from optimised smelter design.
Pollution from solid and liquid waste	Solid and liquid wastes with potential to pollute would be managed in the tailings retention system.	No significant or detrimental pollution is expected.
Noise	Noise emission limits would be specified in equipment supply contracts. Access would be controlled and hearing protection equipment provided, where required. Workplace noise monitoring would be undertaken.	No noise impacts to residential areas are expected owing to distance from site.
Economics	Expansion Project policy is to use South Australian services and labour as far as reasonably practicable, taking into account technical, quality and delivery considerations.	Olympic Dam would continue to be a significant contributor to the State economy. It would provide both short-term and long-term additional employment and revenue for governments.
Social, recreation and community considerations	Additional housing would be provided at Roxby Downs for the increased operational workforce. Construction personnel would be provided with accommodation and recreation facilities at Olympic Dam Village to minimise the need to interact with Roxby Downs. Arrangements for the provision of social infrastructure at Roxby Downs are contained in the Indenture.	Residents of Roxby Downs would continue to enjoy the benefits of high household incomes and the use of excellent social and recreational facilities.

Summary of environmental safeguards (continued)

Issue	Environmental safeguard	Predicted outcome
Renewable resources (water usage)	Agreed limits on drawdown of potentiometric heads are incorporated into special water licences. Potentiometric heads would continue to be monitored in the borefields region.	Drawdown of potentiometric heads would remain within the agreed limits.
Mound springs	Agreed drawdown limits are set out in special water licences. Ongoing monitoring would be conducted in the EMMP. Enhanced monitoring of Davenport and Welcome spring groups would be undertaken.	Significant positive impact for most mound springs in Borefield A region. Minor to moderate adverse impact on some mound springs in the vicinity of Borefield B (for example, the biologically insignificant Wangianna spring group).
Surface traffic	Transport arrangements during construction would be developed in consultation with relevant authorities.	Some disruption of traffic is inevitable owing to the use of off-site fabrication and hence oversized loads. These loads would have the necessary escorts and provide frequent passing opportunities for other traffic.
Greenhouse gas emissions	WMC has committed to joining the Greenhouse Challenge. An engineer specialising in life cycle analysis has been employed to focus on energy and water use minimisation. Regular energy audits of the site have commenced.	The energy use per unit of production is expected to reduce.
Heritage sites and values	The operations are conducted in accordance with the WMC Indigenous Peoples Policy. Consulting archaeologists and anthropologists consult with the Aboriginal people prior to any construction activities. A Community Liaison Officer is responsible for ongoing consultation with the Aboriginal people.	Disturbance of ethnographic sites would be avoided and disturbances of archaeological sites minimised. Experience with the Borefield B pipeline and the 275 kV transmission line show disturbance of sites of significance can be avoided by careful design and route selection.
Biological diversity	Ongoing monitoring is conducted in accordance with the EMMP.	No reduction in biological diversity of the region is expected. Monitoring and research undertaken by WMC staff and consultants are providing valuable knowledge of the regional environment. WMC also actively controls feral animals and has voluntarily removed stock from previously overgrazed areas.
Design for environmental protection	Environmental design criteria are established prior to commencement of design. Preliminary designs are also reviewed by site staff with responsibility for environmental management prior to finalisation. A signed environmental clearance form is required prior to commencement of construction.	The plant and infrastructure design avoids environmentally sensitive areas wherever practicable. Construction activities are based on facilitation of rehabilitation and are also responsive to previous environmental management experience.
Employee and contractor education	Environmental codes of practice are incorporated into construction contracts. Formal inductions occur for all new employees and contractors on the site, covering safety, environmental issues and radiation management.	There is a thorough understanding of site requirements by all employees and contractors.

Olympic Dam - Statement of Environmental Commitment

WMC (Olympic Dam Corporation) Pty Ltd and its subsidiaries are fully committed to effective management of environmental issues by applying information gained from scientific research, setting environmental objectives and targets, and regular management reviews and innovations. Environmental protection is considered to be an integral part of overall site management strategies.

WMC (Olympic Dam Corporation) Pty Ltd is committed to:

- complying with the WMC Environment and Indigenous Peoples Policies and relevant environmental legislation and regulations as a minimum environmental management standard;

- applying the Australian Minerals Industry Code for Environmental Management, and principles consistent with the ISO 14000 series of Environmental Management Systems standards;

- employing responsible, qualified persons and providing adequate resources and training to all employees;

- actively conducting appropriate environmental research, encouraging innovative environmental solutions, and applying economic environmental best practices;

- liaising with the workforce and community with respect to environmental care and land management;

- assessing, with the aim of minimising, any environmental effects that are likely to occur as a result of developments in the operation of the mine or processing plant;

- maintaining an effective and appropriate environmental monitoring programme.

At WMC (Olympic Dam Corporation) Pty Ltd, all employees and contractors are responsible for ensuring that environmental standards and rules are strictly adhered to. The Environment Section is responsible for educating the workforce on environmental issues and assessing the environmental performance and functions of the operation.

P. M. Bowman

Pearce Bowman
Executive General Manager
WMC Copper Uranium Division