Raising the profile –

GSNSW highlights of 2019

SMEDG, Sydney, 28-11-2019

Chris Yeats, Executive Director, Geological Survey of NSW

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NSW GOVERNMENT

A renewed licence to operate

NSW GOVERNMENT

Following the NSW state election in March

- Hon. John Barilaro, Deputy Premier, Minister for Regional New South Wales, Industry and Trade named as Minister responsible for resources.
- The Deputy Premier has been outspoken in his support for the mining industry as a major contributor to regional NSW economies and communities.

July 2019 Machinery of Government changes

- On 1 July 2019, the former Department of Industry and Department of Planning and Environment were effectively merged to create the **Department of Planning, Industry and Environment.**
- The Division of Resources and Geoscience, including GSNSW, was placed in the Regions, Industry, Agriculture and Resources Group.


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What is the Seamless Geol
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Advanced mineral projects &
July 2019
resourcesandgeoscience.nsw.g
gov.au

What are Cobar's geological secrets?

The secrets hidden deep underground around Cobar will be revealed as part of a national geoscientific program that will commence in the coming months.

The MinEx CRC survey will use the latest technology to look for rare and precious metal deposits around Cobar and Lake Cargelligo as part of a national initiative that will collect data from areas across the country.

Dr Yeats said geologists from the survey will be available at the sessions to provide information on the project, local geology and community benefits.

The Geological Survey will also be holding a community information evening to explore the geology and groundwater sources of the greater Cobar area, how and why different geological

(From left) Dr John Greenfield and Dr Chris Yeats of Geological Survey of New South Wales with Manager of the E C Andrews Drill Core Facility Brian Casey. PICTURE: Callum Marshall

Uncovering the home of the richest lode

MINING VISION FOR LAKE

LAKE and district residents will be kept in the loop about a new vision for Australia in mineral exploration.

A new strategy to elevate Australia as a world powerhouse in the minerals that will underpin the industries of the future including agritech, aerospace, defence, renewable energy and telecommunications is about to be unveiled in Lake Cargelligo.

Known as MinEx CRC the strategy 2019 maps out a vision for Australia as a world leader in exploration, extraction, production and the processing of critical minerals and as such a free drop-in session will be held at Lake tomorrow and Friday.

Minister for Resources and Northern Australia Matt Canavan said there were significant economic opportunities for Australia as global demand for critical minerals grew.

"Investing in critical minerals supports the nation's economy and will create more jobs for Australians by growing our resources sector," Minister Canavan said.

"Australia has abundant critical

In western NSW this will include mapping rocks, soil, water and vegetation, and research drilling.

The sessions will provide information on the project, local geology and community benefits.

For more information about MinEx CRC visit https://www.resourcesandgeoscience.nsw.gov.au/minexcrc

Minister for Trade, Tourism and Investment Simon Birmingham said Australia was uniquely placed to capture the value on offer through rising global demand for critical minerals.

"We have some of the world's richest stocks of critical minerals and while the market for some of our minerals such as lithium is relatively mature, other minerals markets such as cobalt remain

largely underdeveloped in Australia," Minister Birmingham said.

"We've got the stocks, we have the potential and now we need to develop the downstream and high-value activities right here in Australia such as processing and manufacturing.

"With critical minerals driving much of the innovation and downstream projects and greenfield opportunities."

An Australian Critical Minerals Investment Prospectus compiled by Austrade and Geoscience Australia will soon be published on the Austrade website, providing detailed technical, commercial and geological data on the 24 critical minerals identified in the strategy.

The Liberal-National Government's new Australia's Critical Minerals Strategy can be found at www.industry.gov.au/CMStrategy

The session will be held tomorrow:

Thursday 11 April (4 -7pm) and Friday 12 April (9 -10.30am)

Lower Lachlan Community Services Inc meeting room, 30 Foster Street, Lake Cargelligo.

Aerial search for new water

EXCLUSIVE

LINDA SILMALIS
CHIEF REPORTER

ONE of the most ambitious aerial surveys conducted in the state is set to begin in the hope of locating new water supplies for drought-stricken farmers.

Scouring an area around 19,000sq km in size, a team of scientists will take to the air where electromagnetic technology will be deployed to identify undiscovered regional water supplies up to 200m underground.

The three-month survey, to be conducted between Bourke and Lake Cargelligo in western NSW from late September, is part of a joint arrangement between Geoscience Australia and Geological Survey of NSW to urgently find new resources for the state.

The survey will also be looking for mineral deposits.

Nationals leader John Barilaro said identification of both water and potential new mineral deposits was critical for the wellbeing of the state, especially the bush.

"Much of regional NSW is struggling through one of the worst droughts on record and this survey is critical in helping to identify previously undiscovered water reserves," he said.

"That's why the government is taking part in this important initiative which will provide new information about the geology, metal potential and groundwater resources of these areas.

"Securing regional jobs is a high priority. The minerals industry supports thousands of jobs that support the wellbeing of our regions."

The project is being supported by the $200 million MinEx Co-operative Research Centre (CRC), a collaboration between the Federal, State and Territory governments, the CSIRO, Australian universities and the minerals industry.

The Centre, described as the world's largest mineral exploration collaboration, was set up to address the need for mineral resources to meet future demand.

With few new mineral deposits exposed at the surface remaining to be found in Australia, the Centre is working to discover hidden potential new resources.

The government is counting on the survey to also find desperately needed new water supplies with the technology able to identify below-surface reserves.

Geological Survey of NSW Geophysics and Modelling manager, Dr Ned Stolz, said the technology was able to identify conductive materials such as copper, lead and zinc as well as water.

"We fix a transmitter to a small plane or helicopter which emits a weak electromagnetic signal," he said.

"That signal can pick up everything from highly conductive to nonconductive materials, allowing us to create a kind of underground map down to around 200m."

Geological Survey of NSW, a major participant in the MinEx CRC National Drilling Initiative, has committed $16 million over 10 years towards the project.

Government figures show the new mineral industries of platinum, cobalt and lithium, for which demand is rapidly increasing, paid $1.8 billion in royalties to the state last financial year and also generated thousands of jobs.

SYDNEY UNDERGROUND

What lies beneath the Harbour City

Sydney's buried secrets are about to be revealed as engineers look hundreds of metres down to create the very first 3D map of the city, writes Linda Silmalis

AN UNDERGROUND map of Sydney detailing its secret tunnels, faults and even long-forgotten gravesites is being created to prevent infrastructure blowouts and disasters such as the Lane Cove Tunnel collapse.

Described as one of the most ambitious mapping projects ever attempted in NSW, scientists are using seismic and sonar technology together with 3D modelling to compile what will become an invaluable reference tool.

While the project is expected to take years to complete, a prototype of the 3D version has already discovered that the Sydney basin is several kilometres deep.

Deputy Premier John Barilaro said the new map will look hundreds of metres below the surface to Sydney's bedrock, while drawing in hundreds of thousands of pieces of new and historical geoscientific data to enrich the picture.

Once complete, the map will help guide the planning of infrastructure projects by preventing delays, cost blowouts and potential disasters such as the 2005 Lane Cove Tunnel collapse. Post-incident reports showed that better geotechnical investigations were needed during the design and pre-excavation stages of the tunnel's construction.

The map will be available to local councils, government and industry to allow for safer and more efficient decisions around the planning and approvals of future construction and infrastructure projects, he said.

"Our map will look hundreds of metres below, down through soil and bedrock to the natural fault lines that run beneath the city."

Mr Barilaro said. "Then, using 3D modelling technology, we can overlay this with the location of vital infrastructure like gas and sewerage pipes, underground transport tunnels and archaeological sites to create a 'digital twin' of Sydney that architects, engineers and construction professionals can use.

"Access to detailed geotechnical data is critical to any construction project, whether it's digging a hole for a backyard pool or carving under the city for a project like the Western Metro or Sydney Harbour Tunnel."

Geological conditions were blamed for the collapse of the Lane Cove Tunnel, in which the roof of a ventilation tunnel collapsed in the early hours of November 2, 2005.

More than 3400 new reports, maps, plans and heritage records dating back to 1963 have been added to DIGS, the NSW government's public online archive of geoscientific reports, marking the start of the long-term project.

Seismic and sonar technologies measure the variations in sound waves as they pass through and are reflected by features in the subsurface, allowing scientists to accurately predict hidden

TUNNEL VISION

Geotechnical data ensures underground transport such as the new Sydney Metro can be safely installed 40m below ground.

SIX FEET UNDER

From 50,000-year-old seashells to the state's oldest boat (left), geotechnical investigations have revealed fascinating stories of Sydney's past.

MinEx CRC

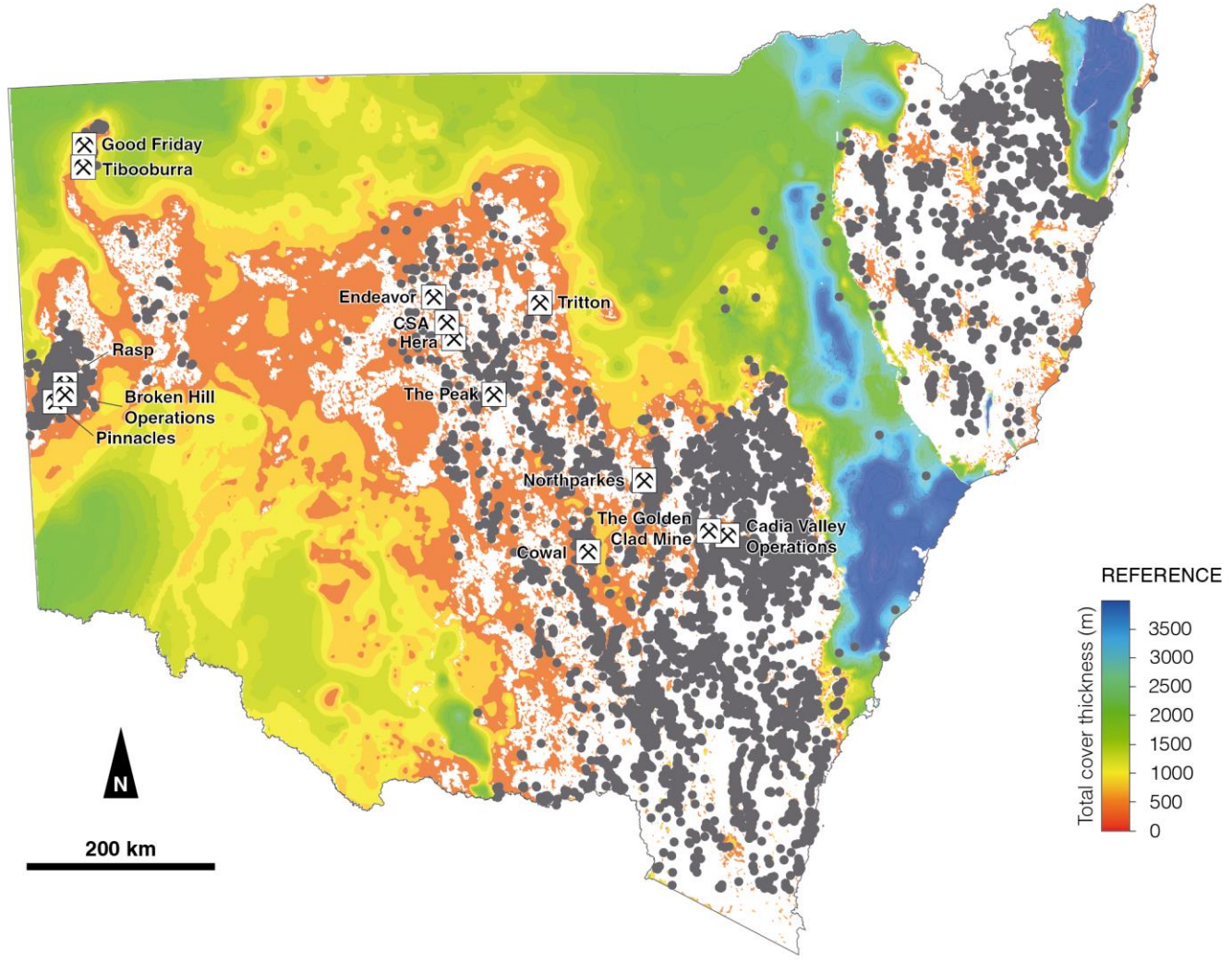
NSW GOVERNMENT

The NSW mineral discovery challenge

NSW GOVERNMENT

The NSW mineral discovery challenge

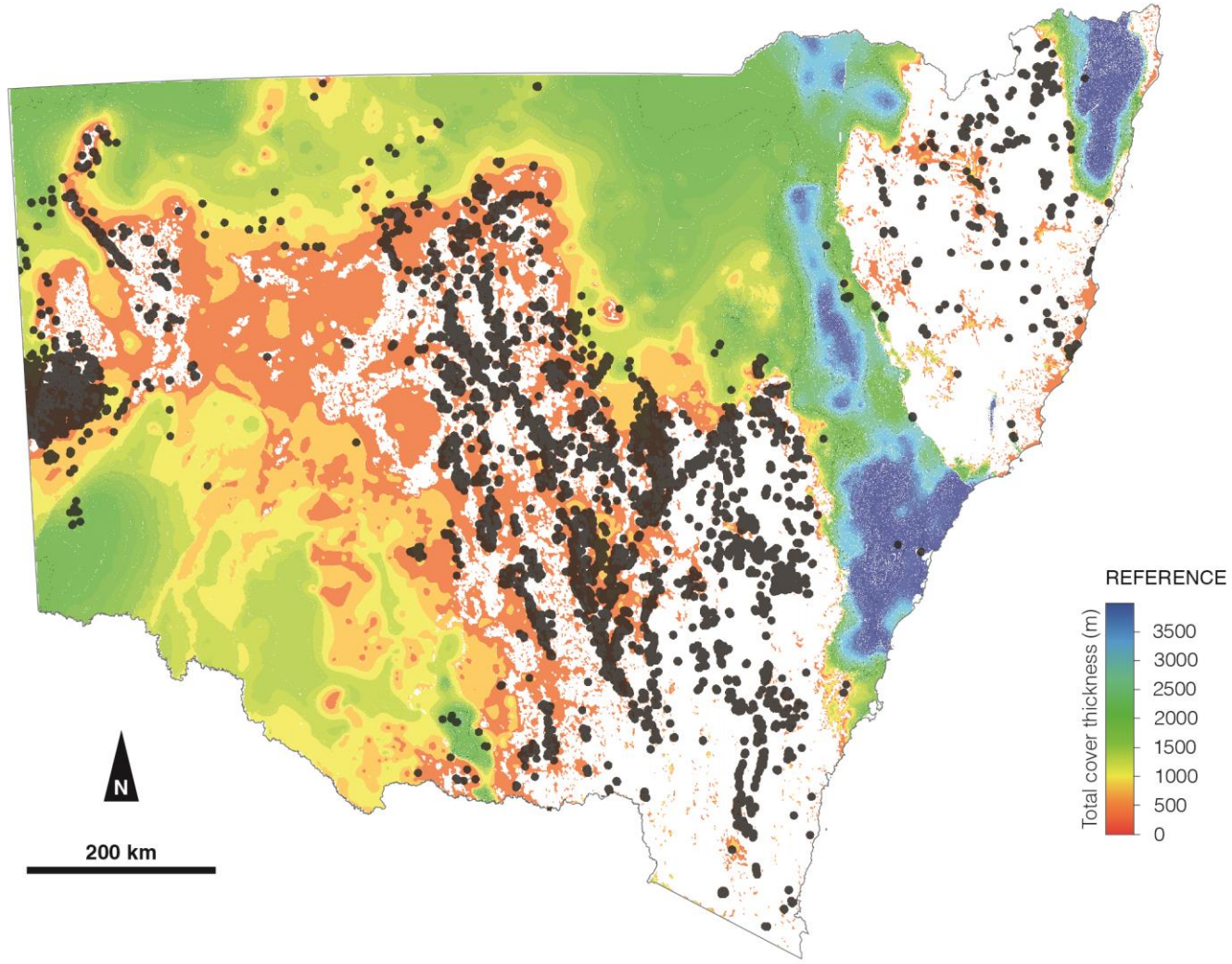
- NSW's known metal occurrences and deposits occur almost exclusively in areas where prospective basement is at or near-surface.



Group 1 mineral occurrences and mines over NSW depth to basement model

The NSW mineral discovery challenge

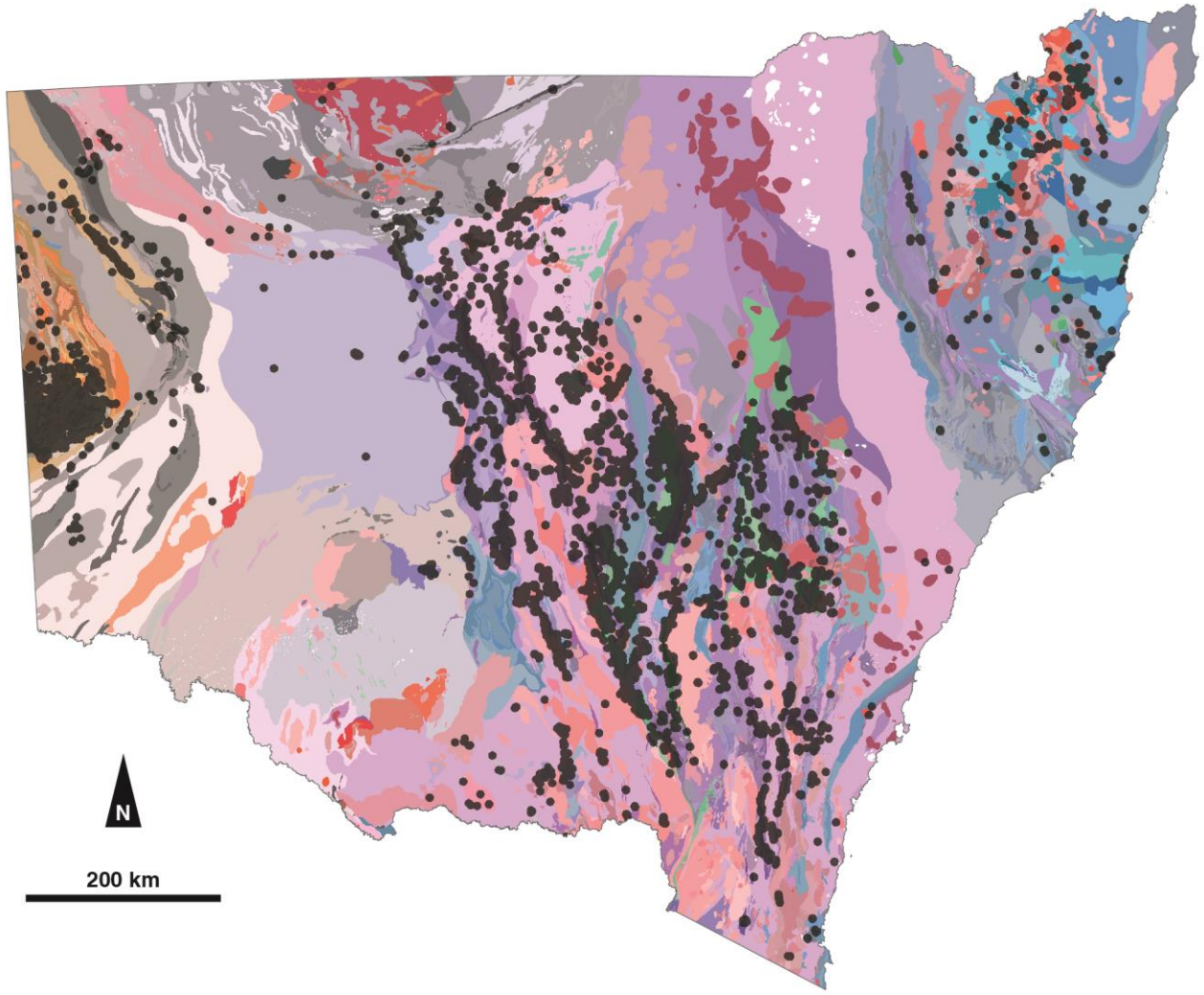
- NSW's known metal occurrences and deposits occur almost exclusively in areas where prospective basement is at or near-surface.
- Mineral exploration has also focussed almost exclusively on these areas.



Group 1 exploration drilling over NSW depth to basement model

The NSW mineral discovery challenge

- NSW's known metal occurrences and deposits occur almost exclusively in areas where prospective basement is at or near-surface.
- Mineral exploration has also focussed almost exclusively on these areas.
- Explorers need new tools and new data to give them the confidence to explore in covered terranes.



Group 1 exploration drilling over NSW Seamless Geology crystalline basement

MinEx CRC overview

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MinEx CRC: 2018–2028

- **$218 million, 10 year investment in mineral exploration R&D**
  - $41 million cash contribution from ‘industry’ partners
  - $127 million in-kind contribution from ‘industry’ partners and research participants
  - $50 million cash contribution from Commonwealth Government Department of Industry, Innovation and Science CRC Program.
- 36 organisations involved, including:
  - major miners, juniors and METS providers
  - all Australian geological surveys (4 participants, 4 affiliates)
  - CSIRO, AuScope and 7 Australian universities.

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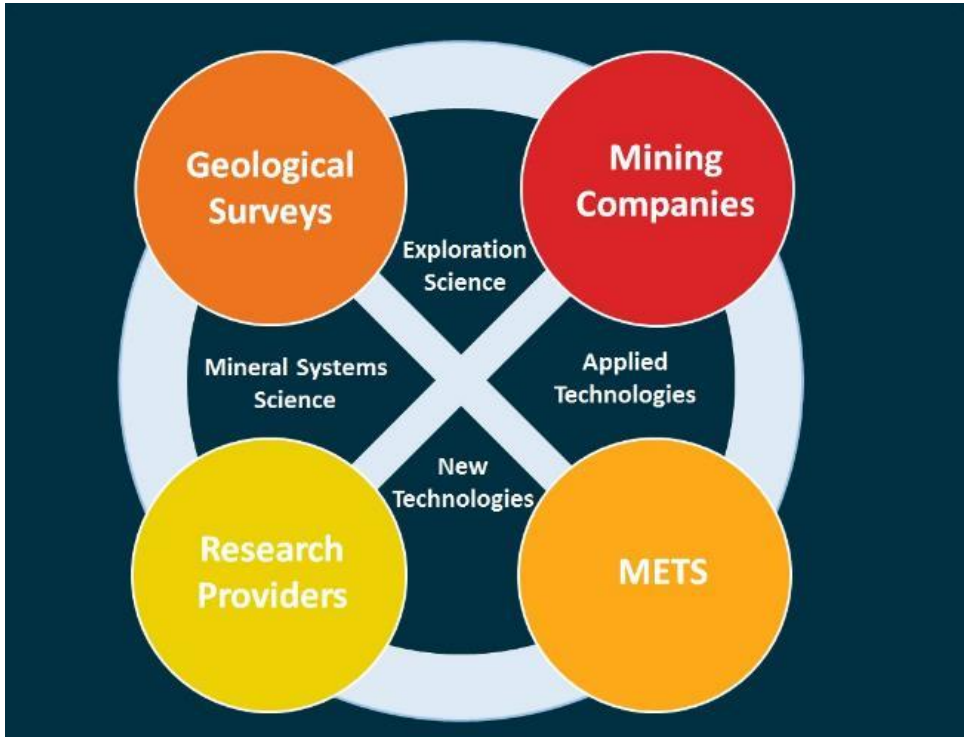
The world’s largest mineral exploration collaboration.

MinEx CRC 3D DRILLING

Three programs



- **Program 1 – Improved drilling efficiency**
  - Developing more productive, safer and environmentally friendly drilling methods to discover and drill-out deposits, including coiled tubing drilling technology.
- **Program 2 – Real-time data collection and analysis**
  - Developing new technologies for collecting data while drilling, bringing forward mine production.
- **Program 3 – National Drilling Initiative (NDI)**
  - A world-first collaboration of Geological Surveys, researchers and industry that will undertake drilling in under-explored areas of potential mineral wealth in Australia.

  Project 7 – Maximising the value of data and drilling through cover

  Project 8 – Geological architecture and evolution

  Project 9 – Targeting mineral systems in covered terranes
- **Plus Education and Training – PhD/MSc/Hons/VET**

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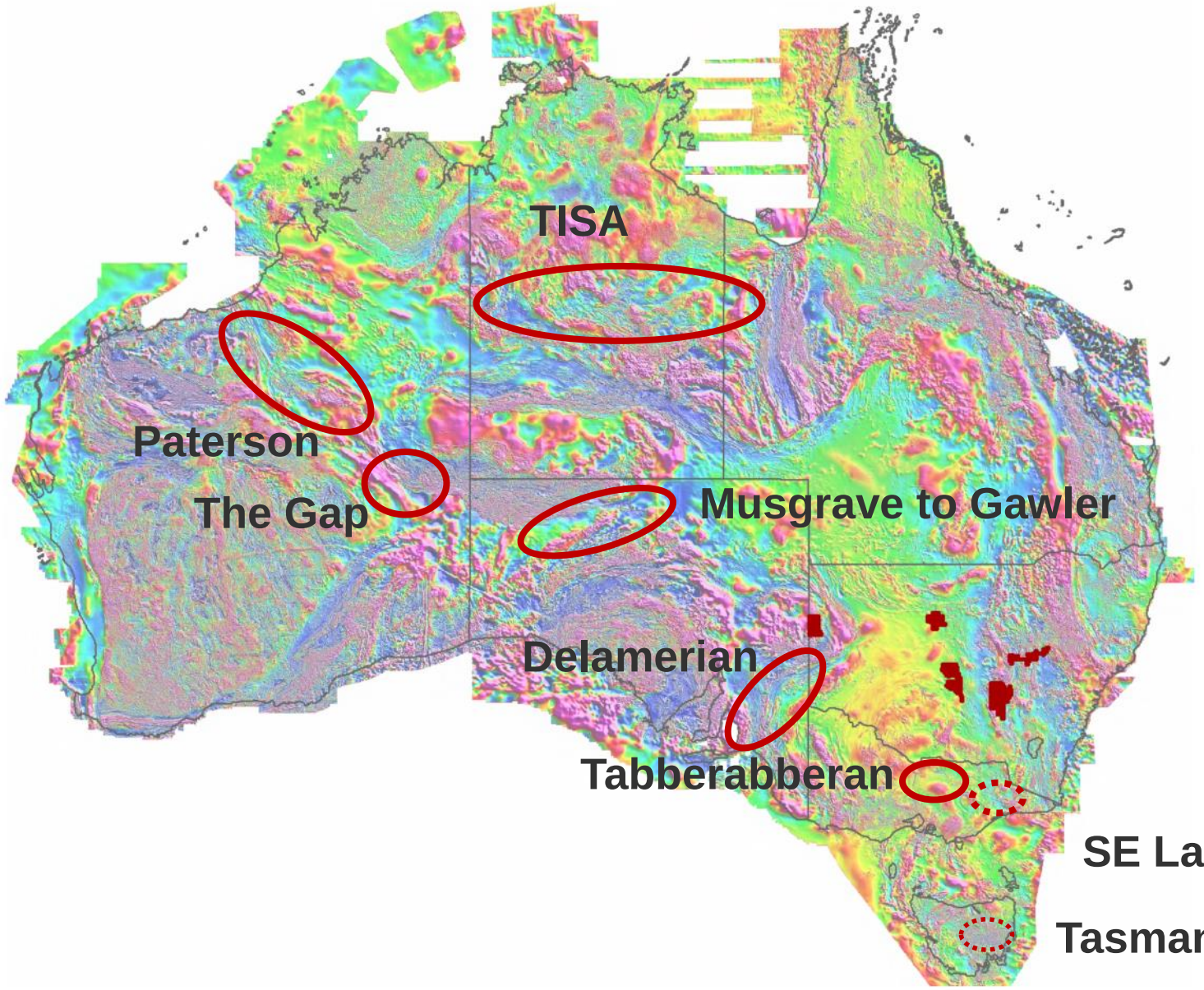
GSNSW involvement

NDI: a national collaboration



- **Participants**
  - GSNSW
  - GSSA
  - GSWA
  - GA
- **Affiliates**
  - GSV
  - MRT
  - NTGS
  - GSQ
- **Research Participants**
  - CSIRO
  - UoA
  - Uni SA
  - Curtin
  - UoN
  - UNSW
  - ANU

GSNSW strategy for MinEx CRC

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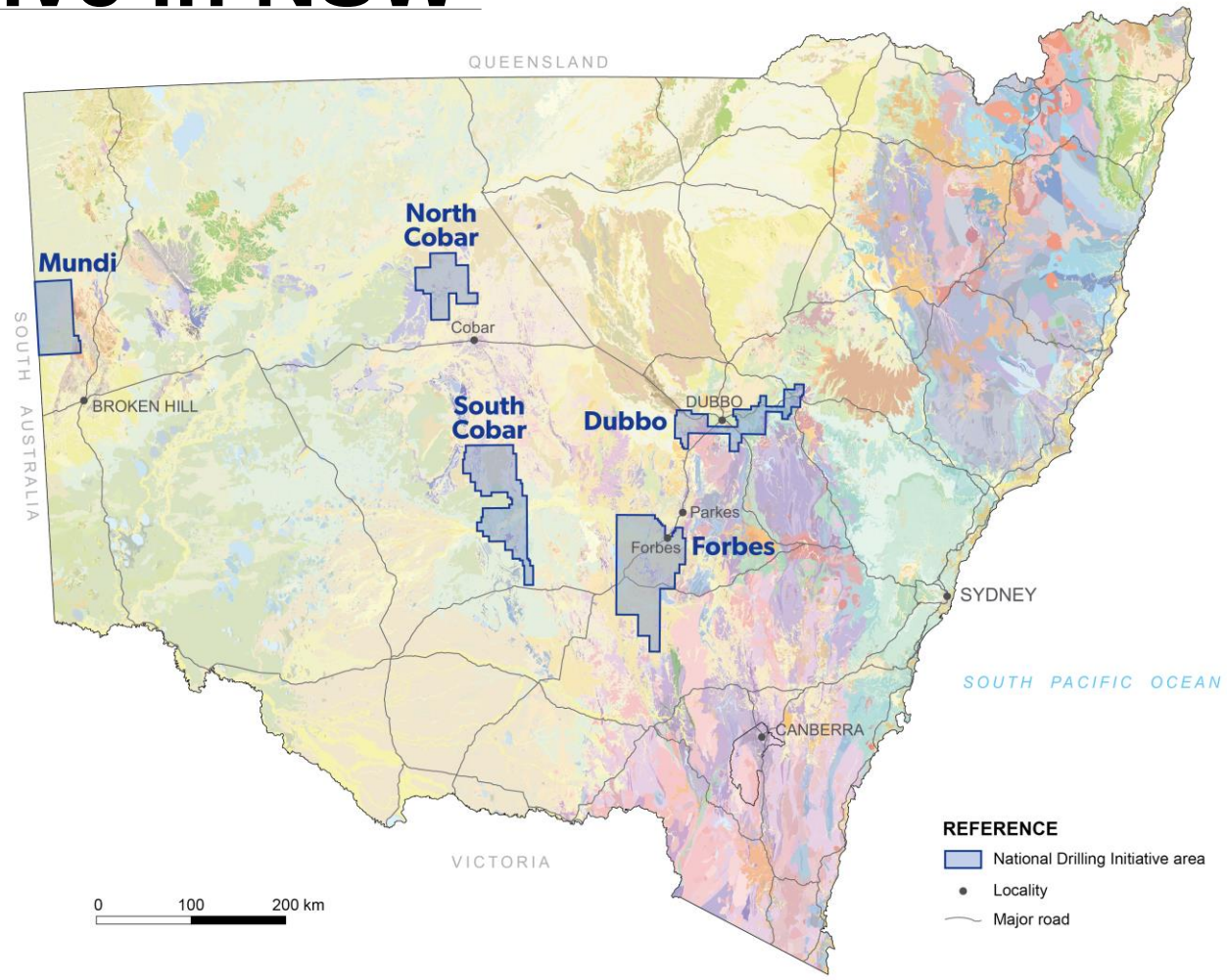
National Drilling Initiative in NSW

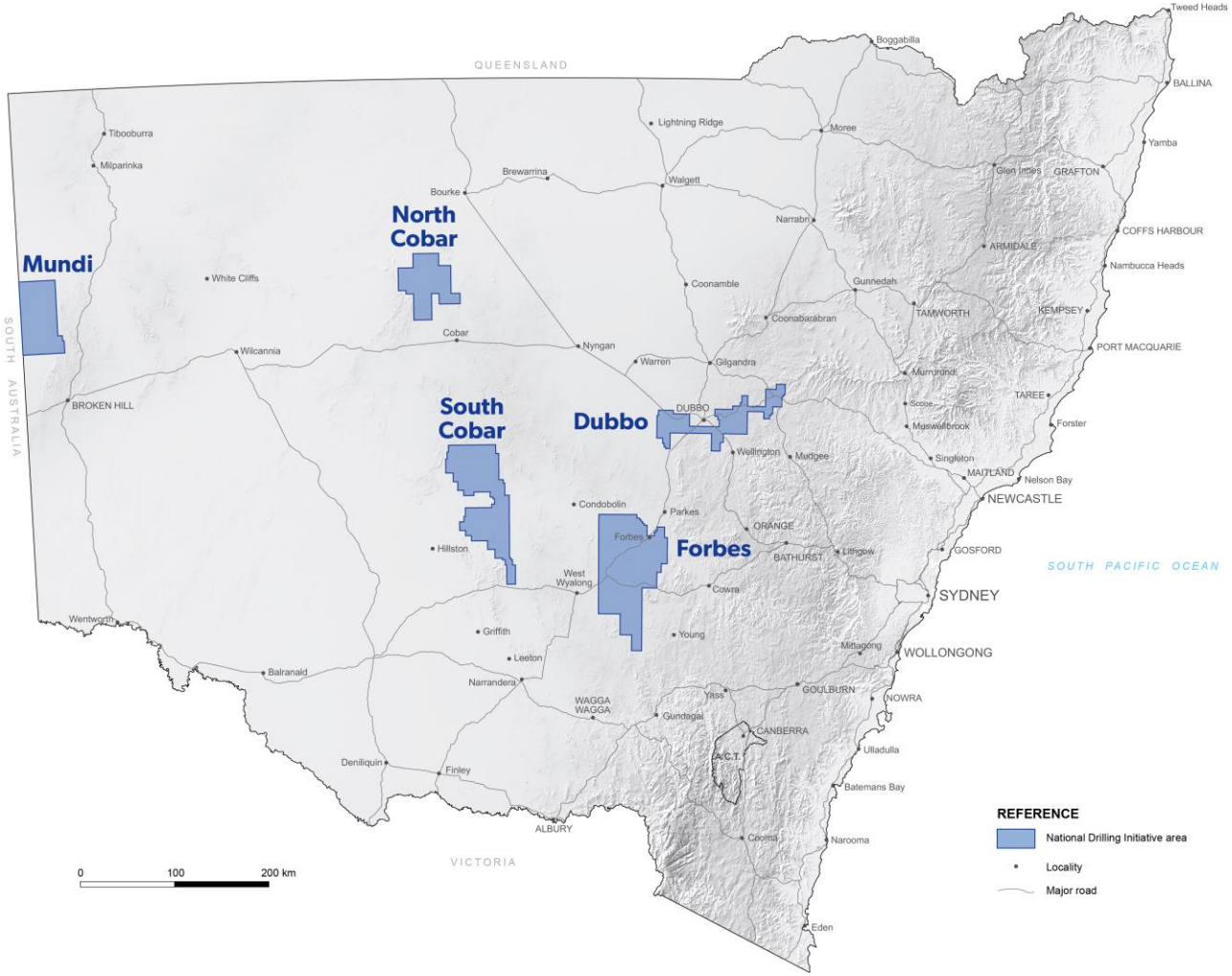
- Focus for GSNSW will be on pre-competitive data acquisition including drilling in five areas.
- These areas are undercover extensions to known mineralised terranes.
- GSNSW will assess legacy materials and data, and undertake targeted mapping, and geochemical and geophysical surveys prior to drilling.
- The data collected will also provide information on potential groundwater resources in the areas (collaboration with NSW Office of Water, GA, UoN, others).



Seamless Geology of NSW v1.1

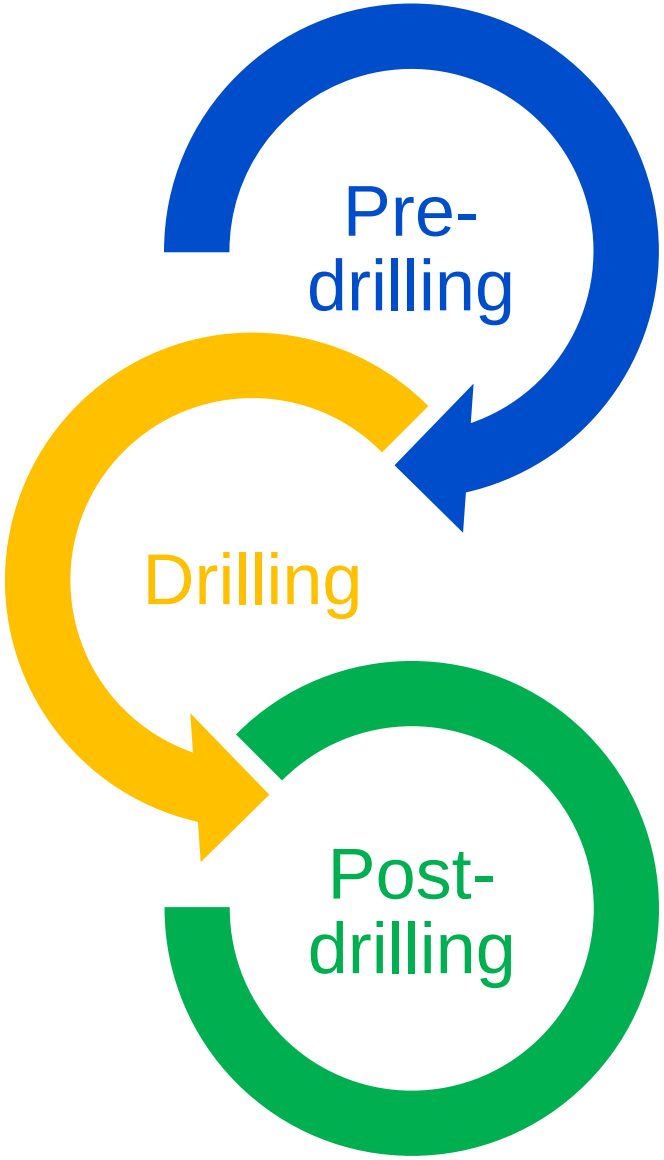
GSNSW NDI commitment – $15.9 million

- **$4.4 million cash**, to be invested in drilling in NSW
  - Based on first pass grid costing.
- **$11.5 million in-kind**
  - $3.5 million new geophysics (AEM, mag/rad, gravity).
  - $0.6 million analytical costs (hydrogeochem, biogeochem, geochem, geochron, mineralogy).
  - $5.0 million staff in-kind.
  - $2.4 million depreciated value of existing data.
- Through MinEx CRC, this investment will leverage significant additional research.



Three phases – key activities

- Pre-drilling phase
  - audit and gaps of legacy materials and data
  - geophysics acquisition and modelling
  - mapping, logging, sampling, analysis, geochron
  - biogeochemistry, hydrogeochemistry.
- Drilling phase
  - data handling, computation
  - analysis (e.g. HyLogger™, isotopic).
- Post-drilling phase
  - interpretation and 3D modelling.



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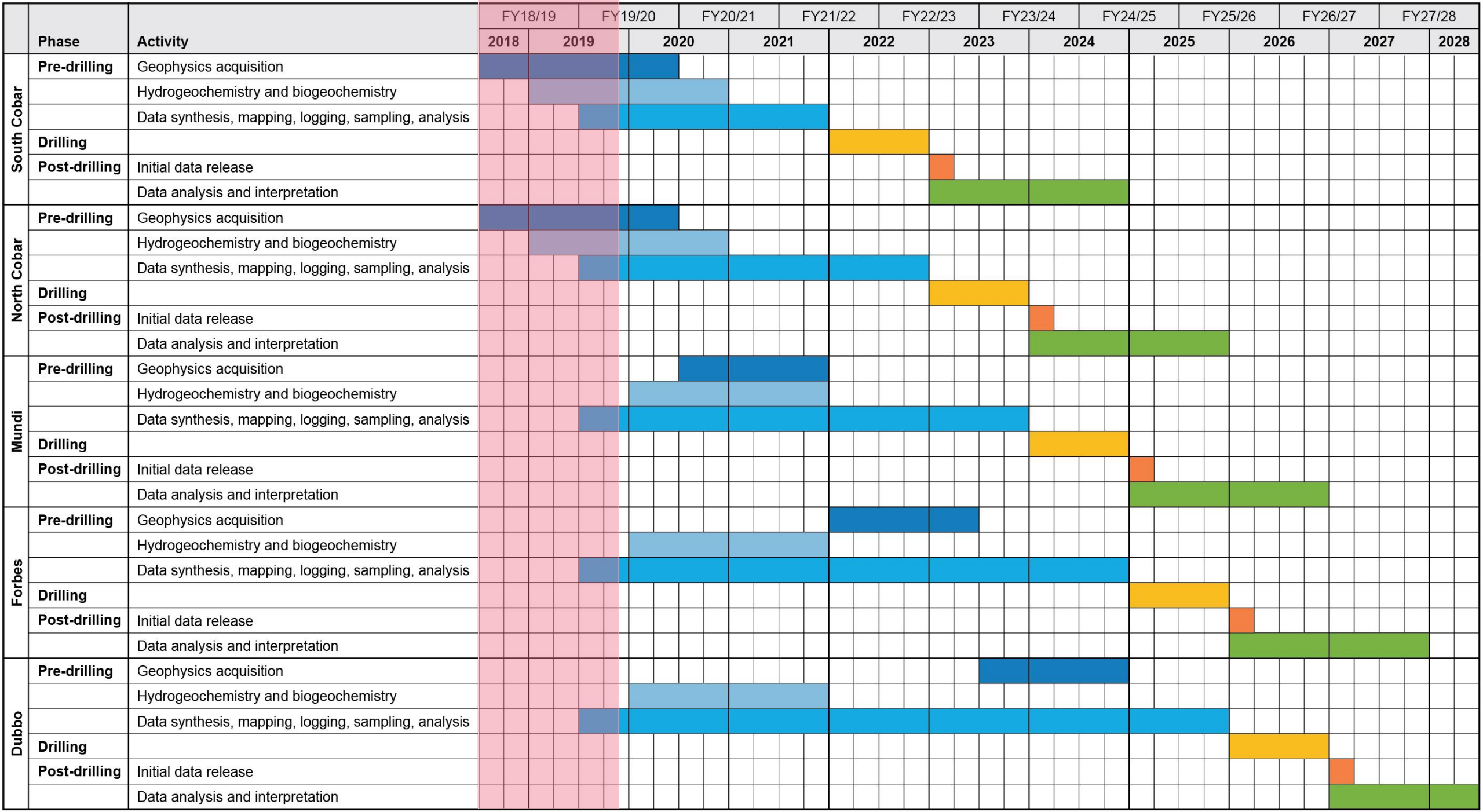

Correct as at 28/8/2019.

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

Activities to date

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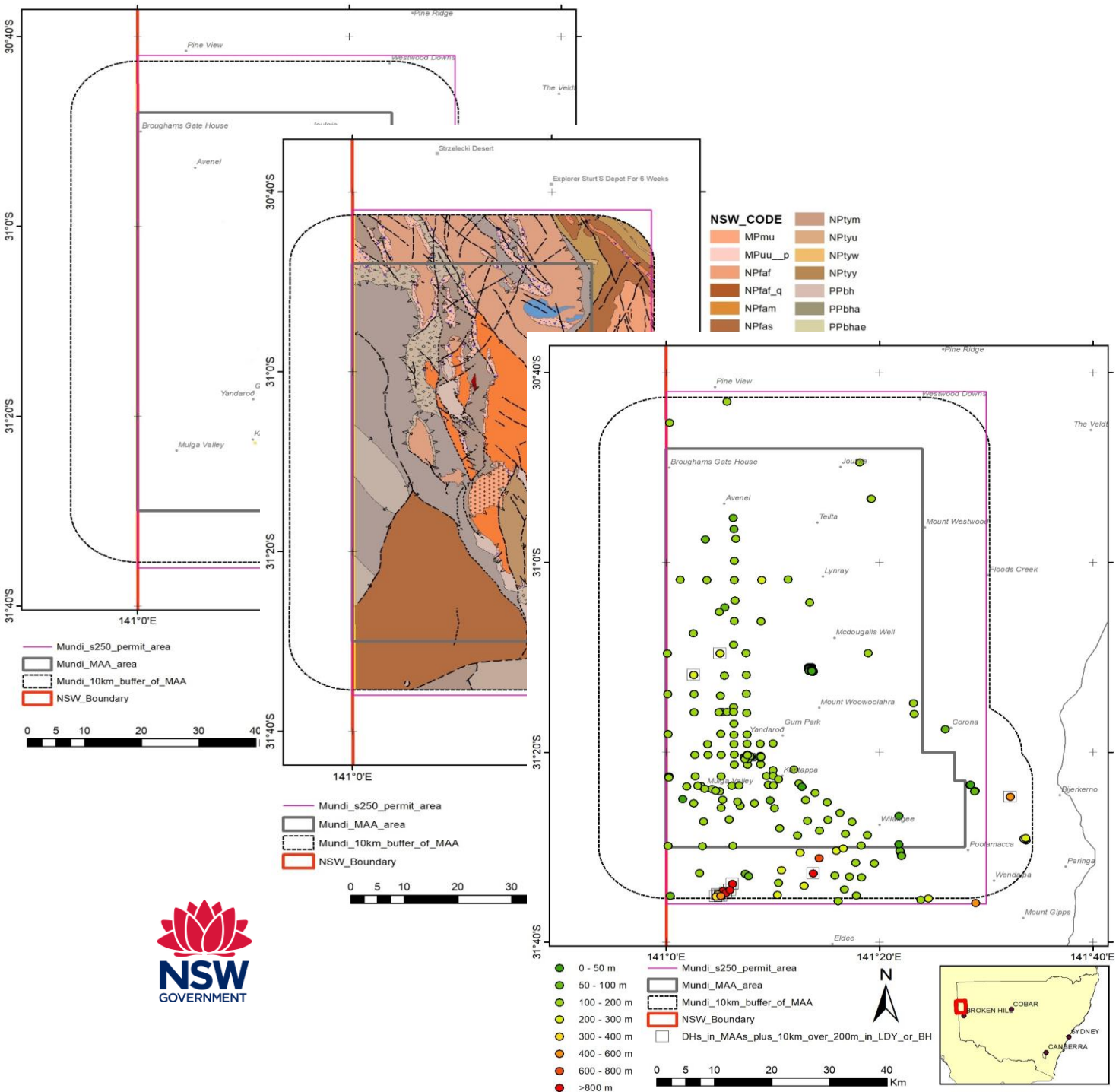

Audit and gaps

- Report for each of the five focus NDI areas.
- Includes previous mapping, geophysics, geochronology, palaeontology, field observations, geochemistry etc.
- Inform work program and research opportunities for each NDI area.
- Underway, will be published by end of 2019.
- Examples from Mundi NDI report, by Chris Folkes

Initial focus on Cobar

- Northern and southern extensions of the Cobar Basin under cover, up to a depth of 500 m.
- Long history of mining, with limited current mine life.
- Recent advances in understanding from GSNSW mineral systems work.
- Exploration interest and significant potential for discovery.
- Community support for mineral exploration and mining.

NSW GOVERNMENT

Cobar community consultation

Cobar to Lake Cargelligo ahead of AEM and hydrogeochemistry

- Community leader meetings (February 2019)
- Community information sessions (April 2019)

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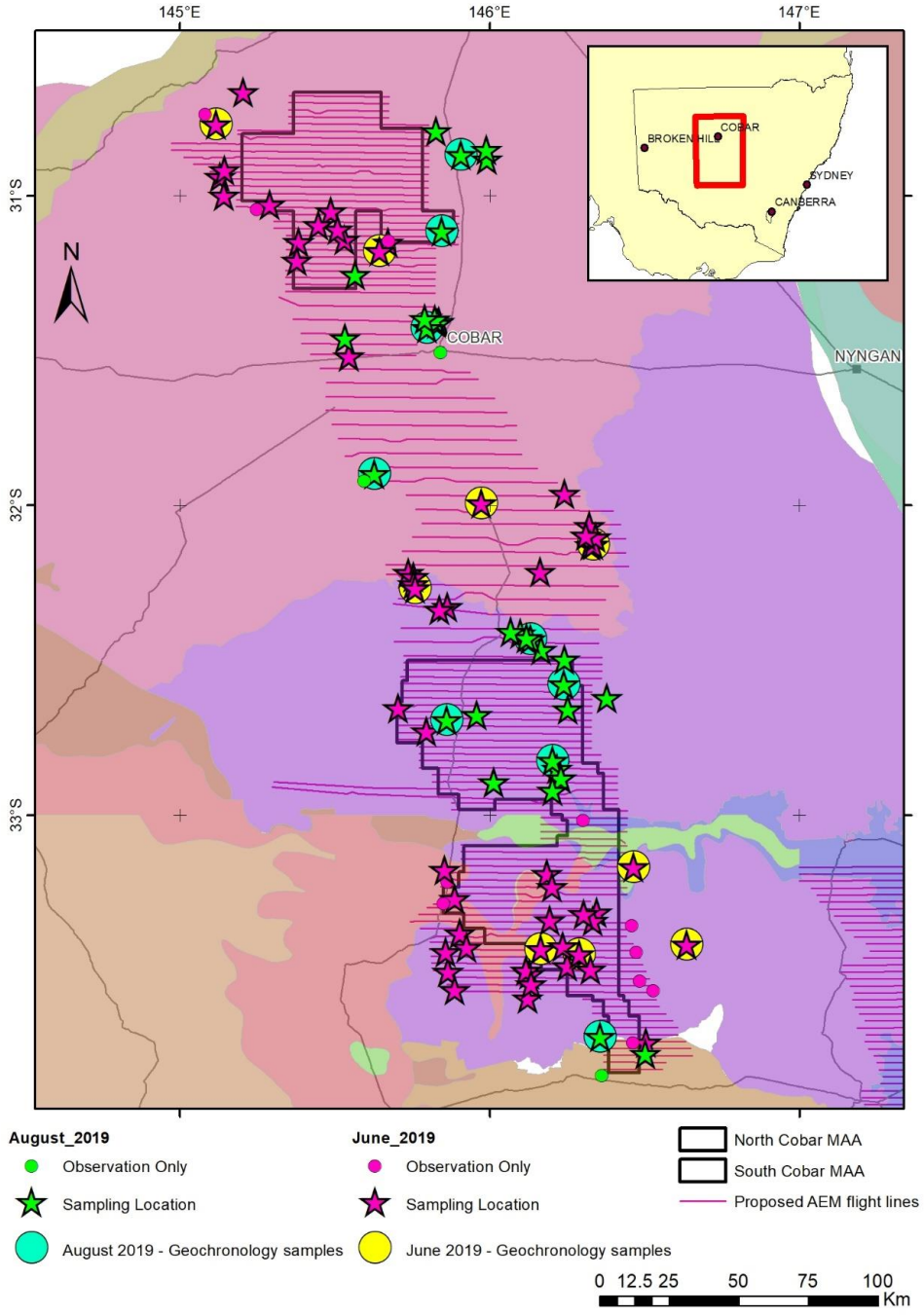
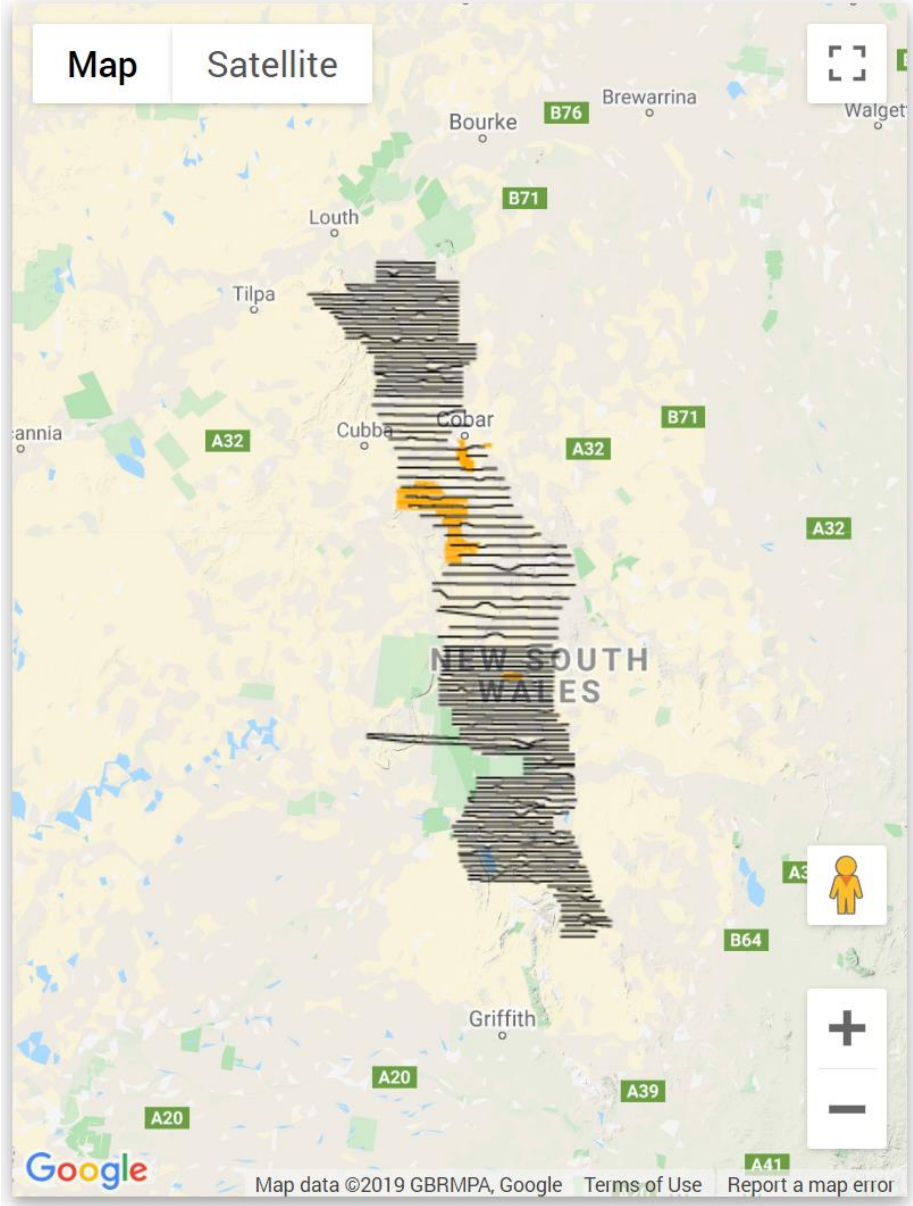
Cobar hydrogeochemistry

- GSNSW now has two kits and is trained up
  - Thanks Nathan Reid, Rob Thorne (CSIRO).
- Designed to test:
  - different aquifers & geology
  - calibration with AEM.
- Two trips sampled 86 sites
  - 16 geochronology.



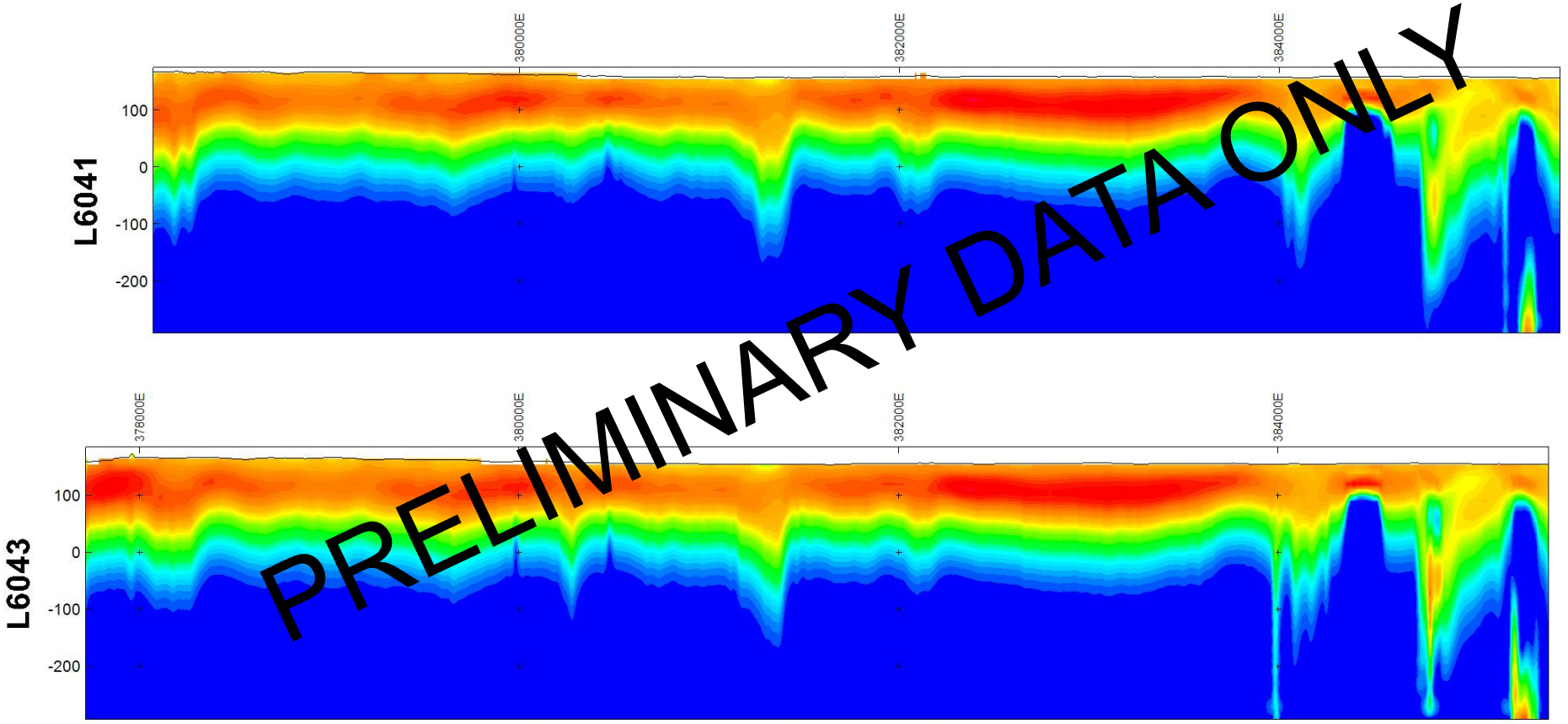
Cobar AEM

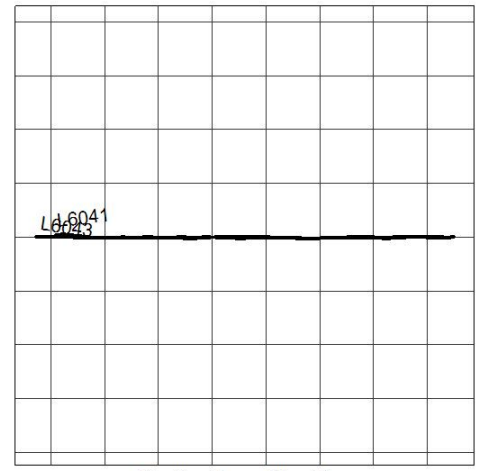
- Collaborative acquisition with Geoscience Australia
  - 12/09/19 to 19/10/19 – acquisition by NRG.
- Data conductivity depth inversions (the coloured sections for interpretation) have been delivered to GSNSW and GA.
- End March 2020 – processed layered inversions from GA.
- Proposed PhD to undertake detailed interpretations and modelling.
- CSIRO research work.



Black lines are completed government flight lines.
Orange lines are completed industry infill lines.

Conductivity





Section Trace Plan View

0.001 0.004 0.014 0.049 0.170 0.588

Conductivity [S/m]

Scale 1:30000

500 0 500

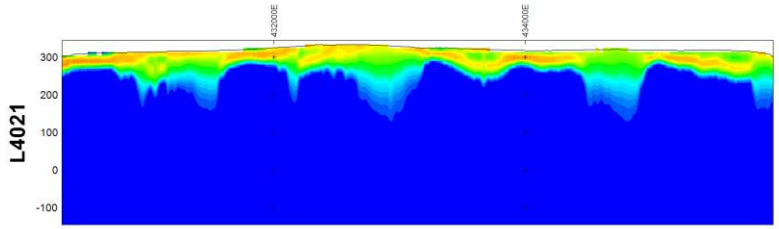
(meters)

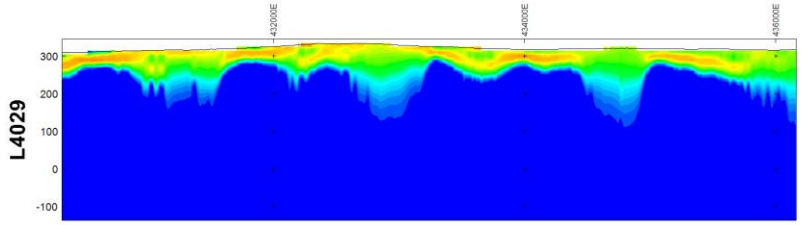
Vertical Exaggeration: 3

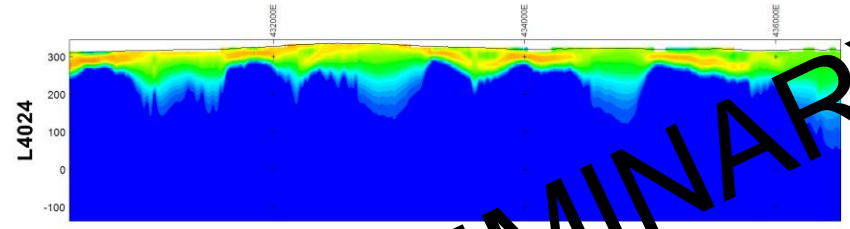
GA Cobar 1321

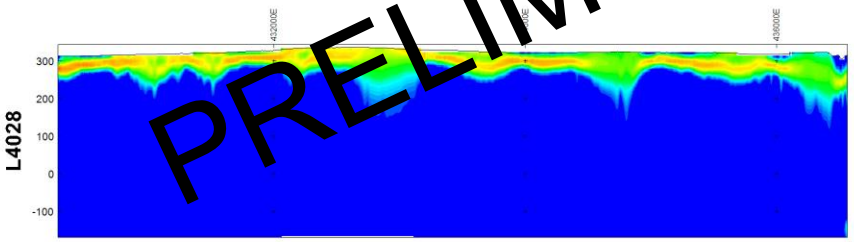
Layered Earth Inversion Results

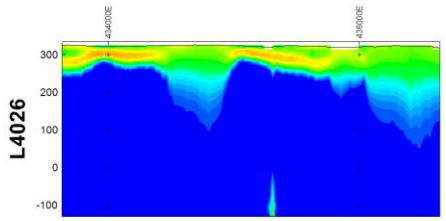
Conductivity



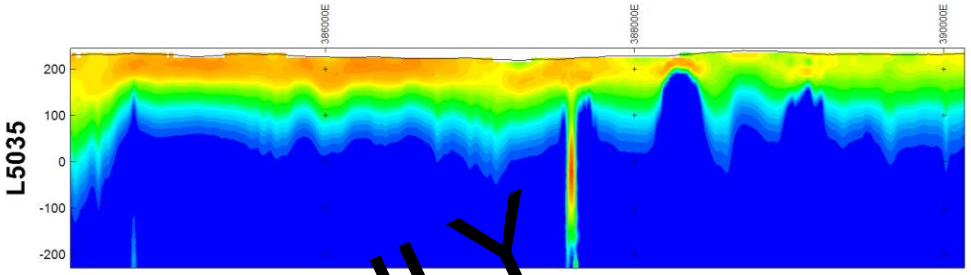


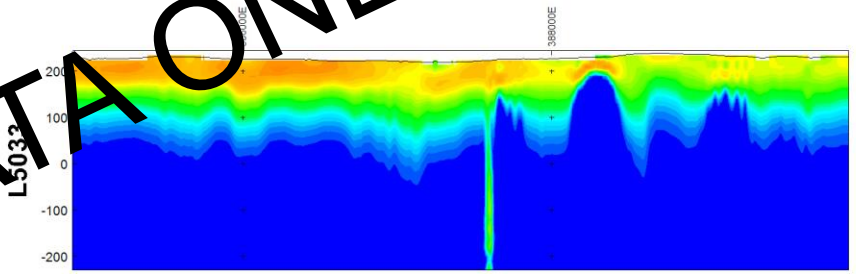


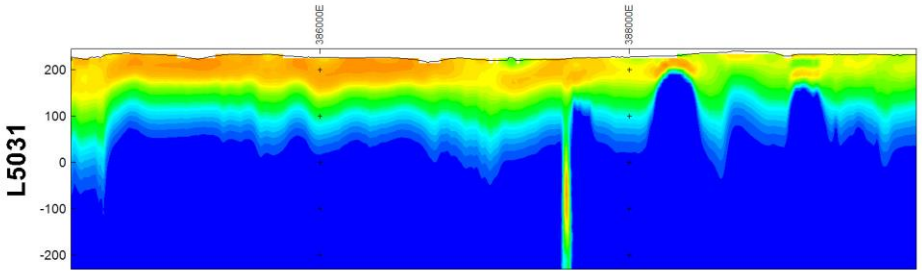


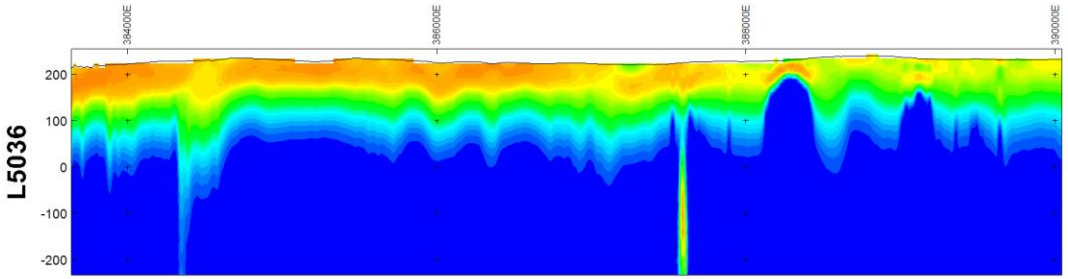


Conductivity





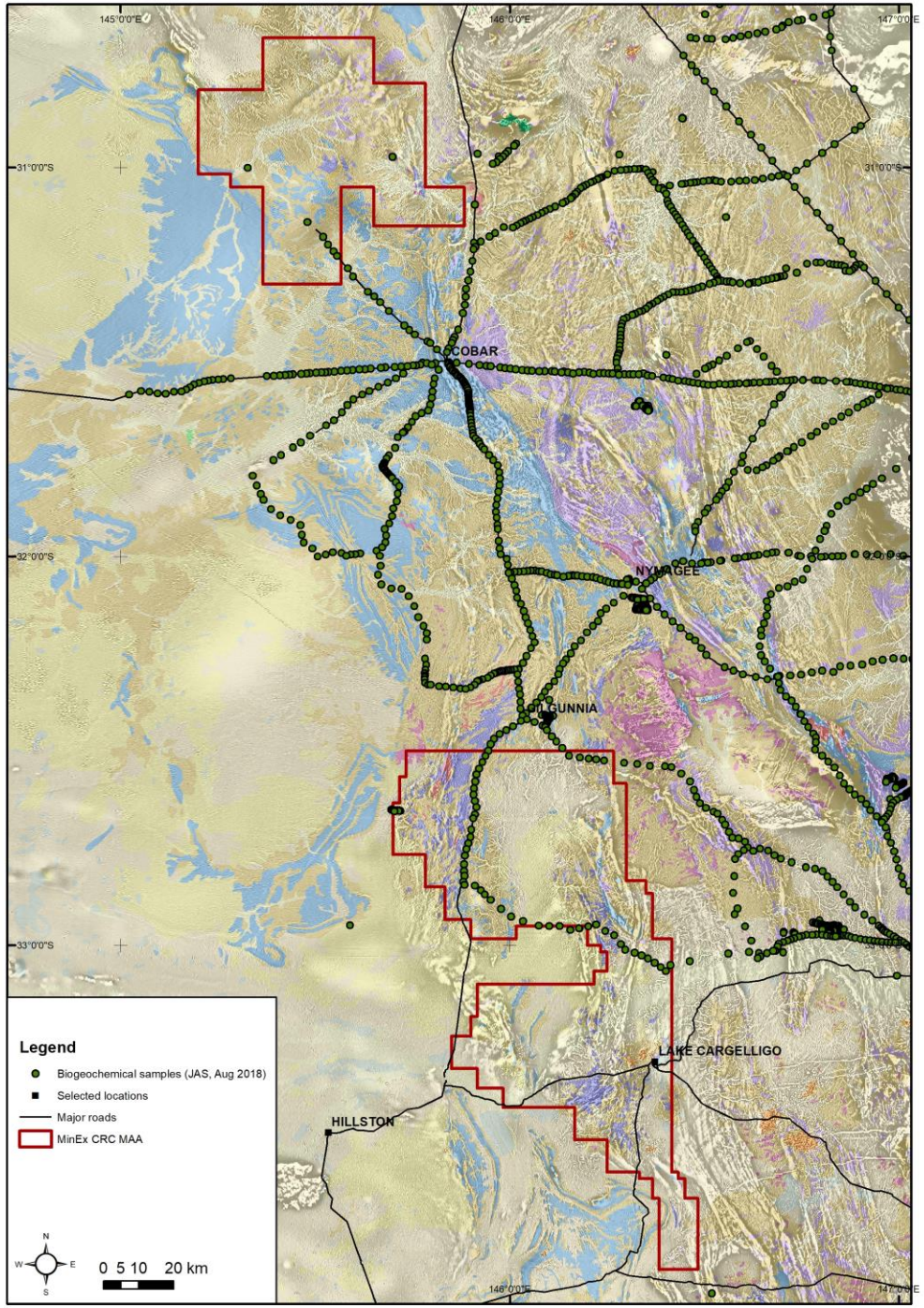




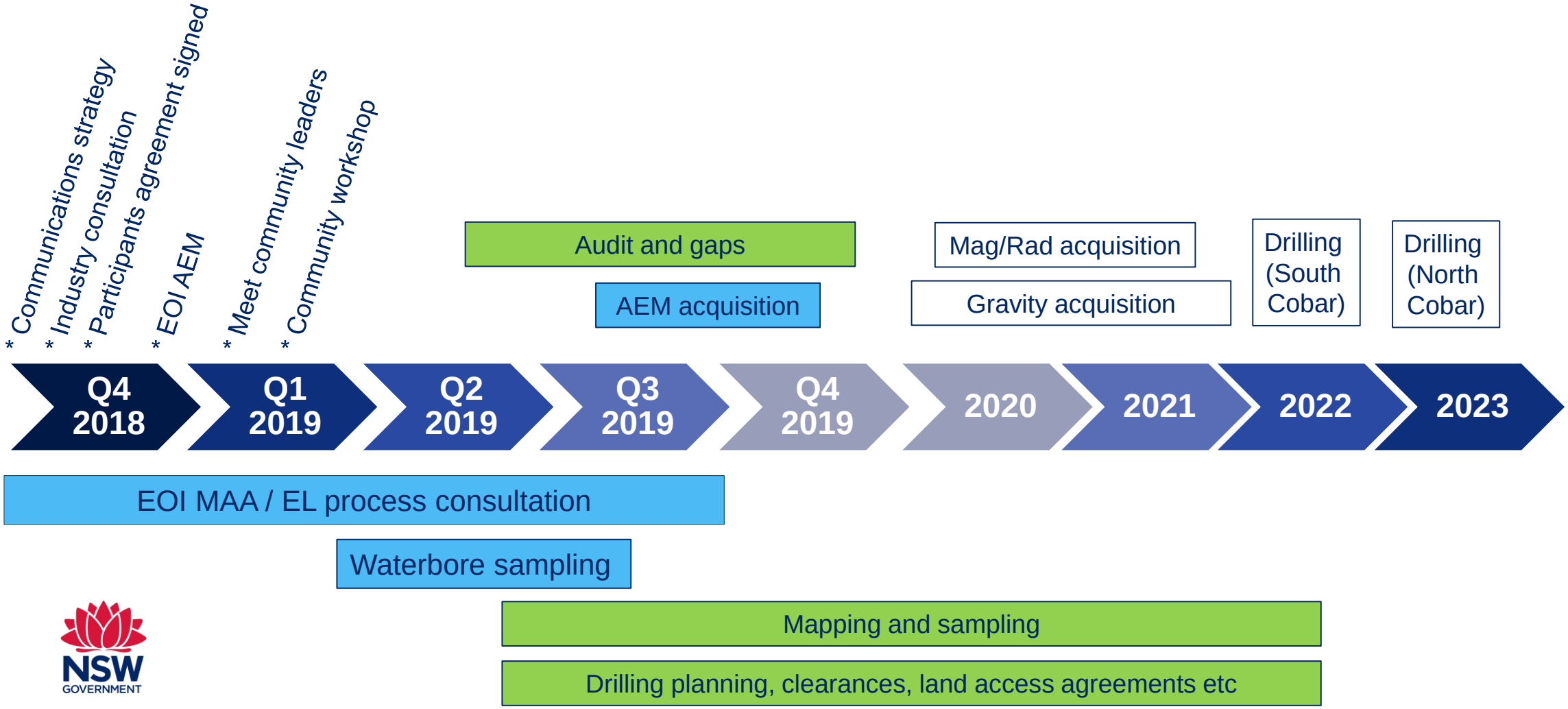
Cobar biogeochemistry

Joe Schifano PhD project (UNSW) in the greater Cobar region:

- Cypress pine trees are the target plant
- common in the region and have deep root systems
- >2000 samples collected
- ~ 50 elements analysed
- Initial results indicate potential to map covered geology, including direct indications of mineralisation.



Cobar timeline

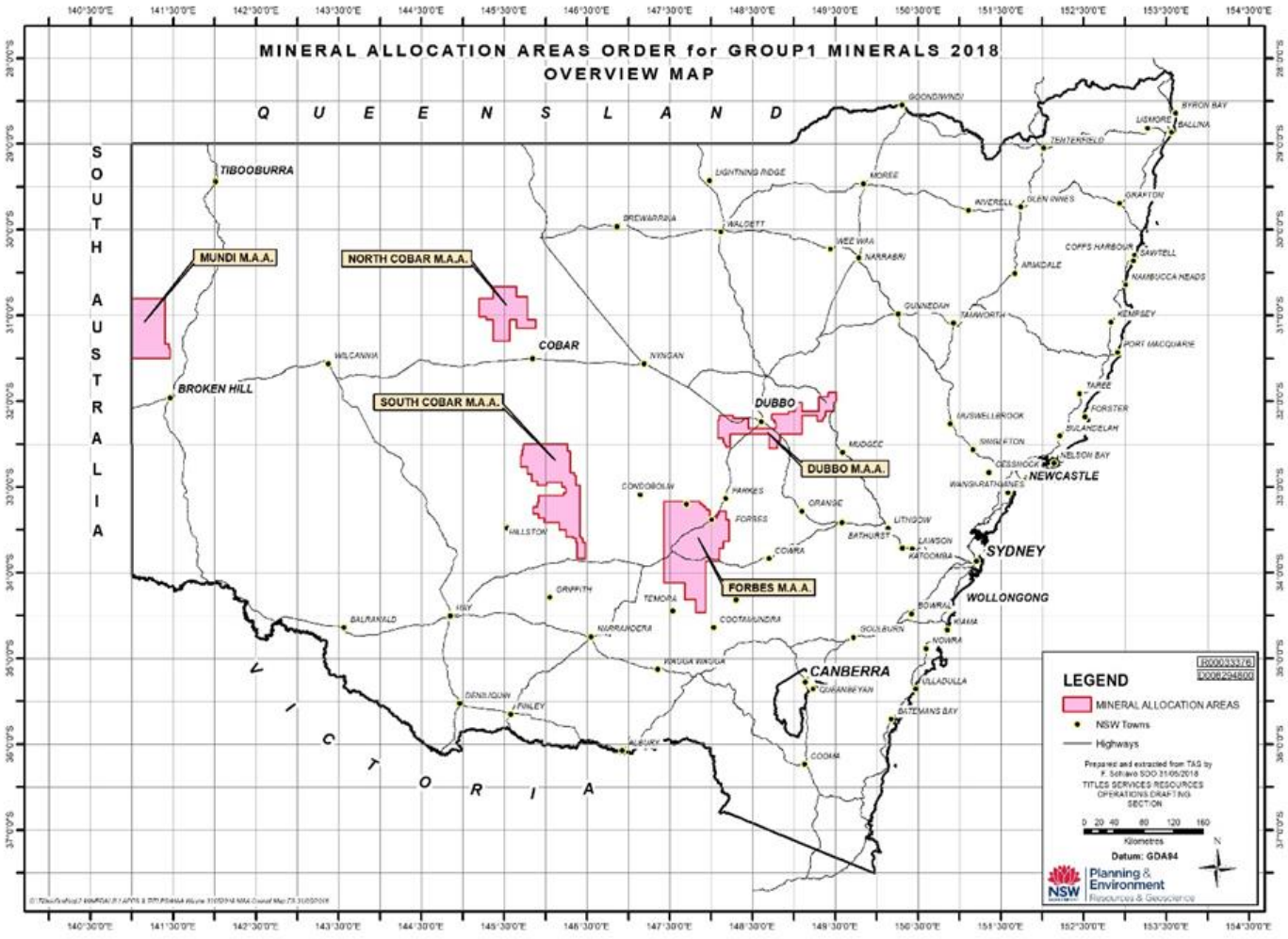


MinEx CRC MAAs

NSW GOVERNMENT

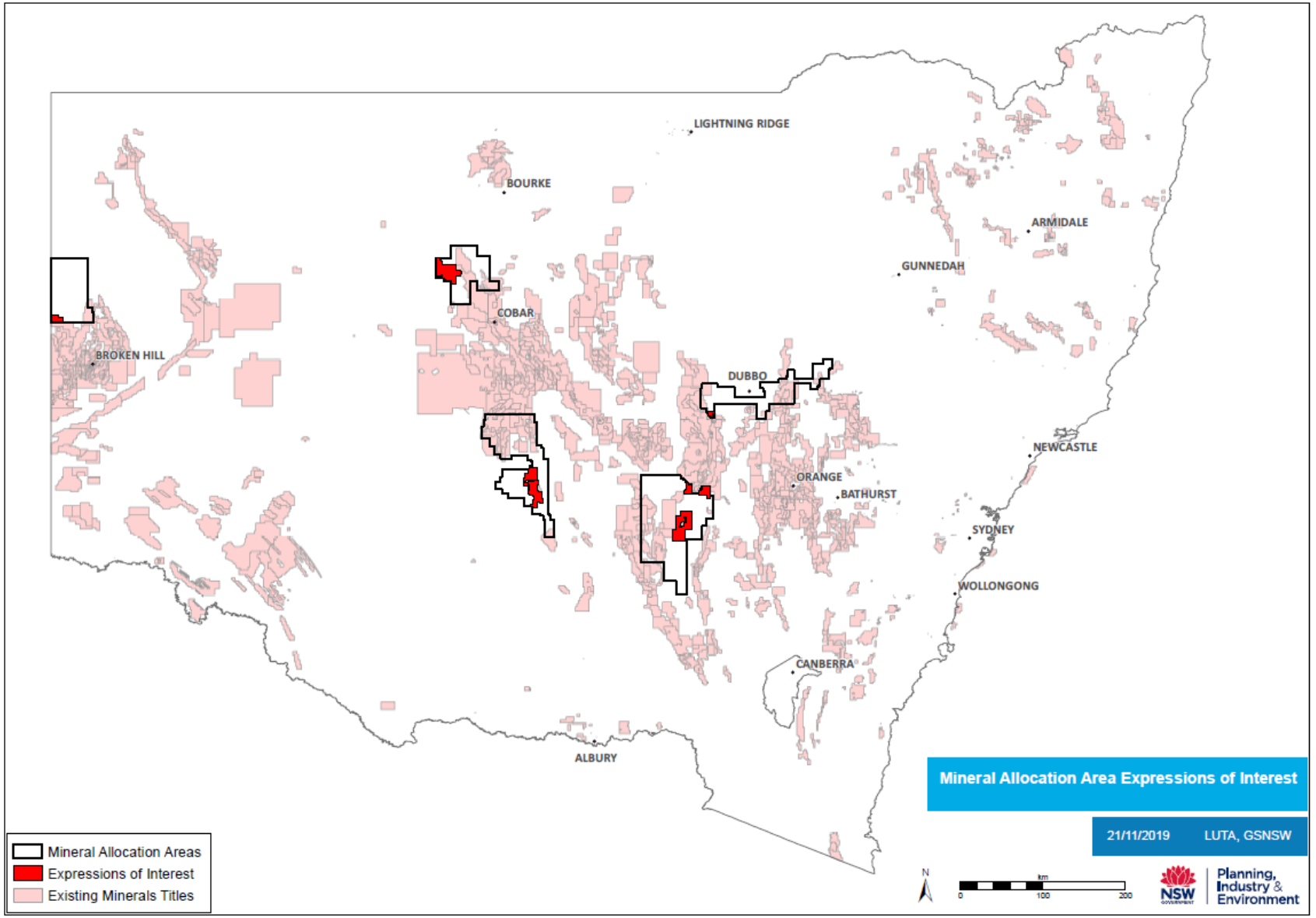
MinEx CRC MAAs

- Gazetted on 10 August 2018
  - Combined area represents 2.59% of NSW.
- No new Group 1 ELAs within MAAs without Ministerial consent.
- **NO IMPACT ON EXISTING ELs/ELAs.**
- Constituted to allow open discussion of NSW MinEx CRC NDI program, without the risk of speculative exploration title applications and land banking.
- GSNSW has worked with the industry to develop an agreed process for grant of Group 1 ELs within the MAAs.



Expression of interest process

- Opened on Friday 16 August, and closed on Monday 30 September 2019.
- **Seven applications received, none of which overlap.**
  - These have been progressed to ED RO for approval.



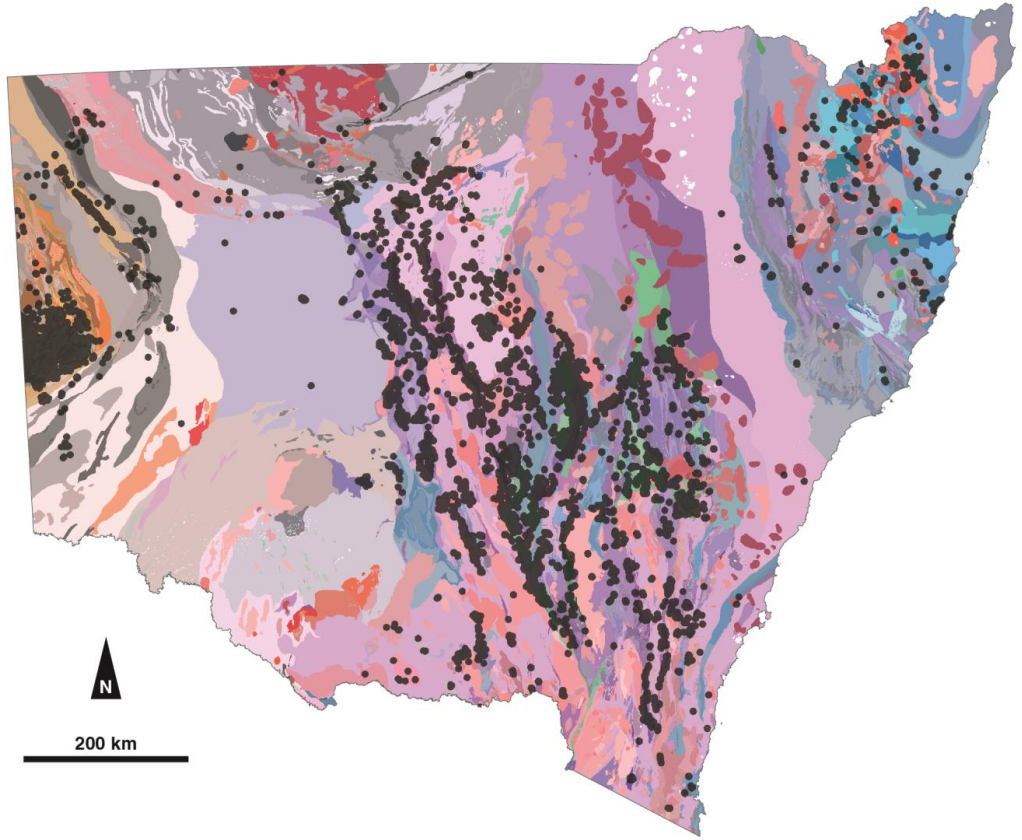
NSW GOVERNMENT

MinEx CRC: Expanding the frontiers of mineral exploration in NSW

NSW GOVERNMENT

The UNCOVER imperative

- The future of the Australian mineral industry hinges on its ability to successfully explore the 70% of the continent that lies undercover.
- To do this the industry needs new tools, technologies and data.
- Just as geological surveys mapped the surface geology to provide a framework for mineral explorers in the 20th century, we need to map the undercover geology to create a framework for 21st century mineral discovery. **Mapping with a drill rig.**
- MinEx CRC NDI is a significant first step on that path.
- 10 years is just the start of a long road.



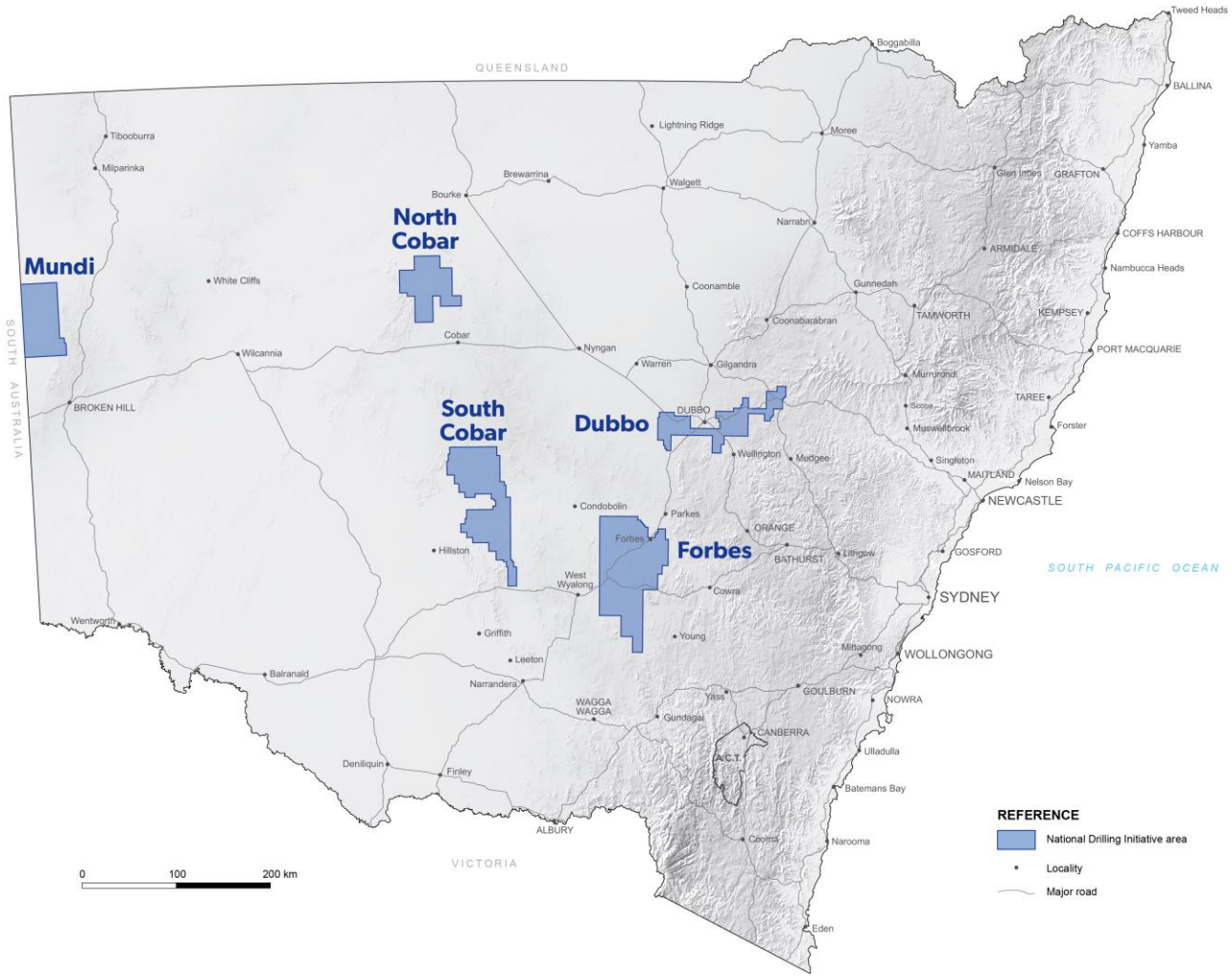
NSW GOVERNMENT

Outcome of the NDI in NSW

Improved understanding of the basement geology and its expression in cover sequences across five areas of the state …

… supporting development of new tools and methodologies for successful exploration undercover…

… **to open up vast new frontiers for explorers, generating a wave of discoveries that will underpin a strong mineral industry and economy for future generations of Australians.**



NSW GOVERNMENT

Cooperative Drilling round 3

NSW GOVERNMENT

Cooperative Drilling round 3

- $2 million allocated from Minerals and Petroleum Investment Fund across FY2019–2020 and FY2020–2021.
- 50% of direct per metre drilling costs up to a maximum of $200,000 per program.
  - Maximise coverage and benefit.
  - Simplicity.
- **Launched by the Deputy Premier at IMARC in his speech on 29 October 2019.**
- **Invitation to Apply open until 31 December 2019.**
- Assessment by joint industry–GSNSW panel and announcement of successful applicants in early 2020.

NSW GOVERNMENT

NSW GOVERNMENT

John Barilaro
Deputy Premier
Minister for Regional NSW
Minister for Trade and Industry

MEDIA RELEASE

Tuesday, 29 October 2019

$2 MILLION IN NEW GRANTS TO BOOST EXPLORATION FOR TRADITIONAL AND HIGH-TECH METALS IN NSW

Explorers will be encouraged to search new areas of the state for traditional and high-tech metal deposits thanks to a $2 million grants boost from the NSW Government that will attract new investment into regional NSW.

Deputy Premier and Minister responsible for Resources John Barilaro said the third funding round of the New Frontiers Cooperative Drilling program will reimburse successful applicants for up to 50 per cent of their per metre drilling costs up to a maximum of $200,000.

Speaking at the sixth annual International Mining and Resources Conference in Melbourne today, Mr Barilaro said the funding boost, on top of $4 million allocated under two previous rounds of the program, is a key deliverable under the NSW Minerals Strategy.

"We've already seen the benefits reaped from previous rounds of this funding program, with the first Cooperative Drilling hole in a project near Broken Hill striking high-grade platinum group metals and leading to a $5 million joint venture investment," Mr Barilaro said.

"Our goal is to make NSW the number one state for new mineral exploration and resources investment across the nation, and we're doing that by providing greater support for explorers and investors, and providing greater certainty for the mining sector."

Mr Barilaro also launched the NSW Government's new Online Minerals Prospectus and highlighted efforts to provide detailed new geoscientific data to the NSW Central West, where large, high-grade scandium oxide deposits were recently discovered.

The NSW Government has just completed the largest-ever aerial electromagnetic (AEM) survey by area in NSW history, with researchers looking for clues for new copper, gold and zinc deposits, and groundwater, over more than 19,000 km^2 in the Greater Cobar region.

"A vast array of metals are used worldwide to manufacture high-tech products such as smartphones, satellite components and pacemakers, as well as renewable energy technologies including wind turbines and the batteries in hybrid and electric cars," Mr Barilaro said.

"Global demand for metals is growing strongly and we want to ensure that the people of NSW, especially the NSW Central West, have every chance to capitalise on that demand, with the exploration for new mineral deposits and groundwater sources generating jobs, attracting investment and bringing economic and social benefits to local communities."

Data from the AEM survey will be available to the public in the first quarter of 2020, adding to a range of other detailed maps and geological information already available from the Resources and Geoscience website.

The newly launched Online Minerals Prospectus, another key deliverable of the NSW Minerals Strategy, provides quick access to this technical data together with commercially useful information for explorers and investors.

"This dynamic online portal acts as a one-stop shop for explorers, project developers and mining investors, giving them the tools and guidance they need to tap into the minerals and business potential of NSW, especially regional NSW," Mr Barilaro said.

Assessment criteria

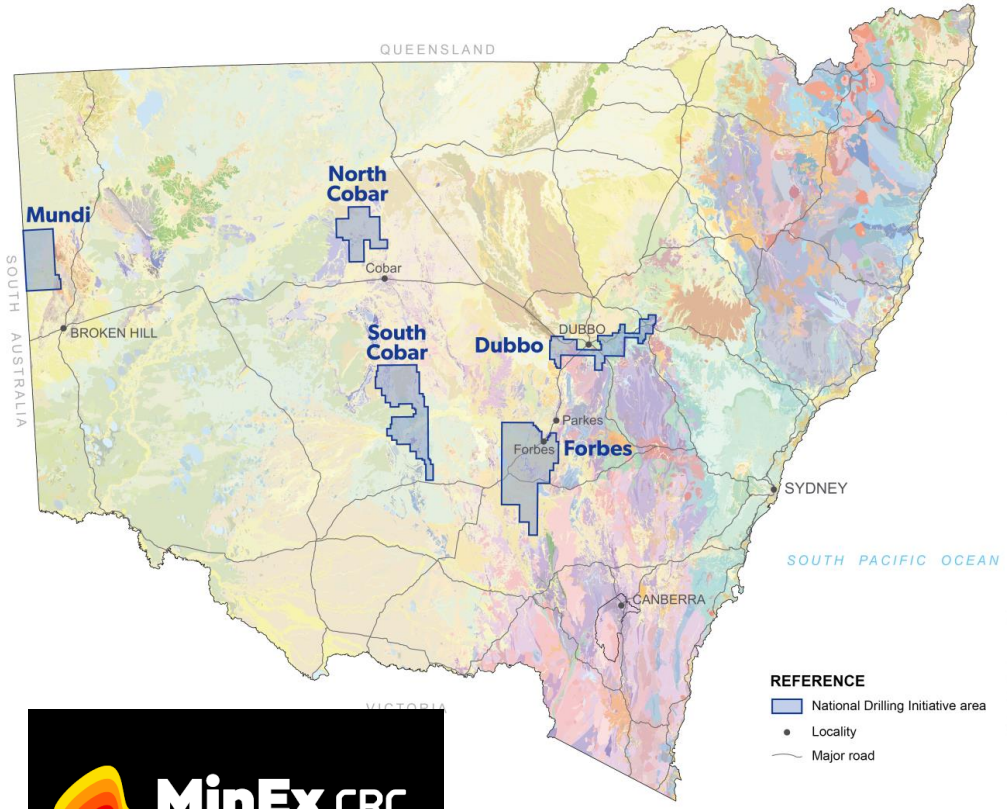
- How does the proposed work program advance exploration in previously underexplored areas (35%)?
- How does the proposed work program test sound geological models, or innovative concepts and ideas (30%)?
- How does the work undertaken to date define the target(s) to be tested (25%)?
- Details of proposed work program and data to be acquired (10%)?

https://www.resourcesandgeoscience.nsw.gov.au/miners-and-explorers/programs-and-initiatives/new-frontiers-cooperative-drilling

Priorities for 2020

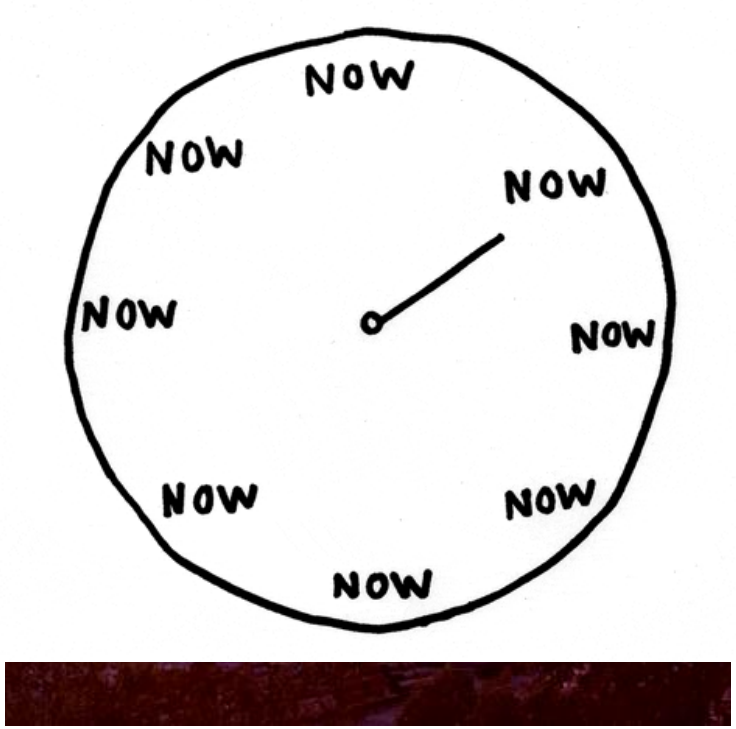
NSW GOVERNMENT

2020 priority projects



MinEx CRC
3D DRILLING

NSW GOVERNMENT



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