

Appendix D1
Terrain and Soil Analysis
(from URS, 2005)

Appendix D1 Terrain and Soil Analysis

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Description of Terrain Mapping Units

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Appendix D.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.

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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)

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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 ☐ ravely 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 ☐ ravely 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.

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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 D1.2
Terrain and Soil Analysis (pH, EC and Dispersion
Class)

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

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

Rock Type WR - Weathered rock EWR - Extremely weathered rock HWR - Highly weathered rock Particle Shape r - Rounded s/r - Sub-rounded s/a - Sub-angular Gravel Type Gv - Gravel Fe - Ferruginous / laterite Si - Siliceous Mn - Manganese Ca - Carbonate Sample Type B - Bulk sample D - Disturbed Sample R - Rock Sample	Moisture Condition MC - Moisture content Wp - Moisture content at plastic limit. Electrical Conductivity (EC 1:5 H ₂ O), values have been reported as (µS/cm). An indicative potential salinity severity rating is: Nil E.C. <280 Slight E.C. >280-570 Moderate E.C. >570-1100 High E.C. >1100-2300 Severe E.C. >2300 Soil Acidity/Alkalinity levels (pH) are: Strongly Acidic pH <5.0 Acidic pH 5.0-6.5 Neutral pH 6.6-7.3 Alkaline pH 7.4-8.5 Strongly Alkaline pH >8.5
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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

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

Appendix D.2 Soil Characterisation

Map Unit	Site ID/Depth (m)	Soil Horizon	Description	Coarse Fragments	Soil pH (1:5 H ₂ O)	Salinity EC (μS/cm)	Dispersion Class	Comments/Soil Classification
Overburden Emplacement Facility (OEF):								
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	-	-	-	-	Weathered Rock
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
	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	Highly saline subsoils
	1.7-2.2+	B-C	Clay (CH) high plasticity yellowish brown	5% fine s/r ca/gypsum nodules.	8.6	1126	4	Moderately highly saline subsoils
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
	0.8-1.2	B2	Silty clay (CL – CH) Medium to high slight plasticity brown	Same fine Ca nodules	8.5	175	2	Moderately dispersive subsoils
	1.2-1.7+	B-C	Silty Clay (CL-CH) medium plasticity yellowish brown and whitish grey	Some Ca nodules	8.5	326	4	Low permeability in the deeper subsoil

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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 ₂ O)	Salinity EC (µS/cm)	Dispersion Class	Comments/Soil Classification
Overburden Emplacement Facility (OEF):								
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. Hard dolomite
	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					
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. Hard dolomite
	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)	—	—	—	
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 Slightly dispersive subsoils Highly saline subsoil
	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	

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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 ₂ O)	Salinity EC (µS/cm)	Dispersion Class	Comments/Soil Classification
Overburden Emplacement Facility (OEF):								
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	

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Map Unit	Site ID/Depth (m)	Soil Horizon	Description	Coarse Fragments	Soil pH (1:5 H ₂ O)	Salinity EC (μS/cm)	Dispersion Class	Comments/Soil Classification
Overburden Emplacement Facility (OEF):								
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

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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 ₂ O)	Salinity EC (μS/cm)	Dispersion Class	Comments/Soil Classification
Tailings Dam (TD) Area:									
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

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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 ₂ O)	Salinity EC (μS/cm)	Dispersion Class	Comments/Soil Classification	
Tailings Dam (TD) Area:									
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

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Map Unit	Site ID/ Depth (m)	Soil Horizon	Description	Coarse Fragments	Soil pH (1:5 H ₂ O)	Salinity EC (μS/cm)	Dispersion Class	Comments/Soil Classification	
Tailings Dam (TD) Area:									
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
		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)	Lithic Rusdosol Variable depth to rock (0.4-1.2m)
		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

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Map Unit	Site ID/ Depth (m)	Soil Horizon	Description	Coarse Fragments	Soil pH (1:5 H ₂ O)	Salinity EC (µS/cm)	Dispersion Class	Comments/Soil Classification
Tailings Dam (TD) Area:								
	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 D1.2

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 ₂ O)	Salinity EC (µS/cm)	Dispersion Class	Comments/Soil Classification
Open Pit (OP) Area:								
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 D1.2

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 ₂ O)	Salinity EC (μS/cm)	Dispersion Class	Comments/Soil Classification
Open Pit (OP) Area:								
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)
	0.5-1.0	B2	Clay (CH) high plasticity, reddish brown	Some fine Ca nodules	7.9	1030	4	Brown Gypsic Vertosol 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 D1.3

*Test Pit Logs for Tailings Dam (TD), Overburden
Emplacement Facility (OEF) and Open Pit (OP)*

Appendix D1.3

Test Pit Logs for Tailing Dam, OEF and Open Pit

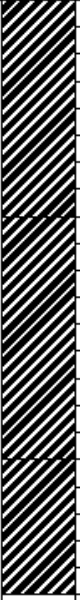
URS Australia Pty Ltd		MRM TEST PIT OEF#1		Sheet 1 of 1
URS Australia Pty Ltd Level 240, Queen Street Brisbane, QLD, 4001	Phone (07) 3243 2111 Fax (07) 3242 2199	Project No.: 24061-015-559	Project Reference:	
Landform/Vegetation Near flat to gently undulating plain with open eucalypt woodland and Terminalia understorey, with mid high grasses.		Surface Slope <1%	Surface Conditions Hardset some surface stone	McArthur River Mine Expansion Project
Local Geology Cz - Residual soil underlain by Pmx - dolomitic siltstone		Relative Level: mRL Coordinates: 8185329 mN 816140 mE	Client: MIM Holdings Ltd	
		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	(0-0.2) 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)			0	5.3	38	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 (10YR8/4) diffusely mottled grey, weak blocky to massive structure, 10-15% s/r Fe gravel (10-15mm)				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							R		Rock joints have ferruginous coatings. No groundwater encountered
				1						
				2						
				3						
TEST PIT SECTION									TEST PIT TERMINATED AT:	
									Target Depth	☐
									Refusal	☒
									Flooding	☐
									Caving/collapse	☐
									SAMPLE TYPE:	
									Bulk Sample	BS
									Tube Sample	TS
									Disturbed Sample	DS

Appendix D1.3

Test Pit Logs for Tailing Dam, OEF and Open Pit

URS Australia Pty Ltd		MRM TEST PIT OEF#2		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: 24061-015-559	Project Reference:	
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 Coordinates: 8185649 mN 617055 mE	Client: MIM Holdings Ltd	
		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	(0-0.8) 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	7.6	96	5	D		Grey - Brown (cracking) Clay. Grey Brown Vertosol 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						
TEST PIT SECTION									TEST PIT TERMINATED AT:	
									Target Depth	☐
									Refusal	☐
									Flooding	☐
									Caving/collapse	☐
									SAMPLE TYPE:	
									Bulk Sample	BS
									Tube Sample	TS
									Disturbed Sample	DS

Appendix D1.3

URS Australia Pty Ltd		MRM TEST PIT OEF#3		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.: 24061-015-559	Project Reference: McArthur River Mine Expansion Project	
Landform/Vegetation Gently inclined floodplain adjacent to drainage, with mixed low open eucalypt/Bauhinia woodland and tussock grasses		Surface Slope 1%	Surface Conditions Cracking clay, thin surface crust	MIM Holdings Ltd
Local Geology Cz - Alluvial (brown and grey clay) deposits		Relative Level: mRL Coordinates: 8180130 mN 617081 mE	Client:	
		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) Silty CLAY (CH) high plasticity light grey brown (2.5Y5/8), dry (MC<<Wp), very stiff to hard, strong medium to coarse blocky structure, some fine carbonate nodules (1-3mm) towards 0.8m	>>500		0	8.1	123	5	D		Weak surface crust with thin self-mulching surface soils prone to "bulldust" development when subject to trafficking. Brown (cracking) Clay Brown Vertisol
B2b	(0.8-1.2) Silty Clay (CL - CH) medium to high plasticity brown (7.5YT5/4) (MC<<Wp) hard massive soil structure, some fine carbonate	>>500		1	8.5	175	2(1)	D		Slightly to moderately dispersive
B2b	(1.2-1.7+) Silty CLAY (CL - CH) medium plasticity, yellowish brown and whitish grey variegated clay with carbonate nodules; dry very hard massive soil structure				8.5	326	4	D		Low permeability in the subsoil. May be a transition horizon to the weathered rock zone
				2						
				3						
TEST PIT SECTION									TEST PIT TERMINATED AT:	
									Target Depth	☐
									Refusal	☐
									Flooding	☐
									Caving/collapse	☐
									SAMPLE TYPE:	
									Bulk Sample	BS
									Tube Sample	TS
									Disturbed Sample	DS

Appendix D1.3

URS Australia Pty Ltd		MRM TEST PIT OEF#4		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: 24061-015-559	Project Reference:	
Landform/Vegetation Broad low rounded rise with mixed low open woodland and mid high grasses	Surface Slope 1%	Surface Conditions Hardset	McArthur River Mine Expansion Project	
Local Geology Pmx - Reward dolomite; residual soil over weathered dolomite	Relative Level: mRL Coordinates: 8186830 mN 817241 mE	Client:		
	Logged By: GJR Date:	MIM Holdings Ltd		

Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H ₂ O)	EC (1:5 H ₂ O) (uS/cm)	Emerson (Dispersion) Class No.	SAMPLING AND OTHER TESTING	Groundwater	COMMENTS/Notes
A1	(0-0.1) Fine Sandy Clay LOAM (SC - CL) low plasticity, dark reddish to yellowish brown (5-10YR3/4) - sharp break to -			0	6.4	37	3(1)	D		Loamy surface red duplex soil - red structured earth: Red Chromosol.
B	(0.1 - 0.8) CLAY (CH) high plasticity, red (10R4/6), just moist, very stiff to hard moderate prismatic structure				7.0	66	5	B(0.3-0.8) D		Surface soils are prone to develop "bulldust" when subject to repeated trafficking
	(0.8+) Weathered rock - Dolomite		x x x x x x x x x x							
				1						
				2						
				3						
TEST PIT SECTION									TEST PIT TERMINATED AT:	
									Target Depth	☐
									Refusal	☐
									Flooding	☐
									Caving/collapse	☐
									SAMPLE TYPE:	
									Bulk Sample	BS
									Tube Sample	TS
									Disturbed Sample	DS

Appendix D1.3

URS Australia Pty Ltd		MRM TEST PIT OEF#5		Sheet 1 of 1	
URS Australia Pty Ltd Level 240, Queen Street Brisbane, QLD, 4000	Phone (07) 3243 2111 Fax (07) 3242 2199	Project No : 24061-015-559		Project Reference:	
Landform/Vegetation Near level plain, with open low mixed eucalypt woodland and mid high grasses		Surface Slope	Surface Conditions Hardest, scattered stone	McArthur River Mine Expansion Project	
Local Geology Cz - Residual soil underlain by Pmx - reward dolomite		Relative Level: mRL Coordinates: 8186433 mN 616001 mE			Client: MIM Holdings Ltd
		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/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	6.6 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						
TEST PIT SECTION									TEST PIT TERMINATED AT:	
									Target Depth	☐
									Refusal	☐
									Flooding	☐
									Caving/collapse	☐
									SAMPLE TYPE:	
									Bulk Sample	BS
									Tube Sample	TS
									Disturbed Sample	DS

MRM TEST PIT MCARTHUR.GPJ WCC_AUS.GDT 270503

Appendix D1.3 Test Pit Logs for Tailing Dam, OEF and Open Pit

URS Australia Pty Ltd		MRM TEST PIT OEF#6		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 : 24061-015-559	Project Reference: McArthur River Mine Expansion Project	
Landform/Vegetation Flat plain with scattered low Bauhinia and mid high tussock grasses		Surface Slope <0.5%	Surface Conditions Creaking thin self-mulching	
Local Geology Cz - Older alluvium - dark clay backplain deposits		Relative Level: mRL Coordinates: 8184791 mN 617047 mE	Client: MIM Holdings Ltd	
		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 (CH) high plasticity brown (10YR4/3) moist (MC<<Wp) stiff friable, some fine gravel (2mm)			0	6.9	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			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			1	7.8	2662	4	D		Extremely saline subsoil - very low permeability
				2						Near refusal at 2.0m
				3						
TEST PIT SECTION									TEST PIT TERMINATED AT:	
									Target Depth	☐
									Refusal	☒
									Flooding	☐
									Caving/collapse	☐
									SAMPLE TYPE:	
									Bulk Sample	BS
									Tube Sample	TS
									Disturbed Sample	DS

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

Appendix D1.3

Test Pit Logs for Tailing Dam, OEF and Open Pit

URS Australia Pty Ltd		MRM TEST PIT OEF#7		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.: 24061-015-559	Project Reference: McArthur River Mine Expansion Project	
Landform/Vegetation Erosion gully slopes with heavy weed (burri) infestation, scattered Bauhinia and Acacia shrubland		Surface Slope 5-10%	Surface Conditions Cracking	Client: MIM Holdings Ltd
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(0.0-0.5) D		Brown (cracking) Clay. Brown Vertosol (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	7.6	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						
TEST PIT SECTION									TEST PIT TERMINATED AT:	
									Target Depth	☐
									Refusal	☐
									Flooding	☐
									Caving/collapse	☐
									SAMPLE TYPE:	
									Bulk Sample	BS
									Tube Sample	TS
									Disturbed Sample	DS

Appendix D1.3

Test Pit Logs for Tailing Dam, OEF and Open Pit

URS Australia Pty Ltd		Sheet 1 of 1	
		MRM TEST PIT OEF#8	
URS Australia Pty Ltd Level 240, Queen Street Brisbane, QLD, 4001	Phone (07) 3243 2111 Fax (07) 3242 2199	Project No : 24061-015-559	Project Reference: McArthur River Mine Expansion Project
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: MIM Holdings Ltd
Local Geology Cz - Older alluvium - dark clay soil in alluvium back plain		Relative Level: mRL Coordinates: 8185017 mN 818526 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	8.1	184	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	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	7.8	2782	4	D		Strongly saline subsoil
				3						
TEST PIT SECTION									TEST PIT TERMINATED AT:	
									Target Depth	☐
									Refusal	☐
									Flooding	☐
									Caving/collapse	☐
									SAMPLE TYPE:	
									Bulk Sample	BS
									Tube Sample	TS
									Disturbed Sample	DS

MRM TEST PIT MCARTHUR GPJ WCC_AUS.GDT 270503

Appendix D1.3

URS Australia Pty Ltd		MRM TEST PIT OEF#9		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: 24061-015-559	Project Reference:	
Landform/Vegetation Near level, plain with heavy melonhole gilgai; tussock grassland with scattered shrubs	Surface Slope 2/1, 3/14	Surface Conditions Cracking - melon hole gilgai	McArthur River Mine Expansion Project	
Local Geology Cz - Older alluvium - dark (cracking) clay in alluvial backplain	Relative Level: mRL Coordinates: 8185017 mN 818525 mE	Client:	MIM Holdings Ltd	
	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	(0-0.15) CLAY (CH) high plasticity, brown (10YR4/3), fine to medium blocky structure, some fine s/r-s/a stone (<10mm)	350		0	6.5	74	3(2)	D		Heavy melon-hole gilia in the adjacent plain
B1	(0.15-0.5) CLAY (CH) high plasticity brown (10YR4/3) strong coarse prismatic to blocky structure, moist (MC<Wp) firm to stiff, some fine carbonate nodules				7.6	93	4	B(0.2-0.5) D		Brown (cracking) Clay soil Brown Vertosol
B2	(0.5-1.4) CLAY (CH) high plasticity brown (10YR4/3) very moist (MC>Wp) tending to massive structure - coarse cloddy			250		8.7	233	1(2)	D	
	(1.4-1.8) CLAY (CH) high plasticity brown (10YR 5/3) just moist (MC<<Wp) very stiff, brittle, flecks of carbonate and gypsum crystals				1	8.2	2063	4	D	
				2						
				3						
TEST PIT SECTION									TEST PIT TERMINATED AT:	
									Target Depth	☐
									Refusal	☐
									Flooding	☐
									Caving/collapse	☐
									SAMPLE TYPE:	
									Bulk Sample	BS
									Tube Sample	TS
									Disturbed Sample	DS

Appendix D1.3

Test Pit Logs for Tailing Dam, OEF and Open Pit

URS Australia Pty Ltd		MRM TEST PIT OEF#10		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: 24061-015-559	Project Reference: McArthur River Mine Expansion Project	
Landform/Vegetation Slightly elevated gently undulating plain with mixed low open Eucalypt and Acacia woodland, some Baulinia		Surface Slope <1% Harsh	Surface Conditions Hardset, some surface stones	
Local Geology Cz - Alluvial soil underlain by weathered dolomitic siltstone/sandstone		Relative Level: mRL Coordinates: 8185398 mN 815630 mE	Client: MIM Holdings Ltd	
		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 (10YR5/8), 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

MRM TEST PIT MCARTHUR.GPJ WCC_AUS.GDT 270503

TEST PIT SECTION										TEST PIT TERMINATED AT:	
										Target Depth	☐
										Refusal	☐
										Flooding	☐
										Caving/collapse	☐
										SAMPLE TYPE:	
										Bulk Sample	BS
										Tube Sample	TS
										Disturbed Sample	DS

Appendix D1.3

Test Pit Logs for Tailing Dam, OEF and Open Pit

URS Australia Pty Ltd		MRM TEST PIT OP#1		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.: 24061-015-559	Project Reference: McArthur River Mine Expansion Project	
Landform/Vegetation Back-sloping 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: MIM Holdings Ltd	
		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			0	6.6	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				6.9	23	3(3)	D		Good topsoil material; slightly to moderately dispersive when reworked in very moist conditions
				1						
				2						
				3						
TEST PIT SECTION									TEST PIT TERMINATED AT:	
									Target Depth	☐
									Refusal	☐
									Flooding	☐
									Caving/collapse	☐
SAMPLE TYPE:										
									Bulk Sample	BS
									Tube Sample	TS
									Disturbed Sample	DS

MRM TEST PIT MCARTHUR.GPJ WCC_AUS.GDT 2705003

Appendix D1.3

Test Pit Logs for Tailing Dam, OEF and Open Pit

URS Australia Pty Ltd		MRM TEST PIT OP#2		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.: 24061-015-559	Project Reference:	
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 617805 mE	Client: MIM Holdings Ltd	
		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 Vertisol
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			0.5	8.5	190	2(1)	D		Slightly to moderately dispersive
B2	(0.4-0.6) CLAY (CH) high plasticity dark brown (10YR4/4) just moist medium blocky to prismatic structure very stiff, with flecks of carbonate			0.7	8.7	271	1(4)	D		Strongly dispersive subsoils
				1						
				2						
				3						
TEST PIT SECTION									TEST PIT TERMINATED AT:	
									Target Depth	☐
									Refusal	☐
									Flooding	☐
									Caving/collapse	☐
									SAMPLE TYPE:	
									Bulk Sample	BS
									Tube Sample	TS
									Disturbed Sample	DS

Appendix D1.3

Test Pit Logs for Tailing Dam, OEF and Open Pit

URS Australia Pty Ltd		MRM TEST PIT OP#3		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 : 24061-015-559	Project Reference:	
Landform/Vegetation Gently inclined alluvial backplain with low open acacia woodland and mid high grasses		Surface Slope <1%	Surface Conditions Cracking - string self-mulching	McArthur River Mine Expansion Project
Local Geology Cz - Alluvial backplain deposits - dark (crackign) clays		Relative Level: mRL Coordinates: 8182098 mN 618407 mE	Client:	
		Logged By: GJR Date:	MIM Holdings Ltd	

Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H ₂ O)	EC (1:5 H ₂ O) (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 Vertisol
B	(0.2-0.4+) Clay (CH) high plasticity brown (10YR5/3) moist, very stiff			7.6	73	5	D		Slight dispersion when reworked in very moist conditions	
				1						
				2						
				3						
TEST PIT SECTION									TEST PIT TERMINATED AT:	
									Target Depth	☐
									Refusal	☐
									Flooding	☐
									Caving/collapse	☐
									SAMPLE TYPE:	
									Bulk Sample	BS
									Tube Sample	TS
									Disturbed Sample	DS

MRM TEST PIT MCARTHUR.GPJ WCC_AUS.GDT 27/05/03

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URS Australia Pty Ltd		MRM TEST PIT OP#4		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 : 24061-015-559	Project Reference:	
Landform/Vegetation Gently inclined backslipping levee of the McArthur River with tall open eucalyptus woodland, some Bauhinia and mid-high grasses		Surface Slope ≤1%	Surface Conditions Not Hardest	McArthur River Mine Expansion Project
Local Geology Qd - Recent Alluvial Deposits, backslope of the river levee		Relative Level: mRL Coordinates: 8182421 mN 617247 mE		
		Logged By: GJR Date:		
		Client: MIM Holdings Ltd		

Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H ₂ O)	EC (1:5 H ₂ O) (uS/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	6.8	32	3(3)	D		Loamy Alluvial Soil - Brown Kandosol. Good quality topsoil for rehabilitation requirements. Slightly dispersive when reworked in a very moist condition. Slightly dispersive, as above
B2	(0.3-0.6) - Fine Sandy Silt LOAM (SC-ML) low plasticity, brown (10YR4/3) massive soil structure				6.8	25	3(3)	D		
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	6.8	19	3(3)	D		
				2						
				3						
TEST PIT SECTION									TEST PIT TERMINATED AT:	
									Target Depth	☐
									Refusal	☐
									Flooding	☐
									Caving/collapse	☐
									SAMPLE TYPE:	
									Bulk Sample	BS
									Tube Sample	TS
									Disturbed Sample	DS

Appendix D1.3

Test Pit Logs for Tailing Dam, OEF and Open Pit

URS Australia Pty Ltd		MRM TEST PIT OP#5		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.: 24061-015-559	Project Reference: McArthur River Mine Expansion Project	
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	Client: MIM Holdings Ltd	
Local Geology Cz - Older Alluvial Deposits - dark (cracking) clay alluvial backplain deposits	Relative Level: mRL	Coordinates: 8182237 mN 818648 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)			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			8.2	1648	4		D		Strongly saline; very low permeability
				2						
				3						

TEST PIT SECTION										TEST PIT TERMINATED AT:	
										Target Depth	☐
										Refusal	☐
										Flooding	☐
										Caving/collapse	☐
										SAMPLE TYPE:	
										Bulk Sample	BS
										Tube Sample	TS
										Disturbed Sample	DS

Appendix D1.3

URS Australia Pty Ltd

MRM TEST PIT MCARTHUR.GPJ WCC AUS GDT 270503

Appendix D1.3

Test Pit Logs for Tailing Dam, OEF and Open Pit

URS Australia Pty Ltd

MRM TEST PIT OP#7

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.:	24061-015-559
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Project Reference:

McArthur River Mine Expansion Project

Landform/Vegetation
Erosional slopes associated with erosion gullies, with low
open acacia woodland

Surface Slope	Surface Conditions
5-20%	Cracking, thin self-mulching

Client:	
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MIM Holdings Ltd

Local Geology
Cz - Older Alluvial Deposits - dark (cracking) clay soils, alluvial backplain deposits

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			0	7.1	1833	2(1)-4	0		Brown (cracking) Clay Brown Gypsic Vertosol Thin (0.05) self mulching surface soil with weak thin surface crust; very slight dispersion when remoulded in very moist conditions, Highly saline
B2	(0.5-1.0+) - CLAY (CH) high plasticity, gypseous clay as above			1						Highly erodible and subject to moderately intensive gulying.
				2						
				3						

TEST PIT SECTION

TEST PIT TERMINATED AT:

Target Depth Refusal ☐

Flooding	☐
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Caving/collapse	☐
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SAMPLE TYPE:

Bulk Sample BS

Tube Sample	TS
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Disturbed Sample DS

ARM TEST PIT MCARTHUR.GPJ WCC_AUS.GDT 270503

Appendix D1.3

Test Pit Logs for Tailing Dam, OEF and Open Pit

URS Australia Pty Ltd		MRM TEST PIT TD#1		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: 24061-015-559	Project Reference:	
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 612483 mE	Client: MIM Holdings Ltd	
		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 reddish brown (5YR5/4) massive structure dense			0	5.8	42	3(3)	D		Approx. 10% fine s/a - s/r ferruginous (Fe) gravel Yellow - Red Massive Earth. Surface horizon prone to bulldust formation
B1	(0.3-0.7) - SILTY FINE SANDY LOAM (SM - SC) low plasticity, yellowish red (5YR5/6), massive structure, friable, moist, with approximately 10% rounded fine Fe gravel 5-10mm				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	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						Slow seepage inflow on top of the weathered rock zone Pit terminated at 2.3m - difficult digging in angular gravel
				3						
TEST PIT SECTION									TEST PIT TERMINATED AT:	
									Target Depth	☐
									Refusal	☐
									Flooding	☐
									Caving/collapse	☐
									SAMPLE TYPE:	
									Bulk Sample	BS
									Tube Sample	TS
									Disturbed Sample	DS

Appendix D1.3

URS Australia Pty Ltd		MRM TEST PIT TD#2		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: 24061-015-559		Project Reference:
Landform/Vegetation Near flat to gently inclined plain with open eucalypt woodland		Surface Slope 1/≤1%	Surface Conditions Hardset	McArthur River Mine Expansion Project
Local Geology Cz - Cainozoic soil, alluvial outwash fan and colluvial deposits		Relative Level: mRL Coordinates: 8185387 mN 612696 mE		Client: MIM Holdings Ltd
		Logged By: GJR Date:		

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Appendix D1.3

Test Pit Logs for Tailing Dam, OEF and Open Pit

URS Australia Pty Ltd		MRM TEST PIT TD#3		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 : 24061-015-559	Project Reference: McArthur River Mine Expansion Project	
Landform/Vegetation Flat plain with open eucalypt woodland and mid high grasses		Surface Slope ≤1%	Surface Conditions Hardset	
Local Geology Cz/Pmx - Residual soil underlain by dolomitic shale/siltstone		Relative Level: mRL Coordinates: 8184358 mN 612222 mE	Client: MIM Holdings Ltd	
		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			0.3	6.2	43	2(2)	D		Clayey fines are moderately dispersive - <30% clay fines content
				1				R		Pit terminated at 1.4 in fractured rock - near refusal
				2						
				3						

MRM TEST PIT MCARTHUR.GPJ WCC_AUS.GDT 270503

TEST PIT SECTION										TEST PIT TERMINATED AT:	
										Target Depth	☐
										Refusal	☐
										Flooding	☐
										Caving/collapse	☐
										SAMPLE TYPE:	
										Bulk Sample	BS
										Tube Sample	TS
										Disturbed Sample	DS

Appendix D1.3

Test Pit Logs for Tailing Dam, OEF and Open Pit

URS Australia Pty Ltd		MRM TEST PIT TD#4		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 : 24061-015-559	Project Reference:		
Landform/Vegetation Broad low rounded rise with low open eucalypt woodland and mid high grasses		Surface Slope <1%	Surface Conditions Hardset	McArthur River Mine Expansion Project	
Local Geology Pmx - Reward Dolomite; thin bedded dolomitic and pyritic shale and siltstone		Relative Level: mRL Coordinates: 8183363 mN 612007 mE	Client:		
		Logged By: GJR Date:	MIM Holdings Ltd		

Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H ₂ O)	EC (1:5 H ₂ O) (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, opace 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						
TEST PIT SECTION									TEST PIT TERMINATED AT:	
									Target Depth	☐
									Refusal	☐
									Flooding	☐
									Caving/collapse	☐
									SAMPLE TYPE:	
									Bulk Sample	BS
									Tube Sample	TS
									Disturbed Sample	DS

Appendix D1.3 Test Pit Logs for Tailing Dam, OEF and Open Pit

URS Australia Pty Ltd		MRM TEST PIT TD#5		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: 24061-015-559	Project Reference: McArthur River Mine Expansion Project	
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: MIM Holdings Ltd
Local Geology Cz - Residual soil underlain by Pmx - dolomitic shale or siltstone		Relative Level: mRL	Coordinates: 8185109 mN 612452 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
AZ	(0.0-0.1) - Gravelly SILT LOAM (SM-ML), low plasticity, brownish grey, 40% r.Fe Gravel (5-10mm).			0	6.1	28	3	D		Surface soil layer prone to bulldust formation
B1	weak prismatic to massive, sharp change to:				5.8	22	3	D		Loamy Yellow Duplex Soil
B2	(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)				6.8	64	2(2)	D		Massive Yellow Earth
B2	weak prismatic to massive structure (0.3-0.6) - SILTY CLAY (CL - CH) medium plasticity, yellowish brown (10YR5/4)				8.3	19	5	D B(0.8-1.3)		Yellow Kandosol Moderately strongly dispersive subsoils
B2	(0.6-1.3) - Gravelly (Rocky) CLAY (GC-CH), medium to high plasticity, light yellowish brown and grey diffuse of mottled, very moist, stiff, friable, massive structure.			1						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			2	8.4	162	2	D		Extremely weathered rock
				3						
TEST PIT SECTION									TEST PIT TERMINATED AT:	
									Target Depth	☐
									Refusal	☐
									Flooding	☐
									Caving/collapse	☐
									SAMPLE TYPE:	
									Bulk Sample	BS
									Tube Sample	TS
									Disturbed Sample	DS

Appendix D1.3

Test Pit Logs for Tailing Dam, OEF and Open Pit

URS Australia Pty Ltd		MRM TEST PIT TD#6		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: 24061-015-559	Project Reference: McArthur River Mine Expansion Project	
Landform/Vegetation Broadly undulating, gently inclined plain, with open mixed eucalypt woodland and mid high grasses		Surface Slope <1%	Surface Conditions Hardset	
Local Geology Cz - Residual ferruginous soil, underlain by Pmq or Pmx - dolomite and/or dolomitic shale/siltstone		Relative Level: mRL Coordinates: 8183716 mN 611603 mE	Client: MIM Holdings Ltd	
		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				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.			1	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)				6.5	20	3(3)	D		
C	(1.7-2.2) - HW Dolomitic Shale with angular rock fragments 20 - 150mm			2						No ground water encountered
				3						
TEST PIT SECTION									TEST PIT TERMINATED AT:	
									Target Depth	☐
									Refusal	☐
									Flooding	☐
									Caving/collapse	☐
									SAMPLE TYPE:	
									Bulk Sample	BS
									Tube Sample	TS
									Disturbed Sample	DS

Appendix D1.3

Test Pit Logs for Tailing Dam, OEF and Open Pit

URS Australia Pty Ltd		MRM TEST PIT TD#7		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: 24061-015-559	Project Reference:	
Landform/Vegetation Gently inclined plain with open mixed eucalypt woodland with medium dense acacia understorey		Surface Slope <1%	Surface Conditions Harshset, 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: MIM Holdings Ltd	
		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)			0	5.8	39	3(2)	D		Gravelly Loam
B-C	(0.15-0.4/1.2) - LOAMY GRAVEL (GC) low plasticity fines, with approximately 60% s/r - s/a ferruginised siltstone - variable depth to rock (0.4-1.2m)			0.5	5.9	21	3(4)	D		Gradational Red Massive Earth; Red Lithic Rudosol 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			1				R		
				2						Groundwater
				3						
TEST PIT SECTION									TEST PIT TERMINATED AT:	
									Target Depth	☐
									Refusal	☐
									Flooding	☐
									Caving/collapse	☐
									SAMPLE TYPE:	
									Bulk Sample	BS
									Tube Sample	TS
									Disturbed Sample	DS

Appendix D1.3

Test Pit Logs for Tailing Dam, OEF and Open Pit

URS Australia Pty Ltd		MRM TEST PIT TD#8		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: 24061-015-559	Project Reference: McArthur River Mine Expansion Project	
Landform/Vegetation Near level plain with open eucalypt woodland and mid high grasses		Surface Slope <0.5%	Surface Conditions Hardset, sparse grave	
Local Geology Cz - Residual ferruginised soil underlain by ?Pmx - Reward Dolomite - dolomitic shale/siltstone		Relative Level: mRL Coordinates: 8183939 mN 811122 mE	Client: MIM Holdings Ltd	
		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;
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		Yellow Kandosol prone to bulldust development; slightly dispersive silty/clayey fines
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 60% 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						
TEST PIT SECTION									TEST PIT TERMINATED AT:	
									Target Depth	☐
									Refusal	☐
									Flooding	☐
									Caving/collapse	☐
									SAMPLE TYPE:	
									Bulk Sample	BS
									Tube Sample	TS
									Disturbed Sample	DS

MRM TEST PIT MCARTHUR GPU WCC_AUS_GDT 270503

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URS Australia Pty Ltd		MRM TEST PIT TD#9		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 : 24061-015-559		Project Reference:
Landform/Vegetation Gently inclined plain with open eucalypt woodland and soft spinifex grassland		Surface Slope	Surface Conditions Hardset	McArthur River Mine Expansion Project
Local Geology Cz - Residual ferruginised soil underlain by HW dolomitic shale		Relative Level: mRL Coordinates: 8183949 mN 610353 mE		
		Client: MIM Holdings Ltd		
		Logged By: GJR Date:		

Soil Horizon	DESCRIPTION OF STRATA	Shear Strength - PP (kPa)	GRAPHIC LOG	Down Hole Depth (m)	Soil pH (1:5 H ₂ O)	EC (1:5 H ₂ O) (µS/cm)	Emerson (Dispersion) Class No.	SAMPLING AND OTHER TESTING	Groundwater	COMMENTS/Notes
A	(0.0-0.2) - Fine Sandy light CLAY LOAM (CL) low to medium plasticity red (10R4/6), massive friable soil structure with approximately 25% r - s/r fine Fe gravel (2-5mm) - sharp break to:			0	5.3	22	3(3)	D		Red structured Earth Loamy surface Red Duplex Soil - Red Chromosol
B2	(0.2-0.95) - CLAY (CL - CH) medium to high plasticity red (10YR4/6) - dry very stiff, hard, moderate prismatic medium blocky structure with approximately 25% fine rounded Fe gravel (3 - 5mm)				5.9	41	5	D		Composite sample 0.4 - 1.2m
B-C	(0.95-1.4) - CLAYEY GRAVEL (GC); medium to high plasticity, red (10R4/6), with approximately 80%, dense dolomitic stone and ferruginised dolomitic shale/siltstone with heavy iron and manganese segregations along structure faces			1	6.3	42	2(1)-3			Slightly to moderately dispersive
				2						
				3						
TEST PIT SECTION									TEST PIT TERMINATED AT:	
									Target Depth	☐
									Refusal	☐
									Flooding	☐
									Caving/collapse	☐
									SAMPLE TYPE:	
									Bulk Sample	BS
									Tube Sample	TS
									Disturbed Sample	DS

Appendix D1.4
Survey Methodology

Appendix D1.4

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

Appendix D1.4
Survey Methodology

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