STEPPING OFF THE EDGE – MINEX CRC DATA ACQUISITION IN NSW

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INTRODUCTION – THE DISCOVERY CHALLENGE

Mining has always been and continues to be a major industry in NSW. In the 2017–18 financial year, the total production value of the NSW mining sector was $27.3 billion, of which $25.3 billion was exported. This represented 45% of the state's total merchandise exports for the year. Over the same period, the industry contributed $1.8 billion in royalties to NSW and currently employs 29,000 people directly and 115,000 indirectly.

However, the minerals industry in NSW faces an uncertain future. The giant Cadia Valley gold–copper mine near Orange has a projected mine life of well over 30 years. In contrast, most of the state's other metalliferous mines are projected to exhaust their known reserves and resources over the next 10 to 15 years. Unless new discoveries are made, it is likely that only one or two metal mines will be operational in NSW by 2040.

As is the case elsewhere in Australia, mineral discovery rates in NSW have been declining since the 1980s. A primary contributing factor to this decline is the technical challenge of effectively exploring the 70% of the Australian continent where prospective geology is buried under younger cover. While acknowledging that it is likely that there are very few, if any, undiscovered major mineral deposits that are exposed at Earth's surface remaining to be found in Australia, explorers have lacked the tools and indeed the confidence, to explore the nation's covered terranes (Figure 1). Schodde (2015) estimated that the unit cost of discovery in NSW approximately doubled over the two decades from 1995 to 2014, as explorers continued to focus on applying new, or in some cases well-established, exploration methods to areas close to exposed prospective geology that have previously been explored. In order to reverse the national decline in exploration success, new exploration tools and methodologies, and new precompetitive data are needed to allow the minerals industry to successfully and cost-effectively explore the undercover portions of the continent.

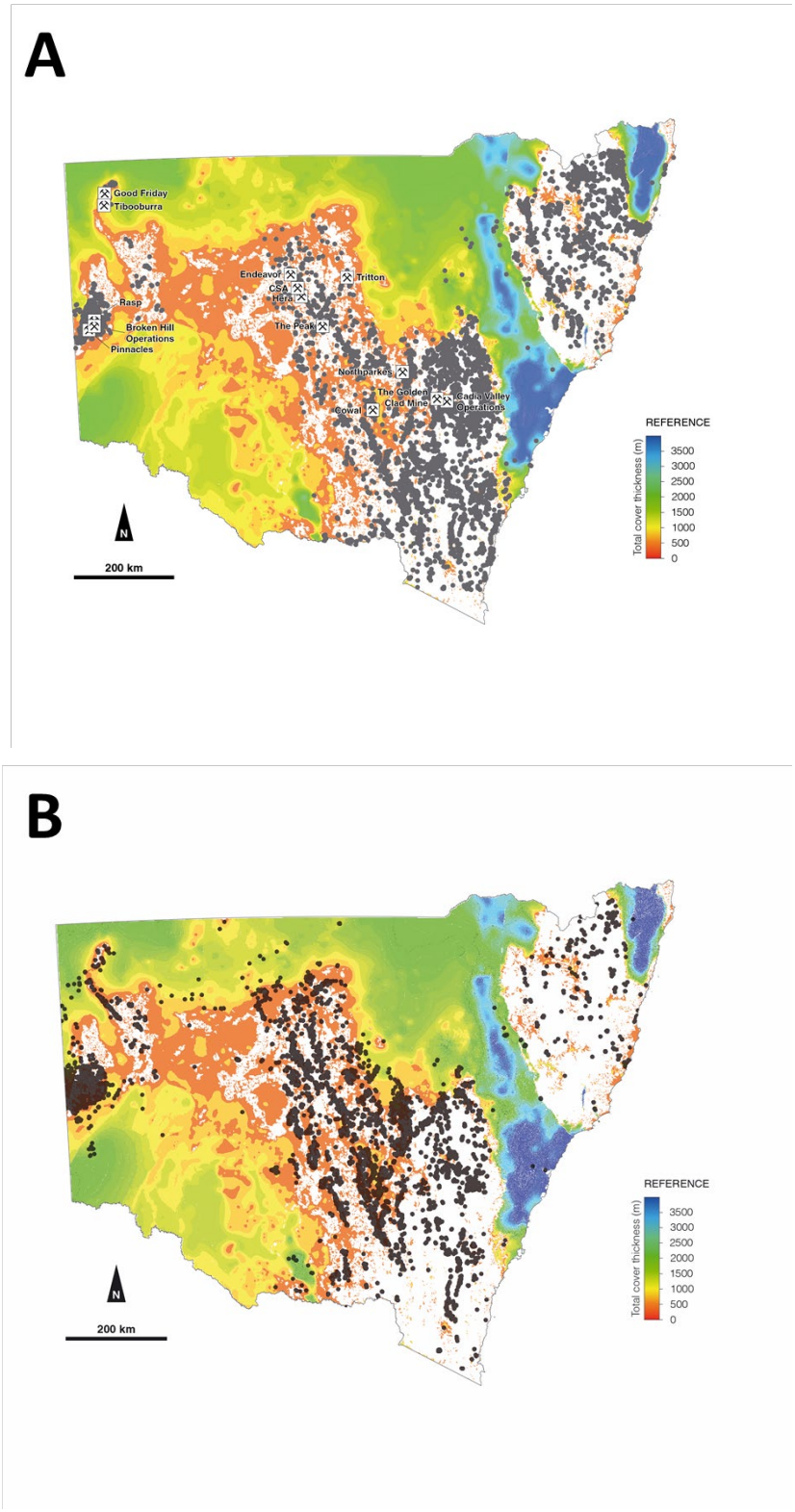

Figure 1. Distribution of (A) mines and known mineral occurrences; and (B) exploration drillholes for Group 1 (metalliferous) minerals in NSW, overlain on the NSW depth to pre-Carboniferous basement model of Robinson (2017). Known mineral occurrences are almost exclusively confined to areas of basement outcrop (white), as are exploration drillholes.

MINEX CRC

The MinEx Cooperative Research Centre (MinEx CRC) is the globe's largest exploration geoscience and technology collaboration, with committed expenditure of almost $220 million across its 10-year life. Launched in October 2018, participants in the CRC include major and mid-tier mining companies, METS providers, Geoscience Australia, all Australian state and territory geological surveys, CSIRO and major Australian universities.

MinEx CRC aims to enable mineral discovery in Australia's covered terranes by:

- developing more productive, safer and environmentally friendly drilling methods, including coiled tubing drilling technology, to discover and drill-out deposits
- developing new technologies for collecting data while drilling
- undertaking drilling to collect vital data in under-explored areas of potential mineral wealth in Australia through the National Drilling Initiative (NDI), a world-first collaboration of geological surveys, researchers and industry.

The Geological Survey of NSW (GSNSW) is a major participant in the NDI, with a planned investment of $16 million over the 10-year life of MinEx CRC.

GSNSW STRATEGY FOR THE NDI

Learning from previous drilling projects

While successful in improving geological knowledge, including understanding of mineral potential (Folkes 2018), the recent southern Thomson Orogen stratigraphic drilling project in northern NSW and southern Queensland failed to stimulate additional exploration interest in this covered terrane. Although generally supportive of the project's aims and execution, NSW mineral explorers cited the geographical remoteness of the region in the state's far north and the low density of data (seven new basement-penetrating drillholes across an area of over 60,000 km^2 in NSW) as impediments to undertaking exploration. Consequently, in order to maximise potential industry interest and the return on NSW's investment in the NDI, GSNSW has chosen to focus on five areas in the state's central and far west that are undercover extensions to known mineralised terranes. In doing so, we have chosen to "step off the edge" of the known, rather than "diving into the deep end".

Declaration of Mineral Allocation Areas

To allow open discussion of GSNSW's planned NDI work program without the risk of speculative exploration title applications and land banking, five areas – North Cobar, South Cobar, Mundi, Forbes and Dubbo (Figure 2)– were gazetted as Mineral Allocation Areas (MAAs) for Group 1 (metalliferous) minerals on 10 August 2018. These areas will be the focus of NDI data acquisition in NSW. The MAAs prevent application for new Group 1 mineral exploration licences without Ministerial consent. Existing titles are unaffected.

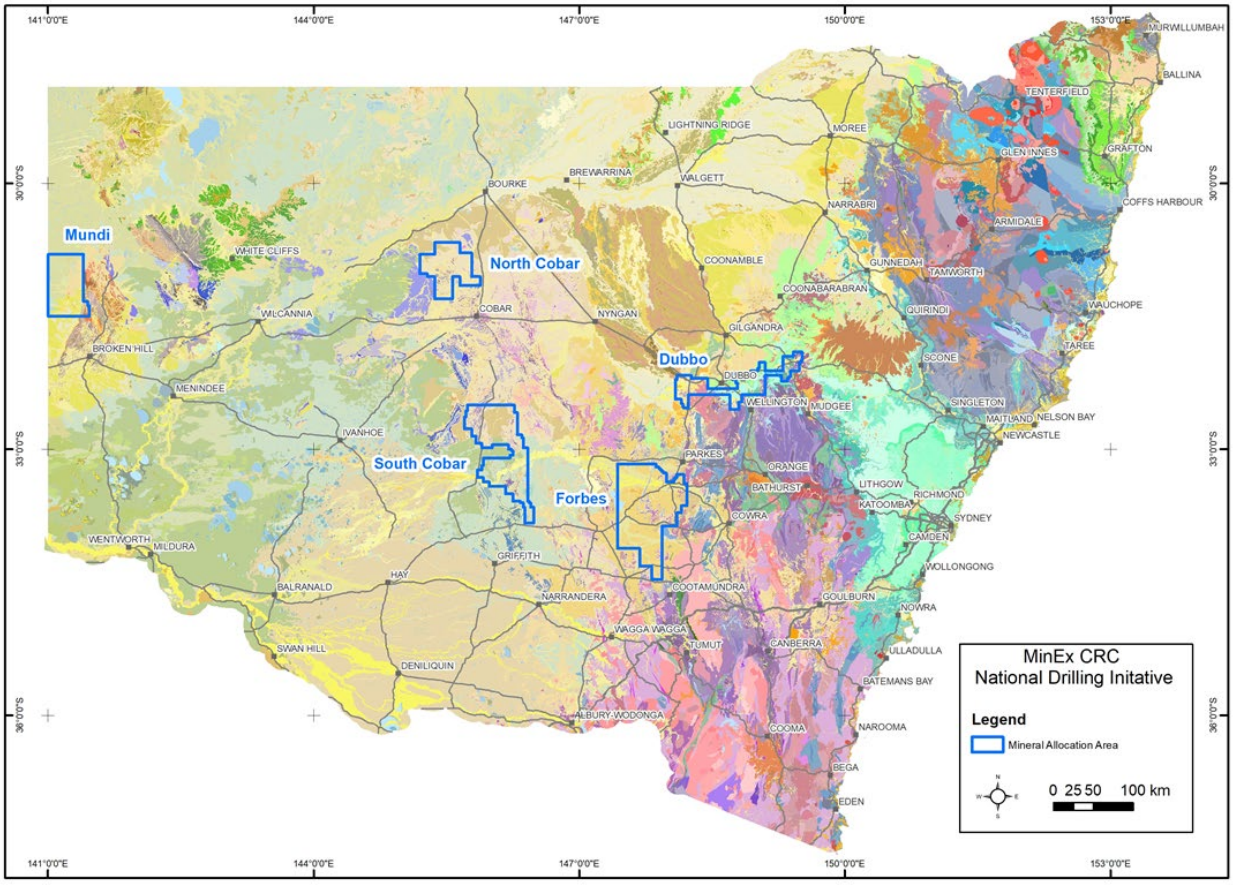

Figure 2. Location of Group 1 MAAs gazetted in NSW on 10 August 2018, overlain on NSW surface geology.

GSNSW has worked with representatives from the NSW mineral exploration industry to develop an open, competitive expression of interest (EOI) process for new exploration licence application within the MAAs. The first round of this process opened in August 2019 for a period of six weeks and will be repeated every 2 years throughout the life of MinEx CRC. Assessment criteria for EOIs are based around the quality and effectiveness of the proposed exploration work program and are designed to ensure that good quality explorers are given the opportunity to leverage the state's significant investment in the NDI.

NDI data acquisition in NSW

GSNSW will progressively undertake a review of legacy data and materials, and an extensive program of new geological mapping, airborne electromagnetic and other geophysical surveys, geochemistry (including hydrogeochemistry, biogeochemistry, geochronology and isotopic analysis), mineralogy (including HyLogging™) and drilling across the five NDI focus areas from 2019 to 2028 (Table 1, Figure 3).

The review of legacy data across each area is already well-advanced, with the results expected to be published as GSNSW reports in the second half of 2019. Acquisition of new data has also commenced for the North and South Cobar areas, with extensive biogeochemical and hydrogeochemical sampling undertaken, and an airborne electromagnetic survey of the greater Cobar Basin, including the two NDI areas, will be flown from September 2019. The data from this survey is expected to be publicly available in March 2020.

Table 1: Summary of target basement, cover sequences, potential mineralisation styles, key scientific questions and planned work program for the five NDI areas in NSW. Due to their common geology the North and South Cobar areas have been grouped together.

Area	Target basement	Cover	Potential mineralisation	Key scientific aims	Pre-drilling work program	NDI drilling
North and South Cobar	Siluro-Devonian basins, Ordovician basement.	Late Devonian and possible Mesozoic basins, Cenozoic regolith	Cobar style polymetallic, Besshi-style volcanic-hosted massive sulfides, possible magmatic systems.	1. Map the geology under cover, particularly key horizons. 2. Understand the geodynamic history – including thermal history, basin architecture, fill, deformation. 3. Understand controls and timing of mineralisation. 4. Understand the expression of basement geology and mineral systems in cover.	1. Resampling of legacy materials. 2. Geophysics: AEM, infill gravity, magnetics and radiometrics. 3. Improve existing mapping, including geochronology. 4. Soil, bio- and hydro-geochemistry.	2022–2023 232 holes 14,685 m
Mundi	Willyama Supergroup, ~1590 Ma igneous rocks, key Neoproterozoic horizons.	Neoproterozoic to Devonian basins, Mesozoic Eromanga Basin, Quaternary Eyre Basin, Cenozoic regolith.	Broken Hill type Pb-Zn-Ag, iron oxide Cu-Au, Mississippi Valley type Pb-Zn, unconformity U possible magmatic systems.	1. Map the geology under cover, including characterisation of key time slices and interfaces. 2. Understand the expression of basement geology and mineral systems in cover. 3. Correlate basement geology between NSW and SA. 4. Understand cause and effects of the Mundi MT conductivity anomaly. 5. Extend Curnamona mineral potential mapping under cover.	1. Resampling of legacy materials. 2. Geophysics: AEM, infill gravity, magnetotellurics. 3. Improve existing mapping, including geochronology. 4. Soil, bio- and hydro-geochemistry.	2024 65 holes 14,844 m
Forbes	Macquarie Igneous Province (MIP), Siluro-Devonian basins and igneous rocks.	Late Devonian basins, possible Mesozoic Great Australian Basin, Cenozoic regolith.	Porphyry Cu-Au, epithermal systems, volcanic-hosted massive sulfides, orogenic gold, possible magmatic systems.	1. Map the geology under cover, including phases of the MIP. 2. Understand the expression of basement geology and mineral systems in cover. 3. Understanding of the geodynamic history, e.g. structural controls, magmatic history, Siluro-Devonian basin fill, deformation. 4. Ordovician mineral chemistry to differentiate alteration vs metamorphism,	1. Resampling of legacy materials. 2. Geophysics: AEM, infill gravity, magnetotellurics. 3. Improve existing mapping, including geochronology. 4. Bio- and hydrogeochemistry.	2025 233 holes 22,735 m
Dubbo	Macquarie Igneous Province (MIP), Siluro-Devonian basins and igneous rocks.	Permo-Triassic Sydney Basin, Mesozoic Surat Basin and volcanic rocks, Cenozoic regolith and volcanic rocks.	Porphyry Cu-Au, epithermal systems, volcanic-hosted massive sulfides, orogenic gold, possible magmatic systems.	1. Map the geology under cover, including characterisation of key time slices/interfaces. 2. Understand the expression of basement geology and mineral systems in cover. 3. Identification, location and nature of MIP under cover. 4. Siluro-Devonian basin opening, fill, thermal history and inversion.	1. Resampling of legacy materials. 2. Geophysics: AEM, infill gravity, possible magnetotellurics. 3. Improve existing mapping, including geochronology. 4. Bio- and hydro-geochemistry.	2026 234 holes 17,172 m

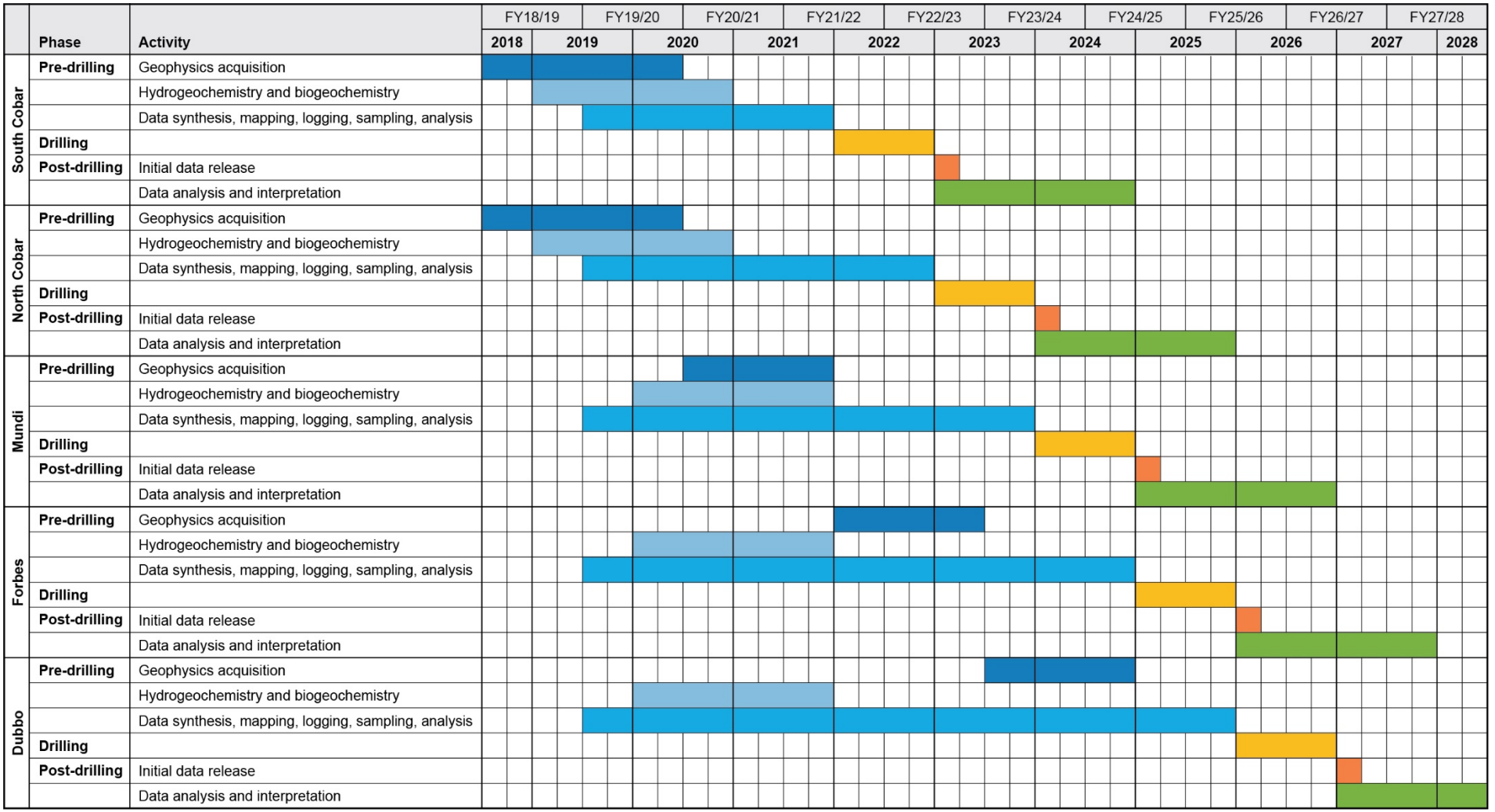

Figure 3. Indicative timeline for data acquisition across the five NSW NDI areas. Activities are broadly divided into pre-drilling, drilling and analysis and reporting phases.

NDI drilling in NSW

GSNSW plans to employ the RoXplorer® coiled tubing drill rig and Lab-at-Rig® analytical unit developed by the Deep Exploration Technologies CRC for all NDI drilling programs in NSW. Drilling will follow a nominal 5 km by 5 km grid pattern with a maximum hole depth of 500 m, including 40 m into basement. For budgeting purposes, a first pass drilling grid has been generated for all NDI areas, using the following constraints:

- depth to basement has been estimated using the statewide post-Carboniferous cover thickness model of New South Wales (Robinson 2017)
- areas of outcrop, and sensitive land such as national parks and state significant aquifers have been excised
- an all-in drilling cost of $50/m for RoXplorer® and $25/m for Lab-at-Rig® analysis has been used to calculate drilling program costs.

This initial grid will be further refined based on the current review of legacy data (for example currently available deep drilling), the results of pre-drilling data collection, which will be used to refine the depth-to-basement model, and practical constraints such as land access, ongoing exploration, and environmental and cultural sensitivities. Where appropriate, other drilling technologies will also be considered.

NDI – EXPANDING THE FRONTIERS OF MINERAL EXPLORATION IN NSW

Australia's geological surveys enabled successful mineral exploration in the 20th century through a program of systematic surface geological mapping and the collection of regional-scale geophysics across the continent. In order to allow mineral explorers to successfully discover the mineral wealth of the 70% of the continent that is covered, geological surveys will need to map these covered terranes in the same way that we once mapped the surface. This will require the cost-effective acquisition of precompetitive drilling data – essentially mapping with a drill rig.

Through its participation in the MinEx CRC NDI, GSNSW will take the first steps towards this next iteration of precompetitive exploration geoscience, by collecting a comprehensive suite of data and participating in collaborative research that will unlock the secrets of five prospective covered areas of the state. In taking these first steps we are confident that we can begin to reverse the decline in mineral discovery rates and ensure that the minerals industry continues to play a key role in the economic and social sustainability of regional NSW into the second half of the 21st century, and beyond.

REFERENCES

FOLKES C. 2018. The Magnificent Seven – reducing exploration risk in the southern Thomson Orogen. Exploration in Another House 2018 presentation, Catalogue Number 9251.

ROBINSON J. 2017. Statewide post-Carboniferous cover thickness model of New South Wales. Geological Survey of New South Wales Report, GS2017/0126.

SCHODDE R. 2015. The importance of Junior Exploration companies to the NSW Mining Industry June 2015 - Updated Report. Geological Survey of New South Wales Report, GS2015/0814.