A NOTE ON THE DISCOVERY OF BOWDENS SILVER DEPOSIT, NSW, AUSTRALIA

Tim McConachy

April 2023

Introduction

Mineral discoveries start from an idea. This idea might be as simple as 'this rock looks interesting' to a well-considered exploration program designed for a particular commodity or deposit type. In the discovery of the Bowdens silver deposit by CRAE (Conzinc Riotinto of Australia Exploration Pty Limited) in 1989, the idea appears to have had its origin in the discovery of gold around 5,000 kilometres away in East Kalimantan, Indonesia, 13 years earlier. What follows is a note on the background to the discovery of Bowdens silver deposit and the people involved. The author is responsible for any omissions or errors.

From Idea to Execution

The broad geological setting of the Kelian gold discovery in 1976, which produced close to six million ounces of gold and nearly five million ounces of silver from 1992 to closure in 2004, occurs in volcanic rocks bordering the coal-bearing sediments of Kutai Basin in East Kalimantan, Indonesia. With this knowledge, CRAE's Ian Johnson and John Bartram hatched the idea that the Rylstone Volcanics near the Sydney Basin were broadly analogous to the Kelian setting. Johnson was responsible for CRAE's overseas exploration which naturally included input to Kelian's drill programs and reserve estimation. Although he was never based at Kelian he visited a number of times. Bartram had not visited Kelian, but was familiar with its geological setting, being part of the CRA/RTZ Group in which exploration staff were encouraged to exchange ideas, knowledge and experience at annual exploration meetings. Johnson's storied career in the resources industry also included mine geology at the famous Vatukoula gold operation on the main island of Fiji, regional mapping for the NSW Geological Survey, senior mine and exploration roles at Broken Hill and other managerial roles in Australia and Papua New Guinea, and a director of Newcrest Mining. [1] In 1987 Bartram relocated to Sydney from Papua New Guinea, where he had been involved in CRAE's discovery of copper and gold at Wafi (now Newcrest-Harmony joint venture, Wafi-Golpu), gold at Hidden Valley (now a mine operated by Harmony Gold) and the bonanza alluvial gold discovery at Mount Kare.

[1] As an aside, Johnson's hobby was breeding horses and in retirement he said *'unlike all of the my other plodders, I now have a horse who can run a bit, he's called Viewed*' – indeed he was right, *Viewed* won the 2008 Melbourne Cup!

Johnson and Bartram initially engaged John Foster, a New Zealand geologist who had worked previously with Kennecott in Papua New Guinea, to identify the most prospective terrains along the borders of the Sydney Basin. Bartram recalls that the identification of the Mudgee area came out of Foster's work, although Foster had left the company soon after.

The then mineral inventory of the Rylstone Volcanics in the general Mudgee area was scarce to say the least in comparison with much of the Lachlan Fold Belt. Bartram had observed hydrothermal alteration and minor low temperature opaline silica veins in road side cuttings during a reconnaissance sortie which provided him with sufficient encouragement to investigate the idea further. These observations were outside what would become the initial application area. Bartram remarked: *"There are strong similarities in the settings of Kelian and the PNG gold discoveries but my own experience was from PNG and I used this in this NSW generative work*." He decided to undertake a grass roots exploration program using the same methodology that had been so successful in Papua New Guinea and Indonesia. *"Although the terrain was a lot older, this approach had not been used before in this area and was only possible because of the development of sensitive analytical techniques for gold so we thought it was worth a punt."*

At the time of the lodgement of the exploration licence application on 28 July 1987, the Rylstone Volcanics covered by the licence area was the only area of Rylstone Volcanics available that was not covered by competitor licences. The licence area covered approximately 180 square kilometres. It incorporated large pastural holdings, small hobby farms and bush blocks, ranging from arable and fertile creek flats to dry, hilly areas and the precipitous sandstone cliffs of the Sydney Basin, mostly eucalypt grazing country with the odd pine plantation.

Previous mineral exploration in the region of the licence application between 1977 to 1986 had consisted of six companies focused on and around known gold and iron occurrences in the Lower Paleozoic sediments and volcanics and one or two granite-related molybdenum occurrences elsewhere. It appeared that no substantial exploration had taken place over the Carboniferous Rylstone Volcanics. No historic mineral deposits were recorded within the exploration licence area on the 1:250,000 Dubbo Metallogenic Map Sheet. The licence therefore covered what was thought to be an essentially virgin area. But like many surprises in mineral exploration, CRAE's work was to reveal evidence of previous prospecting activity which local landowners say most likely predated WWI.

EL 3252 (Bara) was granted to CRAE by the NSW Department of Mineral Resources on 13 January 1989.

Another important moment in the discovery of Bowdens was the appointment by Bartram of John Terrill to design and undertake a regional stream sediment survey across the Rylstone Volcanics within the exploration licence. Terrill, an early to mid-career project geologist, had worked with ESSO Minerals on Feni Island, near Lihir Island, in New Ireland Province of Papua New Guinea and was familiar and experienced with epithermal systems, stream sediment sampling and the follow up work required from this approach. He became the project champion.

The regional stream sediment (and bulk cyanide leach) sample survey highlighted two eye-catching multielement anomalies. The first anomaly was from a sample collected in Blackmans Gully (later becoming the Bowden's Gift prospect) four kilometres north east of the small village of Lue. Here a minus 80 mesh silt sample recorded 200ppm lead, 290ppm zinc, 2.8ppm silver, 65ppm arsenic and 3.1ppm antimony. A rock sample of road fill on nearby Maloney's Road recorded 18ppm silver and 1250ppm arsenic. The second anomaly was located in the main Bara Creek, roughly 10 kilometres north of Blackmans Gully. Here a minus 80 mesh silt sample recorded 0.14ppm gold, 280ppm copper, 42ppm lead, 2.4ppm zinc, 2.4ppm silver, 20ppm arsenic, 1.5ppm antimony. A bulk cyanide leach sample from a nearby tributary recorded 1000ppt gold. By comparison, threshold values for the minus 80 mesh samples were 0.05ppm gold, 50ppm copper, 40ppm lead, 100ppm zinc, 10ppm arsenic, 0.5ppm silver and 2.0ppm antimony; and for bulk cyanide leach samples approximately 500ppt gold. (Terrill, 1989).

Follow up at Blackmans Gully revealed an outcrop of brecciated and veined siliceous volcanic rock containing visible sphalerite, galena and arsenic-iron-sulfide about 100 metres or so upstream from the original stream sediment sample site and old workings nearby returned up to 860ppm silver and 0.5 - 1% lead and zinc. Further stream sediment and rock chip sampling in nearby tributaries were similarly anomalous in these elements, defining an area of interest of approximately three square kilometres in which to conduct more detailed exploration. Meanwhile, follow up at the Bara Creek anomaly discovered interesting looking hydrothermally altered and silica veined Rylstone Volcanics but no mineralised samples were recovered. Terrill (1989) noted that the source of the Bara Creek anomaly remained unresolved.

Based on these results, priority was given to Bowden's Gift now elevated to prospect level. Follow up soil sampling (C-horizon) undertaken over the area of interest defined coherent, lead-zinc-arsenic ± silver anomalies rimmed by an annulus of elevated manganese. In places mapping revealed small (less than one centimetre wide), pristine to slightly oxidised veins of silica, silver-bearing sphalerite-galena and arsenopyrite in outcrop, and further small prospecting pits. CRAE Principal Geophysicist, Tony Doe, designed and managed Induced Polarisation and magnetic surveys that showed good correlation between chargeability and the anomalous soil geochemistry, further enhancing the area's prospectivity.

Drilling

The next step involved two phases of RC and core drilling comprising a total of 4,250 metres in 38 holes. The first hole in Phase 1, BG1, intersected 16m at 88 ppm silver 0.12% lead and 0.28% zinc from 48m and is considered the discovery hole. The second hole, BG2 intersected 48m at 110 ppm silver 0.25% lead and 0.38% zinc from surface. The program quickly continued into a second phase of drilling and similar results kept coming but punctuated in places with narrower zones of higher grade silver-lead-zinc. This initial drilling program was designed by John Terrill and the author and received strong support from CRAE's senior management team, Dermot Ryan, Jacob Rebek and John Collier.

The initial drilling at Bowden's Gift defined an inferred resource of 6.2 million tonnes grading 85 grams of silver per tonne, 0.3% lead and 0.5% zinc.

It took a little over two years from initial discussions to discovery, a relatively short time compared with most other discoveries in mineral exploration. The cost of discovery was very low as the stream sediment survey was done using the existing road network and on foot. No field camps and little logistical support was required since the area had good infrastructure and was around a three hour drive from Sydney.

It was considered that Bowdens represented a potentially new style of volcanic-hosted silver base metal mineralisation in NSW. Analogues of bulk, low grade silver-lead-zinc deposits include the Real de Angeles mine near the famous silver city of Zacatecas, in central Mexico (85 million tonnes at 75 grams of silver per tonne, 1% lead and 0.92% zinc; (Pearson and Clark, 1990)), San Cristobal, Bolivia and other examples in Peru and Chile. First impressions are important; and Jacob Rebek's first impression of the initial RC drilling at Bowdens was the large amount of white dust generated – an indication the

mineralised rocks are hydrothermally altered. Rebek's subsequent observations in Peru and Chile, in similar hydrothermally altered systems, was that donkeys selected the routes for their walking trails to take advantage of such alteration zones because the trail is nice and soft to walk on. These trails are visible on high resolution satellite images because of white dust, and therefore can be used to map zones of hydrothermal alteration. In one region in Australia, for example, he has translated this technique to goat tracks (and other features) to help recognize hydrothermal alteration. Rebek has suggested that one of the alteration minerals is likely halloysite, (doubtless logged as clay or kaolin) but halloysite has not been formally recognized at Bowdens (T. Klein, pers comm. 2023).

In 1994 CRAE sold the property and subsequent extensive drilling programs and development studies were undertaken by four other companies including, in chronological order, GSM Exploration Pty Ltd, Silver Standard Resources Inc., Kingsgate Consolidated Limited and Silver Mines Limited, including wholly owned subsidiary, Bowdens Silver Pty Limited. During this time and some 138,000 metres of drilling later, the resource at Bowdens has grown by a factor of 25 to almost 400 million ounces of silver equivalent from approximately 16 million ounces of silver outlined by CRAE. The current owner, Bowdens Silver, has suggested that it may grow well beyond this figure with further drilling as it plans a two million tonnes of ore per annum open cut over a 16 year mine life (Klein et al., 2022).

Side Stories.

There are two interesting side stories to the Bowdens discovery. The first is that the prospect was initially known as Blackman's Gully as this was the locality name shown on the local 1:25,000 scale cadastral map and, as mentioned earlier, the site of the original anomalous stream sediment sample. At the behest of head office, it was changed to Bowden's Gift, after a local property called Bowden. 'Gift' was added in order to keep the 'BG' in the drill hole identification system. The author's recollection is the name was suggested by one of the Phase 1 drillers 'Marko' in a brainstorming exercise over a few drinks and a meal one evening in Mudgee.

The second story relates to an assay problem in the drill samples from the first phase of drilling. In some batches, but not all, there appeared to be an unusual mirror image of assay results and in one or two places field duplicates were out of sequence. Compounding these observations was the difficulty in visually estimating grade due to the fine grain nature of the sulfides imparting a fairly uniform 'greyness', especially in RC chips. The problem was identified by John Terrill who, guided by the wise and

true words of Tony Doe "*If it looks wrong, then it is wrong"*, eventually traced it to sample preparation in the commercial analytical laboratory being used at the time; and the actions of an individual working in the sample preparation area. The resolution of the problem necessitated the resampling of around half of the Phase 1 drill samples and submitting them for re-assay.

This unexpected revelation forced a critical review of all sampling quality control and quality assurance protocols both within the project team and the commercial laboratory. This resulted in a tightening of the chain-of-custody, regular inclusion of then limited but commercially available basemetal standards as well as field duplicates, and development and preparation of selected RC samples that became in-house standards to check sample preparation, precision and accuracy of assays. This practice was adopted elsewhere in the company and is now accepted generally as best practice. This initial in-house work likely encouraged further development and the impressive growth of more widely and commercially available and geologically relevant/bespoke certified standards in mineral exploration geochemistry.

Summary

The discovery of Bowdens is a good example of a sequence of actions which led to a discovery:

- starting with an idea that was a broad geological analogy with an epithermal gold deposit in another country
- undertaking limited reconnaissance to ascertain if the idea had merit, even with meagre evidence
- lodging a licence application
- securing the tenement
- using a well proven and relatively new geochemical techniques to explore in suitable terrain
- having a project champion to lead the exploration program.

The process highlights what can result from an idea and a 'let's take a punt' approach by geologists all of whom coincidentally exploration experience in the SW Pacific but were at different stages of their careers. Interestingly, the discovery is at odds with the commonly held view amongst many in the industry that future discoveries will be largely undercover. Finally, bulk low grade silver-lead-zinc resources like Bowdens remain an attractive target for exploration.

Acknowledgements

The author would like to thank the following:

- John Terrill, John Bartram, Ian Johnson and Jacob Rebek for sharing their recollections of the discovery.
- Tom Klein, Mathew Gouldstone, Emmanuel Madayag of Bowdens Silver Pty Ltd for taking the time and effort to photograph the original discovery site and mineralised outcrops and old prospecting pits nearby. Tom Klein also for comments on an earlier draft.
- Former CRAE Senior Draftsman, Dean Oliver, for sharing his recollections around the time of discovery and for providing pictures of the Coomber prospect that followed the discovery of Bowdens.

POST SCRIPT

A significant event in the history of Bowdens was the recent announcement on 3 April 2023 by the NSW Independent Planning Commission which determined that the Bowdens Silver mine would go-ahead. *"A mine which would extract and process around 30 million tonnes of ore (up to 2 million tonnes per annum) over a period of approximately 23 years."*

This announcement comes 36 years after the initial idea to explore in the area and 34 years after the discovery hole was drilled. Congratulations to the Bowdens Silver team and to all those who have worked on this project over the many decades.

About the Author

Dr Tim McConachy (BSc Hons 1, PhD) is a geologist with extensive technical, managerial and commercial experience spanning four decades. He was formerly Chief Geologist, Rio Tinto, and Head of Seabed Ore Systems, CSIRO. Since 2007, he has focused on entrepreneurial endeavours in mineral and energy exploration in the Asia-Pacific and Australasia. He was fortunate to be involved in the early days at Kelian and visited the prospect to help design the second round of drilling; and in the Bowdens discovery. Recently retired from serving on the SMEDG Committee for 20 years, he continues as an Executive Director in several unlisted exploration companies which he co-founded.

References

Klein, T., Biggs, D., Holden, D., and Graham, I. (2022); Bowdens epithermal silver deposit: recent knowledge advancements and machine learning cogitations. Mines and Wines Conference, held in Orange, NSW, 11-13 May 2022. https://smedg.org.au/mines-wines-papers-2022-discoveries-in-the-tasmanides/

Terrill, J.E. (1989): Report of EL3252 for Six Month Period ending 12 July 1989, CRA Exploration Pty Ltd, 179pp**.** Open File Reference: GS1989/370.

Pearson, M.F., and K.F. Clark (1990): Geology of the Real de Angeles ore deposit, Zacatecas, Mexico. In: Mexican Silver Deposits, Edited by K.F. Clark, Guidebook Prepared for Society of Economic Geologists, Field Conference: 2-11 March 1990, Guidebook Series Volume 6, 177-192. Series Editor Tommy B. Thompson, Society of Economic Geologists.

Van Leeuwen, Theo, (2015): The Kelian Gold Deposit, East Kalimantan, Indonesia: Its Exploration History, Evolving Geological Model, and "Invisible " Coarse Gold. MGEI 7th Annual Convention, *Indonesia's Mineral and Coal: Discovery to Inventory*. Held in Balikpapan, Indonesia, October 2015. htts://www.researchgate.net/publication/28471650

Appendix – maps and photos

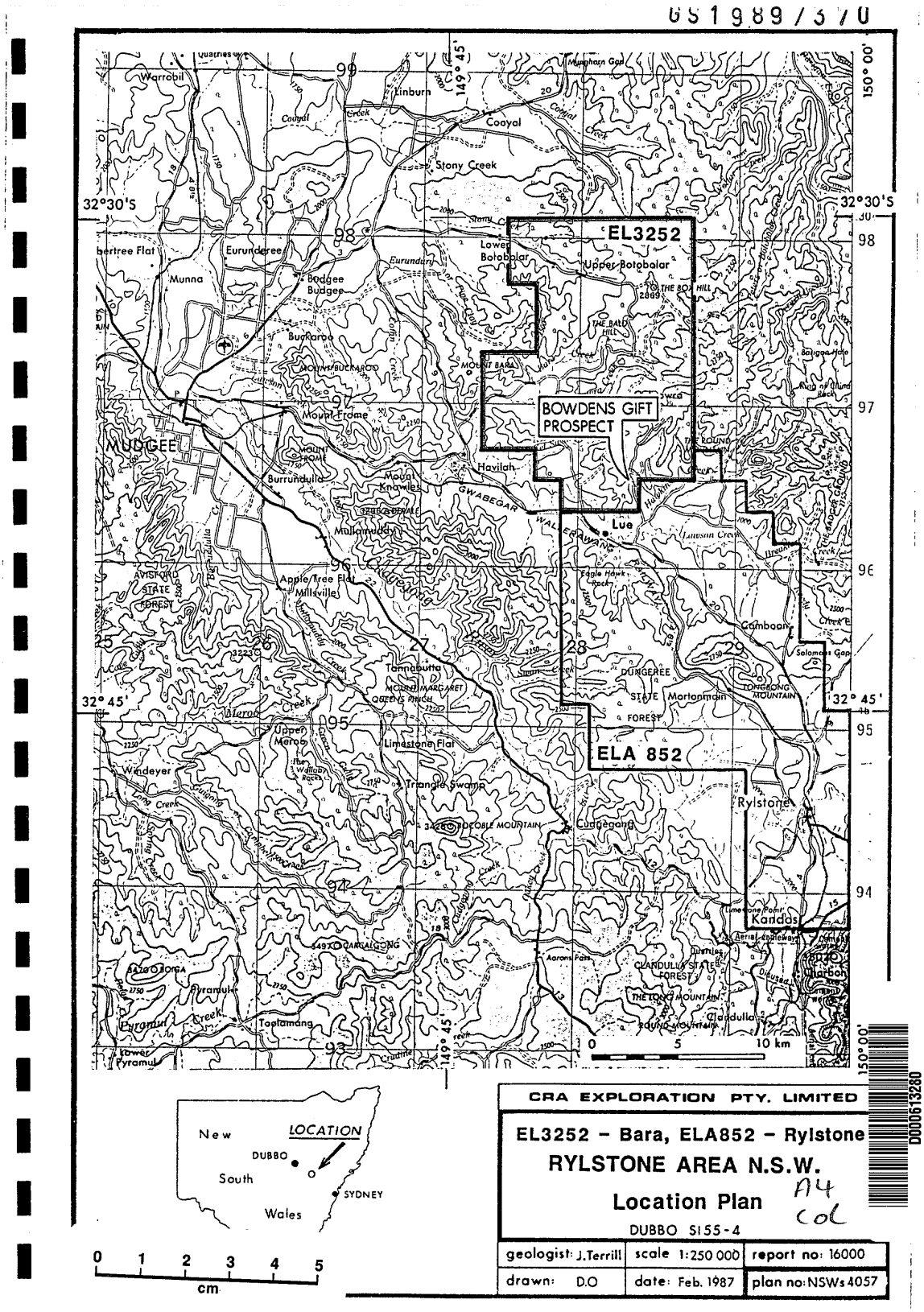

Figure 1. Location map of EL3252 (from Terrill, 1989)

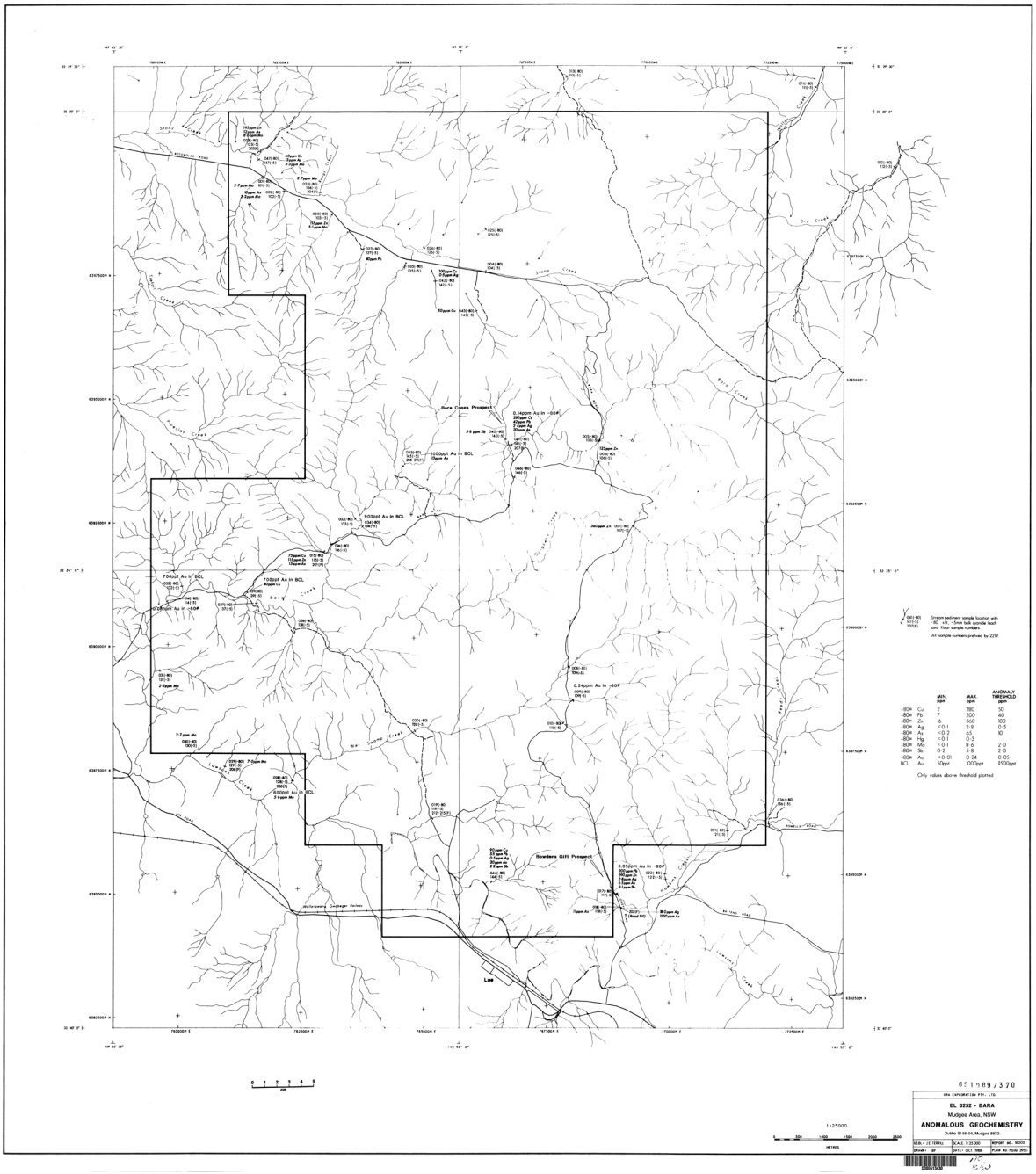

Figure 2. Locations of stream sediment samples
(from Terrill, 1989)

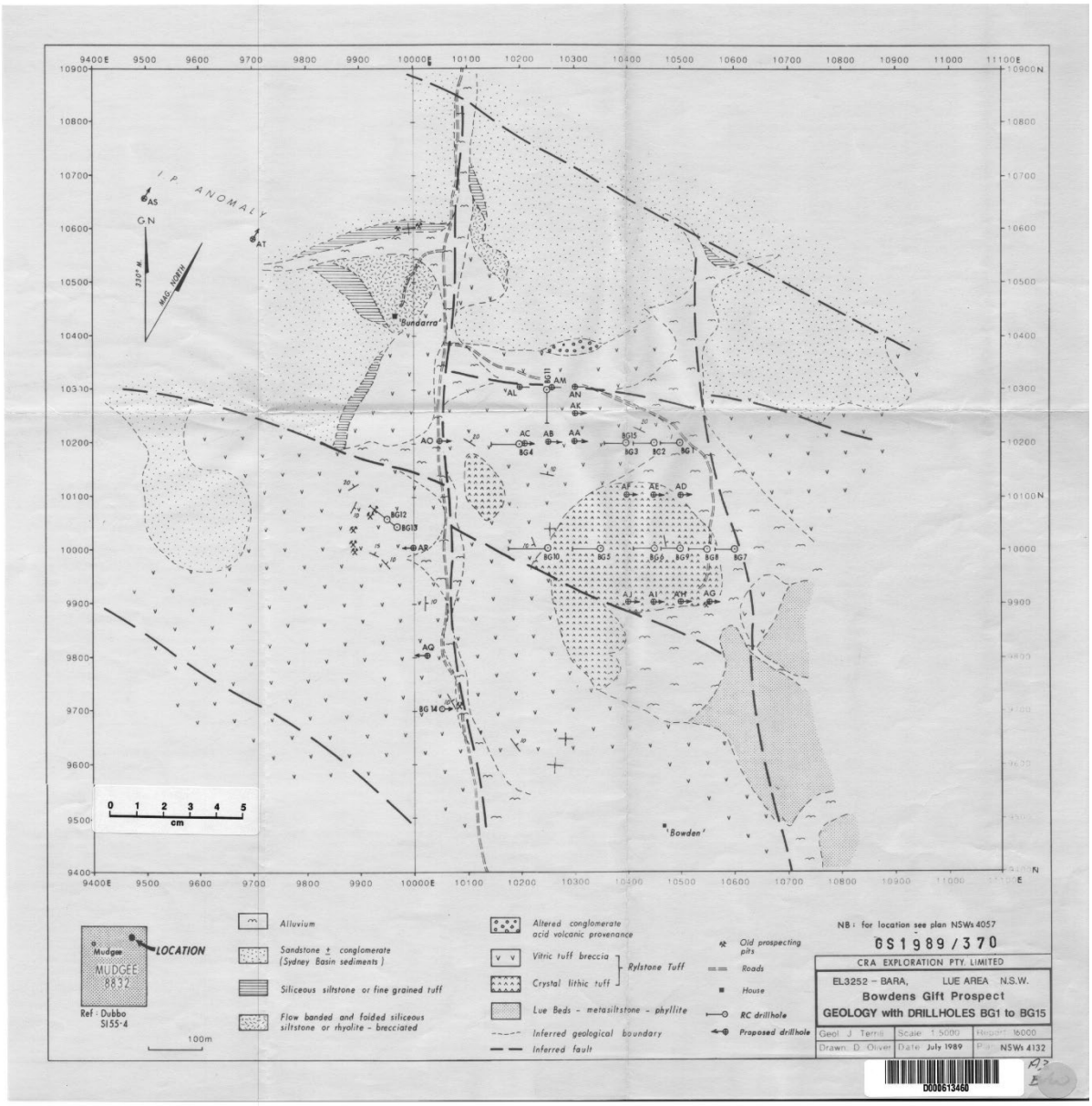

Figure 3. Bowdens – Geology and location of Phase 1 drilling (BG1 to BG15) and planned holes for Phase 2.

(from Terrill, 1989)

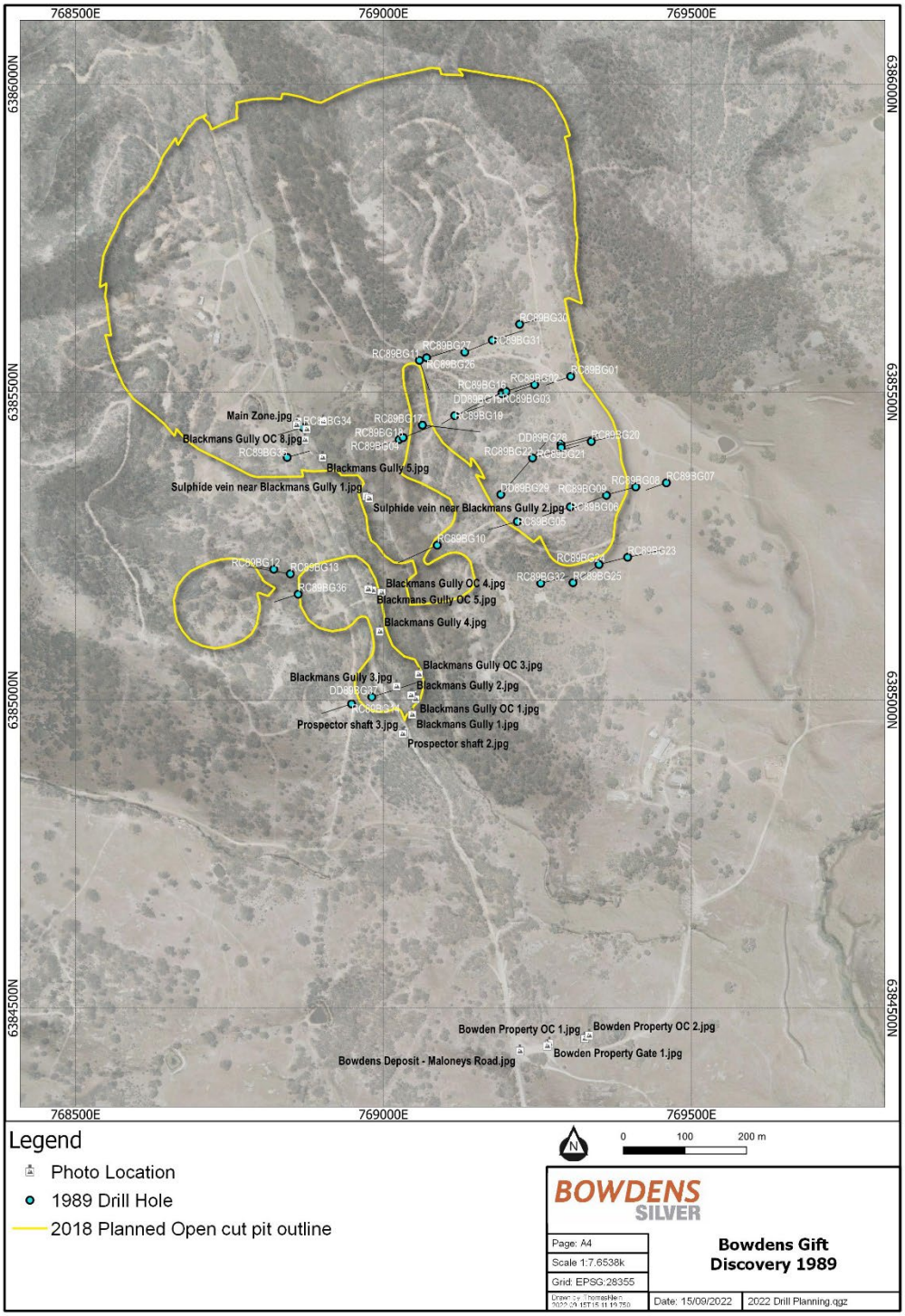

Figure 4. 1989 drillholes overlain on 2018 outline of planned open cut
(source: Tom Klein, Bowdens Silver, 2022)

Figure 5. Blackman's Gully, location of discovery outcrop.
(credit: Tom Klein, Bowdens Silver, Sep 2022)

Figure 6. Blackman's Gully looking southwards downstream to Maloney's Road
(credit: Tom Klein, Bowdens Silver, Sep 2022)

Figure 7. Old prospector shaft, believed to predate WW1
(credit: Tom Klein, Bowdens Silver, Sep 2022)

Figure 8. Blackman's Gull - outcrop of weathered and oxidised, iron oxide rich sulfide vein in Rylstone Tuff.
(credit: Tom Klein, Bowdens Silver, Sep 2022)

Figure 9. Drilling at Coomber silver-lead- zinc prospect and Rylstone Volcanics near Cumber Melon Creek, 25km SSE of Bowdens.
(credit: Dean Oliver, Dean Oliver Graphics Pty Ltd, c1991)