

# Cameco Australia Pty. Ltd.

## Manyalluluk EL 9452 - Outcrop Station Descriptions

Station	Radiometric Anomaly	Geomorphology	Outcrop Description	Formation	Lithology	Sed structure	Gamma Cps (bkqd)	Gamma Cps (max)	Comments
ML040200		Rolling hills. Dip slopes define bedding	Cross bedded, tilted sandstone outcrops. Pebble bands. Overlain by coarse grained quartz rich sandstone	Hindrance Creek Sandstone	Lithic sandstone	Cross bedding.	90	90	
ML040201		Flat plain bounded by gorge to west. Sandstone outcrops to north	Rubbly sandstone outcrops with breccia zones. Sandstone fragments - brecciated - with milky quartz	Hindrance Creek Sandstone	Sandstone Breccia		120	120	Strong red hematite alteration
ML040202		rubbly flat plain with low rounded rubble and subcrop	onion skin weathering rounded outcrops and rubble	Hindrance Creek Sandstone	c-gr to granular hematitic lithic sandstone	massive	190	190	lithic sandstone, angular grains, oval chert balls (<10cm) within sandstone
ML040203		Linear ridge. Plain to south	Rounded rubbly outcrop. Sandstone with adjacent brecciated sandstone ridge.	Mamadawerre Sandstone	Sandstone		70	70	
ML040204		Rounded rubbly hills	Rubbly outcrops	Marlgowa Sandstone	Fine grained Sandstone	Cross bedding. Layers of clay intraclasts	45	45	
ML040205		Rubbly rounded hills next to sandy plain	Lithic hematitic silicified sandstone	McKay Sandstone	Medium to coarse grained sandstone	Small cross beds	75	75	
ML040206		Rounded hills	Rounded to blocky.	Plum Tree Creek Volcanics	Quartz Feldspar Porphyry		380	380	Not certain whether from Plum Tree or Grace Creek Granite - transitional phase? Estimated 3% mafics
ML040207		side of steep hill	large outcrops and boulders of pale pink volcanoclastic rocks	Plum Tree Creek Volcanics	volcanoclastic porphyroclastic flow tuff		480	480	pink flow tuff with large quartz eyes and altered feldspar porphroclasts
ML040208		steep sloping hill, with ubbly outcrop and resistant ridgeline of quartz breccia tracing across slope	resistant quartz breccia within volcanocalstic rocks	Plum Tree Creek Volcanics	quartz brecciated volcanoclastic tuff		340	340	quartz breccia within volcanoclastic, yellow sericitisation of breccia fragments, chalcedonic quartz, angular volcanic breccia fragments
ML040209		Rounded hills	Rubbly rock benches with scree. Massive bedded. Fractured.	Mamadawerre Sandstone	Fine to medium grained sandstone	massive	50	50	Underlying Phn
ML040210	MLR008	Small scarp	Thinly bedded, slabby outcrop. Pebbly. Rubbly	Marlgowa Sandstone	Fine grained sandstone	Cross bedded. Thin pebble beds.	70	210	Remnant Gilruth volcanics in immediate vicinity giving rise to radiometric anomaly
ML040211	MLR004		Rubbly rock benches. Thinly bedded sandstone. Adjacent to contact with Gilruth volcanic member	Gumarrimbang Sandstone	Fine grained sandstone	Undulating bedding	60	150	Ferruginous rubble - remnant volcanic material producing radiometric anomaly
ML040212	MLR019	Timbered area. Slightly higher ground than surrounding sandstone	Sand with minor pisoliths on surface	Gilruth Member	sand		80	130	Remnant volcanics
ML040213	MLR002		Ferruginous debris. Rubble, pisoliths, weathered volcanic material.	Gilruth Member	Ferruginous rubble		150	220	
ML040214	MLR002	Small escarpments	Rock benches, slabby outcrops. Rubbly.	Gumarrimbang Sandstone	Medium grained sandstone	Cross beds. Thinly bedded	50	50	
ML040215	MLR018		Rubbly rock bench	Gumarrimbang Sandstone	Fine to medium grained sandstone	Undulating bedding. Cross beds	65	65	Sample location immediately underlies Gilruth volcanics. Pea weathered surfaces
ML040216	MLR018	Sand covered	Sand cover with lateritised volcanic material, pebbles and cobbles	Gilruth Member	Lateritised volcanic material		190	220	
ML040217	MLR017	Ferruginous debris and rubble scattered over gentle hillslope	Lateritised ferruginous rubble.	Gilruth Member	Ferruginous volcanics		130	190	
ML040218	MLR017	Rounded outcrops on hill slope	Rounded rock bench. Rubbly outcrop.	Gumarrimbang Sandstone	Fine to medium grained sandstone	Cross bedding	40	40	
ML040219	MLR055	reddish to brown rubbly hillside	red hematitic boulders of volcanic material littering hillside	Nungbalgarri Volcanics	vesicular flow top basaltic volcanic		130	150	quartz veining and crystalline filled vesicles, epidote, quartz, chlorite amygdules
ML040220	MLR011	Laterite pavement between sandstone outcrops	Ferruginised lateritised volcanic rubble. Pisoliths and ferricrete	Gilruth Member	Ferruginous weathered volcanic		180	410	area of ferricrete between outcrops of Gilruth and sandstone outcrops
ML040221	MLR011	Prominent ridge above flat area of weathered volcanics	Jumbled blocky sandstone	Marlgowa Sandstone	Sandstone	Cross bedding	60	60	Silicified layers
ML040222	MLR009	Flat sand and pisolith covered terrain with minimal outcrop	Lateritised subcrop, low profile outcrop under sand	Plum Tree Creek Volcanics	Rhyolitic volcanoclastic		250	350	Flow banded
ML040223	MLR009	gentle slope at base of large sandstone mesa	rounded boulders of granite near base of large sandstone mesa	Grace Creek Granite	porphyritic (feldspar and quartz) granite		350	350	pink to red porphyritic granite, large feldspar and quartz eyes, equigranular groundmass, chloritised hornblende
ML040224	MLR009	Pinnacle of granite capped by sandstone. Steep rubbly hill	Fallen block of silicified sandstone	Mamadawerre Sandstone	Medium to coarse grained sandstone	Cross bedding	60	60	From basal unit in unconformable contact with the Grace Creek Granite
ML040225	MLR031	Rock benches overlooking sandy ferricrete-covered flat	Thinly bedded, jointed, slabby outcrop	Mamadawerre Sandstone	Medium grained sandstone		40	40	
ML040226	MLR047	Terraced, flat ridge	Ferricete with sandstone	Mamadawerre Sandstone	Sandstone		60	100	
ML040227	MLR047	Rubbly blocks on side of rubbly hill slope	Rounded rubbly blocks. Intense quartz veining, brecciation	Mamadawerre Sandstone	sandstone		40	40	
ML040228	MLR047	gentle sloping hill	large rounded sandstone fault breccia boulders and sandstone rubble, minor quartz vein breccia cross cutting fult breccia	Mamadawerre Sandstone	m-c gr sandstone fault breccia		40	40	jumbled and amalgamated rounded sandstone blocks and cobbles in fault breccia, some aligned with later quartz veining; fault brecciation with later quartz vein brecciation as R1 extension
ML040229	MLR102	Sandstone bench disappearing under sand cover	Lateritic ferricrete with sand overlying sandstone	Cretaceous	Ferricrete		250	370	Hematite-goethite rich ferricrete after ?sandstone
ML040230	MLR102	Rock bench disappearing under lateritic ferricrete and sand cover	Cross bedded to massive sandstone. Benches.	Mamadawerre Sandstone	Sandstone	Cross bedding	50	50	
ML040231	MLR033	small strip of rubbly outcrop on sandy pisolith covered flat	silicified and fractured rubbly strip of outcrop	Gumarrimbang Sandstone	brecciated fine grained sandstone		50	70	sandy pisolite covered flats possibly related to Gilruth Volcanics to the east of outcrop up to 200cps
ML040232	MLR033	terrace following contour of small rise	ferrigenous ubble and pisoliths littering surface	Gilruth Member	ferricrete		170	210	minor rubbly ferrigenous sandstone
ML040233	MLR033	silicified sandstone outcrop above pisolith and ferricrete littered flat	brecciated sandstone, rubbly shattered outcrop	Marlgowa Sandstone	brecciated sandstone		70	70	no indication of movement
ML040234	MLR034	sandstone capping small ridges and hills above small floodplain	black sandstone with clasts of Kombolgie Sandstone and boulders	Cretaceous	hematitic sandstone		150	150	specular hematite and red hematite matrix with angular quartz grains and clasts of Kombolgie Sandstone
ML040235	MLR034	small floodplain and black swamp at base of steep hill	black soil swamp	Cainozoic	black soil		750	1150	area of average 800cps asociated with black soils
ML040236	MLR034	rubbly hill overlooking black soil floodplain	blocky debris and fallen blocks littering hill slope	Marlgowa Sandstone	medium to coarse grained sandstone	thinly bedded, crossbedded	70	70	poorly sorted sandstone
ML040237	MLR024	extensive pisolith and ferrigenous rubbly plain	isolated outcrops of dark iron stained partially laterised rocks	West Branch Volcanics	fine grained partially laterised basic volcanic		75	75	fine grained volcanic, fragmented, cherty quartz lenses, partially laterised with goethite coated fractures
ML040238	MLR024	large ridge of tilted sandstone and outcrops from sandy plain	ridge of tilted sandstone with smaller tilted rounded outcrops on sandy plain	Gundi Sandstone	cobbly coarse grained sandstone	cross bedded, cobbles	75	75	rounded polymictic cobbles <65mm, quartz chert sandstone, quartzite cobbles nd pebbles floating within cross bedded sandstone
ML040239		scattered rubble on sandy plain underlying prominent outcropping of sandstone	small rubbly blocks of limonite and hematite weathered volcanics	Diamond Creek Volcanics	finely banded and amygdule volcanics		90	90	finely banded siliceous flow tuff? massive and amygdule rich volcanics, weak quartz stockwork, limonite and hemaite weathered

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ML040240	MLR006	north south gully, possibly fault related with Phr to East and Peh to west	boulder conglomerate, debris fan? Conglomerate, rounded boulders	Hindrance Creek Sandstone	boulder conglomerate	conglomerate, debris fan	115	115	basal unit of Peh? Fault related debris fan? Very coarse grained sandy matrix; clast supported; sandstone, quartz, hematitic volcanic angular clasts
ML040241	MLR006	large boulders on gentle slope below low Kombolgie sandstone escarpment leading down to shallow gully	boulder and cobble conglomerate outcrops, large rounded cobbles and boulders, crude imbrication of cobbles	Hindrance Creek Sandstone	boulder conglomerate	conglomerate, debris fan	300	390	basal unit of Peh? Rounded conglomerate clasts (max 50cm avg 9cm) of lithic sandstone, quartz, quartzite, and older conglomerate. Not tallis deposit, no Kombolgie sandstone
ML040242	MLR006	small terraced area, gentle rubbly slope below low Kombolgie sandstone escarpment	terrace covered in small purplish volacnic chips and debris, unit appears to be approximately 5m thick	Nungbalgarri Volcanics	weathered andesitic? Basic volcanic flow		200	250	underlies boulder conglomerate; possibly 5m thick horizon; boulder conglomerate unconformably overlying volcanic unit
ML040243	MLR006	large bouldery hill, leading up up to small sandstone scarp	rounded boulders and fallen blocks resting on hill overlooking boulder conglomerate	Gumarrimbang Sandstone	medium to coarse grained sandstone	pebbly	50	50	
ML040244	MLR006	small terrace at base hill	weathered and bleached volcanic material on side of creek bank	Nungbalgarri Volcanics	weathered andesitic/basic volcanic		140	140	
ML040245	MLR006		large sandstone blocks and quartz clasts bounded by sand matrix in conglomerate or fault breccia	Hindrance Creek Sandstone	sandstone boulder conglomerate	basal conglomerate	65	65	
ML040246	MLR014	rubbly blocky rounded hill top and slopes	rubbly rounded blocks of reddish brown sandstone lying loose on surface, with minor insitu outcrop	Hindrance Creek Sandstone	lithic hematitic c-gr sandstone		190	190	mapped as Phe, definitely Hindrance Creek Sandstone
ML040247	MLR014	rounded blocky and rubbly hill top	slightly resistent and prominent breccia outcrop across top of rounded rubbly sandstone covered hill	Hindrance Creek Sandstone	lithic sandstone quartz hematite breccia		500	2000	mapped as Phe, definitely Hindrance Creek Sandstone; strike length of 1m wide breccia up to 500m, anomalous rad patchy along breccia, 2-3 sub parallel breccias, hematite, clay and quartz breccia
ML040248	MLR001	sandy flat country with low mounds of outcrop	low rounded heavily jointed oucrop	Grace Creek Granite	medium grained waethered pink granite		500	1800	possible U2nd on fracture surface; quartz feldspar-biotite
ML040249	MLR001	sandy flat country with low mounds of outcrop	low rounded moderately fractured outcrop	Grace Creek Granite	medium grained waethered pink granite		500	1000	
ML040250	MLR001	sandy flat country with low mounds of outcrop	large rounded outcrop with cross cutting ramifying quartz veining and possibly aplite dyke	Grace Creek Granite	quartz vein and aplite in pink m-gr granite		500	700	granite clasts within quartz and aplite? breccia; crosscut by later quartz veining
ML040251	MLR013	low rounded rubbly hills leading onto sandy creek flats	rounded rubbly porphyritic granite, quartz and feldspar phenocrysts	Grace Creek Granite	qtz fspar porphyritic granite		340	340	
ML040252	MLR013	rubble on creek flat	low rubbly heavily ractured granite	Grace Creek Granite	qtz fspar porphyritic granite		500	580	
ML040253	MLR039	low rounded hills	low heavily fractured granite outcrop, clay weathered, manganese and limonite coating fractures	Grace Creek Granite	clay weathered granite		300	350	limonite and manganese? Coatings on fractures, clay altered (weathered)
ML040254	MLR039	low rounded hills and shallow gullies	low heavily fractured granite outcrop, clay weathered, manganese and limonite coating fractures	Grace Creek Granite	clay weathered granite		800	2600	weak hematite alteration, specular hematite quartz veins, small isolated radiometric anomalies within granitic debris
ML040255	MLR015	gently sloping area with shallow gullies	ferricrete exposed on granitic derived soils	Cainozoic	ferricrete		450	500	
ML040256	MLR015	large gully within rolling hills	clay altered granite, minor fracturing and possible shearing, exposed in side of creek gully	Grace Creek Granite	clay altered granite		1100	2800	greenish mineral, possible clay or U2nd along fracture surface, possibly shearing
ML040257	MLR015	large gully within rolling hills	whitish weathered surface and rad anomalous linear depression crosscutting topography, surrounded by rounded rubbly granite	Grace Creek Granite	highly clay altered granite		1000	3800	quartz eyes and feldspar porphyroclasts; white clay altered, possibly sheared; radioactivity within 6m wide depressed topography
ML040258		gently rolling hills	resistant ridge of quartz hydraulic brecciation containing granitic clasts and hematite	Grace Creek Granite	quartz breccia		170	170	hydraulic brecciation, granitic clasts <8cm, moderate hematite replacement of granite clasts
ML040259	MLR007	steeply incised gorges within steep rugged hills, small terraces at base of rugged sandstone ridges	small terrace immediately at unconformity below -Phe Sandstone, red zone altered granite	Grace Creek Granite	granite		300	300	granite has undergone hematite alteration due to unconformity processes, with overprinted weathering effects
ML040260	MLR007	steeply incised gorges within steep rugged hills, small terraces at base of rugged sandstone ridges	large rounded sandstone blocks from Phe Sandstone immediately above unconformity with Peg granite	Mamadewerre Sandstone	pebbly granule stone	trough cross bedding, pebbly bands	85	85	pebbly granule stone immediately above unconformity
ML040261	MLR007	flat terrace above steeply incised gorge	rounded rock bench on edge of gorge, inclined and contorted bedding possibly related to proximal shearing	Mamadewerre Sandstone	silicified fine grained sandstone		70	70	contorted and folded sandstone bedding related to shearing/faulted along north-east trending gorge, bedding flattens out rapidly to the south of the gorge
ML040262	MLR050	gently sloping hills with shallow gullies	scattered rubbly partially laterised volcanics, limonite and goethite weathering surfaces	Nungbalgarri Volcanics	basic volcanics		120	120	
ML040263	MLR021	flat sandy area	flat sandy area littered with pisoliths and ferricrete	Gilruth Member	lateritic ferricrete		150	150	fused pisoliths and cutans
ML040264	MLR021	small sandstone scarps above sandy flats	broken blocky silicified sandstone with quartz and drusy quartz veining with minor hematite	Marigowa Sandstone	fine grained sandstone	cross bedding	55	55	quartz veining slightly tangental to major jointing and the orientation of the small scarp
ML040265	MLR090	low rounded hills and gullies	rubbly volcanic material littering low rounded hill	Nungbalgarri Volcanics	massive basic volcanics		150	150	minor agate and flow top brecciated volcanics, amygdaloidal volcanics and massive volcanic rocks
ML040266	MLR003	rounded rubbly hills and gullies	ferrigenous volcanic rubble and debris littering hill slope	Gilruth Member	quartz banded volcanics		250	250	
ML040267	MLR003	resistant sandstone ridges above flat sandy areas	silicified resistant sandstone ridge, blocky outcrops, weakly brecciated	Gumarrimbang Sandstone	fine grained brecciated sandstone		50	50	weakly brecciated, hematitic fractured sandstone
ML040268	MLR020	resistant sandstone ridges and hills above recessive gentle slopes	vertically fault defined sandstone face ~6m high, over recessive volcanics	Gumarrimbang Sandstone	fine grained sandstone		50	50	vertical fault displacement, normal dip slip movement
ML040269	MLR020	resistant sandstone ridges and hills above recessive gentle slopes	partially laterised volcanic rubble and cobbles	Nungbalgarri Volcanics	amygdaloidal volcanics		150	200	faulted contact with -Phr to north
ML040270	MLR086	steep conicle hill rising above sandy plain	rubbly scree littering surface of slope	Diamond Creek Volcanics	mafic massive flow volcanic		110	145	fine quartz bands within hematitic bands
ML040271	MLR081	steep sided hills capped by resistant laterised rocks	large blocks of hematitic replaced volcanics or iron bands within volcanics capping hill	Diamond Creek Volcanics	specular hematite replaced volcanics		250	400	botryoidal cystals of specular hematite within open spaces, minor chalcadonic quartz cystals, thin iron and quartz bands
ML040272	MLR081	low resistant sandstone ridge at base of large hill	thin ~15m thick tilted sandstone unit, low resistant ridge	Shadforth Formation	m-c gr sandstone	large cross beds	100	100	quartz rich with ~7%clay (after feldpsar?) Fe reduction spots, sandstone clasts and pebbles at base of unit
ML040273	MLR032	large sandy flats peripheral to large resistant sandstone ridges	scattered pisoliths covering sandy flats	Cainozoic	pisoliths		70	120	
ML040274	MLR032	rubbly hill slopes defined by bedding slope leading onto sandy flats	tilted cross bedded sandstone with blocky boulders	Marigowa Sandstone	medium to coarse grained sandstone	cross beds	50	50	tilting may relate to large fault block rotation
ML040275	MLR046	small mounds of rubbly granite	fractured and rubbly granite	Grace Creek Granite	red microgranite		480	580	large area of uniformly high radiometrics, quartz vein to south of anomaly
ML040276	MLR016	small mounds of rubbly granite outcrop on sandy flats	two blocky rubbly mounds of granite, two phases of granite, microgranite phase has increased radioactivity	Grace Creek Granite	red microgranite		600	700	one granite phase contains minor feldspar phenocrysts, which may have been intruded by a microgranite phase of increased radioactivity

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ML040277	MLR079	steep large rounded hills incised by gullies	phenocrystic volcanoclastic with pervasive banding	Plum Tree Creek Volcanics	volcanoclastic		300	300	phenocrysts of feldspar (now clay) and quartz, pervasive banding throughout outcrops
ML040278	MLR082	low rounded rubbly mounds on extensive flats	low rounded rubbly mounds of clay weathered granite	Grace Creek Granite	coarse grained porphyritic granite		450	520	onion skin weathering
ML040279	MLR079	small resistant outcrops on sandy creek flats	small rounded tors poking through sandy flat	Grace Creek Granite	microgranite		450	500	
ML040280	MLR060	low rubbly hills with shallow gullies	linear outcrops of sheared fractured granite	Grace Creek Granite	sheared porphyritic granite		600	600	radioactive trend along sheared granite, 500cps along trend with isolated hotspots of 1250cps
ML040281	MLR060	low rubbly hills with shallow gullies	linear outcrops of sheared fractured granite	Grace Creek Granite	sheared porphyritic granite		800	1150	along trend from ML040281, 6m to west of sample 3800cps recorded in soils, hematitic clay altered granite
ML040282	MLR074	low rubbly hills on sandy clay flats	rubbly low knoll of equigranular fine grained volcanic rubble with minor hin lenses of amygdaloidal varieties	Nungbalgarri Volcanics	amygdaloidal basic volcanics		170	170	quartz filled amygdules
ML040284	MLR053	gentle rubbly slopes below rubbly scarps	blocky outcrops at edge of gentle rubbly scarp above valley	Gumarrimbang Sandstone	medium grained sandstone		45	45	minor siliceous fracturing
ML040285	MLR107	large resistant outcrops on sandy clay flats at edge of floodplain	tilted blocks of lithic sandstone on sandy clay flats, hematite rich sandstone	West Branch Volcanics	medium to coarse grained lithic sandstone	cross bedded, floating pebbles	100	100	volcanic derived hematitic lithic sandstone
ML040286	MLR107	large resistant outcrops on sandy clay flats at edge of floodplain	linear tilted outcrops on sandy clay flat, reddish lithic sandstone	West Branch Volcanics	coarse grained lithic sandstone	corss bedded	100	140	volcanic derived hematitic lithic sandstone
ML040287	MLR096	small laterite capped hills above low sandy flats	small hill capped by laterite and ferricrete	Cainozoic	ferricrete		80	80	
ML040288	MLR025	rubbly gentle slopes and flat areas	laminated rubble littering extensive flat terraces	Cottee Formation	fine grained sandy siltstone	laminated, flute markings	140	140	small muddy silty chips and slabs of ferrigenised material on surface
ML040289	MLR005	steep bare rounded hills of resistant rock and boulders	25cm wide breccia crosscutting cobble conglomerate	Hindrance Creek Sandstone	sandstone breccia		120	120	sandstone clasts up to 8cm, areas of boudanaged breccia
ML040290	MLR005	steep rubbly hill slope and rugged boulder outcrops	sandstone blocks and rubble; sandstone rubble littering hill slope	Hindrance Creek Sandstone	sandstone breccia; rounded sdst cobbles and clasts		500	1250	fault breccia, sandstone breccia clasts and cobbles; crushed sandstone fault matrix, minor chalcedonic quartz veins
ML040291	MLR052	gentle sloping hills with slope defined by bedding	tilted bedding plane along slope	Hindrance Creek Sandstone	graded beding sandstone	ripples, graded bedding	80	80	upwards coarsening beds 3cm thick, interference and wave ripples