February 2006
CR 836_10_v1

Public Environmental Report

Supplement

Compass Resources NL, Browns Oxide Project

Compass Resources NL

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Compass Resources NL

Browns Oxide Project

Public Environmental Report

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12 Waste Rock Geochemistry
13 Browns Oxide Project Tailing Storage Facility Batchelor NT Preliminary Design Report (Revision 1)
14 Radiation Monitoring and Management Program
15 Batchelor and Rum Jungle Roads. Stuart Highway to Rum Jungle. Stage 5 Safety Audit Report
16 Browns Oxide Mine Project. Batchelor/Rum Jungle Road. Traffic Impact and Risk Assessment Report

1. Introduction

1.1 General

The Browns Oxide Project Public Environmental Report (PER) was made available for public comment over the period 10 November to 15 December 2005, with the Environment Protection Agency (EPA) agreeing to accept submissions up to 22 December 2005. Advertisements in The Australian, Territory Times and Northern Territory News directed interested parties to copies on display at a range of locations in Darwin and Batchelor, and in the ACT, and to the Department of Natural Resources, Environment and the Arts' (DNRETA's) website where it could be accessed. Copies were distributed to a number of interested parties and were also made available on request (for a modest cost) from Compass' Sydney office.

In accordance with the Northern Territory/Commonwealth Bilateral Agreement, the PER allows assessment of the project under both the Northern Territory's *Environmental Assessment Act* and the Commonwealth's *Environment Protection and Biodiversity Conservation Act (1999)*.

The Northern Territory EPA provided to Compass via email and fax copies of the 24 submissions that they received in response to the call for public comment, including those from various government agencies and the EPA itself. As required by this agreement, Compass has prepared a PER Supplement (this document) that addresses these submissions[1]. The PER Supplement will be posted on NRETA's website and copies will be provided to those parties who made submissions. However, there is no scope for further public submissions. A 28-day period is allowed for EPA to prepare an assessment report and for an assessment decision to be made by the NT Minister for Natural Resources, Environment and Heritage, with a subsequent 30 day review by Commonwealth.

1.2 The Decision-making Process and the PER

The PER and its public review is a major component in the overall process of environmental planning and assessment, and represents the definition of the project to the point where:

- Environmental factors have been identified.
- The project has been planned and conceptually designed to accommodate those factors.

[1] A Supplement is normally required under NT legislation only for an EIS, not a PER.

- The residual environmental impacts can be discussed.
- The priorities for management and monitoring can be identified.

In effect, the approach that underpins the PER is that the project is sufficiently well defined to be assessed by stakeholders in terms of key factors, conceptual responses by the proponent and notional impacts. The PER is not intended to describe detailed engineering aspects of the project, nor does it provide detailed management measures.

1.3 Report Structure

Chapter 1 of the PER Supplement (this chapter) provides an introduction to the preparation of the PER Supplement.

Chapter 2 lists the various agencies and individuals who submitted comments on the PER, and also provides a listing of the various issues raised as main headings with associated subheadings. Cross-referencing between the two lists shows which issues were raised in which submissions.

Chapter 3 presents Compass's response to the issues raised in the submissions, and incorporates information that was unavailable at the time of the PER preparation or otherwise provides clarification.

Chapter 4 lists references that have been used in the preparation of this supplement.

The approach adopted for the preparation of this document reflects the fact that a range of issues, comments and questions were common across a number of submissions. Grouping the various issues provides an efficient mechanism by which Compass can respond to the concerns of the various parties. The alternative of responding to each issue separately within the context of each submission would result in a document that would be excessively repetitive and difficult to read.

This PER Supplement contains a number of appendices additional to those appended to the PER, as listed in Table 1.1.

The Supplement should be read in conjunction with the PER Main Report and Appendices.

Table 1.1 Appendices to the PER Supplement

Topic	Author	Appendix
Application for Authority Certificate	Compass Resources NL	10
Revised Table of Commitments	Enesar Consulting Pty Ltd	11
Waste rock geochemistry	Environmental Geochemistry International Pty Ltd (EGi)	12
Tailing management	Australian Tailings Consultants (ATC)	13
Radiation	Australian Nuclear Science and Technology Organisation (ANSTO)	14
Traffic safety audit	Sinclair Knight Merz (SKM)	15
Traffic impact and risk assessment	Sinclair Knight Merz (SKM)	16

2. Summary of Submissions

Submissions were received from private individuals, non-government organisations (NGOs) and government agencies, as listed in Table 2.1. This table also includes cross-references to the summary of issues presented in Table 2.2, where the individual comments have been categorised into 19 main headings and 150 subheadings (or individual issues).

Table 2.1 Summary of parties making submissions

Submission Number	Name	Affiliation	Region	Issue Summary No. (see Table 2.2)
1	J. Tutty	Member of Darwin's No Waste Alliance	Noonamah, NT	M3, M1, P3, N9, S27
2	A. Padovan	Northern Territory Government (NRETA)	Darwin, NT	S6, B3, F15, E17, F5, F11, F13, F16
3	T. Ward	Northern Territory Government (DHCS)	Darwin, NT	I1, E6, I2, E5, K10, J2, S10, O6, Q4, F2
4	M. Hawkins	Finniss Valley Tree Supplies	Batchelor, NT	S2, S6
5	M. J. Starcevich	Finniss Valley Tree Supplies	Batchelor, NT	S28, B2, P2, M2, N9, K11, Q1, Q5, S8, S2
6		Australian Conservation Foundation	Carlton, Vic	P3, M3, F13, N9, K7, B2, M1, A4, Q1, K11, E17, O2, F8, E7, S6, S16
7	--	The Environment Centre N.T. Inc.	Darwin, NT	P3, M3, F13, B2, S6, P2, K4, K11, P6, E4, B3, E17, E2, S28, S16, F10, F7, C2, G3, F8, S27, O6, S3, A1, A4, N8, N9, O4, O3
8	J. Brown		Batchelor, NT	M3, S6, M4
9	J. Oakley		Batchelor, NT	P4, M3, N10, N8, N7, E1, S18, Q1, O1, H2, N1, L5, K6, K9, K3, S4, S6, S2, E11, S14, C1, C5, C3, C4, P3, N2, K7, N5, N3, L2, N11, K1
10	N. Fry	Northern Land Council	Northern Territory	K4, S3, A5, K8, B2, B1, S28, O6, S8, O11, J1, A2, Q2
11	A. Pedder		Nightcliff, NT	P5, N7, M3, Q1, F13, S6, B2
12	Strider		Humpty Doo, NT	S18, E10, S3, S21, M3
13	M. C. Dillon	Northern Territory Government (Dept. Local Government, Housing and Sport)	Darwin, NT	R2

Table 2.1 Summary of parties making submissions (cont'd)

Submission Number	Name	Affiliation	Region	Issue Summary No. (see Table 2.2)
14	J. Hassed	Northern Territory Government (Dept. Employment, Education and Training)	Darwin, NT	K2
15	B. Wernham	Batchelor Police Station	Winnellie, NT	R6, L4, K11
16	Dr G. M. Mudd	Monash University (Dept. Civil Engineering)	Clayton, Vic	K4, M2, N10, S3, S6, B2, O7, S20, K8, E13, E9, N8, N6, B4, L1, S24, S26, S28, S1, S9, N4
17	K. Wood	Power and Water Corporation	Palmerston, NT	S6, O6, S2, K5
18	A. Malgorzewicz	Museum and Art Gallery NT	Darwin, NT	F12, F1
19	R. Sellers	Northern Territory Government (DPIFM)	Darwin, NT	B1, B3, E17, E18, O12, S16, S2, S19, S3, S12, O13, E2, N9, S9, P1, S8, E15, S11, O2, S15
20A	L. Allen	Northern Territory Government (EPA) - Waste and Pollution Management	Darwin, NT	O11, S23, F4, S16, E8, B1, N8, E18, S13, S17, E3, S26, S27, E12, F14, O8, F3, I3, S22, S5, O10, O9, P1, S8, S7, N4, S19, S25, L4, E16, O5, S3, S11, E14, L3, H1, O6, O4
20B	--	Northern Territory Government (EPA) - Environment and Greenhouse Policy	Darwin, NT	K5, H3, G3, G1, G2
20C	--	Northern Territory Government (EPA) - Heritage Conservation Services	Darwin, NT	A3, D1
21	S. Butterworth	Northern Territory Government (Dept. of Planning and Infrastructure)	Darwin, NT	R4, R7, R5, R1, R3
22	J. Bastin	DEH	Canberra, ACT	F6, F9
23	M. Burgess	Northern Territory Government (Dept. of Business, Economic and Regional Development)	Darwin, NT	Q3
24	J. Stead	AAPA	Darwin, NT	D1, A1, I1

Table 2.2 Summary of the main issues contained in the submissions

Main Heading	Main Heading No.	Issue Summary	Issue Summary No.	Number of Submissions Referring to Each Issue
Aboriginal cultural heritage	A	AAPA Certificates	A1	2
		Cultural heritage management plan	A2	1
		Heritage/archaeology	A3	1
		Indigenous values	A4	2
		Traditional owners	A5	1
Acid mine drainage/Acid rock drainage	B	ARD characterisation	B1	3
		ARD impacts	B2	6
		ARD management	B3	3
		Under-estimation of AMD	B4	1
Air quality	C	Air quality impacts from dust	C1	1
		Air quality impacts from processing	C2	1
		Health impacts from lead-bearing dust	C3	1
		Health impacts from radon	C4	1
		Air quality impacts from radionuclides	C5	1
Editorial	D	Editorial	D1	2
Engineering design/Project description	E	Lack of detail on process water dam	E1	1
		TSF seepage	E2	2
		Water treatment	E3	1
		Borrow areas	E4	1
		Site infrastructure	E5	1
		Effluent re-use	E6	1
		Final design	E7	1
		Inconsistency	E8	1
		Metallurgical process	E9	1
		Mining schedule	E10	1
		Pit wall failure	E11	1
		Process water dam design	E12	1
		Project layout/footprint	E13	1
		Sediment trap, closure	E14	1
		Sedimentation trap design	E15	1
		TSF closure	E16	1
		TSF design	E17	4
		TSF design/ARD mgmt/groundwater impacts	E18	2

Table 2.2 Summary of the main issues contained in the submission (cont'd)

Main Heading	Main Heading No.	Issue Summary	Issue Summary No.	Number of Submissions Referring to Each Issue
Flora and fauna	F	Aquatic fauna characterisation	F1	1
		Biting insects	F2	1
		Cane toads	F3	1
		Clearing plan (pit)	F4	1
		Clearing program	F5	1
		Fauna impacts (adequately addressed)	F6	1
		Fauna impacts (general)	F7	1
		Fauna impacts (noise)	F8	2
		Fauna management	F9	1
		Flora impacts (general)	F10	1
		Riparian vegetation	F11	1
		Terrestrial fauna	F12	1
		Threatened species	F13	4
		Vegetation clearance / vine forest management and monitoring	F14	1
		Vine forest impacts	F15	1
		Weeds	F16	1
				1
Greenhouse gases	G	GHG commitments	G1	1
		GHG management	G2	1
		GHG targets	G3	2
Impacts on landuse and infrastructure	H	Landscapes	H1	1
		Planning conflicts	H2	1
		Public infrastructure	H3	1
Legislation/Approvals	I	Additional inclusions	I1	2
		Approvals for accommodation facilities	I2	1
		Beneficial use	I3	1
				1
Management systems/plans	J	ISO standards	J1	1
		Management plans	J2	1
				1
PER process/contents/ specialists	K	Lack of alternatives	K1	1
		No comment	K2	1
		No cooperative programs	K3	1
		PER premature	K4	3
		Power line	K5	2
		Aerial photograph doctoring	K6	1

Table 2.2 Summary of the main issues contained in the submission (cont'd)

Main Heading	Main Heading No.	Issue Summary	Issue Summary No.	Number of Submissions Referring to Each Issue
PER process/contents/ specialists (cont'd)		ANSTO	K7	2
		Baseline conditions	K8	2
		Bioremediation	K9	1
		Community complaints process	K10	1
		Consultation	K11	4
Pollution	L	Arsenic concentration	L1	1
		Cobalt production	L2	1
		Contaminated soil removal	L3	1
		Hazardous materials storage	L4	2
		Pollution pathways	L5	1
Proponent	M	Capability	M1	2
		Credibility	M2	2
		Future plans	M3	7
		Subsidy	M4	1
Radiology	N	EPBC - nuclear action	N1	1
		Radiological assessment	N2	1
		Radiological baseline	N3	1
		Radiological impacts	N4	2
		Regional implications	N5	1
		Uranium	N6	1
		Uranium impacts/management	N7	2
		Uranium levels	N8	4
		Uranium management	N9	5
		Uranium mining	N10	2
		Uranium production	N11	1
Rehabilitation, monitoring and decommissioning	O	Closure and rehabilitation	O1	1
		Closure criteria	O2	2
		Closure monitoring	O3	1
		Closure planning	O4	2
		Mine closure	O5	1
		Monitoring	O6	5
		Rehabilitation	O7	1
		Revegetation	O8	1
		Seepage	O9	1
		Surface water monitoring	O10	1
		Topsoil	O11	2
		TSF monitoring	O12	1
		TSF seepage management	O13	1

Table 2.2 Summary of the main issues contained in the submission (cont'd)

Main Heading	Main Heading No.	Issue Summary	Issue Summary No.	Number of Submissions Referring to Each Issue
Rum Jungle	P	Groundwater impacts	P1	2
		Increased ARD at Rum Jungle	P2	2
		Links with Rum Jungle rehabilitation	P3	4
		Mining in Rum Jungle area	P4	1
		Rum Jungle interactions	P5	1
		Source of material from Rum Jungle site	P6	1
Socio-economic impacts	Q	Local impacts	Q1	4
		More information required	Q2	1
		Regional and NT impacts (beneficial)	Q3	1
		Health service interactions	Q4	1
		Potential risk to BIITE	Q5	1
Traffic and roads	R	Future expansion	R1	1
		Impact on local roads	R2	1
		Impacts on future arterial road corridor	R3	1
		More information required	R4	1
		Risk assessment	R5	1
		Road safety	R6	1
		Upgrade road intersection	R7	1
Water and waste management	S	Contaminated groundwater	S1	1
		Darwin River Dam impacts	S2	5
		Downstream water quality impacts	S3	6
		Fate of Browns test pit water	S4	1
		Groundwater discharge	S5	1
		Groundwater impacts	S6	9
		Groundwater impacts/ Monitoring/ Rum Jungle interactions	S7	1
		Groundwater mitigation	S8	3
		Groundwater understanding	S9	2
		Management Plans	S10	1
		Mine pit - end use	S11	2
		Mine pit water quality	S12	1
		Mine water	S13	1
		Mt Bennet dam catchment	S14	1
		Potable Water Supply	S15	1
		Surface water management	S16	4

Table 2.2 Summary of the main issues contained in the submission (cont'd)

Main Heading	Main Heading No.	Issue Summary	Issue Summary No.	Number of Submissions Referring to Each Issue
Water and waste management (cont'd)		Surface water management/ Sedimentation trap design	S17	1
		Surface water management/water structures design	S18	2
		Surface water monitoring	S19	2
		Surface/groundwater quality	S20	1
		Tailing management	S21	1
		TSF seepage water quality	S22	1
		Waste management	S23	1
		Waste rock	S24	1
		Waste tyres	S25	1
		Water balance	S26	2
		Water management	S27	3
		Water treatment	S28	4

3. Response to Comments

Aboriginal Cultural Heritage (A)

A1 AAPA Certificates

In response to comments from Aboriginal Areas Protection Authority (AAPA), most of which focus on Authority Certificates, Compass:

- Acknowledges that the phrase 'sites of significance to Aboriginal people' (Executive Summary, Section 7.12) should read 'Aboriginal sacred sites', and that the heading 'Archaeology and Heritage' could read 'Heritage, Archaeology and Protection of Aboriginal Sacred Sites'.
- Has applied for Authority Certificates for the project and associated infrastructure[1] (Appendix 10), and has added the required commitment and performance indicator to the summary of commitments (see Appendix 11).
- Acknowledges that the *Northern Territory Aboriginal Sacred Sites Protection Authority Act* should be included in Section 2.1.3.

A2 Cultural Heritage Management Plan

Compass will ensure that AAPA's comments concerning the *Northern Territory Sacred Sites Act* will be reflected in the project's Cultural Heritage Management Plan, which will also require fulfilment of all conditions of Authority Certificates as a specific implementation measure.

Compass agrees to further develop this plan in consultation with the NLC (as has always been Compass's intention).

A3 Heritage/Archaeology

Section 9.8.8 of the PER describes the implementation strategies and measures that Compass will adopt in relation to heritage and archaeological matters, as based on the specialist's report (Appendix 6 of the PER).

A4/A5 Indigenous Values/Traditional Owners

As stated in Section 6.5.2 of the PER, Compass's intention is that involvement of indigenous people will be a particular focus of the project's ongoing consultation

[1] Excluding the powerline, for which permitting and related issues will be the responsibility of the Power and Water Cooperation (PAWC) (see the response to Issue K5).

program. In particular, this will focus on matters such as further development of the Cultural Heritage Management Plan and identifying and protecting indigenous environmental values and land uses.

Acid Mine Drainage/Acid Rock Drainage (B)

B1 ARD Characterisation

The geochemical characterisation presented in Section 4.9 of the PER is based on relevant data from geochemical testwork undertaken in 1997 and 2002, plus that from analysis of 16 near-surface drill core samples in August 2005.

Additional testwork undertaken in late 2005 included characterisation of another 14 samples, and a summary of all data from 2005 is shown in Appendix 12 (Table 1). The results of the additional testwork (which are summarised in Table 3.1) support specific aspects of the classification described in the PER, as follows:

- Carbonates with total sulfur up to 0.5% will be NAF (see results for samples 29315, 29316, 29317 and 29318).
- Well-oxidised shale with low (<0.5%) sulfur levels is likely to be NAF (see results for samples 29310, 29311, 29313 and 29314).
- Shale with substantially elevated total sulfur (e.g., 2.9% to 10.8%) is likely to be PAF (see results for samples 29735, 29736, 29737, 29738 and 29739).

Table 3.1 Additional geochemical data from November/December 2005

EGi Code	Rock Type	Depth (from/to) (m)	Total S (%)	ARD Category
29310	Ferruginous oxidised footwall shale	1.0 to 6.0	<0.01	NAF
29311	Footwall shale	1.0 to 6.0	<0.01	NAF
29312	Near ore horizon	1.0 to 6.0	<0.01	NAF
29313	Hanging wall shale	1.0 to 5.0	0.14	NAF
29314	Hanging wall shale	1.0 to 6.0	0.02	NAF
29315	Outcropping magnesite/dolomite	--	<0.01	NAF
29316	Outcropping magnesite/dolomite	--	<0.01	NAF
29317	Weathered ferruginous dol/mag	2.0 to 6.0	<0.01	NAF
29318	Weathered ferruginous dol/mag	2.0 to 6.0	<0.01	NAF
29735	Black shale	16.0 to 17.0	2.9	PAF
29736	Black shale	21.0 to 22.0	8.6	PAF
29737	Black shale	26.0 to 27.0	10.8	PAF
29738	Mudstone	31.0 to 36.0	9.6	PAF
29739	Shale and schist	46.0 to 51.0	7.4	PAF

In addition to this static testwork, five leach columns have been established to further examine the acid-forming potential of waste rock from the Browns Oxide deposit. The five columns contain a range of material types (see Appendix 12, Table 2):

- High sulfur black shale.
- Low to medium sulfur black shale.
- Weathered (barren) black shale.
- Weathered ferruginous dolomite/magnesite.
- Sulfidic dolomite/magnesite.

Data from these columns, which have now been established by Environmental Geochemistry International Pty Ltd (EGi)[1], will provide information about the kinetics of acid formation and will allow further refinement of material classification in terms of acid-forming potential.

The mine plan is and mining schedule will be verified in April 2005 (following receipt of the most recent drilling and assay information), at which time the available data from the column leach tests will be reviewed and taken into account. This process, i.e., addressing the latest information concerning the acid-forming potential of waste rock, will be repeated whenever the mine plan is revised. Should the relative tonnages of NAF and PAF material alter from those described herein (see Issue B3) with deleterious outcomes, Compass will inform the NT authorities and, in conjunction with those authorities, determine an appropriate course of action. This is reflected in the updated Table of Commitments (Appendix 11).

Monitoring of PAF/NAF material during mining will involve visual classification of rock type combined with routine sulfur analyses.

B2 ARD Impacts

Impacts associated with ARD focus on downstream water quality effects, mine closure and rehabilitation, and monitoring. These are addressed elsewhere within this chapter in terms of the specific individual issues.

B3 ARD Management

Additional information concerning the mine plan and the design of the tailing storage facility (TSF) has become available since completion of the PER, and this is attached as Appendix 12. As described in that appendix, the revised design for the TSF provides for all PAF waste rock to be encapsulated in a specific, designated area within the structure (Figure 3.1). The TSF will comprise a zoned soil and rockfill embankment, with the low permeability soil zone being located on the upstream face (Figure 3.2).

The rockfill to be used in the external embankment will be derived from NAF waste material, with PAF waste being separated from the tailings by an internal dividing bund that will be constructed with compacted layers of PAF waste (see Figure 3.2). The design does not require the bund to be of low permeability and, in the final design,

[1] EGi undertook the initial testwork reported in the PER (Appendix 9).

provision will be made to pump excess water that accumulates in the PAF area back into the tailings side of the bund. The general PAF waste that will be placed behind the bund will be similar to the actual bund material, the main differences being that there will be no particle size limitation and no need for it to be placed in thin layers and compacted.

This change in design of the TSF and the PAF waste rock encapsulation requires revised waste movement, as shown in Table 3.2, where this has been achieved by relocating the mine ramp. Mine planning has also been revised (Tables 3.3 and 3.4) to ensure both an even supply of ore to the processing plant and the availability of the requisite waste materials required for TSF construction, with the revised pit being 800 m long and 250 m wide.

Table 3.2 Revised summary of pit waste utilisation

Embankment Stage	Mine Year	Pit Waste Production (m^3)*		
		NAF (Zones 3 and 4)	PAF (Zone 2 and Internal Dump)	Total
1	-1	222,000	38,000	260,000
2	1	499,000	52,000	551,000
3	2	614,000	132,000	746,000
4	3	351,000	165,000	516,000
	4	0	277,000	277,000
	Total	1,686,000	664,000	2,350,000

*For material placed in embankment at assumed density of 2.0 t/m^3.

Table 3.3 Revised total waste rock production

ARD Category and Type	Total Waste Rock Production (t)	Waste Rock Type as % of all Waste Rock
NAF1	2,057,000	38.7
NAF2	1,843,000	34.7
NAF3	82,000	1.5
PAF4	402,000	7.6
PAF5	126,000	2.4
PAF6	800,000	15.1
All NAF	**3,982,000**	**74.9**
All PAF	**1,328,000**	**25.1**
All waste	5,310,000	100.0

Note: NAF/PAF waste rock definitions are as described in Table 4.9 of the PER.

Table 3.4 Revised waste rock NAF and PAF breakdown*

ARD Category and Type	Waste Rock Production Schedule (t)				Waste Rock Types as % of all Waste Rock			
	Year 1	Year 2	Year 3	Year 4	Year 1	Year 2	Year 3	Year 4
NAF1	799,000	566,000	228,000	464,000	49.3	37.9	22.1	39.9
NAF2	639,000	650,000	465,000	89,000	39.4	43.6	45.1	7.6
NAF3	4,000	12,000	9,000	57,000	0.2	0.8	0.9	4.9

Table 3.4 Revised waste rock NAF and PAF breakdown* (cont'd)

ARD Category and Type	Waste Rock Production Schedule (t)				Waste Rock Types as % of all Waste Rock			
	Year 1	Year 2	Year 3	Year 4	Year 1	Year 2	Year 3	Year 4
PAF4	130,000	56,000	126,000	90,000	8.0	3.8	12.2	7.7
PAF5	0	0	10,000	116,000	0.0	0.0	1.0	10.0
PAF6	50,000	208,000	194,000	348,000	3.1	13.9	18.8	29.9
All NAF	1,442,000	1,228,000	702,000	610,000	**88.9**	**82.3**	**68.0**	**52.4**
All PAF	180,000	264,000	330,000	554,000	**11.1**	**17.7**	**32.0**	**47.6**
All waste	1,622,000	1,492,000	1,032,000	1,164,000	100.0	100.0	100.0	100.0

Note: NAF/PAF waste rock definitions are as described in Table 4.9 of the PER.
*Includes some rounding error.

Closure of the TSF is discussed in the response to Issue E16.

B4 Under-estimation of AMD

As indicated above (Issue B1), additional characterisation testwork has been undertaken since completion of the PER and will continue. Section 8.3.4 of the PER states that management of PAF wastes will be an ongoing and will continue, high-priority focus during project development and implementation, and this remains the case.

Given the planned rate of rise of the tailing in the TSF, no single surface will be exposed for any significant time during filling, hence onset of acid conditions is not expected to occur during operations. Regular sampling and testing will be undertaken to confirm the geochemistry of the tailing, and will be a requirement of the TSF Operations and Maintenance Manual. The proposed mining sequence will result in approximately 3 to 3.5 m of NAF secondary copper[1] tailing being deposited as the top tailings layer, and this will further minimise the likelihood of acid generation occurring. Further description of the preliminary final cover design is provided in the response to Issue E16 and Appendix 13.

Air Quality (C)

C1 Air Quality Impacts from Dust

Compass will adopt an approach to dust control that is best practice for mines in Australia, with specific measures being outlined in Sections 7.3.3 and 9.8.5 of the PER. These measures are designed to ensure that relevant dust assessment criteria for $PM_{2.5}$, PM_{10} and TSP (generally based on NSW Department of Environment and Conservation and National Environment Protection Measures for Ambient Air Quality) are met.

[1] Formerly referred to as supergene tailing.

Air quality monitoring for staff and contractors will be performed as part of the project's Occupational Health and Safety System. Ambient air quality monitoring will occur in response to public complaint.

C2 Air Quality Impacts from Processing

Crushing and transporting of ore during processing will occur and has the potential to generate dust with consequent adverse impacts on air quality. Dust from haul roads will be minimised by use of a water truck for dust suppression. Compass will operate water sprays in the crusher and conveying system (including transfer points), thereby minimising dust generation (see Section 9.8.5 of the PER). Annual dust generation during mining and processing is estimated at 260 t/a and will therefore comply with ambient air quality goals (see Section 7.3.4 of the PER).

The processing plant will be powered by electricity drawn from the Northern Territory grid (see Section 4.12.1 of the PER). Therefore, no particulate or gaseous emissions from power generation will occur at site.

Project emissions from those components of the process beyond the comminution circuit are expected to be too small and too widely dispersed to impact on air quality at the nearest off-site residences.

C3 Health Impacts from Lead-bearing Dust

The measures described above and in the PER for dust control (taking into account dust control during mining and vehicle movements [see Section 9.8.5 of the PER]) will also serve to minimise any health risk associated with any lead-bearing dust and similar materials.

C4 Health Impacts from Radon

Radiological doses to the workforce and the public from inhalation of radon have been calculated by ANSTO (see Appendix 7 of the PER) based on a conservative range of exposure scenarios to various workgroups and the public.

The estimated dose to indicative workgroups and the public from inhalation of radon and the estimated total dose is shown in Section 7.13.4 of the PER and indicates that doses will be well below the allowable exposure limit (1mSv/a).

C5 Air Quality Impacts from Radionuclides

As for radon, radiological doses to the workforce and the public from inhalation of long-lived radionuclides via dust have been calculated by ANSTO based on a conservative range of exposure scenarios to various workgroups and the public.

The maximum potential radiological dose to workers and members of the general public via inhalation of dust will be less than the annual dose limit of 1 mSv/a for an adult (see the PER - Section 7.13.4 and Appendix 7).

General good practice in dust control and waste management will limit the already negligible amount of radionuclides associated with fugitive dust.

Radiological monitoring is discussed in Section 9.9.4 of the PER and addressed in further detail in the response to Issue N2 herein.

Editorial (D)

D1 Editorial

Compass notes that a small number of editorial suggestions were made in some submissions.

Engineering Design/Project Description (E)

E1 Lack of Detail on Process Water Dam

The process water dam will be a small (1 ha area) engineered dam designed to retain water; further engineering information will become available during detailed design. This dam will be designed and constructed by competent personnel, does not pose any particular problems from an engineering perspective, and will be consistent with the many similar dams constructed throughout the Northern Territory and Australia.

E2 TSF Seepage

Additional information concerning seepage from the TSF has become available since completion of the PER, and this is attached as Appendix 13.

'Mature storage' seepage through the base of the TSF is likely to be of the order of 50 m^3/day. Mounding beneath the storage facility is expected to be a local response only, and seepage from the active storage will be captured by the drawdown cone resulting from the pit. More detailed assessment of seepage from the TSF and the overall groundwater response to the pit will be carried out using the results from monitoring during production, with final closure protocols determined during this period.

As discussed in Appendix 13, the critical factor for seepage quality post-closure is the air/oxygen diffusion rate through the cap, not the rate of seepage. The primary design criteria for the TSF cap will be to ensure that there is sufficient depth of water available in the 'store and release' layer to protect the clay layer from drying out. Closure of the TSF is addressed in more detail in the response to Issue E16.

Groundwater monitoring will be undertaken as described in response to Issue O6.

E3 Water Treatment

This issue is addressed in response to Issue S27.

E4 Borrow Areas

As described in Section 4.5.1 of the PER, the main requirement for external borrow material will be the first stage of the TSF construction. This material will be sourced from within the project footprint or, if this is not possible, from within the footprint of a possible future pit associated with development of the sulfide deposit.

There are no indications that borrow material will be required from beyond these areas.

E5 Site Infrastructure

A mess will not be provided on site. Appropriate amenities (a 'crib room') will be provided for the eating meals brought to site and, if necessary, appropriate approvals will be obtained.

E6 Effluent Re-use

Compass will undertake the required discussions with The Department of Health and Community Services (DHCS) regarding reuse of effluent and final design of the system.

E7 Final Design

The approach that underpins environmental impact assessment in general, and the PER in particular, is that the project is sufficiently well defined to be assessed by stakeholders in terms of key factors, conceptual responses by the proponent and notional impacts. The PER is not intended to describe detailed engineering aspects of the project, nor does it provide detailed management measures.

E8 Inconsistency

With regards to inconsistencies between Section 4.9.1 and Section 4.6.3, a detailed pit design and schedule will be conducted after the completion of the resource modelling, with this likely to occur in April 2005. However, a mine design and schedule has been developed that meets the ore production requirements and generates the required NAF (and PAF) waste material utilised for the construction of the TSF (see Table 3.2). This production schedule brings forward the mining of some of the waste material to enable the TSF to be built in stages ahead of tailing storage needs.

E9 Metallurgical Process

As proposed by Compass, ore will be crushed and ground in a conventional comminution circuit ahead of acid leaching (Figure 3.3). The oxide ore dissolves readily in sulfuric acid, especially when assisted by heating. Solid-liquid separation is achieved using conventional thickeners to produce a pregnant solution that feeds the copper solvent extraction circuit. Significantly, however, a conventional counter-current decantation circuit is replaced by a resin-in-pulp circuit. This best practice hybrid circuit maximises metal recoveries, improves the process water balance and ensures that heavy metals in the tailing stream are minimised. It also minimises capital cost, operating cost and plant footprint. Copper recovered in the solvent extraction circuit is electrowon as LME (London Metal Exchange) grade A cathode copper for direct sale into the copper

market. Cobalt and nickel are precipitated from the solvent extraction raffinate as a conventional mixed sulphide precipitate, filtered and bagged in bulka bags for sale. Tailings from the process will be delivered to the TSF from which water will be recovered for reuse.

The process described above consists of a combination of well-proved metallurgical components, i.e., comminution, acid leaching, solid-liquid separation, resin-in-pulp and solvent extraction/electrowinning. Sufficient testwork has been undertaken by Compass during project development since 1997 (albeit with a focus on the sulfide deposit) to provide a high level of confidence that the process will successfully recover the target metals.

E10 Mining Schedule

Mining operations may be constrained during the wet season, with the mining contractor being expected to either work on upper benches of the pit or alternatively temporarily suspend operations. A decision between these options will be made after discussion with the selected contractor and an appropriate mining schedule will be used.

E11 Pit Wall Failure

Given the relatively shallow nature of the pit and the conservative approach taken to pit slope angles, the risk of a catastrophic pit wall failure is considered to be low. Regular wall inspections will be made, and external geotechnical advice sought when needed. Failure monitoring and warning devices will be installed if required.

E12 Process Water Dam Design

See the response to Issue E1.

E13 Project Layout/Footprint

The project layout reflects the existing leases held by Compass and minimises additional disturbance to the area. Final design will ensure that environmental and safety considerations are maximised within the footprint, with suitable provision for relevant contingency plans that take the layout into account.

The main single component in terms of surface area is the TSF and the possibility of extending the TSF is limited. However, as described in Appendix 13, the TSF has sufficient capacity for the proposed 4-year mine life (plus additional material such as water treatment plant sludge and sedimentation trap sludge). Development of additional deposits or the underlying sulfide deposit will therefore require additional permitting that will accommodate an expanded footprint, and this has been Compass' consistent position.

E14 Sediment Trap, Closure

Maintenance of the sedimentation traps during operations will be incorporated into the project's day-to-day monitoring, maintenance and management schedule. Depending on

the sediment chemistry, sediment recovered from the traps may be used as a rehabilitation 'soil'. Alternatively, if contaminated, it could be placed into the TSF and buried with the tailing.

Closure will involve appropriate rehabilitation and stabilising of the traps, most likely leaving the main sedimentation trap with its emergency spillway. Post-closure maintenance requirements will be agreed between Compass and the Department of Primary Industry, Fisheries and Mines (DPIFM) as part of the lease relinquishment process.

E15 Sedimentation Trap Design

The main sedimentation trap will have a volume of 118,000 m^3, with water discharge occurring via a pipeline to the East Finniss River (see Section 4.14.6 of the PER); an emergency spillway will be provided for extreme rainfall events. Further details of the capacity and management regime of the trap will be developed during detailed design.

E16 TSF Closure

The preliminary design of the TSF final cover described in Appendix 13 has considered current best practice and design factors contributing to the failure of covers at Rum Jungle. Compass therefore considers that an expanded, documented review of TSF covers to include areas beyond Australia is not warranted.

E17 TSF Design

Further details on the TSF design, for a storage capacity of 4 MT of tailing, are provided in Appendix 13. Key points to note include:

- A design philosophy based on the storage being raised and managed so that there is no discharge from the storage up to a 1 in 200 ARI (Average Recurrence Interval) rainfall year.
- Provision for all PAF waste rock to be incorporated in a specific, designated area within the TSF (see response to Issue B3).
- An emergency-level spillway capable of accommodating an extreme rainfall event without compromising safety and integrity of the storage (in accordance with the ANCOLD (Australian National Committee on Large Dams) consequence category given to the storage). The spillway will be designed to discharge into the main sedimentation trap; details will be provided in the final design.

Emerson tests have been conducted on samples of Zone 1 material that will be used to provide an internal lining to the TSF embankment and indicate that the materials do not show dispersive behaviour. Laboratory permeability tests of compacted Zone 1 materials have returned permeability values in the range $3x10^{-9}$ to $6x10^{-9}$ m/s.

As indicated in the response to Issue E16, preliminary design of the TSF closure cover has taken into account the performance of the Rum Jungle covers. Incorporating this review with the experience of Compass' tailing management consultants has led to the

proposal of different cover treatments for the tailings and the PAF waste rock zones, although both treatments would involve a 'store and release' type cover. Details are provided in Appendix 13, while both options are shown schematically in Figure 3.4.

E18 TSF Design/ARD Management/Groundwater Impacts

See the responses to Issues B4, E2 and E17.

Flora and Fauna (F)

F1 Aquatic Fauna Characterisation

Aquatic fauna were characterised via a desktop study (all fauna) and field studies (amphibians, reptiles and migratory species) during the dry season of 2002 and the wet season of 2005 (see sections 7.2 and 7.8 of the PER, and Appendix 4). Sufficient information was obtained to determine the status of the East Finniss/Finniss River system and to provide the context within which the project will be developed and discharges will occur.

F2 Biting Insects

The additional information provided in the submission from the NT Department of Health and Community Services will be reflected in the final Biological and Land Management Plan (see Section 9.8.3 of the PER for a description of the issues that are addressed in this plan).

F3 Cane Toads

Compass will investigate the practicalities of instigating an inspection program to minimise the likelihood of cane toads being transported into and from the project area. Compass will also seek advice from expert groups (such as FrogWatch) on effective control of cane toads and will endeavour to coordinate such activities with other groups, where practicable.

F4 Clearing Plan (Pit)

Clearing of the pit could occur over the initial two years of the operation. However, given the modest size of the area, Compass' current intention is to clear the total footprint during favourable weather conditions and establish the required erosion, sediment and dust control measures as soon as possible.

F5 Clearing Program

A clearing program will be submitted as part of the MMP prior to work commencing on site and will include management strategies and measures as described in Section 9.8.3 of the PER.

F6 Fauna Impacts (Adequately Addressed)

Compass notes the Australian Government's DEH (Department of the Environment and Heritage) comment that the PER adequately addresses Commonwealth issues.

F7 Fauna Impacts (General)

The fauna survey was undertaken by specialists in this discipline who established sufficient sites to characterise the existing fauna and provide an impact assessment for the Browns Oxide Project.

Avoidance, management and mitigation measures designed to reduce impacts of threatened fauna species (including the Red Goshawk and Partridge Pigeon) are described in Section 7.2.5 of the PER and include reducing habitat loss and fragmentation. Additionally, fauna management procedures (as described in the Biological and Land Management Plan, Section 9.8.3 of the PER) will be implemented for fauna protection.

F8 Fauna Impacts (Noise)

The noise and vibration from haulage trucks and four-wheel drive vehicles within the project area may act as a deterrent to fauna crossing the road during haulage. Other site roads will be speed-limited.

Noise impacts will be controlled to a level that will meet the assessment criteria that would apply to similar mines in NSW based on the use of acoustic treatment or shielding for the process plant and smart alarms on items of mobile plant.

A Noise and Vibration Management Plan will be implemented to minimise the potential impacts to wildlife. Details of the plan are given in Section 9.8.6 of the PER.

F9 Fauna Management

A Biological and Land Management Plan will be incorporated in the MMP completed prior to work commencing on site. Issues, objectives, performance standards, implementation strategies and measures of the plan are described in Section 9.8.3 of the PER. In addition to addressing fauna in general, specific consideration will be given to threatened fauna species.

F10 Flora Impacts (General)

The final Biological and Land Management Plan (see Section 9.8.3 of the PER and responses above to fauna issues) will ensure that impacts to vegetation communities and threatened species are managed in an appropriate manner. Nevertheless, it should be noted that, in the regional context, the conservation value of the terrestrial flora found in the project area is not significant.

The only protected species found or likely to occur in the project area is the cycad *Cycas armstrongii*, with this species being present within several vegetation communities in the

project area (see Section 7.1.2 of the PER). Compass is currently engaged in discussion with Friends of the Batchelor Open Wildlife Sanctuary about possible use of some of these plants in the proposed sanctuary, and Greening Australia has offered their assistance in transplanting the cycads for this sanctuary. Compass will also ensure that the provisions of the draft Management Plan for Cycads (PWCNT, 2003) will be taken into account during site preparation.

F11 Riparian Vegetation

No riparian vegetation along the East Finniss River will be cleared by Compass during project construction and operations. The main sediment trap will be constructed to protect the drainage line in the eastern section of the project area, as shown in Figure 3.5 (which is an updated version of Figure 4.1 in the PER). Construction of the sediment trap is not expected to require the clearing of riparian vegetation but will be sited within 50 m of the drainage line.

F12 Terrestrial Fauna

Compass notes the Museum and Art Gallery NT's comment that the PER adequately addresses issues relating to terrestrial vertebrate fauna.

F13 Threatened Species

Responses to Issues F7 to F11 provide a description of mitigation and management of impacts to threatened flora and fauna species. In particular, the on-going implementation of the site-specific Biological and Land Management Plan (Section 9.8.3 of the PER) will ensure that impacts to vegetation communities and threatened species are managed in a sensitive manner.

In specific relation to the bare-rumped sheathtail bat (*Saccolaimus saccolaimus nudicluniatus*), bat surveys were undertaken during the 2005 wet season in and around the project area by Ecological Management Services (see Appendix 4 of the PER). No evidence of this bat was found in the area during this or previous surveys. However, Compass acknowledges that location of this species during such surveys is very difficult as a result of its high-flying nature that makes net trapping ineffective, and the absence of a known echolocation call making echolocation non-viable (Milne, pers. com., 2006). There have been only two confirmed records of the bare-rumped sheathtail bat in the Northern Territory post-1970, these being at sites about 150 km and 160 km east northeast of the project area. While knowledge of this species is poor, it is thought to roost in tree hollows (*Eucalyptus platyphylla*) and coastal caves (DEH, 2005), and neither of these habitat types occur in the project area. While it is possible that this species may overfly the project area, the likelihood of this occurring is extremely difficult to predict given the paucity of information regarding this species.

F14 Vegetation Clearance/Vine Forest Management and Monitoring

Figure 3.6 shows the project footprint and components superimposed onto Figure 7.1 from the PER so that a better spatial understanding of vegetation communities that will be impacted can occur.

Responses to Issues F10 and F11 describe the proposed mitigation and management methods to minimise impacts to threatened flora species, including vine forest.

Pit dewatering and groundwater level monitoring will occur as discussed in the response to Issue O6. Monitoring will allow management of vegetation communities VC10 (*Acacia auriculiformis)* and VC12 (*Acacia auriculiformis/Melaleuca dealbata/Lophostemon grandiflorus)* to ensure that impacts to these communities are minimised (as discussed in response to Issue F15).

F15 Vine Forest Impacts

Further to the information provided in the response to Issue F14 and in specific reference to the vine forest patches, the likely impacts of lowering the water table will depend largely on the degree of reliance that the forest patches actually have on any underlying water table (as opposed to being maintained by seasonal rainfall). The vine patches in the project area possibly rely more heavily on seasonal rainfall and on moisture transferred through the soil from the adjacent Finniss River than from a geologically defined water table.

However, if the forest patches are indeed reliant on an underlying water table, then the effects of lowering the water table would also depend on the extent by which it is lowered and the duration for which the lowered water table is maintained. Wet season rainfall is typically predictable and substantial in the project area and full recharge of the rivers, aquifers and soil-borne moisture usually occurs each wet season.

If drying out of the vine forest were observed and could be attributed to the project, Compass would consider irrigating the vine forest. Possible irrigation methods could include spraying from water tankers (with the attendant issues of providing access through the forest, creating greater access for weeds and dissecting the forest patches further) or dripper tape or similar (although this would require greater maintenance as it is sometimes chewed by animals) (Egan, pers. com., 2006).

F16 Weeds

Finalisation and implementation of the Biological and Land Management Plan (Section 9.8.3 of the PER) as part of the MMP will ensure improved weed control relative to the current status of the site, where the central and eastern sections of the project area are dominated by weeds and introduced grasses.

Compass has already committed to submitting a detailed weed management plan as part of the Mining Management Plan (see the PER Table of Commitments and Appendix 11).

Greenhouse Gases (G)

G1 GHG Commitments

The Mining Management Plan will address actions to reduce greenhouse gas emissions and will include these as specific commitments.

G2 GHG Management

The project is not classified as a large energy user (>9.5 PJ/a) and is not required to publicly report GHG emissions. Therefore, Compass does not propose to join the Greenhouse Challenge Plus Program. However, Compass is committed to reducing GHG emissions associated with the project and has committed to best practice GHG emission reductions as described in Section 7.4.3 of the PER and as will be reflected in the Mine Management Plan.

Compass has already committed to submitting a detailed fire management plan as part of the Mine Management Plan (see the PER Table of Commitments and Appendix 11). This plan includes consideration of minimising GHG emissions.

Assessment of greenhouse gas emissions associated with the provision of a power line will be the responsibility of the Power and Water Corporation (PAWC), which has agreed with Compass to undertake the permitting for, and construction and operation of, such a power line.

G3 GHG Targets

No initial target for GHG emissions exists as such. However, the estimate for initial GHG emissions of 4,200 t CO2-equivalent during construction and 47,400 t CO2-equivalent during operations (with 39,000 t CO2-equivalent resulting from electricity generation by PAWC for use in the processing plant and on-site power) can be adopted as initial emission targets.

Impacts on Landuse and Infrastructure (H)

H1 Landscapes

Landscapes have been identified in the region and are detailed in Section 3.1.2 of the PER. The final landforms created, including the TSF, will be compatible with the surrounding landscape (which is already significantly modified).

H2 Planning Conflicts

The PER addresses all seven of the key objectives contained within Section 2.3 of the Coomalie Planning Concepts and Land Use Objectives, which include the need to protect the environmental qualities of the area while promoting the development of mining and extractive industries (see Section 7.7.1).

The proposed project is therefore consistent with the relevant planning scheme.

H3 Public Infrastructure

Compass has undertaken to provide significant new bitumen roads near the mine site. Traffic studies by Sinclair Knight Mertz (Appendix 16) have demonstrated a relatively small increase in traffic volumes over existing roads (see response to Issue R2 and Table 3.10). The small number of predicted heavy vehicle movements (3.35 return trips per day) is not expected to lead to a significant increase in road maintenance requirements. Any contribution options to increased maintenance will be considered in keeping with maintenance contributions from present heavy vehicle users (including the cattle industry).

Legislation/Approvals (I)

I1 Additional Inclusions

In response to comments regarding additional inclusions to the PER, Compass:

- Acknowledges that the Northern Aboriginal Sacred Sites Protection Authority (1989) is an omission from the list of other relevant Northern Territory legislation (see Section A1).
- Acknowledges that the *Code of Practice for Small On-site Sewage and Sullage Treatment Systems and the Disposal and Reuse of Sewage Effluent* is an omission from the list of applicable standards and codes.
- Acknowledges that the following comment from the Aboriginal Areas Protection Authority provides additional relevant information:

  Under the Northern Territory Aboriginal Sacred Sites Act (1989) all sacred sites in the NT are protected and it is an offence to damage, or illegally enter, a sacred site. The NTASSA allows land users to apply for an Authority Certificate. Compliance with an Authority Certificate is indemnity against prosecution.

I2 Approvals for Accommodation Facilities

Compass acknowledges that facilities that may be used to accommodate staff would need to be registered as boarding houses in accordance to the Public Health Act and regulations.

I3 Beneficial Use

Compass acknowledges that the process that needs to be undertaken to declare a beneficial use for the East Finniss/Finniss river system under the Water Act involves stakeholder consultation and that this can take some months to complete.

Management Systems/Plans (J)

J1 ISO Standards

As stated in Section 9.2 of the PER, Compass is committed to working within the framework of an environmental management system (EMS) in accordance with the international EMS standard, ISO 14001:1996, adapted for use in Australia and New Zealand as AS/NZS ISO 14001:1996. Compass will not develop full certification but will include its own management systems adapted from the international EMS standard.

J2 Management Plans

The DHCS will have an opportunity to view and make comment on relevant management plans (as part of the MMP) as they are developed by Compass within the framework of the Public Health Act.

PER Process/Contents/Specialists (K)

K1 Lack of Alternatives

Chapter 5 of the PER discussed project alternatives, including not proceeding with the project and alternatives considered in project planning.

K2 No Comment

Compass notes that the PER does not come under the jurisdiction of NT Worksafe.

K3 No Cooperative Programs

To date no co-operative research programs have been entered into with either the Batchelor Institute or Charles Darwin University. However, Compass has already used the services of both of these institutions over the past few years, with BIITE contributing to the studies undertaken in the early 2000s for the sulfide project and Charles Darwin University providing water quality data for the East Finniss/Finniss river system for the PER (see Appendix 2, Attachment A). Compass remains receptive to any research proposals that these two institutes (or others) may wish to submit.

K4 PER Premature

Compass is advancing with the planning and development of the Browns Oxide Project as a stand-alone project. All project decisions made by Compass are based on the project as described in the PER (and supplemented by additional information contained herein), i.e., development of an oxide resource over a 4-year mine life to produce copper, cobalt and nickel.

Nevertheless, Compass has spent a number of years building a resource asset base at Browns and surrounding areas, in addition to the oxide ore at Browns. This includes 37.2 Mt of sulfide resources on the Browns mineral leases. Therefore, the stand-alone

Browns Oxide Project has a closure plan that has been specifically designed to ensure that these sulfide resources are not sterilised, but remain a resource asset for the future.

At the appropriate time, Compass plans to process other oxide and sulfide resources in the area. Before this occurs, each project will be subjected to a separate environmental assessment via the NT's approval process (and including Australian Government participation, if required under the EPBC Act).

The Rum Jungle mineral field, well known for its uranium potential, is close to the Browns mine site. Compass has been actively exploring for uranium and, on successful delineation of economic uranium resources, would aim to become a uranium producer in the short term. As with the sulfide resources, any such proposal would be subject to a separate environmental assessment and approval.

K5 Power Line

Compass has continued discussions with PAWC since completion of the PER, with the outcome being that Compass still intends to connect to the Northern Territory grid, with the environmental assessment and subsequent construction and operation of this power line being PAWC's responsibility.

Responsibility for permitting, including the opportunity for stakeholders to comment on the final preferred option (which is still under consideration), will be part of the permitting process that PAWC will undertake.

K6 Aerial Photograph Doctoring

No aerial photographs in the PER have been intentionally or unintentionally modified, blurred or filtered in any way by Compass or its consultants/contractors. Considerable care has been taken to ensure that overlays on aerial photographs have not obscured important data.

K7 ANSTO

ANSTO is Australia's premier organisation with respect to radiological issues and is in an un-paralled position to provide expert advice concerning such matters. Compass believes that such advice is unbiased, and that Appendix 7 of the PER appropriately reflects the experience, expert knowledge and professionalism of the ANSTO personnel responsible for its preparation.

ANSTO's assessment, as presented in Appendix 7, is based on both historical data (including ore and flotation concentrates from the sulfide ore body) and more recent assays of ore samples (which has focussed on drill samples of Browns oxide material. As described in the response to Issue N2, Compass will undertake additional sampling of the ore (as well as other media such as process streams, possible scale build-up, equipment, green tissue and dust/air) to confirm that the concentrations used in ANSTO's assessment are appropriate. If warranted, the assessment will be repeated using updated assay data and the required management and mitigation measures implemented.

K8 Baseline Conditions

The information presented in Chapter 7 of the PER allows an impact assessment to be undertaken and is sufficient to provide a basis for ongoing monitoring, although additional information will need to be obtained in some areas (as described in the response to Issue O6. However, as stated in Section 7.8.2 in relation to surface water quality, baseline conditions are difficult to establish when the existing environment is in a state of flux. For example, it is possible that, even with no further activity on the Rum Jungle site, water quality and the ecological health of the Finniss River system may deteriorate due to the failure of the Rum Jungle waste rock dump covers. Compass will discuss this issue with NRETA during its application for a discharge licence under the *Water Act*.

K9 Bioremediation

Compass will implement clean up and remediation procedures, as required. This involves treating and disposing of spilt substances, contaminated materials and debris in accordance with MSDS requirements, relevant guidelines and waste management procedures (Section 9.8.7 of the PER).

Compass will not implement new bioremediation technologies such as phytoremediation, since existing remediation strategies are adequate. Should the need arise, Compass welcomes suggestions concerning possible bioremediation technologies.

K10 Community Complaints Process

Persons wishing to make a complaint during the construction and operation stages of the mine are invited to make submissions in writing to:

Mr Rod Elvish

Compass Resources NL

Level 5, 384 Eastern Valley Way

Roseville NSW 2069

Fax 02 9417 8750

Email admin@compass.com.au

Alternatively, the Northern Territory's EPA can be contacted as follows:

Ms Sally-Anne Strohmayr

EPA, NT

PO Box 496, Palmerston NT 0831

Phone 08 8924 4123

sally-anne.strohmayr@nt.gov.au

OR

Pollution Hotline 1800 064 567

K11 Consultation

Compass acknowledges that further consultation will be undertaken with the Officer in Charge of Batchelor Police Station in his role as the local Fire and Emergency Response Group Coordinator.

Compass will continue to expand the consultation program described in Chapter 6 of the PER and will make a concentrated effort to ensure that the goals described in Section 6.1 of the PER are met. In particular, and as described in Section 6.5.2 of the PER and the Table of Commitments (Appendix 11), a particular focus of the consultation program will be on indigenous groups.

Pollution (L)

L1 Arsenic Concentration

As stated in Section 4.9.1 of the PER, elements of most concern from an environmental perspective are copper, lead, cobalt and arsenic, and hence particular attention will be given to monitoring these metals in project water quality monitoring programs (see the response to Issue O6).

L2 Cobalt Production

The Cobalt 60 isotope does not occur naturally and no process used at Browns will result in the production of this isotope.

L3 Contaminated Soil Removal

Compass acknowledges that approval is required from the Northern Territory EPA to remove contaminated soil from site. Management and mitigation measures for both hazardous and general wastes are described in Section 9.8.7 of the PER.

L4 Hazardous Materials Storage

Compass will ensure that the final Hazardous Materials and Waste Storage Plan will include the information that, in the event of a hazardous materials spill, the General Manager Operations should report the spill containment within 24 hours of the incident to the Pollution Hotline (1800 064 567) to ensure notification under Section 14 of the Waste Management and Pollution Control Act.

As described in the response to Issue K11, Compass will consult with the local Fire and Emergency Response Group Coordinator in relation to the storage of chemicals and explosives on site.

Risks associated with stockpiling tyres on site, such as fire, mosquitoes/cane toad breeding, weeds and vermin, will be considered during finalisation of the Hazardous Materials and Waste Storage Plan, with inclusion of appropriate mitigation and management measures.

L5 Pollution Pathways

Groundwater movement is discussed in Section 7.9.1 of the PER, although it should be noted that, despite the considerable time and sums of money spent on investigating the Rum Jungle site, detailed information about this subject is lacking. Nevertheless, the occurrence of significant levels of contamination in seepage from the Rum Jungle waste rock dumps, and in Whites Open Cut, would be expected to have already caused significant adverse impacts on regional groundwater quality if such pathways were to exist.

Proponent (M)

M1 Capability

Compass is assembling a project management team that will include the required expertise to ensure that construction, commissioning and ongoing operations proceed with minimal interruptions.

Compass acknowledges that such personnel are a key requirement for successful project development and has already initiated the recruitment of senior staff. This is augmented by the use of appropriately qualified consultants and contractors.

M2 Credibility

As described in the response to Issue K4, Compass is advancing with the planning and development of the Browns Oxide Project as a stand-alone project. However, Compass has consistently been transparent in stating that the company objectives include further development, if possible, of the sulfide resources on the Browns mineral leases, other oxide and sulfide resources in the area, and the definition and development of uranium resources elsewhere in the area. Meeting these objectives will require separate environmental assessment via the NT's approval process (and including Australian Government participation, if required under the EPBC Act).

M3 Future Plans

Compass rejects the proposal that approval of the Browns Oxide Project should be denied on the basis that the company intends to develop other projects in the area. The approach adopted by Compass and reflected in the PER is consistent with that used by resource development companies throughout Australia, i.e., the scale of the project is consistent with the proponent's resources and provides a suitable basis for other

projects (or expansions thereof), taking into account environmental assessment and permitting requirements.

M4 Subsidy

Compass works closely with both the Northern Territory and Commonwealth governments. No subsidies have been provided by either government for the Browns Oxide Project.

Compass has applied for and received a qualification to apply for Research and Development Taxation Status for certain of its expenditures on the Browns Oxide Project. To date no benefit has been claimed.

In 1999 Compass received a Research and Development State Grant for the development of sulfide ore processing technologies. This program cost some $9.4 million of which the Commonwealth Government paid 50%.

Radiology (N)

N1 EPBC Nuclear Action

In December 2001, Compass lodged a Referral under the EPBC Act with Environment Australia (which is now DEH). That document referred to the proposed development of a large-scale mining project, i.e., the Browns Polymetallic Project, that would produce lead, cobalt, copper, nickel and silver over a project life of at least 15 years through the extraction of about 45 Mt of mainly sulphide ore and up to 700 Mt of waste rock. Two options were being considered by Compass, with the footprint associated with the larger option overlapping the Rum Jungle Mine. The possible pit outline for this larger option notionally included Rum Jungle's Intermediate and Whites pits, while it was anticipated that the waste rock dumps would probably incorporate some of Rum Jungle's waste dumps.

As indicated in the 2001 Referral, Compass considered that the Browns Polymetallic Project was a 'nuclear action' under the EPBC Act, on the basis that the project could be considered to include rehabilitating a facility or area in which mining or milling of uranium ore has been undertaken.

As described in the PER, the Browns Oxide Project is substantially different from the Browns Polymetallic Project, having only a 4-year life, extracting 4 Mt of ore and 4.7 Mt of waste rock, and with a project footprint that is next to, but does not impinge upon, the Rum Jungle site. Uranium occurs only at low concentrations in the oxide project ore and waste, and will not be a product of the operation. The Browns Oxide Project therefore does not trigger the nuclear action controlling provisions of the EPBC Act, although it has been declared a controlled action under the listed threatened species and communities provisions (see Section 2.2.1 of the PER).

N2 Radiological Assessment

Compass considers ANSTO to be the best-credentialled organisation in Australia to undertake a radiological assessment of the project, as presented in the PER. Furthermore, Compass refutes any inference that the Browns Oxide Project is an attempt to construct and operate a uranium mine by stealth. Should Compass discover an economically-viable uranium resource and subsequently wish to pursue it, all required environmental assessment and permitting processes would be followed, including referral under the EPBC Act.

Compass together with ANSTO have provided estimated radiological doses (Table 7.32 in the PER), avoidance, mitigation and management measures and a residual impact assessment on radiology. Section 7.13 describes the radiological assessment undertaken by ANSTO.

N3 Radiological Baseline

Background radiological data is presented in Appendix 7 of the PER (which also includes reference to data sources such as an airborne gamma-ray survey of the Rum Jungle area in 1996) and summarised in Section 7.13.1. However, Compass acknowledges that, while the existing database is sufficient for impact assessment, additional monitoring is required before and during construction and operations. Appendix 14 therefore describes a radiation monitoring program that involves:

- Site radiation surveys prior to commencement of mining activities, early in the life of the operation (i.e., after 6 months to one year) to obtain baseline radioactivity levels associated with the process, and then repeated surveys after extended plant operation (i.e., 2 to 3 years) to ascertain whether radioactivity concentrations are increasing due to the process chemistry, and and/or changes in ore and operating practices/procedures and equipment.

  The frequency of radiation surveys will be determined by the history of results obtained from progressive surveys of the operation (including baseline data collected prior to commencement of mining activities).

- Regular sampling and assaying of process streams to assess the likelihood of build-up of radionuclides. Accumulation of radioactivity will depend on the natural bleed-off of various streams in the process, and sampling and monitoring during the first 6 months to 2 years of operation will identify whether or not radionuclides are accumulating.

- Monitoring of radionuclides, e.g., ^{238}U, in seepage water from ore stockpiles and waste disposal facilities.

Compass is committed to undertake the quarterly radiation monitoring program proposed by ANSTO and summarised in Table 3.5.

Table 3.5 Radiological monitoring program

Sample Type			Assays	Method
N°.	Description	Medium		
1	Ore	solids	U	DNA, XRF, other
2	Leach solution	solution	U, progeny	ICP MS, gamma spectrometry
3a-x*	Process scales	solids	^{226}Ra	gamma spectrometry
4	SX raffinate	solution	U, progeny	ICP MS, gamma spectrometry
5	SX other	solution	U, progeny	ICP MS, gamma spectrometry
6	Co/Ni precipitate	solids	U	DNA, other
7a-x	Ore and waste stockpile seepage	solution	U	ICP MS
8a-x	Tailing storage facility seepage	solution	U, progeny	ICP MS, gamma spectrometry
9	Treated water	solution	U, progeny	ICP MS, gamma spectrometry
10a-x	Bleed stream products	solid	U, progeny	DNA, gamma spectrometry
		solution	U, progeny	ICP MS, gamma spectrometry
11a-x	Green tissue (local plants, crops)	solids	U, progeny	gamma spectrometry
12a-x	Dusts and air samples	solids	U, progeny	DNA, gamma spectrometry
13-x	Other streams as identified in early surveys for radioactivity	solutions and solids		

* The number of samples will vary depending on experience gained.

N4 Radiological Impacts

As stated in Section 7.13.3 of the PER, the entry of NORM into the environment will be minimised through management measures relating to waste rock (see Section 4.9.2), tailing (see Section 4.10.3), erosion (see Section 4.5.2), surface water (see sections 4.14.2 and 7.8), discharge of excess water from the TSF (see Section 9.8.4), seepage from the TSF (see Section 9.8.4) and dust (see Section 7.3.3).

Compass acknowledges that accumulation of radiation may occur anywhere during mining, ore stockpiling, plant processing, water management and waste disposal (see Appendix 14), and is therefore committed to undertake the monitoring program described in Table 3.5. Management strategies that will be implemented are described in Appendix 14 and include:

- Development of a Radiation Management Plan as part of the MMP.
- Regular reporting.
- Specific measures such as appropriate equipment and procedures, instruction and training programs, and designating controlled or supervised areas.

N5 Regional Implications

The level of radiation associated with Browns Oxide Project will be low (see Section 7.13 of the PER) and hence is expected to have only minor, if any, impact in terms of regional implications.

N6 Uranium

As noted in Section 4.9.2 of the PER, 'the concentration of uranium in Browns oxide ore is very low', with uranium concentrations in the waste rock likely to be lower again. These low levels of uranium are not considered likely to require specific management measures (or impose specific constraints) concerning the use of waste rock in the construction of the TSF embankment.

Uranium dissolution in the process leach stage is addressed in Section 7.13.4 of the PER, where the accumulation of uranium in recycled process water (to be removed as part of the neutralisation waste) is described. In addition, ^{226}Ra may also be present at low concentrations in the leach solutions and could appear at higher concentrations in scales on equipment surfaces and/or absorbed into synthetic materials such as filter cloths and rubber linings.

The monitoring program described in Table 3.5 addresses the deportment of uranium through the process and in waste streams.

N7 Uranium Impacts/Management

See the responses to Issues K7, N2, N3, N4, N5 and N6.

N8 Uranium Levels

Appendix 9 of the PER presents results from multi-element analysis of one sample of sulfidic dolomite and four samples of black shale. Uranium concentrations in these waste rock samples ranged from 5.8 to 14 ppm.

As described in the response to Issue B1, five leach columns have been established to further examine the acid-forming potential of waste rock from the Browns Oxide deposit. The material in these columns ranges from high sulfur black shale through to weathered ferriginous dolomite/magnesite. Analysis of these samples, which includes uranium determination, is currently in progress. For comparison, the mean uranium concentration in ten core samples reported by ANSTO (Appendix 7) was 13.9 ppm (8.1 to 28.6 ppm).

N9 Uranium Management

The monitoring program described in Table 3.5 will allow Compass to determine if elevated radiation levels are encountered during mining or occur during processing. Possible management measures are discussed in the response to Issue N4 (and see Appendix 14).

N10 Uranium Mining

The Browns Oxide Project does not involve mining of uranium ore. Development of a uranium orebody, should Compass discover one and choose to proceed in this direction, will involve environmental assessment and permitting separate from, and additional to, that required for the Browns Oxide Project (see also the response to Issue N2).

N11 Uranium Production

Compass rejects any inference that uranium will be produced as part of the Browns Oxide Project (see also the response to Issue N2 and Issue N10).

Rehabilitation, Monitoring and Decommissioning (O)

O1 Closure and Rehabilitation

Compass rejects any analysis of the PER that describes parallels between closure of the Browns Oxide Project and that at Rum Jungle.

Rehabilitation and closure of the Browns Oxide Project will reflect current standards and will follow a process that is agreed between Compass and the NT authorities. Post-closure radiological monitoring requirements will be determined during operations, and will be based on the results from the monitoring program described in Table 3.5.

O2 Closure Criteria

Section 9.10.5 of the PER addresses end land uses within the context that the proposed final landforms and uses will be subject to ongoing discussion with stakeholders. Table 3.6 below (which is based on Table 9.5 from the PER) includes proposed final landforms that will act essentially as closure criteria for the project, with the final Mine Closure Plan being focused on achieving these criteria (or agreed variations thereof).

Water quality guidelines or criteria that might apply to the project will be determined as part of the application for a waste discharge licence under the *Water Act*. However, Compass remains committed to ensuring that the quality of the existing aquatic ecosystem in the Finniss/East Finniss River is maintained and, if possible, improved (see response to Issue O3 and Issue O6).

Table 3.6 Proposed closure criteria

Component	Final Landform
Mine pit	Walls left in stable condition, perimeter secured by fence. Final void left to naturally fill with groundwater/rainfall unless ARD is a significant issue, in which case the final void may be rapidly filled by diverting the East Finniss River through the pit. A bund will be constructed around the final excavation to prevent accidental ingress.
TSF	Tailing material capped with a 'store and release' type cover (see Figure 3.4). Excavation of a long-term spillway. Possible additional flattening of external slopes of the embankments. See Appendix 13 for further details.

Table 3.6 Proposed closure criteria (cont'd)

Component	Final Landform
Ore stockpiles	Ore removed for processing or returned to pit, area ripped, topsoiled and revegetated.
Processing plant, mine contractor area and site offices	Plant and material salvaged, structures removed, area ripped, topsoiled and revegetated. 'Clean' concrete foundations may be left in situ.
Magazine	Material salvaged, structures removed, area ripped, topsoiled and revegetated. 'Clean' concrete foundations may be left in situ.
Topsoil stockpiles	Topsoil removed for rehabilitation of other project components and base revegetated.
Sediment traps	Cleaned out, stabilised and left. The main sedimentation trap will remain with its emergency spillway.
Runoff drainage	Cleaned out, stabilised and left.
Haul and site roads	Ripped and revegetated.
Rum Jungle Road	Ripped and revegetated (unless consultation outcomes suggest otherwise).

O3 Closure Monitoring

Compass has acknowledged in Section 9.10.7 of the PER that ongoing sampling and monitoring of selected groundwater, surface water and final void water will continue for a period of not less than three years from the cessation of operations. The responsibility for ongoing monitoring, if required, will be negotiated with the government once stable conditions have been reached and water quality reflects the agreed closure criteria, and will be based on the program described in the response to Issue O6.

Post-closure monitoring will also involve the TSF and revegetation works.

O4 Closure Planning

Planning for mine closure has already commenced. Compass acknowledges that the final decommissioning plan will require further development in the early stages of operation, and will be developed in consultation with regulatory authorities and other key stakeholders during operations. The final closure plan will detail completion criteria and establish the timeline for decommissioning and determination of compliance with regulatory authority requirements.

This dynamic nature of the closure plan was acknowledged in Section 9.10.1 of the PER where it was stated that:

> Mine closure planning is a continuous process and this strategic plan is the first step. The mine closure plan will be refined as inputs from detailed project design, stakeholder consultation on end land uses and completion criteria, and various investigations/studies become available.

Compass' commitment to this is reflected in the fact that this statement is contained in the summary Table of Commitments in the PER (and updated as Appendix 11).

O5 Mine Closure

As noted in Table 9.5 of the PER, the sediment traps will be cleaned out, stabilised and left. The main sedimentation trap will be left with its emergency spillway.

Other aspects of closure will be addressed in subsequent versions of the closure plan (see response to Issue O4).

O6 Monitoring

Compass acknowledges that, prior to project development, the monitoring program (based on that described in Section 9.9 of the PER) will be agreed with DPIFM. Given the focus of a number of the submissions matters relating to water discharges, surface water and groundwater, additional detail concerning the discharge and ambient stream and groundwater monitoring programs (and based on sections 9.9.3 and 9.9.4 of the PER) is provided below. A waste discharge licence under the Water Act will be agreed with EPA prior to water discharge from the project. These programs will be reviewed and revised after 12 months of data has been obtained, and at 12-monthly intervals thereafter.

Discharge (Emission) Monitoring

Discharge or emission monitoring records the passage of contaminants at points outside the perimeter of activity. Discharge monitoring provides direct information concerning the concentrations and loads of contaminants being discharged from the operation, and also serves as a link between ambient monitoring results and the operation itself.

National Environment Protection Measure for National Pollutant Inventory (NEPC, 2000) provides lists of contaminants that must be reported if they are emitted to water above a certain annual mass threshold. Reporting requirements will be determined during detailed design and will be incorporated into the final monitoring program.

Main Sedimentation Trap

Water discharge from the site will occur primarily via the main sedimentation trap. Monitoring will therefore be undertaken (based on fortnightly sampling intervals during the wet season and monthly sampling intervals during the dry season) to characterise the nature of the water contained within this trap. Variables to be determined are described in Table 3.7. These results will be reported to DPIFM and EPA on a regular basis. Water will be treated prior to discharge if water quality does not meet water discharge requirements.

Excess Water Discharges (interception bores and main sedimentation trap)

Water quality will be monitored at the discharge point to the East Finniss River (near where the Rum Jungle Road crosses the river immediately upstream of gauging station

GS8150200) on a weekly basis during periods of discharge. Discharge rates to the East Finniss River will also be automatically monitored. Monitoring details for excess water discharges from the main sedimentation trap are provided in Table 3.7, whereas details on monitoring of interception bores are provided in Table 3.9 later in this section.

Pit Water

Pit water produced during operations, comprising groundwater inflows and incident rainfall over the pit area, will be pumped to the main sedimentation trap. The quality of pit water will be monitored on a monthly basis to provide a link between water quality in the main sedimentation trap and inputs from mine water. Pumping rates will also be automatically monitored. This will allow alternate water management practices to be implemented should pit water prove to be a major contaminant source, e.g., preferential re-use of this water in the process plant. Other water sources flowing to the main sedimentation trap, e.g., runoff from low grade ore and lead ore stockpiles, would also be monitored in the event that further investigation of poor water quality in the main sedimentation trap was required. The variables to be determined in the pit water are described in Table 3.7.

Tailing Decant

Tailing decant will be recovered and returned to the process circuit via the process water dam. The probability of excess water occurring in the TSF during the 4-year mine life is low since it is designed to retain water from major rainfall events, including the wettest year on record (1996/97) for the period 1958 to 2004. However, monitoring of TSF decant will be undertaken on a monthly basis to determine the quality of water contained within the TSF (see Table 3.7).

TSF Embankment Runoff/Seepage

Encapsulation of PAF waste rock in a designated area within the TSF means that monitoring is required to ensure that formation of ARD has been minimised. Monitoring of TSF seepage will therefore be undertaken on a monthly basis for the parameters described in Table 3.7.

Table 3.7 Summary of discharge monitoring program

Site	Sampling Frequency	Parameters
Discharge monitoring		
Main sedimentation dam	Fortnightly during wet season Monthly during dry season	• pH, conductivity, turbidity • TSS • Al, As, Cd, Co, Cr, Cu, Fe, Mn, Hg, Ni, Pb, Se, Ag, Zn, U (filtered and unfiltered) • Ca, Mg, SO_4 • Alkalinity • Oil and grease • Total N and total P

Table 3.7 Summary of discharge monitoring program (cont'd)

Site	Sampling Frequency	Parameters
Discharge monitoring (cont'd)		
Discharge point to East Finniss River	Weekly during discharge Automatic monitoring of discharge rates	• pH, conductivity, turbidity • TSS • Al, As, Cd, Co, Cr, Cu, Fe, Mn, Hg, Ni, Pb, Se, Ag, Zn, U (filtered and unfiltered) • Ca, Mg, SO_4
Pit water	Monthly Automatic monitoring of pumping rates	• pH, conductivity, turbidity • TSS • Al, As, Cd, Co, Cr, Cu, Fe, Mn, Hg, Ni, Pb, Se, Ag, Zn, U (filtered and unfiltered) • Ca, Mg, SO_4 • Oil and grease
TSF decant	Monthly	• pH, conductivity, turbidity • TSS • Al, As, Cd, Co, Cr, Cu, Fe, Mn, Hg, Ni, Pb, Se, Ag, Zn, U (filtered) • Ca, Mg, SO_4
TSF embankment runoff/seepage	Monthly	• pH, conductivity, turbidity • TSS • Al, As, Cd, Co, Cr, Cu, Fe, Mn, Hg, Ni, Pb, Se, Ag, Zn, U (filtered and unfiltered) • Ca, Mg, SO_4 • Alkalinity

Ambient Monitoring

While operational and discharge monitoring should determine if environmentally significant releases have occurred, effects on the ultimate receptors within the receiving environment can be determined only by ambient monitoring.

Stream Water Quality Monitoring

Key factors to be considered in the design of the ambient stream water quality monitoring program include:

- Statistical and spatial design and sampling frequency.
- Physico-chemical and biological indicators.
- Sampling site access.
- Possible mixing zone(s) downstream of project inputs.
- Procedural details, e.g., detection limits for trace metal determinations and sampling methods, and the availability of appropriately experienced laboratories to undertake the analyses.

Monitoring Design. The goal of the ambient water quality monitoring program is to determine the status of the aquatic ecosystems that potentially can be affected by the project, and to detect improvements or deterioration over time.

Establishment of specific water quality targets for the East Finniss River (and subsequently discharge limits for water discharges) can only be achieved after beneficial uses have been declared after consultation with relevant stakeholders. A key objective in selecting sampling site locations has been to allow assessment of a management target of maintaining, and allowing improvement of, the existing aquatic ecosystem. Sites have therefore been selected to characterise existing water quality of the East Finniss River downstream of influences from the Rum Jungle site, but upstream of influences from the Browns Oxide Project. This would allow a management strategy of comparing water quality in the main sedimentation dam and water produced from interception bores with existing water quality in the East Finniss River prior to any release. Sites have also been selected downstream of the proposed discharge point to assess the impact of discharges on existing water quality (by comparison with upstream sites).

Sampling Sites. The proposed water quality monitoring site locations are shown in Figure 3.7. The proposed sites coincide with stream gauging locations previously monitored under the Rum Jungle Rehabilitation Project, where appropriate. Monitoring locations have been selected to characterise water quality of the:

- East Finniss River upstream of the discharge point:
  - New site upstream of the Rum Jungle Bridge, but downstream of diversion through Intermediate Open Cut (to capture water quality when the river diverts through the Rum Jungle mine pits during the wet season, and water quality during lower flows when water flows through the East Finniss Diversion past Intermediate and Whites overburden heaps).
  - New site upstream of Whites Open Cut and overburden heaps (to capture water quality prior to influences from the Rum Jungle site).
- East Finniss River downstream of the discharge point:
  - Immediately downstream of the discharge point near GS8150200 (at a location where the discharge is fully mixed within the East Finniss River).
  - At gauging station GS8150097, approximately 5 km downstream from the discharge point. This site has been the designated site for estimating annual pollutant loads for the Rum Jungle Rehabilitation Project.
- Finniss River downstream of the confluence with the East Finniss River (at gauging station site GS8150204).
- Finniss River upstream of the confluence with the East Finniss River (new site).

Note that the final location of the new monitoring sites will be determined taking into consideration factors such as sampling access and suitability for achieving monitoring objectives.

Water Quality Indicators. A range of factors has been examined to allow selection of monitoring indicators that would:

- Be affected by the mine.
- Are significant in terms of the quality of the receiving aquatic ecosystems.

These considerations are reflected in the program's subsequent emphasis on the following variables:

- Physical characteristics (e.g., TSS, turbidity and conductivity).
- Water chemistry (e.g., pH, sulfate, calcium, magnesium, trace metals, nutrients, chlorophyll–a, dissolved organic carbon (which ameliorates toxicity due to metals)).
- Stream flow rate.

Water sampling will include both routine monthly sampling (at all sites) and opportunistic event sampling (at a selected site) where the latter is focused on obtaining samples from the river during a flood event, thereby taking into account flow-related variations in water quality.

Sediment. Chemical analysis of sediment complements water quality data, in that the latter provides instantaneous information about the water column while the former, in its capacity as a sink for many contaminants, provides an integrated picture of stream quality over time. Bed sediment samples will be sampled annually (in conjunction with the biological monitoring described below) from river water quality sampling sites. Analyses will be undertaken for total metals in the <2000 μm fraction and particle size distribution (PSD).

Monitoring of sediment aggradation will also be undertaken, involving cross-sectional surveys at sites GS8150200 and GS8150097, to determine changes to the fate and movement of sediment within the East Finniss River.

Stream Biological Monitoring

Benthic macroinvertebrate surveys of the East Finniss and Finniss rivers will also be undertaken to determine indices of stream health and identify spatial and temporal changes in the river system. Macroinvertebrates will be sampled annually using standard methods outlined by AUSRIVAS (Australian River Assessment Scheme) or other appropriate sampling protocols.

Given the interest of a number of parties in determining the ongoing water quality and ecological status of the East Finniss and Finniss rivers due to the impacts from the Rum Jungle Mine site, Compass intends to discuss the proposed sampling program with the relevant Northern Territory and Commonwealth authorities with a view to ensuring that a cost-effective, integrated program is implemented. Details of the monitoring program will therefore be determined during these discussions.

A summary of the ambient stream monitoring program is provided in Table 3.8.

Table 3.8 Summary of ambient stream monitoring program

Site	Sampling Frequency	Parameters
Project area streams — water quality		
East Finniss River: – u/s of Rum Jungle Bridge (new site) – u/s of Whites Open Cut (new site) – d/s of discharge @ GS8150200 – d/s of discharge @ GS8150097 Finniss River: – d/s of confluence @ GS8150204 – u/s of confluence (new site)	Monthly	• pH, conductivity, turbidity • TSS • Al, As, Cd, Co, Cr, Cu, Fe, Mn, Hg, Ni, Pb, Se, Ag, Zn, U (filtered and unfiltered) • Ca, Mg, SO_4 • Alkalinity (quarterly) • Chlorophyll-a and nutrients (quarterly) • DOC (quarterly) Stream flow rate (at gauging station sites)
East Finniss River @ GS8150097	Flood-event sampling	• pH, conductivity, turbidity • TSS • Al, As, Cd, Co, Cr, Cu, Fe, Mn, Hg, Ni, Pb, Se, Ag, Zn, U (filtered and unfiltered) • Ca, Mg, SO_4 • Nutrients Stream flow rate
Project area streams — sediment quality		
East Finniss River: – u/s of Rum Jungle Bridge (new site) – u/s of Whites Open Cut (new site) – d/s of discharge @ GS8150200 – d/s of discharge @ GS8150097 Finniss River – d/s of confluence @ GS8150204 – u/s of confluence (new site)	Annually	• Al, As, Cd, Co, Cr, Cu, Fe, Mn, Hg, Ni, Pb, Se, Ag, Zn, U (<2000 μm) • Particle size distribution
Project area streams — sediment aggradation		
East Finniss River @ GS8150200 East Finniss River @ GS8150097	Quarterly during construction, then annually	• Sediment aggradation (cross-sectional surveys)
Project area streams — biological monitoring		
East Finniss and Finniss rivers – locations to be determined in consultation with relevant NT and Commonwealth authorities	Annually	• Benthic macroinvertebrate survey (AUSRIVAS)

Groundwater Monitoring

Compass will undertake groundwater monitoring to provide a better understanding of hydrogeology and groundwater quality in the surrounding area and assess changes due to the project. This monitoring will provide information concerning groundwater transmissivity and drawdown, seepage from the TSF, groundwater quality (including

impacts due to the project and influences from the Rum Jungle mine site) and effects on regional groundwater uses.

Mine Monitoring. Groundwater monitoring will be undertaken at ten bores in the mine vicinity as shown in Figure 3.5:

- Five bores located around the perimeter of the TSF (BH 1 to BH 5). These will detect seepage and, if necessary, will provide a focus for collection and recycling of seepage plumes, should this prove necessary.
- Three interception bores installed for mine dewatering, located north of the pit. These will also provide make-up water for the process plant as required, with excess water being discharged to the East Finniss River (after treatment if necessary). Volumes of water extracted from these boreholes will be recorded, in addition to monitoring of water levels and water quality.
- One monitoring bore located between the Browns pit and the Rum Jungle pits and waste rock dumps, to assess groundwater quality in inflows from these areas.
- One monitoring bore located to the north of the interception bores, to assess groundwater drawdown impacts on root zones of vegetation in this area.

Table 3.9 describes the parameters that will be monitored and the sampling frequency of the program.

Regional Monitoring. Compass will undertake monitoring at a number of existing bores in the surrounding area to reduce uncertainties identified in the conceptual groundwater model. Objectives of this monitoring include identification of the nature of aquifer boundaries and drawdown along geological faults in the direction of the irrigation area, southwest of the project area.

It is proposed that monitoring will be undertaken at 12 existing bores shown in Figure 3.8, many of which were established to monitor the impact of the Rum Jungle Mine. The position of these sites will be reviewed to take into consideration the location of project infrastructure (e.g., RN023138 is located in the area of the proposed main sedimentation trap). The 12 monitoring locations shown in Figure 3.8 cover groundwater conditions to the northeast and southeast of the project area. Monitoring sites will also be established to the northwest and southwest of the project area at locations selected to provide information concerning hydrogeology and impacts on other groundwater users, including Batchelor's groundwater supply. A number of key landholder bores will be included in the monitoring program, after negotiation with landholders once appropriate bores are identified.

Table 3.9 describes the parameters that will be monitored and the sampling frequency of the program.

Table 3.9 Summary of ambient groundwater monitoring program

Site	Sampling Frequency	Parameters
Groundwater		
Mine monitoring: • TSF periphery (BH1, BH2, BH3, BH4, BH5) • Three interception bores • One bore b/n Browns pit and Rum Jungle pits and waste rock dumps • One bore north of interception bores in area of vegetation (water level, pH and conductivity only)	Fortnightly	• Water levels • pH, conductivity
	Monthly (Quarterly when steady conditions are established)	• Al, As, Cd, Co, Cr, Cu, Fe, Mn, Hg, Ni, Pb, Se, Ag, Zn, U (filtered) • Ca, Mg, Na, K, Cl, SO_4, CO_3, HCO_3
Regional monitoring: RN022039 RN022081 RN022083 RN022084 RN022085 RN022107 RN022544 RN023137 RN023138 RN023140 RN023515 RN023790 Further sites to be established to the northwest and southwest of the project area Selected bores of other regional groundwater users	Fortnightly	• Water levels • pH, conductivity
	Monthly (Quarterly when steady conditions are established)	• Al, As, Cd, Co, Cr, Cu, Fe, Mn, Hg, Ni, Pb, Se, Ag, Zn, U (filtered) • Ca, Mg, Na, K, Cl, SO_4, CO_3, HCO_3

O7 Rehabilitation

The mine closure and rehabilitation measures described in Section 9.10 of the PER and further addressed above relate solely to the Browns Oxide Project. Rehabilitation and closure of any other project that may be developed by Compass will be addressed separately as part of the environmental assessment and permitting process for that project.

O8 Revegetation

Revegetation measures to be included in the final Mine Closure Plan and the final Biological and Land Management Plan will focus initially on erosion control and then on habitat reinstatement for fauna species.

The clearing program (referred to in the response to Issue F5) will include an optimisation of the clearing schedule.

O9 Seepage

This is addressed in response to Issue E2.

O10 Surface Water Monitoring

See the response to Issue O4 and O6 regarding the duration of post-closure monitoring of groundwater, surface water and sediment.

O11 Topsoil

Topsoil management during construction is addressed in Section 4.5.2 of the PER. Key points include:

- The topsoil stockpiles will be formed into low, uncompacted, flat-topped mounds, up to 2 m high.
- Unnecessary compaction of the topsoil will be avoided in order to minimise degradation of soil structure.
- Where stockpiles are to be left for more than several months before re-use, they will be sowed with cover crops of fast-growing grass species (such as Cynodan, Urochloa or various sorghums) to prevent them becoming a source of dust or sediment.

Additional detail will be included in the final Biological and Land Management Plan.

O12 TSF Monitoring

See the response to Issue O6 for a description of proposed TSF drainage monitoring.

O13 TSF Seepage Management

This is addressed in response to Issue E2.

Rum Jungle (P)

P1 Groundwater Impacts

Consideration of possible impacts of drawdown on the Rum Jungle Mine pits is given in Section 7.8.4 of the PER. The proposed groundwater monitoring program (described in

the response to Issue O6), which contains monitoring bores on the Rum Jungle site, will provide information as to possible changes to the local groundwater regime.

P2 Increased ARD at Rum Jungle

This issue was addressed in Section 7.9.4 of the PER.

P3 Links with Rum Jungle Rehabilitation

Compass recognises its obligations with respect to the Browns Oxide Project area and will implement a rehabilitation program that reflects current standards and requirements. Responsibility for rehabilitation of the Rum Jungle Mine or associated impacts does not belong to Compass. Similarly, determination of the future of the Rum Jungle Mine site is likely to involve a number of stakeholders, of whom Compass is one.

Nevertheless, Compass is of the view that sufficient recognition must be given to the fact that the Browns Oxide Project will be developed within a modified natural landscape that has varying degrees of disturbance from previous exploration activities and, more importantly, from previous mining at Rum Jungle (see Chapter 3 of the PER). Notwithstanding the constraints imposed by this existing environment, Compass has committed to a management target of maintaining, and allowing improvement of, the existing aquatic ecosystem.

P4 Mining in Rum Jungle Area

A decision as to whether the Rum Jungle Mine site could be mined or not, assuming the existence of an economically-viable deposit, does not lie with Compass alone. Key stakeholders involved in such a decision would be the Northern Territory and Australian governments, and Indigenous groups.

Additional information is contained in responses to Issue P3 and Issue S1.

P5 Rum Jungle Interactions

See the response to Issue P1, P2, P3, P4 and S1.

P6 Source of Material from Rum Jungle Site

As noted in Section 4.5.1 of the PER, the main requirement for external borrow material will be the first stage of the TSF construction, and this material will be sourced from within the project footprint or, if this is not possible, from within the footprint of a possible future pit for the sulfide deposit on the Browns mineral leases. This list is preliminary and will be refined once detailed engineering is completed.

Socio-economic Impacts (Q)

Q1 Local Impacts

The socio-economic impacts of the project are described in Section 7.10 of the PER and address matters such as employment, economic benefits, existing services and facilities, education, accommodation and tourism. Concerning the last of these issues, the project area is located some 14 km from Litchfield National Park and is not expected to materially affect the conservation values of that park.

Possible impacts on Batchelor inhabitants from factors such as noise and dust are also addressed within the PER, with additional information on risks associated with increased traffic being given in the response to Issues R4, R5, R6 and R7 (and Appendices 15 and 16).

Compass acknowledges that a development of a project such as the Browns Oxide Project may not be compatible with the lifestyle preferences of all inhabitants in Batchelor and the surrounding area. However, the project is consistent with both a key land use objective for the Coomalie region, i.e., to promote the development of mining and extractive industries (see Section 7.7.1 of the PER) and historic land uses in the area.

Q2 More Information Required

Compass contends that the information presented in Section 7.10 of the PER is sufficient for the purpose of impact assessment. The social monitoring program described in the PER (Section 9.9.5) will be reviewed after 12 months of data have been obtained.

Q3 Regional and NT Impacts

Compass notes the NT Department of Business, Economic and Regional Development comment that the department has no issues of concern in relation to the PER.

Q4 Health Service Interactions

Given that the workforce will be sourced locally and from Darwin, there is expected to be little additional demand on the Batchelor Community Health Centre. Nevertheless, Compass will undertake discussion with the centre to further explore possible concerns.

Q5 Potential Risk to BIITE

The Batchelor Institute of Indigenous Tertiary Education (BIITE) is one stakeholder that may be potentially affected by the project. While adverse environmental impacts are unlikely (as described within the context of the various issues addressed in Chapter 7 of the PER), the project is likely to result in beneficial socio-economic impacts, particularly in terms of training and employment opportunities.

Traffic and Roads (R)

R1 Future Expansion

Compass acknowledges that any proposal for future expansion may require further detailed traffic assessments.

R2 Impact on Local Roads

Appendices 15 and 16 describe a Level 5 — Road Safety Audit of the Batchelor and Rum Jungle roads from the Stuart Highway to the Litchfield Park Road intersection, and a review of traffic-related risks and impacts associated with project development, respectively.

Average Annual Daily Traffic (AADT) counts for the Batchelor Road and Litchfield Road in 2004 are 645 and 353, respectively, with more than 85% of traffic being cars/cars and trailers, and 8 to 12% being rigid vehicles and buses. The corresponding estimated AADT count for both Rum Jungle Road and Litchfield Park Road is 492 vehicles.

Taking into account the existing traffic movements and those that will be associated with the project (see Section 4.12.4 and Appendix 16), projected combined traffic estimates have been calculated (Table 3.10).

Table 3.10 Projected combined traffic*

Traffic	Road	Cars/ Cars+trailers	Rigid Vehicles	Articulated Vehicles	B-Doubles, Double Road Trains	Triple Road Trains
Existing	Batchelor	559	75	9	0.65	0
	Rum Jungle	425	55	11	0.65	0
	Litchfield Park	425	55	11	0.65	0
Mine construction	Batchelor	57	4	0	2	0
	Rum Jungle	57	4	0	2	0
	Litchfield Park	0	0	0	0	0
Mine operational	Batchelor	100	0	0.5	4.7	2
	Rum Jungle	100	0	0.5	4.7	2
	Litchfield Park	0	0	0	0	0
Total (including construction phase)	Batchelor	616	79	9	3	0
	Rum Jungle	525	55	11.5	5.3	2
	Litchfield Park	425	55	11	0.65	0
Total (including operational phase)	Batchelor	659	75	9.5	5.3	2
	Rum Jungle	525	55	11.5	5.3	2
	Litchfield Park	425	55	11	0.65	0

Table 3.10 Projected combined traffic* (cont'd)

Traffic	Road	Cars/ Cars+trailers	Rigid Vehicles	Articulated Vehicles	B-Doubles, Double Road Trains	Triple Road Trains
Relative increase in construction phase	**Batchelor**	**0.10**	**0.05**	**0.00**	**3.08**	**0.00**
	Rum Jungle	**0.13**	**0.07**	**0.00**	**3.08**	**0.00**
	Litchfield Park	**0**	**0**	**0**	**0**	**0**
Relative increase in operational phase	**Batchelor**	**0.18**	**0.00**	**0.06**	**7.18**	**2.00**
	Rum Jungle	**0.24**	**0.00**	**0.05**	**7.18**	**2.00**
	Litchfield Park	**0**	**0**	**0**	**0**	**0**

*Bold rows show relative increases due to the Browns Oxide Project (calculated as a fraction of the existing traffic, except for triple road trains where absolute vehicle numbers are used).

The impact of project-related traffic is expected to be marginal with respect to road carrying capacity, with the geometry and carriageways of the road sections being adequate.

The heavy vehicle proportion of the marginal increase to current traffic will comprise only a low number of trips through Batchelor and the road network. No significant increase in risk within Batchelor is expected, primarily due to the slower speed environment (Appendix 16).

R3 Impacts on Future Arterial Road Corridor

Compass acknowledges that the final Mine Closure Plan will take into account Coomalie planning requirements such as future arterial road corridors and similar. The forming and bituminising of Lithgow Road has been considered in the light of future arterial road corridors and present plans can be readily adopted along this route.

R4 More Information Required

See the response to Issue R2.

R5 Risk Assessment

See the response to Issue R2.

R6 Road Safety

Compass will enter into discussions with the Road Networks Division concerning improvements to the local road network that may be required. Possible measures to be considered include (see Appendix 15):

- Lowered speed limit on rough and windy road sections.
- Improved guideposts and line marking.
- Removal of poles and other obstructions.

R7 Upgrade Road Intersection

Further to the response to Issue R6, Compass will specifically consider improvements to the intersection of Rum Jungle Road and Litchfield Road, where these may include (see Appendix 16):

- Additional/improved signage.
- Contrasting aggregate seal to reinforce the signage and line marking.
- Reduced speed limit on Rum Jungle road to 80 km/h from the currently unlimited speed limit.

Water and Waste Management (S)

S1 Contaminated Groundwater

Compass recognises that there is some uncertainty associated with the quality and quantity of groundwater that will be produced during dewatering, due primarily to the influence of contamination from the Rum Jungle Mine site and uncertainties in the hydrogeology of the area. Despite 12 years of monitoring conducted in the area as part of the Rum Jungle Rehabilitation Project by the Federal and Northern Territory governments, costing approximately $3 M (Supervising Scientist, 2002), there remains a general lack of information on groundwater movement and contamination at the Rum Jungle site, as noted in ANSTO (2002). Due to this knowledge gap, it is currently not possible to accurately predict the implications of contamination from the Rum Jungle Mine site for the Browns Oxide Project.

Compass will extend its groundwater monitoring as described in the response to Issue O6 to provide a better understanding of the area's hydrogeology (including groundwater quality). This benefit associated with development of the project is recognised in ANSTO (2002). Compass will consult with the managers of the Rum Jungle Mine site regarding this monitoring program as part of its stakeholder consultation program. Should monitoring indicate that the quality of water produced from interception bores is unacceptable for discharge to the East Finniss River, Compass will provide treatment as described in the response to Issue S27. Consideration of the possible impact of drawdown of water contained in Rum Jungle mine pits is given in Section 7.8.4 of the PER.

S2 Darwin River Dam Impacts

The Darwin River Dam is located in a different catchment to the Browns Oxide Project and beyond the area of predicted groundwater drawdown, and is unlikely to be impacted by the project, including dust emissions. Dust will be managed as described in Section 7.3.3 of the PER to comply with relevant dust assessment criteria. As described

in Section 7.3.4, levels of total suspended particulates are expected to comply with ambient air quality criteria well before the dam. Radiological levels in dust are assessed in Section 7.13.4 of the PER and are not considered to present a significant risk.

S3 Downstream Water Quality Impacts

As discussed in the response for Issue S1, it is not currently possible to accurately predict the quality of excess water discharges (from interception bores and the main sedimentation trap), and hence the consequent downstream water quality impacts, due to uncertainties concerning groundwater quality and hydrogeology.

However, Compass proposes to manage excess water discharges such that existing water quality of the East Finniss and Finniss rivers is maintained and allowed to improve. Water treatment will be undertaken if required to achieve this objective, as described in the response to Issue S23. Monitoring will also be undertaken as described in the response to Issue O6 to ensure that water discharges are of suitable quality and that there is no deterioration of existing water quality in the East Finniss and Finniss rivers. Magnesium and calcium will be included in the water quality monitoring program.

S4 Fate of Browns Test Pit Water

Water in the existing trial pit will be used in the process plant, treated to a suitable quality for direct discharge to the East Finniss River or pumped to the main sedimentation trap.

S5 Groundwater Discharge

Groundwater from the interception bores will be discharged to the East Finniss River at the same location as the discharge point from the main sedimentation trap. The discharge will be monitored as described in the response to Issue O6. Erosion at the discharge point will be controlled by installing rip rap lining, gabion lining or a concrete filled ‘revetment’ mattress (to be determined during detailed design).

S6 Groundwater Impacts

The issue of potentially contaminated groundwater as a legacy of the Rum Jungle Mine and the impact on downstream water quality is addressed in the response to Issue S1.

A number of submissions have expressed concerns regarding reduced groundwater availability for other users and impacts on vegetation. As discussed on Section 7.9.4 of the PER, it is considered unlikely that drawdown due to pit dewatering will reduce water availability for other users. Monitoring of the local and regional groundwater will be undertaken as described in the response to Issue O6, consistent with recommended bore locations described in Appendix 3 of the PER, to identify material impacts on other groundwater users and provide a better understanding of regional groundwater behaviour. Monitoring will also be undertaken to identify if water in root zones of sensitive vegetation communities is impacted by mine dewatering, as described under Issue O6. Possible management measures should such impacts be determined are discussed in the response to Issue F15.

S7 Groundwater Impacts/Monitoring/Rum Jungle Interactions

These issues are addressed in response to Issue S1.

S8 Groundwater Mitigation

Compass will consult with local groundwater users as part of its community consultation program. Appropriate mitigation measures will be developed, including identification of alternative water sources, in consultation with affected parties should loss of groundwater resource occur due to project activities.

S9 Groundwater Understanding

See the response to Issue S1.

S10 Management Plans

The management of effluent from the package sewage treatment plant will be included in either the revised water or waste management plan prepared for the Mining Management Plan (and see the response to Issue E6).

S11 Mine Pit – End Use

The potential for development of ARD from pit walls will be monitored during development of the mine. If necessary, various management strategies will be investigated to control ARD, such as application of layers of Virotech Terra B® and shotcrete to PAF material in pit walls to inhibit oxidation. Temporary diversion of the East Finniss River to rapidly fill the mined-out pit will be considered only if ARD from pit walls is likely to have a detrimental effect on agreed beneficial uses of the pit lake, as determined in consultation with relevant stakeholders. The consequences for water flow and quality of the East Finniss River would be considered prior to implementation of this management strategy.

Modelling will be undertaken prior to mine closure to determine the time to fill the final void, the probability of any overflow during the wet season and likely pit water quality.

S12 Mine Pit Water Quality

The closure objective for the mine pit is that water quality is suitable for the agreed beneficial use. Description of any treatment that may be required to achieve this objective will be provided in the final Mine Closure Plan, taking into consideration information obtained during operations.

S13 Mine Water

See the response to Issues S1, S11 and S12.

S14 Mt Bennet Dam Catchment

Water discharges from the project will be licensed under the Water Act and hence will be compatible with the relevant beneficial uses of the Finniss/East Finniss river system (once declared).

S15 Potable Water Supply

The project's potable water supply will be trucked to the site.

S16 Surface Water Management

Runoff from the ROM, low grade ore and lead stockpiles will report to the main sedimentation trap, where water quality will be routinely monitored (see the response to Issue O6). Excess water requiring discharge to the East Finniss River will, if required, be treated to a suitable quality prior to release. The quality and quantity of these discharges will be monitored at the discharge point as described under Issue O6. Should poor water quality in the main sedimentation trap be an issue, the sources of contamination would be identified through additional monitoring. Alternate management strategies for this water would be pursued, such as reuse in the process plant.

S17 Surface Water Management/Sedimentation Trap Design

The locations of all three sedimentation traps are shown in Figure 3.5. Most of the surface flow is towards the east, only flowing to the west from the west end of the plant site. The operating plan for the main sedimentation trap will be to provide sufficient freeboard to allow capture of water from the two smaller sedimentation traps.

S18 Surface Water Management/Water Structures Design

Detailed design of the sedimentation traps, TSF, process water dam and other structures involved in surface water management will occur once project approval has been obtained. The design philosophy incorporates zero discharge from the TSF (except under extreme rainfall conditions) with discharges from the main sedimentation trap to occur primarily during the wet season.

S19 Surface Water Monitoring

Further details on proposed water monitoring programs is provided in response to Issue O6.

S20 Surface/Groundwater Quality

The management target for surface waters proposed by Compass to maintain, and allow improvement of, the existing ecosystem is consistent with the approach recommended by ANZECC/ARMCANZ (2000) for highly disturbed ecosystems, such as the East Finniss River. Compass proposes to treat any contaminated groundwater drawn from the Rum Jungle site to a suitable quality prior to release to the East Finniss River.

S21 Tailing Management

Returning tailing to the pit would sterilise deeper sulfide resources should Compass (or other parties) wish to develop this resource in the future (subject to obtaining necessary approvals).

S22 TSF Seepage Water Quality

See the response to Issue E2.

S23 Waste Management

Compass will maximise the extent to which waste is managed via waste facilities at Batchelor and/or Darwin rather than using on site facilities (and being consistent with the standard waste minimisation principles of avoid, minimise, reuse, recycle/reclaim, treat and dispose (see Section 9.8.7 of the PER).

S24 Waste Rock

Stage 1 material for construction of Zone 1 of the TSF will be sourced from a borrow pit located within the storage area of the TSF (see Appendix 13). It is intended to limit material taken from this borrow to a depth of around 1.0 to 1.5 m, with the intent of leaving at least 3 m of the existing soil layer in place over the entire base of the storage area.

Maximum utilisation will be made of the NAF waste rock from the open pit to provide the necessary rockfill for the TSF embankment. The embankment has been sized to provide capacity for both the tailing and the projected PAF waste within the confines of the low permeability liner to the external embankment. An internal dividing bund will separate the tailing from the PAF waste rock within the embankment (see Appendix 13 and the response to Issue B3).

S25 Water Balance

Discharge rates from the main sedimentation determined in the preliminary water balance modelling for various scenarios are as presented in Figure 4.16 of the PER. Further refinement of the water modelling will be undertaken during detailed design, which will also include design of the sedimentation traps.

S26 Water Management

Issues such as water quality targets and discharge quality from the main sedimentation trap are addressed in response to Issue S3 and O6.

S27 Water Treatment

During the peak of the wet season, the main sedimentation trap (containing surface runoff and pit water) may contain more water than necessary for processing requirements. If the capacity of the sedimentation trap is exceeded, water will be discharged to the East Finniss River. Similarly, groundwater extracted from interception

bores, in excess of plant requirements, will also be discharged to the East Finniss River. Any discharge to the East Finniss River will be treated as necessary to ensure conformance with the water discharge licence. The proposed location for the water treatment plant is shown in Figure 3.5.

The treatment process will use a conventional precipitation treatment plant system, with specifications to be finalised during detailed design. The operation of this process involves precipitation of metals as insoluble metal hydroxides under alkaline conditions. Water requiring treatment will be neutralised in a mix tank by controlled addition of hydrated lime to attain a desired pH set-point, typically pH 9.5 but dependent on the metals to be removed. If high amounts of iron are present in the water, aeration may also be undertaken to reduce the amount of lime required to precipitate this metal. After a suitable reaction time, the slurry will then be fed to a clarifier for solid/liquid separation, where a flocculant may be added to improve the settling characteristics of the precipitate. This sludge will be pumped to the TSF and the clarifier overflow will be released to the East Finniss River after appropriate monitoring. A sand filtration system or polishing pond could be used to reduce residual concentrations of suspended solids if necessary. Such a treatment system has been used for the past 25 years to treat contaminated water from the Brukunga Mine Site in South Australia (Taylor and Cox, 2003).

Each of the metals has a specific pH at which its solubility is minimal. The selection of the pH at which the metal hydroxides are to be precipitated will therefore be dependent on the mixture of metals in the water. Effective precipitation of metal hydroxides of Al, Cu, Fe, Pb, and Zn (to a concentration of 0.1 mg/L or lower) can be achieved at a typical pH set-point of 9.5 (Environment Canada, 1987; EPA, 1982). Other metals such as Ni and Cd require a higher pH, in the range 10.5 to 11 to effectively precipitate the hydroxides. Manganese precipitation is variable due to its many oxidation states, but will generally precipitate at a pH of 9.0 to 9.5 (although a pH of 10.5 is sometimes necessary for complete removal of manganese (Skousen et al., 2006)). Interactions among metals will also influence the rate and degree to which metals precipitate, e.g., co-precipitation with Fe will largely remove Mn from water, if Fe concentrations are much greater than Mn (Skousen et al., 2006). Metal hydroxides also become increasingly soluble if the pH increases above the level at which the solubility is a minimum (Environment Canada, 1987).

Since the minimum solubility of metal hydroxides occur at different pHs, it will be necessary to determine an optimum pH control set-point. This may be based on the need to reach a low concentration for a particular metal that is regulated to a lower concentration than other metals. The level of residual dissolved metals after treatment will therefore be dependent on the mixture of metals at elevated concentrations in the water and the pH control set-point in the treatment plant. Adjustment of the final discharge pH may be required (by the addition of acid) to lower the pH to a suitable level for discharge to the environment (although it may be considered more beneficial to maintain an alkaline discharge to provide some neutralisation to the acidic water of the East Finniss River).

As discussed in Section 7.9.1 of the PER, monitoring of groundwater undertaken for the Rum Jungle Rehabilitation Project indicated that leachate had contaminated the ‘shallow

aquifer' in the vicinity of the Rum Jungle waste dumps with Cu, Mn, Ni and Co, with typical concentrations being 10 to 100 mg/L. However, it is unlikely that groundwater extracted during pit dewatering for the Browns Oxide Project will be of such poor quality since ARD-impacted groundwater would be diluted with water drawn from deeper, cleaner groundwater.

The water quality of the East Finniss River adjacent to the Browns Oxide Project at gauging station site GS8150200, as measured in recent years, is shown in Table 7.25 of the PER. Metal concentrations measured in pools during the dry season are higher than contained in contaminated shallow groundwater in the vicinity of the Rum Jungle waste dumps. With water treatment at an appropriate pH control set-point, it is expected that any contaminated groundwater drawn to interception bores can be successfully treated to reduce metal concentrations to levels currently existing in the East Finniss River during the wet season.

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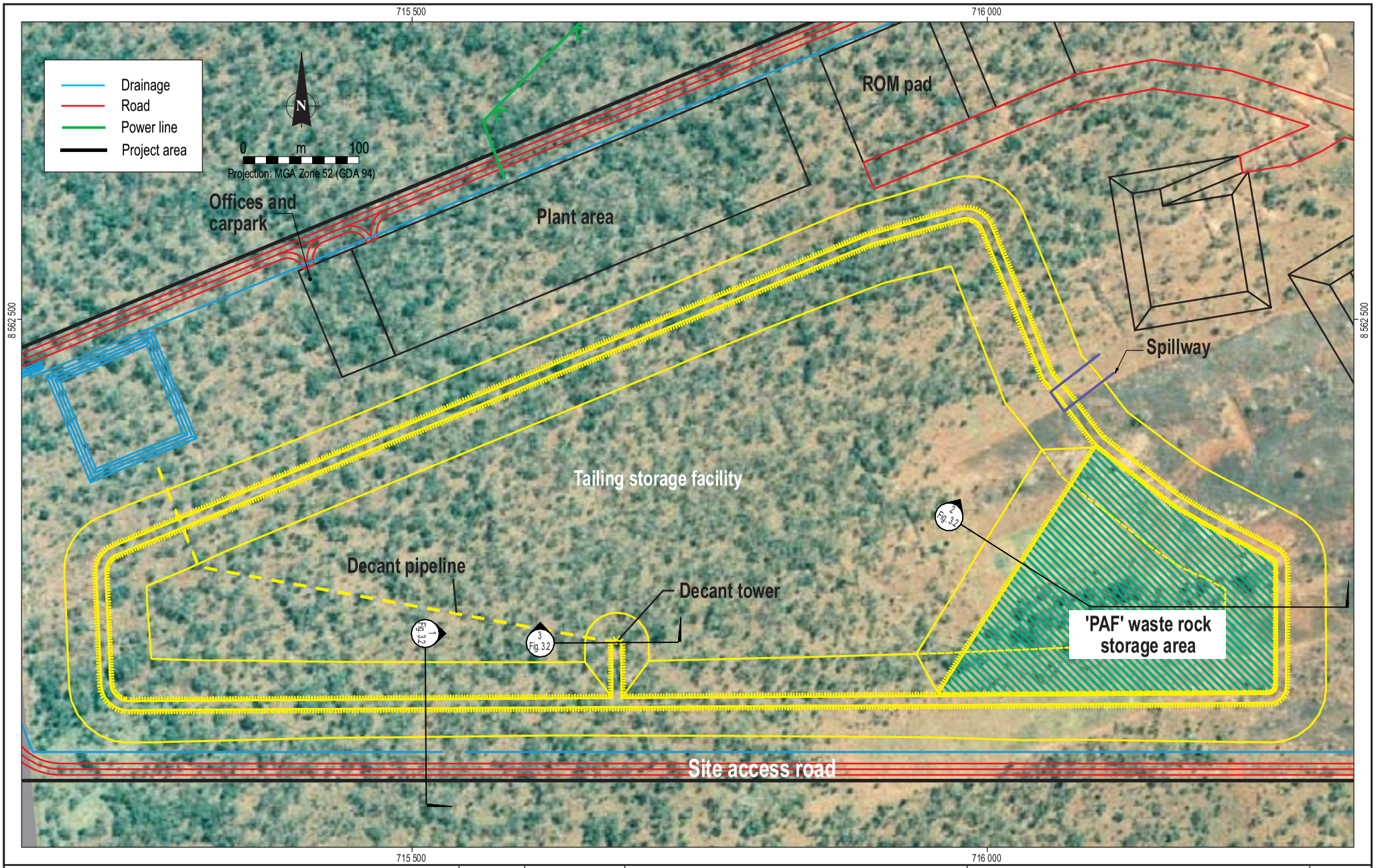
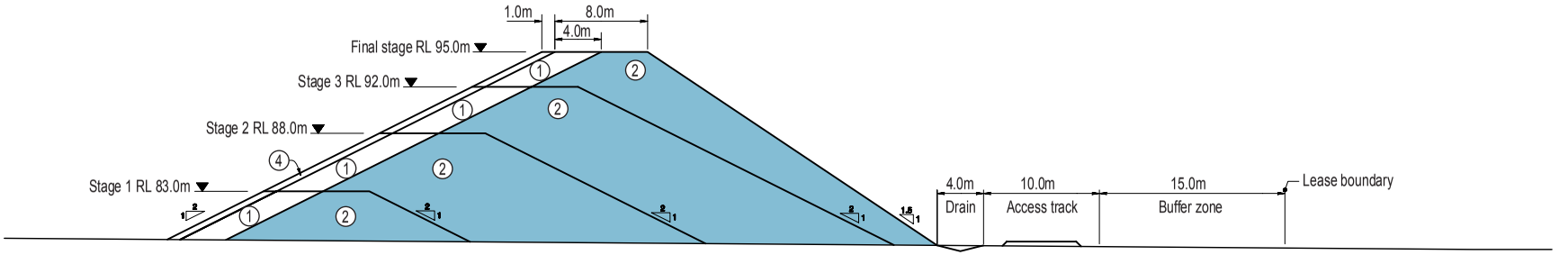
Figures

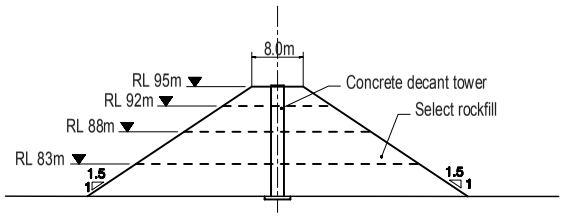


Source: Appendix 8, figure 1.

Job No: 836	Compass Resources NL	TSF general layout	Figure No: 3.1
File No: 836_10_F3.01_HB	Browns Oxide Project		



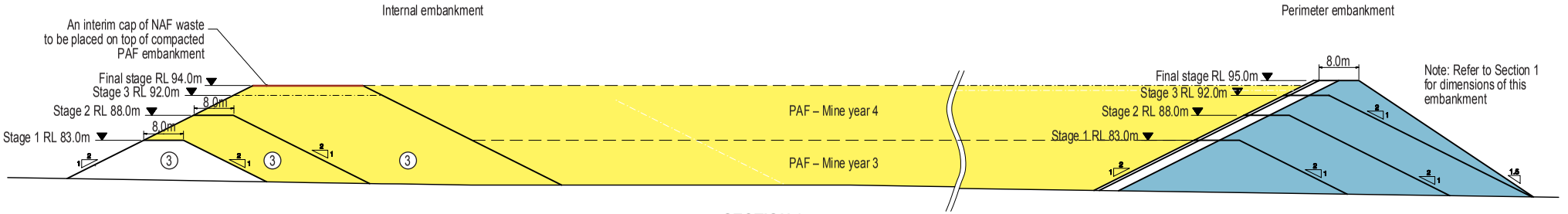
SECTION 1
Scale 1:1000



SECTION 3 (DECANT)
Scale 1:1000

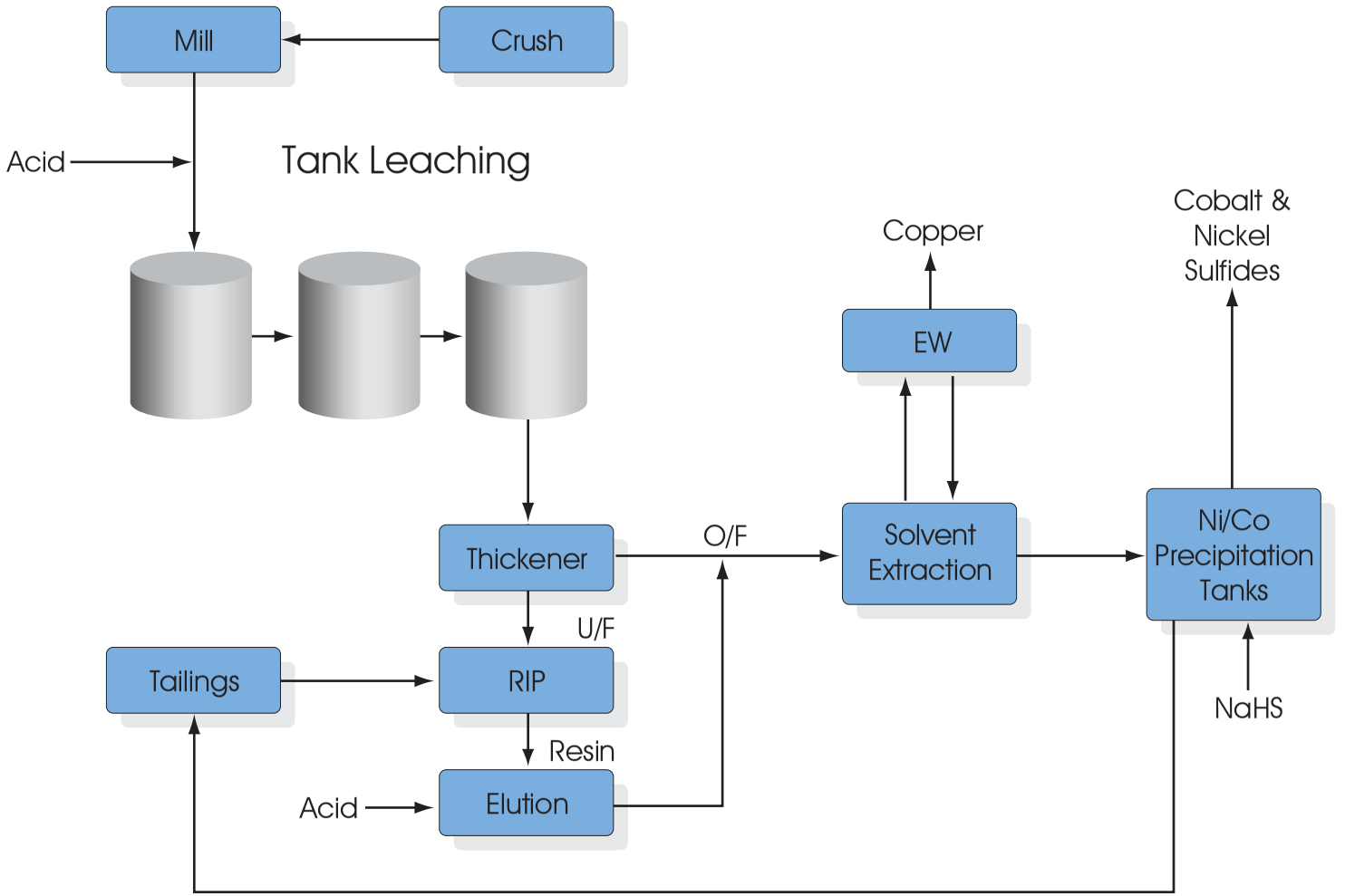
SUMMARY OF MATERIAL ZONES

ZONE	MATERIAL	SOURCE	PLACEMENT AND COMPACTION
①	CLAY, Sandy Clay, Clayey Sand (low permeability material)	Stage 1: Internal borrow Stage 2: Borrow from footprint Stage 3: External borrow	Place in layers 0.15m max. compacted thickness compact at not less than 95% Standard DD at moisture content in range (omc -2%) to (ome +2%)
②	ROCKFILL: EW, HW, MW NON-ACID FORMING	PIT WASTE	Spread and compact in 0.3m thick layers (compacted thickness). Compaction to comprise of 8 passes of a 10t vibrating pad foot roller.
③	ROCKFILL: All weathering categories POTENTIAL ACID FORMING	PIT WASTE	
④	ROCKFILL: NON-ACID FORMING	PIT WASTE	Spread on face. Compaction not required.

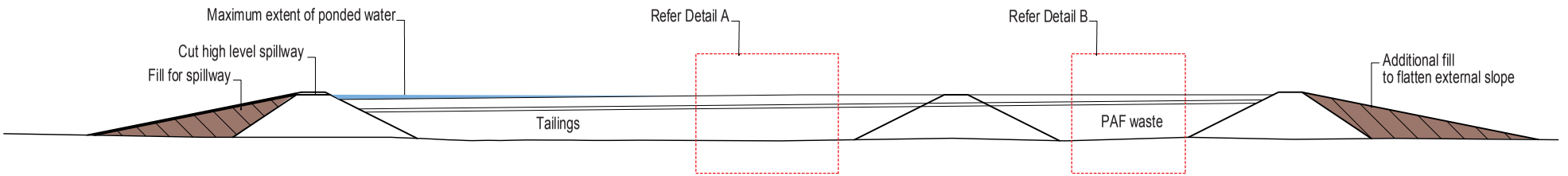


SECTION 2
Scale 1:1000

Source: Appendix 12, Figure 2.	enesar people and place	Job No: 836	Compass Resources NL	Figure No: 3.2
		File No: 836_10_F3.02_HB	Browns Oxide Project	Sections and materials

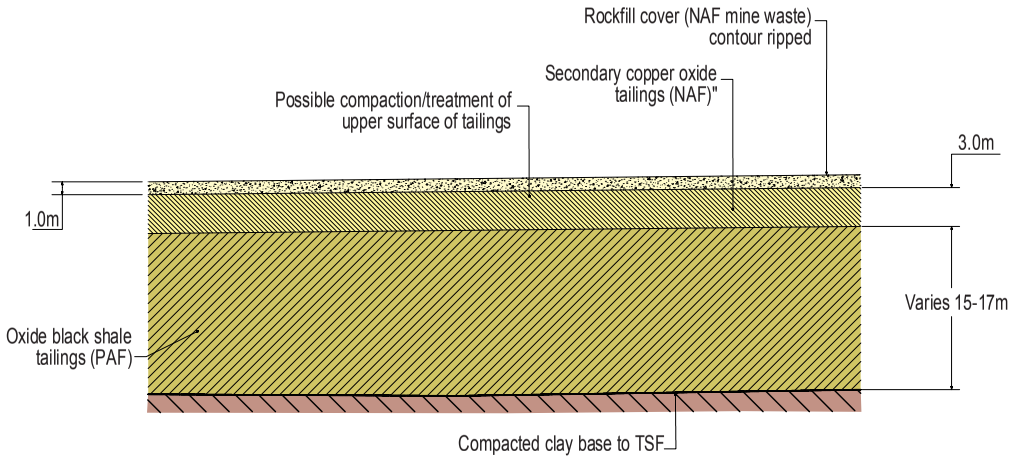


enesar peopleandplace	Job No: 836	Compass Resources NL	Simplified process flowsheet	Figure No: 3.3
	File No: 836_10_F3.03_HB	Browns Oxide Project		



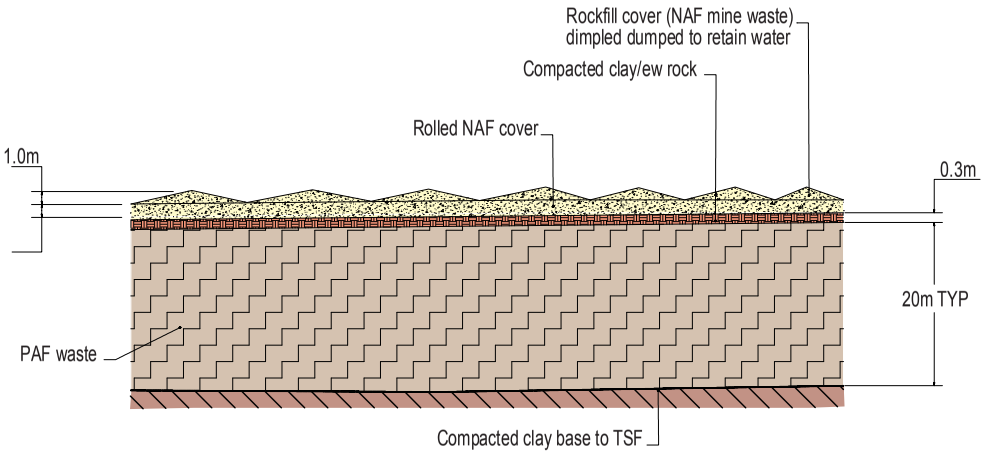
SCHEMATIC CLOSURE PROVISIONS

Scale 1:2000 @ A3



DETAIL A – TAILINGS

Not to scale



DETAIL B – PAF PIT WASTE

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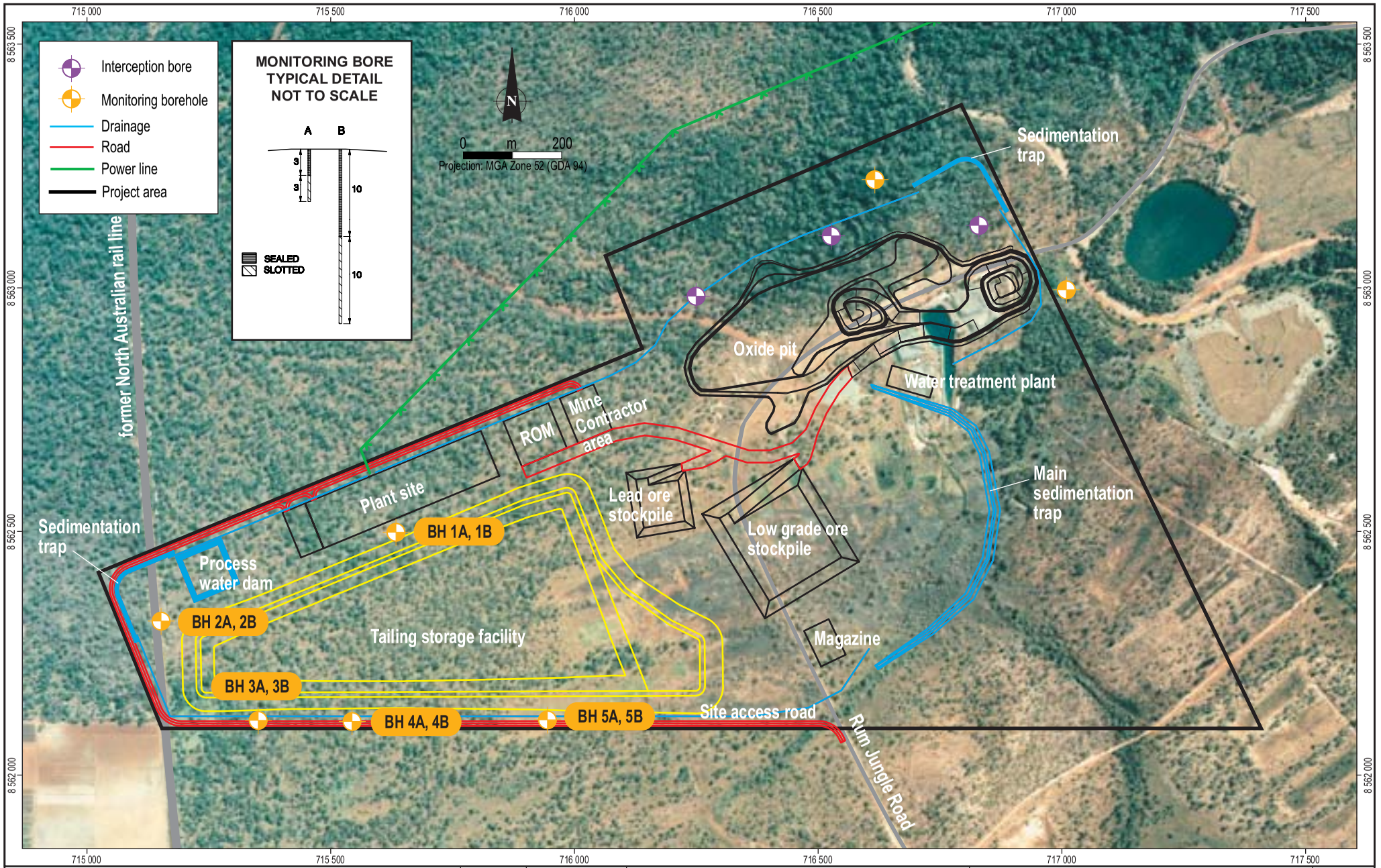
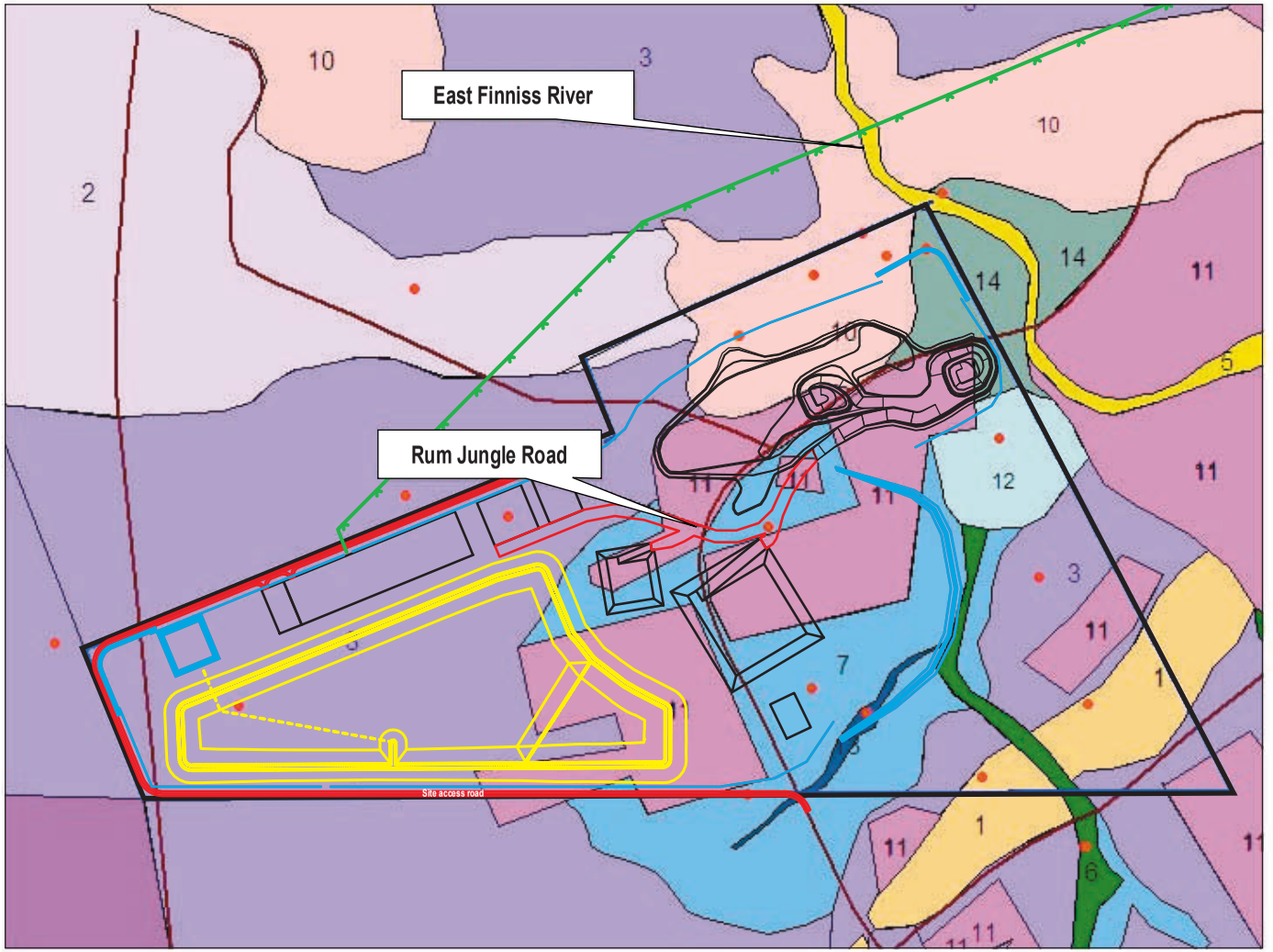
Source: Appendix 12, Figure 9.	enesar people and place	Job No: 836 File No: 836_10_F3.04_HB	**Compass Resources NL** **Browns Oxide Project**	**Schematic TSF closure arrangement**	Figure No: **3.4**

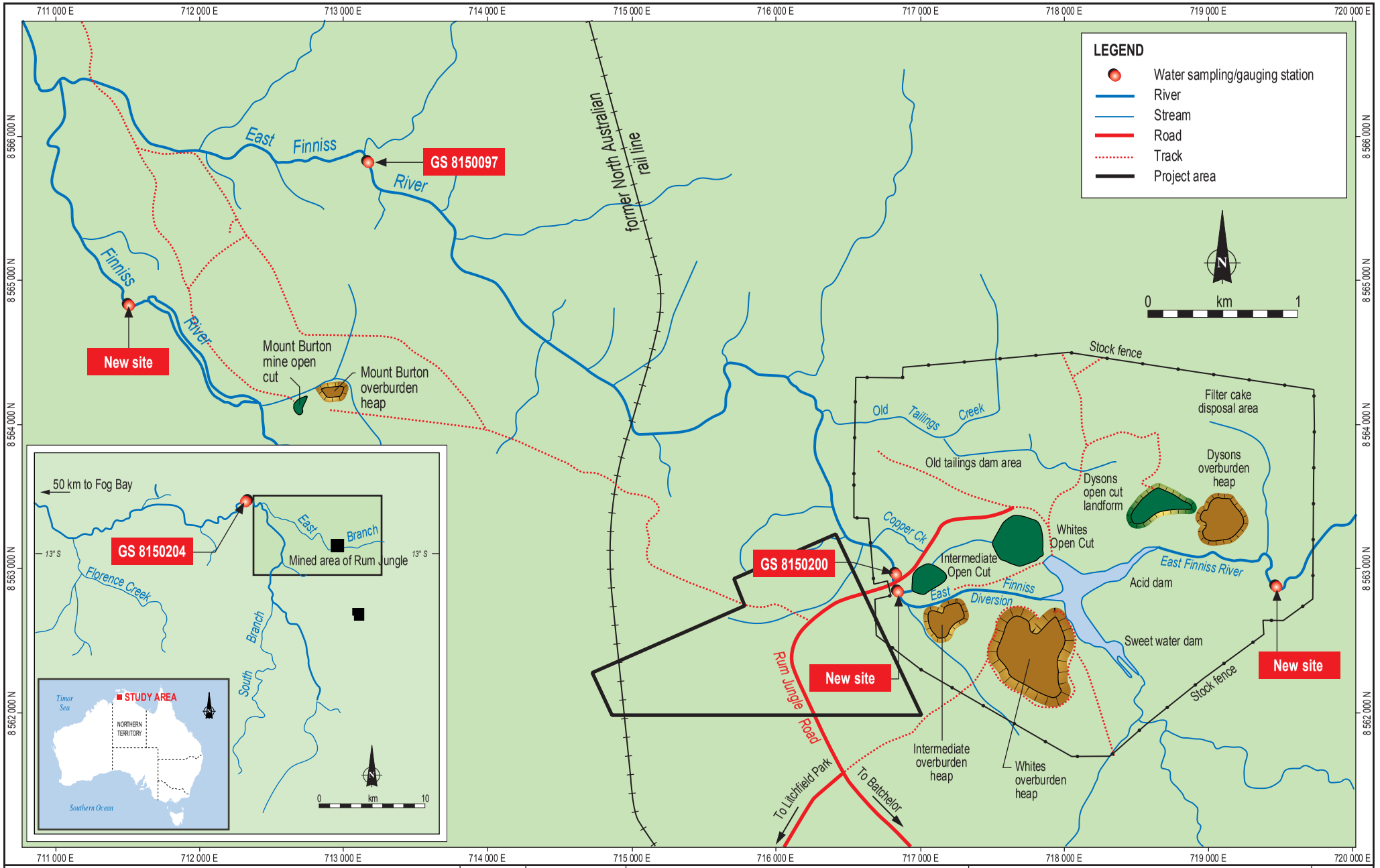


enesar people and place	Job No: 836	Compass Resources NL	Project layout and proposed mine monitoring bore locations	Figure No: 3.5
	File No: 836_10_F3.05_HB	Browns Oxide Project		



Source: Appendix 5A

enesar people and place	Job No: 836	Compass Resources NL	Project layout in relation to vegetation communities
	File No: 836_10_F3.06_HB	Browns Oxide Project	Figure No: 3.6



Source: Lawton and Overall, 2002.

enesar people and place

Job No: 836

File No: 836_10_F3.07_HB

Compass Resources NL

Browns Oxide Project

Proposed water monitoring sites on the Finniss and East Finniss rivers

Figure No: **3.7**

Projection: MGA Zone 52 (GDA 94)

- Groundwater monitoring borehole
- Drainage
- Road
- Power line
- Project area

enesar people and place	Job No: 836	Compass Resources NL	Figure No: 3.8
	File No: 836_10_F3.08_HB	Browns Oxide Project	Proposed groundwater monitoring bore locations

Appendices

Appendix 10

Application for Authority Certificate

COMPASS RESOURCES NL
ABN 51 010 536 820

Level 5, 384 Eastern Valley Way
Roseville NSW 2069
Telephone: 02 9417 3588
Facsimile: 02 9417 8750
email: admin@compassnl.com.au
website: www.compassnl.com.au

24 October 2005

Mr. J. Stead,
Chief Executive Officer,
Aboriginal Areas Protection Authority,
GPO Box 1890,
DARWIN NT 0801

Dear Mr. Stead,

Authority Certificate Application - Browns Project

We refer to our previous correspondence on this subject.

Application for Authority Certificate

The potential development of the Browns Oxide Project is being progressed by Compass, and a PER will be lodged shortly. To ensure that any works proposed either do not interfere with any sacred sites or deal with any existing sacred sites in a manner authorised by the *Northern Territory Aboriginal Sacred Sites Act* ("Act") Compass is seeking the issue of an Authority Certificate in relation to the proposed works.

Accordingly we attach:

1. Certificate application covering the Browns Project lease block; and

2. Topographical map and Cadastral map (4 copies of each) with lease block area marked. To further assist, we will forward by email a digital version of the attached maps; a RASTER map; and an air-photo with the lease block and proposed infrastructure marked (Note: siting of proposed infrastructure may change).

Based upon the Regulations to the Act, we understand that the Authority is likely to classify the application as a non-standard application and in such event we request (pursuant to section 19E(2) of the Act) an estimate of the amount of the charges that will apply.

Conference with Custodians

Pursuant to section 19G of the Act, Compass requests a meeting with Custodians in the event of the following:

(a) if Custodians wish to meet with Compass regarding the application or any matter related to the application; or

(b) if it becomes apparent that there is a sacred site within the area of the application (or that will affect the proposed works) and it is possible that a restriction in relation to entry, works and damage to the site is contemplated.

Unless the Custodians request otherwise, Compass would request that any conference to be held was held in the presence of the Authority.

Timing and Previous Certificates

Please let us know if we can assist further and we would greatly appreciate any possible expediting of the application. Compass (acknowledging the statutory time limits pursuant to section 19F of the Act) would appreciate any indication that can be given of the likely timing of the process.

In this regard, we note that a number of site assessments have been carried out with Custodians regarding previous certificates C95/013 and C98/104 that cover the lease block, and certificates covering adjacent areas.

We look forward to hearing from you.

Yours sincerely,

Philip Cohen
Company Secretary

c.c. Ms T. Halliday, Enesar
Mr. K. Stephens, Ward Keller

Authority Certificate
APPLICATION FORM

(APPROVED FORM S.19B NT ABORIGINAL SACRED SITES ACT 1989)

OFFICE USE ONLY

Applicant _____

File no. _____ Document no. _____

Application fee paid: ☐ yes ☐ no Authority Certificate fee paid: ☐ yes ☐ no

Applications cannot be accepted unless ALL information requested in this form is provided.

PART 1 APPLICANT

Note: The Authority Certificate will be issued under the name and address of the **"Applicant"**.
If you are making an application on behalf of somebody else fill in **both** the **"Applicant" and "Agent or Representative"** box below.

APPLICANT DETAILS:

Name of the Applicant (usually individual, organisation, joint ventures, partners or associates) to appear on the Authority Certificate

COMPASS RESOURCES NL ACN 010 536 820

Postal Address Level 5, 384 EASTERN VALLEY WAY
ROSEVILLE NSW 2069

Telephone No. (02) 9417 3588 Facsimile No. (02) 9417 8750

INDUSTRY GROUP OF APPLICANT: (Please tick one box only)
(Refers to Certificate holder or funding body for work, **not** the agent arranging the Certificate)

- Commonwealth *(including Commonwealth statutory and other Commonwealth-funded bodies such as the major Land Councils)* ☐
- NT Government *(including NT statutory and other NT-funded bodies such as public schools)* ☐
- Local Government ☐
- Non-government Organisation *(including Church groups, Greening Australia, Scouts, non-profit private schools)* ☐
- Mining *(including oil and gas exploration and extraction)* ☑
- Pastoral ☐
- Agriculture/ Aquaculture/ Horticulture ☐
- Other ☐

Authority Certificate
APPLICATION FORM

(APPROVED FORM S.19B NT ABORIGINAL SACRED SITES ACT 1989)

AGENT OR REPRESENTATIVE DETAILS:

ONLY FILL IN THIS SECTION IF YOU ARE MAKING AN APPLICATION ON BEHALF OF THE ABOVE "APPLICANT".

Name _____

Contact Person _____

Postal Address _____

Telephone No. ( ) _____ Facsimile No. ( ) _____

Does Agent require a copy of Authority Certificate? ☐ Yes ☐ No

Does billing party know they are to meet costs? ☐ Yes ☐ No

MAILING AND INVOICE DETAILS:

NAME AND ADDRESS OF BILLING PARTY.

Name COMPASS RESOURCES NL

ABN 51 010 536 820

Postal Address LEVEL 5, 384 EASTERN VALLEY WAY
ROSEVILLE NSW 2069

Contact Person PHIL COHEN, Co. Secretary

Telephone No. (02) 9417 3588 Facsimile No. (02) 9417 8750

Does the applicant request a digital copy of the Authority Certificate? ☑ Yes ☐ No

Electronic mail address (e-mail) phil.cohen@compassnl.com.au

Authority Certificate
APPLICATION FORM

(APPROVED FORM S.19B NT ABORIGINAL SACRED SITES ACT 1989)

PART 2 AREA TO BE COVERED BY CERTIFICATE

Please complete each section below. This will help the Authority determine whether the costs are to be standard or non-standard

PROPOSED WORK OR USE

Please supply a concise description of proposed work or use (e.g. road building, bore sinking, quarrying etc)

MINING & PROCESSING OF A POLYMETTALLIC DEPOSIT, INCLUDING MINING OF ORE; ORE STOREAGE, PROCESSING AND TREATMENT; TAILINGS STOREAGE AND TREATMENT; AND ALL ANCILLARY WORKS AND INFRASTRUCTURE.

LAND TITLE OF APPLICATION AREA

Please provide the lot, pastoral lease, portion, section, mining lease or exploration licence numbers

MINERAL LEASES N139 to 147 AND 150 to 152 incl (on Section 2940 Hundred of Goyder) - Finniss River Aboriginal Land Trust Land

Briefly describe the area to be covered by the Certificate APPROX. 65 KM SOUTH OF DARWIN AND 7KM NORTHWEST OF BATCHELOR, 12 MINERAL LEASES BLOCK COVER A 175 HA AREA ON THE NORTHERN SLOPE OF THE PINE CREEK GEOSYNCLYNE AND PRIMARILY A PENEPLAIN OF GENTLY UNDULATING LAND INTERSPERSED BY PLAINS, BUT WITH A MODIFIED NATURAL LANDSCAPE WITH VARYING LEVELS OF DISTURBANCE.

Is the area to be covered by the application within the municipal boundaries of Darwin, Palmerston or Litchfield Shire or within 25km of the Alice Springs Post Office?	☐ Yes	☑ No
Is the application on residential freehold land within a municipal boundary?	☐ Yes	☑ No
Is the applicant either the 'owner and occupier' of the land or the 'owner and intended occupier' of the land?	☐ Yes	☑ No
Is the total perimeter of the area to be covered by the application equal to or greater than 20km ?	☐ Yes	☑ No
Does the work the application relates to:		
• require a public environmental report or an environmental impact statement under the Environmental Assessment Act?	☑ Yes	☐ No
• involve a complex development (such as a resort, mine or major horticultural development or an area of sea)?	☑ Yes	☐ No
• involve the acquisition or extinguishment of Native Title rights?	☐ Yes	☑ No
Does any of the area covered by the application include Aboriginal Land (within the meaning of the *Aboriginal Land Act or the Aboriginal Land Rights (Northern Territory) Act 1976*)?	☑ Yes	☐ No

Authority Certificate
APPLICATION FORM

(APPROVED FORM S.19B NT ABORIGINAL SACRED SITES ACT 1989)

PART 3 STATEMENT OF APPLICATION OR AUTHORISED AGENT

I understand the Authority is required to recover from the applicant the costs of issuing a certificate.
(Please complete all the required details under applicant, mailing and invoice details)

I understand in accordance with section 19C of the *Northern Territory Aboriginal Sacred Sites Act 1989* my application will be assessed as a 'standard' or a 'non-standard application' and the fee or charges for my application will be in accordance with the Northern Territory Aboriginal Sacred Sites Regulations.

This assesment will be made based on the information I have provided in this application.

Sign: P Cohen Date: 24 / 10 / 05

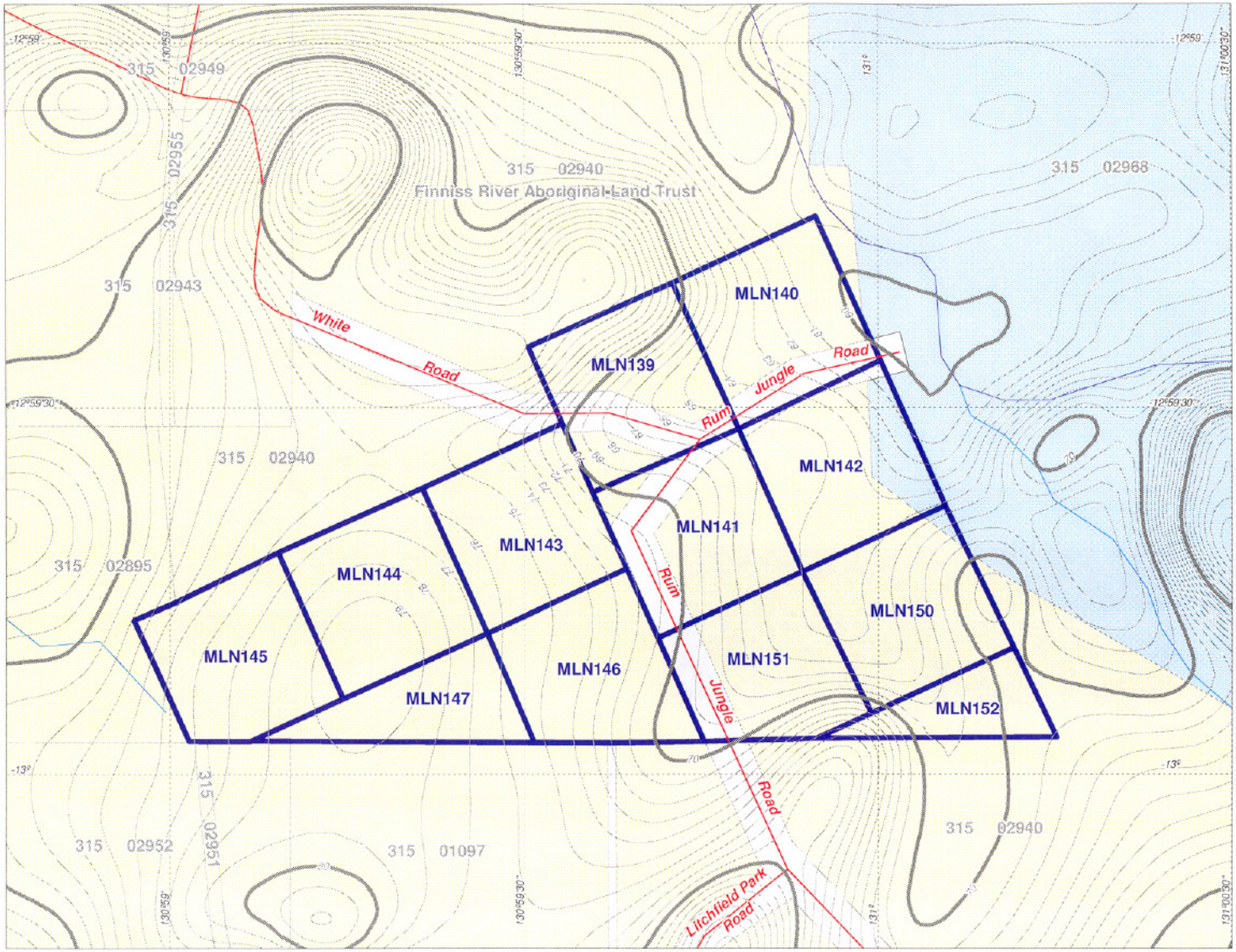
Name: PHILIP COHEN / COMPANY SECRETARY FOR COMPASS RESOURCES NL

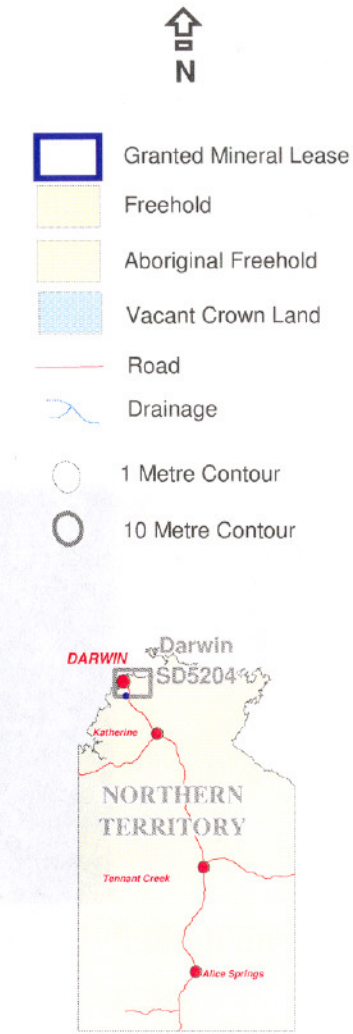
Applicant/Agents will be informed of the basis of costs before consultations commence. Further details of our regulations and fee system can be found on the Aboriginal Areas Protection Authority web page http://www.nt.gov.au/aapa.

LODGEMENT OF APPLICATIONS:

Applications may be lodged by post or in person at the following addresses:

	DARWIN	**OR**	**ALICE SPRINGS**
By Post:	GPO Box 1890 Darwin NT 0801		PO Box 3656 Alice Springs NT 0871
In Person:	1st Floor, T.I.I. Building 74 Cavenagh Street		Ground floor Belvedere House Cnr Bath & Parsons Streets
Telephone ✆	(08) 8981 4700		(08) 8952 6366





200 0 200 400 600 800 1000

Meters

Scale: 1:15,000

COMPASS RESOURCES NL

"BROWNS LEASES"

CADASTRE & TOPOGRAPHY

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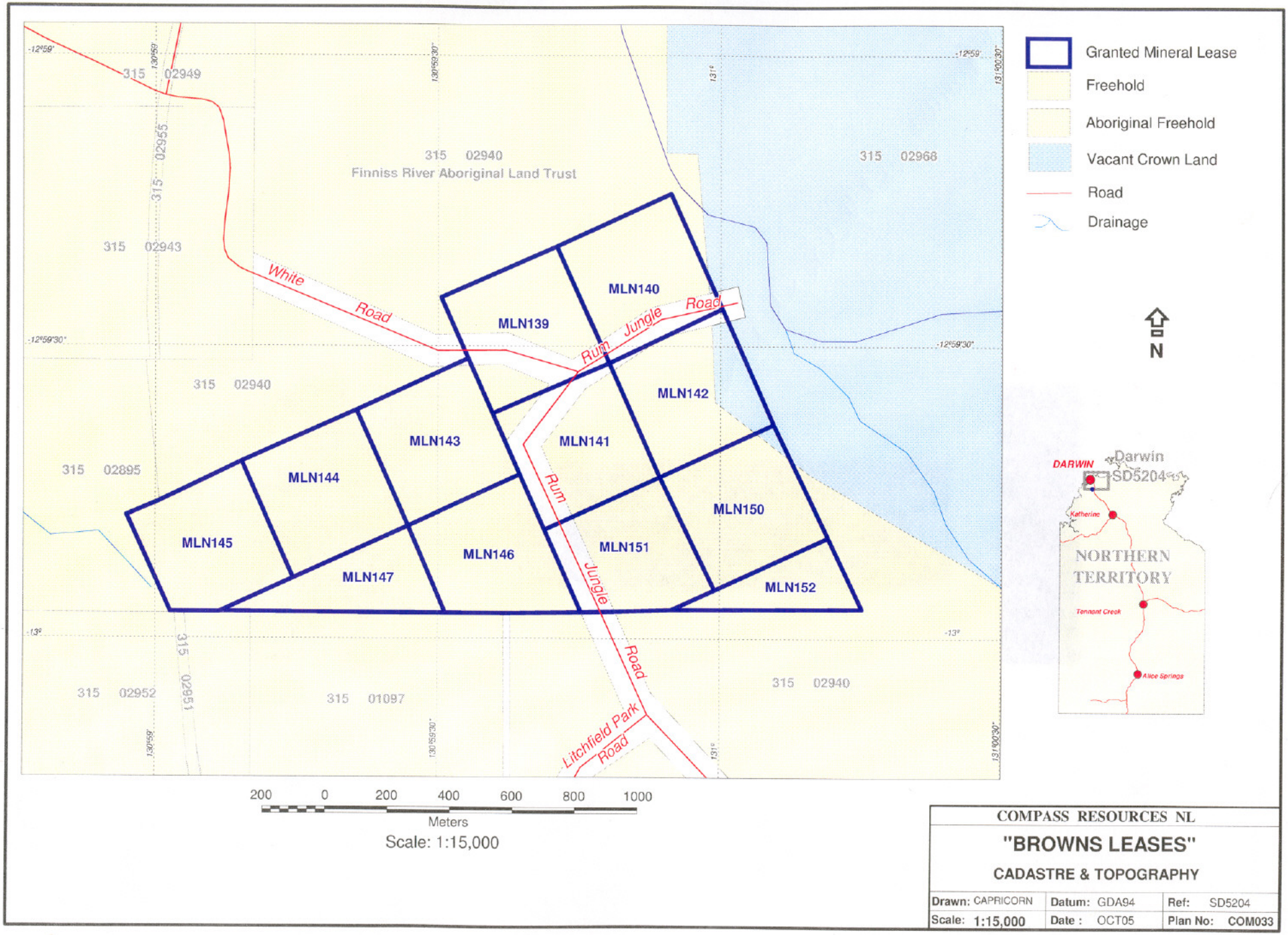
Scale: 1:15,000	Date : OCT05	Plan No: COM033



COMPASS RESOURCES NL		
"BROWNS LEASES"		
CADASTRE & TOPOGRAPHY		
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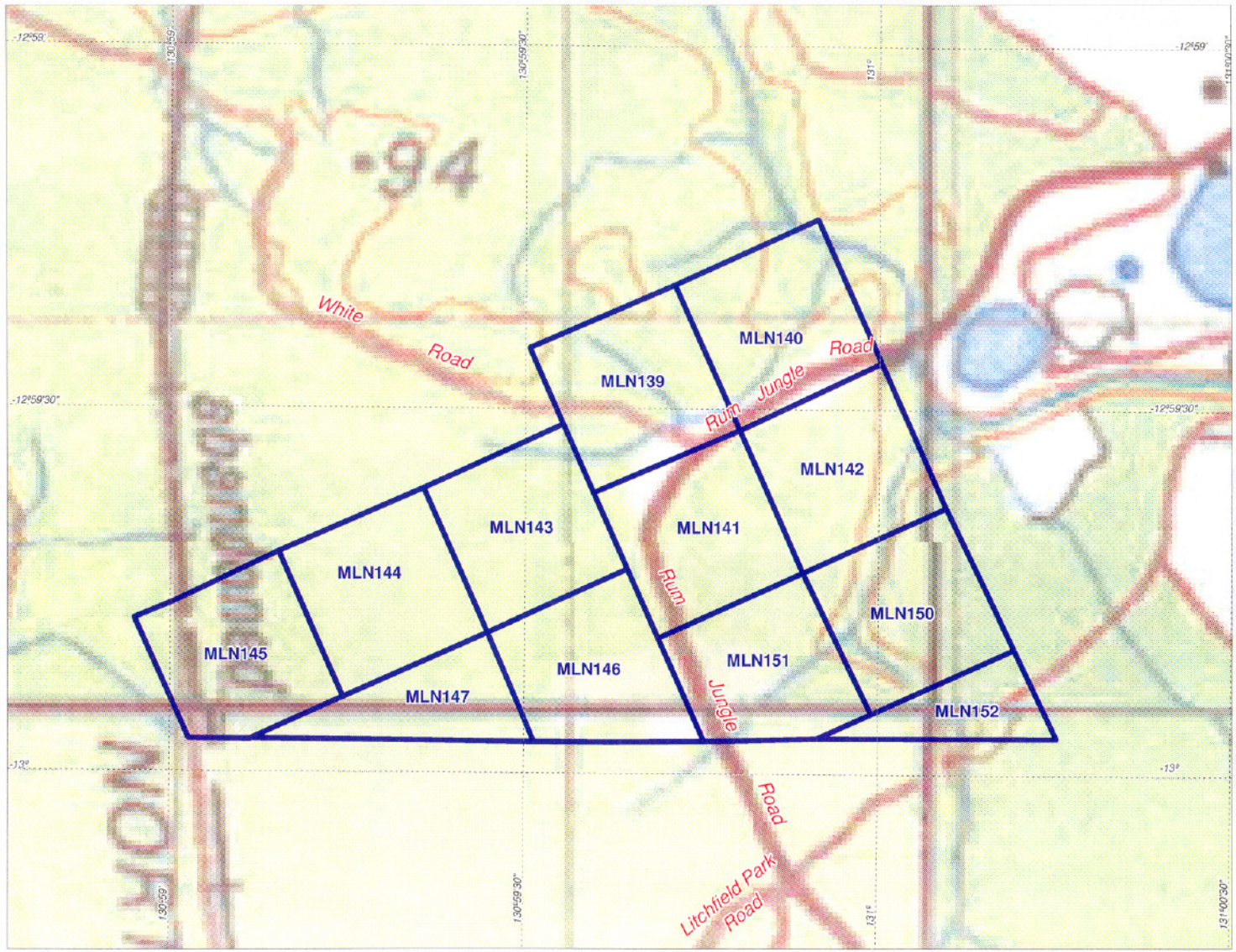

Granted Mineral Lease

200 0 200 400 600 800 1000

Meters

Scale: 1:15,000

COMPASS RESOURCES NL

"BROWNS LEASES"

1:100,000 RASTER IMAGE

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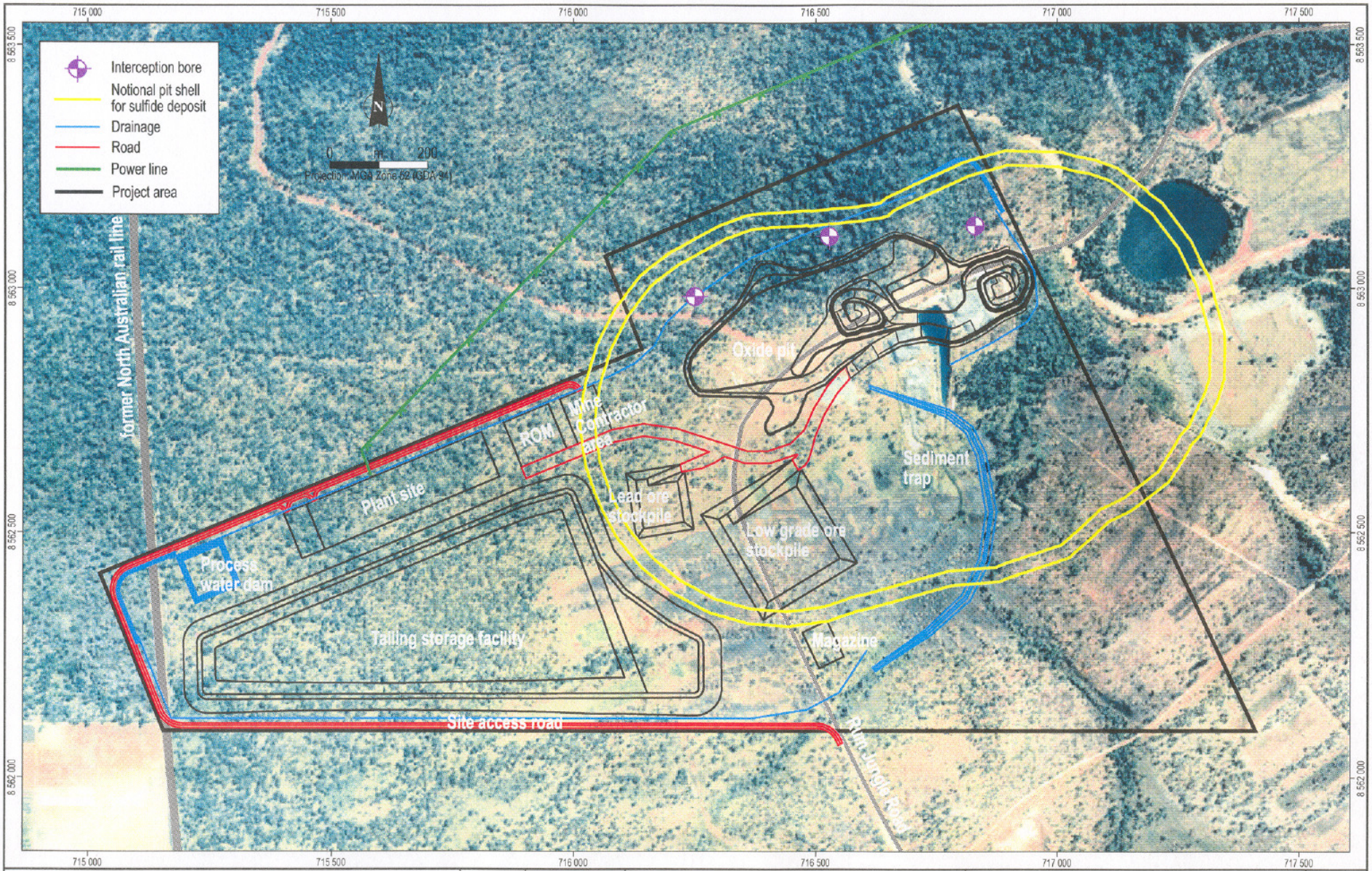

N.B Sulfide deposit not part of the Browns Oxide Project.
Pit shell is indicated as it impacted placement of project components.

Job No: 836	Compass Resources NL	Project footprint and components	Figure No: ES3
File No: 836_8_ES_F003_HB	Browns Oxide Project		

Appendix 11

Revised Table of Commitments

Revised table of commitments (Feb 2006)

No.	Section	Commitments	Performance Indicators
PER			
1	4.7.3	Low grade ore and lead ore stockpile material that is considered uneconomic to process at the end of the project life will be returned to the mined-out pit.	Final Mine Closure Plan detailing the fate of this material.
2	4.9.1	Column leach test results for selected waste rock samples will be reported in the Mining Management Plan, with ongoing reporting as required.	MMP containing waste rock column leach test results.
3	4.9.2	Compass will ensure direct supervision by a qualified person during construction of the TSF and, upon completion, sign off by that qualified person on submission of the 'as constructed' designs and plans.	Sign-off on 'as constructed' designs and plans.
4	4.9.2	The implementation of selective handling of PAF material requires integration with the mine plan, with identification of material types involving continuous in-pit sampling, logging, mapping and testing during mining.	Records of monitoring results. Records of volumes and placement of waste material.
5	4.10.1/ 7.8.4	Further geochemical testwork will be undertaken to address inconsistencies in tailing testwork results. This testwork will also include column leach tests and tailing liquor characterisation.	Report containing results of further geochemical testwork.
6	4.12.4	Compass will ensure that haulage contracts stipulate that loads are properly secured and in compliance with appropriate road vehicle axis limits.	Compliance with transport requirements. Vehicle log books. On-site records of transport volumes and transportation vehicle details.
7	6.5.2	A particular focus of the ongoing consultation program will be the involvement of indigenous people in the project.	Consultation records.
8	7.8.3	Compass will further develop during detailed engineering the water treatment system for treating water from the main sedimentation trap that is to be discharged to the East Finniss River.	A design for the water treatment system.
9	7.8.4	Compass will obtain improved estimates of ARD during project development and will closely monitor TSF runoff and drainage.	Monitoring records of TSF runoff and drainage. Reporting of geochemical testwork.
10	7.8.4	Additional management and mitigation measures for ARD will be investigated as required (incorporating information obtained as the mine is developed), including options for ongoing collection and treatment of ARD prior to discharge if warranted.	Records of investigations included in annual reporting to DPIFM.
11	7.9.3	Should adverse impacts occur to groundwater users, mitigation measures may involve sourcing suitable alternative water.	Groundwater monitoring data.
12	7.10.3	Compass will implement a preferential employment policy focusing on traditional owners and the local community.	Project employment policy. Employment records.

Revised table commitments (cont'd)

No.	Section	Commitments	Performance Indicators
13	7.10.3	Compass will provide employment and training opportunities for the traditional owners and will develop specific procedures for the administration and implementation of these opportunities.	Employment and training records.
14	8.1	Compass will undertake a detailed hazard identification and risk assessment prior to commencement of construction and operations.	Submission of report detailing outcomes of the assessment.
15	9.6.2	Audits will be undertaken by an appropriately qualified person on a regular basis to ensure compliance with the environmental management procedures. Auditing will be conducted twice during the construction phase and yearly during operations.	Audit records.
16	9.8	The issue-based management plans will be refined and will form the basis of a detailed MMP that will be completed prior to construction. The detailed MMP will expand on the information contained herein, including implementation measures, schedules and responsibilities.	Submission of MMP.
17	9.8.2	A detailed Fire Management Plan will be developed in consultation with key stakeholders such as traditional owners, the NLC and local fire authorities (fire brigade and Bushfires Council NT).	Consultation records and submission of detailed fire management plan as part of the MMP.
18	9.8.3	A detailed weed management plan will be developed in accordance with the Northern Territory *Weeds Management Act*.	Submission of the detailed weed management plan as part of the MMP.
19	9.8.7	A recycling and waste minimisation program will be implemented and regularly (e.g., quarterly) reviewed during the lifetime of the operation.	Maintenance of waste inventory. Record of revisions to program.
20	9.9.4	Detailed radiological and river (water quality and macroinvertebrates) monitoring programs will be developed after discussion with relevant authorities to ensure a cost-effective, integrated program.	Detailed monitoring program.
21	9.9.6	Cavities and karsts will be further examined during detailed site investigations to ensure the suitability of the TSF site.	TSF site geotechnical report and final design.
22	9.9.6	A TSF closure study will examine the technical feasibility of dry cover system designs.	TSF closure study report.
23	9.10.1	The mine closure plan will be refined as inputs from detailed project design, stakeholder consultation on end land uses and completion criteria, and investigations/studies become available.	Consultation records, investigation/study reports. Updates of the Mine Closure Plan as reported in the MMP.
24	9.10.1	As part of Compass' mine closure planning redundancy provisions and consideration of training schemes with long-term benefits will be considered.	Updates of Mine Closure Plan.
25	9.10.7	Ongoing sampling and monitoring of groundwater boreholes (water level and quality), selected surface water sampling locations and mine water will continue for a period of not less than three years from the cessation of operations.	Monitoring records.

Revised table commitments (cont'd)

26	9.10.7	The TSF will be monitored and audited regularly to assess whether closure objectives have been achieved.	Monitoring records.
PER Supplement			
27	Issue A2	AAPA's comments concerning the *Northern Territory Sacred Sites Act* will be reflected in the project's Cultural Heritage Management Plan.	Submission of the detailed Cultural Heritage Management Plan.
28	Issue E6 and J2	Compass will undertake the required discussions with DHCS regarding reuse of effluent and final design of the system, and other relevant management plans.	Consultation records. Submissions of the MMP.
29	Issue E15	Compass will provide detailed design information for the sedimentation traps to DPIFM.	Submission of the detailed design report.
30	Issue F3	Compass will investigate the practicalities of instigating an inspection program to minimise the likelihood of cane toads being transported into and from the project area, and will seek advice from expert groups (such as FrogWatch) on effective control of cane toads.	Consultation records.
31	Issue F11	No riparian vegetation along the East Finniss will be cleared by Compass during construction and operations.	Monitoring records.
32	Issue L4	Compass will consult with the local Fire and Emergency Response Group Coordinator in relation to the storage of chemicals and explosives on site.	Consultation records.
33	Issue N3 and O6	Further to Commitment 20, implementation of the monitoring programs described in these sections will be undertaken after discussion with relevant authorities.	Monitoring records.
34	Issue Q4	Compass will undertaken discussion with the Batchelor Community Health Centre.	Consultation records.
35	Issue R5 and R7	Compass will continue discussions with the Road Networks Division concerning improvements to the local road network, including the intersection of Rum Jungle Road and Litchfield Road.	Consultation records.

Appendix 12

Waste Rock Geochemistry

Table 1: Acid forming characteristics of waste rock samples - Browns Oxide Project

EGi Code	Client Code	Drill Hole or Location	From (m)	To (m)	Interval (m)	Rock Type	Total %S	MPA	ANC	NAPP	ANC/MPA Ratio	NAGpH	NAG	ARD Classification
Batch 1 - August 2005														
28559	O56389	05BD02	20.00	30.00	10.00	black shale high %S	3.59	110	<1	110	~ 0	2.2	105	PAF
28557	O56387	CDH04	34.00	34.50	0.50	black shale med %S	3.16	97	2	95	0.02	2.2	101	PAF
28556	O56386	02BD03	138.00	140.00	2.00	black shale 2.5%S	1.95	60	3	57	0.05	2.3	57	PAF
28560	O56390	05BD02	16.00	20.00	4.00	black shale med %S	1.37	42	<1	42	~ 0	2.3	42	PAF
28558	O56388	CDH04	12.00	14.00	2.00	black shale low %S	1.27	39	<1	39	~ 0	3.0	32	PAF
28563	O56393	95BD07	22.00	24.00	2.00	black shale low %S	0.02	1	1	0	1.6	6.7	0	NAF (barren)
28561	O56391	05BD02	5.00	10.00	5.00	black shale low %S	<0.01	<0.3	1	-1	-	6.9	0	NAF (barren)
28555	O56385	CDH04	75.80	76.00	0.20	dolomite high sulphide	2.12	65	243	-179	4	8.2	0	NAF
28552	O56382	CDH06	87.25	87.40	0.15	dolomite sulphidic	4.39	134	412	-277	3	8.2	0	NAF
28550	O56380	CDH06	85.80	86.00	0.20	magnesite	0.40	12	441	-428	36	8.1	0	NAF
28554	O56384	CDH04	79.50	79.65	0.15	dolomite and magnesite	0.48	15	512	-497	35	8.5	0	NAF
28551	O56381	CDH06	88.05	88.20	0.15	dolomite	0.42	13	544	-531	42	8.3	0	NAF
28553	O56383	CDH04	75.30	75.45	0.15	dolomite	0.70	21	662	-641	31	8.6	0	NAF
28565	O56395	95BD10	41.00	42.00	1.00	dolomitic shale med-high %S	3.52	108	896	-789	8	8.3	0	NAF
28564	O56394	95BD10	52.00	52.20	0.20	dolomite med %S	0.35	11	872	-861	81	8.2	0	NAF
28562	O56392	95BD06	44.50	44.70	0.20	magnesite/dolomite low S	<0.01	<0.3	980	-980	-	9.2	0	NAF
Batch 2 - November 2005														
29310	W1 /75018	8900 W / 850 N	1.0	6.0	5.0	Ferr oxidised footwall shale	<0.01	<0.3	3	-3	-	7.5	0	NAF
29311	W2 /75019	8900 W / 600 N	1.0	6.0	5.0	footwall shale	<0.01	<0.3	2	-2	-	7.6	0	NAF
29312	W3 /75011	7350 W / 550 N	1.0	6.0	5.0	near ore horizon	<0.01	<0.3	3	-3	-	7.5	0	NAF
29313	W4 /75002	8600 W / 350 N	1.0	5.0	4.0	hanging wall shale	0.14	4	2	2	0.5	6.9	0	NAF
29314	W5 /75001	8800 W / 300 N	1.0	6.0	5.0	hanging wall shale	0.02	1	8	-7	13.1	7.2	0	NAF
29315	W6 /75007	7800 W / 575 N	-	-	na	Outcropping magnesite/dol	<0.01	<0.3	2	-2	-	7.4	0	NAF
29316	W7 /75008	7925 W / 575 N	-	-	na	Outcropping magnesite/dol	<0.01	<0.3	102	-102	-	8.2	0	NAF
29317	W8 /75013	7600 W / 800 N	2.0	6.0	4.0	weathered ferruginous dol/mag	<0.01	<0.3	5	-5	-	8.0	0	NAF
29318	W9 /75012	7400 W / 900 N	2.0	6.0	4.0	weathered ferruginous dol/mag	<0.01	<0.3	7	-7	-	7.9	0	NAF
Batch 3 - December 2005														
29735	na	CDH 4	16.0	17.0	1.0	Black shale	2.9	90	0	90	0.0	2.3	64	PAF
29736	na	CDH 4	21.0	22.0	1.0	Black shale	8.6	264	0	264	0.0	2.2	106	PAF
29737	na	CDH 4	26.0	27.0	1.0	Black shale	10.8	330	0	330	0.0	2.2	136	PAF
29738	na	CDH 4	31.0	36.0	1.0	Mudstone	9.6	293	13	280	0.0	2.1	109	PAF
29739	na	CDH 4	46.0	51.0	1.0	Shale and Schist	7.4	226	0	226	0.0	2.2	87	PAF

KEY

MPA = Maximum Potential Acidity (kgH_2SO_4/t)
ANC = Acid Neutralising Capacity (kgH_2SO_4/t)
NAPP = Net Acid Producing Potential (kgH_2SO_4/t)

NAGpH = pH of NAG liquor
NAG = Net Acid Generation capacity (kgH_2SO_4/t)

NAF = Non-Acid Forming
PAF = Potentially Acid Forming

Table 2: Suggested composites for column leach testing - Browns Oxide Project

EGi Code	Drill Hole or Location	From (m)	To (m)	Interval (m)	Rock Type	Wght (kg) in Composite	Total %S	MPA	ANC	NAPP	ARD Class
29736	CDH 4	21.0	23.0	1.0	Black shale	1.5	8.6	264	0	264	
29737	CDH 4	26.0	27.0	1.0	Black shale	1.5	10.8	330	0	330	
					avge	**3.0**	**9.7**	**297**	**0**	**297**	PAF
28556	02BD03	138.0	140.0	2.0	black shale med %S	0.9	1.95	60	3	57	
28557	CDH04	34.0	34.5	0.5	black shale med %S	0.8	3.16	97	2	95	
28558	CDH04	12.0	14.0	2.0	black shale low %S	0.4	1.27	39	<1	39	
28560	05BD02	16.0	20.0	4.0	black shale med %S	0.9	1.37	42	<1	42	
					avge	**3.0**	**2.0**	**61**	**1.4**	**60**	**PAF**
29313	8600 W / 350 N	1.0	5.0	4.0	hanging wall shale	1.5	0.14	4	2	2	
29314	8800 W / 300 N	1.0	6.0	5.0	hanging wall shale	1.5	0.02	1	8	-7	
					avge	**3.0**	**0.1**	**2**	**5**	**-3**	**Barren**
29317	7600 W / 800 N	2.0	6.0	4.0	weathered ferruginous dol/mag	1.5	<0.01	<0.3	5	-5	
29318	7400 W / 900 N	2.0	6.0	4.0	weathered ferruginous dol/mag	1.5	<0.01	<0.3	7	-7	
					avge	**3.0**	**<0.01**	**<0.3**	**6**	**-6**	**Barren**
28555	CDH04	75.8	76.0	0.2	dolomite high sulphide	1.1	2.12	65	243	-179	
28552	CDH06	87.3	87.4	0.2	dolomite sulphidic	0.7	4.39	134	412	-277	
28565	95BD10	41.0	42.0	1.0	dolomitic shale med-high %S	0.7	3.52	108	896	-789	
28554	CDH04	79.50	79.65	0.15	dolomite and magnesite	0.5	0.48	15	512	-497	
					avge	**3.0**	**2.6**	**80**	**480**	**-399**	**NAF**

Appendix 13

Browns Oxide Project Tailings Storage Facility Batchelor NT Preliminary Design Report (Revision 1)

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COMPASS RESOURCES NL

BROWNS OXIDE PROJECT
TAILINGS STORAGE FACILITY
BATCHELOR
NT

PRELIMINARY DESIGN REPORT
(REVISION 1)

Job No. 105026.01

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ACEA
The Association of Consulting Engineers Australia

CONDITIONS OF INVESTIGATION AND REPORT

CONDITIONS OF REPORT

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2. This report is based in part on information which was provided to us by the client and/or others and which is not under our control. We do not warrant or guarantee the accuracy of this information.

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7. Geotechnical site investigation necessarily involves the investigation of the subsurface conditions at a site at a few isolated locations, and the interpretation and extrapolation of those conditions to elsewhere on the site not so investigated. This procedure has been adopted at the site that is the subject of this report and due care and skill has been applied in carrying out and reporting on the work. Thus the findings, conclusions and comments contained in this report represent professional estimates and opinions and are not to be read as facts unless the context makes it clear to the contrary. In general, statements of fact are confined to statements as to what was done and/or what was observed. Other statements have been based on professional judgement.

8. The scope of the work has been planned in the absence of any fore-knowledge of the site other than that stated in the report. Unless otherwise stated we consider that the number of locations investigated and the depths to which they have been investigated are reasonable bearing in mind the scale and nature of the project, and the defined purpose for which the investigation was undertaken.

9. We do not accept any responsibility for any variance between the interpreted and extrapolated conditions and those that are revealed by any means subsequently. Specific warning is also given that many factors, either natural or artificial, may render ground conditions different from those which pertained at the time of the investigation. Should there be revealed during the construction or at any other time any apparent difference from subsurface conditions described or assessed in this report, it is strongly recommended that such differences be brought to our attention so that its significance may be assessed and appropriate advice given.

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1 INTRODUCTION

This study was commissioned by Compass Resources NL (Compass), in accordance with a proposal submitted by Australian Tailings Consultants (ATC), dated 21 June 2005.

The aim of the study was to prepare a preliminary design of the Tailings Storage Facility (TSF) for the Browns Oxide Project, and prepare a summary report for the principal purpose of inclusion in the PER for this project. The original report was prepared in mid 2005.

This current version (Revision 1) has been prepared to address comments and issues raised by the PER review process with respect to the TSF.

In addition, a geotechnical investigation for the TSF was carried out in late 2005, and preliminary results from this have been incorporated in this revision.

Finally, the quantities of ore/tailings, and proposed waste rock have been reassessed by Compass, and revised quantities (from December 2005), have been incorporated in this review.

2 PROJECT OUTLINE

The Browns Oxide Project is located near Batchelor, NT. It is immediately west of the old Rum Jungle mine site. The proposal is to mine approximately 4.0Mt of a poly-metallic ore containing copper, nickel, cobalt and lead by open cut methods. It is understood that virtually no pre-stripping of the ore-body is required, but that as the development of the pit progresses, a minimum of 4 Mt of waste material will be generated. It is expected that this material will be comprised of weathered (oxidised) rock. The intent is to maximise the utilisation of this waste material in construction of the retaining embankment for the TSF.

Mining operations will be undertaken on a contract mining basis, and the aim is for the contractor to carry out progressive construction of the TSF as an integral part of the mine waste handling operation.

3 STUDY PARAMETERS

There are two distinct types of ore associated with this mine. The first is an oxidised Black Shale, comprising around 3.1 Mt of ore. The second is a Secondary Copper ore comprising around 0.9 Mt. Mining is planned to be at a rate of 1 Mtpa. The sequence of processing is planned as follows:

Year 1	Black Shale ore	1 Mt
Year 2	Black Shale ore	1 Mt
Year 3	Black Shale ore	1 Mt
Year 4	Black Shale ore	0.1 Mt
	followed by	
	Secondary Copper ore	0.9 Mt

The preliminary design is therefore based on the requirement to retain 4.0 Mt of tailings.

It is understood that the tailings will be discharged at a slurry density around 45% Solids (w/w).

4 TAILINGS CHARACTERISTICS

4.1 Physical

Two prototype samples of tailings (remaining from metallurgical testing) have been submitted to ATC for testing and evaluation.

Visually the Black Shale tailings are a grey silty material. The Secondary Copper tailings are a brown colour, typical of oxide tailings, and the fines are clayey. Testing of both of these samples was carried out for the following index properties:

- Particle size distribution (sieve plus hydrometer sizing)
- Plasticity (Atterberg Limits test)
- Soil particle density (SG)
- Initial settled density

The test results are summarized in Table 1. Result sheets are presented in **Appendix A**.

TABLE 1: SUMMARY OF LAB TEST RESULTS

TEST	SAMPLE	
	BLACK SHALE TAILINGS	**SECONDARY COPPER TAILINGS****
Particle Size Distribution Max Size:	0.425 mm	2.36 mm
Passing 0.075mm	79%	42.8 %
Passing 0.010mm	45%	26%
Atterberg Limits:		
LL:	24	37
PI:	10	21
USC Classification:	Sandy SILT (MC)	Clayey SAND (SC)
Soil Particle Density (G)	2.80 t/m^3	2.98 t/m^3
Initial Settled Dry Density * (from 45% Solids)	0.90 t/m^3	0.99 t/m^3

* Tested in tap water

**Note: referred to as “Supergene Tailings” on the test certificates.

4.2 Geo-Chemical

Following the completion of the physical testing, the tailings samples were submitted for geochemical tests (NAPP, NAG) to assess the potential for acid generation.

The initial report from EGi is presented in **Appendix B**.

The testing has confirmed that the Secondary Copper tailings have a low sulphur content, and they have been classified as Non-Acid Forming (NAF).

The tests on the oxide black shale tailings show a total sulphur content of close to 1%, but suggest that possibly only one-third of this is present as pyrite. The sample returns test values of:-

Net Acid Producing Potential (NAPP)	31 kg H_2SO_4/t
Net Acid Generation (NAG)	11 kg H_2SO_4/t,

and has been classified as Potentially Acid Forming (PAF).

However, the results of the Kinetic NAG tests carried out on this sample suggest a lag time of at least several months before the initiation of acid conditions.

It should be noted that these results are based on single tests of "proto-type" tailings. Compass have indicated that on the basis of the metallurgy of the oxidized black shale, a PAF result was not expected. Further testing is planned to clarify this matter.

It is noted that the current mine plan is to process all of the Black Shale ore first, followed by the Secondary Copper ore. Given the planned rate of rise of the tailings on the storage, there will be no single surface exposed for any significant time during filling. Hence, the commencement of oxidation/onset of acid conditions is not expected during filling.

5 STORAGE SITE CHARACTERISTICS

5.1 General

The possible sites for a tailings storage on the mine lease area are constrained by the location of the pit, existing water courses, provision by Compass for possible future expansion of the pit, and by the overall shape of the lease boundaries.

The adopted site for the TSF is at the west end of the lease, adjacent to the proposed plant site (refer **Figure 1**).

Air photos of the site indicate that in general it is previously undisturbed ground, with a vegetation cover of trees and grass. An old railway formation runs across the western end of the site. The TSF location has been adjusted so that the railway and the existing access road beside it are left in place.

Previous clay borrow pits which are understood to have been the source of material used to cap the Rum Jungle waste dumps exist on the mine lease area. These are mostly to the east of the TSF site, with just short sections of the east embankment being located over the edge of the old borrow area.

A number of costean trenches from previous exploration activities exist across the site.

5.2 Topography

The TSF site is located on the top of a gentle, broad rise. The general terrain is flat to very gently sloping, with average ground slopes less than 1%, with isolated areas slightly steeper.

Because of the location and the configuration of the storage, the catchment of the TSF will be limited to the surface area of the storage only. At final capacity (ie the largest extent of the storage) this will be an area of around 26 ha.

5.3 Geology

A site visit was undertaken by Keith Seddon of Australian Tailings Consultants on 28 July, 2005, accompanied by Mr. M. Boots of Compass Resources.

A walk-over inspection of the tailings storage area was undertaken, together with an inspection of the bulk sample pit, and the waste rock from the bulk sample pit.

The rocks underlying the TSF area are understood to comprise a sequence of shales and dolomites, similar to the ore body host rocks. The general arrangement is as follows:-

- Carbonate derived rocks (from dolomite/magnesite) occur on the northern side (Coomalie Formation).
- The black shales subcrop in a band running approximately through the middle of the site, (Whites Formation) and
- Amphibolites (and interbedded shales) occur towards the south (part of Whites Formation).

Approximate boundaries over the TSF area are shown on **Figure 3** based on observations from the site inspection. These observations include limited surface outcrop, the types of soil and soil cover developed over each rock type, and inspections of the existing exploration costeans. These boundaries have generally been confirmed by the geotechnical investigation (see below). Some minor amendments to the preliminary boundaries may be required, but these amendments have not yet been shown of **Figure 3**.

It is understood that in the pit area some solution cavities / voids occur in conjunction with the occurrence of a fault zone in these rocks, close to the boundary between the carbonates and the black shales.

This fault is not considered by Compass geologists to continue through the TSF locality, and there appears to be no surface expression of cavities or karst type terrain. Further consideration will be given to this aspect during detailed design. One small incipient depressional area near the northern east corner of the site was noted during the walk over inspection and a borehole (BH 6) was included in this area as part of the geotechnical investigation. No voids or high permeability zones were encountered to the depth of investigation.

It is considered that the geology will be suitable for the proposed storage.

5.4 Geotechnical Investigation

A geotechnical investigation of the tailings dam site (and the plant site) was carried out in November – December 2005.

The investigation comprised:
-drilling of boreholes
-in-situ permeability testing in the holes
-completion of selected holes as long term monitoring bore,
-excavation of test pits to define shallow soil conditions in both the TSF and potential borrow area
-laboratory testing of selected soils samples.

Borehole and test-pit locations are shown on **Figure 4.**

Note that in the TSF area, boreholes were installed in pairs (eg BH 2A and 2B). The “A” series holes

were drilled, tested, and completed as monitoring bores to a depth of 6m. The "B" series holes were to a depth of 20m.

A detailed factual report of the geotechnical investigation is being prepared **(Ref 5)**.

Relevant results from the geotechnical investigation are summarized in the following sections.

5.5 Soils / Stratigraphy

5.5.1 Stratigraphy

There is limited rock outcrop over the TSF area, and the surface profile consists of a layer of clayey/silty soils overlying extremely and highly weathered rock.

As a broad generalisation the following soil profiles exist (note that these depths are based on borehole intersections only at this stage, the test pit results are still to be evaluated):

- Over the carbonate rocks (NW side of the TSF site): typically residual Sandy Silt (high plasticity) with some layers of Sandy Clay (and some lateritic zones), typically to depths of 5m – 6m.

- Over the Shales (band through the central section of the site): generally Silt/ gravelly Silt, with some Clay layers (gravels comprise angular rock flakes), typically to depths of around 3m,and

- Over the Amphibolites: (SE side of the site): Silts and Clays of intermediate and high plasticity, continuing to depths of up to 17m in places (BH5A and 5B)

Records of previous resource drilling held by Compass indicate that auger drilling was undertaken to target depths (probably not auger refusal) of 10m across the area, and this provides general support of the more recent results.

The proximity to the old Rum Jungle clay borrow pits is also an indicator of the likely presence of surface clays. These pits appear to have generally been located in the clayey soils developed over the amphibolites.

5.5.2 Permeability

Reliable results from the in-situ permeability test results (down to depths of 20m) gave results in the range 0.3×10^{-7} to 3×10^{-7} m/sec, with a typical value being 1×10^{-7} m/sec. Differences between the different geological formations were not apparent.

It should be noted that 1×10^{-7} m/sec is equivalent to around 0.01 m/day. These results are significantly lower than the typical permeability values of 4 – 30m/day reported by the Coffey groundwater report **(Ref 2).** The reason for this is that the results reported by Coffey were derived from pump test analysis, and presumably reflect the results of more permeable rock at depth.

5.6 Climatic Conditions

5.6.1 Rainfall

Rainfall data have been obtained from a number of surrounding stations, as follows: Rum Jungle, Batchelor Post Office, Batchelor Aerodrome, and Batchelor Aero (note: this not the same station as

Batchelor Aerodrome). Data from Darwin River Dam were also obtained, but have been excluded from the present analysis because the rainfall at that location is higher.

A composite record has been compiled from this data for the period 1958 to 2004. The record has been analysed on a July to June basis so that the full wet-season rainfall is included in each annual record. There are 6 years of incomplete record, giving 41 years of full annual data.

The results show annual rainfall varying from just above 900mm per year to in excess of 2300mm per year. The mean annual rainfall is around 1475 mm.

Table 2 shows the results for monthly rainfall for the driest year, the wettest year, and a year close to the mean annual rainfall.

These years have been used in the water balance calculations.

TABLE 2 : MONTHLY RAINFALL (mm)

Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Dry Year (1985/86)	0.0	0.0	4.2	52.4	117.2	56.2	331.6	138.2	44.2	178.6	0.0	0.0	922.6
“Mean” Year (1972/3)	0.0	0.0	1.5	45.2	152.2	109.4	398.8	316.1	274.4	103.6	6.1	76.5	1483.8
Wet Year (1996/97)	0.0	26.0	0.0	90.8	86.2	482.8	801.0	452.4	312.2	1.2	51.0	0.5	2304.1

Extrapolation of the annual rainfall record indicates that expected annual rainfalls at larger Average Recurrence Intervals years (ie lower probability of exceedance) are:

ARI = 1 in 100 years Annual rainfall = 2500 - 2700mm
ARI = 1 in 200 years Annual rainfall = 2650 - 2900mm.

These results indicate that the 1 in 200 rainfall is only 15-25% higher than the 2304mm recorded in 1996/97, and used in the water balance.

5.6.2 Evaporation

Preliminary information on evaporation has been derived from the Australian Climate Atlas (**Ref. 1**). The monthly evaporation data (in mm) are shown in **Table 3**, for a July-June period to match the rainfall period.

TABLE 3 : MEAN MONTHLY EVAPORATION (mm)

July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	TOTAL
225	230	250	260	250	240	200	175	185	230	230	200	2675

5.7 Groundwater

Groundwater monitoring at the pit area (**Ref.2**) has indicated that groundwater levels vary by up to 8m between the wet and dry season, with wet season levels being typically 2-4m below ground level. ATC have observed similar behaviour in monitoring bores at other mine sites in the region.
The preliminary results from the geotechnical investigation provide broad support for these results.

The monitored levels are all from Dec 2005 and therefore represent the end of the dry season. The results are as summarized in **Table 4.**

Of the six sets of monitoring bores installed around the site, groundwater was encountered in three, at depths between 9.6 and 12.6m (and an estimated RL of 65.3 to 66.8m RL). The other three sets of holes appeared to be dry (ie the water table was greater than 20m deep). It is possible that these holes were in low permeability formations and had not yet equilibrated following drilling, but this is unlikely. Arrangements for a second round of measurements are underway, and will help clarify this issue.

TABLE 4 : INITIAL GROUNDWATER LEVEL RESULTS AT TSF

Borehole Number	Geology	Depth to GW (m)	Approx RL (m) (see note)
BH1B	Carbonate	10.95	~66.8
BH2B	Carbonate	Dry (>20m)	<55
BH3B	Boundary carbonate/shale	Dry (>20m)	<57
BH4B	Shale	12.67	~65.3
BH5B	Amphibolite	9.6	~65.6
BH6B	Carbonate	Dry (>20m)	<56

Note: Level on top of hole not yet confirmed by survey.

Our preferred interpretation of the groundwater level results is that the permeability/transmissivity varies significantly at depth in the different geological formations underlying the site. It is likely that higher groundwater levels are maintained in the (overall) lower permeability rocks such as the shales, whilst levels in the higher permeability zones (eg carbonates) fall faster to reflect more distant boundary conditions.

Water monitoring bores at the bulk sample pit (**Ref.3**) indicate that the water quality in the carbonate rocks is good, with neutral pH and low conductivity. It appears that lower pH and higher conductivity values apply in the weathered black shales.

Groundwater investigations carried out for the project (Coffey, Ref.2) indicate that the draw-down cone created by pit excavation and dewatering will extend between 1000 m and 1500m from the pit.

Reference to **Figure 1** indicates that the western end of the TSF is a maximum of 1200m from the pit. The location of the decant structure (and the decant pond) is only 700m from the edge of the pit. The consequences of this are that groundwater movements in the area beneath the TSF will be predominantly towards the pit throughout the active life of the storage.

6 SITE CONSEQUENCE CATEGORY

The consequences of possible failure of a storage can be categorized in accordance with the provisions of the ANCOLD Guidelines on the Assessment of the Consequences of Dam Failure (**Ref.3**). This requires an assessment of the risk to life and the magnitude of damage (both physical and environmental) in the event of a failure.

In this case, because of the location of the storage adjacent to the plant area, and of the importance

of the storage to the viability of the overall project, we have adopted an initial Consequence Category of HIGH C.

The consequences of this with respect to design are specified minimum requirements for flood capacity and stability under seismic conditions. There are also implications with respect to requirements for monitoring and surveillance of performance.

7 EMBANKMENT DETAILS AND STAGING

7.1 General

A "paddock" style storage (ie one comprising an embankment around all sides) is proposed for this storage. The embankment will be constructed progressively in stages throughout the period of mining.

Tailings discharge will be sub-aerial. A ring main will run around the embankment crest, and tailings will be discharged through a series of spigots (typical spacing 20m) onto a sloping beach. Decant water and rainfall run-off will collect at a low point on the beach, and will be recovered through a decant system (see below).

The combination of the rate of filling, the water management requirements, and the expected physical characteristics of the tailings means that "up-stream" raising methods are not considered to be suitable for this site. Raising of the embankment will consequently be undertaken using "down-stream" methods.

The general layout of the storage is shown on **Figure 1**, attached. Typical Sections are shown on **Figure 3**.

The storage will be formed by a zoned embankment, comprising a low permeability internal liner of clayey soils, with the majority of the embankment formed by rockfill.

Maximum utilization will be made of the waste material from the open-pit to provide the necessary rockfill. The mine bulk sample pit provides an indication of the likely material which will be available. Compass advise that almost all of the material was less than 600mm in size, with a large proportion being less than 200mm, with a well graded mix of intermediate and fine fractions. The rockfill is expected to be predominantly extremely, highly and moderately weathered. This is supported by observations made during the site visit.

7.2 Capacity and Staging

On the basis the initial laboratory testing, and previous experience, we have adopted an "end of filling" dry density of 1.3t/m3 for the tailings. This gives an overall storage capacity requirement of 3.07 Mm^3, in accordance with the mine production schedule of 4.0 Mt of tailings.

The volume v elevation characteristic for the storage is shown in **Figure 5**, assuming a horizontal tailings surface. Our initial calculations suggest that an allowance of 1m for the effects of final freeboard, beach slope and storm-water storage is reasonable.

On the basis of **Figure 5**, the following preliminary staging for construction of the embankment is proposed:1

Stage	Mine Year	Stage Crest mRL	Capacity
1	-1	83	10 months
2	1	88	1 year 2 months
3	2	92	1 year
4	3	95	1 year

It should be noted that for the proposed site, and production details, a storage capacity of about 4Mt represents a practicable upper limit on the tailings which can be accommodated.

7.3 Embankment Details

7.3.1 Foundation Preparation

All vegetation will be cleared from within the storage area, and retained for rehabilitation activities.

Topsoil will be stripped and stockpiled.

All of the old, open exploration costeans will be backfilled with compacted material, and will be capped with a minimum of 1 m of compacted clayey material.

Beneath the embankment footprint all tree roots and stumps will be grubbed and removed.

The exposed foundations beneath the embankment will be tyned, moisture conditioned and compacted. The same treatment will also be applied to the storage area foundations, but this will be timed to take place immediately prior to the commencement of deposition, so that the prepared surface cannot subsequently dry out.

It is proposed that compaction will be carried out to a depth of 200mm, to a level of not less than 95% Standard compaction.

Laboratory permeability test results on compacted foundation soils indicate a compacted permeability of less than 2×10^{-8} m/sec. This test was carried out on one of the coarser foundation soils encountered (a clayey gravel) and probably represents an upper limit.

7.3.2 Embankment Details

The embankment has been designed as a zoned soil and rockfill embankment. The low permeability soil zone will be located on the upstream face of the embankment.

The rockfill to be used in the external embankment will be derived from non-acid forming (NAF) pit waste (refer below). The embankment has been sized to provide capacity for both the tailings, and the projected potential acid-forming (PAF) waste, within the confines of the low permeability liner to the external embankment. An internal dividing bund is required to separate the tailings from the PAF pit waste.

The embankment will be constructed with upstream and downstream slopes of 2:1 (H:V) for all stages except the final. The external slope of the final stage has been increased to 1.5:1 due to space constraints. The stability of this slope will be checked as part of detailed design

The embankment will be comprised of the following zones:-

Zone 1

This zone will provide an internal lining to the embankment, and will be formed from compacted low permeability material including clayey soils, high plasticity silts, and EW rock.

The likely compaction standard will be to not less than 95% Standard (Hilf) density, and a moisture range of (OMC-2)% to (OMC+2)%, where OMC is optimum moisture for compaction. Layer thickness will be a minimum of 150mm after compaction.

Stage 1 material for this zone will be sourced from a borrow pit located within the storage area. It is generally intended to limit material taken from this borrow to a depth of around 1.0m to 1.5m, with the intent of leaving at least 3m of the existing soil layer in place over the entire base of the storage area.

The material for subsequent stages will be derived from stripping the foundation area of the embankment, and from an external borrow area.

Laboratory permeability tests of compacted Zone 1 materials **(Ref 5)** have returned permeability values in the range 3 x 10^{-9} to 6 x 10^{-9} m/sec.

Emerson tests have been carried out on samples of Zone 1 material. All results are Emerson Class 5 and 6, indicating the materials do not show dispersive behaviour.

Zone 2

This zone applies to the internal dividing bund between the tailings and the PAF waste. It will be constructed with compacted layers of PAF waste, 300mm thick. The maximum particle size will be 300mm, reflecting the layer thickness.

It is noted that the purpose of this internal bund is to provide physical separation between the tailings and the PAF waste zone. It is required because the tailings level is higher than the PAF waste level in the early stages. It is not a requirement of the design that the bund should be of low permeability. In final design provision will be made to pump any excess water (both rainfall and seepage) which accumulates in the PAF area, back into the tailings side of the bund.

The general PAF waste which will be placed behind the bund will be essentially similar to the actual bund material in origin. The only differences will be that there will be no particle size limitation, and no requirement for it to be placed in thin layers and compacted.

Zone 3

Zone 3 comprises the rockfill zone for the external embankment. It will be constructed using NAF pit waste, generally placed and compacted in 300mm thick layers.

In final design provision may be made for a sub-zone on the downstream side of the embankment where placement of larger size materials is permitted, to accommodate potential oversize materials from the pit excavation.

Zone 4 (Protection Layer)

A 0.5 m thick layer of rockfill will be placed (loose) over the face of the Zone 1 layer to provide protection from erosion and evaporative drying. This material will also be obtained from NAF pit waste.

7.4 Management of NAF and PAF Pit waste

Compass has undertaken a preliminary classification of the acid forming potential of the mine waste. We understand that this classification is likely to be conservative. The preliminary classification divides the waste into “Non Acid Forming” (NAF), and ‘Potentially Acid Forming” (PAF) materials. It is understood that additional geochemical evaluation is being carried out to provide more detailed information.

As noted above, the design provides for all PAF waste to be incorporated in a designated area within the TSF.

Details of the utilization of the pit waste material within the embankment are summarised **Table 5**. The embankment stages have been calculated assuming that an average minimum freeboard of 1m remains between the tailings and the crest level of the preceding embankment stage.

This assumes that pit waste rock will have an average in-situ dry density of 2.0t/m3 when placed in the embankment, and in the general PAF dump.

TABLE 5 : SUMMARY OF PIT WASTE UTILIZATION

EMBANKMENT STAGE	MINE YEAR	PIT WASTE PRODUCTION **		
		NAF (Zones 3 & 4)	PAF (Zone 2 and Internal Dump)	TOTAL
		(m3)	(m3)	(m3)
1	-1	222,000	38,000	260,000
2	1	499,000	52,000	551,000
3	2	614,000	132,000	746,000
4	3	351,000	165,000	516,000
	4	0	277,000	277,000
	Total:	1,686,000	664,000	2,350,000

**(For material placed in embankment at assumed density 2.0 t/m3)

8 WATER MANAGEMENT AND SEEPAGE

8.1 Water Balance

A preliminary water balance has been prepared for the TSF site, using monthly rainfall and evaporation data.

The aims of the model have been to evaluate:
-the quantity of excess water which may be generated in a wet year, and the required additional

storage capacity to retain this water within the system
-the need for additional make-up water in a dry year and during the dry season
The model has been prepared on the basis of the conventional mass balance approach:

Stored Water = Inputs – Water Retained in Tailings - Outputs

Features of the model are set out below.

Inputs:

Tailings Water:

A slurry solids content of 45% Solids (w/w) has been adopted. For a throughput of 1.0 Mtpa of tailings on a dry basis (83,000 t/month), this is equivalent to a make-up water volume of 102,000 m3/month (about 40L/sec).

It should be noted that the possibility of modifying the process and discharging the tailings at a lower solids content has also been discussed. The water balance model has not yet been run for this case. However it is expected that whilst it would result in a requirement for higher internal flows to handle the higher recycle water rate, the influence on the overall water balance will be minor.

Precipitation & Runoff:

Precipitation values as discussed in Section 5.6 have been adopted.

A contributing surface area for the TSF of 26 ha has been adopted. Of this area it has been assumed that 50% represents wet beach and the surface of the decant pond. A runoff co-efficient of 1.0 has been adopted for this area. A reduced runoff coefficient of 0.5 has been adopted for the dry beach area.

Make Up Water:

Compass has advised that any required make-up water will be obtained from pit-dewatering, or from groundwater derived from a dedicated bore-field if this is required.

Retained Water:

Retained water has been calculated on the basis of the assumed initial settled density of the tailings. As a simplification, further reductions in tailings water content due to beach evaporation and consolidation have been assumed to be losses. A settled density of 0.9t/m^3, relevant to the black shale tailings (**Table 1**) has been used.

Outputs:

Evaporation:
Evaporation values as set out in Section 5.6 have been adopted.

Evaporation contributing to the pond water balance has only been allowed off the wet beach and decant pond area. (For this preliminary study, this has been assumed to be a constant area. A rigorous water balance would allow for variations in pond area as a function of the volume of stored water).

Recycle:

Recycle as plant make-up water has been allowed as the lesser of:
-the volume available for recycle, and
-the maximum plant capacity for recycle (ie 102,000 m3/month).

In cases where the volume of water exceeds the re-cycle capacity, the stored water in the decant pond increases.

8.2 Results

The results of the water balance model are summarised in **Figures 6 – 8** for the dry, mean and wet year cases respectively.

The results indicate that in the dry season, recycle from the storage may only be around 10,000 m3/month. The balance of the make-up water requirement (ie around 90,000 m^3/month, or 35 L/sec), will need to be obtained from other sources. In the wet season, the volume of recycle rises. For the run using the wettest year on record, 100% make-up water is available from recycle from the TSF for 4 consecutive months, and up to 125,000m3 of excess water needs to be stored in the decant pond in this period (ie to an average depth of about 0.5m).

In an average wet season, 100% make-up from the TSF is achieved only for isolated months, and the need to store significant excess water on the tailings does not arise.

8.3 Management of Extreme Rainfall Events

8.3.1 Retention Capacity

The design intent will be for the storage to be raised and managed so that there is no discharge from the storage up to a 1 in 200 ARI rainfall year.

As noted in Section 5.6.1 the 1 in 200 ARI rainfall is calculated to be between 350mm to 600mm in excess of the rainfall results used for the “high” rainfall year in the water balance. At the most unfavourable rainfall distribution, this would increase the excess water storage requirement in the TSF to around 290,000m3 or an average depth of 1m.

It will be function of detailed design and management of the construction operations to ensure that the completion of the external embankment (rockfill and Zone 1) is completed to the required design level each year before the commencement of the wet season, to ensure that the retention capacity (to the spillway level) is available.

8.3.2 Spillway capacity

Because of the ANCOLD consequence category (Section 6) the storage will be designed to have an emergency high level spillway capable of passing excess rainfall (over and above the specified retention amount), without compromising the safety and integrity of the storage. For this storage a spillway capacity equal to a PMP storm event is proposed. The design would assume that the storage is full to the spillway at the start of the design storm.

Preliminary calculations indicate that the 72 hr PMP could be in the range 1500 – 2000mm. The

spillway would discharge to the Sedimentation dam. A schematic location for the spillway is shown on the layout plans. Details will be developed as part of final design.

8.4 Groundwater Interactions

Because of the fast rate of rise, and the relatively high proportion of external make-up water which will be required to operate the storage (Section 8.2), it is expected that leachate/seepage will be of relatively low salinity.

Definitive seepage quantities from the storage have not yet been calculated. However, the proposed design provisions, including the foundation preparation and embankment design indicate that seepage from the storage will be low.

If it is assumed that:-

- seepage originates from beneath the base of the TSF (an area of ~16 ha)
- the in-situ tailings has a typical permeability of around $1x10^{-8}$ m/sec
- the compacted foundation clay layer has a typical permeability of around $5\ x10^{-9}$ m/sec
- the underlying foundation materials have a maximum permeability of around $1x10^{-7}$ m/sec,

preliminary calculations indicate that for the “mature storage” seepage through the base is likely to be of the order of 50 m^3/day. This assumes that a degree of mounding will occur beneath the storage, which will influence the seepage gradients. Higher rates may apply during the start-up period.

The extent of groundwater mounding which occurs beneath the facility will be a function of the transmissivity of the underlying rock formations. In the shales and amphibolites, all the indications are that the transmissivity is low, and a significant degree of mounding is expected (in the same way that existing water levels are comparatively high in these formations). A somewhat more subdued response is possible in the carbonate rocks which are believed to have a higher transmissivity at depth.

More detailed groundwater modelling of the interaction between seepage from the TSF and the overall groundwater response to the pit is planned to be carried out as part of final design. However in general it is our expectation that mounding beneath the TSF will be a local response only. It is expected that seepage from the active storage will be captured by the groundwater drawdown cone resulting from the pit. This particularly applies to the carbonate rock formation, where the extent of the drawdown cone will be larger because of the higher transmissivity at depth.

Provisions will be included in detailed design to collect any shallow seepage through the embankment if this emerges at any point, and recycle this. A check on the operation of these systems will be part of the weekly inspection and monitoring requirement for the storage (see below).

9 MONITORING, SURVEILLANCE AND REPORTING

An Operations and Maintenance Manual will be prepared for the TSF prior to the commencement of tailings deposition.

This will include details of the following:

- provisions for raising
- monitoring of the tailings and stored water levels/volumes and stored water quality

- regular sampling and testing to confirm the geochemistry (acid forming potential) of the tailings
- routine inspections and monitoring of installed instrumentation
- non routine inspection requirements in abnormal circumstances
- provisions for annual surveillance audits of the storage
- requirements for reporting on performance
- protocols for action and reporting of emergency situations

10. DECOMMISSIONING AND TSF CLOSURE

In developing a preliminary final cover design, consideration has been given to the experiences of the Rum Jungle covers (**Ref.4**). The cover at Rum Jungle was designed and placed in the early 1980's, and is understood to have comprised (from the base upwards):-

- a 225 mm thick low permeability layer (Zone 1A)
- a 250 mm thick "store and release" layer (Zone 1B)
- a 150 mm thick erosion protection lay (Zone 2A)

These thicknesses were increased on the batters.

This design only provides a cover of 0.4 m over the top of the low permeability layer. On the basis of current understanding of the seasonal effect of wetting and drying, it is our assessment that this would be insufficient to stop the Zone 1A layer from drying out throughout the dry season. Almost all clay soils show a degree of reactivity (i.e. exhibit shrink-swell movements in response to moisture change). The formation of shrinkage cracks in the Zone 1A is an inevitable consequence of the seasonal drying. Subsequent invasion by vegetation roots and/or burrowing insects would follow.

The overall conclusion is that the thickness of the store and release cover (Zone 1B) needs to be substantially greater than 0.4m.

Different cover treatments are proposed for the tailings and the PAF waste zones **(Figure 9).** In both cases, the most suitable form of capping would be a "store and release" type cover.

For the tailings, the proposed sequence of mining (**Section 3**) will result in approximately 3 - 3.5m of secondary copper tailings (clayey sand) being deposited as the last layer of tailings. This material is non-acid forming, and is expected to be of low permeability. The aim would be to utilize these tailings as the base, low permeability layer. This would then be capped by 1m of rockfill (NAF pit waste) to provide the water retention cover. The top of this surface would be contour ripped.

Seepage through cap and into the tailings in this case will be dependent on the permeability of the secondary copper tailings, and the extent (area and depth) of the ponded water which occurs in the wet season. An indicative seepage value would be 5% of the incident annual rainfall, ie an overall average value of about 50m^3/day. This is of the same order of magnitude as the estimate of seepage out the base of the storage (Section 8.4).

For the PAF waste rock, the proposed cover will consist of (bottom to top):-

- a 0.3m thick layer of compacted low permeability material (clay and EW rock)
- a 1.0m thick layer of rolled NAF rock (expected to be obtained from additional excavation of the NAF pit waste)
- a layer of "dimple dumped' NAF rock, to a maximum thickness of 1m.

The design seepage through the cap would be expected to be similar to the tailings cover (ie 5% of annual incident rainfall or less). For a final top surface area of around 4 ha, this amounts to an average flow of less than $10m^3$/day.

However it is noted that for cover design to limit the development of acid generating conditions, the most critical factor is the air/oxygen diffusion rate through the cap, not the rate of seepage. Test work has shown that a saturated clay layer is practically "air tight", and hence the primary design criteria will be to ensure that there is sufficient depth of water available in the "store and release" layer to protect the clay layer from drying out.

The design will recognise that in the case of final closure where there is no active management of the site, vegetation will eventually re-establish on the cover.

Additional work required for closure of the facility would include:-

- excavation of a long term spillway to prevent ponding of large amounts of excess water and overtopping due to wet season rainfall,
- flattening of the external slopes of the embankments.
- decommissioning of the decant spillway.

It is expected that post closure monitoring will be undertaken for not less than 3 years to confirm that the closure is operating in accordance with the design.

11 CLOSURE

Your attention is drawn to the Terms and Conditions which appear on the title page of this report.

AUSTRALIAN TAILINGS CONSULTANTS

KEITH SEDDON

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Ref.1 Bureau of Meteorology. Climatic Atlas of Australia, 1988.

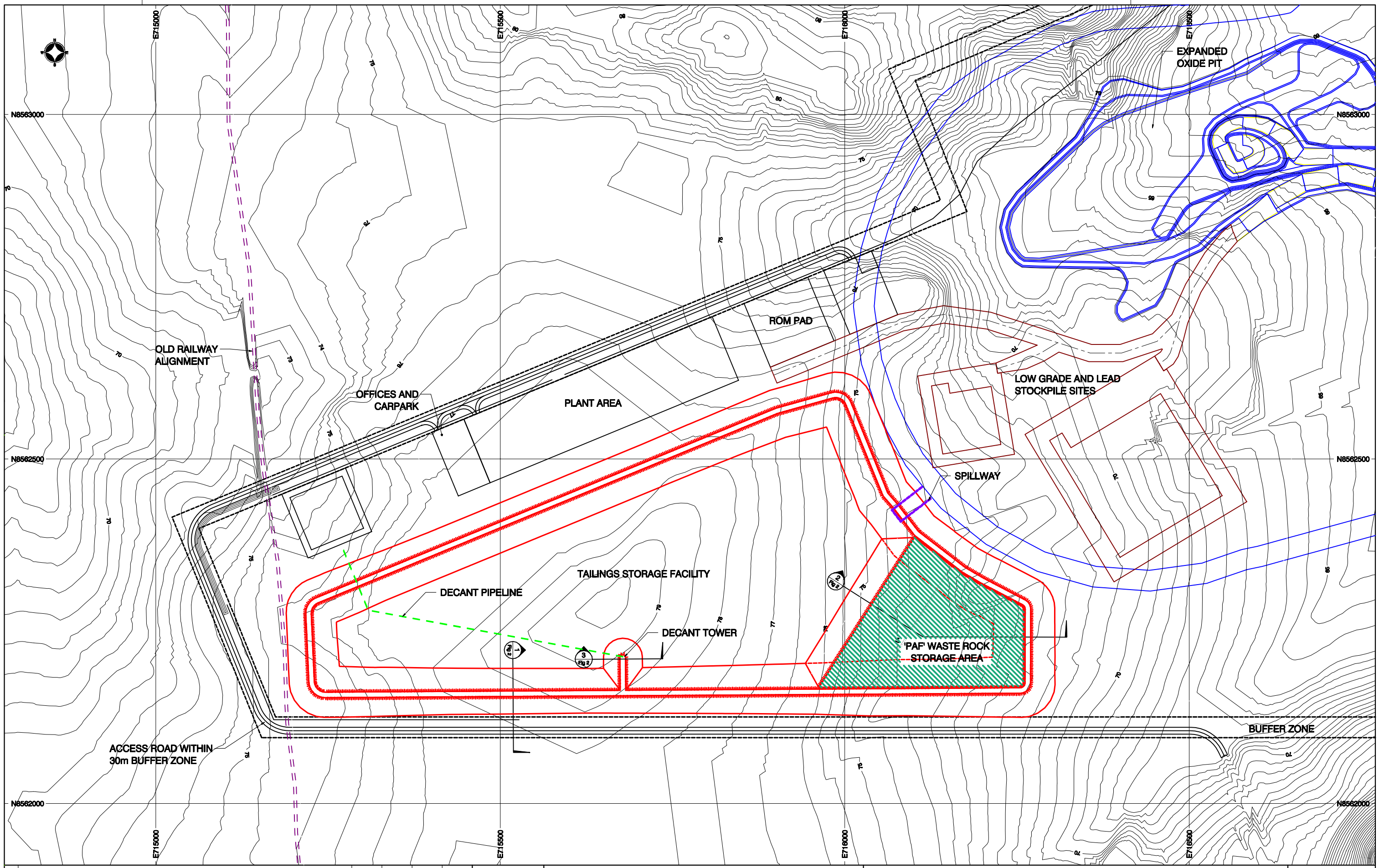
Ref.2 Coffey Geosciences Pty Ltd, "Browns Oxide Project, Groundwater Assessment, Batchelor, NT". Ref 18183/01 Nov 2005.

Ref.3 ANCOLD "Guidelines on the Assessment for the Consequences of Dam Failure", 2000.

Ref.4 Taylor, G., Spain, A., Nefiodovas, A., Timmes, G., Kuznetsou, V. and Bennet, J. "Determination of the Reasons for Deterioration of the Rum Jungle Waste Rock Cover". (Australian Centre for Mining Environmental Research, Brisbane), July 2003.

Ref.5 Australian Tailings Consultants. "Browns Oxide Project, TSF. Report on Geotechnical Investigation" – in preparation

FIGURES



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DATE	01.01.06
DESIGN	KDS
DRAWN	HAR
CHECKED	
APPROVED	

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COMPASS RESOURCES NL
BROWNS OXIDE PROJECT

GENERAL LAYOUT

FIGURE 1

CLIENT No.	
CAD REF.	105026.01
REV. No.	A
SHT SIZE	A3
SHEET	1 OF 1

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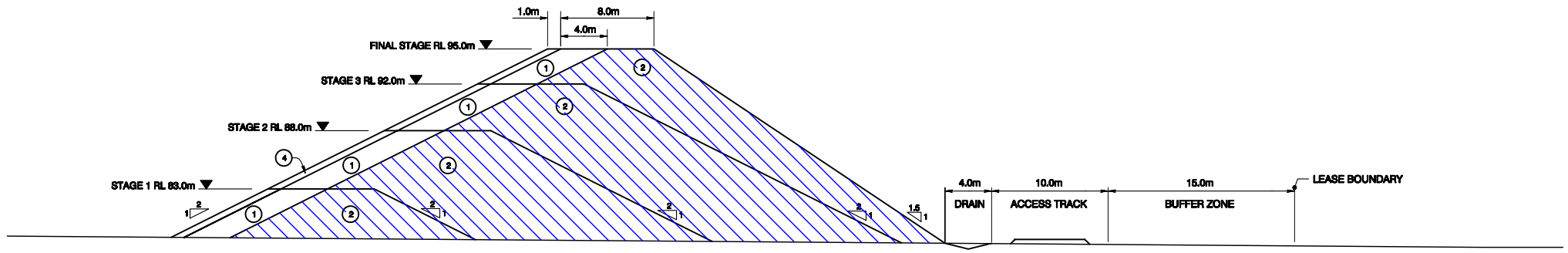

SECTION 1 FIG 1

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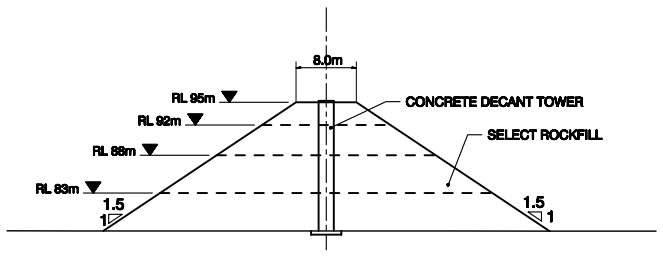


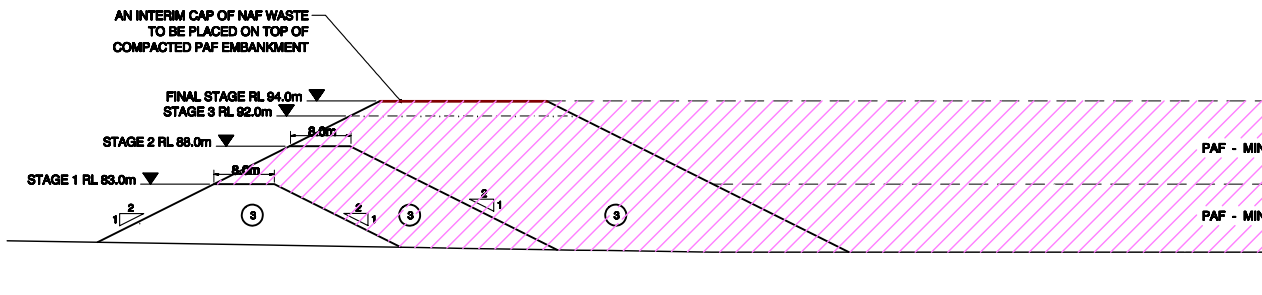
SECTION 3 FIG 1 (DECANT)

SCALE 1:1000

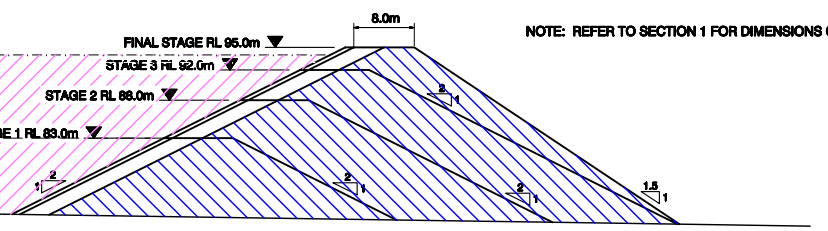
SUMMARY OF MATERIAL ZONES

ZONE	MATERIAL	SOURCE	PLACEMENT AND COMPACTION
1	CLAY, Sandy Clay, Clayey Sand (low permeability material)	Stage 1: Internal borrow Stage 2: Borrow from footprint Stage 3: External borrow	Place in layers 0.15m max. compacted thickness, compact at not less than 95% Standard DD at moisture content in range (omc -2%) to (omc +2%)
2	ROCKFILL: EW, HW, MW NON-ACID FORMING	PIT WASTE	Spread and compact in 0.3m thick layers (compacted thickness). Compaction to comprise of 8 passes of a 10t vibrating pad foot roller.
3	ROCKFILL: All weathering categories POTENTIAL ACID FORMING	PIT WASTE	
4	ROCKFILL - NON-ACID FORMING	PIT WASTE	Spread on face. Compaction not required.

INTERNAL EMBANKMENT



PERIMETER EMBANKMENT



NOTE: REFER TO SECTION 1 FOR DIMENSIONS OF THIS EMBANKMENT

NON-ACID FORMING (NAF) ONLY

NON ACID FORMING AND POTENTIALLY ACID FORMING (PAF)

SECTION 2 FIG 1

SCALE 1:1000

FIGURE 3 FOR REPORT 105026 R01 REV 1

No.	DESCRIPTION	DATE	DRAWN	CHECKD	APPRD

SCALE	AS SHOWN
JOB No.	105026.01
DATE	23.01.06
DESIGN	KDS
DRAWN	HAR
CHECKED	
APPROVED	

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SECTIONS & MATERIALS

FIGURE 2

CLIENT No.

CAD REF. 105026.01

REV. No. A | SHT SIZE A3

SHEET 1 OF 1

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LEGEND

- CARBONATE ROCKS
- BLACK SHALE
- AMPHIBOLITES WITH MINOR BLACK SHALE
- EXISTING CLAY BORROW PITS

NOTE: BOUNDARIES ARE FROM INITIAL SURFACE OBSERVATIONS AND ARE APPROXIMATE.

E715000 E715500 E716000 E716500

N8563000 N8562500 N8562000

EXPANDED OXIDE PIT

ROM PAD

OLD RAILWAY ALIGNMENT

OFFICES AND CARPARK

PLANT AREA

LOW GRADE AND LEAD STOCKPILE SITES

SPILLWAY

EXISTING CLAY BORROW PITS

TAILINGS STORAGE FACILITY

DECANT PIPELINE

DECANT TOWER

EXISTING CLAY BORROW PITS

BUFFER ZONE

ACCESS ROAD WITHIN 30m BUFFER ZONE

No.	DESCRIPTION	DATE	DRAWN	CHECK'D	APPR'D

SCALE	1:5000
JOB No.	105026.01
DATE	23.01.06
DESIGN	KDS
DRAWN	HAR
CHECKED	
APPROVED	

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SITE GEOLOGY (CONCEPTUAL)

FIGURE 3

CLIENT No.

CAD REF. 105026.01

REV. No. A | SHT SIZE A3

SHEET 1 OF 1

File J:\2005\105026 Browns Oxide Project\01 PER & Geotech\Data & Calcs\HAR\TSF preliminary design rev C1.pro (Terramodel) Mon 30 Jan 2006 9:37:30

MONITORING BORE
TYPICAL DETAIL
NOT TO SCALE

A B

3
3
10
10

SEALED
SLOTTED

EXPANDED
OXIDE PIT

OLD RAILWAY
ALIGNMENT

ROM PAD

PS1

PS6

PS5

PS2

OFFICES AND
CARPARK

PLANT AREA

PS3

PS4

BH 1A, 1B

BH6

TP30

TR11

TR8

TR9

TR10

TR12

TP31

TP36

TP37

TP29

TP23

TP19

TP12

TP7

TP3

TR5

TR4

TR6

TR7

TP21

TP10

TP9

TP1

LOW GRADE AND LEAD
STOCKPILE SITES

TP22

TP20

TP11

TP8

TP2

BH 2A, 2B

TP42

TP41

TP38

TP35

TP32

TP28

TP24

TP18

TP13

TP6

TP4

TP47

TAILINGS STORAGE FACILITY

TP46

TP39

TP33

TP25

TP17

TP14

TP5

TP45

TP44

TP43

TP40

TP34

TP27

TR3

TR1

TR2

TP26

TP16

TP15

BUFFER ZONE

ACCESS ROAD WITHIN
30m BUFFER ZONE

BH 3A, 3B

BH 4A, 4B

BH 5A, 5B

N8563000
N8562500
N8562000
E715000
E715500
E716000
E716500

No.	DESCRIPTION	DATE	DRAWN	CHECK'D	APPR'D

SCALE	1:5000
JOB No.	105026.01
DATE	25.01.06
DESIGN	KDS
DRAWN	BJT
CHECKED	
APPROVED	

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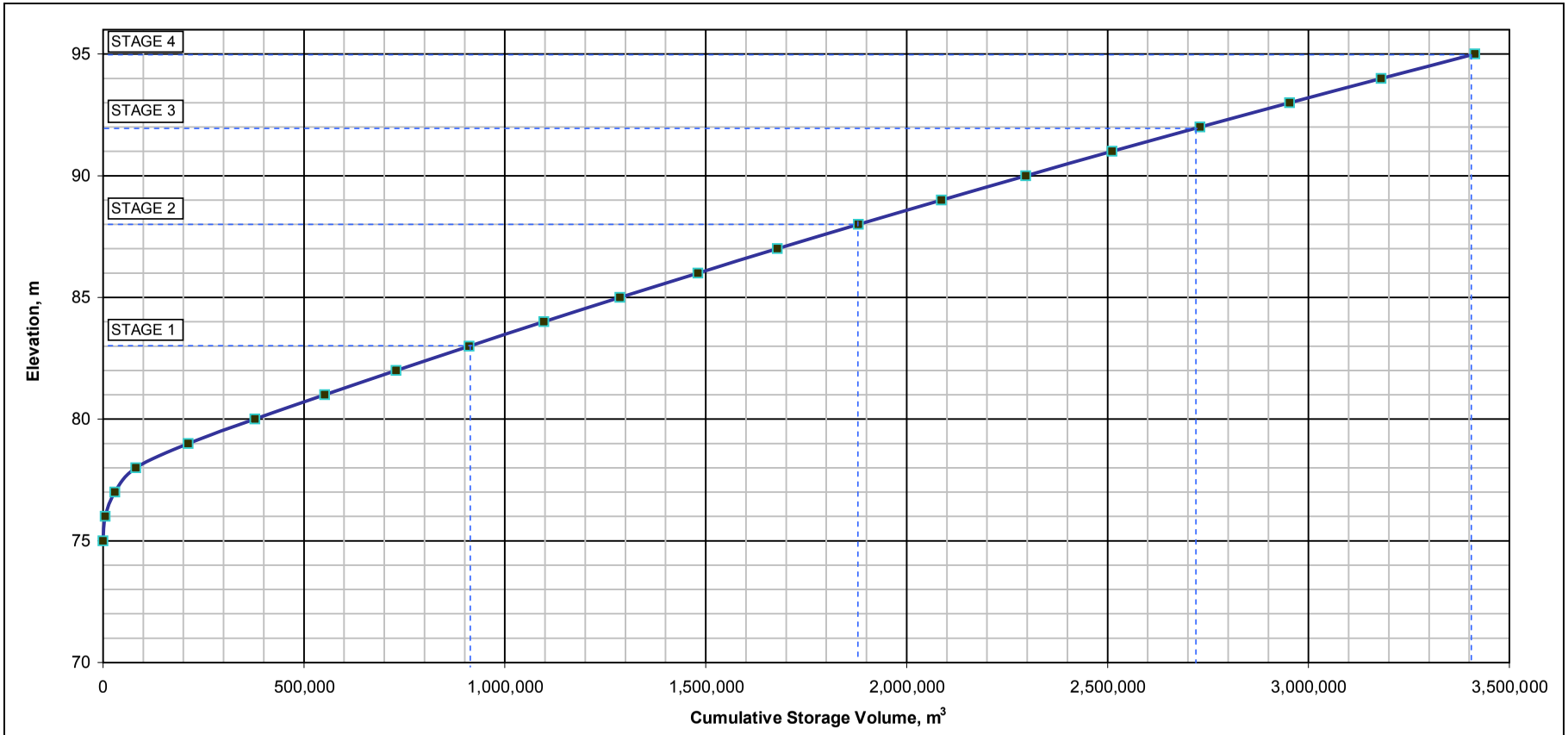
COMPASS RESOURCES NL
BROWNS OXIDE PROJECT

TEST PIT AND MONITORING BORE LOCATIONS

FIGURE 4

CLIENT No.
CAD REF. 105026.01
REV. No. A | SHT SIZE A3
SHEET 1 OF 1



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COMPASS RESOURCES
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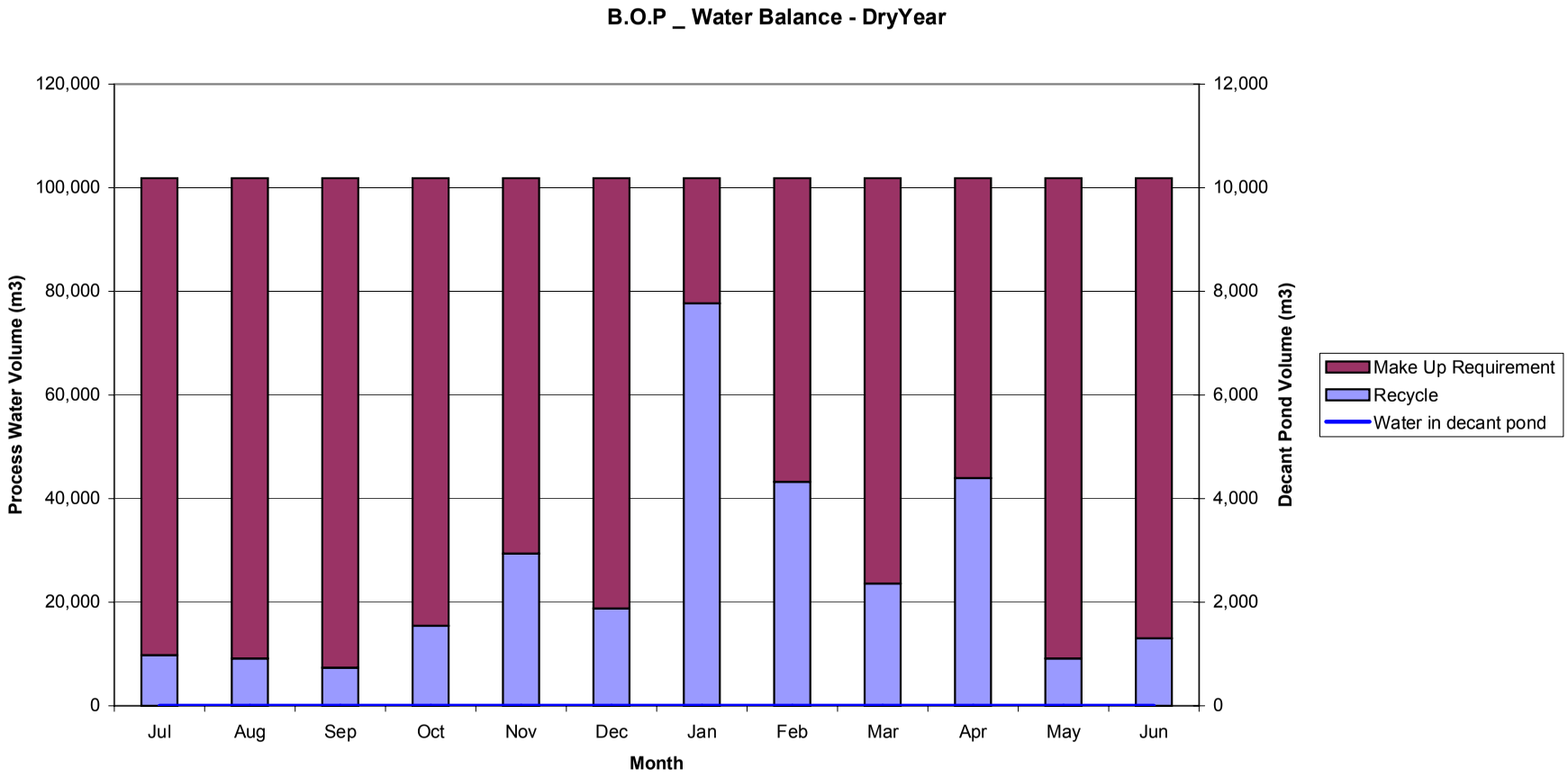
TSF - STORAGE RELATIONSHIP

Our Ref:

Date: 30-Jan-06 **Job No:** 105026.01

Figure 5



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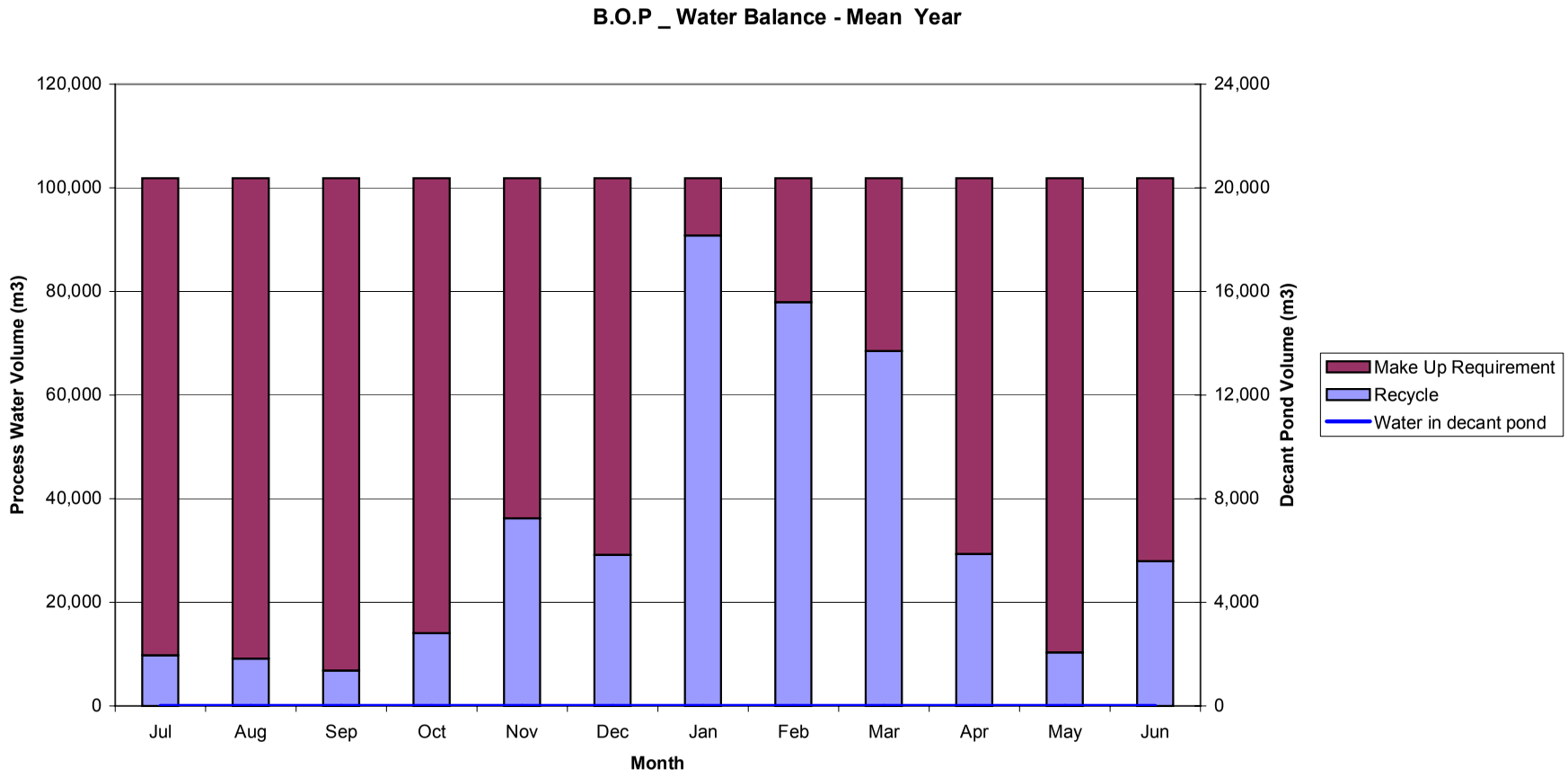
COMPASS RESOURCES
BROWNS OXIDE PROJECT

WATER BALANCE - DRY YEAR

Our Ref:
Date: 01-Aug-05 **Job No:** 105026.01

Figure 6



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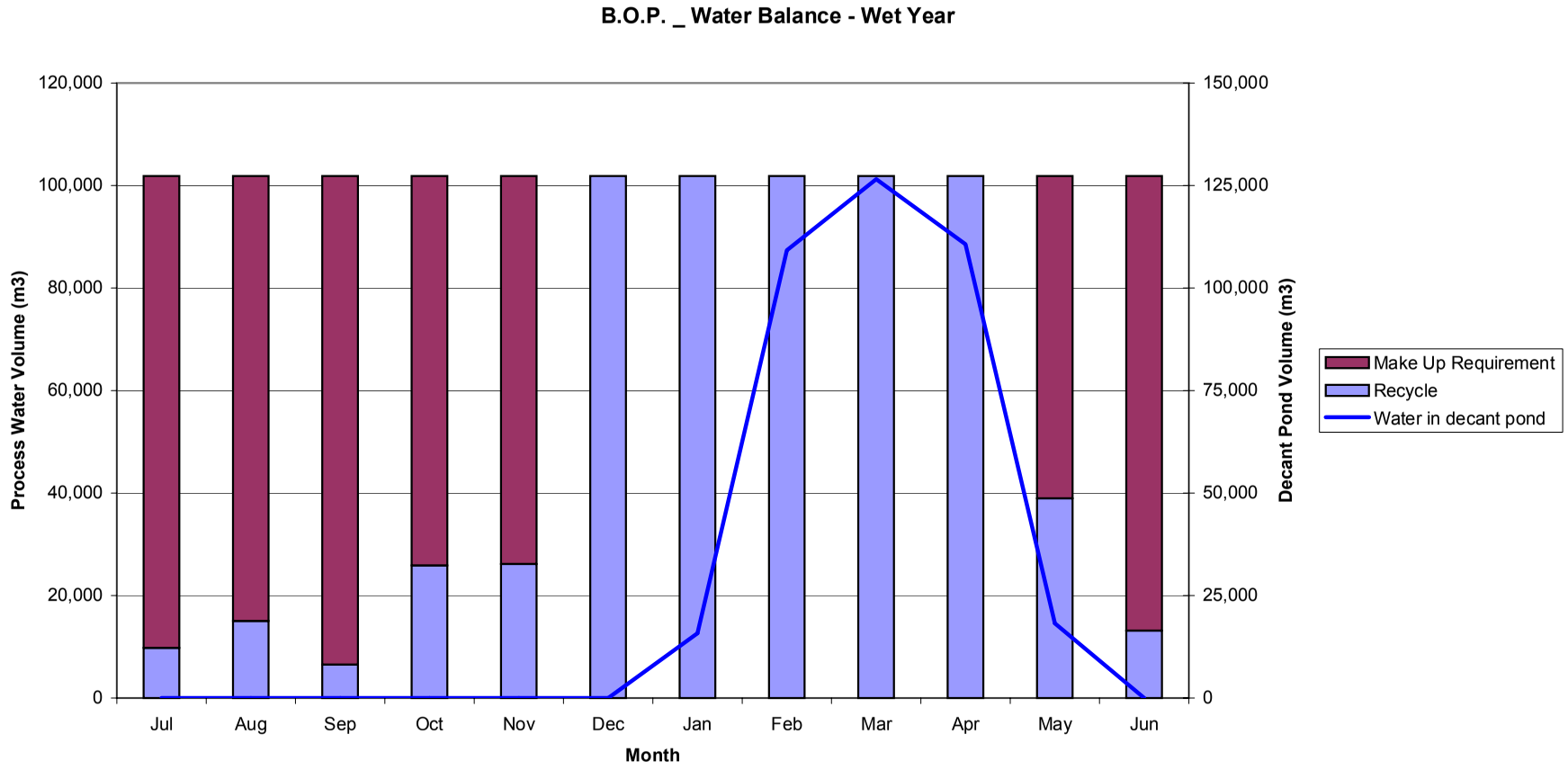
COMPASS RESOURCES
BROWNS OXIDE PROJECT

WATER BALANCE - MEAN YEAR

Our Ref:
Date: 01-Aug-05 **Job No:** 105026.01

Figure 7



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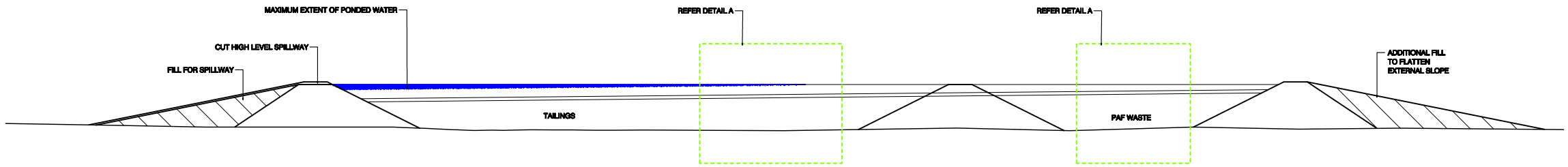
COMPASS RESOURCES
BROWNS OXIDE PROJECT

WATER BALANCE - WET YEAR

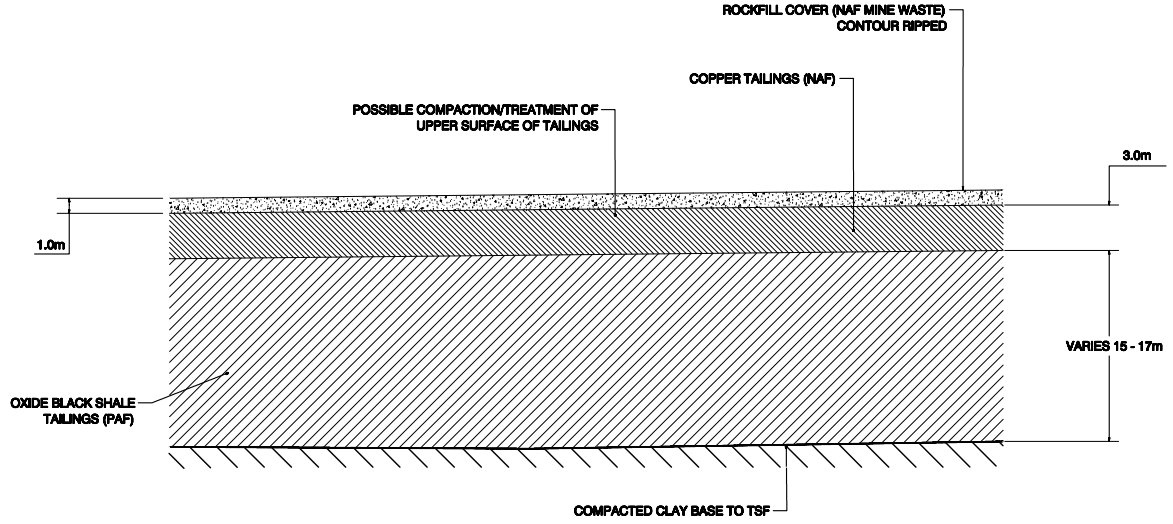
Our Ref:
Date: 01-Aug-05 **Job No:** 105026.01

Figure 8



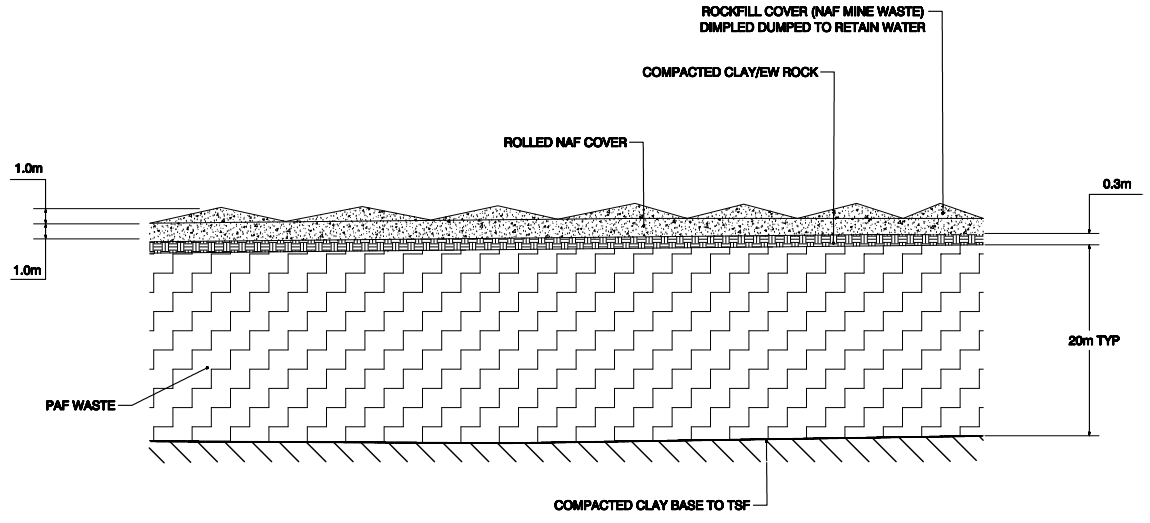
SCHEMATIC CLOSURE PROVISIONS

SCALE 1:2000 @ A3



DETAIL A - TAILINGS

NOT TO SCALE



DETAIL B - PAF PIT WASTE

NOT TO SCALE

No.	DESCRIPTION	DATE	DRAWN	CHECK'D	APPR'D

SCALE	AS SHOWN
JOB No.	105026.01
DATE	23.01.06
DESIGN	KDS
DRAWN	HAR
CHECKED	
APPROVED	

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COMPASS RESOURCES NL
BROWNS OXIDE PROJECT

SCHEMATIC CLOSURE ARRANGEMENT

FIGURE 9

CLIENT No.

CAD REF. 105026.01

REV. No. A | SHT SIZE A3

SHEET 1 OF 1

APPENDIX A

PARTICLE SIZE DISTRIBUTION

☐ AS 1289.3.6.1 ☑ AS 1289.2.1.1
☑ AS 1289.3.6.2
☑ AS 1289.3.6.3

NATA
REPORT No. : R08205
JOB No. : 105026.01
REGISTER No. : 10605

CLIENT: Compass Resources NL.

CLIENT ADDRESS: Suite 4B, 384 Eastern Valley Way, Roseville, NSW, 2069

PROJECT: Browns Oxide Project **LOCATION:** Northern Territory

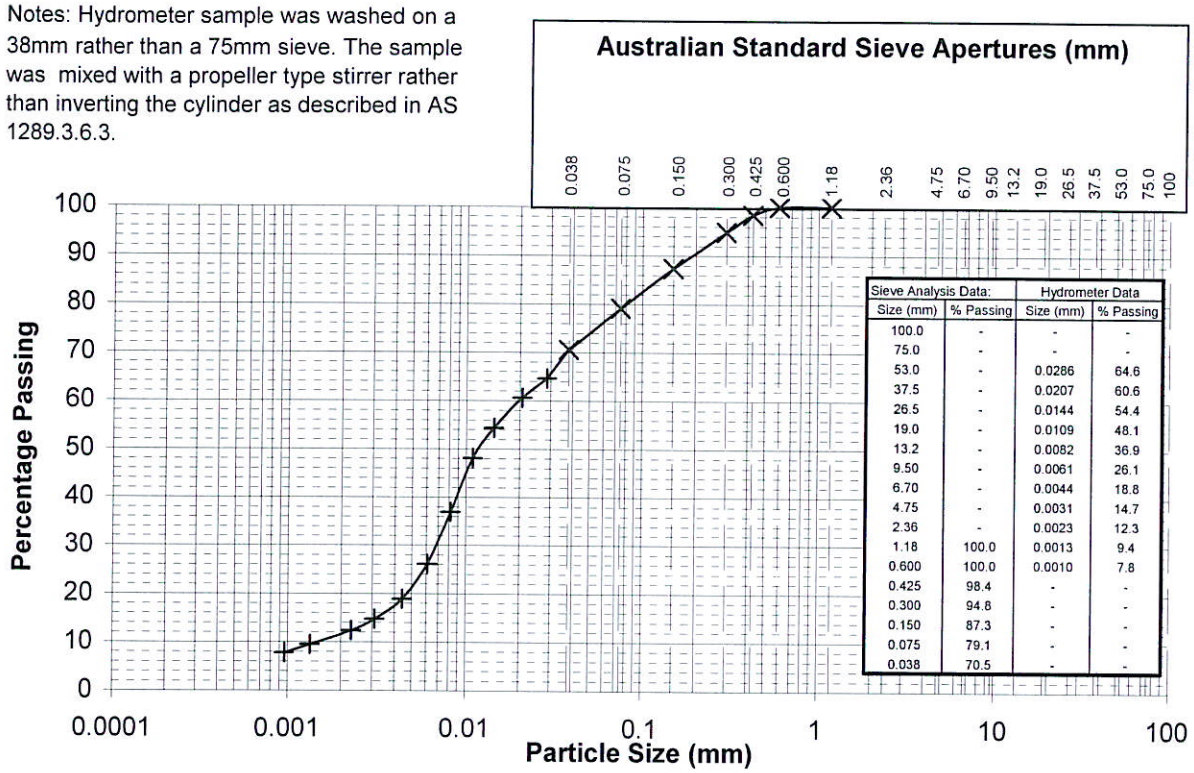
SAMPLE DESCRIPTION : Black Shale Tailings

BOREHOLE ☐ TEST PIT ☐
No. : DEPTH :

Dispersion Method Used: Mechanical Stirrer. Hydrometer Type Used: ASTM 152H

☐ Sampled by MPA Williams & Associates Pty. Ltd. in accordance with AS 1289.1.2.1.
☑ Sampled provided by the client.

Notes: Hydrometer sample was washed on a 38mm rather than a 75mm sieve. The sample was mixed with a propeller type stirrer rather than inverting the cylinder as described in AS 1289.3.6.3.



Sieve Analysis Data:		Hydrometer Data	
Size (mm)	% Passing	Size (mm)	% Passing
100.0	-	-	-
75.0	-	-	-
53.0	-	0.0286	64.6
37.5	-	0.0207	60.6
26.5	-	0.0144	54.4
19.0	-	0.0109	48.1
13.2	-	0.0082	36.9
9.50	-	0.0061	26.1
6.70	-	0.0044	18.8
4.75	-	0.0031	14.7
2.36	-	0.0023	12.3
1.18	100.0	0.0013	9.4
0.600	100.0	0.0010	7.8
0.425	98.4	-	-
0.300	94.8	-	-
0.150	87.3	-	-
0.075	79.1	-	-
0.038	70.5	-	-

CLAY	SILT			SAND			GRAVEL			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
0.002	0.006	0.02	0.06	0.2	0.6	2	6	20	60	

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Approved Signatory Steven Murphy Date 30/8/05

Name Of Signatory STEVEN MURPHY

PARTICLE SIZE DISTRIBUTION

☐ AS 1289.3.6.1 ☑ AS 1289.2.1.1
☑ AS 1289.3.6.2
☑ AS 1289.3.6.3

NATA
REPORT No. : R08105

JOB No. : 105026.01

CLIENT: Compass Resources NL.

REGISTER No. : 10505

CLIENT ADDRESS: Suite 4B, 384 Eastern Valley Way, Roseville, NSW, 2069

PROJECT: Browns Oxide Project

LOCATION: Northern Territory

SAMPLE DESCRIPTION : Supergene Tailings

BOREHOLE ☐ TEST PIT ☐

No. :

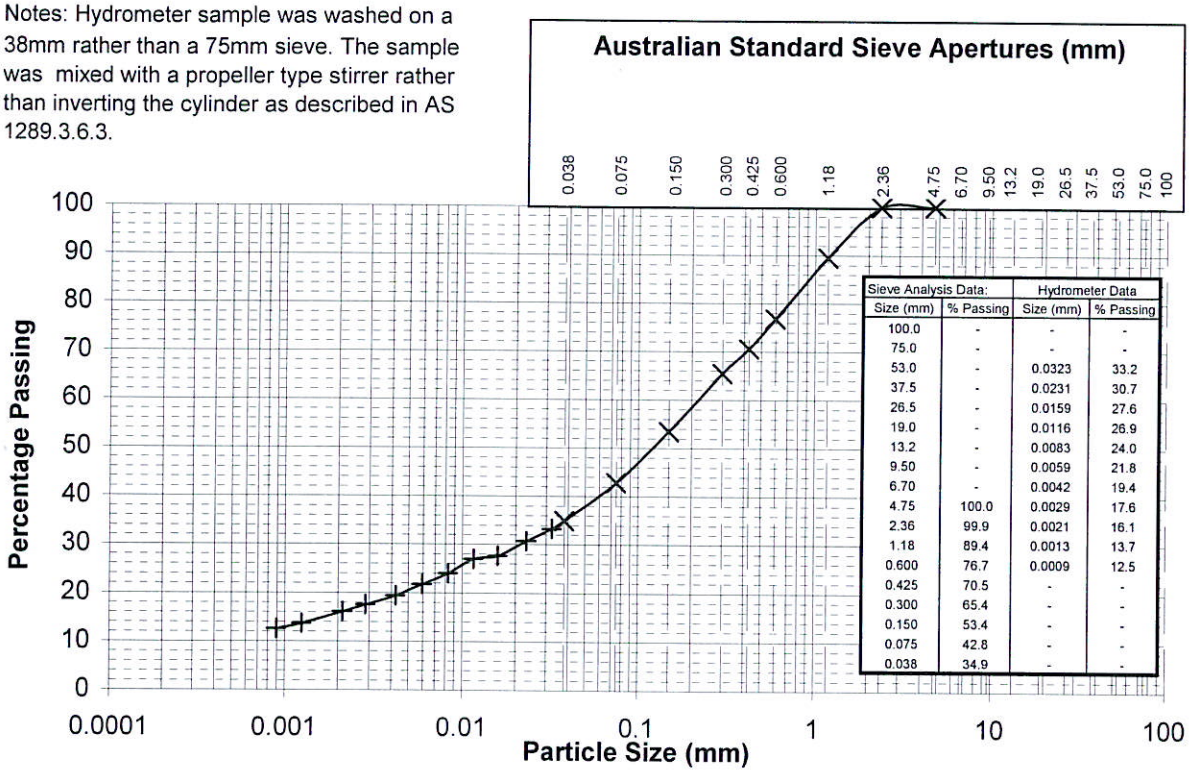
DEPTH :

Dispersion Method Used: Mechanical Stirrer. Hydrometer Type Used: ASTM 152H

☐ Sampled by MPA Williams & Associates Pty. Ltd. in accordance with AS 1289.1.2.1.

☑ Sampled provided by the client.

Notes: Hydrometer sample was washed on a 38mm rather than a 75mm sieve. The sample was mixed with a propeller type stirrer rather than inverting the cylinder as described in AS 1289.3.6.3.



Sieve Analysis Data:		Hydrometer Data	
Size (mm)	% Passing	Size (mm)	% Passing
100.0	-	-	-
75.0	-	-	-
53.0	-	0.0323	33.2
37.5	-	0.0231	30.7
26.5	-	0.0159	27.6
19.0	-	0.0116	26.9
13.2	-	0.0083	24.0
9.50	-	0.0059	21.8
6.70	-	0.0042	19.4
4.75	100.0	0.0029	17.6
2.36	99.9	0.0021	16.1
1.18	89.4	0.0013	13.7
0.600	76.7	0.0009	12.5
0.425	70.5	-	-
0.300	65.4	-	-
0.150	53.4	-	-
0.075	42.8	-	-
0.038	34.9	-	-

CLAY	SILT			SAND			GRAVEL			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
0.002	0.006	0.02	0.06	0.2	0.6	2	6	20	60	

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Approved Signatory ..Steven Murphy.. Date ..30/8/05..

Name Of Signatory ..STEVEN MURPHY..

Form No. : RSN 004.8
Date of Issue : May, 2005

DETERMINATION OF THE SOIL PARTICLE DENSITY OF A SOIL - TEST RESULTS

AS 1289 3.5.1

NATA REPORT No. R08005

JOB No. : 105026.01

CLIENT : Compass Resources NL.

CLIENT ADDRESS : Suite 4B, 384 Eastern Valley Way, Roseville, NSW, 2069

PROJECT : Browns Oxide Project | LOCATION : Northern Territory

REGISTER NUMBER	SAMPLE DESCRIPTION	TEST PIT NUMBER	DEPTH (m)	TEST TEMPERATURE (°C)	% OF SAMPLE >2.36mm	PARTICLE DENSITY (g/cm^3)
10505	Supergene Tailings	-	-	21.4	0	2.98 #
10605	Black Shale Tailings	-	-	21.3	0	2.80 #

NOTES :

☐ Sampled by MPA Williams & Associates Pty. Ltd. in accordance with AS 1289.1.2.1.

☒ Sample provided by the client.

* = [Apparent average soil particle density - particle size less than 2.36 mm]

X = [Apparent average soil particle density - particle size greater than 2.36 mm]

\# = [Soil particle density of the total sample]

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Approved Signatory Steven Murphy Date 30/6/05

Name Of Signatory STEVEN MURPHY

Form No. RSN 003.2
Date of Issue : May, 2005

CLASSIFICATION TEST RESULTS

NATA REPORT No.	R07905
JOB No.	105026.01

CLIENT : Compass Resources NL.

CLIENT ADDRESS : Suite 4B, 384 Eastern Valley Way, Roseville, NSW, 2069

PROJECT : Browns Oxide Project | LOCATION : Northern Territory

REGISTER NUMBER	SAMPLE DESCRIPTION	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	LINEAR SHRINKAGE (%)	SAMPLE CURLED (CU) / CRUMBLED (CR)
10505	Supergene Tailings	37	21	16	-	-
10605	Black Shale Tailings	34	24	10	-	-

☐ Sampled by MPA Williams & Associates Pty. Ltd. in accordance with AS 1289.1.2.1.

☒ Sample provided by the client.

TEST METHODS :

LIQUID LIMIT	☐	AS 1289. 3.1.1	(Standard method)
	☒	AS 1289. 3.1.2	(Subsidiary method)
PLASTIC LIMIT	☒	AS 1289. 3.2.1	
PLASTICITY INDEX	☒	AS 1289. 3.3.1	
LINEAR SHRINKAGE	☐	AS 1289. 3.4.1	
MOISTURE CONTENT	☒	AS 1289. 2.1.1	

SAMPLE PREPARATION :

☐ Natural Moisture	☒ Air Dried	☐ Oven Dried	☐ Unknown
☐ Wet Sieved	☒ Dry Sieved	☐ Unsieved	

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Name Of Signatory ..... STEVEN MURPHY .....

Form No. RSN 002.2
Date of Issue : May, 2005

MOISTURE CONTENT TEST RESULTS
AS 1289.2.1.1

NATA REPORT No. R07805

JOB No. 105026.01

CLIENT : Compass Resources NL.

CLIENT ADDRESS : Suite 4B, 384 Eastern Valley Way, Roseville, NSW, 2069

PROJECT : Browns Oxide Project | LOCATION : Northern Territory

REGISTER NUMBER	TEST PIT NUMBER	SAMPLE DESCRIPTION	DEPTH (m)	MOISTURE CONTENT (%)
10505	-	Supergene Tailings	-	0.7
10605	-	Black Shale Tailings	-	0.7

☐ Sampled by MPA Williams & Associates Pty. Ltd. in accordance with AS 1289.1.2.1.

☒ Sample provided by the Client.

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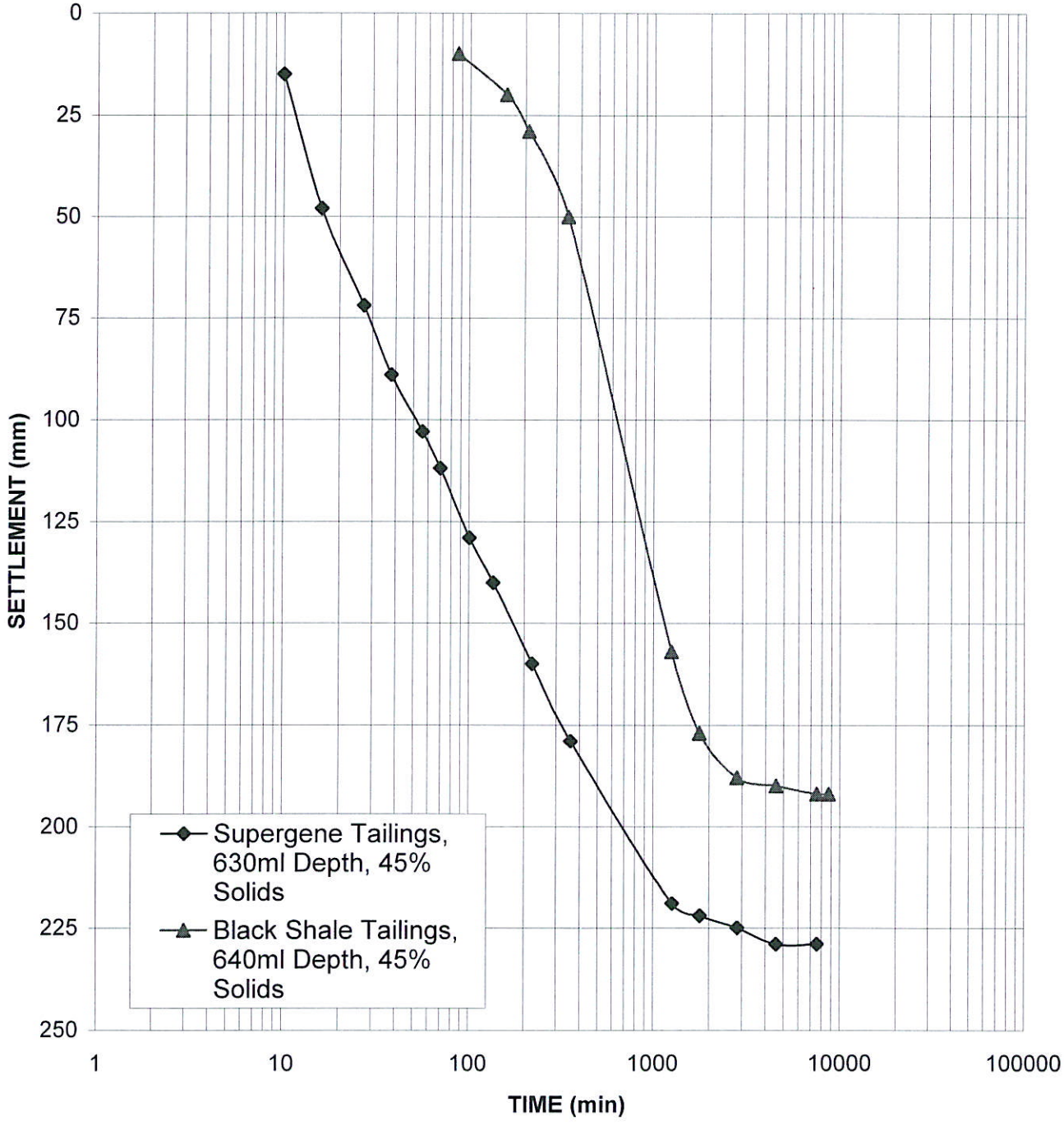
Approved Signatory ..... Date 30/5/05

Name Of Signatory STEVEN MURPHY

Cylinder Settlement
105026.01
Browns Oxide Project
#10505, Supergene Tailings
#10605, Black Shale Tailings



Compass Resources NL
Browns Oxide Project

SETTLING TEST RESULTS
Sample Nos. 10505, 10605

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Phone (03) 9772 9966 Fax (03) 9772 4775 Email mtech@mpaw.com.au

Job No. 105026.01
Date 30/08/2005
Our Ref

FIGURE ??

APPENDIX B

TO: AUSTRALIAN TAILINGS CONSULTANTS PTY LTD

ATTENTION: Keith Seddon

FROM: John Jeffery

DATE: 22 August 2005

SUBJECT: Browns Oxide Project - Acid forming characteristics of tailings

---

As requested, EGi have carried out geochemical testing of two tailings samples from the Browns Oxide Project in the Northern Territory. One sample was representative of Black Shale tailings and the other sample was representative of Supergene tailings. The samples were provided as water slurries containing approximately 200 g of solids. The test program conducted by EGi included the following assays and calculations:

Solids

- Total sulphur content
- Acid neutralising capacity (ANC)
- Maximum potential acidity (MPA)
- Net acid producing potential (NAPP)
- Net acid generation (NAG) capacity
- Kinetic NAG testing
- Acid buffer characteristic curve
- Multi-element composition

Liquor

- pH
- Electrical conductivity (EC)

An explanation of these measurements is provided in Appendix A, and the results are summarised in Table 1 (acid forming characteristics), Table 2 (multi-element composition), Figure 1 (acid buffer characteristic curve) and Figure 2 (kinetic NAG).

Acid Forming Potential of Supergene Tailings

The results indicate that the sample representing supergene tailings was non-acid forming. The total sulphur content was low (0.16 %S) and, given the weathered nature of the material, it is likely that the sulphur present was mainly non-pyritic. The acid neutralising capacity of the supergene tailings was also low, equivalent to only 2 kg H_2SO_4/t. Although the NAPP for this sample was slightly positive (3 kg H_2SO_4/t) there was no indication of any acid generation when the sample was oxidised with hydrogen peroxide in the NAG test.

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Environmental Geochemistry International Pty Ltd ABN 12003 793 486

Table 1. Acid forming characteristics of tailings samples

Assay	Unit	Supergene Tailings	Black Shale Tailings
Liquor pH		7.2	8.2
Liquor EC	µS/cm	2430	2210
Total Sulphur	%S	0.16	1.06
Maximum Potential Acidity (MPA)	kg H_2SO_4/t	5	32
Acid Neutralising Capacity (ANC)	kg H_2SO_4/t	2	1
ANC/MPA Ratio	-	0.4	0.03
Net Acid Producing Potential (NAPP)	kg H_2SO_4/t	3	31
Net Acid Generation (NAG)	kg H_2SO_4/t	0	11
NAGpH	-	5.3	2.8
Classification	-	NAF	PAF

# Classification Key
PAF = Potentially Acid Forming
NAF = Non-Acid Forming

Acid Forming Potential of Black Shale Tailings

The characteristics of the sample representing black shale tailings indicate significant acid forming potential. The black shale tailings had a sulphur content of 1.06 %S and virtually no ANC. The net acid producing potential (NAPP) based on the sulphur and ANC results was 31 kg H_2SO_4/t, and the tailings acidified to pH 2.8 when the sulphides within the tailings were oxidised in the NAG test. The amount of acidity generated in the NAG test was 11 kg H_2SO_4/t. Based on the positive NAPP and NAG test results the black shale tailings were classified as potentially acid forming (PAF).

It is worth noting, however, that the amount of acidity generated in the NAG test was only approximately one-third of the NAPP. The lower NAG value may indicate incomplete oxidation of sulphides during the NAG test and/or some of the sulphur occurs in forms that are not acid generating.

To ensure complete oxidation of all sulphides, a sequential NAG test was carried out on the black shale tailings. This involved reaction of the solids three times with hydrogen peroxide. The pHs of the NAG liquor after each stage were 2.8, 3.7 and 4.8, respectively. The acidities after each stage were 9, 2 and 0 kg H_2SO_4/t, respectively. These results indicate that most sulphide was oxidised in the first stage, and the remainder oxidised in stage 2. There was no evidence of sulphide oxidation or acid generation in stage 3.

Therefore, the difference in the NAPP and NAG results suggests that a significant amount of the sulphur within the black shale tailings occurs in forms that are either not acid generating (e.g. sulphate) or generate less acidity than pyrite when oxidised (*e.g.* sphalerite and galena).

[NOTE: the multi-element data, when available, should shed more light on this]

Acid Buffer Characteristic Curves

Acid buffer characteristic curves were produced for the two tailings samples to verify the low ANCs (Figure 1). The buffer characteristic curve is determined by slow addition of weak acid to a sample, and it represents a far less aggressive treatment of a sample than that applied in the ANC method. The acid buffer curve provides an indication of the presence of more soluble carbonates within a sample such as calcite and dolomite.

The shapes of the curves in Figure 1 suggest there is little, if any, reactive carbonate within either of the two tailings samples. When carbonate mineralisation is present, and is the main contributor of ANC, it typically produces a plateau region in the buffer curve between pH 7 to 8. Clearly, no plateaus were produced by the tailings, and the curves indicate that an addition of only 2 kg H_2SO_4/t was sufficient to acidify the tailings to around pH 4.

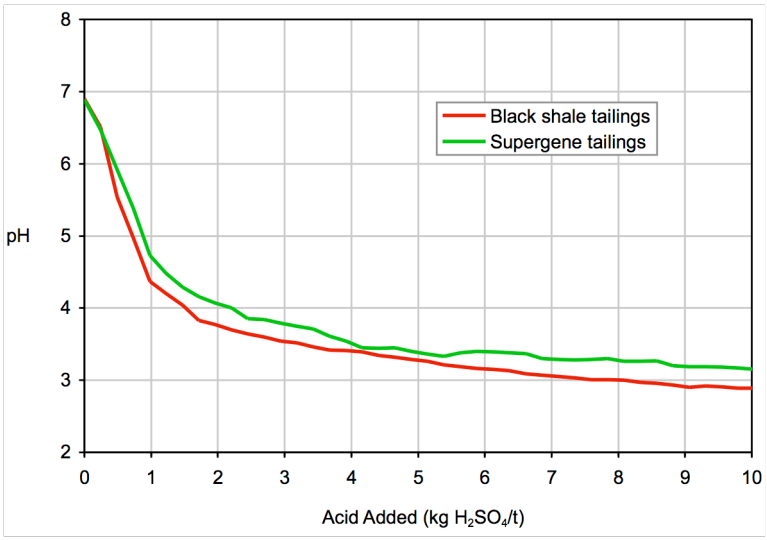

Figure 1. Acid buffer characteristic curves for tailings samples

Kinetic NAG Test

Given the low acid buffer capacity within the black shale tailings it might be expected that such tailings would acidify rapidly (*i.e.* have a short lag) if exposed to atmospheric conditions within a tailings storage. However, the results of the kinetic NAG test (Figure 2) suggest that the sulphides within the tailings are not highly reactive and that it may take some time for a low pH condition to be reached. The pH profile indicates a small amount of buffering at around pH 5.7 during the first two hours, after which the tailings steady acidified to pH 2.8.

The overall time for acidification was relatively slow for a PAF material under NAG test conditions. Based on EGi's experience with similar behaving materials from other mine sites, the kinetic NAG results suggest a lag of several months or more. Further clarification of the likely lag period will require longer-term column testing.

Another feature of the kinetic NAG test was that there was only limited heating of the NAG liquor during the test. Typically, samples that contain more than 1 %S as pyrite produce a significant temperature increase, often to the point of the NAG liquor reaching boiling point. The temperature increase can be attributed primarily to catalytic decomposition of the peroxide (which is an exothermic, or heat generating, process) which usually only occurs in the presence of significant pyrite content (*i.e.* at least 0.5 %S as pyrite). The absence of this type of response with the black shale tailings is consistent with the expectation that only some of the sulphur within the tailings occurs as pyrite. Sphalerite, which probably accounts for the majority of the sulphur, does not generate acidity when oxidised, nor does it result in catalytic breakdown of the hydrogen peroxide.

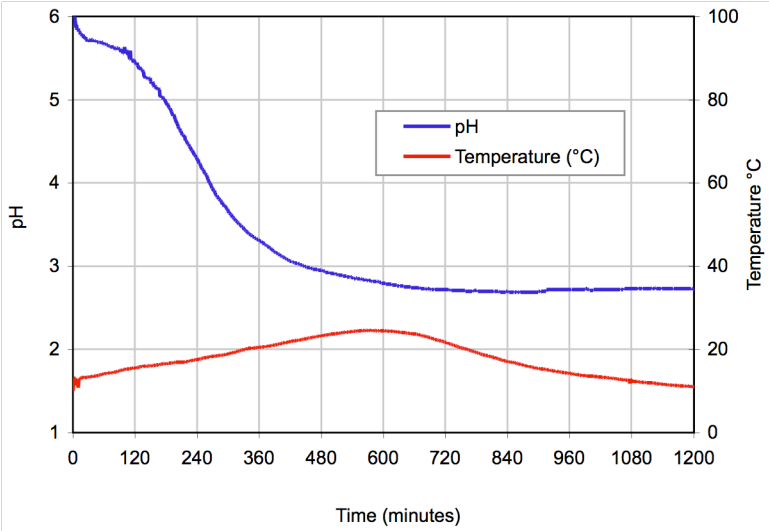

Figure 2. Kinetic NAG profiles for the Black shale tailings

Multi-Element Composition of Tailings

Multi-element analyses of the tailings solids were carried out by Genalysis Laboratory Services Pty Ltd using NATA registered procedures. Samples were digested by multi-acid addition and the digests were analysed for a suite of 29 elements.

The multi-element data for the tailings solids are given in Table 2, together with the respective geochemical abundance indices (GAI). The GAI for a particular element provides an indication of the relative enrichment of that element within the tailings solids compared to the median soil abundance. The GAI is expressed on a log 2 scale which includes 7 integer increments (0 through to 6, respectively). A GAI of 0 indicates the element is present at a concentration similar to, or less than, median soil abundance and a GAI of 6 indicates approximately a 100-fold, or greater, enrichment above median soil abundance. The main purpose of the GAI is to identify elements that occur at concentrations that may be environmentally significant.

[NOTE; Multi-element data will be included when available]

Table 2. Multi-element composition of tailings samples

Element	Unit	Composition Supergene Tailings	Composition Black Shale Tailings	Median Soil	GAI Supergene Tailings	GAI Black Shale Tailings
Al	%			7.1		
Ca	%			1.5		
Fe	%			4.0		
K	%			1.4		
Mg	%			0.5		
Na	%			0.5		
S	%			0.03		
Si	%			33.0		
As	ppm			6		
Ba	ppm			500		
Be	ppm			0.3		
Cd	ppm			0.35		
Co	ppm			8		
Cr	ppm			70		
Cu	ppm			30		
F	ppm			200		
Hg	ppm			0.06		
Mn	ppm			1000		
Mo	ppm			1.2		
Ni	ppm			50		
P	ppm			800		
Pb	ppm			35		
Sb	ppm			1		
Se	ppm			0.4		
Sn	ppm			4		
Sr	ppm			250		
Th	ppm			9		
U	ppm			2		
Zn	ppm			90		

 # Median soil abundance data were taken from Bowen, H.J.M. (1979). Environmental Chemistry of the Elements, Academic Press, New York, p36-37.

Appendix A

Determination of Acid Forming Characteristics

Total Sulphur Content

The total sulphur content of each sample was determined by the Leco furnace method. Sulphur assays were carried out by Sydney Environmental Laboratory Pty Ltd under a quality assurance system certified as complying with ISO 9002.

Maximum potential acidity (MPA) of the contained sulphur

The MPA is the maximum amount of acid that could be generated by the sulphur contained within a sample assuming that all the sulphur occurs as reactive pyrite. The MPA of each sample was calculated from the total sulphur content as follows: MPA (kg H_2SO_4/t) = (Total %S) x 30.6.

Acid neutralising capacity (ANC)

The acid produced by pyrite oxidation will to some extent react with other minerals contained within a sample. This inherent acid buffering is quantified in terms of the ANC, which has the same units as MPA. The ANC was determined using the Sobek Method. This involved reacting a sample with a known amount of acid at a pH of less than 1 for 1 to 2 hours, then back-titrating the residual acidity to determine the amount of acid consumed by the sample.

Net acid producing potential and ANC/MPA Ratio

The NAPP is the amount of acid that potentially can be produced by a sample after allowing for ANC. It is calculated by subtracting the ANC value from the MPA value. If the NAPP is negative then it is likely that the material has sufficient inherent buffer capacity to prevent acid generation. Conversely, if the NAPP is positive then the material may be acid generating.

The ANC/MPA ratio is essentially another way of looking at the balance between ANC and MPA, and provides an indication of the relative margin of safety with respect to the acid forming potential of a sample. A ratio less than 1 corresponds to a positive NAPP and indicates a material may be acid generating. Conversely, an ANC/MPA ratio of 2 or more generally signifies that there is a high probability that the material will remain circum-neutral in pH (*i.e.* the material should not be problematic with respect to ARD).

Net acid generation (NAG)

NAG is an alternate method of estimating the acid forming potential of a sample. The NAG test involves reaction of a sample with hydrogen peroxide to rapidly oxidise any sulphide minerals present. Both acid generation and acid neutralisation occur simultaneously during the NAG test, hence the end result represents a direct measurement of the net amount of acid that a sample can generate. If the sample after reaction has a pH of 4.5 or less (*i.e.* NAGpH≤4.5) then it is considered to be acid forming. The actual amount of acidity generated can be determined by titration of the mixture.

Sequential NAG Test

The sequential NAG test is a multi-stage procedure involving a series of single addition NAG tests on the one sample (*i.e.* 2.5 g of sample was reacted three times with 250 mL aliquots of 15% hydrogen peroxide). At the end of each stage, the sample is filtered to separate the solids and NAG liquor. The NAG liquor is assayed for pH and acidity, as per a standard NAG test. The solids are recovered for repeat oxidation using another aliquot of hydrogen peroxide the solid residue. The overall NAG capacity of the sample is determined by summing the individual acid capacities from each stage.

Kinetic NAG Testing

The kinetic NAG test provides an indication of the reactivity of sulphides within a sample and provides a quick, qualitative assessment of the likely lag time for acidification to occur under field conditions. The method is similar to the standard NAG test, except that pH and temperature are constantly recorded during the test. The reaction kinetics exhibited in the NAG test are extrapolated to the field situation on the basis of correlations previously derived by EGi from numerous leach column tests and field observations at other mine sites.

Measurement of acid buffering characteristic curves (ABCC)

The ABCC is determined by slowly acidifying a sample with dilute acid to around pH 3 over a 16 to 24-hour period. It therefore represents a far less aggressive treatment of a sample than that applied in the ANC method, and it typically only accounts for more readily-available carbonates such as calcite and dolomite. When present in sufficient quantity, these minerals will typically buffer a waste rock at near-neutral pH, which is essential for maintaining low metal solubilities.

ARD Classification Scheme

The acid forming potential of a sample is classified on the basis of the NAPP and NAG test results into one of the following categories:

Non-acid forming (NAF) A sample classified as NAF may, or may not, have a significant sulphur content but the content and reactivity of carbonate minerals and ANC within the material is more than adequate to neutralise all the acid that theoretically could be produced by any contained sulphide minerals. Material classified as NAF is considered unlikely to be a source of acidic drainage. The criteria used to define a NAF material are a negative NAPP and a NAGpH greater than 4.5.

Potentially acid forming (PAF) PAF material always has a significant sulphur content, the acid generating potential of which exceeds the inherent acid neutralising capacity of the material. This means there is a risk that such a material, even if pH circum-neutral when freshly mined and processed, could oxidise and generate acidic drainage if exposed to atmospheric conditions. The criteria used to define PAF material are a positive NAPP and a NAGpH less than, or equal to 4.5.

Uncertain (UC) An uncertain classification is used when there is an apparent conflict between the NAPP and NAG results (*i.e.* when the NAPP is positive and NAGpH > 4.5, or when the NAPP is negative and NAGpH ≤ 4.5). Uncertain samples are generally given a tentative classification that is shown in brackets *e.g.* UC(PAF), but further testing would be required to confirm the tentative classification.

Appendix 14

Radiation Management Plan

REPORT TO COMPASS RESOURCES LTD

RADIATION MONITORING AND MANAGEMENT PROGRAM

1. INTRODUCTION

Compass Resources NL has had submissions, in regard to uranium, to its PER for the Browns base metals project in the Northern Territory. These submissions are being addressed in a supplementary PER due to be submitted in early February 2006. Whilst our earlier report noted the presence of only background levels of uranium at the Browns deposit, one aspect of the submissions received calls for an appropriate uranium and radiation monitoring program (management plan) to be in place. The proposed monitoring program would be included in the supplementary PER.

ANSTO Minerals was requested by Compass to prepare a preliminary "in principle" operational monitoring program to track any build-up of uranium and radioactivity that may occur anywhere from mining, ore stockpiling, plant processing, water management (including process water dam and sedimentation dam) and waste disposal, together with management protocols to follow up the results from monitoring to ensure that dose/exposure limits to the public, the workforce and the environment are not exceeded.

This report presents the recommended Radiation Management Plan (RMP) prepared by ANSTO.

2. BACKGROUND

Mining at the Browns Oxide Project will be carried out using an open-cut method. The potential for significant exposure from radon/radon progeny is therefore minimal.

The Browns project processing flowsheet comprises mining, coarse ore storage, SAG milling, tank leaching with sulphuric acid, solids/liquid (S/L) separation by thickening, copper solvent extraction (Cu SX) and electrowinning (EW), with recovery of Co and Ni from a Cu raffinate bleed by precipitation using sulphide chemicals such as NaHS. The leach thickener underflow will pass to a resin-in-pulp (RIP) circuit to scavenge any remaining dissolved metals, with the resulting resin eluate joining the feed to Cu SX. Tailings will be sent to a tailings dam, along with Fe and Mn precipitated from bleed streams. Plant water will be re-used. Allowance will be made for some water discharge from the site, if it meets the regulatory discharge quality standards or it will be treated (a lime based precipitation of heavy metals from water is proposed) if required, to ensure discharge water quality standards are met.

A detailed monitoring and management program should be developed to meet all requirements. The radiation monitoring and management plan (RMP) should be incorporated into the Mine Management Plan (MMP). The RMP will evolve with the development of the project, as specific areas (critical groups and process areas) are identified. Reporting is not expected to be excessive and might be comparable to that required of the heavy minerals industry, where areas (monazite processing) and products (radium bearing scales) have been identified to be potentially radiological significant.

3. RADIOACTIVITY MONITORING AND MANAGEMENT PROGRAM

Process stream sampling for assay is carried out in conjunction with site radiation monitoring. External gamma measurements will identify any build up of radionuclides inside sealed plant equipment. Analysis of samples for alpha and beta emitters is more sensitive than external gamma measurements and will indicate lower concentrations of radionuclides, which have the potential to build up in the plant equipment. Sampling in association with plant mass flow data provides valuable information in understanding how any radioactivity is behaving (deportment) through the process.

Previous analytical work by Compass Resources indicated that naturally occurring radioactivity associated with the Browns project is due primarily to the presence of ^{238}U in the ore. Radionuclides in the ^{235}U and ^{232}Th decay chains may still become significant, if such radionuclides accumulate in the process. The nature of any continued monitoring requirement for the project should depend on the results of background data collection currently being carried out.

3.1 Sampling and Assaying Program

Regular sampling and assaying of process streams is required to assess the likelihood of build-up of radionuclides. Build-up which may occur in such hydrometallurgical circuits, include:

- ^{226}Ra accumulation in recycled process water circuits in the form of radium bearing process scales on equipment surfaces;
- ^{226}Ra accumulation on equipment due to adsorption ("plating") onto rubber and other synthetic construction material/equipment surfaces, *e.g.* filter cloths;
- uranium and thorium accumulation in recycled SX raffinate; and
- uranium concentration in solution purification products.

Accumulation of radioactivity will depend on the natural bleed-off of various streams in the process. Sampling and monitoring during the first 6 months to 2 years operation will identify whether or not radionuclides are accumulating.

Any changes introduced to the circuit, *e.g.* filter medium, surface coatings modifications etc, will need to be assessed with regard to the potential for radionuclide accumulation.

Analysis should initially be done by delayed neutron counting (DNA) for uranium, and gamma spectrometry for decay chain progeny. In time, this information may be able to be obtained by more conventional methods, by Compass, as knowledge is gained on the behaviour of any radionuclides in the process.

Gamma spectrometery is required for ^{226}Ra determination and to detect the possible accumulation of radioactivity from other decay chains, which are less prevalent in the ore, *i.e.* the ^{232}Th and ^{235}U decay chains.

Monitoring of radionuclides, *e.g.* ^{238}U, in any seepage water from ore stockpiles and waste disposal facilities is also required.

Table 1 is a preliminary list of samples requiring routine assaying (say quarterly) for their contained radioactivity. Many of the samples would be collected as part of the broader plant control and non-radiological environmental monitoring systems.

TABLE 1

Sampling Schedule

Process Stream			Assays	Method
N$^{o.}$	Description			
1	Ore	solids	U	DNA, XRF, other
2	Leach solution	solution	U, progeny	ICP MS, gamma spectrometry
3a-x*	Process scales	solids	^{226}Ra	gamma spectrometry
4	SX raffinate	solution	U, progeny	ICP MS, gamma spectrometry
5	SX other	solution	U, progeny	ICP MS, gamma spectrometry
6	Co/Ni precipitate	solids	U	DNA, other
7a-x	Ore and waste stockpile seepage	solution	U	ICP MS
8a-x	Tailings facility seepage	solution	U, progeny	ICP MS, gamma spectrometry
9	Treated water	solution	U, progeny	ICP MS, gamma spectrometry
10a-x	Bleed stream products	solid	U, progeny	DNA, gamma spectrometry
		solution	U, progeny	ICP MS, gamma spectrometry
11a-x	Green tissue (local plants, crops)	solids	U, progeny	gamma spectrometry
12a-x	Dusts and air samples	solids	U, progeny	DNA, gamma spectrometry
13-x	Other streams as identified in early surveys for radioactivity	solutions and solids		

* the number of samples will vary depending on experience gained

3.2 Radiation Surveys

Radiation surveys should be undertaken early in the life of the operation (after 6 months to one year) to obtain base line radioactivity concentrations associated with the process. The build-up of radioactivity in such circuits is usually very slow and a survey earlier than after 6 months of operation is not normally recommended, unless routine analyses (discussed above) suggest that an earlier survey is warranted. Base line data will be available for the site prior to commencement of mining operations The survey should be repeated after extended plant operation (2 to 3 years) to ascertain whether radioactivity concentrations are increasing due to the process chemistry, and and/or changes in ore and operating practices/procedures and equipment. The radiological effect of some of these changes are often not realised by the operator at the time.

The frequency of radiation surveys is determined by the history of results obtained from previous surveys of the operation (including base line data collected prior to commencement of mining activities). Contaminated equipment and its disposal is frequently the only significant issue arising from radioactivity accumulation. This is often detected during routine (6 month to yearly depending on the previous results and potential for exposure) site surveys.

Measurements taken over the operation during site surveys should include:

- external gamma – the source radionuclides can be identified;
- radon gas and progeny; and

- dust loadings and the radioactivity content of the dusts.

The identification of critical groups by examination of work conditions, *i.e.* occupancy time, proximity to naturally occurring radioactive sources, dust loadings *etc* may require that such groups be subject to monitoring (TLD).

3.3 Reporting

Reporting should be in accordance with regulatory requirements. This will demonstrate, to all stakeholders, that sufficient data is available to show that:

- radioactivity is not accumulating in the process, with the associated potential for increased exposure to the workforce and public; and/or
- radioactivity, which is accumulating or is present in significant concentrations, is being managed in an appropriate way.

The creation of a data base will also identify:

- critical workforce groups or individuals;
- any elevated radioactivity concentrations and/or dose measurements; and
- the effects of the implementation of appropriate controls, *e.g.* occupancy, use of PPE, following specific procedures *etc*.

3.4. Management Strategies

Management protocols include;

- establishment and development of a Radiation Management Plan in association with the regulatory authority as part of the MMP;
- regular (annual) reporting on agreed assaying and survey results; and
- regular (annual) reporting on results of actions on issues identified in previous reports.

  e.g. monitoring of groups or individuals exposed to elevated doses and measures taken to reduce the doses in future,

  the practice agreed on with the authority for the disposal of any specific identified contaminated items of equipment, etc.

Compass should ensure that:

- responsible officers are designated to ensure that the RMP meets the regulatory requirements;
- the RMP and reports are submitted as required (contents, timing and changes / amendments);
- measures are taken to control the exposure of employees and members of the public by:
  - use of appropriate equipment and procedures;

- having a monitoring program in place;
- using appropriate dose assessment procedures;
- using appropriate incident reporting procedures;
- having instruction and training programs;
- designating controlled or supervised areas;
- including a suitable waste management systems (restricted release, storage/disposal, decommissioning and rehabilitation relation to radioactivity);

Best practice should be adopted in carrying out the requirements for radiation management.

Doug Collier
ANSTO Minerals for Compass Resources Ltd
January 2006

Appendix 15

Traffic Safety Audit

Batchelor and Rum Jungle Roads

Stuart Highway to Rum Jungle

STAGE 5 ROAD SAFETY AUDIT REPORT

- Existing Road
- 25 January 2006
- Revision 1

Batchelor Road

Stuart Highway to Rum Jungle

STAGE 5 ROAD SAFETY AUDIT REPORT

- Existing Road
- 25 January 2006
- Revision 1

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1. Introduction

1.1 The Commission

Sinclair Knight Merz (SKM) has been commissioned by Compass Resources NL to undertake a road safety audit of Batchelor Road from the Stuart Highway to the old Rum Jungle Mine site.

The purpose of this Road Safety Audit is to assess Batchelor and Rum Jungle Roads from the Stuart Highway to the Litchfield Park Road Intersection (Ch 00 to Ch 19.30) to assess any current risks associated with the existing road construction and any impacts of and to the projected traffic generated by the new Browns Oxide Mine project.

1.2 Road Safety Audit

Road safety auditing is a formalised procedure that can be applied to all phases of a road project development or to an unsafe feature of an existing road system. The purpose of this report is not to rate the existing road design, but rather to address any road safety concerns.

The objectives of this road safety audit are -

To evaluate the existing road in terms of interaction with its surrounds and nearby roads, and to visualise potential impediments and conflicts for road users; and

To report on the conclusions drawn and to make recommendations regarding aspects which involve unnecessary or unreasonable hazards.

It is intended that the prioritised issues be provided to Compass Resources for their consideration, to determine whether the risks on the Mine's proposed operation warrant specific procedures to be put in place by the Mine for safety reasons. The report findings and recommendations should also be forwarded to the relevant road Authority for consideration, and where they consider necessary as part of their policy, implementation.

1.3 Prioritised Findings

This Stage 5 road safety audit report is intended to translate audit findings into a prioritised list for action (where necessary) for an existing road construction. It is normally the responsibility of the road Authority to consider the findings and recommendations of the audit team and consider the planning of actions relating to each item.

Audit Team

The following personnel carried out the Road Safety Audit:

Team Leader:

Ross Treacy - Sinclair Knight Merz (Darwin)

Team Member:

Rod Page - Sinclair Knight Merz (Darwin)

Audit Process

A stage audit was carried out on 5th January 2006, and also 10th January 2006 generally in accordance with Austroads publication Guidelines for Road Safety Audit – Stage 5.

The Checklist from the above publication was used and a summary of this is included at Appendix A of this report.

Disclaimer

This report is issued for comment on its conclusions and recommendations. This report contains the findings, opinions and recommendations of the Audit Team based on the examination of information referred to throughout this report. Notwithstanding that this report may contain statements in relation to technical matters, both of a general nature and in relation to specific issues; in no way should readers of the report rely solely on its contents for application elsewhere. Readers must seek appropriate expert advice on their own particular circumstances and rely on such advice.

2. Background Information

2.1 Site Description

Batchelor Road is a rural road connecting the Stuart Highway to the township of Batchelor and after Batchelor Township the road becomes Rum Jungle Road through to its end at the old Rum Jungle mine. It is also a tourist route to the Litchfield Park for 19km from the Stuart Highway to the intersection of Litchfield Park Road and Rum Jungle Road .

2.2 Average Annual Daily Traffic (AADT) Volumes

Traffic counts data for Batchelor Road and Litchfield Park Road supplied by the Department of Planning and Infrastructure. A review of the traffic numbers and classes currently using Batchelor Road and Litchfield Park Road recorded at primary count stations 5 kilometres west of the Stuart Highway and 5 kilometres west of the Finniss River Crossing respectively are provided below.

No vehicle Average Annual Daily Traffic (AADT) counts are available for Rum Jungle Road.

Batchelor Road	2004 AADT	645
Litchfield Park Road	2004 AADT	353

It should be noted that traffic in July exceeds AADT counts by 50% on Batchelor Road and 100% for Litchfield Park Road.

A break up of the vehicle categories observed on the roads is:

	Percentage by Category			
Road	**Cars** **Cars & Trailers**	**Rigid Vehicles & buses**	**Articulated Vehicles**	**B-Doubles, Doubles & Road Trains**
Batchelor	86.7	11.7	1.4	0.1
Litchfield	88.0	8.8	3.0	0.1

The translation of these percentages produces the following vehicle traffic based on the AADT's provided by Department of Planning and Infrastructure.

Road	Cars Cars & Trailers	Rigid Vehicles & buses	Articulated Vehicles	B-Doubles, Doubles & Road Trains	Total
Batchelor	559	75	9	1	645
Litchfield	310	31	11	1	353

As there is no information available for the Rum Jungle Road and the count station on the Litchfield Park Road is 5 kilometres west of the Finniss River the number of vehicles that access properties off the Litchfield Park Road and via White Road of Rum Jungle Road are missed.

It could be expected that the number of vehicle trips on Rum Jungle Road would be in excess of that on Litchfield Park Road at the count station but not exceed that of Batchelor Road.

An approximation of traffic on Rum Jungle Road could be calculated as:

	Cars Cars & Trailers	Rigid Vehicles	Articulated Vehicles	B-Doubles, Doubles & Road Trains
AADT	425	55	11	1

2.3 Crash Data

Crash data collected by NT Police over the past 6 years for Batchelor and Rum Jungle Road was provided by the Department of Planning and Infrastructure. It shows the following crash statistics for:

a) Batchelor Road

There were 11 crashes recorded in the 6 year period from 1st Jan 1999 to 31st Dec 2005.

4 accidents were at intersections - 3 at the Stuart Highway

- 1 at Cameron Street in Batchelor

9 were single vehicle accidents out of control on or running off the carriageway and 6 of the 9 single vehicle accidents were along the road – 3 were at intersections.

1 accident involved a pedestrian walking along the side of the road in Batchelor.

1 accident involved a rear end with a car turn left.

5 accidents occurred at night and 6 occurred in the daytime.

There were no recorded fatalities, and 4 accidents necessitated admission to hospital for treatment.

b) Rum Jungle Road

There were 9 accidents recorded in the 6 year period from 1st Jan 1999 to 31st Dec 2005.

3 accidents were at the Litchfield Park Road intersection.

7 of the 9 accidents were single vehicle accidents out of control on or running off the carriageway.

1 accident involved a reversing car.

1 accident involved a collision between two cars

1 accident occurred at night and 8 occurred in the daytime.

There has been one recorded fatality at the Litchfield Park Road intersection, and two other accidents necessitated admission to hospital for treatment.

3. Audit Findings and Recommended Priorities

The Findings and Recommended Priorities of each arising from this Road Safety Audit are presented as **Appendix C**.

4. Summary

4.1 Findings

Generally the road condition falls into three categories – sections that appear older and rough in ride quality, more recently constructed sections and intersections and those that appear to be better maintained within the town 60 km/h speed limit.

Site distance and visibility were generally good but there are a number of curves on the unrestricted speed section of Rum Jungle Road that do not appear to have adequate lateral clearance due to the presence of trees and steep cut out batters.

The road carriageway varies over its length with carriageway widths generally as follows:-

Older Sections Ch 00 to 3.5 km, Ch 8.1 to 11.15, Ch 13.65 to 19.1
- 6.2 m seal with approx 1.0m shoulders

Older Section Ch 19.1 to 19.4 – approx. 5.0m seal 0 - 0.5m shoulders

New Section Ch 3.5 to 8.1 – 8.0 m seal (2/3.5m) with 1.0 unsealed shoulders

Town Section Ch 11.15 to 13.65 – 6.4 m seal & varying shoulder widths 1.0+m

Shoulders were not well maintained for significant lengths of road, were narrow i.e. under 1.0m and rounded to non existent in others. Cut and fill batters are steeper than 1 in 4 for a significant portion and showed significant scour creating vertical drops of up to 0.5m within the clear zone. Some steep fill batters on the outside of curves were approx. 2.0m high or greater. Cut-out batters in a number of sections in the old and newly constructed sections were in excess of the recommended slopes within clear zone for the posted speed limits.

Both Batchelor and Rum Jungle roads have sections that produce a quite bumpy ride in both sedans and 4WD vehicles. There also are locations associate pavement deformations where some ponding of water occurs and could lead to loss of breaking and or potential for aqua-planing.

Signage and line marking were noted as adequate to marginal on most of the older sections outside the township limits with missing guideposts, inadequate spacing of guideposts and missing, faded, incorrectly located, or incorrectly sized advance warning signs.

No edge lines were marked along a majority of the road; the exception being the more recently constructed section of the Batchelor Road. Overtaking barrier lines are inconsistent and do not appear to be located correctly in some locations. A section of recently resealed road in the town section had not been line marked at the time of the site works.

In addition to the steep fill and cut-out batters within the clear zone a number of other objects were identified as obstructions. These include property access culverts, trees, non-frangible based poles and road culvert headwalls within a metre of the edge of seal.

A detailed list of observations is presented in Appendix C prioritised in order of potential risk. The general shortcomings identified lead to the recommendation that the speed limit on at least the Rum Jungle section should be lowered to preferably 80 km/h or a maximum of 100 km/h. The reduction in speed limit would also reduce the clear zone widths required and therefore reduce clearing / relocation operations indicated as necessary by this report.

4.2 Concluding Statement

We have examined the contents of this report and its appendices. We have inspected the site. The audit has been carried out for the sole purpose of identifying any existing features that are missing, or could be altered or removed to improve the safety of the road. The identified issues have been noted in this report. The accompanying findings and priorities (in the form of a Findings and Recommended Priorities: **Appendix C**) are put forward for consideration by Compass NL and the Road Authority(s) for consideration and implementation.

Whilst every attempt has been made by the Audit Team to identify possible safety issues, no responsibility can be accepted for any issues identified after finalisation of this report.

Ross Treacy – Sinclair Knight Merz

Rod Page – Sinclair Knight Merz

Appendix A Check List

Stage 5
Existing Roads

Checklist 5.1

General Topics

Item	Issues to be Considered	Check	Comments
1 Landscaping	Is landscaping in accordance with guidelines (e.g. clearances, sight distance)?	✓	NO APPLICABLE
	Are required clearances and sight distances not likely to be restricted following future plant growth (landscaping and natural)?		—
2 Parking	Are provisions for parking satisfactory in relation to traffic operations and safety?	✓	NO GENERALLY APPLICABLE BUT SHOULDER ARE BARELY WIDE ENOUGH TO PARK ON ALONG MOST OF THE LENGTH.
3 Temporary works	Are all locations free of construction or maintenance equipment, and any signing or temporary traffic control devices that are no longer required?	✓	NIL
4 Headlight glare	Have any problems due to headlight glare (e.g. two-way service road close to main traffic lanes) been addressed?	✓	NO PROBLEM.

Project BATCHELOR ST RUN JUNGLE ROADS

Audited by ROSS TREACY / RON PAGE

Date 5/1/06 & 10/1/06

Stage 5
Existing Roads

Checklist 5.2

Alignment and Cross Section

Item	Issues to be Considered	Check	Comments
1 Visibility, sight distances	Is sight distance adequate for the speed of traffic using the route?	✓	YES GENERALLY BUT NOT THE OPEN SPEED LIMIT ON RUM JUNGLE ROAD.
	Is adequate sight distance provided for intersections, crossings (e.g. pedestrian, cyclist, cattle, railway) etc.?	✓	YES GENERALLY.
2 Design speed	Is the horizontal and vertical alignment suitable for the (85th %ile) traffic speed? If not:	✓	ROAD IS I
	(a) Are warning signs installed?	✓	YES – MOSTLY
	(b) Are advisory speed signs installed?	✓	NO
	Are the posted advisory speeds for curves appropriate?	✓	NIL.
3 Overtaking	Are adequate overtaking opportunities provided?	✓	YES
4 Readibility by drivers	Are there any sections of roadway which may cause confusion e.g.:		
	(a) Is alignment of roadway clearly defined?	✓	
	(b) Has disused pavement (if any) been removed or treated?	✓	N/A
	(c) Have old pavement markings been removed properly?	✓	N/A
	(d) Do streetlight and tree lines conform with the road alignment?	✓	YES SOME NEED TRIMMING.
5 Widths	Are all traffic lane and carriageway widths, including bridges, adequate?	✓	TRAFFIC LANES ARE OK BUT SHOULDER / CARRIAGEWAY IS NARROW
6 Shoulders	Are shoulder widths appropriate (e.g. for broken down or emergency vehicles)?	✓	NO – SHOULDER GENERALLY VERY NARROW
	Are shoulders traffickable for all vehicles and road users?	✓	NOT IN SOME PLACES.
	Is the shoulder crossfall sufficient to provide proper drainage?	✓	YES.
7 Batter slopes	Are the batter slopes and table drains safe for run off vehicles to traverse?	✓	NO

BATCHELOR & RUM JUNGLE ROADS
ROSS TRENCH & ROD PAGE 10/1/06
5/1/06

Stage 5 Existing Roads

Checklist 5.3

Intersections

Item	Issues to be Considered	Check	Comments
1 Location	Are intersections located safely with respect to horizontal and vertical alignment?	✓	YES
2 Warning	Where intersections occur at the end of high speed environments (e.g. at approaches to towns), are there traffic control devices to alert drivers?	✓	YES
3 Controls	Are pavement markings and intersection control signing satisfactory?	✓	YES GENERALLY.
4 Layout	Is the alignment of kerbs, traffic islands and medians satisfactory?	✓	YES
	Is the intersection layout obvious to all users?	✓	YES
	Are turning radii and tapers appropriate?	✓	YES.
5 Visibility, sight distances	Is sight distance adequate for all movements and all users?	✓	YES.

Project BATCHELOR & TUNGLIE ROADS

Audited by ROSS TREACY / ROD PAGE

Date 5/1/06 & 10/1/06

Stage 5
Existing Roads

Checklist 5.4

Auxiliary Lanes and Turn Lanes

Project BATCHELOR & REMOTE TOWNSHIP ROADS

Audited by KOSS TREACY & ROD PAGE

Date 5/12/06 10/1/06

Item	Issues to be Considered	Check	Comments
1 Tapers	Are starting and finishing tapers located and aligned correctly?	✓	N/A
2 Shoulders	Are appropriate shoulder widths provided at merges in accordance with design guidelines?	✓	N/A
3 Signs	Is signing and marking installed in accordance with standards?	✓	N/A.
4 Turning traffic	Is there advance warning of the approaching auxiliary lane (1km, 5km or whatever)?	✓	N/A
5 Visibility, sight distances	Have right turn movements within the length of the auxiliary lane been avoided?	✓	N/A.
	Has stopping sight distance been provided to the rear of turning vehicles?	✓	YES
	Has stopping sight distance been provided for entering and leaving vehicles?	✓	YES

Stage 5 Existing Roads

Checklist 5.5

Non-Motorised Traffic

Item	Issues to be Considered	Check	Comments
1 Paths	Are there appropriate travel paths and crossing points for pedestrians and cyclists?	✓	RURAL ROAD N/A
2 Barriers and fencing	Where necessary, is fencing installed to guide pedestrians and cyclists to crossings or overpasses?	✓	NO
	Is fencing of your design (e.g. avoid solid horizontal rails)?	✓	N/A
	Where necessary, is crash barrier installed to separate vehicle, pedestrian and cyclist flows?	✓	N/A
3 Bus stops	Are bus stops appropriately located with adequate clearance from the traffic lane for safety and visibility?	✓	NONE PRESENT.
4 Elderly and disabled	Are there adequate provisions for the elderly, the disabled, children, wheelchairs and baby carriages (e.g. holding rails, kerb and median crossings, ramps)?	✓	NIL N/A
	Where necessary, are hand rails provided (e.g. on bridges, ramps), and are they adequate?	✓	NIL N/A
	Distance between stop line and pedestrian crossing at signalised intersections (for visibility of pedestrians from truck driver's seat).	✓	NIL N/A
	Signal timing – cycle length – pedestrian clearance time – are pedestrian buttons operable?	✓	NIL N/A
5 Cyclists	Is the pavement width adequate for the number of cyclists using the route?	✓	NO PROVISION
	Is the bicycle route continuous, i.e. free of squeeze points or gaps?	✓	"
	Are bicycle safe grates provided at drainage pits where necessary?	✓	NIL N/A

Project: BATCHELOR / RUM JUNGLE ROADS

Audited by: ROSS TREACY / ROD PAGE

Date: 5/1/06 10/1/06

Stage 5
Existing Roads

Checklist 5.6

Signs and Lighting

Project: BATCHELOR & RUM DARWIN ROADS

Audited by: ROSS TREACY & ROD PAGE

Date: 5/11/06 10/11/06

Item	Issues to be Considered	Check	Comments
1 Lighting	Is appropriate lighting installed at intersections, roundabouts, pedestrian and bicycle crossings, pedestrian refuges, etc?	✓	LIMITED LIGHTING – MAY NEED INVESTIGATION FOR UPGRADE TO CURRENT STANDARDS.
	Is all lighting operating satisfactorily?	✓	MARGINALLY.
	Are the appropriate types of poles used for all locations and correctly installed (e.g. slip-base at correct height, rigid poles protected if within clear zone)?		
	Are all locations free of any lighting which may conflict visually with traffic signals or signs?	✓	N/A.
	Has lighting for signs, particularly overhead signs, been provided where necessary?	✓	NO.
2 Signs	Are all necessary regulatory, warning and direction signs (including detours) in place? Are they conspicuous?	✓	SOME ADDITIONAL ADVANCE WARNING SIGNS ARE REQUIRED.
	Are there any redundant signs?		
	Are traffic signs in their correct locations, and properly positioned with respect to lateral clearance and height?	✓	SOME NEED TO BE RELOCATED.
	Are the correct signs used for each situation, and is each sign necessary?	✓	NO – SOME ARE THE WRONG SIZE
	Are signs placed so as not to restrict sight distance, particularly for turning vehicles?	✓	YES
	Are all signs effective for all likely conditions (e.g. day, night, rain, fog, rising or setting sun, oncoming headlights, poor lighting)?	✓	OK FOR DARWIN WEATHER.
	Do sign supports conform to guidelines?	✓	YES.

Signs and Lighting – contd.

Item	Issues to be Considered	Check	Comments
3 Marking and delineation	Have retroreflective markers been installed? Where coloured markers are used, have they been installed correctly?		
	Is all necessary pavement marking installed?	✓	EDGE LINES FOR FULL LENGTH WOULD BE ADVANTAGE.
	Are pavement markings (centre lines, edge lines, transverse lines) clearly visible and effective for all likely conditions (e.g. day, night, rain, fog, rising or setting sun, oncoming headlights, light coloured pavement surface, poor lighting)?		
	On light coloured pavement surfaces (e.g. concrete) are RRPMs used to simulate traffic lanes?	✓	N/A.
	Has raised profile edge marking been provided where necessary (e.g. fatigue zones)?	✓	N/A.
	Is delineation adequate and in accordance with guidelines (e.g. post-mounted delineators, RRPMs, chevron alignment markers)?		
	Is delineation effective for all likely conditions (e.g. day, night, rain, fog, rising or setting sun, oncoming headlights)?		
	If chevron alignment markers are installed, have the correct types of markers been used?		
	Are vehicle paths through intersections delineated where required?	✓	GENERALLY YES.
	On truck routes, are reflective devices appropriate to driver's eye height?		

Stage 5
Existing Roads

Checklist 5.7

Traffic Signals

Project: Batchelor & Alan Tawse Roads

Audited by: Ross Treacy & Rod Page

Date: 5/1/06 10/1/06.

Item	Issues to be Considered	Check	Comments
1 Operation	Are traffic signals operating correctly? Is the number and location of signal displays appropriate?		
2 Visibility	Are traffic signals clearly visible to approaching motorists?		
	Is the end of likely vehicle queues visible to motorists so that they may stop safely?		
	Have any visibility problems caused by the rising or setting sun been addressed?		N/A.
	Are signal displays shielded so that they can be seen only by the motorists for whom they are intended?		
	Where signal displays are not visible from an adequate distance, are signal warning signs and/or flashing lights installed?		
3 Other provisions	Where necessary, are there provisions for visually impaired pedestrians (e.g. audio-tactile push buttons, tactile markings)? Are they working?		
	Where necessary, are there provisions for elderly or disabled pedestrians (e.g. extended green phase, phase displacement)?		

Stage 5 Existing Roads

Checklist 5.8

Physical Objects

Item	Issues to be Considered	Check	Comments
1 Clear zone	Is a clear zone provided in accordance with the guidelines?	✓	Trees & batters do not NO comply
	Is the appropriate treatment or protection provided for any objects within the clear zone (e.g. slip-base or frangible poles, crash barrier, crash cushions, sloping culvert headwalls)?	✓	NO - poles. Some culverts do not comply.
2 Crash barriers	Are safety barriers installed at all necessary locations, including on bridges, in accordance with guidelines?	✓	NO No barrier Roll at Roadway / Culverts.
	Are the crash barrier systems suitable for the purpose?	✓	NIL INSTALLED
	Is the length of crash barrier at each installation adequate? Are the crash barriers correctly installed?	✓	N/A
	Are Guard Rail Energy Absorbing Terminals (GREAT) or crash cushions installed where necessary (e.g. off ramp, bridge piers)?	✓	N/A
	Where works are subject to stage construction, are temporary barriers installed in accordance with guidelines?	✓	N/A.
	Is there a safe run off area behind breakaway terminals?	✓	N/A
3 Fencing	Is pedestrian fencing where needed?	✓	N/A
	Is fencing in the clear zone free of separate horizontal rails?	✓	NIL.
	Is there adequate delineation/visibility of barriers and fences at night?	✓	YES / NIL.

Project: BATHURST & RUM JUNGLE ROAD

Audited by: ROSS TREACY / ROAD PLACE

Date: 5/1/06 10/1/06

Stage 5
Existing Roads

Checklist 5.9

Delineation

Project: BATCHELOR & RUN TWELVE ROADS

Audited by: ROSS TREACY / ROD MACE

Date: 5/1/06 10/1/06

Item	Issues to be Considered	Check	Comments
1 Linemarking	Are all linemarkings (centre line, edge line, transverse lines) in good order?	✓	AVERAGE
2 Guide posts	Are guide posts correctly placed, clean, and visible?	✓	NO — need closer spacing
3 RRPMs	Are RRPM's in good order?		
4 Chevron Alignment Markers	Are Chevron Alignment Markers placed correctly, and used only according to standards?		

Stage 5 Existing Roads

Checklist 5.10

Pavement

Item	Issues to be Considered	Check	Comments
1 Pavement defects	Is the pavement free of defects (e.g. excessive roughness or rutting, potholes, etc) which could result in safety problems (e.g. loss of steering control)?	✓	Surface is Rough in places but no a problem.
2 Skid resistance	Does the pavement appear to have adequate skid resistance, particularly on curves, steep grades and approaches to intersections?	✓	YES.
	Has skid resistance testing been carried out where necessary?	✓	NO TESTING DONE.
3 Ponding	Is the pavement free of areas where ponding or sheet flow of water may occur, with resultant safety problems?	✓	DISTORTED PAVEMENT DOES POND WATER IN PLACES
4 Loose screenings	Is the pavement free of loose screenings?	✓	YES.

Project BATCHELOR & RUM JUNGLE ROADS.

Audited by ROS TREACY / ROD PAGE

Date 5/1/06 10/1/06.

Appendix B Site Photographs

All of the following photographs were taken during the site visits on 5th and 10th January 2006

Ch. 0.25	Ch. 0.4 – Unlimited Speed restriction sign on approach to Stuart Highway
Ch. 0.4 – Winding road, rough surface – requires more guide posts.	Ch. 0.65 – On approach to railway crossing, church campsite intersection on left hand side.

Ch. 0.7 – Looking from Church Campsite access. *Note: incorrect hazard sight board*	Ch. 0.9 – Approach to Commalie Creek
Ch. 1.10 Approach to Coomalie Creek. Large trees adjacent carriageway.	Ch. 2.8 – *Note: right hand curve sign at Ch. 3.02 needs to be relocated.*

Typical steep cut	Ch. 3.7 – Steep cut batters left hand side and right hand side.
Ch. 5.9 – On approach to Crater Lake Road left hand side	Ch. 6.1

Ch. 6.1 – Looking back to crest and left hand curve	Ch. 6.2 – Crater Lake Road Intersection
Ch. 6.8 – Looking to gravel access with culvert.	Ch. 6.8 - Looking to gravel access with culvert.

Ch. 6.9 looking back to gravel access.	Ch. 8.0 – On approach to floodway large trees adjacent carriageway.
Ch. 10.05 – Typical culvert Headwall. Close to edge of seal.	Ch. 10.05 - Typical culvert Headwall. Close to edge of seal.

Ch. 11.10 – Entering town area 60km/hr speed zone. *Note: no guide posts.*	Ch. 11.25 – On approach to Cameron Road on left hand side.
Ch. 11.30 – Cameron Road on left hand side. *Note: some guide posts missing.*	Ch. 12.4 – Coach Road Roundabout – incorrect signposting and no line marking. Needs to be reviewed and fixed.

Ch. 12.4 – Coach Road Roundabout – incorrect signposting and no line marking. Needs to be reviewed and fixed.	Ch. 12.4 – Coach Road Roundabout – incorrect signposting and no line marking. Needs to be reviewed and fixed.
Ch. 12.4 – Coach Road Roundabout – incorrect signposting and no line marking. Needs to be reviewed and fixed.	Ch. 12.85 – Meneling Road Intersection. *Note: damaged sight board.*

Ch. 12.85 – Meneling road Intersection. *Note: signposting hidden behind advertising signs and overhanging tree.* *Note also: lack of line marking and guideposts.*	Ch. 18.6 – Skewed culvert – Headwalls close to road are a hazard.
Ch. 18.6 – Skewed culvert – Headwalls close to road are a hazard.	Ch. 18.6 – Skewed culvert – Headwalls close to road are a hazard.

Ch. 18.6 – Culvert is exposed and inadequate cover	Ch. 18.6 – Culvert is exposed with drop off from the road shoulder.
Ch. 18.65 – On approach to Litchfield Park Road	Typical culvert headwall close to edge of seal.

Large trees in steep cut batter	Ch. 18.9 – Approach Litchfield Park Road Intersection
Ch. 19 – Table Drain scour left hand side	Ch. 19.05 – Litchfield Park Road Intersection

Ch 19.0 Note vertical drop into table drain LHS due to scour.	Ch. 19.05 – Looking back to Batchelor from Litchfield Park Road Intersection
View from Litchfield Park Road toward the intersection of Rum Jungle Road	Ch. 19.15 –Narrow sealed section from Litchfield Park Road toward Rum Jungle Mine Note Seal cracking and edge break back steep batters in table drains and need for maintenance mowing.

Appendix C Prioritised Findings

Location/Report Title:**…..Batchelor / Rum Jungle Roads**

Austroads Audit Stage:**….Stage 5 Existing Road**

Auditors:**……...Ross Treacy and Rod Page**

Organisation:**…….Sinclair Knight Merz**

Audit Date:**..……...5th and 10th January 2006**

Report Date:**…….20th January 2006**

Audit Finding	Recommendations	Ranking (1 highest)
1. Batters and Table Drains		
Steep Fill batters, table drains and steep Cut Batters are common in a number of sections along the road	Require general review and determine economic benefit of either flattening batters / installation of barrier protection	2
	Scouring intersection table drains requires maintenance	3
2. Carriageway		
Posted speed limit section of rough and windy roads are too high	Reduce the speed limit or reconstruct the road pavement	2
Carriageway is rough and has nil width or narrow shoulders for significant lengths.	Construct and maintain shoulders	3
Long grass adjacent carriageway	Maintenance mowing needed	3

Audit Finding	Recommendations	Ranking (1 highest)
3. Line marking and Delineation Lack of guideposts and appropriate line marking.	Ch. 00 – 1.20 – Winding road needs additional guideposts to define alignment	3
	Ch. 1.20 – need to define narrow road, needs edge line and bigger hazard markers at Coomalie Creek.	2
	Ch. 1.80 – need extra guideposts around curve, curve approach sign required.	2
	Ch. 2.40 - need extra guideposts around curve	2
	Ch. 3.02 - need extra guideposts around curve, curve approach sign incorrectly located.	2
	Ch. 4.40 - need extra guideposts around curve	2
	Ch 5.50 – need extra guideposts around curve	2
	Ch. 9.50 - need extra guideposts around curve	2
	Ch 11-13.5 – Town Section. Inconsistent use of guide posts. Resealed road requires line marking, review the need for extra guideposts.	3
	Ch 11.75 – Awilla Road Intersection – Hold line and Double Barrier line needed.	3
	Ch 12.40 – Coach Road Roundabout line marking required.	2
	Ch 12.85 – Meneling Road Intersection – Hold line and Double Barrier line required.	3
	Ch 13.10 – Farkarri Road Intersection – Hold line and Double Barrier line required.	3

Audit Finding	Recommendations	Ranking (1 highest)
	Ch. 13.80 - need extra guideposts around curve	2
	Ch. 14.30 - need guideposts around curve	2
	Ch. 14.90 - need guideposts around curve.	2
	Ch. 15.70 – need extra guideposts around curve.	2
	Ch. 16.80 – need extra guideposts around curve.	2
	Ch. 18.3 – need extra guideposts around curve.	2
	Ch. 18.6 – Narrow culvert define road with edge lines and Hazard markers	2
Overtaking line marking identified as inadequate.	Requires review for full length of road.	2
	Repaint Linemarking	3
Faded line marking throughout	Paint edge lines for full length of road	3
	Ch. 19.0 – Intersection on crest required no overtaking zone to be defined	2
Resealed section of road in town has no line marking	Ch. 19.0 – 19.3 – Edge line and centre line marking required	3
Road is hard to read at night	Ch. 19.0 – 19.3 – Guideposts required	3

Audit Finding	Recommendations	Ranking (1 highest)
4. Signs The signage was identified as being inadequate. Inappropriate location, missing signs, undersized.	Ch. 0.15 – Replace hazard marker with bigger D4-1-1B (3200x800)	2
	Ch.0.40 – Unrestricted speed signs to be removed. These are misleading before a curve prior to the Stuart Hwy intersection. Relocate unrestricted speed limit signs onto the Stuart Highway.	3
	Ch. 0.80 – D4-2-1 hazard board incorrect, replace with D4-4A	4
	Ch. 1.20 – Coomalie Creek - Bigger hazard markers required at narrow culvert.	2
	Ch. 1.80 – advance warning signs needed for horizontal curve.	2
	Ch.3.02 – right hand curve approach sign in wrong location, relocate to Ch.2.9	2
	Ch. 5.90 – need crest warning signs	3
	Ch. 6.20 – sight boards are too low, raise typical at all intersections	3
	Ch. 6.28 – side road junction sign needs to be relocated to the top of crest at Ch. 6.40	2
	Ch. 11.0 – Install flood gauge post in Floodway.	3
	Ch. 11 – 13.5 – review needed for advanced warning signs. Town section – inconsistent use of intersection advance warning signs	3

Audit Finding	Recommendations	Ranking (1 highest)
	Ch 11.75 – Awilla Rd Intersection requires give way sign and side road junction sign.	3
	Ch 12.40 – Coach Road roundabout signage incorrect, requires correction.	3
	Ch. 12.85 – Meneling Road intersection, clear tree from signposting, replace damaged sight board, relocate advertising sign (on trailer), requires give way sign	3
	Ch.13.65 – new 80km/h speed restriction sign required for existing post right hand side	2
	Ch. 14.90 – advance warning signs needed for horizontal curve	2
	Ch. 15.9 – advance warning signs needed for horizontal curve	2
	Ch. 18.60 – Narrow culvert – install narrow width hazard markers (may also need flood gauge posts if regularly overtopped).	2
	Ch. 19.0 – Need to install signage for no through road.	2
	Ch. 19.20 – 'Litchfield park' direction sign too close to edge of seal - relocate	2
	Ch.19.30 – need intersection advanced warning signage	2

Audit Finding	Recommendations	Ranking (1 highest)
5. Poles and other obstructions		
Ch. 0.10 – tree overhanging road	trim	2
Ch. 1.20 – trees adjacent seal (Coomalie Creek)	Remove trees	2
Ch 3.30 – 'Johnies Farm' – large trees adjacent carriageway.	Remove trees	2
Ch. 6.85 – gravel driveway with culvert close to seal.	Review potential accidents. Remove or modify obstructions	2
Ch. 8.15 – Large trees adjacent seal.	Remove trees	2
Ch. 9.6 – 9.8 – trees cut batter in.	Remove trees as part of cut batter flattening if required	2
Ch. 11.0 – 13.5 - Large trees adjacent seal (town section)	Clear trees obstructing sign posting.	3
Ch 12.85		
Ch. 18.6 – Large trees adjacent seal.	Remove trees	2

Audit Finding	Recommendations	Ranking (1 highest)
6. Bridges, Culverts and Causeways / Floodways Several culverts identified with headwalls encroaching into shoulder too close to edge of seal. The following identified as less than 1.0m from edge of seal which reduces shoulder to less than minimum desirable width		
Ch 1.20 – Coomalie Creek Headwall <1.0 outside lane	Extend culvert	2
Ch. 3.20 – Headwall 1.0 m from edge of bitumen	Extend Culverts and causeways to outside of shoulder (carriageway width)	2
Ch. 8.60 – Headwall 0.7m from edge of bitumen	Extend culvert	2
Ch. 9.80 – Headwall 0.9m from edge of bitumen.	Extend culvert	2
Ch. 9.95 – Headwall 0.8m from edge of bitumen	Extend culvert	2
Ch. 10.05 – Headwall 0.9m from edge of bitumen	Extend culvert	2
Ch. 18.60 – Skew culvert exposed, no cover, headwalls are a hazard, overtopping has created a drop off from the shoulder.	Extend culvert	2

Audit Finding	Recommendations	Ranking (1 highest)
7. Street Lighting		
Street lighting present through township.	Review for compliance with lighting standard.	3
Numerous street lights not working	Maintenance required	3
8. Speed Limits		
Ch. 00-1.3 is winding and rough surface.	Reduce speed limit from 100km/hour to 80km/hour	2
Ch. 16-20 unlimited speed zone is too high for this section	Reduce speed limit to 80km/hour	2

Appendix D Detailed List of Observations for Inspections of 5/1/06 and 10/1/06

BATCHELOR ROAD SAFETY AUDIT

CHAINAGES START AT THE STUART HIGHWAY INTERSECTION

CHAINAGE	SIDE	DESCRIPTION
00 to 20		**slash grass both sides of road**
00 to 20		**linemarking on old road is faded, most curves do not appear to have enough guide posts**
11 to 13.5		**town section - recent resealing reuires linemarking**
11 to 13.5		**town section - inconsistant use of guide posts, guide posts missing at intersections**
0.02	rhs	giveway sign
0.10	rhs	tee junction advance warning
0.15	rhs	sight board D4-1-3 sharp bend
0.20		culvert
0.30	lhs	distance sign - Batchelor 12
0.35	lhs	distance sign - litchfield 30
0.40	lhs & rhs	speed restriction signs 100km and unlimited
0.40		**remove unlimited speed signs on approach to Shwy - install speed signs on Shwy**
0.41		culvert
0.42	lhs	tourist sign WWII and parking
0.42	rhs	guide sign Darwin/katherine
0.60		culvert
0.60	lhs	advance warning sign - railway crossing
0.61	lhs	access to WWII site
0.70	rhs	tourist sign WWII and parking
0.80	lhs	seales access road to church facility
0.80	rhs	hazard board opposite int D4-2-1incorrect
0.80	**rhs**	**replace D4-2-1 with D4-4A**
0.85		railway crossing
0.98	lhs	blank sign
1.05	lhs	floodway sign & fgp
1.10	rhs	railway crossing
1.20		Coomalie creek
1.20		narrow road hazard markers D4-3 each side on both approaches
1.20		creek name pate and fgp on both approaches
1.20		large trees adjacent seal
1.20		**Coomalie creek - need to better define narrow road - edge lines and bigger hazard markers**
1.25	lhs	deep table drain
1.30	rhs	floodway sign & fgp
1.30		**reduce speed limit from 00 to 1.3 from 100k to 80k**
1.55	rhs	blank sign
1.80	lhs	driveway "BUNYIP"
1.80	**lhs**	**need additional GPs around curve**
2.00	lhs	driveway disused
2.05		culvert
2.20		6.3m seal 1.5m shlds
2.40	**rhs**	**need additional GPs around curve**
2.50	lhs	sign NT S003
2.85		culvert narrow - needs extending
2.85	lhs	HW 1.1m off seal
2.85	rhs	HW 1.4m off seal
2.85		**culvert needs extending both sides**
2.90	rhs	steep cut batter
3.02	lhs	right hand curve on crest, high fill steep batter, sign is incorrectly located too close to curve
3.02	**lhs**	**need additional GPs around curve**
3.02	**lhs**	**relocate right hand curve sign to 2.9**
3.20		culvert
3.21	lhs	driveway
3.30	lhs	driveway "Johnies farm" large trees adjacent carriageway
3.30	**lhs**	**remove trees adjacent carriageway**
3.31	lhs	trees close to road
3.45	lhs	gate/access
3.50	rhs	sign NT S003
3.50		8m seal (2/3.5 lanes) 1m unsealed shoulder
3.60	rhs	left hand curve sign
3.70	rhs	steep cut batter
3.70	lhs	steep cut batter
3.90		culvert
4.15		culvert
4.10	rhs	steep cut batter
4.30	lhs	high fill
4.30	rhs	steep cut batter
4.40	**lhs**	**need additional GPs around curve**
4.70		culvert
4.98		culvert
5.20	lhs	steep cut batter
5.20	rhs	steep cut batter
5.40	rhs	high fill

5.40	lhs	right hand curve sign
5.42		culvert
5.45		culvert
5.50	lhs	high fill steep batters
5.50	**lhs**	**need additional GPs around curve**
5.60		some holes in seal need patching
5.60		**patch holes as part of maintenance**
5.80		culvert
5.90	lhs	sign watch for entering traffic
5.90		**need crest signs**
6.00	rhs	left hand curve sign
6.10	lhs	side road junction sign
6.10	rhs	100k speed restriction
6.20	lhs	intersection "crater lake road"
6.20	rhs	sight board and road name sign
6.20		**sight boards are typically too low - check all and raise**
6.25	lhs	crest sign
6.25		culvert
6.28	rhs	side road junction sign relocate to top of crest
6.40	**rhs**	**relocate side road junction sign to top of crest from 6.28**
6.30	lhs	100k speed restriction
6.40	rhs	sign watch for entering traffic
6.65	lhs	floodway sign
6.70	lhs	left hand curve sign - not required
6.70	**lhs**	**remove left hand curve sign - chech right hand curve sign rhs ch 7.5 ???**
6.75	rhs	crest sign
6.80	lhs	fgp
6.80		culvert
6.88	rhs	gravel driveway with culvert - potential hazard
6.88	rhs	driveway culvert is 8m from edge of seal
6.88	**rhs**	**review potential accidents at access culvert facing oncoming traffic**
6.90	rhs	floodway sign
7.00	lhs	high fill
7.00		culvert
7.30		culvert
7.50		culvert
8.00		culvert
8.10		end new roadworks
8.10		**overtaking linemarking needs review - entire length of road**
8.15		culvert
8.15		**large trees adjacent seal**
8.20	lhs	crest sign
8.20	rhs	steep cut batter
8.50		culvert
8.60		culvert
8.88		culvert
9.00		culvert
9.10		culvert
9.20	lhs	gravel driveway "Sundance farm"
9.50	rhs	steep cut batter with large trees
9.50	**lhs**	**need additional GPs around curve**
9.60		culvert
9.60	lhs	fencing is close to road typical
9.80		culvert may need extending
10.05		narrow culvert HWs 1m from edge of seal
10.05		**extend culvert**
10.10	rhs	gravel access
10.33		culvert
10.48	lhs	signs - "we like our lizards frilled not grilled"
10.50	lhs & rhs	speed restriction signs 80 and 100
10.70	lhs	gravel access
10.80	lhs	floodway sign
11.10		culvert narrow
11.13		start of town section
11.13	lhs	start of layby for tourist info signs
11.13	lhs & rhs	speed restriction signs 60 and 80
11.15	lhs	side road warning sign
11.33	lhs	intersection "Cameron road"
11 to 13.5		**town section - large trees are close to road - slow speed environment - review**
11.75	rhs	intersection - Awilla road
11.75	**rhs**	**Awilla road - install giveway sign, side road junction sign, linemark HL and DBL remove large tree**
12.30	lhs	intersection - parachute club access
12.35	lhs	intersection
12.40	lhs	intersection - airport access road roundabout (Coach road)
12.40		**roundabout - signage is incorrect and confusing - install correct signage and linemarking**
12.50		large culvert - hw close to back of kerb
12.50		**review culvert headwall location - potential hazard - low speed environment/intersection**
12.60	rhs	gravel track
12.80	rhs	intersection - Batchelor outdoor education unit

12.85	lhs	intersection - Meneling Road
12.85	**rhs**	**clear tree from signposting, replace damaged sight board, relocate advertising sign (on trailer)**
12.85		**linemark HL and DBL, install giveway sign and advance warning tee junction sign**
13.00	rhs	access to police station
13.10	rhs	intersection - Farkarri Road
13.10		**Farkarri rd- install advance warning signs side road and tee junction, linemark HL and DBL**
13.30	lhs	access to caravan park - not used
13.50	lhs	access to service station
13.58	lhs	access to service station
13.60		grid - end of town section
13.62	lhs	sign slipery when wet
13.65	lhs and rhs	speed restriction signs 80 and 60 (80k sign on rhs missing)
13.65	**rhs**	**install 80k speed restriction sign on existing post**
13.68	lhs	gravel access
13.80	**rhs**	**need additional GPs around curve**
13.93	rhs	sign - information 500m
14.00	lhs	left hand curve sign
14.30	**rhs**	**high fill need additional GPs around curve**
14.50	rhs	right hand curve sign
14.90	**lhs**	**need additional GPs around curve**
15.70	**rhs**	**need additional GPs around curve**
16.10	lhs and rhs	speed restriction signs unlimited and 80
16.1 to 20		**review unlimited speed limit on this section - 100 or 80 seems more appropriate**
16.80	**lhs**	**need additional GPs around curve**
17.05	rhs	gravel access
17.60		**crest - need no overtaking linemarking - review entire road**
17.70		culvert/fw
18.30	**rhs**	**left hand curve may need GPs rhs**
18.60		skew culvert headwalls are a hazard - top of culvert exposed no cover
18.60		**culvert requires extending to place headwalls outside of clear zone**
18.60		**need floodway signs/FGP and narrow road hazard markers**
18.70	rhs	floodway sign
18.85	lhs	side road warning sign
18.93	lhs	direction sign "Litchfield park"
19.05	lhs	intersection Litchfield Park road (on top of crest)
19.05		**crest - need no overtaking linemarking - review entire road**
19.10		road narrows
19.10		**need to install signage for "no through road"**
19.20	rhs	direction sign "Litchfield park"
19.30	**rhs**	**need intersection advance warning signage**
19.40		culvert

Appendix E Department of Planning and Infrastructure Traffic Count Data

Batchelor Road & Litchfield Park Road Traffic Figures - Rum Jungle road not available

2004 Monthly AADT

Road Name	ADT Station	Related Primary Station	Direct	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	AADT
BATCHELOR ROAD																	
5KM WEST OF STUART HWY	RDVDP015		I	VEH	211	233	252	249	325	393	468	412	382	333	279	231	315
			O	VEH	218	240	261	274	347	426	491	437	392	344	286	234	330
LITCHFIELD PARK ROAD																	
5KM WEST OF FINNIS RIVE	RDVDP035		I	VEH	89	73	85	185	194	255	343	297	213	162	109	85	175
			O	VEH	89	72	85	189	202	262	357	300	216	165	110	85	178

Vehicle Class counts

Road No.	Road Name / Location	ADT Station	Month	Year	<------ Percentage of Vehicles in each Vehicle Category -------> 1	2	3	4	5	6	7	8	9	10	11	12	13
57	BATCHELOR ROAD	RDVDP015	Oct	2004	83.6	3.1	7.6	4.0	0.1	0.4	0.4	0.3	0.3	0.0	0.1	0.0	0.0
340	LITCHFIELD PARK ROAD	RDVDP035	Sep	2003	83.7	4.3	7.9	0.9	0.0	2.3	0.6	0.1	0.0	0.0	0.1	0.0	0.0

10 Year AADT

Road Name / Location	Road No.	ADT Station	Direction	Units	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
0BATCHELOR ROAD	57	RDVDP015	INBOUND	VEH	445	465	467	469	475	349	369	353	318	315
5KM WEST OF STUART HWY			OUTBOUND	VEH	319	337	362	364	345	341	371	365	329	330
					764	802	829	833	820	690	740	718	647	645
0LITCHFIELD PARK ROAD	340	RDVDP035	BOTH	VEH	234	251	295	317						
5KM WEST OF FINNIS RIVER CROSSING			INBOUND	VEH					162	155	156	158	159	175
			OUTBOUND	VEH					163	153	158	159	161	178
					234	251	295	317	325	308	314	317	320	353

Appendix F Crash Data – 1999 to 2005

Vehicle Crashes Rum Jungle Road (01/01/1999 - 31/12/2005)

Accident	Date	Time	Day	Type	Units	geway ?	Alcoh.	RUM No	Road Name	Suburb/Area	From ID	Direction	Nearest ID Mrk	Intersection	Lighting	Traffic	Injury 1	Injury 2	Injury 3	Injury 4	Direct Trav 1	Direct Trav 2	Direct Trav 3	Direct Trav 4	Direct Trav 5	Direct Trav 6	Direct Trav 7
96701	9/7/1999	1730	TU	15	1	Y	N	90	RUM JUNGLE RD	RUM JUNGLE				LITCHFIELD PARK RD	1	1	0	0	0	1	W	-	-	-	-	-	-
88986	8/20/2000	1045	SU	1	1	Y	N	74	RUM JUNGLE RD	BATCHELOR	6 km	N-NORTH	BATCHELOR		1	1	0	0	0	0	N	-	-	-	-	-	-
91157	2/16/2001	1745	FR	15	2	N	N	45	RUM JUNGLE RD	BATCHELOR					1	1	0	0	0	0	9	9	-	-	-	-	-
93851	7/15/2001	1100	SU	2	1	Y	N	82	RUM JUNGLE RD	RUM JUNGLE	20 km	W-WEST	LITCHFIELD PARK RD	LITCHFIELD PARK RD	1	1	0	0	1	0	W	-	-	-	-	-	-
102816	7/31/2003	0	TH	3	1	N	N	81	RUM JUNGLE RD	RUM JUNGLE	4 km	N-NORTH	LITCHFIELD PARK RD		5	1	0	2	0	0	N	-	-	-	-	-	-
106749	7/6/2004	930	TU	15	1	Y	N	88	RUM JUNGLE RD	RUM JUNGLE	4 km 500 metres	N-NORTH	BATCHELOR		1	2	0	0	0	0	S	-	-	-	-	-	-
107304	8/20/2004	1130	FR	8	2	Y	N	13	RUM JUNGLE RD	RUM JUNGLE				LITCHFIELD PARK RD	1	1	0	0	0	0	E	N	-	-	-	-	-
109089	1/8/2005	1700	SA	3	1	Y	N	80	RUM JUNGLE RD	RUM JUNGLE	2 km	N-NORTH	MENELING RD		1	1	0	0	0	0	S	-	-	-	-	-	-
109783	5/8/2005	1230	SU	1	1	Y	N	88	RUM JUNGLE RD	BATCHELOR	550 metres	N-NORTH	TARKARRI RD		1	1	0	0	1	0	S	-	-	-	-	-	-

Appendix 16

Traffic Impact and Risk Assessment

Browns Oxide Mine Project

BATCHELOR / RUM JUNGLE ROAD

TRAFFIC IMPACT AND RISK ASSESSMENT REPORT

- Traffic Study
- Final
- 27th January 2006

Browns Oxide Mine Project

BATCHELOR / RUM JUNGLE ROAD

TRAFFIC IMPACT AND RISK ASSESSMENT REPORT

- Final
- 27th January 2006

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1. Introduction

SKM was commissioned by Compass Resources NL to review risks associated with the Batchelor / Rum Jungle Road, both in terms of its current condition and traffic, and in terms of the impact on its current operation as impacted by the proposed mine generated traffic.

The extent of road reviewed as part of the study was the section from the Batchelor Road / Stuart Highway intersection to the roped off road at Ch 20.45km on the Rum Jungle section of the road.

The study does not involve risk analysis matrices or associated risk probability models but reviews the impact of the proposed mine generated traffic in terms of additional traffic of various vehicle categories on the road network and those impacts on Batchelor / Rum Jungle Road and specifically the Litchfield Park Road intersection with Rum Jungle Road.

The initial and integral part of this study involved a separate Level 5 – Road Safety Audit (RSA) of the road to assess any current safety issues. This RSA is referred to throughout this report and can be used by Compass Resources NL to develop any safety and transportation procedure deemed applicable by them to the proposed mine operations.

2. Traffic

2.1 Existing Traffic

The most recently available traffic survey information from the NT Department of Planning and Infrastructure was supplied to SKM on request. A review of the traffic numbers and categories currently using Batchelor Road and Litchfield Road recorded at primary count stations 5 kilometres west of the Stuart Highway and 5 kilometres west of the Finniss River Crossing respectively are provided below.

No vehicle Average Annual Daily Traffic (AADT) counts are available for Rum Jungle Road.

Batchelor Road	2004 AADT	645
Litchfield Road	2004 AADT	353

It should be noted that traffic in July exceeds AADT counts by 50% on Batchelor Road and 100% for Litchfield Road.

A break up of the vehicle categories observed on the roads is:

	Percentage by Category			
Road	Cars Cars & Trailers	Rigid Vehicles & buses	Articulated Vehicles	B-Doubles / Road Train Doubles
Batchelor	86.7	11.7	1.4	0.1
Litchfield	88.0	8.8	3.0	0.1

The translation of these percentages produces the following vehicle traffic based on the AADT's provided by Department of Planning and Infrastructure.

Road	Cars Cars & Trailers	Rigid Vehicles & buses	Articulated Vehicles	B-Doubles / Road Train Doubles	Total
Batchelor	559	75	9	0.65	645
Litchfield	310	31	11	0.35	353

As there is no information available for the Rum Jungle Road and the count station on the Litchfield Road is 5 kilometres west of the Finniss River the significant number of vehicles that access properties off the Litchfield Road and via White Road of Rum Jungle Road are missed. These would include daily return trips to or from Batchelor and beyond from these properties.

It could be expected that the number of vehicle trips on Rum Jungle Road and the first kilometre section of Litchfield Park Road would be in excess of that on Litchfield Road at the count station but not exceed that of Batchelor Road.

Without other vehicle survey data a reasonable estimate of traffic on Rum Jungle Road and Litchfield park Road could be made as:

	Cars Cars & Trailers	Rigid Vehicles	Articulated Vehicles	B-Doubles / Road Train Doubles
AADT	425	55	11	0.65

The volume of traffic continuing on Rum Jungle Road to White Road is expected to be minimal and with the development of the Mine need to use Litchfield Park Road to access Lithgow Road via Bevan Road.

2.2 Existing Road Capacity

The existing sections of Batchelor and Rum Jungle Roads are generally 6.2 to 6.3 metre seal and 1.0^{+} metre shoulders. The current condition of some shoulder sections was found to be unsatisfactory in the recently completed Stage 5 – Road Safety Audit – subject of a separate report.

Recommended road traffic capacities for various road carriageways configurations are specified in the Austroads Publication – A Guide to the Geometric Design of Rural Roads 2003:

Minimum Seal Traffic Lanes

Design AADT's	1-150	150-500	500-1000	1000-3000
Minimum Lane Width (m)	One Lane 3.5	Two Lanes 3.1	Two Lanes 3.1 – 3.5	Two Lanes 3.5

And shoulder widths associated with the various volumes are:

AADT (vpd)	Total Shoulder Width (m)	Shoulder Seal Width (m)
Single Lane Roads	2.0	0.5
Two Lane Roads		
1-500	1.5	0.5
500-1000	1.5	0.5
1000-3000	2.0	1.0

When the road was constructed the road parameters would have been in accordance with an earlier edition of the Austroads Guide that had the following carriageway widths.

Minimum Seal Traffic Lanes

Design AADT's	1-150	150-500	500-1000	Over 1000
Minimum Lane Width (m)	One Lane 3.5	Two Lanes 3.0	Two Lanes 3.0-3.5	Two Lanes 3.5

And shoulder widths associated with the various volumes are:

AADT (vpd)	Minimum Width (m)
Single Lane Roads	1.5-2.5
Two Lane Roads	
1-500	1.0*-1.5
500-100	1.0*-2.0
Over 1000	1.0-3.0

* Where 1.0m shoulders are used, provisions should be made for vehicles to stop clear of the traffic lanes in locations of low fills and transitions of cut to fill. It becomes more important where traffic volumes are over 500 vpd.

It can be noted that as traffic volumes on Batchelor and Rum Jungle Roads are around the 500vpd the shoulder section of the carriageway section does not comply with the current guidelines but has adequate capacity in terms of AADT. However, reconstruction and maintenance of shoulders and table drains must be initiated and programmed to ensure the level is maintained or improved.

2.3 Crash Data

Crash data collected by NT Police over the past 6 years for Batchelor Road and Rum Jungle Road was provided by the Department of Planning and Infrastructure. It shows the following crash statistics.

a) Batchelor Road

There were 11 crashes recorded in the 6 year period from 1st Jan 1999 to 31st Dec 2005.

- 4 accidents were at intersections - 3 at the Stuart Highway
- - 1 at Cameron Street in Batchelor
- 9 were single vehicle accidents out of control on or running off the carriageway and 6 of the 9 single vehicle accidents were along the road – 3 were at intersections.
- 1 accident involved a pedestrian walking along the side of the road in Batchelor.

- 1 accident involved a rear end with a car turn left.
- 5 accidents occurred at night and 6 occurred in the daytime.

There were no recorded fatalities, and 4 accidents necessitated admission to hospital for treatment.

b) Rum Jungle Road

There were 9 accidents recorded in the 6 year period from 1st Jan 1999 to 31st Dec 2005.

- 3 accidents were at the Litchfield Park Road intersection.
- 7 of the 9 accidents were single vehicle accidents out of control on or running off the carriageway.
- 1 accident involved a reversing car.
- 1 accident involved a collision between two cars
- 1 accident occurred at night and 8 occurred in the daytime.

There has been one recorded fatality at the Litchfield Park Road intersection, and two other accidents necessitated admission to hospital for treatment.

2.4 Browns Oxide Mine Projected Traffic

The traffic on Batchelor and Rum Jungle Roads generated by the Browns Oxide Mine Project has been developed for the Public Environmental Report is broken down into the various vehicle types as shown below:

Table 1 - Projected Traffic Generation

Contruction Phase (5 months)

Vehicle	Type	Monthly trips	Daily traffic (both ways)	
construction materials	B-double	30	2	
Bus	36 person	60	4	rigid vehicle
Light Vehicles	passenger	850	56.7	

or Grouped into General Vehicle Categories

Light Vehicles	56.7
Rigid Vehicles	4
Articulated Vehicles	0
B-Doubles / RT Doubles	2
Triple RT's	0

Operation Phase

Vehicle	Type	Monthly trips	Daily traffic (two way)	
Employees	Light Vehicles	1500	100	
Fuel	100t Road Train - triple	30	2.0	
Acid	60t B-Double	4	0.3	
Explosives	40t Special Tank	8	0.5	articulated
Reagents	B-Double	18	1.2	
Lime	60t B-Double	20	1.3	
Stores etc.	B-Double	8	0.5	
Product Haulage	60t B-Double	20	1.3	

or Grouped into General Vehicle Categories

or

Light Vehicles	100
Rigid Vehicles	0
Articulated Vehicles	0.5
B-Doubles / RT Doubles	4.7
Triple RT's	2.0

2.5 Projected Combined Traffic

To review the relative additional traffic in vehicle categories we have produced a tabulated comparison for the construction phase and operational phase of the mine.

Table 2 –Projected Combined Traffic.

Traffic	Road	Cars / Cars+Trailers	Rigid Vehicles	Articulated Vehicles	B-Doubles, Double Road Trains	Triple Road Trains
Existing	Batchelor	559	75	9	0.65	0
	Rum Jungle	425	55	11	0.65	0
	Litchfield Park	425	55	11	0.65	0
Mine Construction	Batchelor	57	4	0	2	0
	Rum Jungle	57	4	0	2	0
	Litchfield Park	0	0	0	0	0
Mine Operational	Batchelor	100	0	0.5	4.7	2
	Rum Jungle	100	0	0.5	4.7	2
	Litchfield Park	0	0	0	0	0
Total (Including Construction Phase)	Batchelor	616	79	9	3	0
	Rum Jungle	525	55	11.5	5.3	2
	Litchfield Park	425	55	11	0.65	0
Total (Including Operational Phase)	Batchelor	659	75	9.5	5.3	2
	Rum Jungle	525	55	11.5	5.3	2
	Litchfield Park	425	55	11	0.65	0
Relative increase in Construction Phase	Batchelor	0.10	0.05	0.00	3.08	0.00
	Rum Jungle	0.13	0.07	0.00	3.08	0.00
	Litchfield Park	0	0	0	0	0
Relative Increase in Operational Phase	Batchelor	0.18	0.00	0.06	7.18	2.00
	Rum Jungle	0.24	0.00	0.05	7.18	2.00
	Litchfield Park	0	0	0	0	0

The distribution in the above table of traffic assumes all traffic travelling to the Mine site originates from the Stuart Highway and returns there. This is conservative for numbers on all roads as a number of personnel during the construction phase may be based in Batchelor and in the Operational phase may be based in Batchelor and locally – possibly on properties accessing the Lichfield Park Road.

However it is expected the supply vehicles approaching and departing site would originate from the Stuart Highway.

A comparison of traffic generated by the mine in the two phases shows the increase in daily traffic are marginal for all vehicle categories except B-Doubles / Road Train Doubles and Road Train Triples.

However, the concern in average daily traffic for the B-Double, Road Train Doubles and Road Train Triples in only small in numbers at a total of 6.7 vehicles per day (v.p.d) or 3.35 v.p.d each way

If triple road trains are not permitted to operate at Batchelor and Rum Jungle Road the increase in B-Double or Road Train Doubles would only amount to an average of 1 v.p.d or a total daily volume of 7.7 v.p.h or 3.85 v.p.d in each direction.

To put this into perspective three Road Train Doubles were observed hauling cattle on Litchfield and Rum Jungle Roads to Batchelor within a period of 1.5 hours at an inspection of the roads on the 5th January 2006.

2.6 Peak Traffic Movements

The peak morning and evening traffic movements must be considered as the work force segment of traffic generated by the mine will be concentrated at change of shifts.

The peak traffic from the mine, with a three shift cycle is 33% of the 100 light vehicles per day or 34 vehicles – 17 vehicles arriving, 17 vehicles departing.

Mine Morning Peak Period 6:30 – 7:30 am

Mine Evening Peak Period 2:30 – 3:30 pm

The percentage of the base level existing traffic travelling in the morning and evening peak hour coinciding with mine peak traffic movements is difficult to predict.

However, the majority of morning tourist traffic is not likely to use Batchelor and Rum Jungle Roads until after 7:30 am. There if there is a coincidence of peak hour movements it is likely to be in the afternoon with tourists etc. returning through Batchelor. Base traffic is likely to be in the order of 10% of the AADT or

60 vph on Batchelor Road

and about 45^{+} vph on Rum Jungle Road

The projected 34 vph from the mine result in an aggregate total traffic flow of 94 and 79 vph respectively. Mine generated traffic being an estimate of approximately 50% the Batchelor Road traffic and 50 – 75% of the Rum Jungle Road traffic.

The percentage of peak hour traffic on Batchelor Road is conservative as a portion of the Browns Work Force would be expected to reside in Batchelor.

The total estimated traffic is well within the carrying capacity of the sealed road lanes and carriageway and the National Road Design Guidelines.

Comments by Northern Territory Police associated with previous accidents on the road involving road trains confirm observations in the Road Safety Audit Report that shoulders are too steep, too narrow and require reconstruction and regular maintenance. Deep scours in table drains directly adjacent shoulder compound the shoulder problems. Once the responsible Authority undertakes the required maintenance works, heavy vehicles (of all categories) should travel the roads with an improved level of safety (including the small number of Browns Mine traffic). This inproved level of safety would be further underpinned by reducing the posted speed limit to 80km/h.

The Road Safety Report findings reinforce the current safety concerns with the Rum Jungle Road in particular, and recommends that the speed limit be reduced to 80 kilometres per hour or as a maximum 100km/h in lieu of the currently posted unlimited speed.

2.7 Rum Jungle Road / Litchfield Park Road Intersection

Correspondence received from the Northern Territory Government recommends improvements be made to the above mentioned intersection.

The intersection is currently constructed and operates as a Tee-intersection with give way signed control of Litchfield Park Road at Rum Jungle Road i.e. traffic approaching the intersection on Litchfield Road must slow or stop to give way to through or right turning traffic on Rum Jungle Road. The posted speed limit for both roads is Unlimited.

The intersection was reviewed as part of the separate Road Safety Audit and was not noted as warranting any specific upgrading apart from more additional and better placed advanced warning signage. This is primarily due to the tight horizontal alignment of Litchfield Road and the vertical alignment of both roads on the approach to the intersection (at a crest on Rum Jungle Road).

The projected addition low numbers of Browns Mine traffic to Rum Jungle Road does not impact on the efficient operation of the intersection that is subject to low traffic flows even in peak periods. The current intersection has more than adequate capacity to accommodate the projected traffic including any natural growth in the coming years.

However, it is acknowledged that traffic passing through the intersection to Browns Mine on Rum Jungle Road will be higher by up to around 20 vph. The increased traffic will improve the awareness of locals using the intersection that traffic controls at the intersection must be complied with. Concern for tourists and other drivers unfamiliar with the Litchfield Park Road approach to

the Rum Jungle Road intersection is acknowledged due to the tight curves on the approach and the posted unlimited speed. Drivers are often weary and not alert after a long day and improved advanced warning signage and devices have been recommended for the current intersection configuration.

To emphasise the increased through and turning traffic on Rum Jungle Road it is recommended that the intersection operation be changed to a Stop sign / Hold line controlled intersection to reduce the tendency of drivers to just slow down without stopping, before turning onto Rum Jungle Road from Litchfield Park road.

The intersection could be resealed with different aggregate to provide a visual clue of the intersection hierarchy. New linemarking would be required as part of the works in addition to new signage on the approaches to the intersection. New signage recommended should include:

Lichfield Park Road

Advanced Intersection Directional Signs	Stop Sign Ahead & Rumble Strips	Reduce Speed	Tee Intersection T	Stop sign

Rum Jungle Road South

Rum Jungle Road North

In addition guide posts should be installed at closer spacings on the Litchfield Park Road approach and the opposite side of Rum Jungle Road adjacent to the existing Direction Sign and Hazard Board. Rumble strips should also be considered for installation just prior to the Reduce Speed sign.

Completion of part of this intersectional signage and line marking should be implemented as part of for the current intersection arrangement as remedial works by the road authority.

3. Conclusions and Recommendations

Generally the impact of traffic generated by the proposed Browns Oxide Mine Project would be marginal in terms of impact on road carrying capacity. The geometry and carriageways of the road sections are adequate for the current and resultant traffic volumes in accordance with all but the latest edition of the Austroads – Guide to the Geometric Design of Rural Roads.

The additional traffic generated by the proposed development will create a marginal increase to the current traffic with the heavy vehicle proportion of that forming only a low number of trips though Batchelor and the road network. Intersections and roads currently carry similar vehicles and the extra 4.1 v.p.d. in each direction should not create any significant increase in risk within the Batchelor township; primarily due to the slower speed environment.

The number of accidents recorded for both Batchelor Road and Rum Jungle Road are primarily single vehicle accidents rather than collisions and the additional traffic generated by the proposed development should not change those trends.

Works recommended that should improve safety of the intersection and Rum Jungle Road are:

1) Remedial works and continued maintenance of the road to the level and standards to that which it is designed and constructed – to provide for safe passage of all traffic.
2) Modify the intersection with additional / improved signage to rely and reinforce the recommended modification to the intersection control and road hierarchy.
3) Reseal the intersection with a contrasting aggregate seal including the carriageway on Litchfield Park road for a distance of 200 metres to reinforce the signage and line marking.
4) Lower the posted speed limit on Rum Jungle Road to 80 km/h from the unlimited speed limit currently posted.
5) Communicate the planned operational changes to local residents by regular consultation and post during the change process.