

Highlights of mineral and petroleum exploration and development in 2023

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Introduction

The Territory's exploration sector reached near-record levels of activity during 2023, with unprecedented levels of exploration for critical minerals and a strongly recovering uranium sector. Exploration in the Beetaloo Sub-basin also made significant advances towards first production of shale gas in the Territory.

According to the Australian Bureau of Statistics (ABS), mineral exploration expenditure in the Territory in 2022/23 was \$204.3 million, up 19% on the figure of \$171.5 million for 2021/22. For the full 2023 calendar year, mineral exploration expenditure in the Territory was \$228.1 million, up 14% on the figure of \$199.9 million for 2022 (Figure 1).

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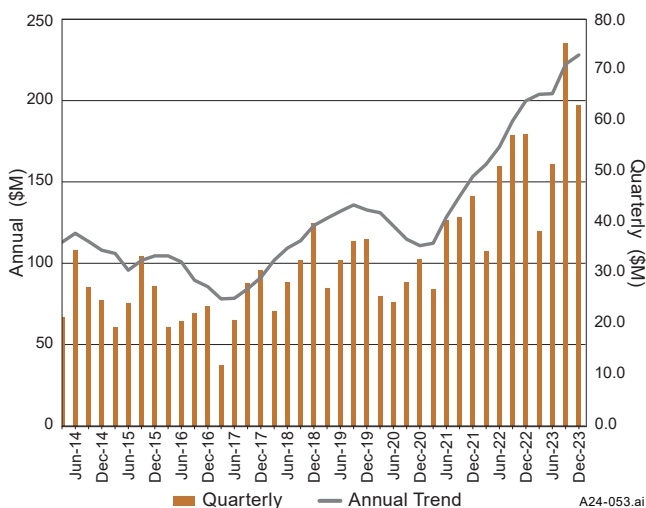


Figure 1. Annual and quarterly mineral exploration expenditure for the Northern Territory according to the Australian Bureau of Statistics figures, from 2014 to 2023.

This is marginally lower than the record expenditure of \$228.4 million set in 2011. The 14% rise in expenditure was higher than the Australia-wide increase of 5%. Around 45% of the Territory's mineral exploration in 2021 was greenfields exploration (away from existing deposits), well above the national average of 31%.

The breakdown of expenditure by commodity according to the ABS was dominated by 'Other' minerals (likely to be mainly lithium, rare earths, graphite, tungsten, phosphate and other critical minerals, but excluding nickel and cobalt) at \$106.7 million (47% of total). This was followed by gold (\$64.8 million; 28% of total), base metals (mainly copper and zinc) at \$40.5 million (18% of total), uranium (\$13.2 million; 6% of total), with mineral sands, iron ore and diamonds making up the remainder. The figures reflect strong growth in exploration for critical minerals and uranium, with gold and base metals exploration remaining relatively steady. **Figure 2** shows a breakdown of mineral exploration expenditure by commodity.

The very strong exploration for 'Other' minerals in the Territory is reflected in the fact that the Territory has the second highest expenditure on these minerals in Australia, following Western Australia (\$547.4 million), well ahead of Queensland (\$46.8 million), South Australia (\$32.0 million) and Tasmania (\$15.7 million).

In addition to ABS exploration statistics, the Northern Territory Geological Survey (NTGS) collects statistics on the admissible exploration expenditure reported by industry under the *Mineral Titles Act*. This shows that expenditure reports submitted in 2023 for exploration activities on exploration licences (which may relate to activity in 2022 and/or 2023) was \$150.3 million, the highest ever recorded in the Territory. When exploration on mineral leases is also included, admissible exploration expenditure reported to NTGS during 2023 totals \$224 million.

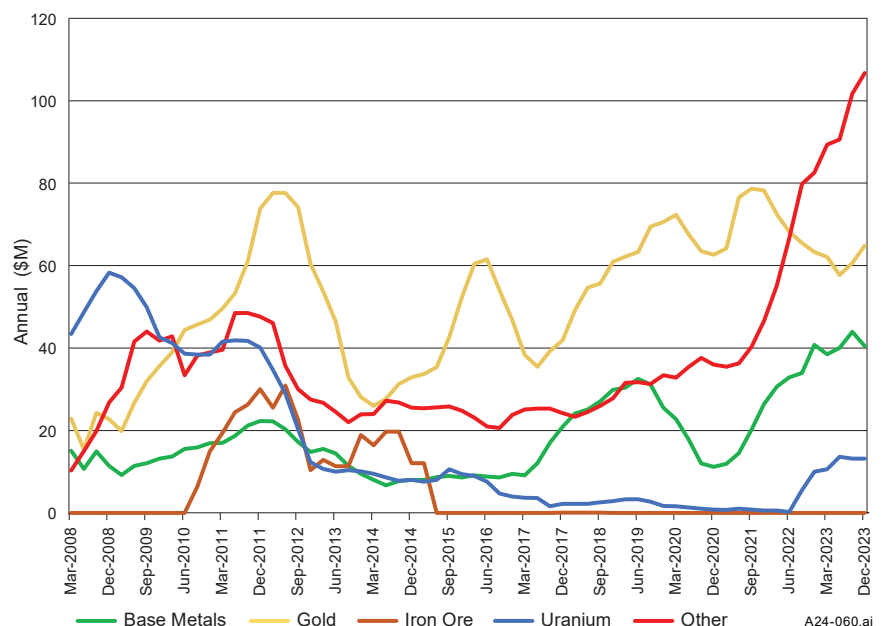


Figure 2. Long-term trends of mineral exploration expenditure by commodity in the NT, as measured by the ABS, showing the dramatic increase in exploration for 'Other' commodities since 2021.

At the end of 2023, there were 1077 granted non-extractive mineral exploration licences in the Territory (compared with 1083 at the end of 2022), and 701 outstanding exploration licence applications. During 2023, 178 new applications were received (down from 202 in 2022), 107 were granted (down from 192 in 2022), and 94 licences ceased (up from 25 in 2022). The area of the Territory covered by granted exploration tenure was 22.6% (up from 11% at the start of 2021), with a further 21.8% of the Territory covered by applications. In the onshore petroleum sector, there were 37 granted petroleum exploration permits, three retention licences and five production licences in the onshore Territory and coastal waters.

Exploration and production highlights

In the following summary of exploration and mining results for the Territory during 2023, all mineral resources are assumed to have been reported in accordance with the JORC or NI43-101 codes. Where resource categories are not listed, readers are directed to the original sources for this information. Most material cited here has been sourced from company websites, news releases and Stock Exchange announcements by companies. As a result, details of exploration by some private and other non-listed companies that do not report publicly could not be included.

Mineral production statistics for the Territory for 2022/23 collected under the *Mineral Titles Act* are listed in **Table 1**. This shows mineral production was \$4.39 billion in 2022/23, the fourth highest figure on record. **Figure 3** shows a map with selected mineral exploration highlights for 2023.

All mentions of ‘co-funded’ refer to NTGS funding under the Geophysics and Drilling Collaborations program (GDC).

Gold – Tanami Region and Aileron Province

Newmont Corporation’s *Tanami Operations*, located 550 km northwest of Alice Springs, remains the Territory’s largest gold operation, reporting 448 000 oz of gold produced in 2023. The 7% decrease in gold production was largely due to a rain event in early 2023. During 2023, 2.31 Mt of ore was mined at an average grade of 6.01 g/t Au. As of 31 December 2023, Proven and Probable Ore Reserves were 26.6 Mt at 5.66 g/t Au, containing 4.80 Moz of gold, a decrease of 0.86 Moz on 2022. Additional Measured and Indicated Mineral Resources total 41.2 Mt at 2.06 g/t Au for 2.70 Moz of gold (an increase of 0.15 Moz); Inferred Mineral Resources are 20.1 Mt at 3.78 g/t Au for 2.40 Moz of gold (an increase of 0.78 Moz). Newmont reported that brownfield exploration and development for new reserves is ongoing with the focus being underground ore definition drilling of the Auron, Federation and Liberator ore bodies, as well as exploration of the Oberon deposit.

Newmont also continued to progress the Tanami Expansion 2, which is designed to secure Tanami’s future as a long-life, low-cost producer by extending mine life beyond 2040 through the addition of a 1460 m hoisting shaft and supporting infrastructure to process 3.3 Mt per year. The expansion is expected to increase average annual gold production by ~150 000–200 000 oz per year for the first five

Table 1. 2022/23 mining production statistics for the Northern Territory.

Commodity	Unit quantity ²	2022–2023 ^{1,4,5}		
		Quantity produced	Quantity sold	Quantity sold (\$) ³
Metallic minerals				
Bauxite	tonnes	11 153 002	11 153 002	\$421 293 923
Gold ⁶	grams	358	0	\$0
Gold dore ⁷	grams	13 707 699	13 805 474	\$1 209 355 931
Iron ore	tonnes	53 914	50 050	\$6 862 022
Lithium	tonnes	18 104	20 197	\$52 236 618
Manganese	tonnes	5 907 928	5 435 136	\$1 526 388 050
Mineral sands concentrate	tonnes	47 500	47 500	\$26 500 000
Lead concentrate	tonnes	39 510	37 299	\$56 753 976
Zinc concentrate	tonnes	297 122	300 070	\$526 274 668
Zinc lead concentrate	tonnes	291 550	265 140	\$489 941 712
Metallic minerals value	n/a			\$4 315 606 900
Gemstones				
Diamonds	carats	0	0	\$0
Gemstones	carats	0	0	\$0
Mineral specimens	kilograms	1 000	700	\$76 118
Gemstones value	n/a			\$76 118
Non-metallic minerals				
Crushed rock	tonnes	2 402 102	2 162 932	\$58 130 814
Dimension stone	tonnes	0	0	\$0
Gravel	tonnes	229 197	222 340	\$3 685 723
Sand	tonnes	261 222	248 390	\$7 058 197
Soil	tonnes	42 986	42 941	\$659 874
Garnet sands	tonnes	0	0	\$0
Limestone	tonnes	0	0	\$0
Quicklime ⁸	tonnes	0	0	\$0
Vermiculite	tonnes	0	0	\$0
Non-metallic minerals value	n/a			\$69 534 608
Energy minerals				
Uranium oxide	tonnes	0	0	\$0
Total minerals value				\$4 385 217 626

Explanatory notes:

¹ Fiscal year is 1 July to 30 June.

² Data is from production returns lodged by operators under statutory obligations.

³ \$ Amount for quantity sold is in AUD and is the gross amount paid to the operator.

⁴ Data has been rounded and autosum applied.

⁵ Data is correct as at 12 September 2023 and may be subject to revision due to late lodgements and/or receipt of superior data.

⁶ Pure gold (100%); does not include gold reported as gold dore.

⁷ Gold dore is primarily comprised of gold with additional silver and accessory elements.

⁸ Quicklime is derived from limestone. Processing input and output data is deemed operator commercial-in-confidence.

years and reduce all-in sustaining costs to \$900–\$1000/oz. Capital costs for the expansion are now estimated to be between US\$1.7–1.8 billion for Tanami Expansion 2, with an expected commercial production date in the second half of 2027.

In the Tobruk and Monza JVs with Prodigy Gold NL, Newmont undertook surface geochemical surveys utilising

Newmont's proprietary deep sensing geochemistry technique and horizontal to vertical spectral ratio passive seismic surveys. A magnetotelluric survey was also undertaken in the Tobruk JV.

The Central Tanami Project Joint Venture (CTPJV) is a 50/50 joint venture between Tanami Gold NL and Northern

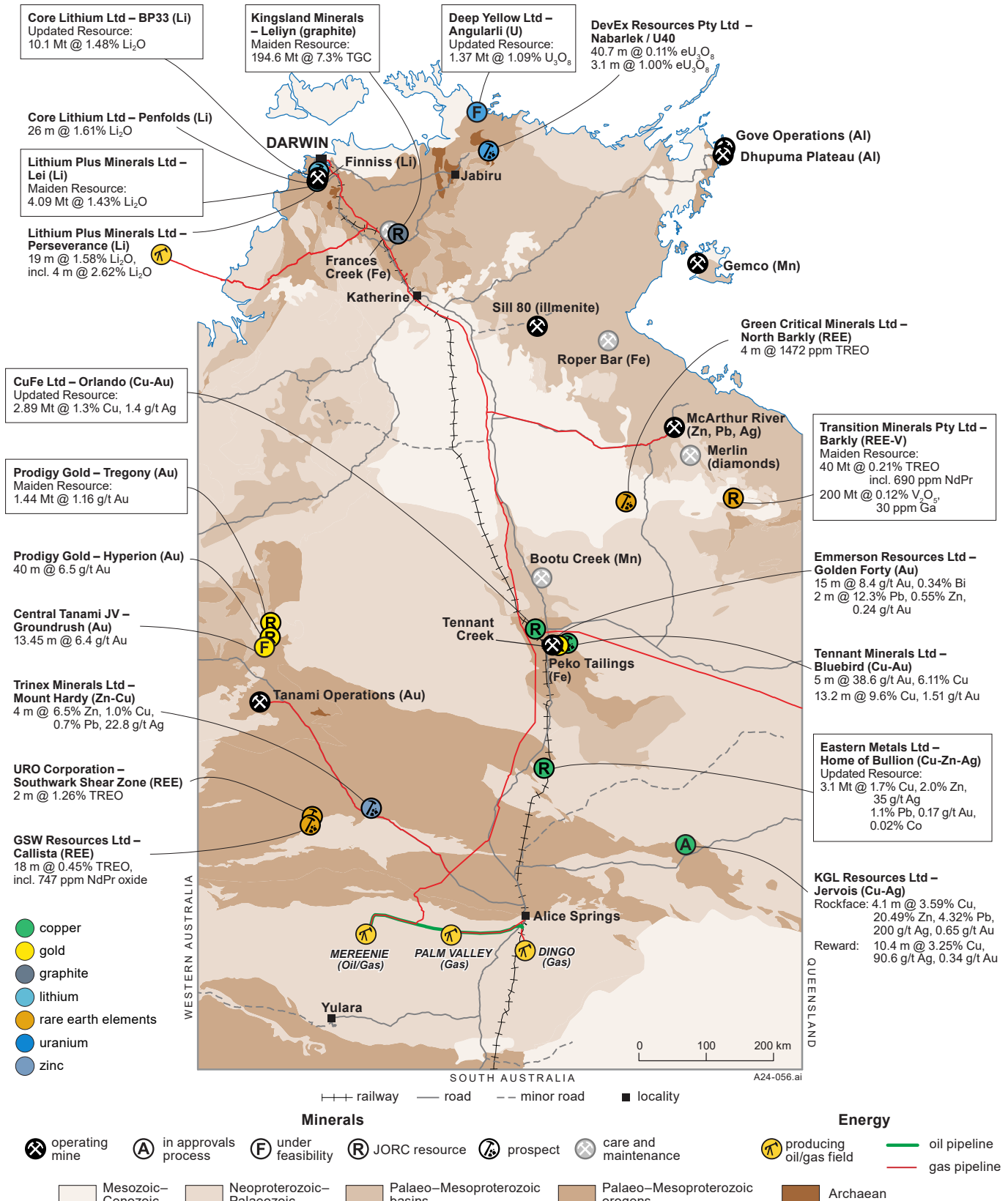


Figure 3. 1:2.5 M geological regions map of the Northern Territory showing selected mineral exploration highlights for 2023.

Star Resources Ltd covering the Central Tanami Project, which includes the Tanami mine corridor and Groundrush deposits. The project contains combined Mineral Resource totalling 13.0 Mt at 3.7 g/t Au for 1.5 Moz of gold, with the Groundrush deposit containing the majority of the resource (7.70 Mt at 4.3 g/t Au for 1.1 Moz of gold). In April 2023, the CTPJV reported a scoping study on the development of an underground mining operation at Groundrush, an open pit operation at Ripcord, and an open pit and underground operation at the Jims deposit, with processing of all through a new carbon-in-leach mill at the existing Central Tanami mill. During 2023, the CTPJV undertook a major drilling campaign, including 113 reverse circulation (RC) and diamond drillholes for more than 20 700 m at Groundrush, Ripcord, Tandem (north of Groundrush), Beaver, and Jims. Reported intersections included 13.45 m at 6.4 g/t Au (Groundrush), 3 m at 12.72 g/t Au (Jims), and 5 m at 3.5 g/t Au (Ripcord). An aircore drilling campaign of 120 holes for 8450 m was undertaken at prospects in the Molech area (36 km west of the Central Tanami mill) and in the Ripcord area. The JV also undertook a high-level review of the existing process equipment at the Central Tanami mill site to investigate potential options going forward.

In February 2023, Prodigy Gold announced a maiden Inferred Resource at the **Tregony** deposit in the Hyperion project area of 1.44 Mt at 1.16 g/t Au (using a 0.6 g/t Au cut-off) for 54 000 oz of gold. During 2023, Prodigy Gold undertook a 37 hole, 4840 m RC program at Tregony designed to improve confidence and increase the metal inventory of the resource; results returned high-grade intersections including 6 m at 15.7 g/t Au (with 1 m at 92.0 g/t Au). A co-funded diamond hole was drilled down-dip and down-plunge of the current Tregony resource and intersected 3.4 m at 4.29 g/t Au, including 0.4 m at 32.9 g/t Au.

Prodigy Gold also undertook a 24 hole, 2506 m RC drilling campaign at the **Hyperion** project, which has an existing Mineral Resource of 4.4 Mt at 2.2 g/t Au for 314 000 oz of gold. Best intersections from the program included 40 m at 6.5 g/t Au from the Hyperion deposit, and 6 m at 8.1 g/t Au from the Brokenwood deposit. A 9 hole, 1647 m co-funded drilling program at Boco North, returned no significant results. The company also undertook a co-funded detailed ground gravity survey over the Tanami North project area, including Tregony and Hyperion.

In August 2023, Prodigy Gold released an updated Mineral Resource for the **Buccaneer** deposit, 90 km west-northwest of Callie. The updated Indicated and Inferred Resources total 9.2 Mt at 1.2 g/t Au for 359 000 oz of gold, which represented a reduction in tonnes, grade and contained ounces from previously reported resources at the deposit.

Gold – Pine Creek Orogen

Vista Gold Corporation's **Mount Todd** gold project, northwest of Katherine, has Measured and Indicated Mineral Resources of 299.1 Mt at 0.82 g/t Au containing 7.87 Moz of gold, and Inferred Mineral Resources of 65.3 Mt at 0.77 g/t Au containing 1.61 Moz of gold. Proven

and Probable Ore Reserves at the end of 2023 were 280.4 Mt at 0.77 g/t Au for 6.98 Moz of gold. A 2022 feasibility study on the project envisaged a 16 Mtpa operation to produce 479 000 oz of gold per annum in the first seven years. In March 2023, Vista announced results of a scoping study, which indicated that a smaller scale, 5 Mtpa project could be designed and constructed with an initial capital expenditure of less than US\$350 million, utilizing contract mining, and would achieve initial production in the range of 150 000–250 000 oz per year at competitive all-in sustaining costs. In March 2024, Vista announced the results of an updated feasibility study on the project. The project has a Mining Authorisation in place, and Vista Gold have continued to seek a partner or another form of transaction to progress the project.

Agnico Eagle Mines Ltd's operations in the Pine Creek region remained in care and maintenance through 2023. The company announced that \$3.3 million was budgeted in 2023 for 4000 m of drilling in the Territory, mostly to test new targets at Pine Creek, Maud Creek, Mt Paqualin, and Union Reefs. Results have not been publicly released. Combined Mineral Resources for all of Agnico Eagle's Territory assets at the end of 2023 comprised Measured and Indicated Resources of 21.8 Mt at 2.38 g/t Au and an Inferred Mineral Resource of 17.8 Mt at 2.4 g/t Au, for total contained 3.04 Moz of gold.

PNX Metals Ltd continued to progress their **Fountain Head** gold project, located 50 km northwest of Pine Creek. Combined Indicated and Inferred Resources for the Fountain Head and Tally Ho deposits total 2.94 Mt at 1.7 g/t Au for 156 000 oz of gold. The project received Territory environmental approval in February 2023, and a mining management plan (MMP) for the project was submitted in May 2023. The company announced they were also finalising an MMP for the Mount Porter gold project, 50 km southeast of Fountain Head, which has a Mineral Resource of 0.68 Mt at 2.2 g/t Au.

During 2023, PNX Metals announced that surface rock-chip sampling at their **C6** prospect, on their northern leases near the historic Goodall deposit, returned high-grade gold assay results in excess of 100 g/t Au from quartz-gossan, which sporadically outcrops along the northern extension of the C6 anomaly. Reconnaissance drill testing yielded a best RC intersection of 2 m at 1.05 g/t Au, and an aircore intersection of 2 m at 1.86 g/t Au.

Privately owned Bacchus Resources Pty Ltd continued exploration and development studies at the **Brocks Creek** project, 12 km north of Hayes Creek. An MMP for the recommencement of mining and processing at Brocks Creek has been submitted to the Territory Government.

Hanking Australia Pty Ltd continued development plans and approvals processes for the **Mount Bunday** project, which includes the Toms Gully, Rustlers Roost and Quest 29 deposits, located 90 km east-southeast of Darwin. The December 2021 reported Mineral Resources for the entire project are 109 Mt at 0.9 g/t Au for 3.01 Moz of gold, with 75% in the Indicated category, including a higher grade Resource of 6.3 g/t Au for 514 000 oz of gold at Toms Gully. The project received Territory environmental approval in June 2023. In November 2023, the company released a

definitive feasibility study for the project, based on open pit mining at Rustlers Roost and Quest 29, underground mining at Tom's Gully, and the construction of a new 5 Mtpa central processing plant and tailings storage facility at Rustlers Roost. The study envisaged two development scenarios, with an 11 or 13 year mine life, producing 170 000 ounces per annum for the first 5 or 7 years respectively.

Private company PC Gold Pty Ltd has approvals in place for mining at the **Spring Hill** gold project, pending the availability of a gold processing facility in the region. The project has a Mineral Resource of 6.9 Mt at 1.74 g/t Au.

DeSoto Resources Ltd undertook their first drilling program at the **Fenton** gold prospect, 60 km west of Pine Creek. The first two holes intersected mineralisation along strike from gold intersections drilled by Homestake Mining in the 1990s, with a best intersection of 23 m at 0.37 g/t Au, including 2 m at 1.78 g/t Au. Mineralisation is interpreted to occur within the Koolpin Formation beneath the Daly Basin. An airborne electromagnetic survey commenced over the mineralised corridor in October 2023, co-funded by NTGS.

Gold and copper–gold – Warramunga Province

The Barkly region continues to be the key area of focus for copper–gold exploration in the Territory, with significant exploration programs in the Rover and Tennant Creek fields, as well as in undercover areas in the Barkly Tableland region east of Tennant Creek.

Tennant Creek mineral field

During 2023, Tennant Minerals Ltd continued drilling their **Bluebird** ironstone-hosted copper–gold discovery, 45 km east of Tennant Creek. In March 2023, the company announced final assay results from 2022 drilling, which included 5.7 m at 49.3 g/t Au and 0.74% Cu, and 16.45 m at 2.31 g/t Au and 3.05% Cu. In May 2023, the company commenced a Stage 3 drilling program, testing an expanded mineralised target footprint at Bluebird. Stage 3 drilling resulted in additional high-grade intersections, ie 5 m at 6.11% Cu and 38.6 g/t Au, and 61.8 m at 2.3% Cu, and 0.4 g/t Au (including 13.2 m at 9.6% Cu and 1.51 g/t Au). Drilling also identified a shallow eastern extension of Bluebird, with a best intersection to date of 14.1 m at 7.6% Cu, 2.4 g/t Au and 0.32% Bi. The company reported that drilling to date at Bluebird has identified copper–gold mineralisation over an 800 m strike length and to more than 400 m depth. The mineralisation is associated with intense hematite alteration and brecciation, with malachite, native copper and visible gold in the upper parts of the zone, which transitions at depth to primary sulfide mineralisation, including chalcocite, bornite and chalcopyrite.

Tennant Consolidated Mining Group Pty Ltd (TCMG) continued feasibility and planning studies for the establishment of an 840 000 tpa carbon-in-leach plant to form a central processing facility at Nobles Nob. In September 2023, TCMG submitted an MMP for proposed activities including extraction and processing of the existing Southern Waste Rock Dump and existing Northern Tailings at Nobles Nob, plus an expansion of the existing Nobles Nob

pit. This will require the establishment of a new processing plant and tailings storage facility that will then be used to process ore from surrounding sites, including Rising Sun, Weabers Find and Black Snake.

In March 2023, Emmerson Resources Ltd released results from the final holes from a phase 1 drilling program at the **Golden Forty** prospect, 4 km northeast of Nobles Nob. Intersections included 15 m at 8.4 g/t Au and 0.34% Bi from a new zone of high-grade gold mineralisation at Golden Forty North; 4.6 m at 9.0 g/t Au and 0.54% Bi from Golden Forty East; and 1.5 m at 27.1 g/t Au from extensions to the historic Golden Forty mine. Base metal mineralisation was also discovered at Golden Forty East, with 28 m intersected at 3.5% Pb, 0.31% Cu and 0.36% Zn, including 2 m at 12.3% Pb, 0.55% Zn and 0.24 g/t Au. In November 2023, Emmerson completed 7 extensional drillholes at Golden Forty that expanded known mineralisation at depth below the historical mineralisation, with a best intersection of 20 m at 4.7 g/t Au, including 6 m at 15.2 g/t Au. The Golden Forty drilling was managed and funded by Emmerson as part of an earn-in exploration joint venture with TCMG, with Emmerson now about halfway toward earning a 75% interest in the Tennant Creek Project by funding \$10.5 million in exploration.

In July to September 2022, Emmerson undertook an 11 hole extensional drilling program at their 100% owned **Hermitage** discovery in the northern corridor of the Tennant Creek field. Eight of 11 holes intersected wide zones of mineralisation, such as 20 m at 1.5% Cu, 0.6 g/t Au, 0.7% Bi, 9.6 g/t Ag and 497 ppm Co; and 51.1 m at 0.8% Cu and 0.11% Co. The company reported that mineralisation remains open up plunge to the east, down plunge to the west and at depth below a late low angle fault.

CuFe Ltd has a 55% interest in exploration assets that include the **Orlando**, Gecko and Goanna copper–gold deposits, 28 km northwest of Tennant Creek. In April 2023, the company updated the Mineral Resource at Orlando based on drilling undertaken in 2022, reporting combined Indicated and Inferred Resources of 2.89 Mt at 1.3% Cu and 1.4 g/t Au. This represents a 16% increase in contained copper and a 25% increase in Inferred tonnage. This brings the total Resource for the project area to 7.29 Mt at 1.7% Cu and 0.6 g/t Au. Studies of open pit development options are ongoing.

King River Resources Ltd undertook a substantial geophysical program, including IP surveys and detailed gravity and magnetics, over their Tennant Creek projects, including Kurundi, Rover East and Tennant Creek East. In late 2023, the company undertook a 17 hole, 2790 m RC drilling program targeting gravity, magnetic, and dipole-dipole induced polarisation targets at the **Providence** prospect, along strike from the Bluebird gravity trend. Drilling confirmed the gravity anomaly is associated with a significant, broad ironstone structure (primarily hematite) under shallow cover, with geochemical anomalism intersected.

Rover mineral field

During 2023, Castile Resources Ltd commenced the environmental approvals process for the **Rover 1** copper–

gold–cobalt–magnetite project, 70 km southwest of Tennant Creek. Rover 1 has a 2022 Mineral Resource of 5.58 Mt at 1.76 g/t Au, 1.49% Cu, 0.07% Co and 23.2% magnetite. The project is planned to include downstream processing to produce 99% copper, 99% cobalt and high-grade (96.5%) magnetite concentrate, as well as gold. During the year, Castile advanced their definitive feasibility study for Rover 1 and undertook metallurgical testwork. Castile also commenced a co-funded ambient noise tomography (ANT) passive seismic survey over Rover 1 and the Pathfinder area. Planned co-funded drilling at Pathfinder 35, 20 km west of Rover 1, was deferred due a major rain event in November 2023.

Barkly Tableland

Exploration in the underexplored Barkly Tableland area east of Tennant Creek (informally referred to as the ‘East Tennant region’) is primarily targeting copper and gold mineralisation in Proterozoic basement underlying Cambrian cover of the Georgina Basin. The region experienced a major uptake of exploration tenure from 2019–2021 based on encouraging results from collaborative pre-competitive geoscience in the area by Geoscience Australia, NTGS and the MinEx Cooperative Research Centre (**Figure 4**).

South 32 Ltd are exploring for IOCG mineralisation as part of a \$15 million farm-in agreement with Encounter

Resources Ltd at the Jessica project area, along the Tablelands Highway. Reprocessing of Geoscience Australia seismic data and the infilling of the NTGS Brunette Downs gravity survey identified a series of targets for drill testing, including the *Zeta* IOCG target, 160 km north of Barkly Homestead. The Zeta target, located on a major structure, is associated with co-incident gravity and magnetic features and a discrete seismic reflector. Five diamond drillholes for 4402 m were completed at Jessica in 2023. The first 2 drillholes completed at Zeta, drilled 1.3 km apart, intersected several key IOCG indicators in basement beneath ~400 m of Georgina Basin cover. This included chalcopyrite/bornite in thin quartz-carbonate veins, intense and pervasive red rock hematite alteration and bimodal felsic volcanic–basalt sequences; assays are pending. Geophysical techniques are being evaluated to vector into the best parts of the mineral system at Zeta.

Astute Metals NL (formerly Astro Resources NL) undertook detailed gravity and ANT surveys over their Leichhardt and Banks prospect area, located immediately south of Barkly Homestead. The data enabled a constrained gravity inversion that revealed a high-density target close to a previous drillhole at Leichhardt East, which will be a future drill target.

In July 2023, Middle Island Resources Ltd completed the acquisition of the East Tennant project tenements from

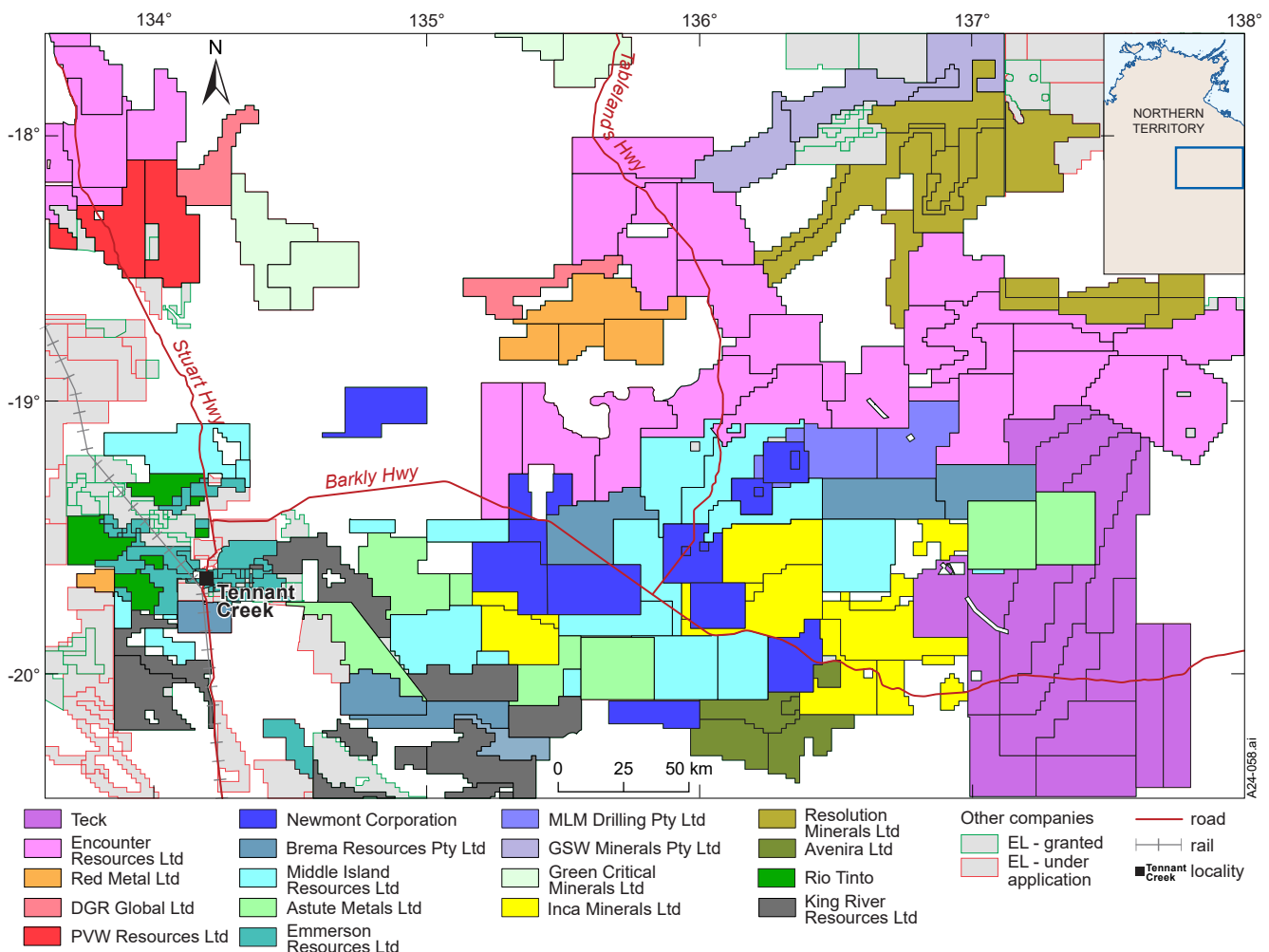


Figure 4. Map showing exploration licences and applications in the Barkly Tableland in February 2024, showing the distribution of tenure for selected exploration companies.

Strategic Energy Resources Ltd, adding to their existing tenement holding in the East Tennant region. The company undertook prospect-scale soil and geochemical surveys over multiple targets in late 2023.

Inca Minerals Ltd drilled a 700 m co-funded diamond drillhole at the Alpaca Hill target in their Frewena Fable project area, 60 km west of Barkly Homestead. The company reported that, although the hole did not intersect visible high-grade mineralisation, there were extensive occurrences of disseminated sulfides, including pyrite and occasional chalcopyrite. The dominant rock type from around 368 m is highly altered granite with strong biotite, K-feldspar and albite alteration, as well as patchy magnetite alteration from 470 m.

Following the merger with Newcrest Mining, Newmont Corporation has a substantial tenement holding in the East Tennant region. No results from exploration activity in this area during 2023 have been publicly reported.

Polymetallic base metals - Aileron Province

KGL Resources Ltd's **Jervois** copper project, located near the Plenty Highway, 380 km northeast of Alice Springs, is the Territory's most advanced copper project, with a total Mineral Resource of 23.8 Mt at 2.02% Cu, 25.3 g/t Ag and 0.25 g/t Au. Mineralisation at Jervois occurs in a series of stratabound, subvertical sulfide-rich deposits along a 12 km strike length in the Bonya Metamorphics in Aileron Province. The 2022 feasibility study on the Jervois project was based on an 11.75 year mine life with steady state annual production of 26 700 t of copper, 945 000 oz of silver and 6500 oz of gold in copper concentrate from two open cut and four underground operations.

KGL Resources continued to drill at Jervois during 2023, with the initial phase of the 2023 program focused on depth extensions to the Rockface orebody, extensions to the Marshall lode, and upgrading the Reward open pit resources. Highlights included 5.6 m at 3.10% Cu, 42.7 g/t Ag, and 0.40 g/t Au from Rockface; and 14.7 m at 2.50% Cu, 25.8 g/t Ag, and 0.87 g/t Au from Reward. The deepest hole ever drilled at Rockface intersected 5 m at 2.43% Cu, 0.55 g/t Au and 18.1 g/t Ag from 1132.5 m; high-grade massive base metal sulfides were discovered at depth with 4.1 m at 3.59% Cu, 20.49% Zn, 4.32% Pb, 199.9 g/t Ag and 0.65 g/t Au from 990 m. Drilling in the latter part of 2023 intersected high grade ore within the Reward open pit design, with 2.8 m at 8.37% Cu, 127.3 g/t Ag, and 1.42 g/t Au from 30 m; and 10.4 m at 3.25% Cu, 90.6 g/t Ag, and 0.34 g/t Au from 123 m depth. KGL have announced that the company is progressing optimisation studies to improve key value drivers and financing options for the project as they move towards a final investment decision and financing for the project, which will be subject to market conditions at the time.

In March 2023, Eastern Metals Ltd announced an updated Mineral Resource at the **Home of Bullion** copper project, located 30 km east of Barrow Creek, consisting of 3.1 Mt at 1.7% Cu, 2.0% Zn, 35 g/t Ag, 1.1% Pb, 0.17 g/t Au and 0.02% Co.

Trinex Minerals Ltd (formerly Todd River Resources Ltd) undertook an RC and aircore drilling program at their

Mount Hardy copper–zinc project, 290 km northwest of Alice Springs. RC drilling was focused on the Lehmann and AB prospects, where base metals were intersected at both prospects with a best intersection of 4 m at 6.5% Zn, 1.0% Cu, 0.7% Pb and 22.8 g/t Ag from the Lehmann prospect. Reconnaissance aircore drilling was undertaken at a number of prospects. The company reported there are no immediate plans for follow-up work at Mount Hardy.

During 2023, Inca Minerals Ltd prepared for a drilling program at the Jean Elson project area 40–60 km southeast of Jervois, focused on the **Camel Creek** prospects, to test an outcropping copper-mineralised vein system at the Ningaloo target. Cultural heritage clearance for drilling was received in February 2024.

Sediment-hosted copper and/or zinc

The Territory's vast Proterozoic basins have substantial potential for sediment-hosted base metals, with significant new greenfields exploration underway for copper and zinc, especially with the greater McArthur Basin, Lawn Hill Platform and South Nicholson Basin.

The **McArthur River** mine is Australia's second largest zinc mine. It is located ~70 km southwest of Borroloola in the McArthur Basin and is operated by McArthur River Mining Pty Ltd, a subsidiary of Glencore. At 31 December 2023, the McArthur River mine had total Reserves and Resources of 136 Mt at 9.85% Zn, 4.39% Pb and 45 g/t Ag, including Ore Reserves of 79 Mt at 8.45% Zn, 3.97% Pb and 40 g/t Ag. During 2023, the mine produced 262 200 t of zinc, 50 400 t of lead and 1.292 Moz of silver in concentrate. The company has reported that open cut mining is planned to be completed in 2040.

Another major shale-hosted zinc resource occurs at Teck Resources Ltd's **Teena** zinc deposit, which was discovered in 2013 about 10 km west of the McArthur River mine. The 2016 Inferred Mineral Resource at Teena is 58 Mt at 11.1% Zn and 1.6% Pb for 6.5 Mt of zinc and 0.9 Mt of lead metal (at a 6% Zn+Pb cut-off). Teck have publicly stated that they are investigating the mineralogical, metallurgical and environmental aspect of the project and an updated mineral resource estimate is underway to assist with future development options. In November 2023, Teck signed an option agreement to acquire four tenements located east of the Emu Fault Zone from NT Minerals Ltd.

In November 2023, BHP advised of their decision to withdraw from their joint venture with Encounter Resources at the **Elliott** project, near Elliott and Newcastle Waters. This follows drilling of 2 diamond holes in 2022 for a total of 1655 m, targeting sediment-hosted copper near the margin of the Beetaloo Sub-basin. Drilling confirmed that the reduced Velkerri and Kyalla Formations are preserved in the target area.

South32 have a \$10 million farm-in agreement with Encounter Resources over the Carrara project, located 110 km north of the Barkly Highway close to the Queensland border. The Carrara project is prospective for sediment-hosted copper and zinc mineralisation in potential Isa Superbasin rocks identified through the 2017 GA–NTGS South Nicholson Seismic Survey and MinEx CRC Carrara-1

drillhole. The project is located at an interpreted structural offset of the western margin of the Carrara Sub-basin where the prospective Isa Superbasin units are modelled closer to surface. Three diamond drillholes (2803 m) were completed at Carrara during October–November 2023; assays are pending for all holes. Teck Resources are also actively exploring a large tenement holding extending from the Carrara area south-southwest to the Barkly Highway.

In May–June 2023, Astute Metals undertook co-funded gravity and passive seismic surveys over their Ranken project area, near the margin of the Carrara Sub-basin, to assist targeting for sediment-hosted base metal mineralisation.

In October 2023, NT Minerals Ltd finalised the purchase of the Wologorang copper project from Resolution Minerals Ltd.

As part of a farm-in agreement with BHP (formerly with OZ Minerals, now BHP-owned), Resolution Minerals undertook three co-funded stratigraphic diamond drillholes for 2002 m in August–September 2023 at their *Benmara* project, located on the margin of the South Nicholson Basin and Lawn Hill Platform adjacent to the Murphy Province. The drill program was designed to test the stratigraphy adjacent to the Fish River and Bauhinia faults. Drilling intersected prospective host rocks, including the Mount Les Sandstone and the Lawn Hill Formation, containing traces of chalcopyrite. In December 2023, BHP advised that it would not be proceeding with further earn-in activities at the project.

The southern Georgina Basin also has known potential for sediment-hosted copper. Encounter Resources are exploring for sediment-hosted copper at their Sandover project, south and southeast of Barrow Creek. Following a co-funded gravity survey in 2022, the company completed a co-funded diamond drillhole at Sandover in November 2023, testing an interpreted structural position in the northwest of the basin. The drillhole reached a depth of 669 m and intersected interpreted Phanerozoic cover prior to a thick interval of interpreted Neoproterozoic sediments, and then granitic basement where a narrow zone of hydrothermal alteration was identified at the interface with the sediments; assay results are pending.

Lithium

During 2023, there was substantial exploration success for lithium in the Territory, with an 84% increase in the Territory's lithium resource inventory. The Territory's first spodumene concentrate exports also occurred during 2023, although a substantial fall in the lithium price adversely affected the sector in the final months of the year.

Pine Creek Orogen

During 2023, Core Lithium Ltd commenced export of spodumene concentrate from the *Finniss* lithium mine, located in the Bynoe pegmatite field, 88 km by sealed road from Darwin port. Lithium mineralisation in the Bynoe field occurs as spodumene in north-trending pegmatites up to 40 m in width along a 30 km north-trending corridor. Mining to date has been from the Grants open pit mine, with on-site processing to spodumene concentrate. During 2023,

Core Lithium produced 67 803 t of spodumene concentrate; product sales totalled 14 774 t of direct shipping ore material, 59 565 t of spodumene concentrate, and 46 298 t of lithia fines. In January 2024, after a 85% fall in the spodumene concentrate price during 2023, Core Lithium announced the suspension of mining from the Grants open pit, although the company would continue to process existing stockpiles until the middle of 2024.

In March 2023, Core Lithium announced that the Mineral Resource Estimate for the BP33 deposit at the Finniss project had more than doubled to 10.1 Mt at 1.48% Li₂O. In April, the total Mineral Resource for the Finniss project increased by 62% to 30.6 Mt at 1.31% Li₂O, with resources defined at ten deposits (Grants, BP33, Carlton, Hang Gong, Sandras, Lees, Ah Hoy, Booths, Bilatos and Penfolds). Drilling at BP33 in 2023 led to a further upgrade of the BP33 Mineral Resource to 10.5 Mt at 1.53% Li₂O. In mid-2023, Core Lithium commenced early development works at the BP33 project, including excavation of the box cut for the underground mine, while a feasibility study for the project was in process.

Core Lithium's 2023 exploration program was undertaken in three phases. Phase 1 focused on infill and resource definition drilling at BP33 and Carlton, with best results including 90.17 m at 1.80% Li₂O from 569 m at BP33, and 15 m at 1.53% Li₂O (including 5 m at 1.88% Li₂O) at Carlton. Phase 2 involved infill and extensional drilling at the Lees-Booths and Penfolds prospects, with intersections including 11 m at 1.75% Li₂O at Lees-Booths and 26 m at 1.61% Li₂O at Penfolds. In Phase 3, the company applied new technologies to explore for new pegmatites, including undertaking an ANT survey over a large portion of the Finniss Project. Other drill targets included outcropping pegmatites and geochemical targets. RC drilling of 14 327 m was undertaken as part of Phase 3 testing of new targets. Soil sampling and RAB drilling was also conducted in previously untested parts of the Finniss district with the aim of generating new exploration targets for 2024. Results of Phase 3 are pending.

At the Shoobridge project, 40 km south of Adelaide River, Core Lithium commenced a soil geochemistry survey, with 1632 samples collected before the end of the field season.

Lithium Plus Minerals Ltd defined a maiden Mineral Resource estimate at the *Lei* prospect in the Bynoe pegmatite field, 2 km south of BP33. Indicated and Inferred Mineral Resources at Lei total 4.09 Mt at 1.43% Li₂O, based on 21 RC holes and 35 diamond drillholes. The modelled pegmatite ranges from 10 m to 60 m in thickness and extends ~230 m northeast from the tenement boundary to where the unit pinches out. The pegmatite is confirmed to have a vertical extent of at least 700 m. In late 2023, a 17 hole, 7332 m deep extensional and infill diamond drilling program was undertaken at Lei to test the depth extent and provide confidence in the grade and geological continuity of the mineralisation. Results included intersections of 50 m at 1.83% Li₂O from 613 m, and 81 m at 1.59% Li₂O from 653 m, with 41 m at 1.94% Li₂O.

Lithium Plus also undertook drilling at the Perseverance prospect, located 6 km northeast of the Grants mine. A

total of 14 RC and diamond drillholes were completed in 2023, with a best intersection from fresh spodumene pegmatite of 19 m at 1.58% Li_2O from 148 m, including 4 m at 2.62% Li_2O . Late in the field season, Lithium Plus also commenced a 9 hole, 1823 m RC and diamond drilling program at the Jennys prospect, west of Perseverance, testing the shallow strike length of the pegmatite body. The drilling program at Jennys will be completed in 2024 after the wet season.

Charger Metals NL undertook a substantial drill program testing seven prospect areas on their **Bynoe** lithium project, located 10–20 km south-southwest of Core Lithium's Grants mine. The program included 63 RC holes for 10 009 m and six diamond drillholes for 1915 m. Results from the drilling confirmed lithium and tantalum mineralisation at three of the prospects (Enterprise, Utopia and 7Up). However, the company reported that fractionation within the lithium-cesium-tantalum pegmatites is not homogeneous, with the spodumene content of the pegmatite intersections inconsistent and of low-grade. Best intersections included 5 m at 0.73% Li_2O at 7Up and 5 m at 1.13% Li_2O at Enterprise. Approximately 20 prospects in the project area remain untested. Charger also completed an ANT survey and detailed gravity survey.

Ragusa Minerals Ltd undertook a co-funded 6 hole, 738 m RC drill program at the **Kilfoyle** prospect in the Litchfield pegmatite belt located 120 km south of Darwin. Drilling intersected several zones of pegmatite within the basalt/dolerite country rock within the weathered zone, with a maximum metre intercept of 0.77% Li_2O .

Evergreen Lithium Ltd listed on the ASX in April 2023, and continued exploration in the western Bynoe field with regional-scale soil geochemistry and an ANT survey. Soil sampling has shown northeast-trending lithium anomalies up to several kilometres long that also include geochemical pathfinder elements Be, Cs, K, La, Rb, Sn, and Ta. Drill testing of geochemical and geophysical anomalies is planned for the 2024 dry season.

Aileron Province

In October 2023, Australasian Metals Ltd commenced a co-funded reconnaissance diamond drilling program at their Mount Peake project near Barrow Creek in the northern Aileron Province. The program involved 3 holes for 594 m, testing geological zones beneath outcropping lithium-bearing pegmatites and soil anomalies. No significant lithium intersections were reported. Oceana Lithium completed a soil geochemistry program targeting lithium at their Napperby project in 2023. Other explorers targeting lithium in the northern Aileron Province include Core Lithium, Askari Metals Ltd, Encounter Resources, Eastern Metals Ltd, Lithium Spring Pty Ltd, Lithium Plus Minerals Ltd, and Tivan Ltd.

Rare earth elements

Arafura Rare Earths Ltd undertook construction works and progressed project financing activities for the **Nolans** rare earth–phosphate project, located near Aileron, 135 km northwest of Alice Springs. Measured, Indicated and

Inferred Mineral Resources at Nolans Bore total 56 Mt at 2.6% total rare earth oxides (TREO) and 11% P_2O_5 , containing 1.46 Mt REO. Neodymium and praseodymium (NdPr) make up 26% of the rare earths in the resource. Proven and Probable Reserves are 29.5 Mt at 2.9% TREO and 13% P_2O_5 , enough to support a mine life of at least 33 years with nameplate production of 4440 tpa of NdPr oxide and 474 tpa of mixed middle-heavy rare earths oxide from an on-site separation plant. During 2023, the company completed early construction works at the Nolans site, including the main site access road, commissioning of the construction camp, and completion and commissioning of the water pipeline, raw water dam, temporary raw water distribution systems, and borefield headworks. In March 2024, the Australian Government announced it had conditionally approved a US\$533 million debt finance package to support development of the project

Bubalus Resources Ltd undertook a soil sampling program at their **Nolans East** rare earths project, located north and east of Aileron Roadhouse; 267 out of 1687 samples returned >500 ppm TREO, defining a 2.4 km × 1.3 km anomaly.

In August 2023, Metalsgrove Mining Ltd announced results from drilling at their Bruce and Plenty River prospects in the Irindina province, northeast of the Harts Range, with a best intersection of 2 m at 0.4% TREO (28% NdPr/TREO), which the company reported to be carbonate-associated. Drilling at the Edwards Creek base metal prospect intersected 17 m at 550 ppm TREO, with 34% HREE/TREO.

In January 2023, Askari Metals Ltd reported elevated rare earth element concentrations associated with discrete pegmatites on the flank of granite outcrops at their **Barrow Creek** project in the Aileron Province. In August 2023, Askari completed an exploration program comprising 73 soil samples and 193 rock samples together with a drone magnetic survey, gravity survey and aerial hyperspectral survey. The highest grade recorded was 11 610 ppm (1.16%) TREO, including 6721 ppm total heavy rare earth oxides.

Heavy Rare Earths Ltd commenced exploration at their **Duke** project, 50 km northwest of Tennant Creek, exploring for Browns Range-style unconformity-related heavy rare earths, with a secondary target of HREE-enriched ion-adsorption clay-type mineralisation hosted in saprolite on the Warrego Granite. In August 2023, the company undertook a soil survey that identified a 7 km² zone of rare earth enrichment. Sampling of historic drill chips in saprolite at the NTGS core library yielded a rare earth intercept of 42 m at 770 ppm TRO, including 6 m at 1481 ppm TREO. The company noted that the historic drill intercepts did test the best rare earth soil anomalies.

In November 2023, Transition Minerals Pty Ltd announced a maiden Inferred Mineral Resource for their **Barkly** rare earths–vanadium project, located 150 km southeast of McArthur River mine. The resource encompasses the Vanadis and Benmara North deposits, and totals 40 Mt at 0.21% TREO, including 690 ppm NdPr. REE mineralisation is stratabound within Cretaceous marine sandstones and siltstones at depths of 3–30 m, with the rare earths hosted within a suite of aluminium–phosphate–

sulfate minerals belonging to the crandalite subgroup. Initial metallurgical testwork indicated that common acid leach yields extraction rates of up to 74% Nd and Pr, within an overall 73% extraction of total rare earth elements (TREE). The company reported that the extraction rates imply that the Barkly rare earth deposit may extract the highest mass of magnet REE (Pr, Nd, Tb, Dy) per resource tonne relative to other regolith-hosted rare earth deposits. The company also announced an increased Exploration Target of 200–1000 Mt at 0.16–0.19% TREO, including 500–700 ppm NdPr.

In September 2023, Green Critical Minerals Pty Ltd conducted a maiden scout drilling program at their **North Barkly** project area located 140 km southwest of McArthur River mine, targeting an extensive >200 ppm TREO soil anomaly. The drilling comprised 14 widely spaced reconnaissance holes testing rare earth enrichment in weathered Mesozoic cover. Best intersections (at a 500 ppm TREO cut-off) were 4 m at 1472 ppm TREO and 1 m at 1812 ppm TREO.

Energy Metals Ltd announced ongoing evaluation of clay-rich regolith materials and granitic saprolite for ionic adsorption on clay-style REE mineralisation at their **Crystal Creek** project area, 45 km west of Yuendumu. In August 2023, the company undertook a 32 hole, 541 m aircore drilling program, intersecting some thick intervals in white, kaolinitic clays; assays are pending.

In August 2023, URO Corporation undertook a 21 hole aircore drilling program at their **Southwark Shear Zone** rare earth project, with a best intersection of 6 m at 5229 ppm TREO with 20% NdPr, including 2 m at 12 631 ppm (1.26%) TREO. Additionally, thick intervals of white kaolin clay with over 80% kaolinite and over 70 ISO brightness were reported.

Private company GSW Resources Pty Ltd undertook a 122 hole aircore drilling program for a total of 2902 m, co-funded by NTGS, at their **Callista** REE prospect west of Yuendumu (see Taylor, this volume). Drilling intersected thick intervals of clay-rich granitic saprolite, with a best intersection of 18 m at 0.45% TREO, including 747 ppm NdPr oxides and 98 ppm DyTb oxides.

Uranium

A strong recovery in the uranium price led to a continued resurgence in uranium exploration in the Territory during 2023. Most activity occurred in western Arnhem Land, but there was an increase in exploration activity in prospective regions across the Territory.

Through the second half of 2023, DevEx Resources Ltd undertook a significant RC and diamond drilling program at their **Nabarlek** uranium project in western Arnhem Land, with particular focus on the U40 and Nabarlek North prospects. Drilling at U40 defined significant strike extents to the mineralisation on both the eastern and western margins of the U40 fault, with intersections of 3.1 m at 1.00% eU_3O_8 including 1.4 m at 1.96% eU_3O_8 ; 40.7 m at 0.11% eU_3O_8 ; and 16.9 m at 0.22% eU_3O_8 , including 1.4 m at 1.62% eU_3O_8 . The company announced that drilling has now confirmed the presence of near-surface uranium mineralisation (within 120 m of the surface) extending for

a strike length of over 500 m at U40. There is also evidence for the potential of significant depth extent at U40 with an intersection of 4.6 m at 0.43% eU_3O_8 from 257.3 m down-hole. At Nabarlek North, shallow uranium mineralisation was encountered at the unconformity between the sandstone and the Cahill Formation, returning intercepts of 11.2 m at 0.33% eU_3O_8 , including 5.1 m at 0.51 eU_3O_8 , and 13.0 m at 0.28% U_3O_8 .

Alligator Energy Ltd undertook a 9 hole RC drilling program of 1398 m at their Nabarlek North project in western Arnhem Land, with a best intersection of 3 m at 0.12% U_3O_8 along trend from the U40 Prospect. The company also undertook a 15 km² gradient array induced polarisation (IP) survey and drilled over 320 aircore holes for 6233 m, as well as 100 shallow auger holes drilled to 1.5 m.

In July 2023, Deep Yellow Ltd announced a Mineral Resource upgrade at the **Angularli** uranium deposit within their Alligator River project in western Arnhem Land, supported by 18 diamond holes drilled in 2022 and 30 historical holes. The updated Inferred Resource, at 0.15% U_3O_8 cut-off, is 1.37 Mt at 1.09% U_3O_8 for 11 748 t of uranium oxide. The Angularli deposit comprises multiple stacked lenses, with the main lens accounting for about 95% of the total volume of the Mineral Resource, the majority of which is sandstone- or silica-flooded breccia-hosted. No further on-ground exploration was undertaken in 2023, with the company focusing on a review of all regional and local project data to develop a comprehensive exploration model.

Following a 2022 drilling program at their **Cleo** uranium project, 35 km north-northeast of Pine Creek in their Allamby project area, Kingsland Minerals Ltd announced in March 2023 an Inferred Mineral Resource for Cleo of 6.8 Mt at 345 ppm U_3O_8 for 2360 t of uranium oxide. No further exploration occurred at Cleo in 2023 as the company focused on the Leliyn graphite discovery.

In November 2023, PNX Metals regained uranium rights over its tenure in the Pine Creek Orogen, including the **Thunderball** deposit that was drilled in 2008–2010. The company reported the results of previously unreported drilling from 2014, including 15 m at 1.35% U_3O_8 from 210 m in the Lower Lode at Thunderball, and 1.5 m at 94.7 ppm U_3O_8 , 0.64 g/t Au, 0.97 g/t Pd and 0.75 g/t Pt from 34 m at the nearby **Goldeneye** prospect.

In Central Australia, significant sandstone-hosted uranium deposits occur in the Ngalia and Amadeus basins. Energy Metals Ltd's **Bigirlyi** uranium–vanadium project is hosted in the Mount Eclipse Sandstone in the Ngalia Basin and has a 2011 Mineral Resource of 7.46 Mt at 0.13% U_3O_8 and 0.12% V_2O_5 . Energy Metals have announced that with the recovery in the uranium market, they are looking to progress the Bigirlyi project with plans for a restart of exploration and development operations at Bigirlyi in 2024.

Laramide Resources commenced exploration on the **Murphy** project area on the Territory side of the border adjacent to their Westmoreland uranium project in Queensland. The project area hosts numerous uranium and base metal targets, some of which have not been subject to on-ground investigation for decades. Initial work was focused on ground radiometric surveys to refine existing airborne radiometric anomalies, in addition to surface rock and soil

sampling. DevEx Resources Ltd have also established a substantial land position in undercover extensions of the Murphy region through earn-in agreements with GSW Resources Pty Ltd and Transition Minerals Pty Ltd.

Graphite

A highlight of exploration in the Territory in 2023 was the emergence of the **Leliyn** graphite discovery by Kingsland Minerals Ltd. The Leliyn deposit occurs along the contact between the Cullen Granite and the Mundogie Formation where carbon-rich sediments within the Mundogie Formation have been contact metamorphosed by the granite. Kingsland commenced a maiden drilling campaign at Leliyn in May 2023, comprising a total of 53 RC holes for 5400 m and 11 diamond core holes for about 2400 m. Drilling consistently intersected 50–150 m of graphitic schist, with best intersections including 206 m at 10.2% total graphitic carbon (TGC), 79 m at 10.48% TGC, and 158 m at 10.13% TGC. In March 2024, Kingsland announced a maiden Inferred Mineral Resource for the Leliyn deposit of 194.6 Mt at 7.3% TGC for 14.2 Mt of contained graphite; this makes Leliyn Australia's largest graphite resource. Preliminary metallurgical testing indicated recoveries of 93–95% at grades of ~90% TGC, with a flake size is generally less than 75 µm and most being less than 3 µm. The company announced that these preliminary metallurgical test-work results are sufficient to imply that a marketable graphite concentrate of >94% TGC could be produced.

Tungsten (–molybdenum)

In the last quarter of 2023, Investigator Resources Ltd commenced their exploration at the **Molyhil** tungsten-molybdenum project under an \$8 million earn-in joint venture to acquire up to 80% of the project from Thor Energy PLC. Molyhil is located near the Plenty Highway, northeast of Alice Springs. Activity at Molyhil in 2023 included a 12 hole, 1650 m diamond drilling program aimed at validating and upgrading the existing Mineral Resource for Molyhil (4.39 Mt at 0.27% WO₃, 0.10% Mo, 0.05% Cu and 17.75% Fe at April 2021). Investigator also completed a 3400 station high-resolution gravity survey over the Molyhil project area, co-funded by NTGS.

Vanadium

In November 2023, Transition Minerals Ltd announced a maiden Inferred Mineral Resource of regolith-hosted vanadium and gallium at their **Barkly** project, 150 km southeast of McArthur River mine near the northern edge of the Barkly Tableland. The Mineral Resource totals 200 Mt at 0.12% V₂O₅ and 30 ppm Ga across three deposit areas: Vanadis, Kiana and Benmara. The vanadium mineralisation occurs above a lower horizon enriched in rare earth elements for which a separate Mineral Resource has also been calculated (see **Rare earth elements**). Mineralisation is hosted in a surficial carapace, comprising up to six identified facies types of mixed detrital (transported) and *in-situ* laterites (up to 3 m thick at Vanadis

and up to 7 m thick at Benmara), as well as two subsurface, subjacent, semi-continuous and sub-horizontal ferruginous sandstones units (≤4 m thick). The Exploration Target has been increased to 300–1000 Mt at 0.12–0.14% V₂O₅. The company has reported that the textures observed support a supergene origin for vanadium enrichment related to laterite and ferricrete formation in the regolith profile.

Energy Metals Ltd's **Bigrlyi** uranium project west of Yuendumu also contains a Resource of 8930 t V₂O₅. The company has announced that the Bigrlyi project contains a vanadium Exploration Target of approximately 44 000 t V₂O₅ within a mineralised envelope that is more than three times the size of the present uranium resource volume. A program to enhance the value of vanadium as a by-product commodity is on-going.

Tivan Ltd's **Mount Peake** project contains a vanadium–titanium–iron deposit hosted in the Mount Peake Gabbro in the northern Aileron Province, 60 km west-southwest of Barrow Creek. It contains Measured, Indicated and Inferred Mineral Resources of 160 Mt at 0.28% V₂O₅, 5.3% TiO₂ and 23.0% Fe. In June 2023, Tivan announced they are focusing on the development of the Speewah vanadium deposit in Western Australia and that development planning work for Mount Peake will be limited, at least in the short term.

Nickel–copper–cobalt

IGO Ltd have ongoing exploration for mafic-hosted nickel–copper–cobalt in central Australia, including their Raptor project area along the 'Willowra Gravity Ridge' in the northern Aileron Province, which has an east–west extent of more than 400 km. IGO also have a province-scale tenement package over more than 11 000 km² in the Irindina Province, east of Alice Springs. Exploration to date on these projects includes large regional magnetic-radiometric and EM surveys, some of which have been co-funded by NTGS.

Diamonds

Throughout most of 2023, Lucapa Diamond Company Ltd continued to progress a feasibility study for the **Merlin** diamond project in the McArthur Basin following the release of an updated scoping study in March 2022. Merlin comprises 14 kimberlite pipes of which nine were subject to open cut mining between 1998 and 2003, producing 507 000 ct of diamonds. The Indicated and Inferred Mineral Resource is 27.8 Mt at 0.16 c/t for a total of 4.35 Mct of diamonds. In November 2023, Lucapa announced that due to market conditions and the softening of the diamond price, the delivery of the feasibility study had been put on pause while a smaller scale, lower cost alternative path to development is examined. The alternate study will include examination of using existing resources such as the trial mining plant and front-end scrubber to get Merlin into production.

Bauxite

Rio Tinto Ltd operates the **Gove** bauxite mine in northeastern Arnhem Land, which has been in production since 1971.

Bauxite at Gove occurs in deeply lateritised, dissected plateau remnants overlying the Cretaceous Yirrkala Formation. At the end of 2023, the Gove operation had Proven and Probable Ore Reserves of 58 Mt at 50.2% Al_2O_3 , with additional Measured, Indicated and Inferred Mineral Resources of 9 Mt at 48.1% Al_2O_3 . During 2023, the Gove operation produced 11.57 Mt of bauxite, a marginal increase on 2022. Bauxite production in the Gove region also includes a second mining operation on the **Dhupuma Plateau**, immediately south of the Gove mineral lease. The mine is operated by the Aboriginal-owned Gulkula Mining Company Pty Ltd and is associated with a Mining Training Centre for local Aboriginal people. The mine produces 0.7–0.8 Mtpa of bauxite, which is sold to Rio Tinto's Gove operation.

Iron ore

Hematite

During 2023, Nathan River Resources Pty Ltd recommenced export of stockpiled ore from their **Roper Bar** iron ore mine, 55 km southeast of Ngukurr, with the first shipment of reprocessed stockpile material exported in August 2023. Approval to recommence mining was given in October 2023 although details of a restart of mining activity have not been publicly announced. The **Roper Valley** project, located 150 km east of Mataranka, has been in care and maintenance since September 2022.

The **Frances Creek** iron ore deposit, north of Pine Creek in the Pine Creek Orogen, has been the Territory's largest historical iron ore producer, with production occurring from 1966–1974 and 2007–2014. During 2023, Linecrest Pty Ltd, a wholly owned subsidiary of NT Bullion Pty Ltd, continued to seek regulatory approvals to extract remnant ore from existing open pits.

In February 2023, CuFe Ltd announced a maiden Inferred Mineral Resource for the **Yarram** iron project near Batchelor of 12.7 Mt at 55.4% Fe, 7.26% SiO_2 , 5.16% Al_2O_3 and 0.2% P. The resource comprises two deposits: Kraken, a high-grade replacement-style deposit; and Captain Morgan, a shallow low-grade lateritic deposit. The Kraken deposit includes a high-grade core (>55% Fe) that contains 5.6 Mt at 60.4% Fe, 5.44% SiO_2 , 4.05% Al_2O_3 and 0.15% P. In 2023, CuFe Ltd completed a 6 hole, 361 m diamond drilling program to provide PQ-size core for metallurgical and geotechnical testwork.

Magnetite recovery from tailings

Throughout 2023, Elmore Ltd operated the **Peko Tailings** project at the Peko mine site near Tennant Creek, which consists of 3.75 Mt of historic tailings containing magnetite along with a gold, cobalt and copper resource. The company exported two shipments in 2023, totalling 58 000 t of magnetite. After a three-week shutdown period to complete a plant upgrade to the magnetite circuit, production recommenced in December 2023. Following a significant rain event that delayed a scheduled shipment of magnetite, the company entered voluntary administration in February 2024, although operations continued.

Northern Iron Pty Ltd are approved to commence operations at the Warrego Rehabilitation Project at the **Warrego Tailings**, located 50 km northwest of Tennant Creek. In September 2023, Northern Iron signed an agreement with rail operator Aurizon to transport up to 1.2 Mtpa of magnetite from the project to Darwin port. This includes construction of a railway siding and stockpile hardstand 18 km north of Tennant Creek along the Warrego Road. The company is planning construction of the plant and first export of magnetite during 2024.

Manganese

South32 Ltd operates the **Groote Eylandt** manganese mine in the Gulf of Carpentaria, which is one of the world's highest-grade manganese deposits; it has remaining resources at 30 June 2023 totalling 127 Mt at 43.6% Mn, including Proven and Probable Ore Reserves of 42 Mt at 42.6% Mn (ROM) and 7.0 Mt at 40.0% Mn (sands). The Ore Reserves increased by 20% compared to the previous year due to the approval of the Eastern Lease South life extension project. The mineralisation is a stratiform sedimentary deposit hosted in shallow marine Cretaceous sediments, and has been continuously mined by the Groote Eylandt Mining Company (GEMCO) since 1966. GEMCO is majority owned by South32 Ltd. Production from Groote Eylandt in 2022/23 totalled 5.91 Mt of manganese ore, down 2% on the previous year. In April 2023, GEMCO submitted a referral to the Territory's Environment Protection Authority (EPA) for development of the Southern Lease Mining Project, which is a proposed expansion of the mine into the area of EL2455 to the south of existing operations.

Winchelsea Mining Pty Ltd's **Winchelsea** manganese project, located on Winchelsea Island off the northwest coast of Groote Eylandt, has Measured and Indicated Resources of 18.5 Mt at 20.9% Mn. The company is a joint venture between the Anindilyakwa Advancement Aboriginal Corporation (representing the two Traditional Owner clans of Winchelsea Island) and AUS China International Mining. In September 2023, the EPA accepted a significant variation to the referral, including a net increase in the number of pits from two to nine, inclusion of a tailings storage facility, and construction and operation of a wharf facility. In early 2024, Winchelsea Mining submitted an environmental impact statement (EIS) for the project for assessment.

OM Manganese Ltd's **Bootu Creek** manganese mine, 110 km north of Tennant Creek, remains in care and maintenance following cessation of mining at the end of 2021. A review of the ultra-fines plant rectification plan and financial model is ongoing to determine optimal production and timing outcomes for standalone processing of tailings and rejects.

Mineral sands

In 2022/23, Australian Ilmenite Resources Pty Ltd produced 47 500 t of ilmenite concentrate from the **Sill 80** ilmenite mine in the Roper region, a 13% increase on the previous year. Ilmenite at Sill 80 occurs in surficial cover overlying sills of Derim Derim Dolerite intruding the Roper Group.

Phosphate

The Georgina Basin in the Barkly region contains large, undeveloped sedimentary phosphorite deposits. During 2023, Avenira Ltd progressed feasibility studies and approvals for the **Wonarah** phosphate project, located 250 km east of Tennant Creek immediately south of the Barkly Highway. In October 2023, the company released a feasibility study for a direct shipping ore (DSO) operation based on a high-grade Mineral Resource of 66 Mt at 30% P_2O_5 (using a 27% P_2O_5 cut-off). The DSO feasibility study focused on the development, extraction and sale of phosphate from the Arruwurra deposit at Wonarah over a 23 month period. In October 2023, an MMP for a bulk sample and initial mining was approved; a MMP for the full DSO operation is under assessment. Avenira also continued to progress studies on downstream processing, including yellow phosphorus production, a thermal-grade phosphoric acid plant, and production of a battery-grade lithium iron phosphate (LFP) powder plant at the Middle Arm Sustainable Development Precinct. In November 2023, Avenira signed a binding Licence and Technology Transfer Agreement with Taiwanese cathode manufacturer Aleees, which grants Avenira the right to use Aleees' intellectual property for the manufacture and global distribution of LFP cathode active material.

In February 2024, Inca Minerals Ltd announced the receipt of cultural heritage clearances to allow drilling to commence for phosphate on their exploration tenements immediately north and south of Wonarah where they have an Exploration Target of up to 761 Mt at 14%–18% P_2O_5 .

Verdant Minerals Ltd's **Ammaroo** phosphate project is located in the southern Georgina Basin, ~80 km east of Barrow Creek. The project has total Measured, Indicated and Inferred Mineral Resources of 1.141 Bt at 14% P_2O_5 (using a 10% P_2O_5 cut-off). Following completion of a feasibility study, the company submitted a referral to the EPA in November 2022 for an ammonium phosphate fertiliser project at Ammaroo. Draft Terms of Reference for the EIS were issued by the EPA in June 2023.

Onshore petroleum

Onshore petroleum exploration activity in the Territory in 2023 was largely focused on appraisal of dry shale gas plays in the Beetaloo Sub-basin as the basin moves towards commercial production. **Figure 5** shows granted petroleum tenure and basins in the Territory, and the location of wells and fields mentioned in the text.

McArthur Basin

The **Beetaloo Sub-basin** is a significant depocentre of Mesoproterozoic Roper Group sedimentary rocks that underlies the Mesozoic Carpentaria Basin in the vicinity of Dunmarra and Daly Waters, and is the Territory's most advanced shale gas play. The B-shale of the Amungee Member of the Velkerri Formation is the primary target for shale gas exploration, with demonstrated continuity of gas-rich productive shales across a vast area of the sub-basin.

Santos Ltd have exploration tenure in the eastern Beetaloo Sub-basin in joint venture with Tamboran Resources Ltd. Following flow-testing by Santos at the **Tanumbirini-2H** and **Tanumbirini-3H** horizontal wells in EP161 in 2022, Tamboran Resources announced in June 2023 that modelling of the production curves by an independent third-party yielded a 20-year Estimated Ultimate Recovery of ~16.8–18.5 billion cubic feet (Bcf) for a proposed ~3000 m development-scale well. In September 2022, the Unrisked 2C Contingent Gas Resource for EP161 was 1.617 trillion cubic feet (Tcf) gas. The wells were suspended in early 2023 with no further drilling or testing occurring on EP161.

Empire Energy Group Ltd continued drilling and flow-testing of wells in EP187 on the eastern margin of the Beetaloo Sub-basin. During the first half of 2023, **Carpentaria-2H** horizontal well, 11 km north of the Carpentaria-1 well, was reopened for extended production testing and flowed for a period of 76 days. The well produced high calorific gas at an average rate of 2.2 million cubic feet per day (mmscfd), with a final rate of 1.6 mmscfd. Following a 5 month shut-in, the **Carpentaria-3H** well, located adjacent to Carpentaria 2H, underwent extended production testing in mid-2023. The well had been drilled in late 2022 to a total depth of 4460 m, with a total horizontal section length of 2632 m of which 2374 m was within the target Velkerri-B shale. Over the 63 day duration of the second phase testing, the well averaged a flow rate of 2.7 mmscfd, with a final rate of 2.0 mmscfd. Following production testing, production results of both Carpentaria 2H and Carpentaria-3H were being reviewed for ongoing optimisation of future fracture stimulation programs. In May 2023, Empire Energy announced a 270% increase in the 2C Contingent Resources for EP187 to 1.467 Tcf.

In December 2023, Empire Energy announced it had acquired AGL Ltd's Rosalind Park Gas Plant in order to accelerate the path to Carpentaria Pilot Project production and reduce the capital expenditure required to commence gas sales. The company announced that they are focused on progressing the Pilot Project towards a final investment decision, targeting a sales gas production rate of up to 25 terajoules (TJ) per day utilising the existing McArthur River Pipeline.

Tamboran Resources, in joint venture with Bryan Sheffield and Falcon Oil & Gas Ltd, is the operator of three permits in the central part of the Beetaloo Sub-basin (EP76, EP98 and EP117). In the first half of 2023, Tamboran stimulated and flow-tested the **Amungee 2H** development well, 60 km east of Daly Waters, which was drilled in late 2022 to a total depth of 3883 m, including a 1275 m horizontal section. The company commenced fracture stimulation of the well across 24 stages in February 2023. The well achieved gas breakthrough, but modelling and independent third-party analysis of fluids recovered from the well identified potential skin inhibiting gas and water flow, with average gas flow rates of 0.97 mmscfd over the first 50 days of testing. In late September 2023, Tamboran commenced drilling the **Amungee 3H** well, which was drilled to a total depth of 3837 m in 17.9 days, including a 1150 m horizontal section within the Mid Velkerri B Shale.

In August 2023, Tamboran Resources commenced drilling of the **Shenandoah S-1H** well in EP117, which reached a total vertical depth of 3300 m, intersecting ~90 m of Mid-Velkerri B-shale with strong gas shows. In February 2024, Tamboran announced that the well achieved

an average 30-day initial production (IP30) flow rate of 3.2 mmscf/d over the 501 m, 10 stage stimulated length within the Mid Velkerri B Shale, normalized to 6.4 mmscf/d over 1000 m. Testing was carried out following the installation of production tubing and a three-week soaking

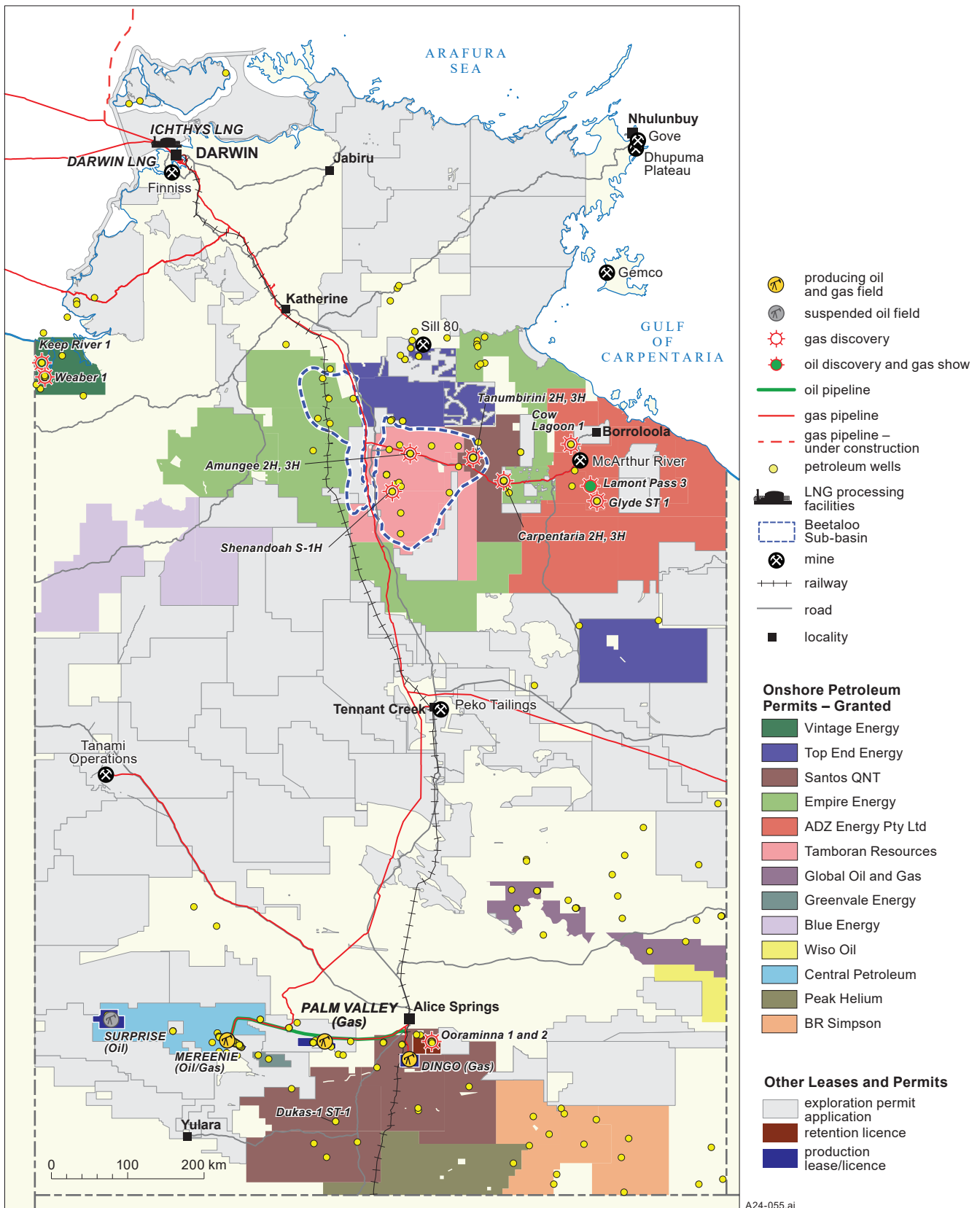


Figure 5. Map of granted exploration permits in the onshore Northern Territory as of March 2024, coloured by current operator, along with names of wells and fields mentioned in the text.

period to allow for water used in the stimulation process to be absorbed by the shale. This was the highest normalised flow-rate achieved in the Beetaloo Sub-basin to date.

Based on the result from the Shenandoah S-1H well, Tamboran announced the company has confidence to progress the proposed 40 mmscfd Pilot Project in the Shenandoah South region. Tamboran is targeting production from the project in first half 2026, which is expected to deliver volumes into the Territory gas market over a 10 year plateau period, subject to completion of a binding Gas Sales Agreement, construction of necessary midstream infrastructure, and funding and key stakeholder approvals. The proposed Pilot Project is planned to include six upfront development wells drilled to 3050 m to achieve plateau production, as well as the construction of compression facility and a 35 km pipeline link to the Amadeus Gas Pipeline.

In January 2024, Armour Energy Group sold its assets, including its exploration permits in the McArthur Basin in the Territory, to ADZ Energy Pty Ltd.

In February 2024, Top End Energy Ltd announced that they had acquired EP144, EP153 and EP154 in the greater McArthur Basin and South Nicholson Basin from Minerals Australia Pty Ltd and Jacaranda Minerals Ltd, wholly owned subsidiaries of Hancock Prospecting.

Amadeus Basin

The Territory's current onshore gas production is entirely sourced from Mereenie, Palm Valley and Dingo fields in the Amadeus Basin operated by Central Petroleum Ltd. In 2023, 13.305 billion standard cubic feet (bscf) of gas was produced in the onshore Northern Territory, a 3% decrease on 2022. This comprised 8.77 bscf from Mereenie, 3.72 bscf from Palm Valley, and 1.22 bscf from Dingo. Onshore oil production in the NT in 2022 was sourced entirely from the Mereenie Field, with 0.120 million barrels (mmbbl) of oil produced. Proven and Probable (2P) gas reserves in the Amadeus Basin total 230 bscf.

In September 2023, Central Petroleum announced that farm-out agreements with Peak Helium Pty Ltd, covering helium, hydrogen and hydrocarbon exploration in the southern Amadeus Basin, had been terminated. As a result, planning has been suspended for drilling of sub-salt exploration wells to be operated by Santos at Dukas (EP112), Jacko Bore (EP125) and Mahler (EP82).

In September 2023, Greenvale Energy Ltd announced it had executed a farm-in agreement with Mosman Oil and Gas Ltd to earn up to 75% in EP145, located east-southeast of Mereenie. EP145 has Best Estimate Prospective Resources of 440 Bcf gas, 26.4 Bcf helium and 26.4 Bcf hydrogen in the permit area.