

Appendix F  
Terrain and Soil Analysis

## Appendix F Terrain and Soil Analysis

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## Appendix F.1

### Description of Terrain Mapping Units



# Appendix F.1 Terrain and Soil Analysis

## Appendix F.1 Description of Terrain Mapping Units

### Geological Regime:

Qa – Quaternary Recent Alluvial Deposits – clay, silt, sand and gravel

Terrain Unit No.	Landform Characteristics	Soil Type	Comments
Qa 04	Channel floors, river banks and intra-channel stream terraces and broadly rounded and back-sloping levees of the McArthur River	Mostly deep sandy and loamy textured alluvial soils, typically uniform or gradational fine sandy loam to clay loam (Um 5.52)	Sources of good quality topsoil suitable for rehabilitation occur in the internal and adjacent river levees
Qa 02	Channel floors with steep rocky river banks and gorges, and flood terraces of the Glyde River and its major tributaries	Rock outcrop mostly along the riverbank gorges, and deep unconsolidated sandy alluvial soils along the channel floors and flood terraces (Uc 1.2)	Channel floor and flood terraces subject to scouring during wet-season flood flows
Qa 13	Alluvial terraces, levees, channel floors and banks of the major tributaries of the McArthur River; overall slopes mostly <1%, locally sleeper internally.	Mostly deep earthy sands with reddish brown or brown surface soils grading to yellowish brown usually mottled sandy loam subsoils (Uc 4.31, Uc 5.22)	Floodprone during the wet season

### Geological Regime:

Cz – Cainozoic Tertiary to Quaternary Undifferentiated – residual soils, colluvial and outwash fan deposits and older alluvium.

Terrain Unit No.	Landform Characteristics	Soil Type	Comments
Cz 1(5,6)	Tributary drainage flats, alluvial plains and levees associated with Barney and Surprise Creeks; overall slopes mostly <1%, steeper on slopes adjacent to drainage.	Mostly yellowish brown, some yellowish red sandy to loamy surface duplex (podzolic-solodic) soils (Dy 3.42) and deep loamy gradational yellow earths with Fe concretions and mottling in the lower (B) horizon (Gn 2.25)	Subject to flooding in the wet season locally prone to moderate to severe sheet and gully erosion on the marginal slopes to drainage
Cz 18	Broadly depressional drainageways in the alluvial backplain of the McArthur River; overall slopes <0.5%	Deep dark-coloured cracking clay soils (grey clays) with thin self-mulching surface soils and strongly alkaline heavy clay subsoils (Ug 5.15)	Poorly drained and subject to surface water ponding for lengthy periods during and following the wet season

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### Geological Regime:

Cz – Cainozoic Tertiary to Quaternary Undifferentiated (Cont.)

Terrain Unit No.	Landform Characteristics	Soil Type	Comments
Cz26	Near level to gently inclined plains and marginal slopes adjacent to drainageways; slopes <2% mostly <1%	Medium to deep weakly gradational massive yellow earths with neutral to slightly acidic often mottled clay loam or silty medium clay horizons with some fine ferromanganiferous concretions throughout (Gn 2.82, Gn 2.94).	These soils have hard setting surfaces and occur in the slightly less well drained areas. The deeper subsoils may contain dispersive soil layers. Some red earth soils occur locally.
Cz27	Near level to gently inclined plains; slopes <2% mostly <1%	Medium to deep hardsetting loamy surface gradational massive red earths or thin loamy surface, red duplex soils with slightly acidic to neutral, medium to heavy clay subsoils with some ferromanganiferous concretions throughout (Gn2.12, Dr 2.52)	These soils may provide material suitable for embankment construction in the Tailings Dam expansion area.
Cz28	Near level to gently inclined and gently undulating plain locally with intensive melon-hole gilgai formation; slopes mostly <1%	Deep brown and grey cracking clay soils and black earths locally with thin (<50mm) self-mulching surface soils with soft carbonate (Ca) segregations and gypsum crystals in the deeper subsoil (Ug 5.15, 5.16, 5.31)	These areas are mostly untrafficable in the wet season and have surface cracking extending to a depth of approximately 0.6-0.8m during the dry season. The deeper subsoils (>1.2m) have massive soil structure and have low hydraulic conductivity.
Cz58	Dissected and eroded slopes along the margins of the alluvial backplain and slopes to drainage; overall slopes up to 15%, locally steeper in dissection gullies.	Mostly deep brown (cracking) clay soils with thin (<100 mm) self-mulching surface soils, strong blocky to prismatic structure in the middle to upper B horizon, tending to massive brown heavy clay with carbonate segregations and gypsum crystals below 0.7-1.0 m approximately (Ug 5.15, 5.16)	Active sheet and gully erosion are evident throughout the unit. The upper A/B horizon may contain slightly to moderately dispersive soil layers; the deeper subsoils are highly saline and gypsic.

## Appendix F.1 Terrain and Soil Analysis

### Geological Regime:

Cz/Pm – Cainozoic Tertiary to Quaternary – residual soils underlain by rock types of the McArthur River Group mainly dolomite or dolomitic shale/siltstone

Terrain Unit No.	Landform Characteristics	Soil Type	Comments
Cz/Pm26	Near level to gently undulating plains and pediplain, with internal drainage flats and ill-defined drainageways included; slopes are locally up to 2% <0.5% on the flatter areas.	Mixed occurrences of shallow to moderately deep (0.5-1.0 m) gradational massive yellow earths (Gn2.94) underlain by weathered rock – mainly dolomite, or dolomitic shale/siltstone.	The surface soils are hardest, generally with some surface stone and may contain slightly dispersive silt/clay fines.  The yellow earth soils tend to occur in the somewhat less well-drained situations.
Cz/Pm3(7,6)	Gently inclined and broadly undulating pediplain/outwash plain with local low rises; slopes are locally up to 3% but mostly 1% or less.	Mixed occurrences of shallow to moderately deep (0.5-1.0 m) gradational massive red earths (Gn 2.22), thin loamy surface structured red earths (Gn 3.11), locally tending to reddish yellow or yellow massive earths (Gn2.82, 2.22), underlain by weathered rock mainly dolomite or dolomitic siltstone/shale.	The surface soils are hardest generally with some surface stone. The surficial and subsoil horizons may contain some slightly dispersive soil layers.  Perched groundwater was encountered in some areas near the transition to the weathered rock layer.
Cz/Pm5(6,3)	Gently to moderately inclined, dissected and eroded slopes adjacent to the McArthur River and its tributaries; overall slopes up to 15%, locally steeper in dissection gullies.	Mixed occurrences or deep gradational, massive yellowish brown, yellowish red and yellow earth soils (Gn 2.22, 2.94), together with yellowish brown earthy sands with mottled yellowish brown and grey sandy loam subsoils (Uc 4.31, Uc 5.22), locally underlain by or transitional to the sandstone weathered rock substrate.	Active sheet and gully erosion occur extensively throughout the unit. Dispersive soil layers may occur within the soil profile (not sampled)

## Appendix F.1 Terrain and Soil Analysis

### Geological Regime:

Clb – Early Cambrian, Bukalara Sandstone – fine to coarse-grained sandstone.

Terrain Unit No.	Landform Characteristics	Soil Type	Comments
Clb33	Near level to broadly undulating intermediate rock cut platforms and river terraces locally along the lower reaches of the Glyde River, slopes up to 3% on the terraces, locally intensively dissected steeper slopes adjacent to the river.	Shallow early sands and ravelly sandy lithosols (Uc1.22, 1.21), with areas of exposed rock mostly along the marginal slopes.	Mostly very shallow siliceous sands over massive sandstone which may be weakly lateritised in places.
Clb4(0,2g)	Undulating to locally near level rugged rocky plateaux surfaces with more than 50% sandstone rock exposed, with deep steep-sided rocky gorges adjacent to the Glyde River; slopes on the plateau surface are up to 15%, locally sub-vertical in the rocky gorges.	Typically >50% of exposed sandstone rock with shallow ravelly sandy lithosols in places-siliceous sands (Uc1.21, 1.22).	The sandstone plateau is extensively jointed in a rectangular pattern and drainage is strongly structurally controlled. Surface runoff rates are high but the local potential sediment source is quite limited.

### Geological Regime:

Pm – Middle Proterozoic McArthur Group – dolomitic, carbonaceous and pyritic shale/siltstone, dololutite, dolarenite, dolomitic breccia and quartz arenite.

Terrain Unit No.	Landform Characteristics	Soil Type	Comments
Pm 44(g)	Undulating plains with low rises with irregular broadly rounded crests and upper marginal slopes up to about 10%, with lower slopes and flats (0-2%).	Shallow to moderately deep (0.3-1.0 m) gravelly, red uniform loamy lithosols – (Um1.23), underlain by weathered rock or gravelly clays – clayey gravels which are transitional to the weathered rock substrate.	The silty/clayey fines component may be slightly to moderately dispersive when reworked in a very moist condition. Local occurrences of low linear rock outcrop mainly dolomitic sandstones and siltstones.

## Appendix F.1 Terrain and Soil Analysis

Terrain Unit No.	Landform Characteristics	Soil Type	Comments
Pm 6(1,3)	Low rounded hilly lands and rises, locally with linear rock outcrop exposed; moderately steep marginal slopes (10-20%)	Dominant soils are shallow gravelly skeletal soils with reddish, brown or yellowish brown earthy sands (Uc5.21) developed on sandstone or quartzarenite bedrock.	Occurs mainly to the eastern sector of the project area.
Pm6(1,4)	Low rounded hilly lands and rises, locally with linear rock outcrop exposed, moderately steep marginal slopes (10-20%)	Dominant soils are shallow gravelly lithosols with reddish or reddish brown gravelly loams to sandy loams (Um1.23, Uc5.21) developed on dolomitic shale/siltstone bedrock.	Occurs mainly in the central and western path of the project area.
Pm71	Steep hills and hilly lands with steep hill and ridge slopes (15-30%) and sharply rounded rocky crests	Much rock outcrop with shallow stony skeletal soils comprising reddish brown gravelly loamy sands (Uc5.21) developed on dolomitic shale/siltstone bedrock.	Occurs mainly in the far western sector of the project area in the vicinity of the far western extension of the tailings dam extension area.
Pm8(2g,0)	Steep linear ridges and strike ridges with narrow rounded ridge crests and steep planar ridge slopes (30-50%).	Rock outcrop and skeletal to shallow yellowish brown gravelly sands (Uc1.22) on the crests and marginal slopes. Some shallow gravelly brown earths (Uc5.22, Um5.51) on the lower parts of the slope.	Occurs mainly in terrain developed along the Emu Fault Zone in the eastern sector of the project area.

Appendix F.2  
Terrain and Soil Analysis (pH, EC and Dispersion  
Class)

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## Appendix F.2

# Terrain and Soil Analysis (pH, EC and Dispersion Class)

### Explanation of Terms and Test Details Used in Sample/Test Pit Descriptions

<p><b>Rock Type</b></p> <p>WR - Weathered rock</p> <p>EWR - Extremely weathered rock</p> <p>HWR - Highly weathered rock</p> <p><b>Particle Shape</b></p> <p>r - Rounded</p> <p>s/r - Sub-rounded</p> <p>s/a - Sub-angular</p> <p><b>Gravel Type</b></p> <p>Gv - Gravel</p> <p>Fe - Ferruginous / laterite</p> <p>Si - Siliceous</p> <p>Mn - Manganese</p> <p>Ca - Carbonate</p> <p><b>Sample Type</b></p> <p>B - Bulk sample</p> <p>D - Disturbed Sample</p> <p>R - Rock Sample</p>	<p><b>Moisture Condition</b></p> <p>MC - Moisture content</p> <p>Wp - Moisture content at plastic limit.</p> <p>Electrical Conductivity (EC 1:5 H<sub>2</sub>O), values have been reported as (µS/cm). An indicative potential salinity severity rating is:</p> <p>Nil E.C. &lt;280</p> <p>Slight E.C. &gt;280-570</p> <p>Moderate E.C. &gt;570-1100</p> <p>High E.C. &gt;1100-2300</p> <p>Severe E.C. &gt;2300</p> <p>Soil Acidity/Alkalinity levels (pH) are:</p> <p>Strongly Acidic pH &lt;5.0</p> <p>Acidic pH 5.0-6.5</p> <p>Neutral pH 6.6-7.3</p> <p>Alkaline pH 7.4-8.5</p> <p>Strongly Alkaline pH &gt;8.5</p>
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Soil dispersion characteristics were determined using the modified Emerson aggregate stability test (Emerson and Seedsman Tech. Memo 15, 1981). Interpretation of the rating classes recorded in Appendix A2 is as follows:

#### Emerson Aggregate Test

This is a measure of soil dispersibility or soil structural stability. The following general levels of dispersibility are assigned:

Dispersibility	Emerson Aggregate Classes
Very High	1 and 2 (3)
High	2 (2)
High to Moderate	2 (1)
Moderate	3 (4) and 3 (3)
Slight	3 (2), 3 (1) and 5
Negligible/Aggregated	6, 7, 8

## Appendix F.2 Terrain and Soil Analysis (pH, EC and Dispersion Class)

The sub-classes of the Emerson Test are defined as follows:

- 1) Slight milkiness immediately adjacent to the aggregate.
- 2) Obvious milkiness, less than 50% of the aggregate affected.
- 3) Obvious milkiness, more than 50% of the aggregate affected.
- 4) Total dispersion, leaving only sand grain.

**Note that Class 2 (4) is equivalent to Class 1.**

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## Appendix F.2

### Terrain and Soil Analysis (pH, EC and Dispersion Class)

#### Appendix F.2 Soil Characterisation

Map Unit	Site ID/Depth (m)	Soil Horizon	Description	Coarse Fragments	Soil pH (1:5 H <sub>2</sub> O)	Salinity EC (µS/cm)	Dispersion Class	Comments/Soil Classification
<b>Overburden Emplacement Facility (OEF):</b>								
Cz/Pm26	OEF #1 0-0.2	A2	Silty Clay Loam (CL – ML) low plasticity, pale brown	Some (<5%)s/r stone	5.3	36	3(3)	Yellow massive earth (Gn 2.94) – Yellow Kandosol
	0.2-0.5	B2	Gv Silty Clay Loam (CL) low-medium plasticity, light yellowish brown mottled	10 - 15% s/r Fe gravel (10-15mm)	5.8	28	5	
	0.5	C	Ferruginised Dolomitic Siltstone	-	-	-	-	
Cz28	OEF #2 0-0.8	A/B	Clay (CH) high plasticity dark grey	-	7.6	96	5	Grey (cracking) Clay – Black Earth (Ug5.16) – Black Vertosol Highly saline subsoils Moderately highly saline subsoils
	0.8-1.7	B2	Clay (CH) high plasticity dark grey-brown with carbonate	Some s/r-s/a fine gravel (2-5mm)	8.1	1353	4	
	1.7-2.2+	B-C	Clay (CH) high plasticity yellowish brown	5% fine s/r ca/gypsum nodules.	8.6	1126	4	
Cz18	OEF#3 0-0.8	A/B	Silty Clay (CH) high plasticity light grey brown	Some fine Ca fragments	8.1	123	5	Brown (Cracking) Clay (Ug 5.31) Brown Vertosol Moderately dispersive subsoils Low permeability in the deeper subsoil
	0.8-1.2	B2	Silty clay (CL – CH) Medium to high slight plasticity brown	Same fine Ca nodules	8.5	175	2	
	1.2-1.7+	B-C	Silty Clay (CL-CH) medium plasticity yellowish brown and whitish grey	Some Ca nodules	8.5	326	4	

## Appendix F.2

### Terrain and Soil Analysis (pH, EC and Dispersion Class)

Map Unit	Site ID/Depth (m)	Soil Horizon	Description	Coarse Fragments	Soil pH (1:5 H <sub>2</sub> O)	Salinity EC (µS/cm)	Dispersion Class	Comments/Soil Classification
<b>Overburden Emplacement Facility (OEF):</b>								
Cz/Pm3 (7,6)	OEF#4 0-0.1	A1	Fine Sandy Clay Loam (SL-CL) low plasticity dark brown	–	6.4	37	3(1)	Loamy surface red duplex soil – Structured Red Earth - (Dr 2.12) – Red Chromosol.
	0.1-0.8	B2	Clay (CH) high plasticity, red	5% fine Fe gravel (2-5mm)	7.0	6.6	5	
	0.8+	C	Weathered rock					Hard dolomite
Cz/Pm3 (7,6)	OEF#5 0-0.1	A1	Fine sandy clay loam (SC-CL) low to medium plasticity, yellowish brown	5-10% s/r – s/a stone (5-20mm)	6.6	121	3(1) – 5	Loamy surface red duplex soil – Structured Red Earth – (Dr 2.12) – Red Chromosol.
	0.1-0.5	B2	Clay (CH) high plasticity	Some fine Fe nodules (2-5mm)	6.3	44	5	
	0.5-0.7	C	Weathered rock - Dolomite	Rock cobbles (5-30cm)	–	–	–	Hard dolomite
Cz28	OEF#6 0-0.3	A	Clay (CH) high plasticity, brown.	Some fine gravel	6.9	35	5	Brown (Cracking) Clay Soil – (Ug 5.15); Brown Gypsic Vertosol
	0.3-1.0	B	Clay (CH) high plasticity, brown.	Fragments of Ca and gypsum crystals	8.2	64	2 (1).3	
	1.0-2.01	B/C	Silty Clay (CL-CH) medium to high plasticity, yellow brown	Some Ca and gypsum crystals	7.8	2682	4	Highly saline subsoil

## Appendix F.2 Terrain and Soil Analysis (pH, EC and Dispersion Class)

Map Unit	Site ID/Depth (m)	Soil Horizon	Description	Coarse Fragments	Soil pH (1:5 H <sub>2</sub> O)	Salinity EC (µS/cm)	Dispersion Class	Comments/Soil Classification
<b>Overburden Emplacement Facility (OEF):</b>								
Cz58	OEF#7 0-0.5	A/B	Clay (CH) high plasticity brown	Some fine Ca inclusions	7.1	93	4	Brown (Cracking) Clay Soil- (Ug 5.15); Brown Gypsic Vertosol
	0.5-1.0	B2	Clay (CH) high plasticity dark brown	—	7.6	1432	4	Highly saline subsoil
	1.0-1.7+	B-C	Silty Clay (CL-CH) medium to high plasticity yellowish red.	Flecks of Ca and gypsum crystals	7.8	1760	4	Highly saline subsoil
Cz58	OEF#8 0-0.7	A/B	Clay (CH) high plasticity, dark brown	—	8.1	164	3(3)	Brown (Cracking) Clay Soil (Ug 5.16); Brown Gypsic Vertosol
	0.7-1.2	B2	Clay (CH) high plasticity, brown	Mn and Ca segregations and gypsum crystals	7.7	2085	4	Highly saline subsoil
	1.2-2.2+	B-C	Clay (CH) high plasticity, brown	Ca flecks and gypsum crystals	7.8	2782	4	Highly saline subsoil
Cz28	OEF#9 0-0.15	A1	Clay (CH) high plasticity, brown	Some s/a – s/r stone (<10mm)	6.5	74	3(2)	Brown (Cracking) Clay Soil (Ug 5.15) Brown Gypsic Vertosol
	0.15-0.5	B	Clay (CH) high plasticity, brown	Some fine Ca nodules	7.6	93	4	
	0.5-1.4	B2	Clay (CH) high plasticity, brown	Flecks of Ca and gypsum crystals	8.7	233	1	Highly saline subsoil
	1.4-1.8	B-C	Clay (CH) high plasticity brown	-	8.2	2063	4	

## Appendix F.2

### Terrain and Soil Analysis (pH, EC and Dispersion Class)

Map Unit	Site ID/Depth (m)	Soil Horizon	Description	Coarse Fragments	Soil pH (1:5 H <sub>2</sub> O)	Salinity EC (µS/cm)	Dispersion Class	Comments/Soil Classification
<b>Overburden Emplacement Facility (OEF):</b>								
Cz1 (5,6)	OEF#10 0-0.1	A2	Silt Loam (ML – CL) low plasticity, brown.	–	5.8	35	3(4)	Gradational Yellow Earth (Gn2.25) Yellow Brown Kandosol
	0.1-0.4	A2/B1	Silty Clay Loam (CL) low to medium plasticity, yellowish brown	5% s/a – s/r Fe gravel (<5mm)	5.9	25	3(3)	Slightly dispersive when reworked
	0.4-1.5	B2	Clay Loam (CL) medium plasticity, yellowish brown		6.2	22	3(2)	Slightly dispersive when reworked
	1.5-1.8	B-C	Fine Sandy Clay (CL-CH) medium to high plasticity yellowish brown, mottled grey.	Some fine Fe concretions (2-5mm) and ferruginised s/a siltstone gravel	7.0	39	3(1)-5	Perched groundwater table

## Appendix F.2 Terrain and Soil Analysis (pH, EC and Dispersion Class)

Map Unit	Site ID/ Depth (m)	Soil Horizon	Description	Coarse Fragments	Soil pH (1:5 H <sub>2</sub> O)	Salinity EC (µS/cm)	Dispersion Class	Comments/Soil Classification	
<b>Tailings Dam (TD) Area:</b>									
Cz/Pm3 (7,6)	TD#1	0-0.3	A1		–	5.8	42	3	Red (Massive) Earth (Gn2.22)Red-yellow Kandosol
		0.3-0.7	B1	Silty Fine Sandy Loam (SM-SC) yellowish red	10% fine rounded Fe gravel (5-10mm)	5.2	25	5	
		0.7-2.0	B2	Fine Sandy Clay (CL-CH) medium to high plasticity yellowish Red	10% fine Fe gravel (5-10 mm)	6.8	51	1(3)	Moderately strongly dispersive subsoils.
		2.0-2.3	C	Gravelly Clay – Clayey Gravel – EW rock	Weathered Rock				Perched groundwater at 2.0m at weathered rock interface
Cz27	TD#2	0-0.1	A1	Silt Loam (SM-ML) low plasticity, red brown	5% s/a – s/r Fe gravel (5-10mm)	5.9	46	3	Loamy surface Red Duplex Soil – (Dr2.52), Red Massive Earth; Red Chromosol
		0.1-0.3	B1	Silty Clay (CL), Medium Plasticity, dark red	5%/s/a – s/r Fe gravel (5-10mm)	6.2	60	5	
		0.3-0.8	B21	Clay (CL-CH) medium to high plasticity, dark red	5%/s/a – s/r Fe gravel (5-10mm)	6.3	31	5	
		0.8-1.7	B22	Clay Loam (CL) medium plasticity, dark red	5% fine Fe r. gravel	7.0	44	5	
		1.7-2.4	B-C	Clay Loam (CL) medium plasticity, grey mottled red	-	6.8	32	5	
		2.4-2.8	B-C	Clay Loam (CL) medium plasticity, brown	Some fine s/r dolomite gravel	8.3	127	4	Groundwater inflow approaching weathered rock interface

## Appendix F.2 Terrain and Soil Analysis (pH, EC and Dispersion Class)

Map Unit	Site ID/ Depth (m)	Soil Horizon	Description	Coarse Fragments	Soil pH (1:5 H <sub>2</sub> O)	Salinity EC (µS/cm)	Dispersion Class	Comments/Soil Classification		
<b>Tailings Dam (TD) Area:</b>										
Pm44(g)	TD#3	0-0.3	A	Gravelly Fine Sandy Clay Loam (SC-CL) low plasticity, dark yellowish brown	15-20% r-s/r Fe gravel (to 15mm)	5.5	23	3(2)	Gravelly Red Loam (Um1.23) – Lithosol; Red Lithic Rudosol	
		0.3-1.4	A/C	Clayey Gravel – Gravelly Clay (GC) – highly weathered rock	Angular rock cobbles(0.1-0.3m)	6.2	43	2(2)	Highly weathered rock with dispersive clayey fines	
Cz/Pm3(7,6)	TD#4	0-0.4	A/B1	Silty Clay Loam (CL> CL-CH) low to medium plasticity becoming medium to high towards 0.3m, red brown	5-10% s/a – s/r fine Fe gravel and stone (20-30mm)	5.3	28	3(3)	Structured Red Earth (Gn 3.11); Red Dermosol . Slightly dispersive in the A horizon.	
		0.4-0.9	B2	Clay (CH) high plasticity, red, strongly structured	10% fine r. Fe gravel (3-5mm)	6.0	30	5		
		0.9-1.2	C	Rocky Clay (GC) – EW rock		6.3	22	5	Weathered Rock	
Cz1(5,6)	TD#5	0-0.1	A2	Gravelly Silt Loam (SM-CL) low plasticity, pale grey – brown	40% r. Fe gravel (5-10mm)	6.1	28	3(3)	Gradational Yellow (Massive) Earth – (Gn2.94); Yellow Kandosol	
		0.1-0.3	B1	Gravelly Silty Clay Loam (CL), low-medium plasticity, yellowish brown	40% r. Fe gravel (5-10mm)	5.8	22	3(3)		
		0.3-0.6	B2	Silty Clay (CL-CH) medium plasticity, yellowish-brown	-	6.8	64	2(2)		Slightly dispersive clayey fines
		0.6-1.3	B-C	Gravelly (Rocky) Clay (GC-CH) medium to high plasticity, yellow, brown and grey	40-60% coarse gravel	8.3	19	5		
		1.3-2.1	C	Coarse Gravelly Clay (GC-CH) medium to high plasticity, light yellowish brown and grey mottled.	>60% coarse siltstone gravel	8.4	162	2(2)		Extremely weathered rock

## Appendix F.2 Terrain and Soil Analysis (pH, EC and Dispersion Class)

Map Unit	Site ID/ Depth (m)	Soil Horizon	Description	Coarse Fragments	Soil pH (1:5 H <sub>2</sub> O)	Salinity EC (µS/cm)	Dispersion Class	Comments/Soil Classification		
<b>Tailings Dam (TD) Area:</b>										
Cz27	TD#6	0-0.3	A	Gravelly Fine Sandy Clay Loam (SC-CL) low plasticity, red	Some s/r Si stone and 20% s/r—s/a Fe gravel (5-15mm)	6.0	50	3(3)	Structured Red Earth –(Gn3.11); Red Dermosol	
		0.3-0.7	B1	Silty Clay (CL) medium plasticity, red	Soft Fe and Mn segregations	6.4	24	5		
		0.7-1.2	B21	Silty Clay (CL-CH) medium to high plasticity, yellowish red	Soft Fe and Mn segregations, 10% fine Fe gravel	6.5	35	5		
		1.2-1.7	B22	Clay (CL-CH) medium to high plasticity, yellowish-red	20% fine Fe gravel	6.5	20	3(3)		Slightly dispersive clayey fines
		1.7-2.2	C	HW Dolomite Shale	Rock cobbles (20-150mm)	-	-	-		
Pm44(g)	TD#7	0-0.15	A1	Gravelly Fine Sandy Clay Loam (SC-CL) low plasticity, red	20% fine s/r-s/a Fe gravel (5-10mm)	5.8	39	3(2)	Gravelly Red Loam –Lithosol - (Um 1.23); Red Lithic Rusdosol Variable depth to rock (0.4-1.2m)	
		0.15-0.4/1.2	B-C	Loamy Gravel (GC) low plasticity, red	60% s/r-s/a ferruginous siltstone	5.9	21	3(4)		
		1.2-1.8	C	HW Dolomite Breccia	-	-	-	-		Groundwater inflow at 1.2m
Cz/Pm3(7,6)	TD#8	0-0.2	A	Gravelly Silt Loam (SM-ML) low plasticity, yellow brown	40% fine rounded Fe gravel (5-15mm)	5.9	54	3(3)	Yellow-brown massive earth (Gn 2.82)-Yellow Kandosol	
		0.2-0.4	B1	Gravelly Clay Loam (CL) medium plasticity, brown	20% s/r Fe gravel(5-10mm)	5.9	21	3(3)		Slightly to moderately dispersive silty and clayey fines when reworked in very moist condition

## Appendix F.2 Terrain and Soil Analysis (pH, EC and Dispersion Class)

Map Unit	Site ID/ Depth (m)	Soil Horizon	Description	Coarse Fragments	Soil pH (1:5 H <sub>2</sub> O)	Salinity EC (µS/cm)	Dispersion Class	Comments/Soil Classification
<b>Tailings Dam (TD) Area:</b>								
	0.4-1.0	B2	Gravelly Clay Loam (SC-CL) medium plasticity, brown	40% fine s/r Fe gravel	6.2	23	5	
	1.0-1.7	C	Gravelly Clay-Clayey Gravel (GC) – Extremely weathered rock	60% s/r Fe and s/r WR gravel (10-30mm+)	6.3	27	3(3)	Slightly dispersive clayey fines
Cz/Pm3(7,6)	TD#9 0-0.2	A	Fine Sandy Clay Loam (CL) low to medium plasticity, red	25% r-s/r fine Fe gravel (2-5mm)	5.3	22	3(3)	Red Structured Earth – (Dr2.11); Red Dermosol
	0.2-0.95	B	Clay (CL-CH) medium to high plasticity, red, well structured	25% r-s/r fine Fe gravel (2-5mm)	5.9	41	5	
	0.95-1.4	B-C	Clayey Gravel (GC) medium to high plasticity, red	60% broken rock pieces	6.3	42	2(1)-3	Extremely weathered rock dolomite shale /siltstone; slightly dispersive clayey lines

## Appendix F.2 Terrain and Soil Analysis (pH, EC and Dispersion Class)

Map Unit	Site ID/ Depth (m)	Soil Horizon	Description	Coarse Fragments	Soil pH (1:5 H <sub>2</sub> O)	Salinity EC (µS/cm)	Dispersion Class	Comments/Soil Classification	
<b>Open Pit (OP) Area:</b>									
Qa04	OP#1	0-0.3	A	Clay Loam (CL) low to medium plasticity, dark brown	–	6.6	54	3(2)	Alluvial Soil – (Um 5.52); Brown Kandosol
		0.3-0.6	B	Silty Clay Loam (CL) medium plasticity, dark brown	–	6.9	23	3(3)	Slightly dispersive silt/clay fines when reworked in moist condition
Cz28	OP#2	0-0.2	A	Clay(CH) high plasticity dark brown	Some fine gravel	8.2	125	3(1)	Brown (Cracking) Clay – (Ug 5.3); Brown Vertosol
		0.2-0.4	B1	Clay (CH) high plasticity dark brown	Trace fine Ca gravel	8.5	190	2(1)	Moderately to strongly dispersive in the subsoil layers
		0.4-0.6	B2	Clay (CH) high plasticity dark brown	Flecks of Ca	8.7	271	1(4)	Strongly dispersive
Cz28	OP #3	0-0.2	A	Clay (CH) high plasticity dark grey brown	–	6.8	43	5	Grey (Cracking) – Clay (Ug 5.2); Grey Vertosol
		0.2-0.4+	B	Clay (CH) high plasticity brown	–	7.6	73	5	
Qa04	OP #4	0-0.3	A	Fine sandy Loam (SC) low plasticity, brown	–	6.6	32	3(3)	Alluvial Soil - (Um 5.52); Brown Kandosol
		0.3-0.6	B21	Fine Sandy Silt Loam (SC), low plasticity, brown	–	6.6	25	3(3)	Slightly dispersive Silty/Clayey fines when reworked in a moist condition
		0.6-1.7+	B22	Fine Sandy Light Clay Loam (SC-CL) low plasticity	–	6.6	19	3(3)	Slightly dispersive fines

## Appendix F.2 Terrain and Soil Analysis (pH, EC and Dispersion Class)

Map Unit	Site ID/ Depth (m)	Soil Horizon	Description	Coarse Fragments	Soil pH (1:5 H <sub>2</sub> O)	Salinity EC (µS/cm)	Dispersion Class	Comments/Soil Classification
<b>Open Pit (OP) Area:</b>								
Cz28	OP#5 0-0.5	A/B	Clay (CH) high plasticity, brown	Some s/a-s/r surface stone	7.0	32	5	Brown (Cracking) Clay (Ug5.31) Brown Gypsic Vertosol
	0.5-1.0	B2	Clay (CH) high plasticity, reddish brown	Some fine Ca nodules	7.9	1030	4	Moderately high salinity
	1.0-1.5	B-C	Clay (CH) high plasticity yellowish red	Some flecks of Ca and gypsum crystals	8.2	1648	4	Highly saline
Qa04	OP#6 0-0.7	A/B	Clay Loam (CL) medium plasticity, dark brown	—	6.7	74	3(3)	Alluvial Soil (Um 5.52); Brown Kandosol
	0.7-1.8+	B (b)	Fine Sandy Loam (SC-CL) brown	—	7.0	26	3(3)	Slightly dispersive fines when reworked in moist condition
Cz58	OP#7 0-0.5	A/B	Clay (CH) high plasticity, brown	Copious Ca nodules and gypsum crystals	7.07	1833	2(1)-4	Brown (Cracking) Clay (Ug 5.31) Brown Self-mulching Gypsic Vertosol. High salinity
	0.5-1.0+	B2	Clay (CH) high plasticity, brown, highly gypseous	Heavy gypsum segregations	—	—	—	Heavy gypsum segregation throughout full depth of profile exposed

Appendix F.3  
Test Pit Logs for Tailings Dam (TD), Overburden  
Emplacement Facility (OEF) and Open Pit (OP)

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# Appendix F.3

## Test Pit Logs for Tailing Dam, OEF and Open Pit

<b>URS Australia Pty Ltd</b>		<b>MRM TEST PIT OEF#1</b>		Sheet 1 of 1
URS Australia Pty Ltd Level 240, Queen Street Brisbane, QLD, 4001	Phone (07) 3243 2111 Fax (07) 3242 2199	Project No: <b>24061-015-559</b>	Project Reference: <b>McArthur River Mine Expansion Project</b>	
Landform/Vegetation Near flat to gently undulating plain with open eucalypt woodland and Terminalia understorey, with mid high grasses		Surface Slope <1%	Surface Conditions Hardset some surface stone	
Local Geology Cz - Residual soil underlain by Pmx - dolomitic siltstone		Relative Level: mRL	Client:  <b>MIM Holdings Ltd</b>	
		Coordinates: 8185329 mN 816140 mE		
		Logged By: GJR Date:		

Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H2O)	EC (1:5 H2O) (µS/cm)	Emerson (Dispersion) Class No.	SAMPLING AND OTHER TESTING	Groundwater	COMMENTS/Notes
AZ	(0-0.2) Silty Loam (CL - ML) low plasticity pale brown (10YR 7/3), dry, very hard, brittle massive soil structure; 5% s/a -s/r Fe fine gravel (3-8MM), some s/r stone (10-20MM)		[Hatched pattern]	0	5.3	36	3(3)	D		Loamy surface - Yellow Massive Earth
B2	(0.2-0.5) Gravely silty clay LOAM (CL) low to medium plasticity, light yellowish brown (10YR6/4) diffusely mottled grey, weak blocky to massive structure, 10-15% s/r Fe gravel (10-15mm)		[Dotted pattern]	0.5	5.8	28	5	B(0.2-0.5) D		Beached surface horizon
C	(0.5-0.7) Ferruginised dolomitic siltstone; strong rock with coarse rectangular fracture pattern (0.1 - 0.2m) - HW - MW rock		[Cross-hatched pattern]	0.7				R		Rock joints have ferruginous coatings. No groundwater encountered
TEST PIT SECTION										
								<b>TEST PIT TERMINATED AT:</b> Target Depth <input type="checkbox"/> Refusal <input checked="" type="checkbox"/> Flooding <input type="checkbox"/> Caving/collapse <input type="checkbox"/>		
								<b>SAMPLE TYPE:</b> Bulk Sample <b>BS</b> Tube Sample <b>TS</b> Disturbed Sample <b>DS</b>		

MRM TEST PIT MCARTHUR.GPJ WCC.AUS.GDT 270503

# Appendix F.3

## Test Pit Logs for Tailing Dam, OEF and Open Pit

<b>URS Australia Pty Ltd</b>		<b>MRM TEST PIT OEF#2</b>		Sheet 1 of 1
URS Australia Pty Ltd Level 240, Queen Street Brisbane, QLD, 4001	Phone (07) 3243 2111 Fax (07) 3242 2199	Project No. : <b>24061-015-559</b>	Project Reference: <b>McArthur River Mine Expansion Project</b>	
Landform/Vegetation Near level to very gently inclined plain with low open mixed Bauhinia and eucalypt woodland /grassland		Surface Slope <0.5%	Surface Conditions Cracking clay - Melon-hole gllal	
Local Geology Cz - Alluvial (heavy clay) deposits		Relative Level: mRL	Client: <b>MIM Holdings Ltd</b>	
		Coordinates: 8185649 mN 6170556 mE		
		Logged By: GJR		
		Date:		

Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H2O)	EC (1:5 H2O) (uS/cm)	Emerson (Dispersion) Class No.	SAMPLING AND OTHER TESTING	Groundwater	COMMENTS/Notes
A/B	(0.0-0.8) CLAY (CH) high plasticity dark grey (5Y3/2), just moist very stiff to hard, medium to coarse blocky structure, trace to fine Fe gravel (<3mm), some flecks of gypsum towards 0.7m	>500	█	0	7.8	96	5	D		Grey - Brown (cracking) Clay. Grey Brown Vertisol weak crusting, thin self-mulching surface soil
B2	(0.8-1.7) CLAY (CH) high plasticity dark grey brown (10YR3/2), just moist (MC<<Wp) very hard, some s/r-s/a fine gravel (2-5mm) with medium to heavy carbonate inclusions	>500	█	1	8.1	1353	4	B(0.8-1.7) D		Strongly saline subsoils
	(1.7-2.2+) CLAY (CH) high plasticity, yellowish brown (10YR6/4) with grey and orange mottles, just moist (MC<<Wp) very stiff to hard, with 5% s/r carbonate/gypseous fine nodules (3-8mm)	>>500	█	2	8.8	1126	4	D		Moderately strongly saline deeper subsoils
			█	3						
<b>TEST PIT SECTION</b>									<b>TEST PIT TERMINATED AT:</b>	
									Target Depth	<input type="checkbox"/>
									Refusal	<input type="checkbox"/>
									Flooding	<input type="checkbox"/>
									Caving/collapse	<input type="checkbox"/>
									<b>SAMPLE TYPE:</b>	
									Bulk Sample	BS
									Tube Sample	TS
									Disturbed Sample	DS

MRM TEST PIT: MCARTHUR.GPJ; WCC\_AUS.GDT; 270503





# Appendix F.3

## Test Pit Logs for Tailing Dam, OEF and Open Pit

<b>URS Australia Pty Ltd</b>		<b>MRM TEST PIT OEF#5</b>		Sheet 1 of 1
URS Australia Pty Ltd Level 240, Queen Street Brisbane, QLD, 4001	Phone (07) 3243 2111 Fax (07) 3242 2199	Project No: <b>24061-015-559</b>	Project Reference: <b>McArthur River Mine Expansion Project</b>	
Landform/Vegetation Near level plain, with open low mixed eucalypt woodland and mid high grasses		Surface Slope	Surface Conditions Harset, scattered stone	<b>MIM Holdings Ltd</b>
Local Geology Cz - Residual soil underlain by Pmx - reward dolomite		Relative Level: mRL		
		Coordinates: 8188433 mN 818001 mE		
		Logged By: GJR		
		Date:		

Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H2O)	EC (1:5 H2O) (uS/cm)	Emerson (Dispersion) Class No.	SAMPLING AND OTHER TESTING	Groundwater	COMMENTS/Notes
	(0-0.1) Fine sandy clay LOAM (SC - CL) low to medium plasticity, yellowish brown (5YR3/3) 5-10% s/a - s/r stone (5-20mm) (0.1 - 0.5) CLAY (CH) high plasticity reddish brown, just moist (MC<<Wp) friable to stiff fine to medium prismatic structure, some fine Fe concretions (2-5mm) (0.5-0.7+) Dolomitic Rock - breaks up to platy rock cobbles (5-30cm)			0	6.8 6.3	121 44	5 5	D B(0.1-0.5) D  R		Slightly dispersive clayey fines - sharp transition Thin loamy surface duplex soil - structured red earth; Red Chromosol  Not rippable beyond 0.7m with end loader
				1						
				2						
				3						

MRM TEST PIT MCARTHUR.GPJ WCC\_AUS.GDT 2705903

<b>TEST PIT SECTION</b>										<b>TEST PIT TERMINATED AT:</b>	
										Target Depth	<input type="checkbox"/>
										Refusal	<input type="checkbox"/>
										Flooding	<input type="checkbox"/>
										Caving/collapse	<input type="checkbox"/>
										<b>SAMPLE TYPE:</b>	
										Bulk Sample	BS
										Tube Sample	TS
										Disturbed Sample	DS

# Appendix F.3

## Test Pit Logs for Tailing Dam, OEF and Open Pit

<b>URS Australia Pty Ltd</b>		<b>MRM TEST PIT OEF#6</b>		Sheet 1 of 1
URS Australia Pty Ltd Level 240, Queen Street Brisbane, QLD, 4001	Phone (07) 3243 2111 Fax (07) 3242 2199	Project No: <b>24061-015-559</b>	Project Reference: <b>McArthur River Mine Expansion Project</b>	
Landform/Vegetation Flat plain with scattered low Bauhinia and mid high tussock grasses		Surface Slope <0.5%	Surface Conditions Cracking thin self-mitching	
Local Geology Cz - Older alluvium - dark clay backplain deposits		Relative Level: mRL		Client:  <b>MIM Holdings Ltd</b>
		Coordinates: 8184791 mN 817047 mE		
		Logged By: GJR Date:		

Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H2O)	EC (1:5 H2O) (µS/cm)	Emerson (Dispersion) Class No.	SAMPLING AND OTHER TESTING	Groundwater	COMMENTS/Notes
A	(0-0.3) CLAY (CH) high plasticity brown (10YR4/3) moist (MC<<Wp) stiff friable, some fine gravel (2mm)		0	0	8.9	35	5	D		Brown Clay Soil: Brown Vertosol
B2	(0.3-1.0) CLAY (CH) high plasticity brown (10YR4/3) moist (MC approximately equal to Wp) friable, stiff, strong blocky to prismatic structure with shiny ped faces	200	1	1	8.2	64	3	B(0.3-1.0) D		Slightly to moderately dispersive when soil is remoulded
B/C	(1.0-2.0+) Silty CLAY (CL - CH) medium to high plasticity, yellowish brown (10YR4/4), just moist, very stiff/hard brittle with flecks of carbonate and gypsum crystals		2	2	7.8	2682	4	D		Extremely saline subsoil - very low permeability
			3	3						Near refusal at 2.0m




MRM TEST PIT MCARTHUR.GPJ MCC\_AUS.GDT 270503

<b>TEST PIT SECTION</b>										<b>TEST PIT TERMINATED AT:</b>	
										Target Depth	<input type="checkbox"/>
										Refusal	<input checked="" type="checkbox"/>
										Flooding	<input type="checkbox"/>
										Caving/collapse	<input type="checkbox"/>
										<b>SAMPLE TYPE:</b>	
										Bulk Sample	BS
										Tube Sample	TS
										Disturbed Sample	DS

# Appendix F.3

## Test Pit Logs for Tailing Dam, OEF and Open Pit

<b>URS Australia Pty Ltd</b>		<b>MRM TEST PIT OEF#7</b>		Sheet 1 of 1
URS Australia Pty Ltd Level 240, Queen Street Brisbane, QLD, 4001	Phone (07) 3243 2111 Fax (07) 3242 2199	Project No: <b>24061-015-559</b>	Project Reference: <b>McArthur River Mine Expansion Project</b>	
Landform/Vegetation Erosion gully slopes with heavy weed (burr) infestation, scattered Bauhinia and Acacia shrubland		Surface Slope 5-10%	Surface Conditions Cracking	<b>MIM Holdings Ltd</b>
Local Geology Cz - Older alluvium dark clay deposits in alluvial backplain of the McArthur River and tributaries		Relative Level: mRL Coordinates: 8184589 mN 818168 mE		
		Logged By: GJR Date:		

Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H2O)	EC (1:5 H2O) (uS/cm)	Emerson (Dispersion) Class No.	SAMPLING AND OTHER TESTING	Groundwater	COMMENTS/Notes
A/B	(0-0.5) CLAY (CH) high plasticity brown (10YR4/3), moist (MC<Wp), strong medium to coarse blocky to prismatic structure, some fine carbonate nodules increasing with depth	500		0	7.1	93	4	B(U,0-0.5) D		Brown (cracking) Clay. Brown Vertisol (not self-mulching)
B2	(0.5-1.0) CLAY (CH) high plasticity, dark yellowish brown (10YR4/4), moist (MC is approximately equal to Wp), coarse blocky to lenticular with carbonate flecks and gypsum crystals	300		0.5	7.8	1432	4	D		Highly saline subsoil
C	(1.0 - 1.7+) Silty CLAY (CL - CH) medium to high plasticity, just moist (MC<Wp) hard brittle with soft ferruginous segregations, flecks of carbonate and gypsum crystals.	>500		1	7.8	1760	4	D		Highly saline subsoil
				2						
				3						

MRM TEST PIT MCARTHUR GRJ WCC-AUS GDT 2705003

<b>TEST PIT SECTION</b>										<b>TEST PIT TERMINATED AT:</b>	
										Target Depth	<input type="checkbox"/>
										Refusal	<input type="checkbox"/>
										Flooding	<input type="checkbox"/>
										Caving/collapse	<input type="checkbox"/>
										<b>SAMPLE TYPE:</b>	
										Bulk Sample	BS
										Tube Sample	TS
										Disturbed Sample	DS

# Appendix F.3

## Test Pit Logs for Tailing Dam, OEF and Open Pit

<b>URS Australia Pty Ltd</b>		<b>MRM TEST PIT OEF#8</b>		Sheet 1 of 1
URS Australia Pty Ltd Level 240, Queen Street Brisbane, QLD, 4001	Phone (07) 3243 2111 Fax (07) 3242 2199	Project No: <b>24061-015-559</b>	Project Reference: <b>McArthur River Mine Expansion Project</b>	
Landform/Vegetation Gently inclined plain at head of erosion gully with open Bauhinia woodland with heavy weed infestation		Surface Slope 1% Heavy cracking; thin self-mulching	Client: <b>MIM Holdings Ltd</b>	
Local Geology Cz - Older alluvium - dark clay soil in alluvium back plain		Relative Level: mRL Coordinates: 8185017 mN 818525 mE		
		Logged By: GJR		
		Date:		

Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H2O)	EC (1:5 H2O) (uS/cm)	Emerson (Dispersion) Class No.	SAMPLING AND OTHER TESTING	Groundwater	COMMENTS/Notes																																				
A/B	(0-0.7) CLAY (CH) high plasticity, dark brown (10YR3/3) dry, very stiff to hard strong medium to coarse blocky structure, some flecks of carbonate; cracking extends to 0.6m approximately	>500	0	0	8.1	164	3(3)	D		Brown (cracking) Clay Soil Brown Vertosol. Heavily cracked surface, thin self-mulching surface soil. Highly eroded marginal slopes																																				
B2	(0.7-1.2) CLAY (CH) high plasticity, brown (10YR 5/3), strong medium to coarse blocky to prismatic with soft Mn segregations along ped faces, moist (MC is approximately equal to Wp) stiff, friable, flecks of carbonate and gypsum crystals.	400	1	1	7.7	2085	4	D		Strongly saline subsoil																																				
B/C	(1.2-2.2+) CLAY (CH) High plasticity, brown (10YR5/3) massive soil structure, just moist very stiff to hard, with carbonate flecks and gypsum crystals	>500	2	2	7.8	2782	4	D		Strongly saline subsoil																																				
			3	3																																										
<b>TEST PIT SECTION</b>									<b>TEST PIT TERMINATED AT:</b>																																					
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Refusal	<input type="checkbox"/>																																													
Flooding	<input type="checkbox"/>																																													
Caving/collapse	<input type="checkbox"/>																																													
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									<b>SAMPLE TYPE:</b>																																					
									Bulk Sample	BS																																				
									Tube Sample	TS																																				
Disturbed Sample	DS																																													

MRM TEST PIT MCARTHUR.GPJ WCC\_AUS.GDT 270903



# Appendix F.3

## Test Pit Logs for Tailing Dam, OEF and Open Pit

<b>URS Australia Pty Ltd</b>		Sheet 1 of 1	
<b>MRM TEST PIT OEF#10</b>			
URS Australia Pty Ltd Level 240, Queen Street Brisbane, QLD, 4001	Phone (07) 3243 2111 Fax (07) 3242 2199	Project No.: <b>24061-015-559</b>	Project Reference: <b>McArthur River Mine Expansion Project</b>
Landform/Vegetation Slightly elevated gently undulating plain with mixed low open Eucalypt and Acacia woosland, some Baulinia		Surface Slope: <1% Surface Conditions: Hardset, some surface stones	Client: <b>MIM Holdings Ltd</b>
Local Geology Cz - Elluvial soil underlain by weathered dolomitic siltstone/sandstone		Relative Level: mRL Coordinates: 8185388 mN 815630 mE	
		Logged By: GJR Date:	

Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H2O)	EC (1:5 H2O) (uS/cm)	Emerson (Dispersion) Class No.	SAMPLING AND OTHER TESTING	Groundwater	COMMENTS/Notes
A21	(0-0.1) Silty LOAM (ML - CL) low plasticity, pale brown (10YR3/2 - dry), brown (10YR5/3 - moist)			0	5.8	35	3(4)	D		Strongly dispersive when reworked
A22/B1	(0.1-0.4) Silty Clay LOAM (CL) low to medium plasticity, light yellowish brown (2.5Y5/4), weak prismatic to massive structure, 5% s/r-s/a Fe gravel (<5mm)				5.9	25	3(3)	B(0.4-0.8) D		Loamy surface yellow duplex soil - Yellow Podzolic Yellow Sodosol
B2	(0.4-1.5) Clay LOAM (CL) medium plasticity, yellowish brown (10YR5/6), moist, friable, firm to stiff with moderate prismatic structure				6.2	22	3(2)	D		Moderately dispersive clayey fines when reworked
C	(1.5-1.8) Fine Sandy Clay (CL- CH) medium to high plasticity, yellowish brown (10YR5/8) mottled grey, massive soil structure some fine Fe concretions (2-5mm) some fine s/a gravel - ferruginised siltstone/sandstone				7.0	39	5	D		Very slightly dispersive fines. Seasonal perched water table
				2						
				3						
<b>TEST PIT SECTION</b>								<b>TEST PIT TERMINATED AT:</b>		
								Target Depth	<input type="checkbox"/>	
								Refusal	<input type="checkbox"/>	
								Flooding	<input type="checkbox"/>	
								Caving/collapse	<input type="checkbox"/>	
								<b>SAMPLE TYPE:</b>		
								Bulk Sample	BS	
								Tube Sample	TS	
								Disturbed Sample	DS	

MRM TEST PIT, MCARTHUR GPJ, MCC\_AUS\_GBT\_2705803

# Appendix F.3

## Test Pit Logs for Tailing Dam, OEF and Open Pit

<b>URS Australia Pty Ltd</b>		<b>MRM TEST PIT OP#1</b>		Sheet 1 of 1
URS Australia Pty Ltd Level 240, Queen Street Brisbane, QLD, 4001	Phone (07) 3243 2111 Fax (07) 3242 2199	Project No: <b>24061-015-559</b>	Project Reference: <b>McArthur River Mine Expansion Project</b>	
Landform/Vegetation Back-sloping levee of levee of the McArthur River with tall riparian woodland, heavy weed infestation		Surface Slope 2%	Surface Conditions Weak crust, not hardset	
Local Geology Qa - Recent alluvial deposits on backsloping river levee.		Relative Level: mRL Coordinates: 8182121 mN 617508 mE	Client: <b>MIM Holdings Ltd</b>	
		Logged By: GJR		
		Date:		

Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H2O)	EC (1:5 H2O) (uS/cm)	Emerson (Dispersion) Class No.	SAMPLING AND OTHER TESTING	Groundwater	COMMENTS/Notes
A	(0-0.3) - Clay LOAM (CL) Low to medium plasticity, dark brown (10YR3/4) friable massive soil structure just moist, firm to stiff		[Hatched Box]	0	6.8	54	3(2)	D		Uniform to gradational (loamy) alluvial soil. Brown Kandosol
B	(0.3-0.6) - Silty Clay LOAM (CL) medium plasticity, dark brown (10Yr3/3), friable moist, weakly developed fine to medium prismatic tending to massive soil structure		[Hatched Box]	0.3	6.9	23	3(3)	D		Good topsoil material; slightly to moderately dispersive when reworked in very moist conditions
				1						
				2						
				3						
<b>TEST PIT SECTION</b>								<b>TEST PIT TERMINATED AT:</b>		
								Target Depth	<input type="checkbox"/>	
								Refusal	<input type="checkbox"/>	
								Flooding	<input type="checkbox"/>	
								Caving/collapse	<input type="checkbox"/>	
								<b>SAMPLE TYPE:</b>		
								Bulk Sample	<input type="checkbox"/>	BS
								Tube Sample	<input type="checkbox"/>	TS
								Disturbed Sample	<input type="checkbox"/>	DS

MRM TEST PIT MCARTHUR GPU WCC-AUS GDT 270503

# Appendix F.3

## Test Pit Logs for Tailing Dam, OEF and Open Pit

<b>URS Australia Pty Ltd</b>		<b>MRM TEST PIT OP#2</b>		Sheet 1 of 1
URS Australia Pty Ltd Level 240, Queen Street Brisbane, QLD, 4001	Phone (07) 3243 2111 Fax (07) 3242 2199	Project No: <b>24061-015-559</b>	Project Reference: <b>McArthur River Mine Expansion Project</b>	
Landform/Vegetation Near level alluvial backplain with tussock grasses and scattered low acacia shrubs		Surface Slope 20.5%	Surface Conditions Cracked not self-mulching	
Local Geology Cz - Older alluvial deposits - dark (cracking) clay river backplain deposits		Relative Level: mRL Coordinates: 8181911 mN 817805 mE	Client: <b>MIM Holdings Ltd</b>	
		Logged By: GJR		
		Date:		



Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H2O)	EC (1:5 H2O) (uS/cm)	Emerson (Dispersion) Class No.	SAMPLING AND OTHER TESTING	Groundwater	COMMENTS/Notes
A	(0-0.2) - CLAY (CH) high plasticity, dark brown (10YR3/4), medium blocky to prismatic structure, some fine gravelly inclusions		█	0	8.2	125	3(2)	D		Brown (cracking) Clay soil - Brown Vertosol
B1	(0.2-0.4) - CLAY (CH) high plasticity, dark brown (10YR4/4) strong blocky to prismatic structure, dry very stiff to hard - trace of fine carbonate gravel		█	8.5	190	2(1)	D			Slightly to moderately dispersive
B2	(0.4-0.8) CLAY (CH) high plasticity dark brown (10YR4/4) just moist medium blocky to prismatic structure very stiff, with flecks of carbonate		█	8.7	271	1(4)	D			Strongly dispersive subsoils
<div style="display: flex; justify-content: space-between;"> <span>1</span> <span>2</span> <span>3</span> </div>										
<b>TEST PIT SECTION</b>								<b>TEST PIT TERMINATED AT:</b>		
								Target Depth <input type="checkbox"/>		
								Refusal <input type="checkbox"/>		
								Flooding <input type="checkbox"/>		
								Caving/collapse <input type="checkbox"/>		
								<b>SAMPLE TYPE:</b>		
								Bulk Sample <b>BS</b>		
								Tube Sample <b>TS</b>		
								Disturbed Sample <b>DS</b>		

MRM TEST PIT MCARTHUR GPU WCC-AUS GDT 270503

# Appendix F.3

## Test Pit Logs for Tailing Dam, OEF and Open Pit

<b>URS Australia Pty Ltd</b>		<b>MRM TEST PIT OP#3</b>		Sheet 1 of 1
URS Australia Pty Ltd Level 240, Queen Street Brisbane, QLD, 4001	Phone (07) 3243 2111 Fax (07) 3242 2199	Project No: <b>24061-015-559</b>	Project Reference: <b>McArthur River Mine Expansion Project</b>	
Landform/Vegetation Gently inclined alluvial backplain with low open acacia woodland and mid high grasses		Surface Slope <1%	Surface Conditions Cracking - string self-mulching	
Local Geology Cz - Alluvial backplain deposits - dark (crackign) clays		Relative Level: mRL Coordinates: 8182096 mN 618407 mE	Client: <b>MIM Holdings Ltd</b>	
		Logged By: GJR		
		Date:		

Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H2O)	EC (1:5 H2O) (uS/cm)	Emerson (Dispersion) Class No.	SAMPLING AND OTHER TESTING	Groundwater	COMMENTS/Notes
A	(0-0.2) CLAY (CH) high plasticity, dark grey - brown (10Yr4/2) medium blocky structure, dry, very stiff			0	6.8	43	5	D		Brown (Cracking) Clay Soil - Brown Vertosol
B	(0.2-0.4+) Clay (CH) high plasticity brown (10YR5/3) moist, very stiff			7.6	7.6	73	5	D		Slight dispersion when reworked in very moist conditions
				1						
				2						
				3						
<b>TEST PIT SECTION</b>									<b>TEST PIT TERMINATED AT:</b>	
									Target Depth	<input type="checkbox"/>
									Refusal	<input type="checkbox"/>
									Flooding	<input type="checkbox"/>
									Caving/collapse	<input type="checkbox"/>
									<b>SAMPLE TYPE:</b>	
									Bulk Sample	BS
									Tube Sample	TS
									Disturbed Sample	DS

MRM TEST PIT MCARTHUR GPJ WCC\_AUS\_GDT 270503

# Appendix F.3

## Test Pit Logs for Tailing Dam, OEF and Open Pit

<b>URS Australia Pty Ltd</b>		<b>MRM TEST PIT OP#4</b>		Sheet 1 of 1
URS Australia Pty Ltd Level 240, Queen Street Brisbane, QLD, 4001	Phone (07) 3243 2111 Fax (07) 3242 2199	Project No: <b>24061-015-559</b>	Project Reference: <b>McArthur River Mine Expansion Project</b>	
Landform/Vegetation Gently inclined back-sloping levee of the McArthur River with tall open eucalyptus woodland, some Bauhinia and mid-high grasses		Surface Slope <1%	Surface Conditions Not Hardest	Client:  <b>MIM Holdings Ltd</b>
Local Geology Qd - Recent Alluvial Deposits, backslope of the river levee		Relative Level: mRL Coordinates: 8182421 mN 817247 mE		
		Logged By: GJR Date:		

Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H2O)	EC (1:5 H2O) (µS/cm)	Emerson (Dispersion) Class No.	SAMPLING AND OTHER TESTING	Groundwater	COMMENTS/Notes
A	(0.0-0.3) - Fine Sandy LOAM (SC) low plasticity, brown (10YR4/3) just moist (MC<Wp) stiff weak coarse prismatic tending to massive soil structure		0	0	6.8	32	3(3)	D		Loamy Alluvial Soil - Brown Kandosol. Good quality topsoil for rehabilitation requirements
B2	(0.3-0.6) - Fine Sandy Silt LOAM (SC-ML) low plasticity, brown (10YR4/3) massive soil structure		0.5	0.5	6.6	25	3(3)	D		Slightly dispersive when reworked in a very moist condition
B22	(0.6-1.7) - Fine Sandy Light Clay LOAM (SC-CL) low plasticity, dark yellowish brown (10YR4/4) just moist (MC<Wp) friable firm massive soil structure		1.0	1.0	6.6	19	3(3)	D		Slightly dispersive, as above
			1.5	1.5						
			2.0	2.0						
			2.5	2.5						
			3.0	3.0						
<b>TEST PIT SECTION</b>									<b>TEST PIT TERMINATED AT:</b>	
									Target Depth	<input type="checkbox"/>
									Refusal	<input type="checkbox"/>
									Flooding	<input type="checkbox"/>
									Caving/collapse	<input type="checkbox"/>
									<b>SAMPLE TYPE:</b>	
									Bulk Sample	BS
									Tube Sample	TS
									Disturbed Sample	DS

MRM TEST PIT MCARTHUR GPU WCC\_AUS GDT 2705603

# Appendix F.3

## Test Pit Logs for Tailing Dam, OEF and Open Pit

<b>URS Australia Pty Ltd</b>		<b>MRM TEST PIT OP#5</b>		Sheet 1 of 1	
URS Australia Pty Ltd Level 240, Queen Street Brisbane, QLD, 4001	Phone (07) 3243 2111 Fax (07) 3242 2199	Project No: <b>24061-015-559</b>	Project Reference: <b>McArthur River Mine Expansion Project</b>		
Landform/Vegetation Gently inclined plain forming upper marginal slopes to drainage. Bauhinia open, low woodland and mid-high tussock grasses		Surface Slope 1-3%	Surface Conditions Cracking thin surface crust	<b>MIM Holdings Ltd</b>	
Local Geology Cz - Older Alluvial Deposits - dark (cracking) clay alluvial backplain deposits		Relative Level: mRL	Client:		
		Coordinates: 8182237 mN 8186648 mE			
		Logged By: GJR			
		Date:			

Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H2O)	EC (1:5 H2O) (uS/cm)	Emerson (Dispersion) Class No.	SAMPLING AND OTHER TESTING	Groundwater	COMMENTS/Notes
A/B	(0.0-0.5) - CLAY (CH) high plasticity brown (10YR4/3) medium to coarse blocky to prismatic structure, just moist (MC<Wp), some s/a-s/r stone in the upper 0.15m		█	0	7.0	32	5	D		Brown (Cracking) Clay Soil - Brown Vertisol. Soil cracking extends to 0.5m
B2	(0.5-1.0) - CLAY (CH) high plasticity reddish brown (5YR4/3) massive soil structure, some flecks and fine nodules of carbonate, just moist (MC<Wp)		█	0.5	7.9	1030	4	D		Moderately strongly saline, very low permeability
B/C	(1.0-1.5) - CLAY (CH) high plasticity yellowish red (5YR4/6), massive soil structure, just moist (MC<Wp) very stiff to hard, moderate to heavy carbonate segregations and gypsum crystals		█	1	8.2	1648	4	D		Strongly saline; very low permeability
			█	2						
			█	3						

MRM TEST PIT MCARTHUR G.P.J. WCC\_AUS\_GDT\_270503

<b>TEST PIT SECTION</b>										<b>TEST PIT TERMINATED AT:</b>	
										Target Depth	<input type="checkbox"/>
										Refusal	<input type="checkbox"/>
										Flooding	<input type="checkbox"/>
										Caving/collapse	<input type="checkbox"/>
										<b>SAMPLE TYPE:</b>	
										Bulk Sample	BS
										Tube Sample	TS
										Disturbed Sample	DS

# Appendix F.3

## Test Pit Logs for Tailing Dam, OEF and Open Pit

<b>URS Australia Pty Ltd</b>		Sheet 1 of 1	
<b>MRM TEST PIT OP#6</b>			
URS Australia Pty Ltd Level 240, Queen Street Brisbane, QLD, 400	Phone (07) 3243 2111 Fax (07) 3242 2199	Project No: <b>24061-015-559</b>	Project Reference: <b>McArthur River Mine Expansion Project</b>
Landform/Vegetation Broadly rounded crest of inter-channel levee, with tall riparian woodland	Surface Slope <1% on crest	Surface Conditions Not hard setting	Client:  <b>MIM Holdings Ltd</b>
Local Geology Qa - Recent Alluvium - inter-channel levee deposits	Relative Level: mRL	Coordinates: 8182249 mN 617392 mE	
	Logged By: GJR	Date:	

Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H2O)	EC (1:5 H2O) (uS/cm)	Emerson (Dispersion) Class No.	SAMPLING AND OTHER TESTING	Groundwater	COMMENTS/Notes
A1/B	(0.0-0.7) - Clay LOAM (CL) medium plasticity dark brown (7.5YR3/4), weak medium to coarse blocky to prismatic tending to massive soil structure, just moist (MC<<Wp) friable firm to stiff			0	8.7	74	3(3)	D		Alluvial Soil - Regolithic Brown Tenosol. Slightly dispersive clayey fines, but good topsoil resource
B2	(0.7-1.8) - Fin Sandy LOAM (SC-CL) brown (7.5YR4/3), massive soil structure, just moist (MC<<Wp) stiff and brittle			1	7.0	26	3(3)	D		Slightly dispersive when reworked at high moisture content; good topsoil resource
				2						
				3						

MRM TEST PIT - MCARTHUR GPU WCC\_AUS\_GDT\_2705903

<b>TEST PIT SECTION</b>										<b>TEST PIT TERMINATED AT:</b>	
										Target Depth	<input type="checkbox"/>
										Refusal	<input type="checkbox"/>
										Flooding	<input type="checkbox"/>
										Caving/collapse	<input type="checkbox"/>
										<b>SAMPLE TYPE:</b>	
										Bulk Sample	BS
										Tube Sample	TS
										Disturbed Sample	DS

# Appendix F.3

## Test Pit Logs for Tailing Dam, OEF and Open Pit

<b>URS Australia Pty Ltd</b>		<b>MRM TEST PIT OP#7</b>		Sheet 1 of 1
URS Australia Pty Ltd Level 240, Queen Street Brisbane, QLD, 4001	Phone (07) 3243 2111 Fax (07) 3242 2199	Project No.: <b>24061-015-559</b>	Project Reference: <b>McArthur River Mine Expansion Project</b>	
Landform/Vegetation Erosional slopes associated with erosion gullies, with low open acacia woodland		Surface Slope: 5-20%	Surface Conditions: Cracking, thin self-mulching	
Local Geology Cz - Older Alluvial Deposits - dark (cracking) clay soils, alluvial backplain deposits		Relative Level: mRL	Client: <b>MIM Holdings Ltd</b>	
		Coordinates: 8182819 mN 817207 mE		
		Logged By: GJR		
		Date:		

Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H2O)	EC (1:5 H2O) (uS/cm)	Emerson (Dispersion) Class No.	SAMPLING AND OTHER TESTING	Groundwater	COMMENTS/Notes
A/B	(0.0-0.5) CLAY (CH) High plasticity, brown (7.5YR4/4), medium to coarse blocky structure, highly gypseous clay with some carbonate nodules		[Hatched Pattern]	0	7.7	1833	2(1)-4	D		Brown (cracking) Clay Brown Gypsic Vertisol. Thin (0.05) self mulching surface soil with weak thin surface crust; very slight dispersion when remoulded in very moist conditions, Highly saline Highly erodible and subject to moderately intensive gulying.
B2	(0.5-1.0+) - CLAY (CH) high plasticity, gypseous clay as above		[Hatched Pattern]	1						
				2						
				3						
<b>TEST PIT SECTION</b>									<b>TEST PIT TERMINATED AT:</b>	
									Target Depth	<input type="checkbox"/>
									Refusal	<input type="checkbox"/>
									Flooding	<input type="checkbox"/>
									Caving/collapse	<input type="checkbox"/>
									<b>SAMPLE TYPE:</b>	
									Bulk Sample	BS
									Tube Sample	TS
									Disturbed Sample	DS

MRM TEST PIT: MCARTHUR.GPJ WCC\_AUS\_GDT 2705603

# Appendix F.3

## Test Pit Logs for Tailing Dam, OEF and Open Pit

<b>URS Australia Pty Ltd</b>		<b>MRM TEST PIT TD#1</b>		Sheet 1 of 1
URS Australia Pty Ltd Level 240, Queen Street Brisbane, QLD, 4001	Phone (07) 3243 2111 Fax (07) 3242 2199	Project No: <b>24061-015-559</b>	Project Reference: <b>McArthur River Mine Expansion Project</b>	
Landform/Vegetation Undulating plain with open Bauhinia and mixed eucalypt woodland		Surface Slope 1%	Surface Conditions Hard set with sparse gravel	
Local Geology Cz - Undifferentiated alluvial, colluvial deposits underlain by Pmx - dolomitic siltstone		Relative Level: mRL Coordinates: 8185582 mN 812483 mE	Client: <b>MIM Holdings Ltd</b>	
		Logged By: GJR		
		Date:		

Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H2O)	EC (1:5 H2O) (uS/cm)	Emerson (Dispersion) Class No.	SAMPLING AND OTHER TESTING	Groundwater	COMMENTS/Notes
A	(0.0-0.3) - SILTY SAND (SM - SC) Fine-grained, some clayey fines low plasticity redish brown (5YR5/4) massive structure dense		0	0	5.8	42	3(3)	D		Approx. 10% fine s/a - silt ferruginous (Fe) gravel Yellow - Red Massive Earth. Surface horizon prone to buildust formation
B1	(0.3-0.7) - SILTY FINE SANDY LOAM (SM - SC) low plasticity, yellowish red (5YR5/8), massive structure, friable, moist, with approximately 10% rounded fine Fe gravel 5-10mm		0.5	0.5	5.2	25	5	D		
B2	(0.7-2.0) - Fine Sandy CLAY (CL - CH), yellowish red (5YR5/8) medium to high plasticity, firm to stiff, moist, friable weak fine blocky structure, with soft red ferruginous segregations and approximately 10% fine rounded Fe concretions		1	1	6.8	51	1(3)	D B(1.0-1.5)		Moderately strongly dispersive
C	(2.0+) - Coarse Gravelly CLAY - Clayey GRAVEL - EW Rock, with rounded silcrete nodules and coarse angular fractured rock partings of dolomitic siltstone		2	2						Slow seepage inflow on top of the weathered rock zone Pit terminated at 2.3m - difficult digging in angular gravel
			3	3						

MRM TEST PIT MCARTHUR GDI WCC\_AUS\_GDI\_270503

<b>TEST PIT SECTION</b>								<b>TEST PIT TERMINATED AT:</b>	
								Target Depth	<input type="checkbox"/>
								Refusal	<input type="checkbox"/>
								Flooding	<input type="checkbox"/>
								Caving/collapse	<input type="checkbox"/>
								<b>SAMPLE TYPE:</b>	
								Bulk Sample	BS
								Tube Sample	TS
								Disturbed Sample	DS

# Appendix F.3

## Test Pit Logs for Tailing Dam, OEF and Open Pit

<b>URS Australia Pty Ltd</b>		Sheet 1 of 1	
		<b>MRM TEST PIT TD#2</b>	
URS Australia Pty Ltd Level 240, Queen Street Brisbane, QLD, 4001	Phone (07) 3243 2111 Fax (07) 3242 2199	Project No: <b>24061-015-559</b>	Project Reference: <b>McArthur River Mine Expansion Project</b>
Landform/Vegetation Near flat to gently inclined plain with open eucalypt woodland	Surface Slope 1/4-1%	Surface Conditions Hardset	Client: <b>MIM Holdings Ltd</b>
Local Geology Cz - Cainozoic soil, alluvial outwash fan and colluvial deposits	Relative Level: mRL	Coordinates: 8185387 mN 812696 mE	
	Logged By: GJR	Date:	

Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H2O)	EC (1:5 H2O) (uS/cm)	Emerson (Dispersion) Class No.	SAMPLING AND OTHER TESTING	Groundwater	COMMENTS/Notes
A1	(0.0-0.1) - SILT - Loam (SM - ML) low plasticity, reddish brown (5YR4/4), massive, with 5% s/a - s/c Fe gravel (5-10mm) - <u>clear change to next layer</u> (0.1-0.3) - SILTY CLAY (CL) - medium plasticity, dark red (2.5YR4/8) with 5% s/r - s/a Fe gravel (5-10mm) (0.3-0.8) - CLAY (CL - CH) medium to high plasticity, dark red (2.5YR4/8); friable, moist with weak prismatic to massive structure; some angular WR fragments to 10mm and 5% s/r - r Fe gravel (5-10mm)			0	5.9 6.2 6.3	46 60 31	3(2) 5 5	D D D		Structured Red Earth, Loamy surface Red Duplex Soil Red Chromosol
	(0.8-1.7) - CLAY LOAM (CL) medium plasticity dark red (2.5YR4/8), friable, moist, weak to moderately well developed structure, with 5% r. Fe gravel			1	7.0	44	5	D B(1.0-1.5)		
	(1.7-2.4) - CLAY LOAM (CL) medim plasticity, grey mottled reddish brown (10YR6/8 and 5YR4/6), moist, friable to stiff			2	6.8	32	5	D B(2.0-2.5)		
	(2.4-2.8) - CLAY LOAM (CL) medium plasticity, brown (4.5 YR 5/4), very moist, still, friable, some s/r fine dolomite gravel			3	8.3	127	5	D		Pit termination at 2.8m; ground water seepage inflow at 2.8m



MRM TEST PIT MCARTHUR GRU WCC\_AUS\_GDT 2705003

<b>TEST PIT SECTION</b>										<b>TEST PIT TERMINATED AT:</b>	
										Target Depth	<input type="checkbox"/>
										Refusal	<input type="checkbox"/>
										Flooding	<input type="checkbox"/>
										Caving/collapse	<input type="checkbox"/>
										<b>SAMPLE TYPE:</b>	
										Bulk Sample	BS
										Tube Sample	TS
										Disturbed Sample	DS

# Appendix F.3

## Test Pit Logs for Tailing Dam, OEF and Open Pit

<b>URS Australia Pty Ltd</b>		<b>MRM TEST PIT TD#3</b>		Sheet 1 of 1	
URS Australia Pty Ltd Level 240, Queen Street Brisbane, QLD, 4001	Phone (07) 3243 2111 Fax (07) 3242 2199	Project No. : <b>24061-015-559</b>	Project Reference: <b>McArthur River Mine Expansion Project</b>		
Landform/Vegetation Flat plain with open eucalypt woodland and mid high grasses		Surface Slope <1%	Surface Conditions Hardset	<b>MIM Holdings Ltd</b>	
Local Geology Cz/Pmx - Residual soil underlain by dolomitic shale/siltstone		Relative Level: mRL	Client:		
		Coordinates: 8184358 mN 612222 mE			
		Logged By: GJR			
		Date:			

Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H2O)	EC (1:5 H2O) (uS/cm)	Emerson (Dispersion) Class No.	SAMPLING AND OTHER TESTING	Groundwater	COMMENTS/Notes
A	(0.0-0.3) - Gravelly fine sandy CLAY LOAM (SC - CL) low plasticity, dark yellowish brown (10YR4/4) with approximately 15-20% r-s/r Fe gravel to 15mm			0	5.5	23	3(2)	D		Residual soil - Gravelly Lithosol; Red lithic Rudosol
A/C	(0.3-1.4) - CLAYEY GRAVEL - EW rock, (GC) - clay shale, heavily fractured 0.1 - 0.3m angular rock partings			0.62	6.2	43	2(2)	D		Clayey fines are moderately dispersive - <30% clay fines content
				1						
				2						
				3						
<b>TEST PIT SECTION</b>								<b>TEST PIT TERMINATED AT:</b>		
								Target Depth	<input type="checkbox"/>	
								Refusal	<input type="checkbox"/>	
								Flooding	<input type="checkbox"/>	
								Caving/collapse	<input type="checkbox"/>	
<b>SAMPLE TYPE:</b>										
								Bulk Sample	BS	
								Tube Sample	TS	
								Disturbed Sample	DS	

MRM TEST PIT\_MCARTHUR.GPJ\_WCC\_AUS\_GDT\_270503

# Appendix F.3

## Test Pit Logs for Tailing Dam, OEF and Open Pit

<b>URS Australia Pty Ltd</b>		Sheet 1 of 1	
<b>MRM TEST PIT TD#4</b>			
URS Australia Pty Ltd Level 240, Queen Street Brisbane, QLD, 4001	Phone (07) 3243 2111 Fax (07) 3242 2199	Project No: <b>24061-015-559</b>	Project Reference: <b>McArthur River Mine Expansion Project</b>
Landform/Vegetation Broad low rounded rise with low open eucalypt woodland and mid high grasses	Surface Slope <1%	Surface Conditions Hardset	Client:  <b>MIM Holdings Ltd</b>
Local Geology Pmx - Reward Dolomite: thin bedded dolomitic and pyritic shale and siltstone	Relative Level: mRL Coordinates: 8183363 mN 812007 mE	Logged By: GJR	
	Date:		

Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H2O)	EC (1:5 H2O) (uS/cm)	Emerson (Dispersion) Class No.	SAMPLING AND OTHER TESTING	Groundwater	COMMENTS/Notes
A	(0.0-0.4) - Silty Clay LOAM (CL, CL - CH) low to medium becoming medium to high plasticity between 0.3 - 0.5m, reddish brown (5YR3/4) becoming red (10R4/8) with 5-10% s/a - s/r fine Fe gravel and s/r stone 20-30mm just moist very stiff, medium prismatic to polyhedral structure. Sharp change to:			0	5.3	28	3	D		Structured Red Earth - Loamy Red Duplex Soil
B2	(0.4-0.9) - CLAY (CH) high plasticity, opaque red (10R4/8) strong prismatic to polyhedral structure with shiny ped faces; 10% fine r. Fe gravel (3-5mm)				6.0	30	5	B(0.4-0.9) D		Very slightly dispersive
C	(0.9-1.2) - ROCKY CLAY - MW Rock, dolomitic siltstone, cream coloured rock with clay coatings along joint faces - very hard.			1	6.3	22	5	D		No groundwater encountered Near refusal at 1.2m
				2						
				3						
<b>TEST PIT SECTION</b>								<b>TEST PIT TERMINATED AT:</b>		
								Target Depth	<input type="checkbox"/>	
								Refusal	<input type="checkbox"/>	
								Flooding	<input type="checkbox"/>	
								Caving/collapse	<input type="checkbox"/>	
								<b>SAMPLE TYPE:</b>		
								Bulk Sample	BS	
								Tube Sample	TS	
								Disturbed Sample	DS	

MRM TEST PIT MCARTHUR.GPJ WCC\_AUS.GDT 270503

# Appendix F.3

## Test Pit Logs for Tailing Dam, OEF and Open Pit

<b>URS Australia Pty Ltd</b>		Sheet 1 of 1	
URS Australia Pty Ltd Level 240, Queen Street Brisbane, QLD, 4001 Phone (07) 3243 2111 Fax (07) 3242 2199		Project No : <b>24061-015-559</b>	Project Reference: <b>McArthur River Mine Expansion Project</b>
Landform/Vegetation Gently inclined slope to drainage, with open eucalypt woodland and medium dense low acacia shrubland	Surface Slope <0.5%	Surface Conditions Hard set, sparse gravel	Client:  <b>MIM Holdings Ltd</b>
Local Geology Cz - Residual soil underlain by Pmx - dolomitic shale or siltstone	Relative Level: mRL	Coordinates: 8185109 mN 812452 mE	
	Logged By: GJR	Date:	

Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H2O)	EC (1:5 H2O) (uS/cm)	Emerson (Dispersion) Class No.	SAMPLING AND OTHER TESTING	Groundwater	COMMENTS/Notes	
A2	(0.0-0.1) - Gravelly SILT LOAM (SM-ML), low plasticity, brownish grey, 40% r.Fe Gravel (5-10mm). <del>weak prismatic to massive structure</del> change to:			0	8.1	28	3	D		Surface soil layer prone to bulldust formation	
B1	(0.1-0.3) - Gravelly Silty Clay LOAM (CL) low-medium plasticity yellowish brown (10YR5/4), manganese along structure faces, 40% r. Fe fine gravel (5-10mm) <del>weak prismatic to massive structure</del>			0.8	5.8	22	3	D		Loamy Yellow Duplex Soil Massive Yellow Earth	
B2	(0.3-0.8) - SILTY CLAY (CL - CH) medium plasticity, yellowish brown (10YR5/4)			0.8	6.8	64	2(2)	D		Yellow Kandosol Moderately strongly dispersive subsoils	
B2	(0.8-1.3) - Gravelly (Rocky) CLAY (GC-CH), medium to high plasticity, light yellowish brown and grey diffuse of mottled, very moist, stiff, friable, massive structure.			0.8	8.3	19	5	D B(0.8-1.3)		Slightly dispersive clayey fines	
C	(1.3-2.1) - Coarse Gravelly CLAY (GC - CH) medium to high plasticity fines, soft ferruginous, segregations and s/a to s/r and angular rock, cobbles (0.15-0.25m), moist MC>Wp; EW dolomite			1.3	8.4	162	2	D		Extremely weathered rock	
				2							
				3							
<b>TEST PIT SECTION</b>								<b>TEST PIT TERMINATED AT:</b>			
								Target Depth	<input type="checkbox"/>		
								Refusal	<input type="checkbox"/>		
								Flooding	<input type="checkbox"/>		
								Caving/collapse	<input type="checkbox"/>		
								<b>SAMPLE TYPE:</b>			
								Bulk Sample	BS		
								Tube Sample	TS		
								Disturbed Sample	DS		

MRM TEST PIT - MCARTHUR GPJ - MCC\_AUS\_GBT - 2705903

# Appendix F.3

## Test Pit Logs for Tailing Dam, OEF and Open Pit

<b>URS Australia Pty Ltd</b>		Sheet 1 of 1	
<b>MRM TEST PIT TD#6</b>			
URS Australia Pty Ltd Level 240, Queen Street Brisbane, QLD, 4001	Phone (07) 3243 2111 Fax (07) 3242 2199	Project No : <b>24061-015-559</b>	Project Reference: <b>McArthur River Mine Expansion Project</b>
Landform/Vegetation Broadly undulating, gently inclined plain, with open mixed eucalypt woodland and mid high grasses	Surface Slope <1%	Surface Conditions Hardset	Client:  <b>MIM Holdings Ltd</b>
Local Geology Cz - Residual ferruginous soil, underlain by Pmq or Pmx - dolomite and/or dolomitic shale/siltstone	Relative Level: mRL	Coordinates: 8183718 mN 611803 mE	
	Logged By: GJR	Date:	

Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H2O)	EC (1:5 H2O) (uS/cm)	Emerson (Dispersion) Class No.	SAMPLING AND OTHER TESTING	Groundwater	COMMENTS/Notes
A	(0.0-0.3) - Gravelly FINE SANDY CLAY LOAM (SC - CL) low plasticity, dusky red (2.5YR4/4) with weak polyhedral fending to massive soil structure with some s/a siliceous stone and approximately 20% s/r - s/a Fe gravel to 15mm			0	6.0	50	3(3)	D		Loamy Red Duplex soil - Structured Red Earth; Red Chromosol
B1	(0.3-0.7) - Silty CLAY (CL) medium plasticity, red (2.5YR5/8), weak to moderate polyhedral structure (5 - 15m soil peds) with soft Fe/Mn segregations, moist, stiff, friable - somewhat subplastic			0.4	6.4	24	5	D		
B2	(0.7-1.2) - Silty CLAY (CL - CH) medium to high plasticity, red (2.5YR5/8), some what subplastic, with soft Fe and Mn segregations along ped faces, weak to moderate polyhedral soil structure tending to become more massive with depth, approximately 10% fine rounded Fe gravel.			0.8	6.5	35	5	B(0.5-1.5) D		
B	(1.2-1.7) - CLAY (CL - CH) medium to high plasticity yellowish red (5YR5/8) with soft Mn segregation and approximately 20% fine rounded Fe gravel (3 - 5mm)			1.2	6.5	20	3(3)	D		
C	(1.7-2.2) - HW Dolomitic Shale with angular rock fragments 20 - 150mm			1.7						
				2.0						
				2.5						
				3.0						
<b>TEST PIT SECTION</b>									<b>TEST PIT TERMINATED AT:</b>	
									Target Depth	<input type="checkbox"/>
									Refusal	<input type="checkbox"/>
									Flooding	<input type="checkbox"/>
									Caving/collapse	<input type="checkbox"/>
									<b>SAMPLE TYPE:</b>	
									Bulk Sample	BS
									Tube Sample	TS
									Disturbed Sample	DS

MRM TEST PIT, MCARTHUR GPJ, WCC\_AUS\_GDT, 270503

# Appendix F.3

## Test Pit Logs for Tailing Dam, OEF and Open Pit

<b>URS Australia Pty Ltd</b>		<b>MRM TEST PIT TD#7</b>		Sheet 1 of 1
URS Australia Pty Ltd Level 240, Queen Street Brisbane, QLD, 4001	Phone (07) 3243 2111 Fax (07) 3242 2199	Project No: <b>24061-015-559</b>	Project Reference: <b>McArthur River Mine Expansion Project</b>	
Landform/Vegetation Gently inclined plain with open mixed eucalypt woodland with medium dense acacia understorey		Surface Slope <1%	Surface Conditions Hardset, local rock exposures	
Local Geology Cz - Residual ferruginous soil associated with Pmq - Barney Creek Formation - crystalline dolomite with interbeds of dolomitic shale, siltstone, breccia		Relative Level: mRL Coordinates: 8183415 mN 8111104 mE	Client: <b>MIM Holdings Ltd</b>	
		Logged By: GJR		
		Date:		

Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H2O)	EC (1:5 H2O) (uS/cm)	Emerson (Dispersion) Class No.	SAMPLING AND OTHER TESTING	Groundwater	COMMENTS/Notes
A	(0.0-0.15) - Gravelly FINE SANDY CLAY LOAM (SC - CL), low plasticity, red (10R4/6), approximately 20% fine s/r - s/a Fe gravel (5-10mm)		[Diagonal hatching pattern]	0	5.8	39	3(2)	D		Gravelly Loam Gradational Red Massive Earth; Red Lithic Rudosol
B-C	(0.15-0.4/1.2) - LOAMY GRAVEL (GC) low plasticity fines, with approximately 80% s/r - s/a ferruginised siltstone - variable depth to rock (0.4-1.2m)		[Diagonal hatching pattern]	1	5.9	21	3(4)	D		Some veins of dolomitic breccia extend to the surface; the silty/clayey fines are slightly to moderately dispersive
C	(1.2-1.8) - HW Dolomitic Breccia, with veins of ? dolomite extending locally to the surface		[Triangle pattern]	2				R	[Water symbol]	Groundwater
				3						


MRM TEST PIT MCARTHUR GRU WCC\_AUS\_GDT 2705903

<b>TEST PIT SECTION</b>										<b>TEST PIT TERMINATED AT:</b>	
										Target Depth	<input type="checkbox"/>
										Refusal	<input type="checkbox"/>
										Flooding	<input type="checkbox"/>
										Caving/collapse	<input type="checkbox"/>
										<b>SAMPLE TYPE:</b>	
										Bulk Sample	BS
										Tube Sample	TS
										Disturbed Sample	DS

# Appendix F.3

## Test Pit Logs for Tailing Dam, OEF and Open Pit

<b>URS Australia Pty Ltd</b>		Sheet 1 of 1	
<b>MRM TEST PIT TD#8</b>			
URS Australia Pty Ltd Level 240, Queen Street Brisbane, QLD, 4001	Phone (07) 3243 2111 Fax (07) 3242 2199	Project No: <b>24061-015-559</b>	Project Reference: <b>McArthur River Mine Expansion Project</b>
Landform/Vegetation Near level plain with open eucalypt woodland and mid high grasses	Surface Slope ~0.5%	Surface Conditions Hardset, sparse grave	Client:  <b>MIM Holdings Ltd</b>
Local Geology Cz - Residual ferruginised soil underlain by Pmx - Reward Dolomite - dolomitic shale/siltstone	Relative Level: mRL Coordinates: 8183939 mN 811122 mE	Logged By: GJR Date:	

Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H2O)	EC (1:5 H2O) (uS/cm)	Emerson (Dispersion) Class No.	SAMPLING AND OTHER TESTING	Groundwater	COMMENTS/Notes
A	(0.0-0.20) - Gravelly SILT LOAM (SM - ML) low plasticity yellowish brown (10YR3/4) diffusely mottled (10YR6/4); massive soil structure with approximately 40% fine rounded Fe gravel (<5 - 15mm)			0	5.9	54	3(3)	D		Gradational Massive Yellow Earth; Yellow Kandosol prone to bulldust development; slightly dispersive silty/clayey fines
B1	(0.2-0.4) - Gravelly CLAY LOAM (CL) Medium plasticity brown (7.5YR5/4) weak prismatic tending to massive soil structure, with approximately 20% s/r Fe gravel (5 - 10mm)				5.9	21	3(3)	D		
B2	(0.4-1.0) - Gravelly CLAY LOAM (SC - CL) medium plasticity; brown (7.5YR5/4) as above but with approximately 40% fine s/r Fe gravel				6.2	23	5	B(0.4-0.8) D		
C	(1.0-1.7) - GRAVELLY CLAY - CLAYEY GRAVEL - EW ROCK, (GC) medium plasticity brown (5YR4/6) with approximately 80% s/r ferruginous and s/a WR fragments (10 - 20mm) increasing to (10 - 30mm+) with depth			1	6.3	27	3(3)	B(1.0-1.7) D		Slightly to moderately dispersive silty/clayey fines content
				2						
				3						

MRM TEST PIT MCARTHUR GPU WCC\_AUS\_GDT 270503

<b>TEST PIT SECTION</b>										<b>TEST PIT TERMINATED AT:</b>	
										Target Depth	<input type="checkbox"/>
										Refusal	<input type="checkbox"/>
										Flooding	<input type="checkbox"/>
										Caving/collapse	<input type="checkbox"/>
										<b>SAMPLE TYPE:</b>	
										Bulk Sample	BS
										Tube Sample	TS
										Disturbed Sample	DS



Appendix F.4  
Results of Geotechnical Testing Programme





















# Appendix F.4



## Results of Geotechnical Testing Programme



1/29 Finchley Street, Milton, Qld. 4064  
P.O. Box 434, Paddington, Qld. 4064

Telephone: (07) 3217 5535  
Facsimile: (07) 3217 5311

<b>PERMEABILITY BY FALLING HEAD</b>	
NATA Laboratory 9926	
TEST PROCEDURE: KH2 (In house method) based on K H Head (1988) Manual of Laboratory Testing 10.7	
Client: URS Australia	Certificate No. 304294-P
Project: McArthur River	Date: 03/05/03
Page 1 of 1 Sample provided by client	

Borehole No.	MA1
Depth (m):	1.0-1.5
Maximum Dry Density (t/m <sup>3</sup> ):	1.72
Optimum Moisture Content (%):	16.0
Placement Wet Density (t/m <sup>3</sup> ):	1.70
Placement Moisture (%):	15.0
Placement Density Ratio :	99.0
<b>PERMEABILITY:</b> $k_{20} = 4 \times 10^{-8} \text{ m/s}$	
Classification: (CI) Sandy Clay, pale brown, moist.	
Remarks:	
 <p>NATA endorsed test report. This document shall not be reproduced, except in full. NATA Accredited Laboratory Number: 9926</p>	<p>AUTHORISED SIGNATORY:</p> <p style="text-align: center;"></p> <p style="text-align: center;">G. HAMILTON</p>
GT010	

# Appendix F.4

## Results of Geotechnical Testing Programme



1/29 Finchley Street, Milton, Qld. 406  
 P.O. Box 434, Paddington, Qld. 406

Telephone: (07) 3217 553  
 Facsimile: (07) 3217 531

<b>PERMEABILITY BY FALLING HEAD</b>	
NATA Laboratory 9926	
TEST PROCEDURE: KH2 (In house method) based on K H Head (1988) Manual of Laboratory Testing 10.7	
Client: URS Australia	Certificate No. 304292-P
Project: McArther River	Date: 03/05/03
Page 1 of 1 Sample provided by client	

Borehole No.	MA4
Depth (m):	0.4-0.9
Maximum Dry Density (t/m <sup>3</sup> ):	1.70
Optimum Moisture Content (%):	17.5
Placement Wet Density (t/m <sup>3</sup> ):	1.69
Placement Moisture (%):	16.1
Placement Density Ratio :	99.5

**PERMEABILITY:**  $k_{20} = 2 \times 10^{-8}$  m/s

Classification: (CH) Sandy Clay, red/brown, moist.

Remarks:

<p>NATA endorsed test report.                  This document shall not be reproduced, except in full.                  NATA Accredited Laboratory Number: 9926</p>	<p>AUTHORISED SIGNATORY:</p> <div style="text-align: center;">   <hr style="width: 100%; border: 0; border-top: 1px solid black;"/> <p>G. HAMILTON</p> </div> <p style="text-align: right;">GT010</p>
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# Appendix F.4

## Results of Geotechnical Testing Programme



1/29 Finchley Street, Milton, Qld. 4064  
 P.O. Box 434, Paddington, Qld. 4064

Telephone: (07) 3217 5535  
 Facsimile: (07) 3217 5311

<b>PERMEABILITY BY FALLING HEAD</b> <b>NATA Laboratory 9926</b> TEST PROCEDURE: KH2 (In house method) based on K H Head (1988) Manual of Laboratory Testing 10.7	
Client: URS Australia	Certificate No. 304293-P
Project: McArthur River	Date: 03/05/03
Page 1 of 1 Sample provided by client	

Borehole No.	MA8
Depth (m):	0.4-0.8
Maximum Dry Density (t/m <sup>3</sup> ):	1.67
Optimum Moisture Content (%):	18.5
Placement Wet Density (t/m <sup>3</sup> ):	1.65
Placement Moisture (%):	17.8
Placement Density Ratio :	98.5

<b>PERMEABILITY:</b>	<b><math>k_{20} = 5 \times 10^{-8}</math> m/s</b>
Classification: (CH) Sandy Clay, red/brown, moist.	
Remarks:	

NATA endorsed test report. This document shall not be reproduced, except in full. NATA Accredited Laboratory Number: 9926	AUTHORISED SIGNATORY: <div style="text-align: center;">                       _____                      G. HAMILTON                 </div>
GT010	

# Appendix F.4

## Results of Geotechnical Testing Programme




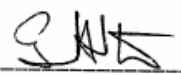
1/29 Finchley Street, Milton, Qld. 406  
P.O. Box 434, Paddington, Qld. 406

Telephone: (07) 3217 553  
Facsimile: (07) 3217 531

<b>PERMEABILITY BY FALLING HEAD</b> <b>NATA Laboratory 9926</b> TEST PROCEDURE: KH2 (In house method) based on K H Head (1988) Manual of Laboratory Testing 10.7	
Client: URS Australia	Certificate No. 304288-P
Project: McArther River	Date: 03/05/03
Page 1 of 1 Sample provided by client	

Borehole No.	OEF4
Depth (m):	0.1-0.4
Maximum Dry Density (t/m <sup>3</sup> ):	1.80
Optimum Moisture Content (%):	12.5
Placement Wet Density (t/m <sup>3</sup> ):	1.77
Placement Moisture (%):	12.5
Placement Density Ratio :	98

<b>PERMEABILITY:</b>	<b><math>k_{20} = 2 \times 10^{-8}</math> m/s</b>
Classification: (CL) Sandy Clay, red/brown, moist.	
Remarks:	

 NATA endorsed test report. This document shall not be reproduced, except in full. NATA Accredited Laboratory Number: 9926	AUTHORISED SIGNATORY:  <hr style="width: 100%;"/> G. HAMILTON
GT010	

# Appendix F.4

## Results of Geotechnical Testing Programme



1/29 Finchley Street, Milton, Qld. 4064  
P.O. Box 434, Paddington, Qld. 4064

Telephone: (07) 3217 5535  
Facsimile: (07) 3217 5311

<b>EMERSON CLASS NUMBER REPORT</b>	
NATA Laboratory No 9926 Test Method: AS1289 3.8.1	
Client: URS Australia	Certificate No. 304288-1
Project: McArther River	Date: 02/05/03
Samples supplied by the client.	

Sample No.	304288	304289	304290	304291
Testhole No.	OEF4	OEF6	OEF7	OEF9
Depth (m)	0.1-0.4	0.3-0.8	0.0-0.5	0.25-0.35
<b>Emerson Class No.</b>	<b>5</b>	<b>4</b>	<b>5</b>	<b>4</b>

Sample No.	304292	304293	304294	
Testhole No.	MA4	MA8	MA1	
Depth (m):	0.4-0.9	0.4-0.8	1.0-1.5	
<b>Emerson Class No.</b>	<b>5</b>	<b>5</b>	<b>5</b>	

Remarks: Tested with distilled water at 21°C



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This document shall not be reproduced, except in full.  
NATA Accredited Laboratory Number: 9926

Authorised Signatory:

\_\_\_\_\_

G. Hamilton

GT003-2

Topsoil Management and Erosion Control Measures



# Topsoil Management and Erosion Control Measures

The following erosion control measures and topsoil management strategies are based on the Engineering Guidelines for Queensland for Soil Erosion and Sediment Control (Institute of Engineers Australia et al. 1996), The Department of Conservation and Land Management (1992) and also from the NT Government Conservation Commission – Applegate (1983). Where appropriate, these strategies will be undertaken to reduce erosion and sediment loss from disturbed areas during the construction period and ongoing mining operations.

### **Infrastructure and Development Areas**

Erosion on construction areas cannot be eliminated completely, but measures can be taken to minimise the impact by:

- Limiting the area disturbed, and clearing progressively, immediately prior to construction activities commencing;
- Safeguarding and surface layer by stripping and stockpiling topsoil prior to construction;
- Using temporary soil diversion mounds to control runoff within and divert water away from the construction site where practicable;
- Minimising the period that bare soil is left exposed to erosion; and
- Using sediment traps/silt fences etc. to minimise off-site effects of erosion.

The control of erosion and sediment movement throughout the site will be necessary both during the construction stage and subsequently during the operating life of the mine. Where access is required for temporary use only, disturbed areas will be lightly ripped, restored to a stable condition and revegetated as soon as practicable following the completion of construction. Particular attention will be paid to those areas that may contain dispersive soils.

### **Service Roads and Temporary Access Tracks**

- Service tracks will be graded to a crown and provided with efficient surface drainage to prevent runoff eroding either the road surface or the adjacent land. Where necessary, low mounds angled across the track will be constructed to divert runoff (at non-erosive velocity) into adjacent areas.
  - Cut and fill batters associated with service tracks will be formed to a safe slope and stabilised by vegetation.
  - Where table-drains need to be established, they will be constructed to a broad dish shape, seeded and fertilised or lined appropriately, to prevent erosion. Table-drains will be slashed periodically to ensure vegetation growth is not restricting drainage
  - Approaches on service tracks to gully and creek crossings will be flat as practicable. The track will be sloped to direct runoff to a table-drain constructed as above. In some
-

# Topsoil Management and Erosion Control Measures

vulnerable areas, it may be necessary to spread and compact coarse aggregate along the approaches to the crossing to provide, permanent, stable access, and reduce erosion.

- Where provision of access across gullies or creeks cause disturbance, revegetation work will be undertaken.
- All temporary construction tracks and associated disturbed areas will be ripped, seeded and fertilised when construction is completed. Stockpiled topsoil will be respread before sowing. On steeper slopes the seeded areas will be protected if necessary.

### **Topsoil Resource Management**

The effective rehabilitation of areas to be disturbed due to construction/mining activities, will ensure that:

- Surface erosion is kept to a minimum;
- The potential for saline or acid groundwater contamination of the topsoil layer due to the capillary rise is minimised; and
- Effective vegetation ground cover is established quickly.

The use of topsoil will significantly improve the chances of successful vegetation. Normally about 10-15cm of topsoil is probably sufficient to provide a planting medium where revegetated lands are to be returned to pasture and the subsoil is conducive to plant growth. However, a greater thickness of topsoil may be necessary in areas where any substrate materials potentially deleterious to plant growth have been placed near the surface.

Stripping of the topsoil and any subsoil layers will be planned, where practicable, to be undertaken during the dry season and/or not following any prolonged wet periods. This will reduce the potential for soil compaction and for degradation of the soil structure due to mechanical handling of soils when in a wet condition.

In all cases, care will be exercised during the removal and replacement of the topsoil material to ensure that physical deterioration of the soil is avoided and that excessive soil compaction does not occur during the stockpiling or replacement processes. Where practicable, freshly stripped topsoil will be respread over areas to be rehabilitated in order to retain seed viability and to keep the soil micro-fauna active. In areas where subsoil resources are indicated to be available, these will only be stripped where the resource would otherwise be lost as a result of earthworks activities.

Biological changes, such as a decline in mycorrhizal propagules and seed viability are likely to occur with extended storage periods if ameliorative measures are not adopted. Accordingly stockpiles, which are to be retained for extended periods of 3 months or more and which have not adequately revegetated naturally, will be seeded with plant species planned for the revegetation component in the rehabilitation programme. This practice will also reduce the potential for weed infestation and resultant weed seed store accumulation in the stockpiled soils.

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# Topsoil Management and Erosion Control Measures

Removal of the soils from the stockpiles will be undertaken using a front-end loader and dump truck operation. This method of topsoil replacement will reduce the structural degradation associated with scraper operations. It will also facilitate the mixing of the upper and lower sections of the stockpiles and the more even spread of mycorrhiza inoculum and seed stock.

Control of erosion will be a high priority both during the preliminary site clearing and topsoil stripping stage and in relation to the long-term stability of stockpiles to be preserved for rehabilitation purposes.

Site clearing and soil stripping operations will be carried out, where practicable, progressively, and immediately prior to the commencement of construction activities in the particular area.

Clearing of vegetation will be limited to that considered necessary for the efficient performance of construction activities. Where the construction activities are likely to extend over a lengthy period, say 1-2 months or more, temporary erosion control measures will be installed to limit surface runoff and restrict sediment loss from any de-vegetated surfaces. Haybales or sandbags to direct site runoff to small retention/sedimentation ponds may be used for this purpose.

Where topsoil is required to be stockpiled for extended periods, the material will be placed a pre-determined area free from regular activities and not within a waterway or drainage path. The material will be placed in low mounds constructed of minimum height and maximum surface area consistent with the space available. The external slopes of the stockpile will be formed to the steepest stable slope that can be re-vegetated and will resist erosion. Maximum slopes will generally not exceed 4:1. Revegetation using natural grass/pasture species will be carried out following grading of the stockpile surface to a stable slope.

When the materials are eventually removed from stockpile, it is preferable that this is carried out using an end-loader/dump truck operation. This material handling method will reduce structural degradation often associated with scraper operations. It will also facilitate mixing of the upper and lower levels of the stockpile and the more even spread of micro-organisms and seed stock.

### **Vegetation Clearing – General**

- Disturbance of vegetation in construction areas will be limited to the minimum practicable.
  - Selective clearing techniques will be used where practicable which will cause a minimum of disturbance to surface conditions.
  - Chipping of smaller branches and foliage from the clearing operations in areas of high and very high erosion potential, will provide a useful form of surface mulch to reduce surface erosion in the rehabilitation area.
  - Clearing will be carried out in such a manner that seed/root stock is left in the ground and surface soils are disturbed as little as possible.
-

Appendix F.6  
Survey Methodology



## Appendix F.6

### Survey Methodology

Sampling sites within each of the Tailings Dam (TD), Overburden Emplacement Facility (OEF), proposed Open Pit (OP) area; and River Diversion (RD) alignment were selected to provide representative coverage of the areas to be disturbed (Figure F.1 below). The sites selected were based on terrain pattern/eco-tone differences evident on the air photos, in areas where there appeared to be reasonable access for a 4WD vehicle and the excavation equipment. GPS references were determined for each of the proposed investigation sites and these were located and flagged in advance of the sampling operations.

A small tracked excavator capable of trenching to a depth of about 2.5-3.0 m was used to investigate the tailings dam extension area. Terrain conditions at each site were recorded, the soil profile classified and representative soil samples were obtained for reference and routine testing requirements. Bulk soil samples (approx. 25 kg) were also obtained from selected soil layers for geo-technical testing purposes.

Due to equipment breakdown problems, test pits in the OEF area and in the OP area, were completed using a large end-loader, the practical excavation depth limitation of which was approximately 2.0 m.

Due to wet weather access restrictions to the eastern side of the McArthur River, investigation of the open pit and river diversion areas were completed by helicopter reconnaissance using hand augering equipment and visual inspection of local soil/rock exposures

Sampling sites completed in each of the investigation areas have been identified by GPS reference locations based on the AGD 84 mapping datum.

A total of 9 test pits were excavated to depths varying between 1.2 -2.8m within the confines of the proposed tailings dam area. Seven of the pits met near refusal on closely jointed and coarsely fractured weathered dolomite or dolomitic shale

Ten test pits were completed in the overburden emplacement facility (OEF) to depths varying from 0.7-2.2m. Refusal on hard weathered dolomite occurred in 3 pits, the remainder encountered near refusal conditions for the end-loader on extremely hard calcareous clays, typically at a depth of about 1.7m below ground surface level.

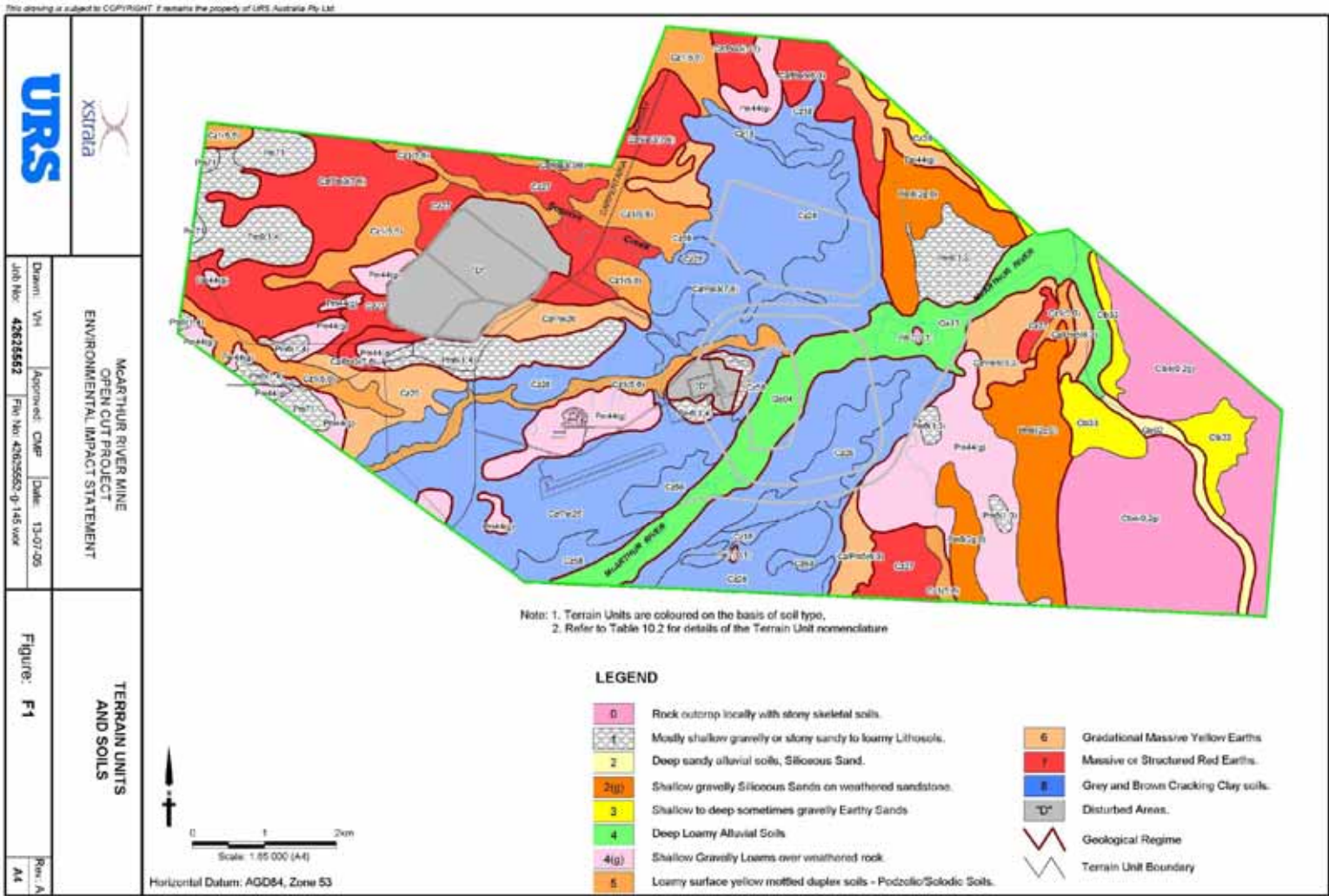
In the designated open pit (OP) area, four test pits were completed on the western side of the McArthur River where vehicle access permitted. The purpose of the investigation in the OP area was mainly to classify the soil types within the area and to identify any potential resources of good quality topsoil material that might be suitable for rehabilitation purposes if required. Three shallow hand auger holes were dug in the OP area on the eastern side of the river as part of the helicopter reconnaissance.

Four sites were investigated by hand augering and inspection of soil/rock exposures along the proposed McArthur River diversion.

A total of 17 bulk soil samples (approx. 25 kg) and approximately 100 (1 kg) reference samples were obtained for geotechnical testing and general soil characterisation requirements. These have been sent by road freight from MRM to AG Laboratories - Unit 1/29 Finchley Street Milton in Brisbane, where the samples were held and made available for inspection prior to determination of the required testing program.

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# Appendix F.6 Survey Methodology



Rev: A

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