

Phillips River Gold Project Tectonic Resources NL

Environmental Protection Statement

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Phillips River Gold Project – Environmental Protection Statement

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Executive Summary

Introduction and Location

Tectonic Resources NL propose to mine the Trilogy and Kundip Ore Reserves in Ravensthorpe, Western Australia, to produce gold and silver bullion and a copper concentrate with precious metal credits as part of the Phillips River Gold Project (the project).

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The entirety of the Phillips River Gold Project is located in the Shire of Ravensthorpe in the South Coast Region of Western Australia (**Figure 1.1**). Ravensthorpe is located 550 kilometres southeast of Perth and 190km west of Esperance. The Trilogy Project area is located approximately 27km southeast of Ravensthorpe and 23km northeast of Hopetoun. The Kundip Project area is located approximately 17km southeast of Ravensthorpe and 33km northeast of Hopetoun. Access to the Kundip and Trilogy project areas is via the sealed Ravensthorpe-Hopetoun Road. The historical town site of Kundip lies on the western margin of the leases. The RAV 8 processing plant is located 25km east of Ravensthorpe.

The Proposal

The project consists of several components as follows:

- The mining and development of the Trilogy Ore Reserve;
- The mining and development of the Kundip Ore Reserve;
- The construction of an ore haulage road from Kundip to the existing RAV 8 mine;
- The upgrade/refurbishment of the processing plant at RAV 8 and processing of the ore; and
- Disposal of tailings into the RAV 8 open pit void.

The key characteristics of the proposal are given in Table A.

Summary of Existing Environment, Potential Impacts and Proposed Management

This Environmental Protection Statement (EPS) document presents an investigation of the existing environment of the project, followed by an evaluation of the potential environmental impacts associated with the project and management strategies proposed to mitigate any potential impacts. A summary of the existing environment, potential impacts and proposed management as discussed further within this document, is included as Table B. The EPS document has been prepared in consultation with the EPA Service Unit and in accordance with EPA guidelines. The principles of environmental protection have been considered during the preparation of the document, as outlined in Table C below. Tectonics' commitments to managing potential environmental impacts are provided in Table D.

Element	Mining and development of the Trilogy ore body	Mining and development of the Kundip ore body	RAV 8 ore processing and tailings disposal
Life of project (mine production)	5-6 months	4.3 years	4.3 years
Size of Resource (t)	4,200,000	3,700,000	-
Number of open pits	1	9	-
Number of underground operations	0	3	-
Depth of mine pits (m)	44	20 to 85	
Total mined ore (t)	350,000	1,200,000	-
Total waste (t)	1,500,000	8,200,000	
Ore mining rate (maximum)	75K / mth	62K / mth	-
Water table depth (m)	33.5	37	
Area of disturbance (including access) (ha)	29.2	109.7	
Native vegetation to be cleared (ha)	0	69.73 – Kundip 15.07 – Haul Road	-
Operating hours	24 hrs	24 hrs	24 hrs
List of major components • pit • waste dump • treatment plant • infrastructure	See Figure 3.1	See Figure 3.2	See Figure 3.4
Water supply source	Groundwater	Run-off / Ground water	Tails return/ groundwater
Water usage - maximum annual requirement	10,000 m³	30,000 m³	630,000m³
Fuel storage (kL)	55,000	110,000	165,000
Fuel usage	90,000 L LOM	10,500,000L LOM	580 L/hr
Power supply	Hopetoun Grid	Diesel generators	Diesel generators
Haulage times	1 truck/hr 7 days/week	1 truck/hr 7 days/week	10 × 1

Table A Key Characteristics of the Phillips River Gold Project

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Table B

Summary of the Existing Environment, Potential Impacts and Proposed Management Measures for the Project

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Potential Management	Predicted Outcome
BIOPHYSICAL		1			
Vegetation & Flora	To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	Due to extensive farming practices on the Trilogy Site very little native vegetation exists. The cleared farmland paddocks are dominated by <i>Carduus</i> sp. (thistle). 280 native plant species were identified and 18 vegetation units were mapped on the Kundip project area. 23 exotic plant species were identified within the Kundip project area. One proposed Threatened Ecological Community is present within the Kundip project area.	Clearing of 15.07ha of vegetation for the haul road Clearing of approx 70ha of vegetation within the Kundip project area Clearing of 0.0138ha of remnant <i>Eucalyptus</i> mallee species The spread of declared and environmental weeds and dieback. Impacts from increased risk of fire Dust impacts to vegetation along haul road and the Kundip project area. Disruption of water supply to vegetation due to creek diversion.	Clearing of native vegetation will be kept to a minimum – areas will be surveyed and clearly demarcated prior to any works being undertaken. Implement dieback management measures as outlined in a dieback management plan (DMP) to ensure that dieback is not introduced or spread within the project area. Establish fire contingency plan to preserve habitat & to prevent loss of leaf litter in bush > 15 years old Implement protocols that eliminate the introduction or spread of declared and environmental weeds & develop management procedures for eradication of existing declared and environmental weeds within the lease and haul road areas as per the EMMP. Implement Environmental Management and Monitoring Plan (EMMP) and Rehabilitation Plans Purchase of 60ha of vegetated land for contribution to the conservation estate	The loss of native vegetation within the Kundip area and the Haul road will be directly offset through the purchase of 60ha of land for the conservation estate. Additional rehabilitation of historically disturbed areas within the Kundip footprint area will result in a net increase in vegetation cover of 18.91ha. The fate of the haul road post- mining will be determined in consultation with CALM and the Shire of Ravensthorpe. The proposed Threatened Ecological Community will not be impacted.

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Potential Management	Predicted Outcome
DRF & Priority Flora	Protect Declared Rare and Priority Flora, consistent with the provisions of the Wildlife Conservation Act 1950. Protect Flora listed under the EPBC Act.	No Declared Rare or Priority Flora species occur within the Trilogy Site. One Declared Rare species (Marianthus mollis) and ten Priority species (Priority One Melaleuca stramentosa, Priority Two Acacia disticha, A. laricina var. crassifolia and Hydrocotylye decipiens, Priority Three A. durabilis, Boronia oxyantha var. brevicalyx, Dodonaea trifida and Spyridium glaucum, and Priority Four A. pinguiculosa subsp. pinguiculosa and Siegfriedia darwinioides) were identified within the Kundip mining lease but were not listed under the Environment Protection and Biodiversity Conservation Act (1999) (EPBC Act). One Declared Rare species (Marianthus mollis) and six Priority species (Priority One - ,Beyeria sp A Ravensthorpe, Melaleuca stramentosa and Pultenaea calycina subsp proxena, Priority Two Acacia laricina var. crassifolia, and Priority Three Spyridium glaucumwere and Allocasuarina scleroclada subsp. Bandalup) identified along the Haul road.	Potential disturbance of 1 DRF species and 9 priority species at Kundip Disturbance of 1 DRF Species and six priority species within the haul road.	Implement the EMMP. Contribution towards a targeted survey for <i>Melaleuca stramentosa</i> and a regional survey for the proposed <i>Melaleuca</i> -over mallee TEC Contribution of 10% or 10,000 seeds, where practicable, of seed collected from each species to the Millennium Seed Bank. CALM collection of seed from the <i>Marianthus mollis</i> and <i>Allocasuarina scleroclada</i> subsp. <i>Bandalup</i> populations identified within the Kundip mining leases and the gazetted road alignment. Clearly demarcate and survey all the populations prior to clearing adjacent areas. Implement a contract brief prior to the commencement of clearing – that clearly outlines the location & extent of all of the DRF & Priority Flora Avoid construction of spur drains into any of the populations. Monitor for dust impacts along the haul road	Four plants of the Declared Rare Marianthus mollis from a disturbed area will be impacted within the Kundip project area. Current and future survey work and seed collection will expand existing knowledge of rare and priority species range/habitats and recruitment ability. Donations to the CALM Threatened Flora Seed Centre will ensure the likelihood o long term species survival/enhancement.

Factor	EPA Objective	Existing Environment	Potential Impact	Potential Management	Predicted Outcome
Fauna	To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	Fauna habitats closely align with the major vegetation communities, which reflect changes in slope, aspect and soil type. The avifauna survey undertaken at Trilogy recorded a total of ten species of birds comprised of six non- passerines from three families and four passerines from three families. Birds present within the RAV 8 site are expected to be similar to those recorded at Trilogy. It should be noted that a number of black swans currently reside on the saline water storage facility. The fauna survey of the Kundip lease area recorded a combined total of 99 vertebrate species, including 62 species of birds, 11 native mammals, 21 reptiles and three frogs. Over 30 invertebrate taxa were recorded. The bird species were comprised of 18 non- passerine and 38 passerines from a total of 27 families.	Disturbance or modification of habitat through clearing of the Kundip project area and the haul road. Increased introduction of predators through fragmentation Impacts relating to dust, noise and 24-hour light No clearing of vegetation is required at Trilogy Exposure to saline water storage facility at Trilogy and tailings storage facility at RAV 8.	 Implement EMMP. Develop a fauna management plan to the satisfaction of CALM as part of the EMMP, to manage fauna interactions. Keep clearing of vegetation to a minimum. Retain all habitat trees where possible. Retain habitat logs during clearing for use in rehabilitation. Retain fresh water dams for avifauna within the region The establishment of a vegetation corridor between the eastern aspect of the PNR with the vegetation north of the South Coast Highway will enhance faunal movement in this area. Increase employee/community awareness via the site specific environmental induction. Contribution of funds to allow fox baiting of the entire Ravensthorpe Range for five years. Design tailings storage facility (Rav 8) and water storage facility at Trilogy such that birds are deterred Manage dust, noise and light according to acceptable standards as detailed within EMMP. 	Securing 60ha of land for addition to the conservation estate, the establishment of a vegetation corridor and an increase in the ne amount of vegetative cover at Kundip following rehabilitation will ensure that the impact on fauna distribution will be negligible. Contribution to regional fox baitine will ensure that increased predation from foxes due to fragmentation of the landscape w be controlled.

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Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Potential Management	Predicted Outcome
Specially Protected (Threatened) and Priority Fauna	Protect Specially Protected (Threatened) and Priority Fauna and their habitats, consistent with the provisions of the Wildlife Conservation Act 1950. Maintain the abundance, species diversity and geographical distribution of fauna. Protect Fauna listed on the relevant schedule of the EPBC Act 1999	No threatened or schedule listed fauna were identified within the Trilogy project area. The fauna survey of the Kundip Mining leases recorded two Schedule listed fauna and three Priority species. 11 others may occur in the area. Three of the species recorded).were listed under the Environment Protection and Biodiversity Conservation Act Cth (1999); Carnaby's Black-Cockatoo Calyptorhynchus latirostris (Endangered); Malleefowl Leipoa ocellata (Vulnerable) and the Western Whipbird (southern WA subspecies) Psophodes nigrogularis Oberon (Vulnerable	Potential disturbance or modification of habitat, which may result in threatened and priority fauna having to relocate to nearby areas of native vegetation. Noise and artificial light influencing behaviour (including nesting) and movements	As for fauna above, but also: All employees encouraged to complete a sighting form for the recording of malleefowl throughout Western Australia – designed by the Malleefowl Preservation Group. Commitment to sweep the haul road area using the "human chain" technique to detect active Mallefowl breeding mounds, as recommended by the Mallefowl Preservation Group.	Securing 60ha of land for addition to the conservation estate, the establishment of a vegetation corridor and an increase in the net amount of vegetative cover at Kundip following rehabilitation will ensure that the impact on fauna distribution will be negligible. Increased knowledge and survival. of Malleefowl by relocation of active mounds Collaboratively assist Mallefowl Preservation Groups in long term species preservation. Increased awareness and scientific survey of fauna throughout current and future monitoring. Collaborative control of feral animals within the proposed nature reserve with CALM through sponsorship arrangement with project Western Shield
Surface Water Quantity	To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.	The Trilogy and Kundip project areas are located in the Steere River Catchment. There are 2 sub-catchments of Kuliba Creek within the Trilogy project area which are tributaties of the Steere River and there are 11 sub-catchments of the Steere River across the Kundip project area. Stream channels within the landscape are moderately spaced forming an integrated network of	Kundip and Trilogy: Disturbance of ephemeral tributaries of the Steere River Haul Road: potential disturbance to flows of the Steere River at the haul road crossing.	Diversion structures will be constructed around pits and waste dumps, such that surface water flows can be diverted and maintained within the same creek system. Monitoring of downstream dam effects Runoff and erosion control measures will be installed for all cleared areas.	Surface water quantity within the Trilogy project area and haul road will be maintained. A minor disruption to surface water flow will occur within the Kundip project area. Exact effect of drainage interception dams will be closely monitored and early detection of effect will assist in remediation measures.

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		convergent creeks. The main river channel crosses under the Ravensthorpe – Hopetoun Road, 200m south of the Kundip site. The haul road crosses over both the Steere and Jerdacuttup Rivers. The Bandalup Creek, a tributary of the Jerdacuttup River, passes the RAV8 minesite. A drainage channel at RAV 8 was constructed and directs uncontaminated water from the upper part of the catchment away from the lease area into the Bandalup Creek System.		Road crossings which ensure minimal flow disruption will be constructed where the Steere and Jerdacuttup Rivers cross the haul road. Implement EMMP	
Ground Water Quantity	To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.	The main aquifer underlying the Trilogy project area is contained within the silicified shales of the mineralised zone and overlying supergene zone. The Kundip mining area is described as having minor structurally controlled local aquifers. The old mine workings are reported to have intersected water bearing fractures, and there are moderate volumes of water stored in the workings. Previous groundwater inflows to the old workings have been estimated to be up to 500m ³ /day.	Dewatering of the Trilogy and Kundip pits will result in a short term decrease in groundwater levels Groundwater levels will be reinstated within the Rav 8 pit once tailings have been deposited	A comprehensive groundwater monitoring regime will be conducted at Trilogy and Kundip and will be continued at RAV 8. Implement EMMP	Groundwater levels will recover to natural levels post-mining.

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Potential Management	Predicted Outcome
		At the RAV 8 deposit, substantial amounts of saline groundwater are contained within the ultramafic host rock and the underlying felsic unit			
Landform	To maintain the integrity, ecological functions and environmental values of the soil and landform.	Trilogy project area is predominantly flat, with very gentle slopes (2-3%). The Kundip project area lies within the southern part of the Ravensthorpe Range. Accordingly it is undulating with approximately 90m relief between the highest and lowest points of the site. Remnants of historical mining activities including pits and waste dumps are scattered through the site.	The landform of both the Kundip and Trilogy areas will be altered through the construction of pits and waste dumps	The waste dumps will be designed and rehabilitated with native vegetation to ensure that they are compatible with the surrounding environment as far as practicable. The waste dump locations were selected based on areas of greatest pre-existing disturbance. and integration into the surrounding topography	Landforms will be integrated into the surrounding environment.
Ecological Linkages	To maintain the integrity, ecological functions and environmental values of the ecological linkages.	The Kundip project area lies at the southern end of the Ravensthorpe Range and within the vegetation corridor that links the Fitzgerald River National Park to the Crown land north of the South Coast Highway.	Ecological linkages will be disrupted within the Kundip mining area and along the haul road	Re-establishment of ecological linkages within Kundip through rehabilitation of disturbed areas. Pending outcome of discussion with Shire of Ravensthorpe and CALM, potential rehabilitation of the haul road.	Re-establishment of linkages temporarily fragmented during operation through successful rehabilitation.

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Potential Management	Predicted Outcome
Conservation Areas	To protect the environmental values of areas identified as having significant environmental attributes.	The Kundip leases are surrounded by an area of the Ravensthorpe Range recommended by the EPA Red Book (Recommendation 3.8) to become a nature reserve (Proposed Nature Reserve 56). Kundip lies within the eastern sector of the Fitzgerald Biosphere Reserve.	Development of an Ore haulage Road through Proposed Nature Reserve 56 within the gazetted road easement. Potential impacts will include direct loss of vegetation through clearing. Indirect impacts may include the introduction of declared and environmental weeds, dieback and feral animals and dust impacts to flora.	Implement the EMMP and DMP All rainfall runoff and drainage generated within the road reserve will be contained within the width of the road easement where possible. Construction of drainage spurs into DRF & Priority Flora populations will be avoided. The workforce will be educated via specific site induction - including dieback management. Introduce weed management control measures to minimise the risk of spreading and transporting declared and environmental weeds and/or weed seeds. Contribute to regional fox baiting through the Western Shield project	Purchase of 60ha of land for the conservation estate and the management measures described in the EPS document will ensure that there will be negligible impact on the proposed nature reserve in the long term. Pre-existing areas of weed infestations as a consequence of previous disturbance will be eradicated Enhanced knowledge of the <i>Melaleuca stramentosa</i> and <i>Melaleuca</i> -over-mallee populations following additional flora surveys. Reduction in predation by foxes due to contribution to regional fox baiting
POLLUTION MANA	AGEMENT	-			
Air Quality	To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards		Potential dust generation on unsealed haul roads. Potential dust generation during movement of topsoil and overburden material at both Kundip and Trilogy. Potential dust generation during blasting and loading of waste rock and ore. Potential Pb and Cu	Establishment of 50m of bitumen at the entrance and cross over points approved by MRWA on the Ravensthorpe-Hopetoun Road and the South Coast Highway. Use a water cart to control dust within the three project areas, but not the haul road. Ensure vehicular movement is confined to designated tracks/roads within the project area.	Dust emissions will be managed to be within acceptable standards under normal operating conditions.

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Acid Rock Drainage	To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards	Some fresh-phyllite waste material within the Trilogy pit is classified as potentially acid forming (PAF). This material is also enriched in copper and lead and forms a low grade halo around the resource. The other PAF material to be mined includes the transition ore at Kundip, the low-grade primary ore at both Trilogy and Kundip and the primary sulphide ore from Kundip. Some low-grade ore from Kundip is enriched in copper, while the low-grade ore from Trilogy is enriched in both copper and lead. These materials will be transferred to the Rav 8 site for processing.	Some fresh-phyllite waste will remain on-site within the waste dump at Trilogy and has the potential to create acid rock drainage issues and leaching of bioavailable forms of copper and lead. The placement of PAF materials within the tailings storage facility may create acid rock drainage issues and lead to leaching of bioavailable forms of copper and lead if the water table is below the final level.	Trilogy: All potentially acid forming material will be selectively handled and encapsulated within the waste dump landforms such that it is isolated from oxygen and rainfall. Rav 8 Pit: If final water table within the pit is above the tailings-bed surface then the tailings will be submerged and will not be exposed to oxygen and acid formation. If the tailings surface is above the water table, material that is non-acid forming will comprise the surface, Stockpiled oxidised material will be processed at completion for use as a capping if necessary	Acid rock drainage will not create any significant impacts within the Trilogy or RAV 8 project areas.
Noise	To protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards.	The surrounding environment consists of agricultural land and nature reserves.	The activities within the open pit mine that will contribute to the overall noise levels on the site include drilling, blasting and loading the haul trucks. The noise levels generated by the project will not exceed that of a typical mining operation and it is unlikely that noise emissions will have the potential to exceed statutory levels. Noise generated from the movement of road trains along the ore haulage road and the mining operations is	All mobile and plant equipment will be regularly checked to ensure that the noise emissions are within the manufacturers specifications. Constructing noise reducing bunding and educating the workforce in noise awareness. Discussions with the nearest residents have indicated that a small increase in noise will not be a problem. Noise will be monitored to ensure compliance with Part 7, Division 1 of the <i>MSIR (1995)</i> and the	Noise generated by the project will comply with statutory noise and safety regulations.

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			deemed to be non disruptive to movement, nesting and behaviour of fauna within the area.	Environmental Protection (Noise) Regulations 1997.	
Light	To avoid or manage potential impacts from light overspill and comply with acceptable standards.	The surrounding environment consists of agricultural land and nature reserves.	Potential impacts arising from illumination at night may impact directly on fauna and neighbouring dwellings, can potentially create safety hazards on adjacent roads due to glare reducing the visibility of objects, can interfere with night time navigation signalling and reduce the overall environmental night amenity. The impact from light generation within the project areas is considered to be minimal (due to the distance to nearby residence).	Manage light according to Australian Standard AS 4282-1997 Control of Obtrusive Effects of Outdoor Lighting.	Light emissions from the project will comply with acceptable standards.
Greenhouse Gases	To minimise emissions to levels as low as practicable on an on-going basis and consider offsets to further reduce cumulative emissions.	Major sources of emissions from the project are due to consumption of electricity, combustion of fuel in mining equipment and vehicles and land use change.	The total emission does not trigger the value within the established Commonwealth & State policies.	Workforce awareness training to reduce electrical consumption. Increase in the net amount of vegetation cover at Kundip Purchase of 60ha of vegetated land for the conservation estate.	The project will have negligible impact on greenhouse gas emissions.
SOCIAL SURROUN	IDS	11 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1			
Indigenous Heritage	To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.	The project areas lie within the traditional lands of the Bibbulmun People (Southwest Nyungars) and the area around Ravensthorpe was traditionally the domain of the <i>Wadjari</i> tribe.	Disturbance to the Jerdacuttup River System, which is an Aboriginal mythological site in association with Waugul beliefs.	Ethnographic surveys have been undertaken over the project area and the haul road, no sites were discovered within the Kundip or Trilogy Sites. The Minister for Indigenous Affairs has granted approval to construct a crossing over the Jerdacuttup River	Compliance with the <i>Aboriginal</i> <i>Heritage Act</i> 1972.

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Potential Management	Predicted Outcome
		Aboriginal surveys have been conducted and no sites were identified within the Trilogy and Kundip project areas. The proposed Haul road crosses over the Jerdacuttup River which is an Aboriginal mythological site in association with Waugal (Marchant) beliefs.		The informants understood the extent of the leases and survey areas and cleared the leases for the purpose of mining. Preserving some kaolin clays within the pits for traditional uses Report any new Aboriginal Heritage sites discovered during the operation of the project. Avoid impact to yate trees and spear-wood Eucalyptus trees along the haul road	
European Heritage	To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.	A search for items within the Kundip mining area of interest to the Australian Heritage Commission and the Heritage Council of Western Australia identified that the Harbour View Mine Shaft was listed on the backlog of places to be considered for assessment. No other site within the historic Kundip mining area is listed in the register of Heritage places or is subject to either a Heritage Agreement or a Conservation Order.	Potential disturbance to relics of historic mining operations at Kundip	Correspondence from the Heritage Council indicates that the Harbour View mine shaft does not warrant further assessment for consideration for entry in the Register of Heritage Places, however requested a full archive record and archaeological survey be done prior to any disturbance. Preserve historical items and sites at Kundip where feasible	A full archive record and archaeological survey of the Harbour View Mine Shaft will be undertaken prior to any disturbance. No other sites of European Heritage will be impacted by the proposal.
Visual Amenity	To ensure that aesthetic values are considered and measures are adopted to	Trilogy project area is predominantly flat, with very gentle slopes (2-3%).	Potential impacts on visual amenity from the project are as follows:	Transport routes and infrastructure will be designed in accordance with soil properties, hydrology,	Visual impacts on the landscape will be negligible in the long term.

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Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Potential Management	Predicted Outcome
	reduce visual impacts on the landscape as low as reasonably practicable.	The Kundip project area lies within the southern part of the Ravensthorpe Range. Accordingly it is undulating with approximately 90m relief between the highest and lowest points of the site. Remnants of historical mining activities including pits and waste dumps are scattered through the site.	 The creation of a waste dump landform and pit within the Trilogy project area The creation of waste dumps and pits within the Kundip project area The creation of the haul road 	local topography, flora and fauna, such that they best integrate into the landscape. The pH, salinity and nutrient availability of the topsoil and subsoil have been determined, together with collection of seed to ensure successful rehabilitation of the waste dump landforms. Establishment of a vegetated corridor will assist in screening the haul road from the South Coast highway. Rehabilitation of the waste dump at Trilogy with native vegetation will assist in reducing the visual impact.	
Recreation	To ensure that existing and planned recreational uses are not compromised.	A railway heritage walk trail extends along the length of the historic Ravensthorpe- Hopetoun railway which runs along the western aspect of the Kundip project area.	Disruption to a railway heritage walk trail extends along the length of the historic Ravensthorpe-Hopetoun railway. Will not be directly impacted by any mining activities.	A fence will be erected along the length of the trail within the lease boundary.	The railway heritage trail will not be impacted by the project.
Rehabilitation	To ensure, as far as practicable, that rehabilitation achieves a stable and functioning landform which is consistent with the surrounding landscape and other environmental values.		The Trilogy and Kundip operations and the haul road will disrupt the existing landform. The Rav 8 operations have already disrupted the landform	Application of rehabilitation procedures in disturbed areas consistent with long term land uses and conservation values, in accordance with the rehabilitation plans.	Post-mining landscape supports the same uses and functions to that which existed pre-mining, to a definitive level.

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Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Potential Management	Predicted Outcome
ITEGRATING FAC	TORS				
iodiversity	Maintain the abundance, species diversity, geographic distribution & productivity of terrestrial flora and fauna	249 native plant species were identified and 18 vegetation units were mapped on the Kundip project area. A combined total of 99 vertebrate species, including 62 species of birds, 11 native mammals, 21 reptiles and three frogs and over 30 invertebrate taxa were recorded. Kundip project area lies within the Fitzgerald Biosphere Reserve, next to a proposed nature reserve and within the vegetation corridor that links the Fitzgerald River National Park to Crown land north of the South Coast Highway.	Short to medium term loss of some individuals of native flora species. Short to medium term loss of portions of some vegetation communities Short to medium term loss of fauna habitat	Clearing of native vegetation will be kept to a minimum – areas will be surveyed and clearly demarcated prior to any works being undertaken. Implement dieback management measures as outlined in a dieback management plan (DMP). Establish fire contingency plan to preserve habitat & to prevent loss of leaf litter in bush > 15 years old Minimise introduction of declared and environmental weeds & develop an Environmental Operations procedure for management and eradication of the declared and environmental weeds within the lease area Implement EMMP and Rehabilitation Plans Purchase of 60ha of vegetated land for contribution to the conservation estate Contribution towards a targeted survey for <i>Melaleuca stramentosa</i> and a regional survey for the proposed <i>Melaleuca</i> -over mallee TEC Contribution of 10% or 10,000 seeds, where practicable, of seed collected from each species to the Millennium Seed Bank.	The loss of native vegetation within the Kundip area and the Haul road will be offset through the purchase of 60ha of vegetated land for the conservation estate. No reduction in the diversity of native flora and fauna species occurring in the area. An increase in the knowledge of biodiversity values within the area due to vegetation, flora and fauna surveys conducted already and in the future.

Environmental Factor	EPA Objective	Existing Environment	Potential Impact	Potential Management	Predicted Outcome
Offsets		Not applicable	Not applicable	 Offsets for the clearing of 85ha of native vegetation within the project area include: The purchase of 60ha of vegetated land for contribution to the conservation estate The rehabilitation of 18.91ha of previously disturbed land Contribution of funds to allow fox baiting of the entire Ravensthorpe Range for five years (\$10,000/yr) Targeted survey of <i>Melaleuca stramentosa</i> to the value of \$10,000 Regional survey of the proposed <i>Melaleuca</i>-over-mallee TEC, to the value of \$10,000 Contribution of 10% or 10,000 seeds, where practicable, of seed collected from each native species to the Millennium Seed Bank. 	The offset package proposed will succeed in offsetting any impacts associated with clearing of 85ha of vegetation within the project area.
Cumulative Impacts		Other mining operations within the Ravensthorpe region include the BHP Billiton Nickel Operations and the Tectonic Resources Nickel Operations.	Potential cumulative environmental impacts of mining in the region. The scale of this project is small in comparison to the BHP Billiton project and therefore its contribution to a cumulative impact on regional biodiversity values is negligible.	Clearing of native vegetation will be kept to a minimum – areas will be surveyed and clearly demarcated prior to any works being undertaken. Implement dieback management measures as outlined in a dieback management plan (DMP). Establish fire contingency plan to preserve habitat & to prevent loss of leaf litter in bush > 15 years old Implement EMMP and Rehabilitation Plans Purchase of 60ha of land for contribution to the conservation estate	Purchase of 60ha of vegetated land for inclusion within the conservation estate, an increase in the net amount of vegetative cover at Kundip following rehabilitation and the scale of the project will ensure that it will have negligible contribution to the cumulative impact of mining in the region.

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Principle	Relevant Yes/No	If yes, consideration		
 The precautionary principle Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In application of this precautionary principle, decisions should be guided by – (a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and (b) an assessment of the risk – weighted consequences of various options. 	Yes	Thorough scientific investigations of potential environmental impacts have been undertaken, such that all potential impacts are understood and documented.		
2. The principle of intergenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.	Yes	Scientific investigations, flora and fauna surveys, sound rehabilitation principles and strong corporate commitment ensure rehabilitation success, disturbance rectification or offset and increased knowledge for future generations		
3. The principle of the conservation of biological diversity and ecological integrity Conservation of biological diversity and ecological integrity should be a fundamental consideration.	Yes	Comprehensive flora and fauna surveys of the project area have been undertaken to enable management strategies to be developed that ensure that the biological diversity and ecological integrity of the area is maintained.		

Table C Consideration of the Principles of the Environmental Protection Act 1986 (Section 4A).

Principle	Relevant Yes/No	If yes, consideration
 4. Principles relating to improved valuation, pricing and incentive mechanisms Environmental factors should be included in the valuation of assets and services. The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement. The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste. Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solution and responses to environmental problems. 	Yes	Tectonic have already commenced thorough investigative studies it identify any potential contamination and have implemented control measures which should minimise any predicted impact. The comprehensive monitoring programme proposed by Tectonic will allow easy detection of any adverse impact and contingencies for alleviation have been considered.
5. The principle of waste minimisation All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	Yes	To be addressed in EPS.

Table D

Proposed Proponent Environmental Management Commitments

No.	Topic	Objective	Commitment	Timing	Advice
1	Environmental Management and Monitoring Plan	Prepare and implement an Environmental Management and Monitoring Plan that describes procedures and practices for protection of key environmental aspects during all phases of mining.	 Prepare and implement an Environmental Management and Monitoring Plan that addresses the following: Information management and document control Stakeholder identification Protection of vegetation and flora Management of fauna including feral animal control Management of declared and environmental weeds Protection of water resources including surface water management Management of dangerous and hazardous substances Management of or size Management of noise Management of visual amenity Management of risk Protection of heritage values Programs for monitoring, auditing and review for the purposes of performance assessment and continual improvement. 	Prior to project commencement, during development, operation and decommissioning	CALM DoE DoIR
2	Conservation Offset	Provide a contribution to regional conservation that will offset the clearing of native vegetation within the Kundip project area and the haul road.	 Purchase a 60ha parcel of vegetated land for contribution to the conservation estate Contribute \$10,000/yr to the Western Shield project to allow fox baiting of the entire Ravensthorpe Range for five years Contribute \$10,000 towards a targeted survey of <i>Melaleuca stramentosa</i> Contribute \$10,000 towards a regional survey of the proposed <i>Melaleuca</i>-over-mallee TEC Contribute 10% or 10,000 seeds where practicable, of seeds collected from each native species to the Millennium Seed Bank. 	Commitment to purchase land prior to project commencement Other contributions throughout life of project as determined appropriate	CALM EPA
3	Rehabilitation and Closure	To ensure, as far as practicable, that rehabilitation achieves a stable and functioning landform which is consistent with the surrounding landscape and other environmental values.	Implement the Rehabilitation and Preliminary Closure Management Plans for the haul road and the Kundip and Trilogy project areas.	Commencement of project	CALM DoIR DoE
4	Dieback	To ensure that dieback is not introduced into the Kundip project area, haul road and surrounding vegetation.	Prepare and implement a dieback management plan that includes measures to prevent the spread of dieback into any of the project areas	Prior to project commencement	CALM

No.	Topic	Objective	Commitment	Timing	Advice
5	Fire	To ensure that appropriate strategies are in place to prevent or control fire.	Prepare and implement a fire management plan	Prior to project commencement	CALM
6	Vegetation and Flora Conservation	To minimise impacts from the implementation of the proposal to local vegetation and flora.	 Keep clearing to a minimum and avoid disturbance of DRF and Priority species where possible. Educate the workforce on DRF and Priority flora conservation. Demarcate, avoid and monitor the following populations within the Kundip project area: The Marianthus mollis population to the north of the northern waste dump; The Marianthus mollis population to the south-east of the southern waste dump; The two western-most Hydrocotylye decipiens populations The entire Mx vegetation unit containing the newly described Melaleuca sp Kundip and Pultenaea sp Kundip Demarcate and take measures to exclude disturbance to populations of Melaleuca stramentosa that will not be directly impacted through clearing Avoid construction of spur drains into the Declared Rare Marianthus mollis and Priority 3 Allocasuarina scleroclada subsp. Bandalup populations during haul road realignment and construction Monitor populations of Declared Rare Marianthus mollis, (Haul road and Kundip) Priority 3 Allocasuarina scleroclada subsp Bandalup(haul road) and Priority 1 Melaleuca stramentosa (Kundip) for dust impacts.	Commencement of project	CALM
7	Fauna	To minimise impacts from the implementation of the proposal to local fauna populations.	Contribute to threatened species preservation Contribute to Western Shield Project fox baiting program (10,000/yr for five years) Provide alternative water sources for fauna in the vicinity of the tailings storage facility	Commencement of project	CALM
8	Light	To avoid or manage potential impacts from light spill to the surrounding environment.	Manage light according to Australian Standard AS 4282-1997 Control of Obtrusive Effects of Outdoor Lighting	Commencement of project	DolR
9	Dust	To ensure that dust emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses.	Manage and monitor dust in accordance with acceptable standards	Commencement of project	DoE DoIR

No.	Topic	Objective	Commitment	Timing	Advice
10	Noise	To protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards.	Monitor mining noise levels to ensure compliance with Part 7, Division 1 of the <i>MSIR (1995)</i> , as well as the <i>Environmental Protection (Noise) Regulations 1997</i> .	Commencement of project	DoE DoIR
11	Waste	To ensure that waste does not adversely affect the environment.	Encapsulate potentially acid forming and metal-enriched material so that is isolated from oxygen and rainfall.	Commencement of project	DoE DoIR
12	Aboriginal Heritage	To ensure that Aboriginal Heritage sites are not adversely affected by the proposal.	Report any new Aboriginal heritage sites discovered during development of the Project to the register of the Department of Indigenous Affairs.	Commencement of project	DIA
13	European Heritage	To ensure that impacts to European Heritage sites are minimised	Conduct a full archive record including an archaeological survey of the Harbour View mine shaft prior to any development.	Prior to commencement of project	Heritage Council of WA

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1.0 INTRODUCTION

1.1 The Proposal

Tectonic Resources NL propose to mine the Trilogy and Kundip Ore Reserves in Ravensthorpe, Western Australia, to produce gold and silver bullion and a copper concentrate with precious metal credits as part of the Phillips River Gold Project (the project). The project consists of several components as follows:

- The mining and development of the Trilogy Ore Reserve;
- The mining and development of the Kundip Ore Reserve;
- The construction of an ore haulage road from Kundip to the existing RAV 8 mine;
- · The upgrade/refurbishment of the processing plant at RAV 8 and processing of the ore; and
- Disposal of tailings into the RAV 8 open pit void.

The key characteristics of the proposal are given in Table 1.1.

1.2 The Proponent

The proponent for the project is Tectonic Resources NL. Tectonic Resources NL is a publicly listed company having been formed some 12 years ago. The company has a track record of mining and exploring for both gold and nickel. The company successfully mined and processed gold ore from a combination of open pit and underground mines at Mt Dimer (150kms NE of Kalgoorlie) over a 4 year period producing some 140,000 oz of gold. The company then acquired the RAV 8 nickel deposit (25kms east of Ravensthorpe) which commenced open pit mining and onsite processing in 2000. Open pit mining and processing continued for 18 months with the processing plant decommissioned. Subsequent ore from underground mining is toll processed through WMC's Kambalda processing plant. Mining ceased from RAV 8 in early October 2005. The company has been actively exploring the Ravensthorpe area for some 3 years with success and the Phillips River Gold Project is the culmination of all this work. Tectonic has more recently taken on a joint venture to mine and process ore from a deposit called Burnakura situated 50kms south east of Meekatharra.

The proponent can be contacted at: Tectonic Resources NL Suite 4 100 Hay Street SUBIACO WA 6008

The key contact for the proposal is: Mr Steve Norregaard - Managing Director Ph: (08) 9388 3872 Fax: (08) 9388-1077 Email: steve.norregaard@tectonicres.com.au

Table 1.1	Key Characteristics	of the Phillips	River Gold Proje	ect
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Element	Mining and development of the Trilogy ore body	Mining and development of the Kundip ore body	RAV 8 ore processing and tailings disposal	
Life of project (mine production)	5-6 months	4.3 years	4.3 years	
Size of Resource (t)	4,200,000	3,700,000		
Number of open pits	1	9		
Number of underground operations	0	3	÷	
Depth of mine pits (m)	44	20 to 85	4-	
Total mined ore (t)	350,000	1,200,000	-	
Total waste (t)	1,500,000	8,200,000		
Ore mining rate (maximum)	75K / mth	62K / mth	+	
Water table depth (m)	33.5	37		
Area of disturbance (including access) (ha)	29.2	109.7	4	
Native vegetation to be cleared (ha)	0	69.73 – Kundip 15.07 – Haul Road	-	
Operating hours	24 hrs	24 hrs	24 hrs	
List of major components pit waste dump treatment plant infrastructure	See Figure 3.1	See Figure 3.2	See Figure 3.4	
Water supply source	Groundwater	Run-off / Ground water	Tails return/ groundwater	
Water usage - maximum annual requirement	10,000 m³	30,000 m³	630,000m³	
Fuel storage (kL)	55,000	110,000	165,000	
Fuel usage	90,000 L LOM	10,500,000L LOM	580 L/hr	
Power supply	Hopetoun Grid	Diesel generators	Diesel generators	
Haulage times	1 truck/hr 7 days/week	1 truck/hr 7 days/week		

1.3 Location

The entirety of the Phillips River Gold Project is located in the Shire of Ravensthorpe in the South Coast Region of Western Australia (**Figure 1.1**). Ravensthorpe is located 550 kilometres southeast of Perth and 190km west of Esperance. The Trilogy Project area is located approximately 27km southeast of Ravensthorpe and 23km northeast of Hopetoun. The Kundip Project area is located approximately 17km southeast of Ravensthorpe and 33km northeast of Hopetoun. Access to the Kundip and Trilogy project areas is via the sealed Ravensthorpe-Hopetoun Road. The historical town site of Kundip lies on the western margin of the leases. The RAV 8 processing plant is located 25km east of Ravensthorpe.

1.4 Land Tenure

All the Phillips River Gold Project tenements are located within the Phillips River Mineral Field. The mining leases that comprise the Phillips River Gold Project are 100% owned by publicly-listed company Tectonic Resources NL (Tectonic). Tectonic has undertaken a boundary survey of all the lease areas affiliated with development of the Phillips River Gold Project (**Figure 1.2**).

The Trilogy deposit is situated on mining tenement M74/176 totalling 937ha within the Myamba farm totalling 1200.19ha and comprised of Oldfield Location 83, 84 and 86. The tenure of Myamba farm is freehold farmland, which is 100% owned by Tectonic.

The Kundip project area encompasses five mining tenements, one prospecting tenement and one miscellaneous tenement, all owned 100% by Tectonic as listed below.

Tenement	Name	Ownership
M74/41	Western Gem	Tectonic 100%
M74/51	Kaolin/Two Boys Tectonic 100%	
M74/53	Gem Restored Tectonic 100%	
M74/135	1	Tectonic 100%
M74/121		Tectonic 100%
P74/153		Tectonic 100%
L74/34		Tectonic 100%

Table 1.2	Kundip	Tenements	and	Ownershi	p

The proposed haulage route is encompassed within M74/176, M74/51, Gazetted Road No. 8432, Oldfield Location 62 and 63, and M74/13. Gazetted Road No. 8432 is vested with the local government authority, the tenure is road reserve. The alignment of gazetted road 8432 transects

Oldfield Location 56 owned by the Daw Family. The tenure of Oldfield location 62 and 63 is freehold farmland owned and managed by the Burton Family.

The RAV 8 project area falls within mining tenement M74/13.

Tectonic maintains a good working relationship with the Shire of Ravensthorpe and the Daw & Burton families who are supportive of the project. Letters from the Shire of Ravensthorpe, and the Daw and Burton families affirming that the proposed works are acceptable to the lessee are included in **Appendix A**.

1.5 History

In 1892 Brothers Stennett first discovered gold in small quantities in conjunction with copper and pyrite, however, with the scarcity of freshwater and the major gold discoveries made at Coolgardie, further prospecting in the area was abandoned until 1893 when H.P. Woodward (government geologist) visited the Phillips River Mining District and recommended thorough prospecting. Dunn Brothers, of Cocanarup, had discovered auriferous quartz in the reef now known as the "Jim Dunn Wonder," in the early part of 1899. This discovery was soon followed up by the discovery of the Floater reef, by Kingsmill, Graig, Stephenson, and party, which, from its richness, led to more extensive prospecting in the vicinity. The discovery of these gold reefs was quickly followed by that of the copper lodes in the vicinity of Ravensthorpe, also at the foot of the range to the north-eastward, which later became known as the Mt. Benson group (Woodward, 1909). In 1900 further discoveries occurred at the Mt. Desmond and Kundip centres.

In 1972 the Geological Survey of Western Australia conducted an excursion through the Ravensthorpe/Kundip area. The general consensus of opinion had been that the area lacks potential for either undiscovered mineralisation or extensions to known mineralisation of sufficient tonnage to allow a viable mining operation (Willett and Jessup, 1975). The opinion was derived by the lack of exploration activity experienced in the area.

In 1975 Union Miniere (Unlimited) entered into a joint venture with Hollandia. Union Miniere conducted geological mapping of the area at a scale of 1:2000 (reference DWG No. 2236). They also conducted soil sampling, magnetometer and IP surveys (results outlined an anomalous area in the vicinity of the Harbour View mine, reference DWG No. 2242).

In 1984 Norseman Gold Mines N.L. (NGM) attempted to quantify the tonnage and gold grade of the near surface oxide ore within the Kundip area. Younger (1984) noted that several samples were taken in accessible locations underground and had been combined with the costean samples to determine oxide ore reserves. NGM commenced mining and milling operations centred on both open pit and underground operations which were ceased in 1989.

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The leases were picked up by prospectors (D & R Walker) who worked the ground until selling it on to Glengold Holdings in 1992. Glengold Holdings sold the tenement package onto Tectonic Resources NL (Tectonic) in 1994.

Throughout 1995, Tectonic consolidated surface drilling data (some 1200 holes dating from 1934-1980s) for the Kundip area into a central database. Most of the historic mining centre is within the mining lease M74/51 that consists of 568 ha. In 1996 Tectonic applied for an exploration license for the area south and west of Kundip (ELA 74/194) to cover extensions of mineralised shears within the mining lease. Exploration work was previously carried out by National Mine Management for Tectonic, with further work done in 1996 by Continental Resource Management Pty Ltd for Tectonic.

In 1996, Tectonic signed the Kundip Joint Venture (KJV) agreement with Homestake Gold of Australia Limited (HGAL), in which HGAL earned a share in the tenement holdings based on specified exploration expenditure. The JV agreement included all tenements associated with the historical Kundip Mining Centre along with extensive exploration tenements to the south. This JV agreement was terminated in October, 2003. Tectonic subsequently bought back 100% ownership of the entire tenement package subject to the KJV in January, 2004.

Gazetted Road No. 8432 is an existing track that will be upgraded for haulage of ore from the Kundip mining leases through to RAV 8 (Figure 1.2).

The Trilogy deposit is located in an area of Western Australia that was developed for farming (land release packages) post World War II.

2.0 EXISTING ENVIRONMENT

2.1 Regional Setting

The Trilogy deposit is located on cleared farmland south of the Kundip Nature Reserve (No. 31128) (**Figure 2.1**). The site of the project is bordered by the Ravensthorpe-Hopetoun Road to the west and surrounded by freehold farm land. To the west of the Ravensthorpe-Hopetoun Road is Unallocated Crown Land (UCL). The general topography of the Trilogy Project area is flat, with little remaining perennial vegetation except for a narrow strip along a drainage line immediately east of the deposit. The Whoogarup fault transects the Myamba farm in a southwest – northeast direction south of the proposed open pit.

The Kundip project area lies at the southern end of the Ravensthorpe Range and within the vegetation corridor that links the Fitzgerald River National Park to the Crown land north of the South Coast Highway (Figure 2.1).

Kundip lies within the eastern sector of the Fitzgerald Biosphere Reserve, in the zone of cooperation. The Biosphere Reserve is a part-tenured management concept recognised by UNESCO as well as State and Commonwealth governments. The concept includes a *core area* (the Fitzgerald River National Park (FRNP) 329,000 ha), a *buffer zone* (Crown land and some unvested reserves totaling 130,000ha) and a *zone of cooperation* (private freehold farmland including 557,000ha cleared and 160,000ha uncleared). As such this Biosphere is one of only two in Western Australia, but more importantly one of only two *functioning* biosphere reserves in Australia (Bradby 1989, CALM 1991).

It is functioning because of community recognition of land management systems and practices in both the buffer and co-operation zones. In recognition of this both UNESCO and Commonwealth funding has been available for management. Mining, subject to sound environmental management practices, is one of many human impacts considered to be acceptable in the zone of cooperation. The holistic 'big picture' approach adopted by the Biosphere concept is important for this and another reason, i.e. it acknowledges that man and his activities are part of the environment in which we live, but that they do require appropriate management.

The Fitzgerald Biosphere project and CALM's *South Coast Region* management plan (1992) both recognise the Ravensthorpe Range vegetation as an important linkage between the Fitzgerald River National Park and Crown land east of the Vermin Proof Fence which extends to the southern Goldfields.

The project is also within one of 15 national biodiversity hotspots as listed by the Commonwealth Department of Environment and Heritage (<u>http://www.deh.gov.au/biodiversity/hotspots/index.html</u>).

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The Kundip leases are surrounded by an area of the Ravensthorpe Range recommended by the EPA Red Book (Recommendation 3.8) to become a nature reserve (Proposed Nature Reserve 56) (Figure 2.1).

There are no World Heritage properties or Ramsar wetlands within the Shire of Ravensthorpe. Mining of the Kundip and Trilogy ore reserves by Tectonic will not impact on any Commonwealth marine areas, Commonwealth land or conservation reserves or parks.

2.2 Climate

Temperatures at the Kundip and Trilogy Project sites are expected to reflect more closely those recorded at Ravensthorpe than Hopetoun.

Summer months are warm with humid days, episodic rainfall events are generated mostly from thunderstorms. The hottest month on average is January with an average daily maximum of 29.2°C and a minimum of 14.0°C. When the wind is from the north temperatures can exceed 38°C by mid-morning. The climate of this region is influenced by the Southern Ocean - typically the cool southeast breeze reaches inland by mid-afternoon.

The winter months usually have cold nights with occasional frost and mild days. The coldest month is July with an average daily maximum of 16.2°C and minimum of 6.8°C. Gale force winds are not frequent but periods of low to moderate wind velocities occur through the year.

The average rainfall for Ravensthorpe is 427.7mm, with half the annual rainfall falling between May and September. The rainfall intensity estimation for Ravensthorpe for a 1 in 100 year ARI 72 hour storm event is 180mm. The average Class A pan evaporation for Ravensthorpe is 1987mm per annum (Luke *et. al.*, 1988), thus potential evaporation is greater than the annual rainfall.

2.3 Geology

Regional Geology of the Phillips River Gold Project Area is illustrated in **Figure 2.2**. The geology of the individual project areas is summarised below:

2.3.1 Trilogy

The Trilogy copper-gold-silver-lead-zinc deposit is hosted in shale contained within the Mt Barren Beds, a Proterozoic sedimentary sequence that outcrops along the south coast of Western Australia between Bremer Bay and Hopetoun. The host sequence is dominated by black shale, with lesser quartzite units. The deposit remains conformable with the lie of regional stratigraphy. A large siliceous alteration halo surrounds the mineralisation. In the oxidized horizon, the mineralised zone is often difficult to define. In the sulphide zone the mineralisation is identifiable by silicification and significant sulphides. The typical sulphide assemblage is represented by pyrite–covellite–chalcopyrite–galena-sphalerite.

The deposit comprises three sub-parallel ore zones that extend over a minimum of 280m of strike and dip to the southeast at about 40°. The mineralisation tends to be copper and gold rich to the south and lead and zinc rich to the north. Their thicknesses range from 10m to 30m, generally separated by barren material varying from 5m to 30m in thickness.

The fundamental nature of the Trilogy mineralisation relates back to large, broad alteration halos. The grade distribution is generally zonal with grade changes generally gradational. These features and how they relate to data density were considered when the resource was classified. The resource estimation has been based on a lower cut-off grade of 1.0% Cu sulphide equivalent.

The total global resource of the Trilogy deposit is presented in **Table 2.1**. This resource figure represents mineralisation greater than a 1.0% Cu sulphide equivalent value. From this resource a mineable reserve has been calculated and is presented in **Table 2.2**. This reserve figure represents what is economically viable in the current cost climate and today's commodity prices. It presents a poor Resource to Reserve conversion although this ratio could change if the external economic factors were to vary.

Trilogy Total Resource							
Category	Volume	Tonnes	Ag	Au	Cu	Pb	Zn
			(g/t)	(g/t)	(%)	(%)	(%)
Measured			÷200	4	Ŧ	-	-
Indicated	992,875	2,908,599	74.75	1.03	1.34	3.63	1.93
Inferred	443,100	1,279,120	23.03	0.94	1.36	1.14	0.84
Grand Total	1,435,975	4,187,719	58.95	1.0	1.35	2.87	1.60

Table 2.1. Trilogy - Total Resource as at 31st August 2004

Table 2.2. Trilogy - Total Reserve

Trilogy Total Reserve							
Category	Volume	Tonnes	Ag	Au	Cu	Pb	Zn
			(g/t)	(g/t)	(%)	(%)	(%)
Proven		-		-	4		
Probable	109,174	272,936	80.6	2.82	0.75		
Grand Total	109,174	272,936	80.6	2.82	0.75		

The base of oxidation occurs at approximately 38–40m vertical depth. Above this level gold and silver mineralisation predominates, with depletion of the base metals except for some copper carbonate minerals close to the base of oxidation. A distinct zone of higher-grade supergene enrichment exists between 40m and about 60m vertical depth. The sulphide resource continues from approximately 40m below surface to a maximum currently defined depth of 150 vertical metres. Significant gold and silver credits occur throughout the sulphide zone.

The better grade oxide gold/silver mineralisation occurs above the copper gold sulphide ore and the higher grade oxide silver mineralisation occurs above the lead zinc sulphide ores. The deposit is currently drilled out at between 40m by 40m and 40m by 20m spacing with some of the more recent drilling detailing the shallow oxide gold resource at 20m by 20m spacing. This drilling, plus previous drilling completed by Homestake indicates the deposit is still open down-plunge to the north and south for up to 80m and down-dip to at least 200m vertical depth.

In the oxide zone, the gold and silver elements are the main contributors with copper having a lesser role. In the sulphide zone, copper, silver and gold contribute in order of importance. In the economic model the lead-zinc mineralisation currently has zero value, reporting only as penalty elements in the copper concentrate. Metallurgical work continues with the aim of extracting economic worth from the lead-zinc mineralisation.

Graeme Campbell & Associates Pty Ltd (GCA) was commissioned to carry out geochemical test work on a range of regolith-material; waste bedrock and low-grade-ore samples derived from the Trilogy and Kundip deposits. Please refer to **Appendix B**.

The Trilogy deposit is characterised by a soil/regolith profile which is c. 30-40 m thick, and comprises a Clay-Rich-Zone (c. 3-5m thick) overlying a Weathered-Shale-Zone. The geochemical analysis results indicate that the waste material generated from the soil/regolith profile is non-acid forming, contains negligible amounts of sulphide minerals, and is mildly alkaline (viz. pH 8-9), with moderate contents of soluble-salts. However, the saprolitic-phyllite may be enriched in Pb especially at depth. A sample of light-brown-clay had a high capacity to consume acid and likely reflects the occurrence of "pedogenic-calcite" in the soil profile. The samples of the regolith materials from depth had a negligible capacity to consume acid (**Appendix B**).

The fresh-phyllite waste rock >0.2-0.3% Sulphide-sulphur is classified as potentially acid forming (PAF), and most probably as PAF (Short Lag). This waste rock is also generally enriched in an array of chalcophyles (especially Cu and Pb) and soluble –Cu and –Pb forms will be released from exposed fresh-phyllite with increasing weathering.

The test work results from representative samples of the low grade ore from the Trilogy deposit indicate that the samples of the Low-Grade-Oxide-Ore and Low-Grade-Transition-Ore are non acid forming, and reflect groundmasses devoid of both sulphide and carbonate materials. The samples of
Low-Grade-primary-Ore were classified as potentially acid forming and reflect "accessory sulphides" in a groundmass devoid of carbonate minerals. All low grade ore samples are enriched in copper (Cu) and lead (Pb) and contain soluble –Cu and –Pb forms that would be released at circum-neutral pH.

2.3.2 Kundip

The Ravensthorpe Terrane, hosting the Kundip mining centre, is a calc-alkaline complex consisting of the Annabelle Volcanics and the Manyutup Tonalite. The Annabelle Volcanics consists of basalt, andesite and dacite with minor occurrences of dolerite. The proportion of dacite increases from near the Ravensthorpe Township, southeast toward Kundip, and southwest toward West River (Witt, 1998). Pervasive alteration occurs through the Annabelle Volcanics as disseminations and discontinuous veinlets. Secondary quartz, biotite, chlorite, epidote and sericite are common. The Manyutup Tonalite varies in composition from diorite to granodiorite but is mainly tonalite. Textural variations exist within the Manyutup Tonalite; micro-tonalite has been identified in drill core from the northern area of Kundip. **Figure 2.3** depicts the local geology of the Kundip mining centre.

Host rocks for the mineral veins comprise an acid volcanic sequence of fine to medium grained dacite and andesite, feldspar porphyry (intrusive or extrusive), crystal tuffs of acid to intermediate composition and intrusive granodiorite. The tuffs range from fine-grained chloritic siltstone/sandstone to a coarse lapilli tuff with fragments to 20 cm in size. Where outcrop is sufficiently good, bedding surfaces may be preserved in the tuffs. Generally, little in the way of deformational or metamorphic fabric was observed in the volcanics. (After Marjoribanks, 2003)

The mineralisation consists of quartz veins ranging from a few centimetres to several metres thick. The veins carry several percent coarse iron and copper sulphide (pyrite, pyrrhotite, and chalcopyrite) with associated gold and silver values. This mineralogy has much more in common with high sulphidation intrusion-related epithermal veins, than with the more typical orogenic gold quartz veins (low sulphide, low silver) of the Achaean.

The ore structure/areas in the Kundip mining field are;

Kaolin and Two Boys

Main rock types in this area are fine-medium grained dacite overlying granite or granodiorite. The deposit is comprised of a stacked series of flat dipping quartz veins.

Western Gem

Drill holes suggest the geology is continuous with neighbouring Kaolin/Two Boys area, consisting of fine-medium grained dacite overlying a substantial granite or granodiorite sequence.

Hillsborough

Geology is dominated by a fine to medium grained sequence of dacite. The high grade mineralisation is surrounded by much broader low grade supergene halo's.

Harbour View and Harbour View North (the master fault)

Mineralisation along the Harbour View line is hosted within an acid volcanic sequence of irregularly inter-layered, fine to medium grained dacite and andesite (dacite is dominant). The ore lodes are primarily steeping dipping quartz veins which form discrete shoots and which are narrow in nature.

May Group (tension veins)

Consist of a series of vein swarms with the local geology of the area consisting of an acid volcanic sequence of irregularly inter-layered, fine to medium grained dacite and andesite.

Flag and Try Again (tension veins)

The Central and Eastern Flag and Try Again deposits are hosted by dacitic lavas, tuffs and agglomerates whereas the Western Flag deposit is contained within granite.

The full resource statement for Kundip of 3.6M tonnes at 4.1g/t gold and 0.47% copper is outlined in **Table 2.3**.

Graeme Campbell & Associates Pty Ltd (GCA) was commissioned to carry out geochemical test work on a range of regolith-material, waste bedrock and low-grade-ore samples derived from the Kundip deposits (**Appendix B**).

The test work results from representative samples of the low grade ore from the Kundip deposit indicate that the samples of the Low-Grade-Oxide-Ores are non acid forming (NAF), and reflect groundmasses devoid of both sulphide and carbonate materials. The samples of Low-Grade-Transition Ore and Low-Grade-Primary-Ore were classified as potentially acid forming (PAF) and reflect "trace/accessory sulphides" in a groundmass devoid of carbonate minerals. The samples were variously enriched in Cu, and in the case of the Low-Grade-primary-Ore samples, also in Ag, Zn, Cd and Pb. The Cu contents ranged up to c. 0.3 - 0.4% (Appendix B).

Geochemical characterisation of the waste material generated from the Kundip soil/regolith profile indicates that the material is characteristically mildly alkaline (viz. pH 8-9), with moderate contents of soluble-salts and a low capacity to consume acid, and is classified as non-acid forming (**Appendix B**).

The analysis results also indicated that geochemically the assayed samples of soil/regolith materials and waste bedrocks were "clean" with low contents of environmentally significant elements (**Appendix B**).

Table 2.3. Kundip Ore Resource Statement

	Measured Resource			Indicated Resource			Inferred Resource			Total Resource						
Prospect	Tonnes	Au (g/t)	Cu (%)	Au (Ozs)	Tonnes	Au (g/t)	Cu (%)	Au (Ozs)	Tonnes	Au (g/t)	Cu (%)	Au (Ozs)	Tonnes	Au (g/t)	Cu (%)	Au (Ozs)
Harbour View			4		591,909	5.13	1.01	97,625	259,997	5.58	1.53	46,644	851,906	5.27	1.17	144,269
Kaolin	275,060	4.32	0.22	38,203	354,040	3.45	0.18	39,270	391,188	3.77	0.27	47,415	1,020,288	3.81	0.22	124,889
Flag					598,183	4.36	0.41	83,852	188,158	5.69	0.42	34,432	786,341	4.68	0.41	118,283
Hillsborough					726,407	2.59	0.12	60,488	58,623	2.59	0.10	4,882	785,030	2.59	0.12	65,370
May Structures					113,980	4.57	0.31	16,747	17,904	2.57	0.25	1,479	131,884	4.30	0.30	18,226
Total	275,060	4.32	0.22	38,203	2,384,519	3.89	0.43	297,982	915,870	4.58	0.65	134,851	3,575,449	4.10	0.47	471,037

Note Western Gem and Two Boys Structures are included in the Kaolin figures.

2.4 Landform and Soils

Outback Ecology Services conducted a comprehensive survey of the Kundip and Trilogy topsoils and subsoils and made recommendations for rehabilitation (**Appendix C**).

2.4.1 Trilogy

Soils were sampled at four sites within the Trilogy project area. The soils formed from the decomposition of the underlying Proterozoic sedimentary sequence have been progressively degraded by grazing and cropping practices and wind erosion. Gravel and quartz fragments currently form some protective cover (up to 20%) over the soil surface.

The surface soils were characterised by an organic-rich loam in the first 5cm over a gravelly brown, medium clay (5-20cm). Below this (to 60cm), the soil tended to become darker brown but with less gravel content. This general pattern was repeated across the area, except on the western edge where there were white rocks visible on the surface and the clay subsoils were noticeably paler in colour when compared to the other sampling sites.

The soils were moderately acidic (pH 4.8 to 6.5; 0.01M CaCl₂), had low salinity, high levels of extractable nutrients (particularly phosphorus, and 3% to 4% organic C) and were relatively stable (reflective of their high organic matter content).

Although the undisturbed topsoils appeared to be relatively stable, it is likely that stripping and re-spreading will breakdown some of the structural stability currently provided by organic matter, and they will become less stable, and less able to resist erosion on waste landform surfaces. Signs of cracking on the soil surface suggest a relatively high content of potentially unstable clays.

The underlying subsoils were more alkaline, and could be expected to contain less available nutrients. The salinity tended to be higher in one of the subsoil samples analysed, and the subsoil clays slaked and were dispersive in their nature.

2.4.2 Kundip

At Kundip, soil sampling points were located within the area of the Flag, Harbour View, Kaolin and Hillsborough geological regions, some additional samples were also collected from the abandoned Western Gem and Two Boys Pits. Representative topsoil samples from across the area of the Kundip deposits were chemically analysed, and the soil texture and dispersion properties of the topsoils and subsoils were assessed.

At most sampling sites there was a clear textual change between the topsoil and underlying clay rich subsoils. In summary the topsoils showed greater physical stability due to the content of gravel and rock fragments than their associated subsoils, which had the potential to slake and were somewhat dispersive.

Surface soils at Flag were typically gravelly loams overlying medium clays; by contrast, the clay subsoils (below 15 cm depth) were unstable. Topsoils from the Flag deposit had low levels of salinity (EC) and were slightly acidic, ranging from pH 4.5 to 5.4. The soils were also characterised by low levels of plant-available nitrogen with moderate levels of extractable phosphorous and organic matter.

The chemical fertility of the topsoils from the Harbour View deposit was similar to those from the Flag deposit, but with generally higher levels of organic carbon and slightly higher soil pH. In well vegetated areas in the vicinity of the Harbour View deposit (as for the Flag area), the existing soil surface is physically well protected with gravel 'lag' and typically the soil crust is firm.

Soils from the area of the Kaolin deposit followed the pattern of all other areas, generally being loamy topsoils over clay subsoils. Topsoil samples from the area of the Hillsborough deposit contained less plant available plant macro-nutrients (N, P & K) than Flag or Harbour View and were characterised by relatively low organic carbon. In summary the topsoils showed greater physical stability due to the content of gravel and rock fragments than their associated subsoils, which had the potential to slake and were somewhat dispersive.

2.4.3 Haul Road

A large percentage of the haul road easement is characterized by Proterozoic rocky substrate and shallow soil profiles.

2.5 Surface Hydrology

A comprehensive surface hydrology assessment was undertaken for the Trilogy and Kundip project area by Jim Davies and Associates (**Appendix D.1 and D.2**). Surface runoff catchments and drainage routes were identified, estimates of the peak and monthly flows for the existing conditions were provided, and surface drainage controls appropriate to the proposed mine site infrastructure were recommended.

2.5.1 Trilogy

There are two sub-catchments of Kuliba Creek within the Trilogy Project area which are tributaries of the Steere River. Kuliba Creek intersects the Steere River on the west side of the Ravensthorpe – Hopetoun Road, approximately 8 km south-west of the project area. The Steere River discharges into the Culham Inlet (a medium sized inlet which borders the Fitzgerald River National Park) north-west of Hopetoun (**Figure 2.4**).

The topography of the area is characterised by low hills with very gentle slopes (2-3%). Stream channels within the landscape are widely spaced forming an integrated network of convergent creeks. Maximum elevation is in the north of the Trilogy site at approximately 90m AHD, falling to 80m AHD at the southern end of the site. Surface drainage within the project area is from north to south via the Kuliba Creek (**Figure 2.5**).

Peak flows have been estimated for each sub-catchment based on the Rational Method described in Australian Rainfall & Runoff (2000). Due to the lack of gauged data for rivers within the Esperance Plains, the peak flows are indicative only. As the catchments are already heavily cleared, the additional runoff generated by the construction of mine infrastructure will be minor.

2.5.2 Kundip

There are 11 sub-catchments of the Steere River within the Kundip project area. Surface drainage is generally south-west towards the Steere River and the main river channel crossing is under the Ravensthorpe–Hopetoun Road, 200m south of the Kundip site (**Figure 2.6**). Stream channels within the landscape are moderately spaced forming an integrated network of convergent creeks.

Peak flows have been estimated for each sub-catchment in the project area based on the Rational Method described in Australian Rainfall & Runoff (2000). Due to the lack of gauged data for rivers within the Esperance Plains, the peak flows are indicative only. Data sheets for flood estimation for each of the eleven sub-catchments are included within **Appendix D.2**.

The historic Elverdton mine, located at the northern boundary of the Steere River catchment, is characterised by the legacy of its unprotected tailings material. The tailings have been left without any form of cover, and have progressively eroded to form an active sediment plume in the upper reaches of the Steere River which has extended down stream to the Kundip site. It is highly probable that the mobile sediment plume will encroach on the culverts proposed for underneath the main haulage route which crosses the Steere River.

Historic mining of the Kundip site has also left open pit voids, affiliated un-contoured waste rock dumps and in excess of one hundred and fifty abandoned open shafts and mine workings which create numerous local surface drainage anomalies.

2.5.3 RAV 8

The RAV 8 pit is surrounded by a bund, thus any watershed into the storage area will be by incident rainfall only. A large percentage of M74/13 is on elevated ground, however, the northern extremity of the open pit cuts across the path of a surface drainage system emanating from slightly undulating country (approx. 1km) to the northwest of the site.

Tectonic have constructed a drainage channel to direct uncontaminated water from the upper part of the catchment away from the lease area and into the Bandalup Creek system avoiding rainfall runoff from entering the open pit.

Bandalup Creek is a tributary of the Jerdacuttup River, originating within native vegetation and farmland to the north-east of the RAV 8 mine site. The creek passes through undisturbed crown land to the north of the South Coast Highway, and then through partly cleared catchment to join the Jerdacuttup River (**Figure 2.4**).

The catchment of Bandalup Creek has been extensively cleared by agricultural practices resulting in a significant environmental impact prior to commencement of mining the RAV 8 orebody. Groundwater inflows may contribute most of the water present in the creek during dry months, and it is possible that it may be of better water quality than that contained in remnant surface water pools. Surface water samples from Bandalup Creek have been analysed biannually since 2002. The results of this sampling are included as **Appendix D.3**. Surface water pools sampled between 2002 and 2005 indicate the water to be saline, having a conductivity of generally about 31,250mg/L TDS, but increasing at times to 360,000mg/L TDS due to evapoconcentration (OES, 2004).

2.5.4 Haul Road

The haul road crosses over both the Steere and Jerdacuttup Rivers. The Jerdacuttup River has remained a closed system terminating in the Jerdacuttup Lakes since the Holocene period (Figure 1.2 and Figure 2.4).

2.6 Groundwater

A comprehensive hydrogeological investigation was undertaken for the Trilogy and Kundip Project areas by Rockwater Pty Ltd in 2004 to assess background conditions and likely dewatering requirements (Appendix E.1 and E.2).

2.6.1 Trilogy

The main aquifer is contained within the silicified shales of the mineralised zone and overlying supergene zone. The permeability is associated with vughs, joints and fractures, which occur locally in the hanging wall and less frequently in the footwall. The hydrogeological study indicates that there will be groundwater encountered during the mining and development of the Trilogy deposit (Appendix E.1).

The groundwater has a salinity of about 18,000mg/L total dissolved solids, and in the mineralised zone is acidic, with an average pH range between 3.9 and 4.7. It is predicted that the low pH values will dominate disproportionately in mixtures of acidic to slightly acidic groundwater (Graeme Campbell pers. comm.). Due to the acidity and mineralised nature of the aquifer the groundwater has elevated levels of some metals, notably Fe - 96mg/L, Zn - 160mg/L and Pb - 7.7mg/L. Groundwater outside of the mineralized zone is circum-neutral.

Groundwater sits at approximately 33.5m below ground level. Airlift yield from the holes ranged from less than 20m³/d to 240m³/d with only two holes having airlift yields greater than 50m³/d. A test production bore (TPB 1) was constructed and test pumped 10m along strike of the highest yielding exploratory monitoring bore (TMB 4). TPB 1 is open to the aquifer from 64.8m to 94.8m depth, and draws most of the water from 88m to 94m depth.

The pumping test results indicated reduced bore efficiency in TPB 1, with water level draw downs much greater than those observed in nearby TMB 4. This may be due to factors such as bore construction, air entrainment in the aquifer and/or restricted hydraulic connection between TPB 1 and TMB 4.

Values of hydraulic conductivity and storage coefficients derived from the pumping test results were used as initial values in the groundwater model utilised by Rockwater Pty Ltd. The aquifer interval was contoured from water intersections identified during drilling and is between 6m and 40m thick. Other assumptions made in assigning initial aquifer parameters include:

- The aquifer is of significant areal extent;
- The aquifer is anisotropic, with higher hydraulic conductivities along strike than across strike;
- Recharge to the aquifer is insignificant over the period of dewatering; and
- Vertical hydraulic conductivity is one tenth of horizontal hydraulic conductivity.

2.6.2 Kundip

The Archaean volcanic rocks of the Kundip region are generally characterised by low permeability, whilst the fractures and joints in the rocks and the mineralized zones can be moderately permeable. The Kundip mining area is described as having minor local aquifers (Appendix E.2).

Six holes were drilled and completed as monitoring bores during the exploratory drilling programme which was designed to test the host rock and fractured/mineralised zones of the Kundip ore bodies. An existing exploration hole drilled to 106m depth was also cased for groundwater monitoring. Of the six holes drilled only four intersected water, Bore KMB 6 (situated in a drainage line along strike of the Harbour View workings), had a maximum airlift yield of 60m³/day; the other bores yielded just a trace.

The groundwater has a salinity range of 22,000mg/L to 38,000mg/L total dissolved solids (TDS), and a near neutral pH. The groundwater table is about 37m below ground level in the vicinity of the Harbour View workings, south of the proposed Maydon open pit. The static water table varies across the site, but indicatively slopes downwards to the south-south-east.

The Kundip project site encompasses the previously mined Beryl, Harbour View and Flag underground workings. The underground operations reported intersected inflows as follows:

- 1. Harbour View 0.29L/sec
- 2. Flag 3L/sec (highest reported inflows in the field)
- 3. Beryl listed only as moderate in flows (<3L/sec)

The old mine workings are reported to have intersected water bearing fractures, and there are modest volumes of water stored in the workings.

Previous groundwater inflows to the old workings have been estimated to be up to 500m³/day. The Flag was recorded as the 'wettest' mine followed by Harbour View and Beryl. Pumping rates from Harbour View were about 25m³/day in 1903, when the main shaft was about 50m deep.

2.6.3 RAV 8

A comprehensive amount of groundwater data has been sourced and collated by Tectonic over the previous five years for the area in the immediate vicinity of the RAV 8 open pit. The first annual production report prepared by Rockwater Pty Ltd was dated September 2001, and covered the period June 2000 to May 2001. Groundwater quality data has been collected over the last 4 years and is included as appendix E.3.

Aquifers in the Ravensthorpe region are mainly of the fractured rock type, and are generally associated with joints, fractures and zones of alteration and weathering of Archaean greenstone rocks. At the RAV 8 deposit, substantial amounts of saline groundwater are contained within the ultramafic host rock and the underlying quartzite. The following aquifers were identified during exploratory drilling for water:

- 1. Fractures in the ultramafic rock and the underlying quartzite within about 20 m of the contact between them. Water yields from this zone generally decreased with depth.
- A northerly trending shear zone, which forms the eastern boundary of mineralised zone. In this zone the ultramafic rocks and the underlying quartzite are strongly fractured and yield high water flows.
- 3. The transition zone (slightly to moderately weathered) of the ultramafic rock.
- 4. Fractures in the ultramafic rocks above the ore body.

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The groundwater is neutral to slightly alkaline (pH ranges from 7.2 to 8.0). Mine discharge water has an average salinity of 25,000 mg/L TDS, and is of a sodium chloride type with relatively high concentrations of soluble magnesium, boron, potassium and sulphate.

Water recovered from dewatering of the mine is pumped to the saline water dam (designed as a retaining structure to hold excess ground water). The dam is located on a farming property south of the main Highway, approximately 1.0 km from the mine. The quality of the water held in the dam has an average salinity in the order of 30,000 to 35,000 mg/L TDS, indicating that evaporation losses generally exceed dilution from rainfall. The current capacity of the dam is 882,000m³ with the embankment crest at RL 1160.5 m. The saline water storage facility at RAV 8 occupies an area of 30.9 ha.

The effects of dewatering have been localised and water levels 500m from the mine remain at background levels. Groundwater salinity east of the saline water dam ranges from 21,000 to 39,000 mg/L TDS.

2.7 Vegetation and Flora

The Project is located in the Eyre Botanical District and the Esperance Plains Bioregion. It is also within the Ravensthorpe system described by Beard (1979), which has been proposed for inclusion within CALM's Threatened Ecological Community database (**Appendix F.1**) The region is situated in one of 25 global hotspots identified for their biological diversity.

Vegetation and flora surveys were completed during 2003, 2004 and 2005 and identified a number of Declared Rare Flora (DRF), Priority taxa, and other species of conservation significance (Appendix F.1, F.2, F.3, F.4 and F.5).

A total of 280 native species are known from the Kundip project area, an area of approximately 3km by 3km, substantiating the status of the area south of Ravensthorpe as a peak area of species diversity in the south-west. The region is also one of three areas of highest endemism in Western Australia, with Mt Lesueur and the Stirling Range being the other two. A number of the identified species of conservation significance are local endemics that, while possibly locally abundant, have restricted distributions.

The Wildlife Conservation (Rare Flora) Notice 2003 of the Wildlife Conservation Act, 1950, provides protection of flora species of conservation significance. The notice lists, in part, protected flora taxa that are extant and considered likely to become extinct or rare.

DRF are regarded as taxa which have been adequately searched for, and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such following approval by the Minister for the Environment, after recommendation by the State's Endangered Flora Consultative Committee. Priority taxa are maintained on a 'reserve list' which is reviewed on an annual basis and are assigned to one of four Priority categories (Atkins, 2005). These categories are summarised below:

- Priority One (P1) Poorly Known: taxa which are known from one or a few (generally less than five) populations which are under threat, either due to small population size, or being on lands under immediate threat, or the plants are under threat. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
- Priority Two (P2) Poorly Known: taxa which are known from one or a few (generally less than five) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
- Priority Three (P3) Poorly Known: taxa which are known from several populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey.
- Priority Four (P4) Rare: taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5–10 years.

2.7.1 Trilogy

A baseline flora survey at Trilogy was undertaken by Outback Ecology Services (**Appendix G**). No Declared Rare or Priority Flora species are known to occur within mining tenement M74/176.

Four species of *Eucalyptus* were identified in the flora survey of the Trilogy deposit M74/176. These species included *Eucalyptus scyphocalyx*, *E. phenax* subsp. *phenax*, *E. suggrandis* subsp. *suggrandis* and *E. kessellii*. The absence of mid stratum vegetation within the project area appears to be predominately due to grazing. Three lower storey species *Austrodantonia setacea*, *Bromus catharticus* and *Panicum* sp. were recorded under the stands of remnant *Eucalyptus* species. Heavy grazing of these grass species was evident and subsequent identification difficult.

The cleared farmland paddocks are dominated by *Carduus* sp. (thistle), and all topsoil stripped from the Myamba farm will most likely contain seeds of this alien species.

2.7.2 Kundip

A vegetation and flora survey of the Kundip mining leases was conducted by Dr. GF Craig in 2004 (**Appendix F.1**). An additional spring declared rare and priority flora survey of the proposed waste dumps and haul road within the Kundip mining leases was conducted by Dr GF Craig in October 2005 (Appendix F.5). Eighteen units, identified by their vegetation formations and associated plant species, were mapped on the Kundip mining leases (**Figure 2.7**). A list of the 303 plant species identified and a matrix of the vegetation units in which they were found is presented, as well as an overview of each vegetation unit with its typical plant association (**Appendix F.5**). The vegetation is described according to landform: Crests and Upper Slopes, Slopes, Lower Slopes and Drainage Lines.

One Declared Rare and ten Priority taxa were identified within the Kundip mining lease (**Table 2.4**). No species were listed under the *Environment Protection and Biodiversity Conservation Act (1999)* (EPBC Act). The locations of DRF and priority species within the Kundip project area are indicated on **Figure 2.8**. The Priority One species *Microcorys pimeloides* may also occur on the mining leases but has not been recorded during recent surveys.

In addition to the species listed in **Table 2.4**, two species were identified as being significant and, dependent upon taxonomic review, may be new species. *Melaleuca* sp. Kundip (GF Craig 6020) is apparently new and undescribed. Although it dominates one of the described vegetation units and over 27,000 plants are estimated to occur at the locality, with three subpopulations over the lease and two populations south of the lease area, its current known range is just 1.1km by 0.5km.

Flowering and fruiting specimens of *Pultenaea* sp. Kundip (GF Craig 6008) have been collected from the lease area to verify taxonomic status. Although over 155,000 plants are estimated from the southern areas of the lease, its current known range is just 1.8km by 0.6km.

Table 2.4	Taxa of conservation significance identified within the Kundip Mining
	Lease Project Area (Appendix F.5).

Category	Species	Comments			
Declared Rare	Marianthus mollis	Four populations were identified – over 40,000 plants east of the Vermin Proof Fence and 800 plants in two Ravensthorpe Range populations to the north and east of the Kundip Mining Leases			
Priority One	Melaleuca stramentosa	Many thousands of plants occur over the Kundip Mining Leases. However, the species is poorly known and appears to be geographically restricted, with a known range of just 8km.			
Priority Two	Acacia disticha	Widespread but rare over the survey area, often only two plants at any location. Has been collected in creeklines from the Corackerup Creek area through Thumb Peak in the Fitzgerald River National Park, to Kundip, a range of 150 km			
	A. laricina var. crassifolia	Tends to grow in patches of 10-30 plants, scattered throughout the eastern sector of the leases. Has a restricted distribution, being mainly collected from Mt Desmond to Kundip			
	Hydrocotyle decipiens	Known from two other populations, one near Mt Ridley and one west of mid Mt Barren			
Priority Three	A. durabilis	Single plants are widespread from the NE to the SW corners of the mining leases. Is restricted to the Ravensthorpe Range			
	Boronia oxyantha var. brevicalyx	Frequent but scattered, in the southern sector of the leases. Known from the Ravensthorpe Range, Kundip and the Fitzgerald River National Park			
	Dodonaea trifida	Widespread through the leases, with scattered occurrences in the majority of minor drainage lines, few populations are known in the Fitzgerald River National Park where it should remain secure			
	Spyridium glaucum	Well represented within the Shire of Ravensthorpe. Recommended that it be reduced to Priority Four (Gil Craig, Appendix F.1)			
Priority Four	A. pinguiculosa subsp. pinguiculosa	Four populations located on the leases, widespread and frequent in the Steere River catchment. Recommended that it be removed from the Priority Species List (Gil Craig, Appendix F.1)			
	Siegfriedia darwinioides	On the mining leases it is frequent in the upper catchments of three drainage lines that flow into the Steere River. Relatively common and widespread through the Ravensthorpe system			

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Both of these species had been nominated for inclusion on CALM's *Declared Rare and Priority Flora List* as Priority One. A survey for these two species was conducted (**Appendix F.2**) and concluded that as the extent of these two co-existing species is known to cover less than 2km x 1km, the recommendation of CALM to include both the *Pultenaea* and *Melaleuca* as Priority One on the Declared Rare and Priority Flora List remains valid. The population of these two species identified within the mining leases is indicated on **Figure 2.8**. The *Melaleuca* sp Kundip is currently listed as Priority One. It is proposed that the *Pultenaea* sp. Kundip will be listed as Priority One on the coming years DRF and Priority Flora list.

A separate regional distribution table has been compiled for each Declared Rare and Priority flora depicting location, site description, date surveyed and number of plants, area searched and the status of the tenement or reserve (see **Appendix F.3** for **Tables 3.6.1 to 3.6.10**). *Hydrocotylye decipiens* is only known from two other populations within the region.

CALM is also currently considering listing the *Melaleuca* sp. Kundip and *Pultenaea* sp. Kundip community as a Threatened Ecological Community due to its topographically restricted location and its nature as a short range endemic community.

Twenty-three exotic species are known from the leases including a Weed of National Significance (**Appendix F.1**). The bridal creeper (*Asparagus asparagoides*) occurs at a number of locations on the leases. A number of exotics have been purposely planted around now-demolished buildings and appear to be confined to those areas. However, others such as succulents and those in the Asteraceae family, appear to be gradually spreading from these areas.

2.7.3 Haul Road

The proposed 17km haul road between Kundip mining leases to the RAV 8 minesite, along Gazetted Road No. 8432 and Hatfield Road was surveyed for declared rare and priority flora in early May 2004 (Appendix F.4). One Declared Rare species and six Priority species were identified (Table 2.5, Figure 2.9). The proposed clearing of vegetation for the haul road does not impact on any threatened ecological communities.

Category	Species	Comments			
Declared Rare	Marianthus mollis	Two populations were identified – over 40,000 plants east of the Vermin Proof Fence and 800 plants in two Ravensthorpe Range populations to the north and east of the Kundip project area.			
Priority One	Beyeria sp A Ravensthorpe	Well represented within the Shire of Ravensthorpe. Recommended to be reduced to Priority Four (Gil Craig, Appendix F.4)			
	Melaleuca stramentosa	Widespread on the Kundip mining leases. Only a small proportion of plants would be impacted by the haul road			
	Pultenaea calycina subsp proxena	Well represented within the Shire of Ravensthorpe. Recommended to be reduced to Priority Four (Gil Craig, Appendix F.4)			
Priority Two	Acacia laricina var. crassifolia	Widespread on the Kundip mining leases. Only a small proportion of plants would be impacted by the haul road			
Priority Three	Allocasuarina scleroclada subsp. Bandalup	This species still may be considered for DRF status, or may change to Priority One depending on the outcome of botanical reports for a nearby mining operation.			
	Spyridium glaucum	Well represented within the Shire of Ravensthorpe			
		Recommended to be reduced to Priority Four (Gil Craig, Appendix F.4)			

Table 2.5 Flora species of conservation significance identified along the haul road (Appendix F.4)

In addition, *Phebalium tuberculosum* 'Maydon form' (GF Craig 6076) should be considered a significant species. The *Phebalium tuberculosum* 'group' encompasses a number of phenotypes and the species requires taxonomic revision to determine the status of the many forms. *Phebalium tuberculosum* 'Maydon form' is present as a population of over 100 plants near the northern limit of Road No. 8432 on Loc. 56.

A number of weeds typical of farmlands were also found along the route of the haul road, including two species 'declared' under the Agriculture and Related Resources Act; narrow leaf cotton bush (*Gomphocarpus fruticosus*) and Saffron Thistle (*Carthamnus lanatus*). A Weed of National Significance was also recorded; bridal creeper (*Asparagus asparagoides*). The weeds principally occur in drainage lines that originate in Locations 249, 57 or 63, except for the latter species which is near the Jerdacuttup River.

2.8 Fauna

The Phillips River Gold Project is situated entirely within the Esperance Plains Bioregion (Thackway and Cresswell 1995, Environment Australia 2000) in the South-West of Western Australia. Two surveys to ascertain the fauna assemblage of the Kundip and Trilogy project areas was conducted by Biota Environmental Sciences Pty Ltd in January 2004 and November 2004 (Appendix H.1 and H.2).

Selected invertebrate fauna, or short range endemics, were targeted as well as terrestrial vertebrate fauna. Fauna habitats were categorised, relative abundances documented as well as existing levels of disturbance.

Fauna habitats closely align with the major vegetation communities, which reflect changes in slope, aspect and soil type. In a review of the fauna of the Fitzgerald Biosphere Reserve three broad habitat types were recognised:

- Mallee-heath –various species of mallee eucalypts over an understorey ranging from scrub to heath from 0.5-2.0 m tall on variable soil types;
- Woodland Moort Eucalyptus platypus and mallet of various species with a shrubland or heath understorey over very sparse herbs on loamy to clayey soils; and
- Shrubland –shrub life forms over 2 m, with or without a lower shrub storey.

In addition the Trilogy Project area on Myamba farm comprised a fourth broad habitat type:

 Farmland – habitat includes open paddocks, farm dams, buildings and shelter belts.

The Western Australia Wildlife Conservation Act (1950) provides protection to native fauna species that are rare, threatened with extinction or have high conservation value. Classification of rare and endangered fauna under the Wildlife Conservation (Specially Protected Fauna) Notice 2003 recognises four distinct schedules of taxa:

Schedule 1	Taxa are fauna which are rare or likely to become extinct and are
	declared to be fauna in need of special protection
Schedule 2	Taxa are fauna which are presumed to be extinct and are declared
	to be fauna in need of special protection
Schedule 3	Taxa are birds which are subject to an agreement between the
	governments of Australia and Japan relating to the protection of
	migratory birds and birds in danger of extinction, which are declared
	to be fauna in need of special protection

Schedule 4Taxa are fauna that are in need of special protection, otherwise than
for the reasons mentioned in the above paragraphs.

In addition to the above classification, fauna are also classified under different priority codes:

Priority One	Taxa with few, poorly known populations on threatened lands
Priority Two	Taxa with few, poorly known populations on conservation lands; or taxa with several, poorly known populations not on conservation lands
Priority Three	Taxa with several, poorly known populations, some on conservation lands
Priority Four	Taxa in need of monitoring
Priority Five	Taxa in need of monitoring and currently subject to a conservation

Threatened fauna of national environmental significance are listed under the federal *Environment Protection and Biodiversity Conservation Act* (1999) in the following categories; extinct, extinct in the wild, critically endangered, endangered, vulnerable and conservation dependent.

program

A search of the CALM Schedule and Priority Fauna database for species potentially occurring in the area showed 14 may be found of conservation significance (**Appendix H.1**).

2.8.1 Trilogy

Habitat at the Trilogy site is comprised of open paddocks, farm dams, farm buildings and shelter belts of *Eucalyptus* spp with little or no understorey. An avifauna survey undertaken at Trilogy recorded a total of just ten species of birds, comprised of six non-passerines from three families and four passerines from three families. The data collected from Trilogy was of an opportunistic nature and largely focused on a small dam south of the proposed open pit.

The species recorded included waterfowl and species typical of farms and open habitat in the south-west such as the Australian Kestrel *Falco cenchroides cenchroides*, Black-shouldered Kite *Elanus caeruleus axillaris*, Yellow-throated Miner *Manorina flavigula*, Magpie-lark *Grallina cyanoleuca* and Australian Pipit *Anthus australis australis*. No threatened or schedule listed fauna were identified within the Trilogy project area.

Stygofauna are predominantly known to occur in calcrete and alluvial aquifers, coastal karst systems, limestone and sandstone environments and palaeodrainages. None of these geological features are present within the Trilogy project area, however the presence of stygofauna in this environment and in fact the region has not been qualified.

2.8.2 Kundip

Fauna surveys of the Kundip lease area recorded a combined total of 99 vertebrate species, including 62 species of birds, 11 native mammals, two introduced mammals, 21 reptiles and three frogs. Over 30 invertebrate taxa were also recorded, many of which were not identified beyond family level.

Within the Kundip lease area, mature woodland habitat is restricted in distribution and supports both an abundant and species-rich fauna assemblage.

Of the species recorded, two were Schedule listed and three were Priority species (**Table 2.6**). Three of these species were also listed under the *Environment Protection and Biodiversity Conservation Act* (1999).

Category	Species	Comments				
Schedule 1	Carnaby's Black-Cockatoo Calyptorhynchus latirostris	Endangered under the EPBC Act 1999 Recorded on three occasions as flocks of between two and seven individuals flying over the project area.				
	Malleefowl <i>Leipoa ocellata</i>	<u>Vulnerable under the EPBC Act 1999</u> A single record from the project area, appears relatively common in the Ravensthorpe district compared to elsewhere in its range (Teale et al., in prep.)				
Priority 1	Skink <i>Lerista viduata</i>	Single individual recorded from a pit trap at KU2				
Priority 4	Western Whipbird (Western mallee subspecies) Psophodes nigrogularis oberon	<u>Vulnerable under the EPBC Act 1999</u> Identified on six occasions from calls given in mallee associations. Johnstone (pers. Comm 2004) considered this species to be common throughout the Ravensthorpe district in suitable habitat.				
	Western Brush Wallaby Macropus irma	Species was recorded from a single carcass on the Ravensthorpe to Hopetoun road, just to the north of the mine entrance.				

Table 2.6 Fauna of Conservation Significance recorded on the Kundip Mining Lease Project Area (Appendix H.1)

The occurrence of Carnaby's Black-Cockatoo, Malleefowl and Western Whipbird at Kundip is not considered exceptional (Biota 2000 and Chapman 2000). Ron Johnstone (pers. comm.

2004) considered these species to be common throughout the Ravensthorpe district in suitable habitat.

Only invertebrate taxa belonging to groups known to contain short range endemics were identified to genus or species level. Two species of mygalomorph spiders from the family Nemesiidae were recorded. Both species, as they are currently recognised, have broad distributions in the south-west. A single land snail of the genus *Bothriembryon* was collected. The conservation status of this taxon is currently unknown.

A second 'Phase II' terrestrial fauna survey was conducted at Kundip during November 2004 (**Appendix H.2**), to target threatened fauna taxa considered not well represented during the Phase I survey, including the rarer rodents known from the region such as the Heath Rat (*Pseudomys shortridgei*) and Western Mouse (*Pseudomys occidentalis*), as well as threatened bird species

Additional trapping transects were established to augment seven systematic trapping grids established during the earlier survey, and a total of 23 hours was spent conducting targeted transects to record the presence of threatened bird species through the entire proposed pit and overburden areas. Opportunistic collecting was also undertaken at locations deemed likely to support fauna of conservation significance, including short range endemics. Fauna trapping grids, transects and avifauna sites within vegetation types are show in **Figure 2.7**.

Eleven vertebrate species not recorded during the initial survey were recorded during the November survey. No evidence of additional species of conservation significance, such as the rarer rodents and birds was obtained, however a westward range extension for the dragon lizard *Amphibolurus norrisi* was recorded, and the Western Whipbird recorded on 12 occasions from four different vegetation types.

The vertebrate fauna assemblage present over the Kundip mining lease is comparable to other regional surveys such as those undertaken at Bandalup Hill (Chapman 2000). However, 13 mammal species were recorded at Kundip with 17 at Bandalup Hill. Of particular note was the presence of the rodents Western Mouse (*Pseudomys occidentalis*) and Heath Rat (*Pseudomys shortridgei*) at Bandalup but not at Kundip. Additional trapping at the Kundip site targeting threatened fauna including rodents documented a significant increase in rodent captures overall, but did not record these species.

Comparisons of the herpetofauna recorded at Kundip indicate a relatively standard assemblage for the region given the duration of the surveys.

The 60 bird species recorded during the two surveys at Kundip compares to 70 at Bandalup Hill and an adjoining site (Biota 2001), and 48 recorded during one survey at the adjacent Kundip Nature Reserve (Buchanan 2004). All species recorded during the initial survey at

Kundip are also present at Bandalup Hill. Additional species are likely to be recorded over the Kundip mining lease, but given the small array of different habitats available the number is likely to be small.

Stygofauna are predominantly known to occur in calcrete and alluvial aquifers, coastal karst systems, limestone and sandstone environments and palaeodrainages. None of these geological features are present within the Kundip project area, however the presence of stygofauna in this environment and in fact the region has not been qualified.

2.8.3 Haul Road

The proposed 17km haul road between Kundip mining leases to the RAV 8 minesite, along Gazetted Road No. 8432 and the fenceline of Oldfield location 62 and 63 is likely to pass through habitats similar to those documented at Kundip and Trilogy, and a similar fauna assemblage would be expected. Fauna present at the RAV 8 site are expected to be similar to those recorded at Trilogy. (It should be noted that a significant number of black swans currently reside on the saline water storage facility at RAV 8)

2.9 Indigenous Heritage

The project areas lie within the traditional lands of the Bibbulmun People (Southwest Nyungars) and the area around Ravensthorpe was traditionally the domain of the *Wadjari* tribe (**Appendix I**). An ethnographic survey for Aboriginal heritage was undertaken over the entire Trilogy and Kundip lease areas by Tamora Pty Ltd (**Appendix J**) and over the Haul road by Brad Goode and Associates (**Appendix I**). The purpose of the survey was to identify, record and delineate the boundaries of the sites of Aboriginal significance within the project development area. A search of the Department of Indigenous Affairs (DIA) register for sites, currently registered in the area was conducted prior to the survey.

2.9.1 Trilogy

No sites were identified within the Trilogy project area. The informants understood the extent of the leases and survey areas and cleared the leases for the purpose of mining (Appendix J).

2.9.2 Kundip

No sites were identified within the Kundip project areas. The informants understood the extent of the leases and survey areas and cleared the leases for the purpose of mining.

The Aboriginal participants requested that some piles of Ochre soils be set aside for the Aboriginal community to be able to collect. These soils are currently piled up around the waste dump area (Appendix I).

2.9.3 Haul Road

A search of the DIA sites register revealed one registered Archaeological site (Site ID 2032) Jerdacuttup River, located within the area. No new ethnographic sites were identified during the community consultation process and the site inspection (**Appendix I**).

The proposed Haul road crosses over the Jerdacuttup River which is an Aboriginal mythological site in association with Waugal (Marchant) beliefs. The large pools north of the Jerdacuttup River were also identified as being of significance for fishing and resource gathering. The Jerdacuttup River has remained a closed system terminating in the Jerdacuttup Lakes since the Holocene period.

An area of bush along the proposed Haul road was identified to be good to use as spear wood. The Aboriginal participants in the site inspection requested that the road be diverted around this area of bush.

2.10 European Heritage

A search for items within the Kundip mining area of interest to the Australian Heritage Commission and the Heritage Council of Western Australia identified that the Harbour View Mine Shaft was listed on the backlog of places to be considered for assessment. Accordingly, Tectonic submitted an application for development of the Harbour View Mine under Section 10 & 11 of the *Heritage of Western Australian Act 1900*. The Harbour View Mine Shaft was reviewed under the Heritage Council of Western Australia's Heritage Council's Assessment and Registration Program. The Register Committee agreed that *Harbour View* does not warrant further assessment for consideration for entry in the *Register of Heritage Places*". The Committee however requested that a full archive record including an archaeological survey of the shaft be commissioned prior to any development.

Please refer to **Appendix L** which includes the application for development of the Harbour View Mine under Section 10 & 11 of the *Heritage of Western Australian Act 1900*, and the response from the Heritage Council of Western Australia.

There are various other remnants of historical mining activities within the Kundip project area. The remnants of a copper separation plant exist in the south-west corner of the site. No other site within the historic Kundip mining area is listed in the register of Heritage places or is subject to either a Heritage Agreement or a Conservation Order.

The Hopetoun Ravensthorpe Railway Heritage Walk Trail extends along the western boundary of the Kundip mining lease. The walk trail follows the abandoned railway that was constructed from Ravensthorpe to Hopetoun in the early 20th century for the purposes of transporting ore to the Hopetoun port.

3.0 PROJECT DESCRIPTION

3.1 General

The project consists of several components as follows:

- The mining and development of the Trilogy Ore Reserve
- The mining and development of the Kundip Ore Reserve
- The construction of an ore haulage road from Kundip to RAV 8
- The upgrade/refurbishment of the processing plant at RAV 8 and processing of the ore
- Disposal of tailings into the RAV 8 open pit void

A description of each component follows.

3.1.1 Trilogy

The ore will be mined by conventional open pit methods; waste products generated from the mining process will be contained within the Trilogy Project area (**Figure 3.1**). The ore will be treated at the process plant located on the RAV 8 mining lease M74/13, waste products generated from the processing of the ore will be contained on M74/13.

The currently identified ore reserves at Trilogy will provide feed to the processing plant for up to six months treating gold and silver ores, given metallurgical constraints the ore will be blended over an extended period of time to allow maximum recovery of the precious metals. The current Trilogy reserve is part of a much larger resource base which will be subject to further testwork, financial evaluation and environmental assessment to confirm viability.

Development within the Trilogy Project area includes:

- Mining of the ore body within the Trilogy project area.
- Transport of overburden to one surface waste rock dump, which will be rehabilitated to form a permanent landscape feature of the site.
- Transport of the ore to a designated Run-Of-Mine (ROM) pad.
- Development of a 1.4km internal haul road from the Trilogy ROM pad to the Ravensthorpe – Hopetoun Road.
- Development of a vegetation corridor along the 1.4 km length of the internal haul road.
- Construction of a water storage facility to contain excess water pumped from the open pit. The water will be returned to the open pit and the embankment walls removed at the end of the project.

3.1.2 Kundip

The ore will be mined by conventional open pit and underground methods; waste products generated from the mining process will be contained within the Kundip Project area (Figure

Phillips River Gold Project

3.2). The ore will be treated at the process plant located on the RAV 8 mining lease M74/13, waste products generated from the processing of the ore will be contained on M74/13.

The currently identified ore reserves at Kundip will provide feed to the processing plant for five years. The process plant will produce gold bullion and a copper concentrate. The Feasibility Study for the Project is based on the currently known resources, however it is highly likely for life to extend beyond this point as exploration to date has failed to confirm the limits of mineralisation ie all ore bodies remain open at depth indicating the depth of current underground workings will potentially extend deeper. Further open pit mining other than that specified in the key characteristics table (Table 1.1) will be subject to further environmental assessment.

Development within the Kundip Project area includes:

- Mining of the ore bodies depicted on Figure 3.2.
- Transport of overburden to surface waste rock dumps, that will be rehabilitated to form permanent landscape features of the site.
- Transport of the ore to designated Run-Of-Mine (ROM) pads.
- Construction of two dams to intercept water and redirect it around the pit.

3.1.3 Haul Road

The proposed haul route is depicted in Figure 3.3.

3.1.4 Ore Processing

To limit the requirement to clear and/or disturb new areas of land Tectonic propose to upgrade/refurbish the existing process plant at RAV 8 and utilise the RAV 8 open pit void as a tailings storage facility for the Phillips River Gold Project.

The ore sourced from the Trilogy and Kundip deposits is to be processed at the RAV 8 minesite using conventional ore processing technology. The crushing and grinding circuits from the RAV 8 processing facility were removed following closure of the mill in December 2001. The crushing and grinding facilities along with additional carbon in leach and elution circuits will be procured and installed to enable the processing of gold bearing ores.

Construction of the new processing facilities and refurbishment of existing facilities will commence following receipt of regulatory approvals. Construction is expected to be completed within nine months of commencement. The layout of the proposed processing facility is shown on **Figure 3.4**.

The metallurgical test work carried out on the oxide and primary sulphide ores from the Trilogy and Kundip deposits confirms that all ore types are amenable to treatment by standard flotation for copper recovery and carbon in leach (CIL) processing for gold/silver recovery.

Please refer to **Appendix M** for a comprehensive description of the proposed treatment plant, crushing and grinding facilities, reagent mixing, storage and distribution by Murray Hill - Metallurgical Consultant.

The treatment plant will be a conventional ore processing facility. The existing flotation, thickening, filtration, concentrate storage, reagent mixing and distribution, laboratory, workshop/store, fuel storage area, power generation area and offices will be re-used.

3.1.5 Tailings Disposal

Tectonic Resources NL propose to store tailings from the new flotation and CIP/CIL plant within the existing RAV 8 pit located on M74/13. A Tailings Storage Facility Notice of Intent – RAV 8 Mine has been prepared by Soil and Rock Engineering (**Appendix N**). The RAV 8 pit is located approximately 800 m east of the existing workshop and offices at Tectonics' RAV 8 operation. Nickel sulphide ore is currently mined from the underground workings located below the RAV 8 pit. Drilling has confirmed that there is no economic mineralisation below the existing workings, subsequently underground mining of the nickel sulphide ore ceased in September 2005.

3.2 Mining

3.2.1 Trilogy

The Trilogy deposit will be mined by conventional open pit methods with a hydraulic excavator and rear dump trucks. Ore will be trucked to the ROM pad to the north west of the open pit and subsequently loaded onto road trains for haulage to the processing plant. Waste will be trucked to the waste rock dump located north of the open pit.

Mining will commence with the stripping of all usable topsoil from the open pit, waste rock dump, ROM pad and water storage facility locations. The material will be stockpiled for use in the rehabilitation works that will be conducted throughout the life of the mine.

The outer faces of the waste dump will be raised ahead of the general level of the dump to enable the revegetation programme to be commenced as early as possible. Selected waste rock will be used to construct the abandonment bund around the outer perimeter of the open pit.

The Trilogy open pit has been designed to be 44m deep, with a surface expression of 3.8 ha. The pit will be mined through the base of oxidation, and marginally into fresh rock.

In-pit dewatering sumps will be developed during mining of the open cut. Tectonic will develop the level in the sumps below the base of the mined ore zone. Conservative pit slopes have been utilised in the open pit design, as such it is not expected that dewatering of the groundwater in the host rock will have a destabilising influence on the pit walls. The test

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production bore was cased with schedule 40 steel, to enable continuity of its use as a dewatering bore whilst mining in the open pit (as it is resilient to drill-hole blasting).

Geotechnical advice has been obtained for the pit design parameters (**Appendix O**). Plan and section views of the Trilogy open pit can be found in **Figures 3.4 and 3.5** respectively. On the footwall the wall angle will be approximately 35 degrees, following the foliation. In order to maintain the integrity of the footwall, no berms are planned for installation on the footwall. All other walls within the open pit are designed at a wall angle of 60 degrees with 7m berms.

The open pit is currently scheduled to be completed in three to four months based on current reserves, although this may be varied once the requirements for blending of the Trilogy ore with ore from Kundip is better understood. Evaluations are continuing as to whether the mining will be carried out by a mining contractor or on an owner operator basis.

3.2.2 Kundip

The Kundip deposits will initially be mined by conventional open pit methods with a hydraulic excavator and rear dump trucks. A number of deposits will also be mined via underground mining methods, with access from the mined open pits.

Ore will be trucked to designated ROM pads and subsequently loaded onto road trains for haulage to the processing plant. The majority of the waste produced will be trucked to the closest waste dump, with backfilling of pits utilised when viable. Please refer to **Figure 3.2** which depicts the proposed site plan.

Mining will commence with the stripping of all usable topsoil from the open pit, waste dump and ROM pad locations. The material will be stockpiled for use in the rehabilitation works that will be conducted throughout the life of the mine. Prior to the removal of the vegetation, seed and other vegetative matter will be gathered for use in the revegetation of the site at the end of the project. An experienced seed collector will be employed to carry out this task.

The outer faces of the waste dump will be raised ahead of the general level of the dump to enable the revegetation programme to be commenced as early as possible. Selected waste rock will be used to construct the abandonment bund around the outer perimeter of the open pit.

Some specifics of the planned open pits are detailed in Table 3.1.

Pit	Pit Depth (m)	Surface Expression (ha)	Ore (t)	Waste (t)
Kaolin	90	7.1	320,000	5,310,000
Western Gem	35	1.0	20,000	240,000
Hillsborough	57	2.2	100,000	1,050,000
Maydon	44	1.4	30,000	540,000
Flag Main	45	1.7	50,000	670,000
Flag West	20	0.4	15,000	80,000
Flag Central	20	0.5	20,000	90,000
Flag Central B	6	0.02	300	900
Try Again	11	0.1	2,000	5,500

Table 3.1 Kundip Open Pits

Geotechnical advice has been obtained for the pit design parameters (please refer to **Appendix P**). Pit wall slope angles of 60° in weathered and transitional rock and 70° in fresh rock have been used. Berms spacing is 18m vertically, with the uppermost berm 5m in width, 6m in weathered rock, 7m in transitional rock and 5m in fresh rock. All the pit ramps are designed at a 1:9m gradient and are 9m wide. Plan and section views of the pits can be found in **Figures 6.1** to **6.4** and **7.1** to **7.4** respectively.

Underground mines have been planned from the base of the Maydon, Flag Main and Kaolin pits. The underground mine on the Maydon pit will access the Maydon, Harbour View and Harbour View North deposits; the underground mine on the Kaolin pit will access the Kaolin, Western Gem and Hillsborough deposits, while the Flag deposit will be accessed from the Flag West pit.

All underground mines will be decline access (typically 1 in 7 gradient) with truck haulage. A combination of longhole stoping and handheld stoping is planned to mine the orebodies. Pillars will be left to support the mined areas as it is not planned to backfill the voids. The existing Flag and Beryl shafts will be intersected with mine development and will be used for ventilation and emergency egress purposes.

Mining will commence on the Kaolin deposit, with Western Gem, Maydon and Hillsborough commencing as required. The Flag pits will be the last pits to be mined. All waste from the Hillsborough pit will be either placed in the Western Gem pit or dumped internally in the Hillsborough pit.

While the majority of the ore will be stockpiled on the ROM pad for transportation to RAV 8, there may be small quantities of low grade sub economic material stockpiled for later blending with higher grade material. A dedicated stockpile area will be established within the ROM pad for the storage of such material.

Evaluations are continuing as to whether the open pit mining will be carried out by a mining contractor or on an owner operator basis. The underground mining operation will be carried out on an owner operator basis. Open pit mining is currently scheduled to be completed in 22 months, with underground mining commencing 5 months before the end of open pit mining and then running for a minimum of 28 months.

In-pit dewatering sumps will be developed during mining of the open cut deposits if required. Tectonic will develop the level in the sumps below the base of the mined ore zone. It is not expected that dewatering of the groundwater in the host rock will have a destabilising influence on the pit walls.

3.3 Mineralised Waste

The waste and overburden material extracted from the area of the Trilogy deposit is to be formed into one waste rock dump located to the north of the open cut pit. The waste rock dump has been designed to contain all the waste generated from the mining of the Trilogy open pit.

The waste and overburden material extracted from the area of the Kundip deposit is to be formed into three waste rock dumps within the Project area.

Management of mineralised waste is discussed further in Section 4.8.

3.4 Treatment Plant

3.4.1 Description

The process plant is designed to treat oxide and sulphide copper/gold/silver ore sourced from the Trilogy and Kundip ore bodies at a nominal average throughput rate of 400,000tpa. Due to the hardness variations of the ore sources the throughput will range from 300,000tpa on the hardest sulphide ore to 600,000tpa on the softest oxide ore.

The existing ROM pad at the RAV 8 plant will be used to establish separate stockpiles of the different ore types for campaign processing through the crushing plant. The crushing plant will be designed for a nominal treatment rate of 125tph. The crushing plant may operate for up to 24 hours per day 365 days per year, depending on throughput rate. Crushing will consist of a primary jaw crusher.

The grinding circuit will operate 24 hours a day, 7 days a week. The circuit will consist of a single SAG mill being fed directly from the primary crusher

The mill will operate in closed circuit with a cluster of cyclones and will include a dedicated ball mill discharge hopper and pump. The cyclone overflows will gravitate to individual trash screens that can then be pumped to either the flotation circuit or leaching circuit. Grinding circuit spillage will be contained by a bunded concrete slab.

Tectonic will appropriately bund specific areas within the treatment plant to enable collection of any spills from the circuit. Tectonic will ensure that all sumps and sump pumps within the treatment plant are appropriately sized.

The flotation circuit is the existing RAV 8 circuit which is to be refurbished. The reagents necessary for processing of the ore from Trilogy & Kundip vary from the reagents used in the nickel processing circuit. Please refer to **Appendix M** for a complete description of the provisions made to add reagents at designated points within the plant.

The final concentrate will be pumped to a new concentrate thickener. The concentrate thickener has been designed for a concentrate feed rate of 4tph. A thickener underflow density of 65% solids will be achieved. A recycle facility is to be installed to recycle the underflow when required or during plant shutdowns.

The existing RAV 8 concentrate storage, concentrate filter and concentrate storage shed will be utilised for the Project. Concentrate production will vary due to a variation in throughput and ore sources processed but will average a nominal 20,000tpa of concentrate. A weighbridge will be installed to monitor the removal of concentrate from site.

The filter cake will be washed with fresh water to reduce the chloride present in the filter cake from the use of saline water in the process plant. In washing out the chlorides the excess flotation reagents will also be washed out, minimising the possibility of evolution of gases from the filtered concentrate. The concentrate will be transported from site to Esperance Port in bulk or bulka bags by road trains.

The leach circuit pulp density will be 42% solids compared to 30% solids for flotation. The existing RAV 8 thickener will be utilised to thicken the flotation tailings prior to leaching. Thickened tailings from the leach feed / flotation tailing thickener will be pumped at 55 to 65% solids. The leach and adsorption circuit will comprise of two leach tanks and six carbon in leach (CIL) adsorption tanks.

The CIL circuit has been designed for an average carbon movement of 1.8 tonnes per day at an average carbon concentration of 10g/L. The total carbon inventory will be 11.7 tonnes, with carbon inventory of 2.0 tonnes in each tank.

The leach tails will be pumped directly to the Tailings Storage Facility (TSF) at 40% solids without a thickening stage.

Tectonic intend to poly-weld the bunded HDPE tailings disposal pipeline. The line pressure will be monitored to indicate abnormal conditions arising from line obstructions or sanding and possible pipe failures. The plant will be equipped with two tailings lines, for the option of dual ore treatment.

Acid washing and elution will be conducted in separate five tonne capacity columns. The ambient temperature acid wash cycle time will be 30 minutes at 3% hydrochloric acid solution. Following the acid wash cycle, carbon will be educted to the elution column.

The pressure Zadra elution process will operate at a nominal temperature of 110°C. The pregnant electrolyte solution is to be pumped through 2 by (11 cathode) electrowinning cells that will operate in parallel. The carbon is then transferred to the regeneration kiln.

Doré will be produced from the electrowinning steel wool and from the electrowinning cell sludges. The gold laden cathodes will be calcined prior to smelting. The calcine and/or cake will be mixed with fluxes and smelted in a gas fired titling bullion furnace. A safe will be provided in the gold room to store the valuable products.

3.4.2 Water Requirements

Raw water is to be provided from the RAV 8 saline water storage facility, return water stored in the RAV 8 open pit/underground workings and/or the existing borefield. The raw water is to be stored in the existing RAV 8 raw water tank and distributed using one of two raw water distribution pumps. Gland seal water is pumped from the tank by dedicated gland water pumps.

Tectonic hold a current Licence to Take Water - GWL 959666(3) from the M74/13 mining lease. The licence is valid to the 30 June 2006; the annual water entitlement is 900,000 kL. It is estimated that the volume within the water storage facility will be emptied after about 14 months. Water will also be drawn from the open pit and underground workings or borefield.

The plant upgrade includes the installation of a Reverse Osmosis (RO) plant onsite at RAV 8. It is proposed that RO water will provide fresh water to the fresh water tank and the potable water tank. The RO plant is fed off the raw water distribution line, the RO tail is to be sent to the process water tank.

Process water requirements will be met by tailings decant and raw water flows. Water will be drawn from the pit (supernatant tailings water), and pumped to a new process water tank located in the process plant area. Return water from the leach feed, concentrate thickener

and float tail thickener overflow will report to the process water tank, a raw water pump will supply additional top up water.

Fresh water will be supplied to the reagents mixing area and to the concentrate filter for cake and cloth wash cycles. The fresh water tank will be equipped with a dedicated fresh water pump and a cake wash pump for the filter.

3.5 Tailings Disposal Facility

Tectonic Resources NL propose to store tailings from the new flotation and CIP/CIL plant within the existing RAV 8 pit located on M74/13. A Tailings Storage Facility Notice of Intent – RAV 8 Mine has been prepared by Soil and Rock Engineering and is included in **Appendix N**.

Geochemical characterisation test work was undertaken by Graeme Campbell and Associates. The report on the process-tailings-slurry samples is included in **Appendix Q**. The 'static-test work' programme focussed on the acid forming potential, multi element composition and mineralogy of the tailings solids samples.

The RAV 8 pit is located approximately 800 m east of the existing workshop and offices at Tectonics' RAV 8 operation. Nickel sulphide ore is currently mined from the underground workings located below the RAV 8 pit. Drilling has confirmed that there is no economic mineralisation below the existing workings, subsequently underground mining of the nickel sulphide ore ceased in September 2005.

The final surface area of the tailings storage area after the pit is filled will be 8.27 ha. The maximum depth of the pit is 129 m; the underground workings extend to a depth of 160 m below the base of the pit. The RAV 8 open pit void has a storage capacity of approximately 3,300,000m³; the underground workings have a capacity of 250,000m³.

The RAV 8 Inpit TSF has been assigned a hazard rating of Low, Category 3. A tailings storage data sheet and explanatory notes are attached as Figures 1 and 2 within the TSF NOI – RAV 8 Mine. The approximate centre (AMG coordinates) of the RAV 8 pit is 6,278,285m north and 249,440m east or mine grid 11,000m north and 6,000 m east.

It is proposed to initially fill the void of the underground workings by discharging tailings directly into the portal via dedicated poly pipelines aimed at filling the majority of the underground voids on a progressive basis from the bottom of the mine upwards. This will be done via a series of discharge points that have been devised to maximise tailings deposition in the underground voids prior to filling the pit. Tailings will be allowed to flow down the workings which plunge at approximately 30° to the southeast. Tailings deposition will be undertaken from the open pit rim via a single point discharge once the underground workings have been filled, and the tailings begin to emerge at the base of the pit.

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The potential exists for some isolated wedge failures to occur during the operation of the TSF, however, these minor failures are considered highly unlikely to effect the operation of the decant system or the access ramp, and are unlikely to pose a risk to personnel servicing pumps. The design concept for the open pit incorporates a surface return water recovery system. The supernatant pond will be kept to a minimum size to minimise evaporation from the surface of the pond, subsequently optimising water recovery and tailings density.

Surface water liberated from the tailings slurry will be recovered from the impoundment area via a pontoon mounted pump. Tectonic will install and maintain roadside bunding along the above ground delivery and return pipelines from the open pit to the process plant. The bunding will be designed to contain any spillages or releases and return any overflow back to the pit/TSF.

Significant infrastructure, roads, return water sumps and reticulated power are already in place and can readily be utilised for this project. Additional monitoring bores will be established adjacent to the RAV 8 open pit and utilised as recovery bores if required. No clearing of native vegetation is required in order to allow the proposed TSF to proceed.

Tectonic will implement the following with respect to the Inpit Tailings Storage Facility:

- An adequate freeboard of 0.68 m will be available to store the design storm event of 1 in a 100 year, 72 hour storm event during the operation of the facility.
- Monitoring/recovery bores adjacent to the pit will be utilised to monitor water levels and water quality.
- The tailings storage facility will be managed and operated in general accordance with the Operations Manual.

On decommissioning the TSF will remain as a permanent feature of the landscape. The tailings within the facility will consolidate to an increasingly stable land mass, with an estimated insitu dry density of 1.5t/m³.

A DoIR requirement for decommissioning of the RAV 8 Nickel Sulphide operation was to place 50,000 bcm of benign waste against the toe of the southern wall of the pit. With the proposed tailings deposition into the RAV 8 pit this requirement will effectively be superseded, however it should be noted this requirement as part of mine closure has been partially fulfilled with fill established to an approximate level of 1042Mrl, some 14m above the ultimate pit bottom.

X.

3.6 Support Facilities

3.6.1 Mine Water Disposal

Trilogy

Tectonic proposes to construct a Water Storage Facility as part of mining operations within the Trilogy Project area. A Trilogy Water Storage Facility Notice of Intent has been prepared by Soil and Rock Engineering and is included in **Appendix R**.

Dewatering operations will be required in order to allow mining of the Trilogy ore body to proceed. It is proposed that groundwater encountered during the development of the open pit will be stored within a purpose built clay lined water storage facility southwest of the open pit. The design concept incorporates perimeter embankments and a compacted clay liner on the 'floor' of the facility. A geotechnical investigation of the site indicates that the locally available sandy clay material (from the surface of the Trilogy pit or from within the facility) is suitable for use in construction of the water storage facility embankments and 'floor' liner.

The hydrogeological study results indicate that an average dewatering pumping rate of about 250m³/d will be required in mining below the water table, from 33.5m to 37m depth. To lower groundwater levels between 37m and 44m depth, a total pumping rate of about 2,500m³/d is anticipated (**Appendix E.1**).

The Trilogy Water Storage Facility (TWSF) has been designed to contain the volume of water generated from mining to a depth of 44m. The Notice of Intent proposal includes the concept of constructing additional cells if mining proceeds beyond this depth (to be included within a separate environmental assessment). Stage 1 of the facility will have an expected maximum storage capacity of 180,000m³ and a surface catchment area of 8.6 ha. The perimeter embankments will have a maximum height of 4 m, and a freeboard of 0.7m will be maintained during the operation of the TWSF.

The TWSF will be formed by perimeter embankments on all four sides and thus any watershed into the facility will be by incident rainfall only. The average Class A pan evaporation for Ravensthorpe is 1987 mm per annum (Luke *et. al.*, 1988), over four times the average rainfall of 427.7mm. The water pumped into the TWSF will largely be disposed of by evaporation.

The site selected for placement of TWSF is characterised by very minor topographic relief and is located approximately 650m southwest of the Trilogy pit on M74/176. The approximate centre coordinates of the Stage 1 TWSF in GDA 94 (Zone 51) is 626 1000 north and 241 130 east. The facility has been assigned a hazard rating of Low, Category 3 by Soil and Rock Engineering 2005. The Whoogarup Fault line transects the Trilogy project area in a northeast – southwest direction, southeast of the proposed water storage facility location. If the water storage facility was moved to avoid any disturbance to the creekline it would overlay the Whoogarup fault – a zone of potentially increased permeability.

Four additional monitoring bores will be established adjacent to the water storage facility, and will be utilised in conjunction with the regional monitoring bores to monitor water levels and water quality (please refer to **Appendix E.1**). One of the additional monitoring bores will be located such that it intersects the Whoogarup fault line.

Tectonic will closely monitor the pumping, water levels and water quality during initial dewatering to confirm the hydraulic characteristics and water chemistry of the site. A bunded delivery pipeline corridor from the pit to the water storage facility will be established.

Testing has confirmed that dosing of the groundwater with lime is technically and economically feasible when required to neutralise pH. Treatment will be undertaken by Tectonic to adjust the pH of the water contained within the water storage facility by lime-dosing.

The TWSF is a temporary facility. On completion of mining any water remaining within the TWSF will be pumped back into the open pit void, the evaporites coating the 'floor' of the facility will also be removed to the open pit. This is detailed further in the Trilogy Rehabilitation and Preliminary Closure Management Plan (**Appendix S**)

Tectonic will ensure that the Trilogy water storage facility is constructed in accordance with the drawings and specifications for the project. A construction report prepared by a geotechnical engineer will be submitted to the DoIR following completion of construction.

Kundip

Dewatering operations will be required in order to allow development and mining of the Kundip ore deposits. The hydrogeological study results indicate that once the historic mine workings are dewatered, continuing groundwater inflows could be up to 500m³/day (Appendix E.1).

It is proposed that groundwater encountered during the development of the open pit and underground mines will be transferred between the historic mine workings, namely the Flag, Harbour View and Beryl shafts. Tectonic will install and maintain roadside bunding along the above ground delivery and return pipelines between the historic mine shafts. The bunding will be designed to contain any spillages or releases.

Tectonic will closely monitor the effectiveness of the proposed groundwater transfer, the volume of water being transferred and the effect on the regional groundwater table.

Tectonic proposes to construct a Water Storage Facility (WSF) as part of mining operations within the Kundip Project area. A Kundip Water Storage Facility (KWSF) Notice of Intent, prepared by Coffey is included in **Appendix T**.

The development of the Flag pit will entail pit development across a valley such that the natural flow of the ephemeral creek will be interrupted. To protect the pit development from water ingress that may occur in the small creek system it will be necessary to construct two containment dams and diversion channels. The main dam (Dam1 on sub-catchment 7a) will have a capacity of approximately 8,000 m³. The tributary dam (Dam 2 on sub-catchment 7b) will have an approximate capacity of 7,000 m³.

Dam 1 (sub-catchment 7a) is designed with an embankment crest RL of 154m, at this height the maximum embankment crest can expected to be 6m. The spillway outflow invert level is designed at RL 153m. Mine waste will be utilised to backfill a portion of the existing valley to RL 151m. With the maximum operating water level at RL 153m it can be expected that the water will cover an area of 1 ha.

Dam 2 (sub-catchment 7b) is designed with an embankment crest RL of 157m, having a nominal embankment height of 4m. The valley will be compacted with mine waste to RL 155m giving a free water depth of 1m behind the dam due to the construction of a 6m wide outflow contour channel having an invert at RL 156m. Collected water will be discharged into Dam 1. The two dams will be constructed in a single stage to the full design height.

Please refer to Figure 4 within **Appendix D.2**, which shows the location of the embankments, diversion channel and spillway in relation to the proposed infrastructure and the pit layouts. The combined dams (two) and associated spillway and channels are expected to occupy an area of approximately 4 ha.

A rating of Significant, Category 2 has been assigned to the two facilities. The significant classification has been adopted based on the clause "*No loss of life is expected, but the possibility is recognised*", as the volume of water being stored in each facility is less than10,000 m³, and as such any inflow to the pit would be to a relatively shallow depth.

The dams have been sized on a hydrological assessment undertaken by JDA to contain the volume of water generated in a 1:100 year rainfall event. The spillway has been located on the western side of the valley such that any discharge will be away from the downstream Flag pit. The spillway invert will be 1m below the embankment crest level of RL 154m. The spillway has been designed to pass a peak flow of 18 m³/sec.

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The main dam will be located approximately 300 m north of the Flag pit. The pit and water dams are located solely on Mining Lease M74/51. The approximate centre coordinate of the KWSF in GDA 94 (Zone 51) is 6 269 600m north and 240 250m east.

The area that will be occupied by the water storage facility on sub-catchment 7a is partially disturbed by an existing dam; the area occupied by the dam on sub-catchment 7b comprises natural vegetation.

A geotechnical investigation of the site undertaken in March 2004 indicates that, sandy clay materials suitable for use in the construction of embankments and 'floor liners' are locally available, especially as part of the pit pre-stripping operations. It is planned to place a mine waste buttress on the downstream face of the valley embankments to assist with stability.

It is proposed that new monitoring bores will be established adjacent to the water storage facility, and will be utilised in conjunction with the regional monitoring bores to monitor water levels and water quality. It is also planned to install two embankment piezometers to allow the phreatic surface within the embankment profile to be monitored.

The KWSF is not a temporary facility. On completion of mining any water remaining within the KWSF will be continue to be stored within facility. The Kundip and Haul Road Rehabilitation and Preliminary Closure Management Plan (**Appendix U**) details proposed rehabilitation for aspects of the facility.

Tectonic will ensure that the Kundip water storage facility is constructed in accordance with the drawings and specifications for the project. A construction report prepared by a geotechnical engineer will be submitted to the DoIR following completion of construction.

3.6.2 Mine Power

Trilogy

The Myamba homestead, the machinery sheds and proposed crib room are currently powered from the Hopetoun grid. No upgrade of power to this area is required.

A small generator will be utilised to power the pumps stationed within the open pit. Tectonic will use a fully autonomous fuelling facility for the short term nature of the project located adjacent to the ROM pad.

Kundip

Power supply to operate the proposed mining operations within the Kundip mining centre will be supplied by diesel generators. During the open pit mining phase, the mine office and workshop will be located south-west of the Maydon pit, and will be powered by a nominal 72 kVA diesel genset. A power station will be constructed for the underground mining

operations, with a nominal 2.5MVa capacity. Power will be reticulated to the underground mines using overhead power lines.

All electrical systems will be designed and installed to provide compliance with all the relevant standards and statutory requirements, high reliability, ease of maintenance and in accordance with best industry practice.

RAV 8

Power supply to operate the process facility at the RAV 8 minesite will be supplied by diesel generators. The load will be supplied by 4 units rated at 1,000 (2) and 1200 (2) kW each, of which the former two are already installed. The new plant and infrastructure electrical systems will be designed and installed to provide compliance with all the relevant standards and statutory requirements, high reliability, ease of maintenance and in accordance with best industry practice. The ultimate total electrical load for the process facility is estimated to be 3.1MW.

3.6.3 Workshop

Trilogy

The existing sheds adjacent to the Myamba farmhouse are suitable for maintenance of the open pit fleet at Trilogy. To ensure all aspects of the workshop area are compliant with the respective site licences the workshop area will be modified to include a concrete floor, a graded drain and concrete apron.

A designated wash down area is to be located adjacent to the workshop. It will be designed with a graded pad, drainage sump and associated oil/water separator.

Kundip

A new workshop will be established for the Kundip project. To ensure all aspects of the workshop area are compliant with the respective site licences the workshop area will include a concrete floor, a graded drain and concrete apron.

A designated wash down area is to be located adjacent to the workshop. It will be designed with a graded pad, drainage sump and associated oil/water separator.

RAV 8

The existing workshop facilities at RAV 8 will be utilised for the provision of light vehicle maintenance and road train maintenance. An additional store/workshop will be built dedicated to the storage of spares and provision of mill maintenance activities.

3.6.4 Potable Water

Potable water for the Trilogy and Kundip project areas will be provided by catching rainfall runoff from the roof of the workshop and offices and directing it into dedicated holding tanks.
Rainfall runoff will be supplemented by water carted from the proposed RAV 8 Reverse Osmosis (RO) plant, or from either Ravensthorpe or Hopetoun. Potable water requirements for the RAV 8 process plant will be met by the RO plant. Drinking water will be tested in accordance with the guidelines to ensure that the quality matches the Australian Standards.

3.6.5 Crib-Room and Ablution Facilities

Trilogy

Tectonic propose to convert the existing office at Trilogy into a designated office, first aid room and crib room for the workforce at the Trilogy minesite. If required the existing facilities at the Myamba farmhouse will be upgraded to ensure they adequately contain the sewage and waste water generated from the office building.

Kundip

Tectonic propose to install a designated office, first aid room, crib room and ablution facilities for the workforce at the Kundip minesite. The shower/toilet building will be segmented for male and female personnel working on site. Consultation with the Shire of Ravensthorpe is currently being undertaken to gain approval for their installation.

RAV 8

The workforce to be employed at RAV 8 for the operation of the process plant will be significantly less than the number of employees currently employed onsite for the mining of the nickel sulphide ore body. Subsequently the existing crib room and ablution facilities will adequately cater for the workforce required onsite for the process plant following cessation of mining.

3.6.6 Communication

Trilogy

A telecommunications link exists into the Myamba farm, this existing linkage is sufficient to provide adequate telephone, fax and email facilities for the Trilogy project.

Kundip

A dedicated telecommunications link will be established, this linkage will provide satisfactory telephone, fax and email facilities for the Kundip project. Tectonic will maintain a single line for emergency use only.

RAV 8

The existing telecommunications line into the RAV 8 mining lease will be maintained.

3.6.7 Blasting of Rock

Explosives required for the blasting of rock within the open pit and underground mine will be stored in a surface magazine with separate containment for detonators. The magazine will be constructed and located in accordance with the requirements of AS2187.1-1998. An

application to licence the magazine as per the Explosives and Dangerous Goods (Explosives) Regulations will be applied for by Tectonic.

Due to the proximity of the Trilogy site to the Shire of Ravensthorpe Airstrip, Tectonic has liaised with the Shire of Ravensthorpe regarding the implementation of NOTAM – which advises all aviation personnel within Australia of the intent to blast within the open pit at a designated time.

The proposed location of the magazine required for the development of the Project is directly south of the Flag West Open pit.

3.7 Transportation Corridors

3.7.1 Consideration of Options and Selection of Preferred Haul Road Route

Four options were considered as possible options for the haul road route. A brief description of each option follows. Table 3.2 outlines the pros and cons of each option from an environmental, economic and social perspective.

Option 1

Use the main Hopetoun-Ravensthorpe Road to transport ore northwards then cut across via the Elverdton Road to the South Coast Highway, before travelling eastwards along South Coast Highway to RAV 8.

This option had an advantage in that no extra haul roads would need to be constructed, however the Shire of Ravensthorpe objected to this proposal for the following reasons:

- Sighting distances on entering South Coast Highway were insufficient to allow continuous heavy haulage;
- Upon vehicles entering the highway they were faced with a steep section of road to first negotiate thus having the effect of creating a road hazard and generally slowing traffic;
- Heavy haulage traffic on Elverdton Road would incur extra road maintenance on the unsealed road; and
- The windy nature of the road would cause safety concerns, especially considering its primary use as a tourist access to the lookout viewing platform.

This option was therefore discounted.

Option 2

Use the main Hopetoun Ravensthorpe Road to transport ore northwards all the way into Ravensthorpe then travel east back along the South Coast Highway to RAV 8

This option also had an advantage in that no extra haul roads would need to be constructed, however the Shire of Ravensthorpe voiced concern at having heavy vehicles entering the town boundaries on a continuous basis. This would create excess noise pollution and would necessitate a bypass road construction as an alternative. In light of Shire concerns, and in order to minimize direct and deleterious effect on the community, this option was discounted.

Option 3

The creation of a haul road from Jerdacuttup North Road directly south of the end point of Hatfield Road. This option would necessitate transport of ore from both Kundip south and Trilogy north along the Ravensthorpe Hopetoun Road then east along Jerdacuttup North Road to the junction of Lee and Jerdacuttup North Road. Then it would run north along the newly created haul road, joining up with the existing Hatfield Road, which would also require upgrading due to its narrow nature.

Enquiries with the Ravensthorpe Shire revealed that the Jerdacuttup North and Lee Road sections were proposed to be resurfaced (bituminised) to a standard able to withstand light vehicle traffic (for the Ravensthorpe Nickel Project). The Shire required a commitment from Tectonic with regards to a haul road route before they progressed with the proposal, so that they could upgrade the road to a standard for heavy vehicles if needed. Tectonic were unable to commit to a haul route at this stage and therefore the standard of this road prohibits it from being used as a haul road. The cost of upgrading the sealed road which has now been in service for 3 months was deemed prohibitive ie +\$100,000/km.

Option 4

Through consideration of options, it was discovered that a gazetted road (8432) from Kundip to Hatfield Road was in existence. The Shire of Ravensthorpe advised that this would be their preferred option as long as permission was granted from the landowners whose boundaries it travels along.

Tectonic considered the proposed route and selected it as the preferred option for the following reasons:

- Environmental impacts associated with the development of the haul road can be adequately managed and offset;
- The haul route will see minimum interaction with general public traffic;
- It allows dedicated usage by mine vehicles only;
- It requires no creation of new gazetted roads;
- It is the most direct route between the origin and destination;
- Crossover points are minimised. Those proposed are approved by MRWA;
- It is deemed most cost effective option; and
- It has minimum impact on the Shire of Ravensthorpe and existing public infrastructure;

		Pros	Cons				
	Environmental	No extra clearing required	Increased emissions from increased fuel usage				
Option 1	Social	Avoids the centre of Ravensthorpe	All public roads, including tourist route Safety concerns with sighting distances and windy, steep road				
	Economic	No extra haul roads to be constructed	High road maintenance				
2	Environmental	No extra clearing required	Increased emissions from increased fuel usage				
tion	Social		Potential impacts on town residents				
Opt	Economic	No extra haul roads to be constructed Low road maintenance	Bypass construction cost prohibitive				
п 3	Environmental	No extra clearing required	Increased emissions from increased fuel usage				
ptio	Social	Avoids the centre of Ravensthorpe	All public roads but mostly rural				
0	Economic		Road upgrade deemed cost-prohibitive				
	Environmental	Shortest route thereby lowest fuel use and emissions	Disturbance to populations of DRF and Priority species and fragmentation of the Proposed Nature Reserve				
Option 4	Social	Interaction with general traffic restricted to 9.85km on the Ravensthorpe-Hopetoun Road Crossover points minimised					
	Economic	No public cost for road maintenance					

Table 3.2 Pros and Cons of Haul Road Opt	ions
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A description of the proposed haul road follows.

3.7.2 Description of Preferred Haul Road Route

The proposed haul road route is depicted in Figure 1.2.

Main Roads of Western Australia (MRWA) have granted approval for Tectonic to develop an access point from the Ravensthorpe – Hopetoun Road into the Trilogy site at Set Linear Kilometre (slk) 26.80 (approximately 1.3 kms north of Lee Road) and into the Kundip site at slk 16.95. Approval has also been granted by MRWA to develop a crossing over the South Coast Highway leading into the existing driveway at RAV 8 (slk 314). Two separate miscellaneous leases (applied for by Tectonic) cover the initial takeoff points from the Ravensthorpe – Hopetoun Road into the proposed mine site areas and to cover the portion of the mine haulroad south of RAV 8 contained on private property (Oldfield location 62).

The Ravensthorpe – Hopetoun Road will provide access to the Trilogy deposit for supply trucks and employees of Tectonic, contractors and other personnel affiliated with the mining of the open pit. It will not be deemed necessary to close the Ravensthorpe – Hopetoun Road during the blasting of ore and waste rock due to the 1.4 km distance from the proposed pit to the road.

Tectonic propose to transport the ore mined from the Trilogy deposit 1.4 km west along the internal mine haulage road to the junction of the Ravensthorpe – Hopetoun Road. This section of the road is not a part of this assessment, and approval for construction has already been granted by the EPA and DoIR. The road trains will then travel along the Ravensthorpe – Hopetoun Road 9.85 km to the approved access point into the Kundip Project area. The internal mine haulage road within the Kundip lease area is approximately 2.7 km in length.

Tectonic have liaised with the Shire of Ravensthorpe regarding the upgrade of the existing gazetted Road No. 8432 from the eastern boundary of the Kundip Mining Lease M74/51 through Unallocated Crown Land (UCL) to the western boundary of Oldfield Location 63. The Shire of Ravensthorpe has positively supported the proposal to upgrade the existing gazetted road.

The existing road follows the alignment of the gazetted road from the Kundip Project area down the eastern slopes of the Ravensthorpe Range and across the Jerdacuttup River. The gazetted road reserve alters between 20 and 40 metres in width. The distance along Section 4 of the haulage road from M74/51 to the western boundary of Oldfield Location 63 is 9.6 km.

The alignment of gazetted road 8432 transects Oldfield Location 56. The existing road currently deviates off the alignment and onto a gazetted firebreak around the southern boundary of Loc. 56. The road alignment through Loc. 56 has never been cleared nor fenced. The existing road then traverses along the southern boundaries of Loc. 57 & 63. Written consent has been given from the owner of Oldfield Location 56 to develop the road within the gazetted road reserve (please refer to **Appendix A**).

Written consent has also been given from the owner of Oldfield Location 63 and 62 to develop an internal haul road within these two freehold farm locations, (please refer to **Appendix A**). The haul road will continue north for 3.8 km along the western boundary of Oldfield location 63 & 62, then east for 1.0 km along the northern boundary of Oldfield Location 62 before crossing the South Coast Highway into the existing mining lease M74/13 at RAV 8. The construction of this portion of the haul road is not part of this assessment and is subject to approval from DoIR.

Australian Standard intersection street lighting will be installed by Tectonic at the RAV 8 South Coast Highway crossover point to warn oncoming motorists of an intersection and adequately highlight traversing road trains. Tectonic will construct the access points described in this document in accordance with MRWA construction standards.

The total distance for haulage of the ore from the Trilogy deposit to the ROM pad at the RAV 8 minesite is 28.35 km. The existing internal haul roads within the RAV 8 minesite will be maintained for transport of ore to the ROM pad.

Tectonic as the proponent of the Phillips River Gold Project intend to transport the ore over a 24 hour period, using road trains 36.5 m in length that have the capacity to carry 55 tonne.

The South Coast Highway will be used for transport of copper concentrate to the Esperance Port from the proposed processing/treatment plant located at RAV 8. This volume of material equates to approximately 20,000 tonnes per annum. The South Coast Highway will also provide access to the RAV 8 site for supply trucks and employees of Tectonic, contractors and other personnel affiliated with the processing of the ore.

3.8 Resource Requirements

Trilogy

Fuel consumption for the Trilogy mining fleet is estimated to be 385,000 litres of low sulphur diesel. Fuel will be stored on site in 55,000 litres self bunded tanks within bunding that meets the relevant Australian Standards. It is proposed that the self bunded fuel tanks be located adjacent to the ROM pad and be utilised only by equipment affiliated with the mining of the Trilogy reserve.

A designated refuelling area will be established (adjacent to the fuel storage facility) for all light vehicles and heavy equipment onsite.

Storage of all the oils and lubes required for the Trilogy Project will be contained within a designated area adjacent to the workshop. The workshop personnel will be equipped with a service truck to undertake maintenance when required within the confines of the pit.

Kundip

Fuel consumption for the open pit mining fleet is estimated to be 3,500,000 litres of low sulphur diesel over a period of 22 months and 5,000,000 litres over a 28 month period for the underground operation. Fuel will be stored on site in 55,000 litres tanks within bunding that meets the relevant Australian Standards.

Tectonic will apply for a Dangerous Goods licence for the onsite storage of diesel fuel within two (2) 55,000 Litre class 3 depots. It is proposed that the self bunded fuel tanks will be located adjacent to the workshop and be utilised only by equipment affiliated with the mining of the Kundip reserve. A designated refuelling area will be established (adjacent to the fuel storage facility) for all light vehicles and heavy equipment onsite.

Tectonic will store all oil and/or other hydrocarbons within a low permeability (10⁻⁹ meters per second or less) compound adjacent to the workshop. The workshop personnel will be equipped with a service truck to undertake maintenance when required within the confines of the pit and/or underground workings.

The road trains utilised in the transport of ore from the Kundip Project area to the process plant at RAV 8 will be serviced and refuelled utilising the existing facilities on M74/13.

RAV 8

Fuel consumption for the process plant will be approximately 580 L/hr. The site will not exceed the trigger fuel usage that requires licensing as a Category 87 – schedule 1 Premises. The RAV 8 site Dangerous Goods licence number S16246 reflects the onsite storage of diesel fuel within three (3) 55,000 Litre and one (1) 10,000 Litre class 3 depots.

The road trains utilised in the transport of ore from the Trilogy Project area to the process plant at RAV 8 will be serviced and refuelled utilising the existing facilities on M74/13.

Tectonic currently stores all environmentally hazardous chemicals including fuel, oil or other hydrocarbons (where the total volume of each substance stored on the premises exceeds 250 litres) within low permeability (10⁻⁹ meters per second or less) compound(s) designed to contain not less than 110% of the volume of the largest storage vessel or inter-connected system, and at least 25% of the total volume of substances stored in the compound. These compounds will be maintained for the operation of the process plant.

3.9 Workforce

A maximum workforce of up to thirty (30) personnel will be required at each of the Kundip and Trilogy project areas. It is anticipated that the number of personnel onsite at one time will not exceed fifteen (15). A maximum workforce of up to twenty five (25) personnel will be required for the operation of the process plant at RAV 8. It is anticipated that the number of personnel onsite at one time will not exceed fourteen (14).

One principal aim of management at Tectonic is the continuity of employees currently working at the RAV 8 minesite who reside in the Shire of Ravensthorpe.

3.10 Housing and Accommodation

The development of the project will ensure personnel currently employed by Tectonic, who reside in the Shire of Ravensthorpe, will continue to have a minimal distance to commute to work from their place of permanent accommodation.

Accommodation is provided by Tectonic in a camp, owned by the company, established in Ravensthorpe, for employees who choose to commute on a continuous roster with workers travelling to and from the mine site daily

Local contractors will be employed by Tectonic where feasible for the construction and development of the project.

4.0 POTENTIAL ENVIRONMENTAL IMPACTS AND MANAGEMENT

4.1 Vegetation and Flora

EPA Objectives

To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge

Protect Declared Rare and Priority Flora, consistent with the provisions of the Wildlife Conservation Act 1950. Protect Flora listed under the EPBC Act.

4.1.1 Potential Impacts

Trilogy

The areas required for the Trilogy open pit, waste rock dump, ROM pad, water storage facility, haulage roads and fuel facility on M74/176 have been extensively cleared by historic farming practices. 0.038ha of vegetation consisting of remnant *Eucalyptus* mallee species is required to be cleared from the area of the proposed pit and waste dump for this proposal.

Kundip

Vegetation Communities

The Kundip mining lease has been heavily disturbed by historical mining activities. **Table 4.1** shows the footprint area of proposed mine pits, waste dumps and other associated infrastructure, the area already disturbed, and the area of each vegetation unit which is to be disturbed. The footprint of disturbance within the Kundip project area is 107ha (this figure is a total of the footprint for each individual component and doesn't take into account overlapping areas), and of this, 35ha is already disturbed. This results in 70ha of clearing required within the Kundip project area. **Table 4.2** presents data on the area of each vegetation unit within the Kundip project area and the percentage proposed for clearing.

	Development	Area already	Area of vegetation units requiring clearing (ha)													Total clearing					
Key Component	Footprint (ha)	disturbed(ha)	Mx	Мр	Мг	Bm	Ms	Ea	BI	Mc	Mh	Mg	Dc	Mm	My	Ec	Mb	En/Ec	Ma	Ep	(ha)
North Waste Rock Dump	20.5	7.5					5.1		7.6							0.3					13
North Dump Topsoil Storage Area	13.76	1.44					1.37		10.85				0.1					-			12.32
South Waste Rock Dump	10.76	1				0.21	0.34		0.7		6.1	0.4				1.47			0.54		9.76
South Dump Topsoil Storage Area	10.47	1.68				2.31	0.73		1.58		3.33					0.71			0.13		8.79
Flag and Try Again Open Pits and Flag Waste Rock Dump	9.94	3.95					0.93	0.3	0.19		3.03			0.5					1.04		5.99
Flag Topsoil Storage Area	2.57	1.17					0.14		0.84		0.42										1.4
Kaolin Pit	16.24	12.34	1.5			1.1	2.22	1	0.17			1		1	1000	0,1			1.41		3.9
Hillsborough Pit	6.78	1.76		E		1	0.71	1	4.23	1.0.1	les and	0.08								121	5.02
Maydon Pit	4.52	0.48							1.00	0.24	0.7	3.1							10.00		4.04
Offices & Workshop	0.22	0.048			-				0.003			0.17									0.173
Internal Roads	5.41	2.42				0.2	0.06			0.14	0.1	0.32							0.06		0.88
Run of Mine Ore pad	1.95	0.43							0.42	1.71	0.28	0.24							0.12		1.06
Water Storage Facility	4	0.85				0.07				0.01	2.1			1		0.42			0.55		3.15
Fuel Facility & Magazine	0.3	0.05						0.006			0.1	0.02		0.12							0.246
TOTAL	107.42	35.118	0	0	0	2.79	11.6	0.306	26.583	0.39	16.16	4.33	0.1	0.62	0	3	0	0	3.85	0	69.729

Table 4.1	Development footprints, areas of historical disturbance and clearing required within the Kundip project area

Notes

The areas reported for the designed open pits includes the area between the pit bund and the pit abandonment bund. Not all of the vegetation between these two bunds will be cleared, therefore an overestimation is made on the clearing required values for the vegetation within these areas.

The values for total vegetation to be cleared for internal roads and ROM pad is not equivalent to 'development footprint' minus 'area already disturbed'. This is because the calculation of development footprint for key components did not take into account overlapping areas (ie is greater than actual), whereas the calculation of areas disturbed and vegetation requiring clearing did account for overlapping areas.

Veg Code	Vegetation Structure	Plant Association	Area within Kundip project area (ha)	Area to be cleared (ha)	% to be cleared
Mx	Open Low Woodland and Dense Heath (<2m)	<i>Melaleuca</i> sp. Kundip (GF Craig 6020)	12.71	0	0.0
Мр	Open Low Woodland and Dense Heath (<1.5m)	Melaleuca haplantha	4.32	0	0.0
Mr	Open Mallee and Dense Heath (shrubs <1m)	Melaleuca rigidifolia	11.23	0	0.0
Bm	Open Mallee and Scrub Heath (mid- dense to open shrubs 0.5-5m)	Banksi media	31.52	2.79	8.9
Ms	Mallee and Dense Heath (shrubs <2m)	Melaleuca stramentosa	81.42	11.6	14.2
Ea	Low Forest	Eucalyptus astringens	18.68	0.306	1.6
BI	Open Mallee and Thicket/Scrub Heath (dense to open shrubs 0.5-5m)	Banksia lemanniana	156.9	26.583	16.9
Мс	Open Low Woodland and Dense Thicket	Melaleuca cucullata	26.09	0.39	1.5
Mh	Mallee	Melaleuca hamata	133.2	16.16	12.1
Mg	Mallee and Dense Heath (shrubs <1.5m)	Melaleuca sp. gorse (AS George 7224)	15.33	4.33	28.2
Dc	Sub-unit of BI	Dryandra cirsioides	1.91	0.1	5.2
Mm	Mallee and Thicket (shrubs >2m)	Melaleuca pauperiflora	1.77	0.62	35.0
My	Mallee and Dense Heath (shrubs <1.5m)	Melaleuca calycina	2.13	0	0.0
Ec	Low Forest	Eucalyptus clivicola	11.32	3	26.5
Mb	Sub-unit of Ms	Melaleuca bracteosa	15.38	0	0.0
En/Ec	Dense Low Forest (mallee regrowth)	Eucalyptus clivicola/Eucalyptus cernua	47.25	0	0.0
Ма	Open Woodland and Thicket (denes to mid-dense shrubs >2m) along drainage lines	Melaleuca acuminata	46.94	3.85	8.2
Ep	Low Woodland	Eucalyptus platypus	2.75	0	0.0
1.11		TOTAL	620.85	69.729	11.2

Table 4.2 Clearing required for each vegetation unit within the Kundip project area (see Figure 2.7)

All of the communities lie within the Ravensthorpe System of Beard (1979), which has been proposed for inclusion in CALM's Threatened Ecological Community database (Appendix F.1).

The majority of the communities present within the Kundip project area are well-represented in the region (see p10 of **Appendix F.1**), except for the units dominated by the Priority One listed *Melaleuca stramentosa* (types Ms and Mb), and the *Melaleuca* sp. Kundip unit, that also includes the co-occurring *Pultenaea* sp Kundip (type Mx). This vegetation unit could also qualify as a Threatened Ecological Community due to its topographically restricted location and its classification of being a short range endemic community (**Appendix F.1**).

The Mx unit is located outside the zone of direct disturbance (Figure 2.8), and therefore its regional significance will not change as a result of this proposal.

The combined Ms and Mb sub-units which are co-occuring occupy ~97ha within the Kundip project area. Only 11.6 of the Ms unit will be disturbed and none of the Mb unit will be disturbed. (Table 4.2).

As well as direct impacts through clearing, indirect impacts to vegetation in the zone of wider interest within the Kundip project area may include:

- Impacts to vegetation downstream of planned creek diversions (as discussed in section 4.3)
- Introduction of dieback into the project area
- · Spread of declared and environmental weeds through the project area
- Impacts from surface runoff and dust
- Impacts to groundwater dependent vegetation from dewatering
- Initiation of fire

Flora

The location of the Declared Rare Flora *Marianthus mollis* in relation to the disturbance areas is depicted in **Figure 2.8**. The two populations to the north of the northern waste dump and to the south of the southern waste dump will not be impacted by mining within the area. The four plants within the northern waste dump area will be disturbed by the mining operations. These plants are located within two previously disturbed sites on a weak drainage line and no plants were found in surrounding undisturbed vegetation. The fact that the plants have appeared in previously disturbed areas is a good indication of the rehabilitation potential of these species post-mining.

Regional surveys of known populations of *Marianthus mollis* estimated over 40,000 plants east of the Vermin Proof Fence (Population 1), and about 5,000 plants from four additional populations within the vicinity of the Ravensthorpe Range (**Table 3.6.1 of Appendix F.3**). Based on this fact, and given that the plants appear to germinate in disturbed conditions, the development within the Kundip project area will have a negligible regional impact on the species.

Development within the Kundip project area will result in disturbance to the following priority species:

Melaleuca stramentosa	Priority 1 – Table 3.6.2
Acacia disticha	Priority 2 – Table 3.6.3
Acacia laricina var. crassifolia	Priority 2 – Table 3.6.4
Hydrocotylye decipiens	Priority 2
Acacia durabilis	Priority 3 – Table 3.6.5
Boronia oxyantha var. brevicalyx	Priority 3 – Table 3.6.6
Dodonea trifida	Priority 3 – Table 3.6.7
Spyridium glaucum	Priority 3 (recommended be reduced to
	Priority 4) – Table 3.6.8
Siegfriedia darwinioides	Priority 4 – Table 3.6.10

Additional flora surveys for these priority species have been conducted outside the area proposed for development, and a number of additional populations have been identified in the region. Please refer to **Appendix F.3** and the relevant table number as indicated above to review the location, site description, date surveyed, number of plants, area searched and the status of the tenement or reserve identified for each of the species.

Hydrocotylye decipiens is only known from two other locations within the region. The population within Kundip consists of three sub-populations to the west of the northern waste dump (**Figure 2.8**). The two western most populations consist of approximately 100 plants each. The location of the waste dump has been changed to avoid direct disturbance to these populations (**Figure 2.8**). The eastern most population consists of approximately 10 plants and will be impacted by construction of the waste dump.

The largest impact on priority flora within the Kundip project area will be on *Acacia laricina* var. *crassifolia*. This species is frequent and widespread in the area at the eastern end of the northern waste dump, and throughout the proposed southern waste dump and areas to the north which will be intercepted by the haul road. It is also known to be frequent in the *Melaleuca stramentosa* (Ms) vegetation unit to the east and areas further to the south-east, which are proposed to remain undisturbed. The known locations of other populations are indicated on table 3.6.4 in Appendix F.3. The Kundip population however is of a significant size and therefore Tectonic propose to maintain as much of its integrity as possible.

There will be no impact on the two new species *Pultenaea* sp. Kundip and *Melaleuca* sp. Kundip, documented during recent flora surveys within the Kundip project area conducted by Tectonic for this proposal. These two species are located outside the proposed mining area (**Figure 2.8**), and within different hydrological catchments. They are located on a different geological unit to the one being mined within the project area, and this geological unit does not contain any minerals of economic interest.

Creek Diversions

Two ephemeral creeks within the Kundip project area will be diverted to allow safe mining of the Flag pit (please refer to section 4.3 for a detailed description). This may result in potential impacts to the vegetation downstream of these diversions.

Management of potential impacts from creek diversions to vegetation communities and flora within the Kundip project area is discussed in **Section 4.1.2**.

Groundwater Dependent Ecosystems

An assessment of the vegetation units identified within the Kundip mining leases concluded that there is limited information available as to the groundwater dependence and salinity tolerance of much of the native flora of the south-west, however given the depth and highly saline nature of the groundwater below the Kundip leases, it may be inferred that much of the flora is unlikely to have either the root system or salt tolerance to utilise this groundwater. It should also be noted that historical underground mining at Kundip to depths of 150m and associated localised dewatering has not had any observed effect on vegetation within the Kundip project area. It is therefore considered that any dewatering within the Kundip mining leases will not have any impact on vegetation within the area.

Haul Road

The proposed haul road will be constructed with an 11m running surface, or 9m where clear vision and safety considerations allow, with a 1:3 batter. The areas required for clearing within sections of the haul road are indicated on **Figure 4.1**. Development of the haul road will require the clearing of 15.07ha of vegetation through the Kundip project area and along the gazetted portion of the road. This will result in disturbance to the following species:

Marianthus mollis	Declared Rare Flora – Table 3.6.1
Beyeria sp A Ravensthorpe	Priority 1 (recommended reduced to
	Priority 4)
Melaleuca stramentosa	Priority 1 – Table 3.6.2
Pultenaea calycina subsp. proxena	Priority 1 (recommended reduced to
	Priority 4)
Acacia laricina var. crassifolia	Priority 2 – Table 3.6.4
Allocasuarina scleroclada subsp Bandalup	Priority 3 – Table 3.6.11
Spyridium glaucum	Priority 3 – Table 3.6.8
Acacia ophiolithica	Priority 3 (recommended to be removed
	from the Priority list)
Phebalium tuberculosum 'Maydon form'	Species of conservation significance

Additional flora surveys for the DRF and priority species have been conducted outside the area proposed for development, and a number of additional populations have been identified in the region. Please refer to **Appendix F.3** and the relevant Table number as indicated

above to review the location, site description, date surveyed, number of plants, area searched and the status of the tenement or reserve identified for each of the species.

Regional surveys to date of known populations of *Marianthus mollis* estimated over 40,000 plants east of the Vermin Proof Fence (Population 1), and about 5,000 plants from four additional populations within the vicinity of the Ravensthorpe Range. The development of the ore haulage road will impact upon the eastern aspect of the population known as 3A. This population contains approximately 300-400 mature plants within an area of approximately 1ha, and it is not anticipated that more than 50 plants will be disturbed.

Regional surveys to date of known populations of *Allocasuarina scleroclada* subsp *Bandalup* estimate 2,870 mature plants from twelve different populations - please refer to **Table 3.6.11** in **Appendix F.3**. It is important to note that a number of these populations were found prior to the Declared Rare and Priority Flora survey of the proposed haul road, and the compilation of the report presented in **Appendix F.4**. The development of the ore haulage road will impact upon the northern aspect of population 11 which comprises approximately 600 plants. The width of the road easement in this area is only 20m and the existing road goes through the middle of the population.

The locations of these species along the haul road are depicted in Figure 2.9.

No threatened ecological communities will be impacted by the development of the haul road.

It is unlikely that the proposed clearing of land required for the upgrade/redevelopment of Gazetted Road No 8432 will significantly impact on the adjoining Proposed Nature Reserve. However, in addition to direct impacts through clearing, indirect impacts on vegetation within the immediate vicinity of the Haul Road area may include:

- Introduction of dieback into the project area
- Spread of declared and environmental weeds through the project area
- · Impacts from surface runoff and increased transportation of suspended solids; and
- Dust

Management on potential impacts to vegetation and flora along the haul road are discussed further in Section 4.1.2.

RAV 8

The first bi-annual assessment of the tree health and water quality of the Bandalup Creek was undertaken by Outback Ecology Services in October 2002. These reports have provided a comprehensive discussion on the existing health of the riparian vegetation and the water quality of the Bandalup Creek. These reports have been forwarded to the DoIR and DoE for review. No additional vegetation clearing is required for the upgrade/refurbishment of the treatment plant at RAV 8, and subsequently the environmental impact on vegetation and flora is deemed to be negligible.

4.1.2 Management

The following management strategies will be adopted in order to manage potential impacts to vegetation and flora and meet EPA objectives.

Trilogy

The impact of agricultural practices, including land clearing, on the flora and fauna within the Trilogy project area has been extensive. Subsequently, the impact of mining the Trilogy ore body within M74/176 will have a negligible effect on the existing environment.

Tectonic will also install a vehicle and machinery wash-down facility to minimise the risk of dieback and declared and environmental weeds. Vehicular traffic movement within M74/176 and the Myamba farm will be confined to designated roads with a hardened surface in order to minimise the exposure to the seed/weed load in the paddocks. Tectonic will commit to preparing an environmental management plan (EMMP) that details measures for the management and eradication of declared and environmental weeds within the Trilogy lease area.

Kundip

Clearing

Clearing within the Kundip project area will be kept to a minimum. All cleared vegetative material will be pushed into piles, track rolled to break it down and transported to a designated stockpiled area. Topsoil from each distinct vegetation community or landscape unit (ie crests and upper slopes, slopes, lower slopes and drainage lines) will be stockpiled separately, to allow re-spreading in a similar landscape position in rehabilitated areas.

The following populations will be demarcated and avoided:

- The Marianthus mollis population to the north of the northern waste dump;
- The Marianthus mollis population to the south-east of the southern waste dump;
- The two Hydrocotylye decipiens populations to the west of the northern waste dump
- The entire Mx vegetation unit containing the newly described *Melaleuca* sp Kundip and *Pultenaea* sp Kundip

In addition the health of these populations will be monitored throughout the life of the mining operation.

An application to take the four plants of *Marianthus mollis* within the vicinity of the northern waste dump will be submitted to CALM.

A proportion (14.2%) of the *Melaleuca stramentosa* populations at Kundip will be affected by clearing. Clearing will be kept to a minimum and the remaining populations will be demarcated with signage to prevent access.

The EMMP will detail measures to ensure that the above management procedures are adopted.

In order to offset the proposed clearing within the Kundip area and the haul road, Tectonic have arranged to purchase a 60ha parcel of vegetated land that abuts the Kundip Nature Reserve (**Figure 4.2**). The land will then be donated to the conservation estate and will further consolidate the area of the Kundip Nature Reserve.

Rehabilitation

All cleared areas will be rehabilitated in accordance with the Rehabilitation Plan for the Kundip project area (**Appendix U**). Final figures on areas to be rehabilitated are included in **Table 4.3**. This will include rehabilitation of 18.91ha of areas previously disturbed by historical mining activities, which will result in a net increase in vegetation cover within the Kundip project area following rehabilitation. The pre and post-mining landscape within the Kundip mining footprint following rehabilitation is indicated within **Figure 4.3**.

Table 4.3 Vegetated and Disturbed Areas, Pre and Post-mining

	Pre-mining	Post-mining	Change
Total Impact Area (ha)	104.85	104.85	0
Disturbed Areas (ha)	35.12	16.21	-18.91
Vegetated Areas (ha)	69.73	88.64	+18.91

Tectonic intend to apply for a Licence to Collect Seed, and contract a number of seed pickers to collect seed on behalf of Tectonic for the purpose of revegetation within the Kundip project area. Tectonic will implement the collecting of seed, the propagating of species endemic to the Shire of Ravensthorpe and the planting and maintenance of revegetated areas.

Only local species will be used for rehabilitation. For the purposes of selecting appropriate rehabilitation species, Tectonic will establish monitoring plots in areas of native vegetation, of similar vegetative type, with a similar slope to that proposed for the waste dumps. A set of permanent monitoring (reference) plots, representing the habitat units that occur on areas to be disturbed will be established in areas that will not be impacted by mining activities within the Kundip project area. Their botanical composition will be quantified at project commencement and as appropriate during operations. These reference plots will provide a continuous and consistent measure of vegetation changes over time in response to climatic conditions. The methodology for establishment of these plots will be determined in consultation with CALM and botanists with extensive experience in the region.

Creek diversions

Tectonic will establish photographic monitoring points in equivalent vegetation types both upstream and downstream of creek diversions, prior to disturbance. Photographic data would be captured annually in order to detect any potential impacts to vegetation downstream of planned diversions.

Flora management

Tectonic have considered future environmental commitments to flora management. In line with this consideration Tectonic invited CALM's Threatened Flora Seed Centre to collect seed from the *Marianthus mollis*, *Melaleuca* sp Kundip, and *Pultenaea* sp Kundip populations identified within the Kundip project area. This has already been undertaken by CALM officers. Seed for rehabilitation purposes is currently being collected from the Kundip project area. Tectonic have agreed to donate in principle 10%, or 10,000 seeds of all native seed collected to the Millenium Seed Bank. However, for species which have low seed numbers, and for which a contribution of 10% may affect revegetation programs, an alternative donation will be negotiated with CALM at that stage. Tectonic also propose to collect the seed of *Acacia laricina* var. *crassifolia* over a number of years, so that it can be used for waste dump and track rehabilitation.

As part of the offset package for the project, Tectonic will also contribute to a targeted survey of the *Melaleuca stramentosa* and a regional survey of the proposed *Melaleuca*-over-mallee TEC. This will contribute to furthering the knowledge of the distribution of these populations.

Dieback and Weeds

In order to manage potential introduction of dieback into the area Tectonic will commit to the preparation of a comprehensive Dieback Management Plan in consultation with CALM. Operational procedures as outlined in the Dieback Management Plan will be adopted by the Shire of Ravensthorpe, Tectonic, and all sub-contractors during construction, maintenance and haulage, to minimise the risk of dieback introduction within the Kundip project area and surrounding areas, and provide measures to control dieback if introduced. Dispersal of weed seeds will be reduced by minimising movement of soil out of drainage lines during construction. A weed eradication/control program will be implemented at current sites of weed infestation and newly identified areas of weed colonisation, in conjunction with the Shire of Ravensthorpe and the Department of Agriculture. The EMMP will further detail measures for the management and eradication of declared and environmental weeds within the Kundip project area.

Fire

Tectonic commit to preparation of a fire management plan in consultation with CALM at the local level. This will include a fire contingency plan to preserve habitat and to prevent loss of leaf litter in bush > 15 years old.

Surface water

Section 4.3.2 provides details on management of surface water such that impacts to vegetation within the Kundip project area are minimised.

Dust

Populations of the DRF *Marianthus mollis*, Priority 1 *Melaleuca stramentosa* and Priority 2 *Hydrocotylye decipiens* will be monitored for dust impacts within the Kundip project area. Minimisation and management of dust is detailed further within section 4.6.2.

It is considered that the above management measures, rehabilitation of previously disturbed areas, regional surveys of vegetation and flora and the purchase of a 60ha vegetated parcel of land for contribution to the conservation estate will effectively mitigate any potential environmental impacts to the vegetation and flora within the Kundip project area.

Haul Road

Clearing and Rehabilitation

Clearing within the confines of the haul road envelope will be done in accordance with procedures outlined in the Rehabilitation Plan and EMMP. Prior to the removal of vegetation within the designated road corridor, Tectonic will employ an experienced seed collector to collect seed for use within the project revegetation programme. The road boundary will be outlined by a surveyor and clearly delineated with survey pegs and flagging before any grubbing and clearing of this area commences.

All cleared vegetative and topsoil material will be stockpiled within the confines of the road easement. All the vegetative material will be pushed into piles adjacent to the haul road and track rolled to break it down. A large percentage of the gazetted road easement is characterised by Proterozoic rocky substrate and shallow soil profiles, and stripping to a nominal depth of 100mm may not always be possible. Soils will be stockpiled near the point of collection to maintain eventual integrity of restored communities. A stock pile register will be maintained that indicates where particular piles were taken from within the cleared area.

Rehabilitation of the haul road will be done in accordance with the rehabilitation plan (Appendix U).

As mentioned previously, Tectonic have entered into negotiations to purchase a parcel of vegetated land in order to offset the proposed clearing within the Kundip area and the haul road.

Significant Flora

Tectonic will ensure that the populations of Declared Rare and Priority Flora are clearly demarcated prior to any clearing being undertaken in order to choose a route within the 40m

wide gazetted road easement that will ensure minimum disturbance to populations. Tectonic will implement an awareness/education session for contractors prior to the commencement of clearing that clearly outlines the location and extent of all the Declared Rare and Priority Flora populations within the gazetted road reserve. Construction of spur drains into the Declared Rare *Marianthus mollis and* Priority 3 *Allocasuarina scleroclada* subsp. *Bandalup* populations will be avoided during realignment and road construction. The environmental impact of the proposal on the population of *Marianthus mollis* is likely to be negligible due to the relatively small number of individual plants affected, and the robust genetics of the five known self-sustaining populations.

Tectonic have liaised with the Shire of Ravensthorpe regarding the possibility of realigning the road to completely avoid the Priority 3 population of *Allocasuarina scleroclada* subsp *Bandalup*. The realignment would involve developing the road 40 to 50m outside the current alignment of the gazetted road. This preferred option is untenable operationally as it means this section of the road would be subject to the Native Title process, which could potentially delay the project by a minimum of 9 months and an unquantifiable compensation payment. This process could take longer if agreement is not found between Tectonic and the two Native Title claimants. Tectonic have also considered narrowing the road at this location to avoid the population. However the nature of the topography in this location is such that this will not be possible from a road safety perspective.

Tectonic will closely liaise with the Shire of Ravensthorpe and all personnel affiliated with the development of the road to minimise any impact or disturbance to the DRF and Priority Flora populations within the width of the road reserve.

The taxonomic status of *Phebalium tuberculosum* 'Maydon Form' is currently being reviewed, this species is present near the northern limit of gazetted Road No. 8432 on Loc. 56. Tectonic will ensure that the population is clearly demarcated within the 40m wide easement prior to any clearing being undertaken. Tectonic is confident that it will be possible to choose a route within the road reserve that will avoid any disturbance to the population. Drainage lines and or spurs into this population will be avoided during construction.

Tectonic have invited the Department of Conservation and Land Management's (CALM) Threatened Flora Seed Centre to collect seed from the *Marianthus mollis* and *Allocasuarina scleroclada* subsp. *Bandalup* populations identified within the gazetted road alignment, as was done for the Kundip project area.

Dieback and Weeds

Operational procedures will be outlined in a comprehensive Dieback Management Plan to be prepared by Tectonic in consultation with CALM. The plan will be adopted by Tectonic during construction, maintenance and haulage, to minimise the risk of dieback introduction along the proposed haul road and control dieback if introduced. Dispersal of weed seeds and dieback

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will be reduced by minimising movement of soil out of drainage lines during construction. A weed eradication/control program will be implemented at current sites of weed infestation and newly identified areas of colonisation, in conjunction with the Shire of Ravensthorpe and the Department of Agriculture and in consultation with CALM.

Surface water

Any rainfall runoff generated by the clearing of the ore haulage road will be contained within the confines of the gazetted road reserve where possible (please refer to section 4.3.2). Drainage management within the haul road will be further detailed within the EMMP.

Dust

Populations of the Declared Rare *Marianthus mollis*, Priority 3 *Allocasuarina scleroclada* subsp *Bandalup* will be monitored for dust impacts along the haul road. This will involve monitoring the health of the individual plants and will be further detailed within the EMMP. Minimisation and management of dust is detailed further within section 4.6.2.

Vegetation Corridor

Tectonic propose to establish and fence a vegetation corridor inside Oldfield location 63 & 62 in the northern portion of the haul road to establish a continuous flora and faunal link to the vegetation north of the South Coast Highway (See **Figure 3.3**). This corridor will run along the eastern side of the haul road for part of the way in order to also act as a screening from the farmhouse located on Oldfield location 63. It will then run along the western side of the haul road and then along the northern side to act as a screening from the South Coast Highway. The linkage will be approximately 15m in width. The establishment of this portion of the haul road and vegetation corridor is not part of this assessment as the environmental impacts are considered to be negligible. Construction of the road and ecological linkage are detailed within a letter of intent submitted to DoIR.

In summary, it is considered that the combined management measures above will effectively mitigate any impacts to vegetation and flora within the Phillips River Gold Project area.

4.2 Fauna

EPA Objective

To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge

Protect Specially Protected (Threatened) and Priority Fauna and their habitats, consistent with the provisions of the Wildlife Conservation Act 1950. Maintain the abundance, species diversity and geographical distribution of fauna. Protect Fauna listed on the relevant schedule of the EPBC Act 1999

4.2.1 Potential Impacts

Trilogy

Direct potential impacts to fauna within the Trilogy project area are limited to potential avifauna access to the saline water storage facility and the open pit.

Kundip

Potential impacts to fauna within the Kundip project area are related to clearing of fauna habitat as outlined in Section 4.1. This is of particular importance for species of conservation significance within the project area. The occurrence of Carnaby's Black-Cockatoos, Malleefowl and Western Whipbirds at Kundip is not exceptional (Appendix H.1). Ron Johnstone (pers. comm. 2004) considered these species to be common throughout the Ravensthorpe district in suitable habitat.

Carnaby's Black-Cockatoo was observed perching and feeding within the Kundip project area. There were no records of breeding during the survey. Carnaby's Black-Cockatoo feeds primarily on the seeds and flowers of a range of species including *Banksia, Dryandra, Hakea, Eucalyptus* and *Grevillea*. Unavoidable impacts within the project area include the clearing of plant associations that include these genera. These vegetation units are well represented in the local region (**Appendix H.1**). It is therefore unlikely that the project will directly impact populations of Carnaby's Cockatoo other than by a slight reduction in regional potential foraging habitat for the project life and until rehabilitated species mature (**Appendix H.1**).

There were no sightings of Malleefowl during the fauna survey conducted in November 2004, although a single individual was reported during the survey in January 2004 (**Appendix H.2**). This species is generally associated with mallee, particularly floristically-rich dense mallee associations. A large percentage of the vegetation units within the Kundip project area are not characterised by a sandy substrate and an abundance of leaf litter – which are requirements for the construction of the birds' incubator-nests. Malleefowl are known to exist in the general region although the occurrence within the project area hasn't been confirmed.

The call from the Western Whipbird is conspicuous and may carry up to 200 metres (Biota 2005). Additional effort was directed towards documenting the occurrence of Western Whipbirds and other rare birds in the project area during the phase II fauna survey. A total of 23 hours was spent conducting transects through the entire proposed pit and overburden areas at Kundip to record the presence of threatened bird species (**Figure 2.7**). None of the records of the Western Whipbird fell within the proposed impact areas at Kundip. However, two of the four vegetation units within which the bird was recorded occurs over the impact areas, and it is likely that some habitat will be lost to local populations during the life of the project and until rehabilitated vegetation units mature (**Appendix H.2**).

It is unlikely that stygofauna are present in both the Kundip and Trilogy project areas. Advice from the EPA Service Unit is that the risk of significantly impacting stygofauna populations is considered to be low. Points to consider in support of this assumption at Trilogy are listed below:

- The low groundwater inflow rates and subsequent dewatering rates will have only localised aquifer effects
- The limited total time of dewatering (approximately 3 months)

Points to consider in support of this assumption at Kundip are listed below:

- The low groundwater inflow rates and subsequent dewatering rates will have only localised aquifer effect
- The Archaean volcanic rocks in the area are of low permeability and therefore any effects on groundwater level changes would be undetectable at more than 500m downgradient
- The groundwater occurs in localised fractures, most of which are probably associated with mineralised zones

Therefore it is considered that any potential impact to stygofauna would be localised and would not be significant in a regional context.

Haul Road

Further fragmentation of the Kundip area is likely to increase access potential for introduced predators, particularly the Red Fox.

RAV 8

Potential impacts to fauna at the RAV 8 site include avifauna being attracted to the tailings within the open pit void.

Additional potential indirect impacts of the Project on fauna including dust, noise and light are discussed further in sections 4.6, 4.8 and 4.9.

4.2.2 Management

Tectonic submitted a referral to the Commonwealth Department of Environment and Heritage (DEH) describing the proposed development of the Kundip ore reserve, and the nature and extent of likely impacts on matters protected by the EPBC Act relevant to the development of the Kundip project. The DEH decreed on the 15th March 2005 that the action proposed by Tectonic is not a controlled action (refer to **Appendix H.3**). Approval is therefore not required under Part 9 of the EPBC Act, prior to applying for separate State or Local Government environmental assessment and approval.

A fauna management plan will be included as a component of the EMMP, to discuss fauna interactions and describe fauna recovery/rehabilitation protocols if disorientated or injured fauna are found within the Project area. More specific management measures are detailed below.

Clearing

Clearing of vegetation and thus fauna habitat will be kept to a minimum as described in Section 4.1.2. Specifically, all habitat trees will be retained where possible. Habitat logs will also be retained during clearing for use in rehabilitation.

It is proposed that the temporary reduction of potential foraging habitat through clearing of vegetation units at Kundip and along the haulage route will be compensated for in part by the purchase of 60ha of vegetated land for contribution to the Kundip Nature Reserve (**Figure 4.2**). The establishment of a vegetation corridor from the eastern side of the Proposed Nature Reserve to the vegetation north of South Coast Highway will also provide increased habitat, as well as facilitate dispersal of fauna populations.

Malleefowl

Tectonic will sweep the area proposed for the ore haulage road, and the Kundip project area, using the "human chain" technique, prior to clearing to detect active Malleefowl breeding mounds. Tectonic have contacted the Malleefowl Preservation Group in respect to methodology and subsequent management. If active mounds are found, the Malleefowl Preservation Group has indicated that any eggs can be successfully relocated and incubated. CALM Ravensthorpe will be involved with all aspects of Mallefowl management. CALM and the Malleefowl Preservation Group will be further consulted in the development of mallefowl protocols as part of the EMMP.

Malleefowl road signs have been erected on the Ravensthorpe–Hopetoun Highway, approximately 1.5 km south of the main access road into the Kundip project area. The signs effectively caution drivers of the presence of Malleefowl in the area, reducing the occurrence of road kills.

Feral animal control

Further fragmentation of the Kundip project area and the Haul Road is likely to increase habitat availability and access potential for introduced predators, particularly the Red Fox. The potential increase of foxes into the adjacent Proposed Nature Reserve will be managed by Tectonic contributing to regional fox baiting of the entire Ravensthorpe Range for five years through the Western Shield Project.

Tectonic currently operates a feral cat trapping program at RAV 8. This will be continued at RAV 8 and will be expanded to include the Kundip project area.

Tailings Storage Facility, Water Storage Facility and Pit Voids

Tectonic will continue to evaluate methods to minimise any environmental impacts resulting from placement of tailings within the RAV 8 open pit on avifauna within the region, including the maintenance of a small fresh water dam west of the saline water storage facility as an alternative/preferred source of water for avifauna. Methods employed by Tectonic to distract avifauna from the tailings storage facility will include but not be limited to:- Locating the supernatant pond away from the bank of the facility; ensuring the banks of the facility do not provide attractive landing sites for avifauna and continual assessment and monitoring of fauna that is noted within the vicinity of the TSF. Should avifauna be observed within the vicinity of the TSF, alternative measures determined in consultation with DoIR will be implemented. It is anticipated that Tectonic will effectively manage any environmental impact to fauna following the deposition of tailings into the RAV 8 open pit void.

Tectonic will also put in place measures to deter avifauna being attracted to the open pit lakes within Kundip and the saline water storage facility within Trilogy. These measures will include but not be limited to, maintaining a farm dam as an alternative source of fresh water for local avifauna, ensuring the berms within the pit are not attractive landing sites and blocking access into the pit via the ramp post-mining. Fauna that is observed within the vicinity of the open pits will be continually assessed and monitored.

It is considered the above management measures will effectively mitigate any impacts to fauna within the Phillips River Gold Project area.

4.3 Surface Water

EPA Objectives

To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.

To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.

4.3.1 Potential Impacts

Potential impacts of the Project on surface waters are as follows:

- Disturbance to flows of ephemeral tributaries of the Steere River within the Kundip and Trilogy project areas;
- Disturbance to flows of the Steere River and Jerdacuttup Rivers at the haul road crossings;
- Increase in, and transportation of, suspended solids and chemical/hydrocarbon contaminants to the Jerdacuttup River, the Steere River and their tributaries, due to runoff from the mining areas and haul road; and
- Chemical contamination of Bandalup Creek due to seepage from the in-pit Tailings Storage Facility at Rav 8.

4.3.2 Management

Surface Hydrology assessments have been undertaken for both the Trilogy and Kundip project areas by JDA Consultant Hydrologists (**Appendix D.1 and D.2**). Management measures to control surface hydrology are described within these reports and are briefly described for each project area below.

Trilogy

Creeklines

The proposed water storage facility will be required for containment of sub-surface waters as a result of pit de-watering. The proposed location of the water storage facility is in the path of the existing creekline of sub-catchment A (**Figure 2.5**). Tectonic investigated alternative locations of the water storage facility in between sub-catchment A and B, however this option was not deemed to be suitable due to the potential underlying permeability of the ground hosting the Whoogarup fault line.

Flows within Creek A and Creek B are characteristically low. However, in order to maintain the flows within the creek system, Tectonic have proposed to divert Creek A around the water storage facility via an open drain (**Figure 4.4**). In order to achieve sufficient grade in the drain the diversion will commence approximately 250m north of the water storage facility (please refer to **Appendix D.1**).

With the diversion in place a small collection area of runoff may pond against the northern bank of the facility. Tectonic will install a cut-off (trapezoidal open) drain along this margin in order to direct the flow west past the top of the water storage facility and then south to connect with Creek A. Tectonic will seek to maintain environmental flows in the creeks at existing rates as much as possible.

The main access/haulage road will cross Creek A approximately 350 m west of the pit. The crossing is immediately upstream of the location of where the proposed diversion of creek A around the water storage facility will commence. Tectonic will construct a road crossing where the ore haulage road crosses Creek A. A description of the type of road crossing is included within **Appendix D.1**.

Rainfall runoff

As the catchments are already heavily cleared within the Trilogy project area, the additional runoff generated by the construction of mine infrastructure will only be minor. Additional runoff will be attenuated on site and used within the mine operation while at all times seeking to maintain environmental flows in the creeks at existing rates as far as possible.

Due to the physical characteristics of the soil, runoff erosion controls will be required for all cleared areas. The additional runoff from these areas will need to be managed to ensure erosion of the surrounding landscape does not occur. To prevent flooding of infrastructure and unwanted ponding of stormwater around the open pit, waste dump and/or the water storage facility, appropriate water control bunds and appropriately engineered drains will be incorporated into the design of these structures. Minimum drainage design will be based on the 1 in 100 year rainfall event.

Rainfall runoff from the Trilogy waste rock dump, ROM pad and sub-economic ore stockpile will be directed into lined containment ponds placed strategically as required. It will then be pumped out into the water storage and redirected into the open pit at the end of the mine life.

The western aspect of the open pit is located on the boundary between sub-catchment A and B and as such surface flows towards the pit will be minor. Appropriate water control bunds and drains will be installed around the open pit to prevent any surface flows from entering the pit during mining operations.

The centre of the waste dump is located on the boundary between sub-catchment A and B, and as such surface flows towards the pit from the waste dump will also be minor. Appropriate water control bunds and drains will be installed to prevent any erosion from surface flows around the base of the facility.

Opportunistic sampling of flows within the creeks will be undertaken in order to ensure that the management of runoff as proposed above is effective in preventing increased suspended solids or chemicals/hydrocarbons within the creek system.

Based on the above management of rainfall runoff and surface water flows, it is unlikely that the environmental values of the Kuliba Creek system or the Steere River will be impacted by the development of the Trilogy project on M74/176.

Kundip

The Kundip mining operation will involve the development of nine pits and three underground operations as follows:

- Hillsborough Pit open cut pit
- Kaolin Pit (incorporating Western Gem Pit) open cut pits with proposed underground decline
- Maydon Pit open cut pit with proposed underground decline
- Flag Pit (incorporating Flag Main, Flag West, Flag Central and Flag Central B) open cut pits with proposed underground decline
- Try Again Pit open cut pit

Creeklines

There are 11 sub-catchments of the Steere River within the Kundip project area (**Figure 4.5**). The development of the Flag pits will entail pit development across a valley such that the natural flow of the ephemeral creeks within two of the sub-catchments will be interrupted. To ensure the safety of the mine workings, it will be necessary to construct two containment dams and associated diversion channels. The main dam (Dam1 on sub-catchment 7a) will have a capacity of approximately 8,000 m³. The tributary dam (Dam 2 on sub-catchment 7b) will have an approximate capacity of 7,000 m³ (**Figure 4.5**). The dams will also include appropriately engineered rock-lined spillways.

The dams have been sized on the hydrological assessment undertaken by JDA (Appendix **D.2**) to contain the volume of water generated in a 1:100 year rainfall event. Water is thus not likely to be discharged unless a prolonged rainfall period or greater than 1:100 year rainfall event occurs. This may result in downstream impacts to vegetation. Health of the vegetation will be monitored photographically on an annual basis to detect any impacts from the creek diversion. If changes in vegetative health are observed at the downstream monitoring sites, Tectonic will implement measures that mitigate the impact during mining operations, and alleviate any on-going effect post-closure. The majority of the water within the dams will be lost to evaporation. Any remaining water will be used for dust suppression within the Kundip project area.

The area that will be occupied by dam 1 on sub-catchment 7a is partially disturbed by an existing dam; the area occupied by the dam on sub-catchment 7b comprises natural vegetation.

A geotechnical investigation of the site undertaken in March 2004 indicates that, sandy clay materials suitable for use in the construction of embankments and 'floor liners' are locally available and should become available as a result of the pit pre-stripping operations. It is planned to place a mine waste buttress on the downstream face of the valley embankments to assist with stability.

The flow within the creek system is characteristically low. Therefore samples upstream and downstream of the proposed diversions will be taken opportunistically to monitor impacts on water quality.

The diversion dams will remain as a permanent feature of the landscape. Therefore the banks of the dams will be revegetated once construction is complete.

No other pits or structures within the Kundip project area will directly interrupt the flow of drainage lines.

Rainfall runoff

Due to the physical characteristics of the soil, runoff erosion controls will be required for all cleared areas. To prevent flooding of infrastructure and unwanted ponding of stormwater around the open pits, waste dumps and dams, appropriate water control bunds and drains as described in **Appendix D.2** will be incorporated into the design of these structures. Tectonic will ensure runoff erosion control measures will be installed for all cleared areas. Drainage will be designed to accommodate the 1 in 100 year rainfall event. Drainage controls required within the Kundip project area are depicted in **Figure 4.5** and described briefly below. Please refer to **Appendix D.2** for a detailed description.

Drainage from the office and workshop areas will be managed using sediment traps, hydrocarbon traps and erosion controls. Drainage will be directed north towards Creek 5. Road drainage will be managed by incorporating road side drains into road designs. Road crossings will be designed as detailed in **Appendix D.2**.

The Hillsborough Pit will not require any drainage development. Drainage from the northern waste dump area near the Kaolin Pit will be directed towards Creek 3. Drainage from the eastern boundary of the Kaolin Pit will be directed towards Creek 5. A drain along the southern end of the Maydon Pit will direct flow towards Creek 5. Flows from the southern side of the Try Again pit will be directed towards Creek 7b. Water that collects along the north-east side of the southern waste dump will be directed into the top end of Creek 7b. Rock-lined silt settling ponds will be installed at the point of discharge from the mining areas

into the surrounding environment. This will prevent any increased sedimentation being discharged into the creeklines.

Based on the above management of rainfall runoff and surface water flows, it is unlikely that the environmental values of the Steere River and its tributaries will be impacted by the development of the Kundip project.

Haul Road

Creeklines

Tectonic will undertake drainage control works where both the Steere River and Jerdacuttup Rivers flow across the path of the proposed ore haulage road. This will include the construction of a concrete stabilized culvert that will be submerged during peak flows but allow average flows to pass under road. It is not anticipated that there will be any movement along the road during these periods or during episodic storm events. Details of drainage design and management will be included within the EMMP.

Rainfall runoff

Rainfall runoff generated by development of the ore haulage road will be contained within the confines of the gazetted road easement where possible. Preliminary discussions with Coffey Geosciences have confirmed that surface drainage can be adequately controlled by roadside V drains and a series of small sediment traps. The V-drain and sediment traps will direct surface waters towards natural drainage lines whilst minimising sediment transportation. In discussions with the Shire of Ravensthorpe and Coffey Geosciences, it is proposed that numerous small culverts are installed in preference to less frequent larger catchment dams in road sections of steeper gradient, or where deemed appropriate. The management of rainfall runoff within the haul road will be further detailed within the EMMP. More competent siltation settling ponds will be established at areas where road surface run-off re-enters natural drainage lines to prevent transportation of sediment to the natural surrounds.

It is considered that the management measures as detailed above and further in the EMMP, will effectively mitigate any impacts to the flows and quality of the Jerdacuttup and Steere Rivers.

RAV 8

Creeklines

Tectonic have constructed a drainage channel to direct uncontaminated water from the upper part of the catchment away from the lease area and into the Bandalup Creek system. Therefore no creek diversion works are required for the RAV 8 Inpit Tailings Storage Facility.

The potential impact of contaminated groundwater seeping from the TSF into the Bandalup Creek system is discussed further in Section 4.5.

Rainfall runoff

Rainfall runoff from the ROM pad at RAV 8 will be directed into a lined containment pond, and directed back into the process water stream.

4.4 Groundwater

EPA Objectives

To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.

To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.

4.4.1 Potential Impacts

Potential impacts to groundwater from the Project include:

- Drawdown of local water tables due to mine dewatering and borefield pumping;
- Permanent modification of groundwater quality and/or groundwater levels as a result of the creation of long term pit lakes that operate as groundwater sinks;
- Adverse impacts on groundwater quality as a result of potential contamination by hydrocarbons, chemicals or potentially acid forming mine wastes; and
- Modification of groundwater quality through the deposition of tailings within the open pit void at Rav 8.

A further discussion of these impacts specific to each project area follows.

Trilogy

Dewatering

Groundwater levels are currently about 33.5m below ground level (bgl). The current pit design has defined a 25m bgl maximum depth for the most part of the pit floor and will therefore not require any dewatering. One portion of the pit (a drop-cut) will be mined to 44m and will require dewatering. Rockwater conducted an exploratory groundwater drilling programme to assess the likely dewatering requirements within the pit (**Appendix E.2**). An average pumping rate of about 250m³/d will be needed over two months to dewater to 37m

depth, during Stage 1 of mining. An average pumping rate of about 2500m³/d would be required to dewater to 44m.

Inflows to the pit between 37m and 44m depth, once pumping has stopped, are calculated to initially be in the order of 1,700 m³/d, decreasing to about 1,400m³/d after six months (**Appendix E.2**). The impact of dewatering the Trilogy open pit is deemed to be short term due to the rate of inflow. A water balance for the Trilogy project area is depicted in **Figure 4.6**.

It should be noted that the groundwater at Trilogy is saline (18,000mg/L), above the salinity suitable for stock drinking water and therefore is unlikely to have any pastoral land use end benefit.

The saline, acidic groundwater extracted during de-watering will be pumped to the water storage facility (WSF) within the Trilogy project area (See **Figure 3.1**). Dewatering of 1,700 m^3/d is expected to be required for 1 month. Due to the size of the aquifer, this extraction will have negligible impact on long term aquifer levels.

The management of potential impacts from dewatering within the Trilogy project area is discussed in Section 4.5.2.

Pit Voids

Tectonic intends to backfill the pit drop-cut area such that the water table is not exposed. In this scenario, groundwater levels will return to around the original levels and there will be no permanent water in the pit as the rainfall accumulating in winter will be evaporated in summer.

Groundwater Contamination

Potential impacts to groundwater quality within the Trilogy project area could result from spillage of hydrocarbons/chemicals during mine operation and subsequent seepage to groundwater, as well as seepage of contaminants from potentially acid forming waste that will be placed within the waste rock dump. Further details of potential impacts of potentially acid forming materials within the Trilogy project area are given in Section 4.7 – Waste Disposal.

Management of potential groundwater contamination is discussed in Section 4.5.2

Kundip

As previously discussed, the Kundip mining operation will involve the development of nine pits and three underground operations as follows:

- Hillsborough Pit open cut pit
- Kaolin Pit (incorporating Western Gem Pit) open cut pits with proposed underground decline
- Maydon Pit open cut pit with proposed underground decline

- Flag Pit (incorporating Flag Main, Flag West, Flag Central and Flag Central B) open cut pits with proposed underground decline
- Try Again Pit open cut pit

Dewatering

Dewatering operations will be required in order to allow development and mining of the Kundip ore deposits. The amount of groundwater expected to be encountered is minimal (less than 3L/sec of inflow), as indicated by historical mining operations and test-drilling results (Appendix E.2). A water balance for the Kundip project area is given in Figure 4.7.

It should be noted that the groundwater at Kundip is saline (22,000mg/L – 38,000mg/L), above the salinity suitable for stock drinking water. Given the end land use for the Kundip project area is a proposed conservation reserve, it is unlikely that saline water storage options proposed herein will have any adverse effect on end land use if managed as per this proposal.

It is proposed that groundwater encountered during the development of the open pit mines at Kundip will be transferred between the historic mine workings, namely the Flag, Harbour View and Beryl shafts. Groundwater will be dewatered from the Kaolin pit at 260m³/day for less than a quarter of the mine life and it will be pumped to the Beryl mine shaft. The Hillsborough and Maydon pits will be dewatered at 90m³/day toward the end of the mine life and will be pumped to the Beryl mine shaft and then the Flag. Flag West will be pumped at 260m³/day for half of its life and it will be pumped to the Flag Shaft. No dewatering will be required from the Western Gem, Flag Main and Flag East pits.

Saline groundwater encountered during the development of the underground mines will be used as service water, specifically underground drilling water, and surface and underground dust suppression. Excess water will be pumped to, and stored within the Hillsborough pit. Utilising Hillsborough pit as a Water Storage Facility during underground dewatering will alleviate any requirement for the construction of a purpose built facility and hence reduce disturbance.

Pit Voids

Rockwater produced a report on the impact of final mine voids at Kundip on the groundwater flow system (Appendix E.4), which can be summarised as follows.

The Try Again, Flag Central and Western Gem open pits will be backfilled during the mining operation such that no pit voids remain. The Flag Main and the Flag Central B pits will remain as open pit voids above the water table. The four remaining pits (Maydon, Hillsborough, Kaolin and Flag West) will remain as open pit voids and will extend below the water table. A portion of the Hillsborough pit will be backfilled and the remainder will only just be below the water table and will act as a throughflow lake. The Kaolin, Maydon and Flag West pits will

capture, contain, and allow some rainfall-runoff to infiltrate the groundwater and will on average be minor groundwater sinks.

Evaporation from the Kaolin, Maydon and Flag West pits will cause a small increase in groundwater salinity in an already saline aquifer (22,000mg/L – 38,000 mg/L). Rainfall accumulation and infiltration to groundwater from the Western Gem, Hillsborough, Flag Central B and Flag Main pits will introduce fresh or less saline water to the aquifer and will probably result in an overall decrease in groundwater salinity in the area.

Surface and open underground mine workings (new and existing) will act as local zones of high permeability that will reduce the hydraulic gradient of the water table. Any effect on groundwater levels in the area would be localised and restricted to no more than 500m down-gradient, because of the low permeability of the rocks in the area. There are no groundwater users or groundwater dependent ecosystems near the Kundip project that could be impacted by the changes to the groundwater flow system.

Preliminary geochemical investigations have identified that Kundip pit water quality may initially experience acidification and elevations in copper levels (less than 1 g/l). This will be attributed to copper enrichment in, and adjacent to, the ore zone, and also the initial acidification of pit infill water as it becomes exposed to acid forming material, including residual blasting agents, in wall fractures. The remaining proportion of Cu enriched ore zone in the pit profile will be very small (2%), and as filling proceeds, Cu levels will decline with dilution, and wall-rock buffering will contribute to alleviate the possible acidity. Tectonic propose to monitor the pit infill water quality to confirm that no long term effect upon pit water will be realised.

Groundwater Contamination

Potential impacts to groundwater quality within the Kundip project area could result from spillage of hydrocarbons/chemicals during mine operation and subsequent seepage to the groundwater table.

Rav 8

Groundwater levels and flow direction

Rockwater Pty Ltd was commissioned to undertake a modelling study on the effects of tailings emplacement and groundwater inflows during deposition and following end of mining (**Appendix V**). This report predicts the rate of water-level recovery in the mine workings, the impact of storing tailings in the mine pit on groundwater levels and groundwater flow directions.

The RAV 8 mine is in an area of crystalline rock of Archaean age. Prior to mining, exploration drill holes at the RAV 8 deposit typically intersected groundwater at about 30 to 45 m depth in slightly weathered or fresh ultramafic rocks with carbonate alteration and some silicification.

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The base of the ore body near the contact with the underlying quartzite was identified as being potentially very permeable.

At present, the mine is dewatered to enable underground mining; dewatering operations have lowered water levels in the workings to 270m or more below ground level. As a result a strong hydraulic gradient currently exists towards the RAV8 pit and underground workings.

Water will initially be drawn from the pit (supernatant tailings water) to use as process water within the treatment plant. Tectonic will, on occasions, source additional plant make-up water from the water storage facility and the bores adjacent to the pit perimeter if required.

Current water inflows to the mine are around 1,600m³/d of which about 900m³/d is water recirculated from the saline water storage dam. The modelling results indicate that tailings and groundwater inflows will fill the underground workings within the first three months. Total water flows to the open pit (groundwater inflows plus tailings water) are predicted to be about 1,940m³/d at the end of the first year of tailings deposition, decreasing to about 1,030m³/d at the end of the second year and further in subsequent years. At these rates, and in the absence of supernatant tailings water recovery, the pit will be full of tailings and water after about five years of emplacing 734,000m³/year. The actual time taken to fill the pit will depend on some factors that are difficult to define, such as evaporation rates, supernatant water recovery rates, and progressive reduction in groundwater seepage to the pit as the hydraulic gradient towards the pit stabilises. A water balance for the RAV8 project area is depicted in **Figure 4.8**. The data used to formulate this diagram is included as Appendix W. Water within the Tailings Storage Facility will be 49m below ground level, and 19m below the standing water level (~30m).

The proposed groundwater inflows to the pit will only continue while tailings are being emplaced below the water table level, i.e. about 30 m below ground level. The in-pit tailings will remain a groundwater sink until the tailings/supernatant pond reaches 30m below ground level in the adjacent aquifer, hence minimizing the likelihood of tailings chemistry influencing local groundwater. Upon reaching 30m below ground level, it could potentially become a flow through "lake". If the pit was full, and contained a large supernatant pond above the baseline standing water level of the surrounding aquifer it would be a groundwater source and water could flow from the pit back into the aquifer. Tectonic propose to manage and monitor this possibility as per section 4.4.2 to ensure all potential impacts are mitigated.

As the tailings consolidate and drain, the phreatic surface in the tailings will fall to a little above the original water table level, and the tailings will be a flow-around feature, as the tailings will be of low permeability and groundwater will tend to flow around them.

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Once tailings deposition has been completed, water levels in the tailings will gradually decline and those in the surrounding rocks will recover to new equilibrium levels that are influenced by the low permeability of the tailings and the high permeability of the underground workings.

Tailings emplacement will be carefully controlled, and can be stopped before the pit is completely full to allow sufficient freeboard (0.68m) which will be capable of containing a high rainfall event (e.g. a 1 in 100 year rainfall), therefore preventing any chance of water overtopping the pit.

Filling of the pit may potentially raise local groundwater levels, causing waterlogging of vegetation roots and salt damage to soil and vegetation in low-lying areas. This may only be an issue towards the end of tailings deposition into the open pit if the tailings deposition and supernatant level is above the natural groundwater levels. It is anticipated that elevation in the water table will lessen after decommissioning, when groundwater levels equilibrate to natural levels. The effect of tailings storage facilities (TSFs) on groundwater and vegetation at mines representing 54% of Australian gold production has been reviewed (MCA (1996), **Appendix X**). This analysis showed that significant contamination of groundwater and salt impact from TSFs rarely occurs. Where salt impact does occur, it is localised and of negligible significance beyond the immediate environs of the operation. Bandalup Creek surface water pools sampled between 2002 and 2004 indicate the water to be saline, having a conductivity of generally about 31,250mg/L TDS, but increasing at times to 125,000mg/L TDS due to evapoconcentration (OES, 2004). Therefore the potential impact of saline water seeping to Bandalup Creek is considered to be minimal.

Groundwater flow direction adjacent to the pit area is in a general southerly direction towards Bandalup Creek (Please refer to Figure 3 of **Appendix V**).

Groundwater contamination and seepage into Bandalup Creek

Metallurgical analysis of the proposed tailings deposition over the life of the project predicted that the tailings solution would consist of 49mg/L WAD CN and 31mg/L soluble Copper at cessation of deposition 19m below the static water table level (**Appendix W**). The Rockwater modelling study as detailed above (**Appendix V**) predicted that any water released from the tailings within the pit will slowly flow to discharge zones along Bandalup Creek, taking as long as 50 years to travel the 1.4km distance. A potential impact considered by Tectonic is that the liquor associated with the tailings contains contaminants that may enter groundwater and have the potential to report to Bandalup Creek, thereby impacting on the environmental values of that surface waterbody. Enesar Consulting Pty Ltd was engaged to assess the likelihood of impacts on the water quality and environmental values of Bandalup Creek and local environs due to seepage from the pit to groundwater (**Appendix X**).

Predicting the final water quality of any seepage reporting to surface water is very difficult to determine empirically (or model) with any certainty. The final quality of the water in the pit will

depend on initial concentrations in the tailings liquor, dilution by rainfall and groundwater inflow, concentration by evaporation, attenuating processes that remove cyanide, the acid-forming potential of tailings solids and the effectiveness of management measures. An assessment of all of these factors relevant to the RAV 8 site is included within **Appendix X**.

The rate of any seepage from the pit to groundwater will be influenced by the permeability of the tailings and the pit wall. This seepage will then be diluted by regional groundwater and recharge as it migrates, during which time further attenuation processes may be expected to occur. Upon expression of the groundwater to surface waters, further changes in chemical speciation may be expected. The final quality of water in the surface water will depend on the relative proportion of the groundwater discharge to the surface water flow at the time. An assessment of these processes relevant to the RAV 8 site is included within **Appendix X**.

Through assessment of the above factors and processes at RAV 8, the Enesar report concluded that 'assuming that the scenarios described are representative of the situation that will occur for tailings discharged to the RAV 8 pit, it is reasonable to conclude that seepage water quality presents a low risk to the environmental values of Bandalup Creek and the surrounding environment. However, if conditions and behaviour are different than envisaged, there is a possibility that seepage may be of poorer quality and consequently impact on the environmental values of Bandalup Creek.' An observational approach as outlined in Section 4.4.2 below was suggested to manage seepage to groundwater in this case.

4.4.2 Management

Trilogy

Dewatering

Groundwater that will be transferred to the water storage facility (WSF) within the Trilogy project area will be saline and acidic. Tectonic will treat the groundwater within the WSF with lime to reduce the acidity.

Eight groundwater exploration holes were drilled and completed as monitoring bores during the groundwater exploratory drilling programme conducted in January 2004. The monitoring bores not located within the confines of the pit will be maintained as regional monitoring bores for the duration of the project. In conjunction with the four additional water storage facility monitoring bores, a groundwater monitoring regime will be conducted within the Trilogy project site during the mining period, and in consultation with the DoE thereafter.

Pit Voids

As previously mentioned, sulphide oxidation and subsequent acidification of pit water postmining will be minimal once the water table reaches an approximate depth of 35 metres (2m above the fresh-phyllite zone). For this reason, Tectonic propose to backfill the drop cut section of the pit above the expected natural groundwater level, which will alleviate any concern for sulphide oxidation.
Groundwater Contamination

In order to minimise any potential for seepage into the ground from any of the facilities within Trilogy, Tectonic will form a clay liner on the 'floor' of the water storage facility, waste rock dump and ROM pad. The waste rock dump will be further designed such that the movement of contaminating solutes from potentially acid-forming material through the profile is prevented. This is discussed further within section 4.7 – Waste Disposal. All storage areas for hydrocarbons and hazardous substances will be designed and operated in accordance with the relevant legislation and standards. As a hydrocarbon remediation area currently exists at the RAV8 site for contaminated soil, any contaminated soil from the Trilogy area will be transported to this facility. By centralising bioremediation activities, greater control over the facility can be gained, and hydrocarbon impact on soils at Trilogy will be negligible. Emergency response procedures will be established in order to contain spills and remediate the affected area. The groundwater bores previously discussed will also be monitored for water quality. Frequency of monitoring, parameters to measure and appropriate trigger values will be determined in consultation with the DoE.

The management measures outlined above will ensure that there will be negligible impact to the groundwater within the Trilogy site.

Kundip

Dewatering

Tectonic propose to install all saline pipelines adjacent to operational roads which will allow frequent inspection. In addition to these measures and in order to contain any inadvertent spillages or releases of saline water, Tectonic will install and maintain roadside v-drains along the above ground delivery and return pipelines between the historic mine shafts.

Six groundwater exploration holes were drilled and completed as monitoring bores during the groundwater exploratory drilling programme conducted in January 2004. The monitoring bores not located within the confines of the pit will be maintained as regional monitoring bores for the duration of the mine life to monitor water quality parameters and static water levels. In addition to the five monitoring bores that will remain for regional monitoring, water samples will also be drawn from clean expression points in underground workings. This combination of regional monitoring and localised sample collection in working areas will enable rapid detection of any deleterious effect of operations.

It is also proposed that new monitoring bores will be established adjacent to the proposed dams, and will be utilised in conjunction with the regional monitoring bores to monitor water levels and water quality. It is also planned to install two embankment piezometers to allow the phreatic surface within the embankment profile to be monitored.

The installation and monitoring of new bores in combination with monitoring of bores already present will ensure that a comprehensive groundwater monitoring regime will be conducted within the Kundip project site.

Tectonic will also closely monitor the pumpage rates, water levels and water quality parameters during initial dewatering to confirm the hydraulic baseline characteristics and water chemistry of the groundwater within the Kundip project area.

Pit Voids

Water quality will be monitored from the commencement of pit filling to confirm the acidity and copper trends, and if required, lime will be added to maintain water pH above 4. In the event that water pit water quality is adversely effected by the above mentioned aspects and in the unlikely event that it is not seen to be self attenuating, further geochemical testwork will be conducted to ensure a closer understanding of the likely trends in pit-water quality, and appropriate management strategies will be developed in consultation with the DoE and relevant experts.

Groundwater Contamination

In order to minimise any potential for seepage into the ground from any of the facilities within the Kundip project area, Tectonic propose to form a clay liner on the 'floor' of the dams, waste rock dumps and ROM pad. All storage areas for hydrocarbons and hazardous substances will be designed and operated in accordance with the relevant legislation and standards. As with Trilogy operations all contaminated soil from the Kundip area will be transported to the RAV8 bioremediation facility. By centralising bioremediation activities, greater control over the facility can be gained, and hydrocarbon impact on soils at Kundip will be negligible. The groundwater bores previously discussed will also be monitored for water quality. Frequency of monitoring, parameters to measure and appropriate trigger values will be determined in consultation with the DoE. These management measures will ensure that any potential contamination of groundwater from hydrocarbons/chemicals will be prevented.

Tectonic believe that the combined management measures outlined above, will ensure that any potential impacts to groundwater within the Kundip project area will be effectively mitigated.

Rav 8

Groundwater levels and seepage

As mentioned in Section 4.4.1, seepage quantities of contaminants will be influenced by the area and depth of water ponded over the tailings material. Tectonic propose to recover the tailings supernatant pond for use in the process plant wherever possible in order to optimise water recovery. Tectonic also propose to deposit tailings in a manner which will ensure outer beach formation hence ensuring the tailings liquor component is centrally located within the pit. As the pit will remain a groundwater sink until such time as the tailings level reaches the

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baseline standing water level of the surrounding aquifer, combined with supernatant pond water recovery, the likelihood of contaminants entering groundwater in the pit vicinity will be significantly reduced. Tectonic propose to recover the supernatant water at a rate which will ensure minimal ponding and assist in rapid tailings consolidation, particularly at the outer edge, for the duration of deposition until as such time as the tailings/pond level approaches the surrounding aquifers standing water level. Due to the low permeability nature of the tailings material, consolidation which will occur from supernatant water recovery, the fact that the pit will act as a groundwater sink, and successful beach establishment which will ensure supernatant liquor is directed away from the pit walls, the likelihood of contaminant migration to the surrounding aquifer is minimal.

If tailings deposition is required above the level of the surrounding aquifers baseline standing water level, CN destruction or detoxification will be implemented to ensure that liquor contaminants are reduced to a level which will not adversely effect the surrounding aquifer if seepage occurs. In this instance maximum supernatant water recover and continued beach formation will ensure consolidation and rapid drying of the tailings against the pit wall and hence reduce the likelihood of seepage. As a consequence of the above mentioned proposed deposition strategies, it is likely that at cessation of deposition the consolidated tailings will ensure groundwater flows in the area will preferentially adopt a 'flow around' path due to the low permeability of the tailings material. In order to monitor the effectiveness of the management strategies mentioned herewith, the following details Tectonic's proposed monitoring regime which will ensure early detection and remediation.

A concentration of 50ppm WAD cyanide or lower in solution is typically viewed as being protective of most wildlife and livestock mortality other than aquatic organisms (www.cyanidecode.org). Therefore the tailings deposition will be analysed monthly to ensure that WAD CN concentrations remain below 50ppm. Should the WAD CN levels exceed 50ppm, cyanide destruction or detoxification will be implemented.

All bores as indicated on **Figure 4.9** will be monitored monthly for pH and TDS and biannually for metals and cyanide, throughout the life of the mining operation.

The standard industry cyanide limit in groundwater has historically been set as 0.5mg/L. Therefore it is proposed that 0.5mg/L CN is used as a trigger limit, subject to approval by DoE through the Works Approval process. A comprehensive amount of groundwater data has been sourced and collated by Tectonic over the previous five years for the area in the immediate vicinity of the RAV 8 open pit (see **Appendix E.3**). This data as well as guideline values will be used to set trigger limits for metals, pH and TDS in consultation with the DoE through the Works Approval process.

In the event that elevated levels of metals or cyanide are detected in bores located at various distances from the pit (see **Figure 4.9**), the following management actions are proposed:

- Bores within 250-500m Monitoring of metals and cyanide will increase from biannually to quarterly
- Bores within 500-750m detailed planning will begin to modify the process plant to cater for cyanide and copper destruction (it should be noted that cyanide detoxification testwork has shown that weak acid dissociable cyanide and copper concentrations in the tailings can be reduced).
- Bores within 750-1000m cyanide detoxification and bore water recovery will be undertaken

Monitoring of water within Bandalup Creek has been undertaken since 2002, as indicated in Section 2.5.3. Baseline water quality results are included within **Appendix D.3**. Biannual monitoring of Bandalup Creek at locations indicated on **Figure 4.10** to determine if there are any impacts from the proposed tailings storage facility will continue for the life of the mining operation. Parameters to be monitored are included within **Appendix D.3**.

Geochemical and hydrological interactions within and surrounding the pit will be monitored during the course of tailings deposition within the pit. This will allow prediction and modelling of long term impacts once the tailings deposition is complete. Post-closure monitoring and management requirements for groundwater and surface water, based on predicted impacts, will then be determined in consultation with stakeholders,.

The proposed monitoring and management strategy as detailed here will ensure that potential impacts to Bandalup Creek from the tailings storage facility will be prevented.

Acid Rock Drainage

Tectonic will stockpile a sufficient quantity of non-acid forming oxide ores for processing after the potentially acid forming sulphide ores. This is to ensure that the final tailings surface, if above the regional watertable, consists of material that is non-acid forming.

Depending on the final tailings RL attained at the end of the project, the surface of the consolidated tailings bed maybe submerged below the watertable. In the event that the total material deposited does not fill the open pit to the height of the water table, it is intended to leave the tailings in a subaqueous state, i.e. have the natural water table sit above the tailings with no further rehabilitation works undertaken. In this scenario the tailings generated from the processing of sulphide ores will not be exposed to oxygen and subsequently will not require any management measures to mitigate against acid mine drainage.

It is considered that the above management measures will effectively mitigate any potential impacts to the groundwater resources associated with the project.

4.5 Landforms and Soils

EPA Objective

To maintain the integrity, ecological functions and environmental values of the soil and landform.

4.5.1 Potential Impacts

The landscape at both Trilogy and Kundip will be altered due to the construction of waste dumps and open pits. It should be noted that the landform at Kundip has already been significantly altered and degraded through historic mining activities. Alteration of the landscape at RAV 8 has already taken place as part of the RAV 8 mining operations. Further changes at RAV 8 as a result of this project include infilling of the open pit void with tailings material.

Potential impacts on soils within the areas of the Haul Road, Trilogy and Kundip projects include:

- Increased soil erosion and sediment movement due to clearing of vegetation;
- Alteration of soil structure and/or soil chemistry beneath infrastructure items, hardstand areas and roads (eg through compaction or contamination with hydrocarbons or chemicals);
- Alteration of soil structure, changes to soil chemistry, and changes to the natural soil evolution/forming processes caused by stripping, stockpiling and re-using topsoil from disturbed areas in rehabilitation;
- Reduction in seed viability, nutrients, organic matter and micro-organisms that assist plant establishment, due to inappropriate stockpiling of topsoil and other soil resources.

4.5.2 Management

Management of soils and landform is detailed further within the Trilogy Rehabilitation and Preliminary Closure Plan (**Appendix S**) and the Kundip and Haul Road Conceptual Rehabilitation Plan (**Appendix U**). An outline of management and commitments detailed within each plan is given here.

Trilogy

Soil within the Trilogy Project area is already heavily degraded due to its current farming land use, which has reduced the value of the pre-mining topsoil. Much of the topsoil that would have once covered the project area has been lost by wind and water erosion. Soil properties and seed value have been compromised by erosion, extensive cropping and grazing practices.

The area of land at Trilogy that will be stripped of topsoil equates to 24.9 ha. Potentially useful topsoil, which remains, will be stripped to a nominal depth of 100 mm and loosely stockpiled in windrows less than 2 m high for re-use in rehabilitation of the proposed areas of disturbance on M74/176. The area from where topsoil can be recovered is characterised by

shallow soil profiles and stripping to the nominal depth of 100mm may not always be possible. Tectonic will make a commitment to ensure that water does not accumulate around the base of the topsoil stockpiles.

The surface topsoils at Trilogy contain a substantial seed bank of pasture and weed seeds. This is an important issue as the operation proposes to rehabilitate the final landform of the waste rock dump with native vegetation. Tectonic will assist the reduction of the weed seed by application of herbicides in the growing season prior to mining. This will prevent seed set and reduce the seed load before stripping and stockpiling of the topsoil.

Tectonic will undertake additional soil characterisation throughout the life of the project to assist in constructing stable, non-erodible landforms. Drainage strategies will also be developed in order to minimise erosion and retain soil properties (to be outlined within EMMP).

A designated storage area for hydrocarbon-based waste lubricants, oils and grease at Trilogy and a hydrocarbon remediation area at RAV 8 (as discussed further in Section 4.8) will help to control any potential impacts on soil from hydrocarbon spills.

The impact of the waste dump on the surrounding landscape will be reduced through rehabilitation of the waste dump with native vegetation.

It is considered that, through the above management measures, any potential impacts to the soils within the Trilogy area can be effectively managed. The project will result in an unavoidable change to the landform within the Trilogy site however measures described as above will ensure that the impact of this change in landform is minimised. Establishing native vegetation on some areas of the project will be of net benefit for this extensively cleared farmland.

Kundip

Where possible, topsoil will be stripped to a depth of 150mm prior to the disturbance of the Kundip mining lease and creation of the waste dumps. Topsoil will then be relocated to a designated topsoil stockpile area surrounding the waste dump footprints (Figure 3.2). It will be loosely stockpiled in windrows less than 2 m high for re-use in rehabilitation of the proposed areas of disturbance.

Topsoil stockpiles at Kundip will be protected from erosion through the placement of cleared vegetation on the outer slopes. Tectonic will ensure that water does not accumulate around the base of the topsoil stockpiles.

Where possible Tectonic propose to develop an approach of sequential stripping of areas to be disturbed at the same time as construction of waste dumps to maximise the opportunity for topsoil to be directly applied to the outer batter of the dumps.

Tectonic will undertake additional soil characterisation throughout the life of the project to assist in constructing stable non-erodible landforms. Drainage strategies will also be developed in order to prevent erosion (to be outlined within EMMP).

A designated storage area for hydrocarbon-based waste lubricants, oils and grease at Kundip and a hydrocarbon remediation area at RAV 8 (as discussed further in Section 4.8) will help to manage any potential impacts on soil from hydrocarbon spills.

The infrastructure placement has been designed in accordance with soil properties, hydrology, local topography, flora, fauna and existing disturbance. In particular the location and scale of the waste dumps has been selected such that they blend in with the main ridgeline and do not protrude above it. This will ensure that the waste dump landforms integrate into the surrounding landscape and provide the least visual impact. The pH, salinity and nutrient availability of the topsoil and subsoil have been determined, and combined with collection of endemic seed, the likelihood of successful rehabilitation and thus integration of the waste dumps is maximised.

Topsoil from each distinct vegetation community or landscape unit (i.e. crests and upper slopes, slopes, lower slopes and drainage lines) will be stockpiled separately, to allow re-spreading in a similar landscape position in rehabilitated areas.

It is considered that the above management measures should ensure that any potential impacts to the soils within the Kundip area can be effectively managed. The impact of new landform development within the project area will be managed through careful siting and rehabilitation. It is considered that rehabilitation of the project area following mining will enhance the current environment, and restore areas that have been disturbed by historical mining activities for many years.

Haul Road

A large percentage of the gazetted road easement is characterised by Proterozoic rocky substrate and shallow soil profiles. Stripping to a nominal depth of 100mm may not always be possible. Topsoil will be transported to a designated topsoil stockpile area and measures put in place to minimise erosion. All the vegetative and topsoil material shall be stockpiled within the confines of the road easement. Drainage measures to minimise soil erosion along the haul road will be detailed within the EMMP.

Soils will be stockpiled near the point of collection to maintain eventual integrity of restored communities. A stock pile register will be maintained that indicates where particular piles were taken from within the cleared area.

It is considered that impacts to landform and soil resources within the haul road can be effectively managed through measures detailed above.

4.6 Air Quality (Dust)

EPA Objective

To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.

4.6.1 Potential Impacts

Potential impacts of the Project on air quality, related to fugitive and point source dust in localised areas, are as follows:

- Dust generation on unsealed haul roads during summer
- Dust generation during movement of topsoil and overburden material at both Kundip and Trilogy
- Dust generation during blasting and loading of waste rock and ore

The low-grade ore and fresh-phyllite waste rock at Trilogy are enriched in Pb and Cu. The saprolitic phyllite within the soil/regolith profile may be enriched in Pb. Low-grade-transition ore and low-grade-primary-ore at Kundip are variously enriched in Cu. Low-grade-primary-ore at Kundip is also enriched in Ag, Zn, Cd and Pb. It will therefore be necessary to implement dust-control measures during handling of these materials.

4.6.2 Management

Trilogy and Kundip

Dust will be created during blasting, loading and hauling of the waste rock and ore. Industry standard practices, as outlined in the following sections, will be used to minimise dust generation at the working faces within the open pit and underground mines and from haul trucks, waste dumps and ore stockpiles.

Saline groundwater of neutral pH will be sourced from outside the mineralised zone for dust suppression within the Trilogy project area. Water for dust suppression at Kundip will initially be drawn from the water storage facility (WSF) north of the Flag Pit, and Tectonic will create a dedicated water cart filling area near the WSF. Saline groundwater will be used for dust suppression when fresh water within the dams is not available. In addition, Tectonic will investigate the use of dust-suppressants other than water and will report on those in the EMMP.

Dust monitoring will commence prior to construction of the project and the results reported as required under the terms of the lease conditions. A Baseline Dust Monitoring survey was undertaken at Kundip by Westsafe – Occupational health, Safety & Environmental Services in January 2005, please refer to **Appendix Y** to review the report. The report provides data on pre-mining dust conditions, but can only reflect the dust load and chemical levels present during the specified sampling period.

Weather information collected for the sampling period depicts prominent south westerly winds throughout the sampling period. Unfortunately this wind pattern did not assist in determining any spread of dusts generated from the Elverdton tailings stockpile to the north – northwest of Kundip on an adjacent lease not owned by Tectonic. The results indicate that in winds higher than approximately 30kph, dust collection may exceed the exposure standard, and if the wind direction was north–northwest, there is a remote possibility that contamination from the Elverdton tailings stockpile may be identified. However, this can not be confirmed without sampling under these conditions.

Tectonic will continue to monitor dust levels throughout all phases of the operation. Due to the probability of copper and lead as likely contaminants within the dust the commonly-accepted TWA exposure standard for copper and lead will be adopted, subject to DoE approval through the Works Approval process.

Haul Road

Tectonic will establish approximately 50m of bitumen at the entrance and cross over points approved by MRWA in order to minimise the transportation of dust by the ore road trains on to the Ravensthorpe–Hopetoun Road and the South Coast Highway.

Dust suppression using saline water will not be undertaken along the haul road as it is considered that risk of potential impacts to vegetation from saline water discharge are greater than those of dust. The speed of the vehicles on the haul road will be strictly controlled and less than other similar roads throughout the Shire of Ravensthorpe, thus the dust generated along this road will also be less.

Tectonic will monitor vegetation along the haul road for dust impacts. If impacts are detected, fresh water or alternative dust suppressants will be used to prevent further impacts. Measures for monitoring of dust impacts will be detailed within the EMMP.

RAV 8

Tectonic will maintain and operate dust control equipment at the ROM bin and primary jaw crusher discharge/conveyor loading points in order to minimise dust emissions. Dust emission from the plant will be continuously monitored in order to ensure acceptable limits are not exceeded. Tectonic will make a commitment to contain dust within the treatment plant by the use of rubber skirting and skirt box covers at feed points on the conveyors.

Tectonic will establish a monitoring program to detect source point odour emissions from the process plant. The monitoring program will identify all discharge points and the type and level of odour potentially emitted. Tectonic will aim to minimise the emission of odour where possible.

4.7 Waste Disposal

EPA Objective

To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards

4.7.1 Potential Impacts

Potential impacts of waste disposal within the project area relate to acid rock drainage and hydrocarbon/chemical contamination of soils and groundwater. Please refer to sections 4.3 and 4.4 for a detailed discussion of the potential impacts and management of tailings disposal within the RAV 8 open pit void.

Acid Rock Drainage

As previously discussed, geochemical characterisation of the mine waste samples has been undertaken and is included as **Appendix B**. Please refer to section 2.3 of this document for a more detailed description of the geochemical characteristics of the mine wastes.

The only potentially acid forming (PAF) material that will not be processed is part of the freshphyllite waste material that is greater than 0.2% total sulphur within the proposed Trilogy pit. This material is also enriched in copper and lead. The PAF fresh-phyllite waste will remain on-site within the waste dump and has the potential to create acid rock drainage issues and leaching of bioavailable forms of copper and lead.

The other PAF material to be mined includes the low-grade transition ore at Kundip, the lowgrade primary ore at both Trilogy and Kundip and the primary sulphide ore from Kundip. The low-grade ore from Kundip is enriched in copper, while the low-grade ore from Trilogy is enriched in both copper and lead. These materials will be transferred to the Rav 8 site and stockpiled prior to processing.

Hydrocarbon/Chemical Contamination

Hydrocarbon or chemical contamination may occur in workshop, transport, storage areas or laboratory areas. Potential impacts are mainly related to spills which might affect soil, groundwater and surface water.

4.7.2 Management Mineralised Waste

Trilogy

The final shape of the waste dump will be decided prior to commencement of construction. Tectonic aims to produce a waste rock landform that has stable non-erodible surfaces which are capable of supporting native vegetation (see Trilogy Rehabilitation and Preliminary Closure Management Plan in **Appendix S**).

Tectonic will undertake selective placement of waste material within the dump to ensure that any mineralised waste material that may be PAF, highly saline, or enriched in appreciable quantities of copper, lead and other metals, will not be placed within the surface zone of the waste rock dump (0 - 2 m) (see **Figure 4.11**). Tectonic have conducted extensive geochemical analysis and have set conservative cut off limits for lead (0.1%) and Total sulphur (0.2%) to ensure suitability of material for encapsulation purposes.

Analysis of soils from within a low grade area of the deposit provide an indication of the baseline levels of some elements (see **Table 4.4**).

Table 4.4	Soil analysis results from 3 samples collected from the southern, low-
grade end d	of the Trilogy deposit

Element	Pb ppm	As ppm	Sb ppm	Bi ppm
Mean	283	150	3	13
Median	220	110	2	9
Count	3	3	3	3

Concentrations of metals within the soil/regolith material that contains <0.1% lead are given in **Table 4.5**. These means are lower than those found in the baseline soil samples, therefore it can be suggested that they would be suitable for use within the surface zone of the waste rock dump (0-2m) and other construction purposes.

T	A	- C	CALL THE	Miles Mile	ten min min at a	20 40/ DL
anie 4 5	Concentrations	of metals	within	sou/redouth	material	SIL 1% PD
10010 4.0	ooncontrations	or motulo		John Cquillin	materia	-0.1/01 0

Element	Pb ppm	As ppm	S ppm	Sb ppm	Bi ppm	Cd ppm
Mean	224	75	1332	8	9	2
Median	139	29	457	2	2	2
Standard Dev	225	163	2210	16	29	1
Count	1113	1082	1054	1080	943	1006

Geochemical analysis has indicated that some of the fresh-phyllite is non-acid forming (ie less than 0.2% total sulphur). Concentrations of metals contained within this NAF fresh-phyllite are given in **Table 4.6**. The mean values of these metal concentrations are also lower than those found in the baseline soil samples, thereby indicating their suitability for use as a capping/construction material.

Element	Pb ppm	As ppm	S ppm	Sb ppm	Bi ppm	Cd ppm
Mean	123	36	1049	3	3	2
Median	46	22	1150	2	2	2
Standard Dev	202	67	607	3	8	1
Count	2880	2821	2880	2875	2695	2634

Table 4.6 Concentrations of metals within NAF fresh-phyllite material <0.2%S

Table 4.7 shows the concentrations of metals within soil/regolith material that has greater than 0.1% lead and will be encapsulated within the waste dump. **Table 4.8** shows the concentration of metals within the PAF fresh-phyllite that will be encapsulated within the waste dump.

Table 4.7 Concentrations of metals within soil/regolith materials >0.1%Pb

Element	Pb ppm	As ppm	S ppm	Sb ppm	Bi ppm	Cd ppm
Mean	2095	245	4989	16	9	2
Median	1710	126	3250	2	2	2
Standard Dev	1342	284	5240	24	19	1
Count	117	115	99	95	95	107

Table 4.8 Concentrations of metals within PAF fresh-phyllite materials >0.2%S

Element	Pb ppm	As ppm	S ppm	Sb ppm	Bi ppm	Cd ppm
Mean	1130	119	10296	7	7	3
Median	92	52	4790	2	2	2
Standard Dev	10408	346	16631	27	39	11
Count	3554	3510	3554	3516	3295	3210

The ratio of the volume of material that is <0.1% Pb and <0.2% Total-sulphur compared to that material with >0.1% Pb and >0.2% Total-sulphur is 6:1, indicating that there will be sufficient material to encapsulate PAF and metal-enriched material.

It should be noted that for the purposes of this operation, NAF fresh-phyllite is defined as that less than 0.2% total-Sulphur, however NAF material is generally defined as that which is less than 0.2-0.3% Sulphide-sulphur (See Appendix B). Therefore the calculation of the amount of material that will be available for use as capping/construction is conservative.

Detailed grade control drilling will be undertaken at the commencement of mining to identify and define the areas of NAF, PAF and metal enrichment. This will then enable each of these materials to be stockpiled separately, before being placed within the waste dump.

The physical properties of the soil/regolith material will be established to ensure it has suitable properties of erosion resistance and capacity to store incident rainfall, before applying it as a cover over PAF and metal-enriched material or on the outer surfaces of the waste rock dump.

Tectonic aims to construct the outer faces of the waste rock dump utilising benign soil/regolith material ahead of the general level of the dump. This will result in the encapsulation of the PAF and metal-enriched material.

The waste rock dump will be designed in accordance with the following parameters: the maximum height of the dump will be 25m, with a 10m bench height between berms. The berm width will be approximately 5 to 8m (a compacted crest bund will be constructed on the outer edge of all the berms). The access ramp gradient shall be 1:10, and the final slope angle of the waste dump following rehabilitation will be less than 18 degrees. Final design will be determined according to DOIR requirements.

Tectonic will ensure that the drainage control measures constructed will handle episodic rainfall events (1 in 100 year rainfall event). Due to the entrapment of mineralised waste, Tectonic will make a commitment to construct the top surface profile of the waste rock dump from soil/regolith material which will prevent infiltration and erosion.

Tectonic will endeavour to mine the fresh-phyllite waste bedrock zone in the drier summer months in order to minimise the oxidation of the sulphide materials.

While the majority of the ore taken from the open pit will be stockpiled on the ROM pad for transportation to RAV 8, there may be small quantities of low grade sub economic material stockpiled temporarily for later blending with higher grade material. A dedicated stockpile area will be established within the ROM pad abutting the south-western aspect of the waste rock dump for the storage of such material.

Kundip

Three waste dumps have been designed to contain all waste generated from the mining of the Kundip deposits (North, Central and South). The final height of the dumps will be 30m, 10m and 10m with surface area of 20.5, 10.8 and 1.1 ha respectively. The South waste dump will be sited over the Flag Central pit, with the pit backfilled first and the dump formed over it. The berm width will be approximately 5 to 8m (a containment bund will be constructed on the outer edge of all the berms). The access ramp gradient shall be 1:10, and the final slope angle of the waste dump following rehabilitation will be less than 18 degrees. Final design of the waste dumps will be according to DOIR requirements.

Placement of all the soil/regolith material will be actively managed, in order to ensure sufficient material is available to coat the outer faces of the upper batters on the waste rock dumps. The physical and chemical properties of the soil/regolith material will be established before applying it as a cover.

Tectonic aims to construct the outer faces of the waste rock dump utilising benign soil/regolith material ahead of the general level of the dump in order to be able to progressively rehabilitate the waste rock dumps. Tectonic aims to produce a waste rock dump landform that has stable non-erodible surfaces which are capable of supporting native vegetation.

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Hydrocarbon & Industrial Waste

All hydrocarbons and industrial waste will be managed in accordance with the EMMP. An area designated for the storage of hydrocarbon based waste lubricants, oils and grease will be located adjacent to the workshops at all three project areas to minimise transport of these wastes. The designated hydrocarbon storage area(s) will be bunded in accordance with the DoE guidelines. A recycling contractor will collect and remove all the hydrocarbon-based waste lubricants, disused filters and chemicals from site.

A hydrocarbon remediation area for contaminated soil is already established within the RAV 8 project area. All hydrocarbon contaminated soil will be transported to this facility. Following placement of contaminated material in this area, the soil profile will be ripped and cross-ripped to ensure that it remains oxygenated, and subsequently enhance microbial activity within the soil profile. Emergency response procedures will be established in order to contain spills and remediate affected areas.

Putrescible waste from all three sites will be transported to the Shire of Ravensthorpe landfill. Inert waste materials, will be buried on-site at all three project areas within a trench located away from drainage channels (burning of waste is not permitted within the Shire of Ravensthorpe) in accordance with DoE requirements. The trench will be progressively filled and covered with low permeability soil. Damaged tyres will be placed flat within the confines of the waste dump and progressively buried or will be disposed of in accordance with DoE requirements. At no stage of the operation will tyres be placed within the trench designated for landfill.

Dangerous Goods and Hazardous Substances

Dangerous goods and hazardous substances will be managed in accordance with the EMMP. All fuel, oils and greases will be stored in bunded holding areas marked with appropriate signs. Fire extinguishers will be available adjacent to each area. Material Safety Data Sheets will be held on site and be readily available to all employees.

Employees directly concerned with the use of dangerous goods and/or hazardous substances will receive formal training in the handling of the materials and in emergency procedures, as part of the induction process.

All hydrocarbons/dangerous goods/hazardous substances will be stored in accordance with *Australian Standard 1940–1993: The Storage and Handling of Flammable and Combustible Liquids.* A dangerous goods manifest/register will be created and maintained on site. A compliance certificate will be generated during the approvals process for construction of the storage facilities.

All hydrocarbons/dangerous goods/hazardous substances will be managed in accordance with relevant DoE licence conditions.

4.8 Noise

EPA Objective

To protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards.

4.8.1 Potential Impacts

The activities within the open pit mine that will contribute most significantly to the overall noise levels on the site include drilling, blasting and loading the haul trucks. Mining of ore and waste rock at Kundip and Trilogy and processing at RAV 8 will occur over a 24 hour period, equivalent to a two shift basis per day. The noise levels generated by the project will not exceed that of a typical mining operation.

The nearest residence to the Trilogy mining operations is a farmhouse belonging to the Hughes family, located approximately 2 km to the north. This is not a permanent residence and is occupied predominantly during agricultural harvesting and seeding. Discussions with the owner indicate that they will have no objection to the small increase in noise which is likely to reach the house, as the inconvenience will be short term.

The nearest residence to the Kundip mining operations is a farmhouse belonging to the Daw Family located approximately 5.9 km to the north east. It is unlikely that increases in noise will be noted at this distance.

The nearest residence to the RAV 8 process plant and the haul road is a farmhouse belonging to the Burton family, located approximately 3 km to the south; (the Burton family are supportive of the project - **Appendix A**). Discussions with the owner indicate that they will have no objection to the small increase in noise which is likely to reach the house from the process plant and the haul road, as they were not inconvenienced during the operation of the Nickel Sulphide Process plant at RAV 8.

It is unlikely that noise emissions will have the potential to exceed statutory levels. Noise generated from the movement of road trains along the ore haulage road and the mining operations is unlikely to have significant impact on fauna movement, nesting and behaviour within the area.

4.8.2 Management

Mining and processing of ore will occur over a 24 hour period, equivalent to two working shifts per day. All mobile equipment will be regularly checked to ensure that the noise emissions are within the manufacturer's specifications.

Noise levels will be monitored to ensure compliance with Part 7, Division 1 of the MSIR (1995), as well as the Environmental Protection (Noise) Regulations 1997.

4.9 Light

EPA Objective

To avoid or manage potential impacts from light overspill and comply with acceptable standards.

4.9.1 Potential Impacts

The project will be run as a 24-hour operation and therefore night lighting is required to ensure that the safety and security of operations is not compromised. Potential impacts arising from illumination at night can arise from obtrusive light spill, by general luminance diffusion, reflection from existing surfaces or through atmospheric scattering. These effects may impact directly on fauna and neighbouring dwellings, can potentially create safety hazards on adjacent roads due to glare reducing the visibility of objects, can interfere with night time navigation signalling and reduce the overall environmental night amenity.

Due to the distance to nearby residences, the impact on people from light generation within the project areas is considered to be minimal. There may be localised effect upon fauna however there will not be any impact on road safety concerns. The project is not likely to interfere with night time navigation signalling however it will have an impact on the overall environmental night amenity.

4.9.2 Management

Tectonic will manage light according to Australian Standard AS 4282-1997 Control of Obtrusive Effects of Outdoor Lighting. In order to minimise lighting impacts, Tectonic will:

- Investigate the use of new light shrouds that were recently nominated for a Golden Gecko Award;
- Observe nocturnal fauna activities to ensure that lighting does not create a significant impact;
- · Direct light sources at targeted work areas, preferably in a downwards direction;
- · Adopt a low vertical aiming angle of the light;
- Locate lighting as close as possible to the target area of illumination;
- Conduct regular maintenance to maintain optimum performance; and
- Conduct workforce awareness training to reduce light emission.

4.10 Indigenous Heritage

EPA Objective

To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.

4.10.1 Potential Impacts

The Trilogy project lies on a 100% Tectonic owned pastoral lease. The Kundip project lies within Unallocated Crown Land (UCL) and the majority of the haul road traverses UCL gazetted road reserve No. 8432. Development of the existing gazetted road No. 8432 as a designated haulage route incorporates constructing a crossing over the Jerdacuttup River. The Jerdacuttup River is an Aboriginal mythological site in association with Waugal (Marchant) beliefs. The Aboriginal participants in the survey also highlighted that they wanted to minimise the impact to the Yate trees in the vicinity of the crossing, as they are of cultural significance to them.

4.10.2 Management

The Shire of Ravensthorpe as managers, of the road reserve and the aboriginal participants in the survey, supported an application under Section 18 of the *Aboriginal Heritage Act WA* (1972) to develop a crossing over the Jerdacuttup River. Tectonic subsequently sought ministerial approval under section 18 of the *Aboriginal Heritage Act WA* (1972) for consent to use the land that contains an Aboriginal site. A copy of the Section 18 submission from Tectonic Resources NL to the DIA and Ministerial approval is included in **Appendix K**. Consent to develop a crossing over the Jerdacuttup River was granted by the Minister for Indigenous Affairs on the 22 of September 2004.

Tectonic has subsequently fulfilled their obligation for heritage protection under the *Aboriginal Heritage Act WA* (1972), and the *Aboriginal Heritage Amendment Act WA* (1995). Tectonic are aware that the *Aboriginal Heritage Act WA* (1972) protects all Aboriginal heritage sites, whether they are known to the Department or not. Tectonic will report any new Aboriginal heritage sites discovered during development of the Project to the register of the Department of Indigenous Affairs.

The primary intent in development of the crossing is to allow for continual flow of water within the Jerdacuttup River system. Tectonic anticipate that the crossing will be inundated during periods of high water flow, it is not anticipated that there will be any movement along the road during these periods or during episodic storm events. Tectonic will avoid any possible impact to the Yate trees in the construction of the Jerdacuttup River crossing.

A stand of Eucalyptus trees on the proposed haulage route was also identified by the Aboriginal participants as 'being good to use as spear-wood' (**Appendix I**). The bush area was not identified as a 'site' and the informants did not request the consultant to record the area as an Aboriginal Heritage Site.

Tectonic have also agreed to provide the Aboriginal participants of the heritage survey with some ochre material that is currently stockpiled adjacent to the Kaolin pit within the Kundip project area.

The management measures as detailed above will ensure that the project will not adversely affect any Aboriginal Heritage site within the area.

4.11 European Heritage

EPA Objective

To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.

4.11.1 Potential Impacts

No site within the historic Kundip mining area is listed in the register of Heritage places or is subject to either a Heritage Agreement or a Conservation Order. The Harbour View Mine Shaft was listed on the backlog of places to be considered for assessment by the Heritage Council. The Heritage Council has subsequently granted permission for the area of the Harbour View Mine Shaft to be developed, subject to a full archive record and archaeological survey being conducted prior to any disturbance (see Section 2.10). There are various remnants of historical mining activities within the Kundip project area that may be impacted by mining activities. The historic remains of a copper separation plant that exists within the south-west corner of the site will not be impacted by any mining activities. The Hopetoun-Ravensthorpe railway heritage walk trail on the western side of the Kundip project area will not be impacted by any mining activities.

4.11.2 Management

Tectonic will undertake a full archive record and archaeological survey of the Harbour View Mine Shaft prior to any disturbance. Tectonic will also preserve any remnants of historical mining activities where practicable. It is considered that these management measures will ensure that all potential impacts to European Heritage sites will be minimised.

4.12 Visual Amenity

EPA Objective

To ensure that aesthetic values are considered and measures are adopted to reduce visual impacts on the landscape as low as reasonably practicable.

4.12.1 Potential Impacts

Impacts on visual amenity from the project are as follows:

- The creation of a waste dump landform and an open pit within the Trilogy project area
- · The creation of waste dumps and open pits within the Kundip project area
- The creation of the haul road

All of these aspects will be visible from the Ravensthorpe-Hopetoun Road. Portions of the haul road will be visible from South Coast Highway.

4.12.2 Management

The visual impact of the waste dump at Trilogy on the surrounding landscape will be reduced through rehabilitation of the waste dump with native vegetation.

As previously mentioned, the infrastructure placement at Kundip has been designed in accordance with soil properties, hydrology, local topography, flora, fauna and existing disturbance. In particular the location and scale of the waste dumps has been selected such that they blend in with the main ridgeline and do not protrude beyond it. This will ensure that the waste dump landforms integrate into the surrounding landscape and provide the least visual impact. The pH, salinity and nutrient availability of the topsoil and subsoil have been determined, and combined with collection of endemic seed, the likelihood of successful rehabilitation and thus integration of the waste dumps is maximised. It is considered that rehabilitation of the Kundip project area following mining will enhance the current environment and restore areas that have been disturbed by historical mining activities for many years.

Establishment of a vegetation corridor that links the eastern aspects of the Proposed Nature Reserve with the vegetation north of the South Coast Highway will assist in screening the haul road from the South Coast Highway.

The above management measures will ensure that the visual amenity of the landscape surrounding the project will not be compromised in the long term.

4.13 Recreation

EPA Objective

To ensure that existing and planned recreational uses are not compromised.

4.13.1 Potential Impacts

The Hopetoun Ravensthorpe Railway Heritage Walk Trail runs along the western aspect of the Kundip project area (Figure 3.2) however will not be directly impacted by any mining activities.

4.13.2 Management

A fence will be constructed along the length of the heritage trail that is within the mining lease. Signs will be erected warning people that a mining operation is nearby. Therefore recreational uses in the vicinity of the project will not be compromised.

5.0 COMMUNITY AND OTHER STAKEHOLDER CONSULTATION

A comprehensive community/stakeholder consultation program for the development of the Phillips River Gold Project has been undertaken by Tectonic, demonstrating the importance the proponent places on the interaction with the community.

5.1 Objectives

Tectonics' objectives throughout the consultation program were to:

- raise awareness of any potential issues in the community;
- enhance the existing partnership within the community;
- gain or gauge public support;
- resolve disputes; and
- ensure any feedback is incorporated into the development of operational procedures or policies.

5.2 Consultation Programme

The Trilogy project will not result in a significant change to the existing social setting. The introduction of the Phillips River Gold Project is viewed by the community as a continuity of the existing RAV 8 Nickel Sulphide Project. Tectonics' consultation program has included but not been limited to all levels of government, industry, conservation groups, indigenous groups, community groups and the general public.

Commencing in early 2004, on a quarterly basis, Tectonic has given an updated progress report to the Shire of Ravensthorpe and Local Council representatives. Tectonic has held community (public) presentation evenings in both Hopetoun and Ravensthorpe which were well attended by members of the local community. The presentation of information during these evenings was followed by an open forum discussion which enabled community members to raise issues of concern to them.

Indigenous groups have been invited to the project site on two occasions to provide input on the development of the project. Tectonic as the proponent has also consulted with the: Ravensthorpe-Hopetoun Railway Heritage Committee; the Malleefowl Preservation Group; the Department of Agriculture; the Western Australian Museum; Birds of Australia, Greening Australia, the Conservation Council and local members of the Wildflower Society of Western Australia. Individual presentations on the development of the Phillips River Gold Project have also been given to the Chairman of the Environmental Protection Authority, the Department of Industry and Resources, the Department of Environment, the Department of Conservation and Land Management and the local Chamber of Commerce. A complete list of stakeholders consulted is given in **Table 5.1**.

Details of consultation, issues raised and Tectonics' responses are given in **Table 5.2**. Information and advice collated from all of these consultations has been incorporated into the management of environmental impacts and subsequent management commitments for the Trilogy Project.

Stakeholder Group Specific Stakeholder		
Community Members	The Burton family – owner of Oldfield location 62	
	The Daw family - owner of Oldfield location 56	
	The Hughes Family – lessees of Trilogy farmland	
	The Ravensthorpe Community	
	The Hopetoun Community	
Community and Industry Groups and Organisations	Hopetoun Ravensthorpe Railway Heritage Trail Steering Committee	
	Conservation Council	
	Wildflower Society	
	South West Aboriginal Land and Sea Council	
	Southern Aboriginal Corporation	[
	Greening Australia	
	Mallee Fowl Preservation Group	
	Birds of Australia	1
Local Government and	Environmental Protection Authority (EPA)	
Government Agencies	Department of Environment (DoE)	
	Department of Industry and Resources (DOIR)	
	Heritage Council	
	Main Roads WA	
	Department of Indigenous Affairs (DIA)	
	Department of Conservation and Land Management	
	Shire of Ravensthorpe	-
	Department of Environment and Heritage	-
	Department of Agriculture	1
	WA Museum	
Other Organisations	Water Corporation	

Table 5.1 List of stakenoiders consulte	Table 5.1	List of	stakeholders	consulter
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Table 5.2 Summary of Stakeholder Issues

Specific Stakeholder	Consultation	Issues Raised	Response
Department of Indigenous Affairs	22 September 2004 Correspondence	Section 18 approval given to construct the haul road through the Jerdacuttup River, an Aboriginal mythological site.	
DoE	30 September 2004 Met with Tim Gentle re Project development		
Hopetoun Community	27 October 2004 Presentation to Hopetoun community members at Hopetoun Mary Anne Haven Centre	 What will the possible impact be on the Kundip project if the RAV 8 mine continues? (Rusty Lee) What is the size of the projected workforce? Is the airport going to be restricted to BHP workforce? Will TTR reinforce the Hopetoun- Ravensthorpe road between Trilogy and Kundip, as it is a light duty road (John Field)? What is the weight of each load? What is the weight of each load? What effect will result from the blasting – size of blasts, noise generated inversions etc.? Do you require Cyanide for both CIP and CIL? Will the Trilogy open pit be operated over a 24 hour period, and how much light pollution will be generated? Is there any ground water generated, is it saline and where will it go? Will the haul road from Kundip to RAV 8 be open for public access? What will happen to the water coming out of Trilogy? 	 Will need to look at alternative TSF – there is a commitment to retain product on the mining tenement. Employ approx. 50 – 60 specifically for mill construction over 7-9 months, commencing potentially in March/April; Employ 40 personnel in the open pit mining stage; Employ 20 personnel for ore processing; Employ approx 100 personnel total in U/G and open pit over 2-3 years. No – it is owned by the Shire - public infrastructure No – Main Roads have given TTR approval to use the road without upgrading it – weight limited loads. The trucks will carry approx 50 tonnes each The size of the blasts will be confined to specification defined within the mine regs. Yes – explanation on CIP/CIL process – cyanide levels do become concentrated in the tails stream The mine will operate over 24 hours – duration of the mine may only be 2-3 months. The light pollution will be minimal – no process plant located at Trilogy, project confined to the northern side of Lee road

Specific Stakeholder	Consultation	Issues Raised	Response
		 12. How big would the TSF be if RAV 8 keeps going? 13. Will there be much visual change to the Landscape at Trilogy? 	 and lights only on the pit floor and waste dump tip head. 9. Yes, Trilogy will produce 250 m³/day to a depth of 35 m, salinity ranges form 15,200 to 24,400 TDS. Kundip minimal flows were encountered. 10. No – it will remain a closed haul road for the life of the mine, it will be constructed to Shire specifications and handed back to them on completion of the project. 11. The water will be retained on site, situation monitored to ensure nothing is transferred off the lease. 12. Option could be to slow the PRGP and speed up mining of the RAV 8 deposit so that they can be concurrent. 13. TTR as owners of the land have the option to limit the height of the waste dump by increasing the size of the footprint – large financial penalty involved.
Ravenshorpe Chamber of Commerce	28 October 2004 Meeting to discuss project		
Ravensthorpe Community	29 October 2004 Presentation to Ravensthorpe community members at Ravensthorpe Red Room	 What will the traffic increase be on the Ravensthorpe- Esperance road? Is it correct that TR will not be using water from the storage dam? How will the Tailings affect the water table in pit? Where will the haul road cross freehold land How will crossing the South Coast Highway be handled? 	 TTR is undecided if the final port is Fremantle or Esperance – transport from site will be same or less than current with transport of Nickel to Kambalda. No - water will be used in the process, it will be taken from the dam to the mill and then to the pit. Environmental impact of dam is controlled and will continue to be. Addressed within EPS Alan Burton's Western boundary, along

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Specific Stakeholder	Consultation	Issues Raised	Response
		 6. What type of truck will we use? 7. Will the discrete nature of the ore impact on the exploration cost and miners profitability? 8. What length of fence will there be along the railway/heritage walk? 	 Rod Daw's southern boundary 5. Lights at night, signage alerting oncoming traffic of crossing, 50m of bitumen at the crossing 6. Ore haulage in the open pits will be by either 50 or 85t off highway trucks, v-double road trains of 50t payload for ore haulage from the mines to the RAV 8 processing facility 7. Yes ultimately result in a higher discovery cost per ounce although TTR hope solid geological modelling will reduce some cost. 8. The railway heritage walk will be fenced along the length that runs parallel with the edge of the Kundip mining lease
EPA	2 November 2004 Presentation of Phillips River Gold Project to Tim Gentle and Wally Cox	 Submit the project to the DEH – Tim Kahn Need to consult with Wildflower Council and Conservation Council 	 Project referred to the DEH and response received Discussed project with both Wildflower Society and Conservation Council
Shire of Ravensthorpe	10 November 2004 Meeting on-site to discuss Haul Road		
CALM	11 November 2004 Meeting with Sarah Barrett and Sarah Comer onsite to discuss <i>Marianthus mollis</i> and <i>Allocasuarina scleroclada</i> subsp <i>Bandalup</i> within the haul road		
CALM	16 November 2004 Meeting with Sarah Barrett onsite at Kundip to discuss <i>Marianthus mollis</i>		
Wildflower Society	17 November 2004 Phone call to Brian Moyle regarding project development		

Specific Stakeholder	Consultation	Issues Raised	Response
CALM	25 November 2004 and 13 Dec 2004 Met Ann Cochran on site at Kundip to collect <i>Marianthus mollis</i> , <i>Pultenaea</i> sp Kundip and <i>Melaleuca</i> sp Kundip.		
Michael Hughes	14 December 2004 Discussion regarding project development		
Shire of Ravensthorpe	16 December 2004 Meeting		
DOIR Bill Biggs Ian Misich Rob Sherwood Danielle Risbey	21 December 2004 Meeting to discuss project	 R Sherwood- filling voids UG in RAV 8 critical 	1 Points addressed to I Misich (email 220905)
Heritage Council	4 January 2005 Phone call to discuss project		
Department of Environment and Heritage	5 January 2005 Phone call to Lara Watson to discuss project		
WA Museum	7 January 2005 Phone call to Ron Johnston regarding management of Carnaby's Cockatoos		Management measures incorporated within EPS document.
Malleefowl Preservation Group	7 January 2005 Phone call to Angela Sanders regarding incubation of eggs and techniques for surveys of malleefowl nests		Incubation of eggs and techniques for surveys included as a commitment within EPS document.
Birds of Australia	12 January 2005 Phone call to Leonie McMahon		

Specific Stakeholder	Consultation	Issues Raised	Response
Gondwanalink Project	12 January 2005 Phone call to Nathan McQuoid regarding development of project in relation to Gondwanalink Project		
DoE Albany Catherine MacCallum Sharon Stratico Melanie Price	19 January 2005 Presentation of project		
CALM	21 January 2005 Presentation of project to Norm Caporn, Daniel Coffey and Malcolm Grant	 Exploration tracks Track rationalisation around site Include all records of malleefowl mounds Part V DoE process should capture all detail including all exploration in future years Gravel pits should also be included in disturbance footprint Piers Goodman, Portman Iron Ore is doing self-contained drainage along the road Offsets need to be negotiated (consider EPA guidance) Will need a priority and DRF table showing all known locations, populations at Kundip and overall impact 	 No intent to rehabilitate or reveg immediately as they will be used for seed picking access – they are a component of the long term conceptual planning This has been done – planning is underway Is a commitment within the EPS All future clearing will be included with works approval application Will include within disturbance Piers was contacted and some information was sent to TTR for consideration Offsets presented in EPS Tables included within EPS
Shire of Ravensthorpe	27 January 2005 Meeting with Peter Wood to discuss development of haul road		
Heritage Council	28 January 2005 Phone call to Clair Schultz regarding Harbour View mine shaft	Requested further information on Harbour View mine shaft	Further information sent through on 21 February. Letter received from Heritage Council on 16 March 2005 indicating that it has been removed from the backlog of Heritage Places.

Specific Stakeholder	Consultation	Issues Raised	Response
CALM – Mal Grant Shire of Ravensthorpe – Peter Wood	14 February 2005 Meeting on site to discuss development of Haul Road		
Conservation Council	30 March 2005 Phone call to Chris Tallentire to discuss project	Did not wish to be briefed on the project until after receiving a copy of the NOI	
Wildflower Society	30 March 2005 Phone call to Brian Moyle to discuss project		
Shire of Ravensthorpe	19 April 2005 Meeting with Russell Weston regarding ablution blocks for Project		
Conservation Council	20 June 2005 Phone call to ask if any queries with regards to Trilogy NOI	No questions as yet	
Wildflower Society	21 June 2005 Phone call to ask if any queries with regards to Trilogy NOI	No questions as yet	
CALM	22 June 2005 Meeting with Daniel Coffey and Grant Lamb to discuss Trilogy NOI		

Specific Stakeholder	Consultation	Issues Raised	Response
DoE Perth (EPA Service Unit) – Ann Stubbs, John Dell, Bec Ryan and Tim Gentle	22 July 2005 Meeting at DoE Perth Offices to discuss Trilogy NOI and incoming Kundip NOI	 Needs an analysis of alternative Haul roads and a justification for selection Consider Ecological Linkages, Mine Closure Planning, Acid Mine Drainage and Offsets as Factors within EPS document Pines are now no longer recommended for use as habitat for Carnaby's Cockatoos A Rehabilitation strategy and closure strategy will be required for Trilogy and Kundip respectively. 	 To be include within EPS document Will be included within EPS document Pines will be removed from the list of species proposed for rehabilitation A Trilogy rehabilitation strategy and Kundip closure strategy will be developed for inclusion within the EPS document.
CALM	1 August 2005 Comments provided on the Trilogy NOI	 Provide sufficient details on the construction standards of the WSF to indicate its capacity of withstanding an earthquake Submit a detailed decommissioning plan for the Trilogy site prior to approval Do not recommend the planting of Pinus species as a foraging offset for Carnaby's Black Cockatoos Clarify that 1.45ha of vegetation impacted by haul road with M74/51 is existing road infrastructure Provide information on alternative routes that have been assessed and explanations why these were note considered viable Address operational and management procedures for sumps and drainage etc within EMP Greater detail needs to be supplied to determine the actual clearing required Prepare a comprehensive dieback management plan Make reference to potential impacts 	 TWSF assigned a hazard rating of Low Category based on DOIR classification criteria and will be constructed in line with these DOIR classifications Decommissioning plan included within the EPS Removed Pinus species from the revegetation programme The road alignment for construction will overlap existing roads/tracks wherever possible. Included within EPS Will be addressed within EMP Included within EPS

Specific Stakeholder	Consultation	Issues Raised	Response
		from fox predation 10. Negotiate offsets	
DoE Albany – Catherine MacCallum CALM – Mal Grant, Grant Lamb and Nisha Powell DOIR – Danielle Risbey EPASU – Ann Stubbs	7-8 September 2005 Site Visit of the entire Project area	 Will 2 new flora species be impacted by non-direct mining activity? Will dieback management be ongoing? Are there plans for weed management on the rehabilitated areas? Are there any measures in place to control water and dust for dieback control? What if active malleefowl mounds are found? Does the decommissioning plan discuss rehabilitation of the creeks? Is there any chance of tailings seeping to surrounds? Any levels been set for detection levels of "effect" and procedure? Any research to reduce deposition rates of Cu, CN, Pb in tailings? Is the Trilogy sulphide ore any consequence to the tailings storage? What are the plans for the lead-enriched waste? Have you considered vegetation stress as a consequence of dust? Have the effects of noise from mining operations on fauna been taken into account? CALM would prefer that the haul road be removed post-mining and the fire management track re-instated 	 No they are located outside the zone of hydrological and dust influences Yes a dieback management plan is currently being prepared Yes rehabilitation plans including weed management will be included in EPS Properly engineered spoon drains to contain surface runoff -management will be detailed within EMP Eggs will be re-located and incubated Diversion structures will remain as permanent structures - banks will be rehabilitated Rockwater estimate it will take 50yrs for tails to travel 1km to creekline Will assess against baseline levels and determine appropriate levels in consultation with DoE Initially will be lower levels, primary ore has greater potential to look at CN destruction There are no plans to extract sulphide ores from Trilogy yet For both environmental and cost benefit It will be contained with the PAF material A commitment will be made to monitor DRF and priority species for dust impacts Will be investigated It has been taken into account and there were no adverse effects at Rav8 Will be discussed with the Shire of Ravensthorpe All pits that don't have underground access or infrastructure requirements will be

Specific Stakeholder	Consultation	Issues Raised	Response
		 17. Is there any provision for backfilling? 18. Consider new light shrouds, nominated for a golden gecko award 19. Fire management 20. Concerns about crossing of creek A at Trilogy site 21. Has seismic activity been taken into account for the WSF? 22. Is there a plan to keep fauna out of pits at Kundip? 23.Establish 10x10m vegetation quadrats for rehab purposes 24. Undertake a spring survey within the footprint of the proposed waste dumps 25. Forward baseline groundwater monitoring data to DoE and consultatively set acceptable Cu limits 26. Investigate feasibility of reducing haul road width in portions 27. Investigate offsets 	 backfilled 18. Will be investigated 19. Will commit to preparation of a fire management plan 20. Diversion of the creek will not have any impact on the flows – 21. Yes the Trilogy WSF was moved off the Whoogarup Fault Line. 22. Through the installation of abandonment bunds 23. Is a commitment within EPS 24. Will be included as an addendum to the EPS 25. To be done for Part V Works Approval 26. Within EPS 27. Addressed within EPS
Hopetoun Ravensthorpe Railway Heritage Trail Steering Committee	Presentation of Project to Committee		
Conservation Council	12 October 2005 Submission of Draft EPS Document for comment	No response as yet	
Wildflower Society	12 October 2005 Submission of Draft EPS Document for comment	It is not clear why there is an offset of 49 ha for the clearing of 84.5 ha. Also the values of the 49 ha are not outlined. Whilst we don't necessarily agree that offsets are an appropriate way of compensation it is often	Offsets Your concern with regards to the proposed offset of purchase of 49ha of vegetation for addition to the conservation estate has been raised previously by CALM and DoE. We are currently negotiating an

Specific Stakeholder	Consultation	Issues Raised	Response
		 better that a project not proceed if is to have significant impacts on an area, we wonder why only 49 ha is seen as sufficient offset for a major impact on a proposed nature reserve. Also we believe DOIR need to be included in the consultation. They have a habit of objecting to the inclusion of any area into the conservation estate. We would argue that if the project is to go ahead subject to what the EPA says finalisation of the 49 ha plus some additional area should be in the conservation estate prior to ministerial consent being given. It should also be classified as a A Class nature reserve otherwise its conservation status is not secure. We are aware that the DOIR have held up for many years land being included in the conservation estate. It is also appropriate that finalising the proposed nature reserve in the conservation estate is also made part of these discussions. We are also concerned about the use of highly saline water for dust suppression, this has the potential to have significant adverse impacts on the surrounding flora. As regards rehabilitation and closure we would want to see some raft completion criteria particularly as regards flora biodiversity and also the monitoring timeframe. This project while only lasting maybe four years has the potential to have a significant adverse impact on the area. 	alternative offset package, that will include purchase of land (>49ha) as well as contributions to regional conservation through vegetation and flora surveys, fox bailting and the millennium seed project. An appropriate offset package is being determined in consultation with CALM and DoE. DOIR has had an opportunity to review the Draft EPS and has provided some comments. We are not aware if CALM, DOIR and DoE are discussing the status of the proposed nature reserve. Saline water for dust suppression Since the draft EPS that you have seen, we have considered the potential impacts on vegetation and flora from using saline water for dust suppression. In light of the potential impacts along the haul road, we have proposed not to use any dust suppressant in the first instance. Should impacts be detected, we propose to use fresh water or other dust suppressants. Fresh water will be used preferentially within the Kundip site. Rehabilitation and Closure Species richness and plant abundance targets have been set in the Draft Kundip and Trilogy Rehabilitation and Closure Plans (see points R6.19-R6.21 of Table 2). These will be subject to review based on rehabilitation experience. Closure standards, objectives and criteria in terms of defining monitoring of rehabilitation will be further developed as the project progresses and there is more of an idea of site specific needs and requirements.
		with you and also would like to know when the final EPS will be available.	and Final EPS are released on January 3 rd .

5.3 Ongoing Consultation

Tectonic will ensure that the public is continually informed with respect to the development of the Phillips River Gold Project via: articles within the "Community Spirit" (local newsletter); information displays at the annual 'Spring Festival'; and continued presentations to the Shire of Ravensthorpe, Local Council representatives, and the local Chamber of Commerce.

6.0 REHABILITATION AND CLOSURE

Draft Rehabilitation and Preliminary Closure Plans for the Kundip project area and haul road and the Trilogy project area have been prepared and are included as **Appendices S** and **U**. A broad outline of the proposed rehabilitation and closure strategies for the project areas is provided here. Each of the Plans will be continuously refined during the course of operations, taking site-specific factors into account.

The following objectives for closure will be incorporated in the project designs:

- minimise areas of disturbance during the construction and operational phases;
- set priorities for mine closure outcomes including the outcomes of community and stakeholder consultation;
- · design waste dumps to blend with the natural landscape and drainage characteristics
- integrate objectives of the closure plans into the general mine planning and budgeting processes including strategic placement of materials to optimise rehabilitation outcomes and minimise handling costs;
- establish adequate financial provisions on the basis of realistic closure costs;
- construct waste dumps to be safe, stable, durable, non-polluting and compatible with surrounding land uses;
- progressively rehabilitate waste dumps to support representative and sustainable local flora that as closely as practicable mirrors the functions and attributes of surrounding native vegetation;
- salvage and remove redundant surface infrastructure on completion of mining and processing operations; and
- actively review and update the mine closure plan and financial provisions.

6.1 Decommissioning

After consulting with stakeholders in relation to each site, redundant surface infrastructure will be salvaged and removed on completion of mining at both project areas. Cost estimates for various decommissioning options will be established early in the operations, to facilitate updating as variables such as the area of disturbance, and unit costs for equipment, change over time.

As part of Tectonic's objective to minimise disturbance at the Kundip area, waste rock material will be used where practicable to backfill pits. The water storage facilities at Kundip will remain as permanent features of the landscape.

As a general approach, hard surfaces remaining after removal of infrastructure will be prepared for rehabilitation by ripping to remove compaction. For areas such as earth pads and roads, which received additional material during their construction, the additional material will be removed so that the final surface is consistent with the surrounding land surfaces after topsoil has been re-spread.

The Shire of Ravensthorpe and CALM will be consulted regarding the post-mining land use of the ore haulage road. If not required, the road will be rehabilitated by ripping and seeding with local native species.

6.2 Rehabilitation

The Rehabilitation Management Plans are aimed at progressively returning areas disturbed by the operations to a stable condition with resilient self-supporting vegetation, taking into account beneficial uses of the site and surrounding land. Each plan will be part of a comprehensive life-of-mine closure plan developed during the first years of operations, building on operational experience with site-specific conditions. The overall closure plan will be reviewed and updated every two years.

The three project areas can be differentiated principally in terms of their expected mine life and their current land-use, and this creates some different objectives at each area. The Kundip project area, supports native vegetation which has been impacted by historic mining activities. By contrast, the Trilogy project area is located on extensively cleared farmland, with no previous mining impacts. The haul road follows a gazetted road that has been historically cleared through a proposed nature reserve. Reflecting this, the broad objectives of rehabilitation management at each site are described separately below

6.2.1 Kundip and the Haul road

The Kundip project area is south-east of Ravensthorpe and lies at the southern end of the Ravensthorpe Range, and within the vegetation corridor that links the Fitzgerald River National Park to the Crown land north of the South Coast Highway. The haul road passes through a Proposed Nature Reserve. At Kundip, the main areas to be rehabilitated will be waste dumps, backfilled areas, haul roads and other areas disturbed for mine infrastructure. The Plan for the Kundip area and haul road of the PRGP has been prepared to include strategies that can reasonably and practically be conducted, before and during mining, to optimise the establishment of a native ecosystem that mirrors the attributes and functions of the pre-mining vegetation.

Landform construction and water management

Earthworks associated with the rehabilitation of areas disturbed by mining activities will be undertaken progressively. These areas primarily include the final batters on external waste dumps and in-pit backfilled areas. A focus will be to minimise erosion risk, by maximising the use of rocky topsoils, and by optimising landform design. Surfaces will also be ripped on contour to maximise infiltration and minimise erosion. Surface water flows will be diverted as appropriate to avoid impacts on waste dumps and stockpiles. Erosion control measures will be established on these diversions and earthworks. Surface water runoff will be contained within the confines of the road easement where possible.

Topsoil management and vegetation establishment

A primary component of the overall rehabilitation strategy will be salvage and storage of vegetation and topsoil for the areas to be disturbed. This will include segregation of soils and related vegetation from distinct vegetation communities, recognising both the links of soils and vegetation in the pre-mining landscape, and the richness and conservation significance of the native vegetation. Salvaged timber and vegetative material will be respread over final surfaces to improve erosion control and to provide fauna habitat.

Monitoring of rehabilitation

Permanent monitoring plots in undisturbed native vegetation will be established to provide reference data for rehabilitated areas over the life of the operations. Key measures of rehabilitation performance will include species richness, plant abundance and projected foliar cover, together with broader measures of soil stability and ecosystem function. Initial targets will be set for these measures based on likely outcomes from the application of best-practice rehabilitation techniques. Initial monitoring data will be used to inform and refine subsequent rehabilitation strategies.

6.2.2 Trilogy

The Trilogy project area is southeast of Ravensthorpe on cleared farmland south of the Kundip Nature Reserve. The site is bordered by the Ravensthorpe-Hopetoun Road to the west and surrounded by freehold farm land. To the west of the Ravensthorpe-Hopetoun Road is Unallocated Crown Land (UCL). The general topography of the Trilogy Project area is flat, with little remaining perennial vegetation. The Rehabilitation Management Plan for Trilogy is aimed at progressively returning both a proposed waste dump, and a proposed revegetation corridor to the west, to a stable condition with supporting resilient native vegetation community, taking into account beneficial uses of the site and surrounding land.

Landform construction and water management

The base of the waste rock dump, water storage facility and ROM pad will be lined with clay liners to minimise seepage. Within the waste dump, waste materials will be placed selectively to ensure that PAF and metal-enriched waste will be placed at least 2m from external surfaces. Infiltration will be minimised through the overall design and by constructing an appropriate store-and-release, vegetated, soil cover. Recognising the potential erodibility of local subsoils, a focus will be to minimise erosion risk through appropriate slope angles and landform design.
As at Kundip, surface water flows will be diverted as appropriate to avoid impacts on waste dumps and stockpiles. Erosion control measures will be established on these diversions and earthworks. Water and evaporites from the water storage facility will be returned to the Trilogy pit.

Topsoil management and vegetation establishment

Areas to be rehabilitated will include the waste dump and areas disturbed by mining infrastructure. Topsoil will be salvaged for subsequent use in revegetation of these areas, recognising its value as a resource of nutrients and beneficial micro-organisms. However, weed control will be a priority on the waste dump, where native vegetation is to be established.

Monitoring of rehabilitation

The broad objective of re-establishing areas of native vegetation will be to develop a resilient, self-perpetuating ecosystem, that has attributes consistent with local natural vegetation communities. As at Kundip, key measures of vegetation performance will include species richness, plant abundance and projected foliar cover, together with broader measures of soil stability and ecosystem function. Given the current agricultural land use, the general intent of the monitoring will be to confirm the satisfactory performance of the revegetation, rather than necessarily aiming for measures equivalent to undisturbed native communities.

7.0

PROPOSED ENVIRONMENTAL MANAGEMENT COMMITMENTS

In order to prevent and mitigate potential environmental impacts associated with the project as discussed within this document, Tectonic has proposed a series of environmental management commitments as outlined in Table 7.1 below. These commitments will be refined in consultation with stakeholders throughout the assessment of this project.

No.	Topic	Objective	Commitment	Timing	Advice
1	Environmental Management and Monitoring Plan	Prepare and implement an Environmental Management and Monitoring Plan that describes procedures and practices for protection of key environmental aspects during all phases of mining.	 Prepare and implement an Environmental Management and Monitoring Plan that addresses the following: Information management and document control Stakeholder identification Protection of vegetation and flora Management of fauna including feral animal control Management of declared and environmental weeds Protection of water resources including surface water management Management of dangerous and hazardous substances Management of oust Management of greenhouse gases Management of visual amenity Management of risk Protection of heritage values Programs for monitoring, auditing and review for the purposes of performance assessment and continual improvement. 	Prior to project commencement, during development, operation and decommissioning	CALM DoE DoIR
2	Conservation Offset	Provide a contribution to regional conservation that will offset the clearing of native vegetation within the Kundip project area and the haul road.	 Purchase a 60ha parcel of vegetated land for contribution to the conservation estate Contribute \$10,000/yr to the Western Shield project to allow fox baiting of the entire Ravensthorpe Range for five years Contribute \$10,000 towards a targeted survey of <i>Melaleuca stramentosa</i> Contribute \$10,000 towards a regional survey of the proposed <i>Melaleuca</i>-over-mallee TEC Contribute 10% or 10,000 seeds where practicable, of seeds collected from each native species to the Millennium Seed Bank. 	Commitment to purchase land prior to project commencement Other contributions throughout life of project as determined appropriate	CALM EPA
3	Rehabilitation and Closure	To ensure, as far as practicable, that rehabilitation achieves a stable and functioning landform which is consistent with the surrounding landscape and other environmental values.	Implement the Rehabilitation and Preliminary Closure Management Plans for the haul road and the Kundip and Trilogy project areas.	Commencement of project	CALM DoIR DoE
4	Dieback	To ensure that dieback is not introduced into the Kundip project area, haul road and surrounding vegetation.	Prepare and implement a dieback management plan that includes measures to prevent the spread of dieback into any of the project areas	Prior to project commencement	CALM

Table 7.1 Proposed Proponent Environmental Management Commitments

No.	Topic	Objective	Commitment	Timing	Advice
5	Fire	To ensure that appropriate strategies are in place to prevent or control fire.	Prepare and implement a fire management plan	Prior to project commencement	CALM
6	Vegetation and Flora Conservation	To minimise impacts from the implementation of the proposal to local vegetation and flora.	 Keep clearing to a minimum and avoid disturbance of DRF and Priority species where possible. Educate the workforce on DRF and Priority flora conservation. Demarcate, avoid and monitor the following populations within the Kundip project area: The Marianthus mollis population to the north of the northern waste dump; The Marianthus mollis population to the south-east of the southern waste dump; The two western-most Hydrocotylye decipiens populations The entire Mx vegetation unit containing the newly described Melaleuca sp Kundip and Pultenaea sp Kundip Demarcate and take measures to exclude disturbance to populations of Melaleuca stramentosa that will not be directly impacted through clearing Avoid construction of spur drains into the Declared Rare Marianthus mollis and Priority 3 Allocasuarina scleroclada subsp. Bandalup populations during haul road realignment and construction Monitor populations of Declared Rare Marianthus mollis, (Haul road and Kundip) Priority 3 Allocasuarina scleroclada subsp Bandalup (haul road) and Priority 1 Melaleuca stramentosa (Kundip) for dust impacts.	Commencement of project	CALM
7	Fauna	To minimise impacts from the implementation of the proposal to local fauna populations.	Contribute to threatened species preservation Contribute to Western Shield Project fox baiting program (10,000/yr for five years) Provide alternative water sources for fauna in the vicinity of the tailings storage facility	Commencement of project	CALM
8	Light	To avoid or manage potential impacts from light spill to the surrounding environment.	Manage light according to Australian Standard AS 4282-1997 Control of Obtrusive Effects of Outdoor Lighting	Commencement of project	DolR
9	Dust	To ensure that dust emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses.	Manage and monitor dust in accordance with acceptable standards	Commencement of project	DoE DoIR

No.	Topic	Objective	Commitment	Timing	Advice
10	Noise	To protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards.	Monitor mining noise levels to ensure compliance with Part 7, Division 1 of the <i>MSIR</i> (1995), as well as the <i>Environmental Protection</i> (Noise) Regulations 1997.	Commencement of project	DoE DoIR
11	Waste	To ensure that waste does not adversely affect the environment.	Encapsulate potentially acid forming and metal-enriched material so that is isolated from oxygen and rainfall.	Commencement of project	DoE DoIR
12	Aboriginal Heritage	To ensure that Aboriginal Heritage sites are not adversely affected by the proposal.	Report any new Aboriginal heritage sites discovered during development of the Project to the register of the Department of Indigenous Affairs.	Commencement of project.	DIA
13	European Heritage	To ensure that impacts to European Heritage sites are minimised	Conduct a full archive record including an archaeological survey of the Harbour View mine shaft prior to any development.	Prior to commencement of project	Heritage Council of WA

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Figure 2.4 REGIONAL SURFACE HYDROLOGY OF THE PHILLIPS RIVER GOLD PROJECT



Figure 2.5 SURFACE DRAINAGE CATCHMENT PLAN OF THE TRILOGY MINING PROJECT AREA













	LEC	GEND		
	Ravensthorpe - Hopetoun Highway			
	Railway -	Abandoned		
	Tenemen	t Boundary		
	Road - Int	ternal		
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Figure 4.4 SURFACE HYDROLOGY CONTROLS WITHIN THE TRILOGY MINING PROJECT AREA


Figure 4.5 SURFACE HYDROLOGY CONTROLS WITHIN THE KUNDIP MINING PROJECT AREA















