# TNG LIMITED

# **TENNANT CREEK GOLD (NT) PTY LTD**

# **MANBARRUM PROJECT**

# **COMBINED ANNUAL REPORT**

## GR044/09

25/09/2015 - 24/09/2016

EL24395 EL25646 MA24518 MA26581

Tenement/s	EL24395, EL25646, MA24518, MA26581	1:250 000 Sheet Name	Auvergne (SD5215)
Holder	Tennant Creek Gold (NT) Pty Ltd	1:100 000 Sheet Name	Legune (4767)
Manager		Datum GDA E	GDA94-52 519650-553750
Operator	Tennant Creek Gold (NT) Pty Ltd	_	
Commodity	Zn, Pb, Ag,	GDA_N	8295900-8337950
Elements Analysed			
Keywords	Renewal, site monitoring, rehabil plains	itation, pXRF, soils	sampling, black soil
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## **EXECUTIVE SUMMARY**

The Manbarrum Project (Northern Territory) is located in the north-western part of the Northern Territory, on Legune station, approximately 70km north east of the regional centre of Kununurra. It is owned by Tennant Creek Gold (NT) Pty Ltd, a wholly owned subsidiary of TNG Limited (TNG). The project comprises four exploration titles, covering a 50 kilometre strike length of the SE margin of the Bonaparte Basin.

A pXRF soil sampling survey was completed across the black soil plains of EL 25646 with 174 samples taken across four lines. No significant results were returned

Final rehabilitation and monitoring was carried at the Legune Hill drillsites and site monitoring was completed across the project area.

A renewal application was completed for MA26581 during the reporting year.

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# 1. INTRODUCTION

The Manbarrum Project (Northern Territory) is owned by Tennant Creek Gold (NT) Pty Ltd, a wholly owned subsidiary of TNG Limited (TNG). The project currently comprises four exploration titles, covering a 50 kilometre strike length of the SE margin of the Bonaparte Basin (Figure 1), considered geologically and temporally favourable for MVT (Mississippi Valley Type Ag-Pb-Zn) mineralization.

The project area is located in the north-western part of the Northern Territory, on Legune station, approximately 70km north east of the regional centre of Kununurra (WA) on the Auvergne 1:250,000 map sheet.

A pXRF soil sampling survey was completed across the black soil plains of EL 25646 with 174 samples taken across four lines.

Final rehabilitation and monitoring was carried at the Legune Hill drillsites and site monitoring was completed across the project area.







# 2. LOCATION AND ACCESS

The Manbarrum Project is located in the north western part of the Northern Territory, on Legune station, approximately 70km north east of the regional centre of Kununurra (WA) on the Auvergne 1:250,000 map sheet. Access is via Weaber Plains Road from Kununurra, then by station tracks which service the interior of the tenement. The tenement is not reliably accessible during the wet season, or following heavy rain.

# 3. TENURE

The Manbarrum Project (NT) comprises four tenements: MA24518, MA26581, EL24395, and EL25646 for a total of 76 blocks (238.86km<sup>2</sup>). Tenure details for the licences are shown in Table 1. A two year renewal application was submitted for MA26581 in August 2016. Approval for combined technical reporting for the Manbarrum Project was received on 10 September 2007 for the agreed end date of 24 September each year. A combined report is due by 23 November each year.

Title	Area (blocks)	Area (km <sup>2</sup> )	Grant Date	Renewal Date	Expiry Date	Status
EL24395	45	144.36	16/08/05	16/08/13	15/08/17	Current
EL25646	19	63	23/08/07	23/08/13	22/08/17	Current
MA24518	6	16.85	25/08/05	25/08/13	24/08/17	Current
MA26581	6	14.65	1/08/08	1/08/14	31/07/18	Current

 Table 1: Manbarrum Project Tenure

# 4. GEOLOGY

## 4.1 Regional Geology

The Bonaparte Basin unconformably overlies the north-eastern margin of the Proterozoic Kimberley block. It is a northward-opening basin of which 10% is currently above sea level, the remaining 90% of the basin is submerged beneath the Timor Sea (Figure 2). The sediments that form the Bonaparte Basin vary from Cambrian to Tertiary in age to a maximum thickness of 5km. The basin is dominantly controlled by faulting; particularly in the south east where extensions of the Halls Creek Mobile Zone fault systems are present (the eastern margin of the Bonaparte Basin sediments is marked by the Cockatoo Fault zone) (Figure 2). The Sorby Hills Pb-Zn-Ag deposits are hosted in a sequence of Devonian–Carboniferous shelf carbonate sediments at the margins of the Burt Range Sub-basin within the Bonaparte Basin.

The basin has been the focus of petroleum exploration since the 1960's and significant gas fields have been discovered (Mai and Smurthwaite, 2000). The first geological study of the basin was completed by Veevers and Roberts (Veevers and Roberts, 1968). More recently the regional geology of the onshore Bonaparte Basin was described by Mory and Beere (Mory and Beere, 1988).

The oldest part of the onshore basin is the Antrim Plateau Basalt, a sequence of tholeiitic flood basalt, which unconformably overlies Palaeoproterozoic basement of the Halls Creek orogen. Clastic sediments of the Late Cambrian and Ordovician Carlton Group locally overlie the basalt, after which there is a period of non-deposition and/or erosion from the Ordovician to the Middle Devonian. The onshore basin is dominated by Middle Devonian to Early Carboniferous carbonate and clastic sediments, commencing with the Frasnian Cockatoo Group, dominated by quartz sandstone. During the Famennian, mixed carbonate-clastic sedimentation deposited the Ningbing Group reef complex in the Carlton Sub-basin and the Buttons Formation in the Sorby Hills area. Reef growth was terminated in the Carboniferous, when shelf carbonates and clastics of the Tournaisian Burt Range Formation were deposited in the Sorby Hills area. These shelf carbonates grade into thick clastic sequences towards the basin centre. The Tournaisian carbonates are overlain transgressively by Visean basinal black shales of the Milligans

Formation. Above this there is an unconformable contact with the Carboniferous – Permian Kulshill Group composed of fluvio-glacial sandstones.

An important NE-trending fault set is found within and at the margins of the basin. These structures are contiguous with structures in the underlying basement of the Halls Creek orogen. The Pincombe Inlier is a large horst block bounded on the east and west by NE trending faults, and separates the Carlton Sub-basin to the northwest from the Burt Range Sub-basin to the southeast. A set of antithetic NW-trending structures has also been defined, including a linear structure believed to control the northern edge of the Pincombe Inlier. The Pincombe palaeohigh continues northeast of this structure and is termed the Pincombe Axis.

Lee and Gunn (1988) have proposed a tectono-stratigraphic model for the evolution of the basin. Initial downwarping of the craton in the late Proterozoic initiated development of the Bonaparte, Ord, Officer and Canning basins, which probably remained interconnected until the Middle Ordovician. A period of non-deposition in the Silurian was followed by development of an extensional depocentre in the Bonaparte Basin in the Middle Devonian. Middle Devonian pre-rift sediments were followed by Late Devonian syn-rift sedimentation in a basin with multiple tilted fault blocks. Post-rift Early to Mid-Carboniferous sediments unconformably overlie the rift sequence and are dominated by the Milligans Formation black shales.

The stratigraphy at Sorby Hills was originally described by Aquitaine geologists as part of the ongoing exploration of the basin during the 1970's. The original stratigraphy has been modified on several occasions since that time as displayed in Table 2. The stratigraphic nomenclature was most recently revised by Rowley and Lee (1986) and forms the basis for the following summary. Proterozoic metasediments of the Halls Creek orogen form the basement in the in the Sorby Hills area and are unconformably overlain by the Lower Cambrian Antrim Plateau flood basalt. In places the basalt is overlain by clastic sedimentary rocks of the Upper Cambrian to Lower Ordovician Carlton Group.



Figure 2: Regional geological setting of the Manbarrum Project (Wong and Larson, 1991).

In the Sorby Hills area the basalts are unconformably overlain by sandstones of the Frasnian Cockatoo Group, subdivided into the Kellys Knob Sandstone (sandstone and pebble conglomerate) and the Abney Sandstone (siltstone, sandstone and occasional sandy dolomite).

Overlying the Cockatoo Group is the Famennian Buttons Formation a sequence of impure back reef/platform carbonates which is interpreted to be the lateral equivalent of the reefal Ningbing Limestone in the west of the on-shore Bonaparte Basin. The dominant rock type is brown fine-to medium-crystalline dolomitic grainstone with interbedded shale and rarer stromatolitic boundstone. Primary textures are generally obscured by intense dolomitisation. Shallow-water fenestral micritic carbonates are apparent in the lower part of the formation. The upper part of the formation (~40m) is comprised of interbedded shale and dolomitic siltstone underlain by oolitic dolostone, argillaceous mudstone and coralline dolostone horizons.

The Buttons Formation is overlain by the Tournaisian Langfield Group, which is subdivided into the Burt Range, Enga and Septimus Limestone formations. The Burt Range Formation is the most important of these as it hosts the majority of the Sorby deposits. It is further subdivided into the Sorby Dolomite Member (formerly 'Dolomite I' or 'DI', divided into upper and lower sub-units), 'Dolomite II' ('DII'), Knox Siltstone Member (formerly 'Clastic I' or 'CI'), Dolomite III (DIII) and Gooseneck Member (formerly Upper Formation or UF).

The Sorby Dolomite Member ('DI', c. 50m) comprises cyclic-bedded grainstones, mudwackestones and silty dolostones, and becomes finer grained and more argillaceous with less grainstone in the upper sub-unit.

Dolomite II is the main host for the Sorby resources within the Burt Range Formation, and often has minor anomalous base metal mineralisation. It occurs as an intraclastic breccia unit which is often present at the contact between the Sorby Dolomite Member and Knox Siltstone Member. It is interpreted as a slump or tectonic breccia, and generally includes clasts of crystalline dolomite and dolomitic siltstone. It is best developed where the Sorby Dolomite Member or Knox siltstone Member thin or pinch out. It is interpreted to reflect an erosional unconformity, with the upper part of the Sorby Dolomite Member extensively removed. The overlying Knox Siltstone Member occurs as well-laminated interbedded silty and argillaceous dolostone, dolomitic siltstone and shale.

The Knox Siltstone is overlain by 'Dolomite III' (DIII, c. 15m), comprising bioclastic dolostone with interbedded shales. This unit contains considerable base metal mineralisation in the North Sorby area (Alpha and Beta Pods). The mineralisation is interpreted to be hosted in tectonic breccias which occur along the two dominant fault orientations.

The Gooseneck Member (formerly the Upper Formation, UF, c. 20-100m) comprises clastic carbonates and argillaceous shaley siltstones, typically dolomitised in the lower part and calcareous in the upper part. Minor mineralisation is recorded within this unit in the north.

The Enga Sandstone comprises laminated dolomitic sandstone. The overlying argillaceous Septimus Limestone may be gradational with the Gooseneck Member, and part of the Septimus Limestone may have been assigned to the UF in the past. The sequence from Dolomite III through to the Septimus limestone becomes progressively less dolomitic. The Langfield Group is overlain by the Milligans Formation of the Visean Weaber Group, a sequence of basinal black shales marking a major transgressive event. Onlap of the Devonian sequence onto the Proterozoic basement of the Pincombe Inlier results in pinch-out of the carbonate sequence between the basement and the transgressive shales.

### 4.2 Local Geology

The Sandy Creek base-metal deposit is very similar to the Sorby Hills lead-zinc deposits which are located in the eastern portion of the Bonaparte Gulf sedimentary basin. The carbonate complex association and epigenetic characteristic of the mineralisation are typical of orebodies of the Mississippi Valley type. Numerous, commonly small orebodies with an average size of 500,000t occur in four areas along two major NE trends - Sorby Hills, Spirit Hill, Sandy Creek and the Gap. These trends are parallel to the eastern basinal margin and to basement-controlled fault structures related to the Halls Creek Mobile Zone. Significant mineralisation is restricted to the Upper Devonian-Lower Carboniferous dolomite horizons, with the Button Beds

being the main host lithology. Mineralised sedimentary breccias, cross-cutting fracture zones and rare replaced narrow dolomite beds are the most important ore types.

The Sandy Creek deposit is situated on the eastern margin of the Bonaparte Gulf Basin where prospective Devonian and Carboniferous sediments unconformably overlie Middle or Upper Proterozoic basement rocks. The Lower Carboniferous-Burt Range Formation (Clb2), 'Sandy Dolomites' is important within the Sandy Creek area as it is host to most of the Pb-Zn mineralisation encountered. The unit consists of massive to poorly bedded, locally fossiliferous rocks ranging in composition from sandy dolomites to dolomitic sandstones. Syn-sedimentary brecciation is common throughout the unit. The upper portions of the unit are in some places very sandy. Mineralisation at Sandy Creek is seen to be principally associated with the basin margin.

	Age	9	Thickness (m)	Sorby Hills 1986 Revised (Rowley & Lee 1986)	Regional Bonaparte Equivalent (Beere & Mory, 1986)	Sorby Hills 1982 Revised (Aquitaine)	Sorby Hills Pre 1980 (Aquitaine)
	Visean	Weaber Group	0-300	Milligans Formation (Clm)	Point Springs Sandstone (Clp) Milligans Formation (Clm)	Milligans Formation (Clm)	Black Shale
		Langfield Group	0-50	Septimus Limestone (Cls)	Septimus Limestone (Cls)	Septimus Formation (Cls)	
S			0-150	Enga Formation (Cle)	Enga Formation (Cle)	Enga Formation (Cle)	Upper Formation (UF)
iferou	_		0-100	Gooseneck Member (Clbg)	Burt Range Formation	Upper Formation (UF)	
Irbon	aisiar		0-15	Dolomite III	(Clb2 - unit of Aquitaine sandy	Dolomite III (DIII)	Dolomite III (DIII)
Ca	ourn		0-80	Knox Siltstone (Clbk)	dolomite)	Clastic I (CI)	Clastic I (CI)
	Г		0-15	Dolomite II	Burt Range	Dolomite II (DII)	Dolomite II (DII)
			0-100	Sorby Dolomite Member (Clbs)	Formation (Clb1 unit of Aquitaine	Upper Dolomite I DI(U)	Dolomite I (DI)
					silty dolomite)	Lower Dolomite I DI (L)	Jeremiah Member Duj (Upper part only)
	nnian	Ningbing Group	0-300	Buttons Formation (Dub)	Buttons Formation (Dub)	Buttons Beds - Dub 'J'	Jeremiah Member Duj J Beds
Famer					Buttons Beds - Dub 'K'	Jeremiah Member - Duj K Beds	
Devoni	u	Cockatoo Group	0-100	Abney Sandstone (Dua)	Cockatoo Formation	Cockatoo Fm Duc 'L'	Jeremiah Member - Duj K Beds
	Frasnia		0-300	Kellys Knob Sandstone (Duk)		Cockatoo Fm - Duc 'S'	Cockatoo Fm- Duc
Ca	mbrian	Carlton Group	0-150	Antrim Plateau Volcs (Cla)	Antrim Plateau Volcs (Cla)	Antrim Plateau Volcs (Cla)	Antrim Plateau Volcs (Cla)
Proterozoic		Carr Boyd Group		Precambrian	Precambrian	Precambrian	Precambrian

Table 2: Bonaparte Basin stratigraphic correlations (KBL, 2012).

# 5. PREVIOUS EXPLORATION

Exploration for base-metals by Aquitaine and its Bonaparte Gulf Joint Venture partners began in 1971. Exploration methods used included detailed IP surveys, seismic reflection surveys, stream/soil geochemistry and drilling. By 1984 a total of 19 diamond drill holes and 50 RC holes had been drilled in the region of the Sandy Creek deposit.

In 1985 BHP entered the Sorby Hills Joint Venture with Triako Resources (who had acquired the project from Aquitaine) and carried out exploration together with adjacent tenements in Western Australia (Sorby). This work was concentrated away from the Sandy Creek deposit but in 1989 BHP carried out an IP survey over the deposit. This IP survey showed that the Burt Range Formation to the north of the Sandy Creek deposit is still chargeable and BHP commenced a fence of diamond drill holes 800 metres north of the Sandy Creek deposit to test the Burt Range Formation.

Table 3 provides a summary of the exploration of the onshore Bonaparte Basin.

Period	Company/JV	Exploration
1971 - 1986	Aquitaine in various JV's	Mapping, sampling, IP, grid drilling, EM, aeromagnetics, RC drilling, DD drilling, gamma-logging, seismic, basin modelling
I972 – 1979	Aquitaine/SEREM JV	Mapping, sampling, IP, grid drilling, EM, aeromagnetics, RD drilling, DD drilling
1977 - 1985	Aquitaine/MIM	Mapping, sampling, EM, aeromagnetics, RC drilling, DD drilling
1981 - 1985	St Joe Bonaparte	Mapping, sampling, IP, grid drilling, EM, aeromagnetics, RD drilling, DD drilling
1985 -1996	Elf Aquitaine Triako/BHP JV	Sampling, IP, grid drilling, EM, aeromagnetic, RD drilling, DD drilling, gravity
1992 - 1995	North farm in	EM, aeromagnetic survey
1992 - 1997	Wilga Mines (Delta) farm in	Sampling, IP, EM, aeromagnetics, RC drilling, DD drilling, MMI

Table 3: Exploration within the onshore Bonaparte Basin (KBL, 2012).

# 6. EXPLORATION COMPLETED

### 6.1 Soil Sampling – EL 25646

A programme of soil sampling was conducted across the northern licence, EL 25646 in August 2016. Sampling was conducted to test if soil sampling was effective over the black soil plains and transported clay soils of the tenement.

Sampling was conducted along existing station tracks for ease of access and in the vicinity of the margin of the Bonaparte Basin where it was considered likely that the stratigraphy and MVT mineralisation seen along strike to the southwest would be present under the thin transported cover.

A total of 174 sample readings were taken of soil on four lines (Figure 3) with samples spaced 100 metres apart.



Figure 3: Soil sample locations across EL 25646.

Sampling was undertaken with a Olympus Delta Pro pXRF unit set on GEOCHEM mode with a 60 second read time.

The following elements were determined: Si, Mg, Al, P, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Rb, Sr, Y, Zr, Nb, Mo, Ag, Cd, Sn, Sb, Ta, W, Hg, Pb, Bi, Th, U, and Au (37 elements).

Many elements returned results below the detection limit and the most useful data were obtained for: Si, Al, K, Ca, Ti, Mn, Fe, Ni, Cu, Zn, As, Rb, Sr, Zr, Nb, Ta, Pb, and Th. All results are included in Appendix 1 and lithological codes are included in Appendix 2.

Samples were taken of the B Horizon soil, after scuffling off the top centimetre of A Horizon organic material.

Sample sites were logged for regolith setting and material. The following codes were used:

- QA Alluvium. Sandy active creek channel
- QL Lacustrine. Lake clay
- QB Black soil plain. Dark clayey soil annual inundation
- QD Aeolian. Dune sandy soil
- QS Sheetwash zone, clay/silty
- ES Residual soil
- ESS Adjacent to sandstone subcrop/outcrop
- ESD Adjacent to dolomite subcrop/outcrop

Results for copper, lead and zinc, which have given anomalous results elsewhere within the project area, are summarised below.

#### Copper (Figure 4)

- 21 of 174 samples above DL of around 10ppm.
- No values exceeded 22ppm.
- No anomalous results.

#### Lead (Figure 5)

- 20 values below DL of ca. 5ppm Pb
- Maximum value 174ppm Pb
- 16 results above 50ppm Pb, including six results above 100ppm Pb
- Average 23ppm Pb

All six >100ppm Pb results and 15 of the 16 >50ppm Pb results on line D (543,800-546,900mE) are associated with a 3km wide lacustrine zone logged on soil sites (and visible on below imagery/plots). This modest anomalism may relate more to sampling medium (lacustrine clays scavenging lead) rather than being a bedrock-related signal. This suspicion is supported by the lack of similar anomalism on line C to the northeast, which falls outside the main lacustrine area. There is also no supporting anomalism from other elements – Zn and Cu – for this zone.

It does not warrant drill testing on the strength of the lead results. Further sampling (-80 mesh with ICP laboratory analysis) will be considered.

#### Zinc (Figure 6)

- 15 values below DL of ca. 5ppm.
- Maximum value 99ppm Zn.
- 12 results above 50ppm Zn.
- Average 34ppm Zn.
- No samples considered anomalous.

#### **Other Elements - Gold**

Six gold values were returned above the DL (ca. 5ppm Au). Given the instrument has such a high level of detection for gold and the sampled material is so small these results are considered to be unreliable. It is recommended that these sites (and adjacent ones) be resampled with -80 mesh soil samples submitted for laboratory low level gold analysis.



Figure 4: Copper results in pXRF soil samples.



Figure 5: Lead results in pXRF soil samples.



Figure 6: Zinc results in pXRF soil samples.

## 6.2 Rehabilitation and Monitoring

Rehabilitation, monitoring and remediation took place in August 2016. Existing access tracks into Legune Hill required minor remediation (Plate 1a,b and 2a,b) but drill sites were revegetated and required no further rehabilitation work. The extra track cleared into 14LHDDH002 and 003 is fully revegetated and required no additional rehabilitation. Legune Hill rehabilitation photos are included in Appendix 2. Monitoring sites are outlined in Table 4 and photos are included in Appendix 3. Sites 1-11 are fully rehabilitated and will no longer be monitored.



Plate 1: Track heading north from Legune Road, a) BEFORE, b) AFTER, remediation.



Plate 2: Track up Legune Hill, a) BEFORE, b) AFTER, remediation

Manbarrum - Environmental Monitoring Stations					
Station	Easting	Northing	Tenement	Description	
1	521240	8297735	MA24518	2006 Sandy Creek RC drillers camp site	
2	520288	8297071	MA24518	2007 Sandy Creek RC drillers camp site	
3	520421	8297339	MA24518	2007 Sandy Creek Diamond drillers camp site	
4	520847	8297505	MA24518	2006 Drill Line 8297500mN Looking in the direction of 06MRC057	
5	520672	8297160	MA24518	2006 Drill Line 8297150mN Looking in the direction of 06MRC038	
6	520751	8297054	MA24518	2007 Drill Line 8297050mN Looking in the direction of 06MRC070	
7	520613	8297050	MA24518	2007 Drill Line 8297050mN Looking in the direction of 06MRC072	
8	524483	8301672	MA26581	2009 Browns IP Anomaly diamond drillers camp site	
9	523772	8301810	MA26581	2009 Browns IP anomaly drill site 09BDD001 looking east	
10	523820	830836	MA26581	2009 Browns IP anomaly drill site 09BDD001 looking south	
11	523203	8301922	MA26581	2009 Access track from Sandy Creek to Browns IP anomaly drill sites	
12	529810	8307039	EL24395	2014 Access track between 14DDH001 and 002 Legune Hill	
13	530270	8306282	EL24395	2014 Access track heading north off Legune Road	

 Table 4: Site Monitoring Stations within the Manbarrum Project Area.

# 7. WORK PROGRAM 2016 - 2017

A regional infill/extensional ground gravity survey took place in September 2012 when KBL were operators of the Manbarrum Project. The survey was aimed at increasing data density proximal to priority exploration targets as well as providing an initial coverage of some areas. A total of 708 gravity data stations made up the survey (Figure 7). Final processing was completed through the compilation and merging of Haines, Atlas and Geoterrex ground gravity data for 2012, 2007 and 1996 respectively, but currently no interpretation has been carried out on the data.

Interpretation of the gravity data will be undertaken during 2017 as part of a project-wide resource study with a view to compilation of updated resource estimates of the Sandy Creek and Djibitgun deposits (currently 2004 JORC compliant).

A demerger of current base metal assets into a new company, Todd River Resources is planned for early 2017 and the Manbarrum project, as an advanced exploration project, plays a key part in the success of this venture.

Continued monitoring of Legune Hill access tracks and drillsites will also take place.



Figure 7: Location of gravity stations in the 2012 gravity survey.

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