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**BRUCE JAMES BREW AM**

**MBBS(Hons) DMed Sci(USyd) DSc(UNSW) FRACP FAAN**

**Professor of Medicine (Neurology)**

**University of New South Wales**

**Adjunct Professor of Medicine (Neurology)**

**University of Notre Dame**

**Consultant Physician and Neurologist**

**Director, Applied Neurosciences Program and Peter Duncan Neurosciences Unit**

**St Vincents Centre for Applied Medical Research**

**Department of Neurology**

**Level 4 Xavier Building**

**St Vincent's Hospital**

**Victoria Street, Darlinghurst NSW 2010 Sydney, Australia**

**Provider No: 0490165B**

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February 21, 2022


Dear Sir or Madam,

**Re:** Bowdens Silver Pty Ltd application for a development consent under Part 4 of the *Environmental Planning and Assessment Act 1979* for the development and operation of an open cut silver mine near Lue, NSW

Please find enclosed my medicolegal report.

With kind regards

Yours sincerely



Bruce J. Brew AM

Professor of Medicine (Neurology)

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## **Medicolegal Report –**

### **Assumptions:**

In preparing this report I have taken into the following:

1. Report by **Environmental Risk Sciences Pty Ltd 2021 from June 2021**  
(henceforth abbreviated to the Bowden report)
2. Information provided to me by Dr Peter and Jayne Bentivoglio

I have confined my report to my area of expertise namely Neurology but especially cognitive impairment and dementia.

### **Qualifications as an Expert:**

My qualifications as an Expert are as follows; presently I am a Neurologist, Professor of Medicine (Neurology) UNSW, practising at St Vincent's Hospital, Sydney; I have been the head of the department of Neurology at St Vincent's Hospital Sydney from 1993 to 2014; I have been the Director of the Peter Duncan Neurosciences Unit at St Vincent's Centre for Applied Medical Research from 2011 and Director of Neurosciences Programme at St Vincent's Centre for Applied Medical Research since 1990; I established the neuropsychology service for the neurology department at St Vincent's Hospital and the clinical trials unit for the neurology service at St Vincent's Hospital; I also established the stroke unit at St Vincent's Public Hospital; I have been a qualified medical practitioner since 1978; I have been a Neurologist since 1986; I am a member of the Australian and New Zealand Association of Neurologists and a Fellow of the American Academy of Neurology. I have a higher degree Doctorate of Medical Science from Sydney University and a higher degree Doctorate of Science from the University of New South Wales (these higher degree doctorates are the highest degrees within the faculty of medicine at the University of Sydney and within the faculty of science and the faculty of medicine at the University of New South Wales. They are above a PhD). I have been awarded an Order of Australia (Member Division) for my services to Neurology. I have published over 450 papers on various aspects of neurology and authored four books. I am a regular reviewer for a variety of medical journals including The Lancet Group of Journals, New England Journal of Medicine and JAMA. I am also on the editorial boards of several journals. I have also been a member of a variety of advisory bodies at both national and international levels on

various aspects of neurology. My curriculum vitae is available on request.

## **Report**

It is my opinion that the proposed Silver mine poses an unacceptable risk to the neurological health of the surrounding community. I will be using the property of Dr Peter and Jayne Bentivoglio in Rylstone as a sentinel example.

My concern in particular relates to the effects of lead and other minerals (especially Cadmium) on cognitive, motor and peripheral nerve function.

Lead is a well-known neurotoxin (please see review by Goldman and Hu attached). It can cause cognitive impairment in children but more recently it has been appreciated to be a very likely contributor to dementia especially Alzheimer's disease (Bakulski et al). There is also evidence of an association with Parkinson's disease (Weuve et al). In a vulnerable elderly population (over 65 years of age) chronic excess lead exposure is now considered to be a likely "accelerant" to Alzheimer's disease. Such exposure probably accelerates the development of mild cognitive impairment (a precursor to Alzheimer's disease) and results in more rapid progression of those who already have Alzheimer's dementia. In the Bowden report, Table 3.1 records 17-28% of the residents in the areas surrounding the proposed mine are over 65 years of age (p48/140). Further, concentrations that exceed either the health-based drinking water or recreational water guidelines are highlighted in **Table 4.3** of the same report, in blue (drinking water) and purple (recreational water) (lead concentration in the soil was assumed to be 50mg/kg based on previous analyses according to the report). As noted in the report, for the alluvium, springs and domestic bores, concentrations of cadmium, cobalt, lead, lithium, nickel, and manganese exceeded drinking water guidelines.

The report noted the results of rainwater tank sampling that involved 84 tanks located up to 5.85 km from the proposed Mine Site (refer to **Figure 4.5**). **Table 4.4** (see below) presented a summary of metals reported in rainwater tanks. It is noteworthy that ***lead and cadmium concentrations are up to three times the recommended upper limit for drinking water*** depending on the type of tank.

Metal or Indicator	Concentration in rainwater tanks, by tank type (mg/L)					Drinking Water Guideline (mg/L)
	Galvanised Iron	Concrete	PVC or poly	Fibreglass	Average	
pH Value	4.5 - 8.1	5.7 - 8.2	3.9 - 7.7	4.6 - 7.5	--	6.5 - 8.5 for aesthetics (corrosion and taste).*
Arsenic	<0.001 - 0.053	<0.001 - 0.005	<0.001	<0.001	0.0033	0.01
Cadmium	<0.0001 - 0.0017	<0.0001 - 0.005	<0.0001 - 0.0019	<0.0001 - 0.0058	0.00065	0.002
Chromium	<0.001 - 0.013	<0.001 - 0.006	<0.001 - 0.006	<0.001	0.0015	0.05
Copper	<0.001 - 0.3	<0.001 - 0.593	<0.001 - 0.624	<0.001 - 0.436	0.065	2
Iron	<0.05 - 0.66	<0.05 - 1.08	<0.05 - 0.86	<0.05 - 0.06	0.23	0.3 for taste*
Lead	<0.001 - 0.015	<0.001 - 0.037	<0.001 - 0.035	<0.001 - 0.004	0.0059	0.01
Manganese	0.001 - 0.064	<0.001 - 0.061	<0.001 - 0.08	0.003 - 0.075	0.013	0.5
Mercury	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.001
Nickel	<0.001 - 0.029	<0.001 - 0.039	<0.001 - 0.05	<0.001	0.014	0.02
Zinc	0.038 - 6.52	0.027 - 2.89	0.053 - 1.51	0.034 - 4.19	0.89	3 for taste*
Notes: Blue text – exceedance of health based drinking water guideline (cadmium = 4 exceedances, iron = 2 exceedances, lead = 2 exceedances and nickel = 3 exceedances) * No health guideline available						

The Bowden report states that, on average, the deposition rate for arsenic, lead and zinc is 0.002 g/m<sup>2</sup>/month, 0.001 g/m<sup>2</sup>/month and 0.002g/m<sup>2</sup>/month respectively. If these figures are applied to the Bentivoglio property (approximately 5km from the proposed mine) the following lead concentrations would be expected:

Deposition rate 2000mg/m<sup>2</sup>/30d = 2000/30mg/m<sup>2</sup>/d = 71.5mg/m<sup>2</sup>/d

The house roof has a catchment area =1100m<sup>2</sup>

The deposition on the roof = 78,650mg/d or 78,650x1000mcg/d

The water tank has a capacity of 100,000L

Therefore an approx. lead concentration in the tank = 786 mcg/L = 78.6mcg/dL.

Assuming 50% absorption through the gastrointestinal tract as a maximum and 10% as a minimum this = 39.3 mcg/dL to 7.8 mcg/dL. These concentrations are significantly outside the NHMRC recommended limit of 5mcg/dL. This is even more concerning when it is realised that the CDC recently revised its recommended maximum concentration to 3.5mcg/dL for children. It is very likely that a similar threshold is relevant to the elderly.

These figures do not account for dust exposure which could be higher.

In the Bowden report, Figures 5.4 and 5.5 relate incremental lead risk in children at an additional 0.03 and adults 0.05. However, it is unclear whether the risk ratio accounts for the cognitive toxicity in elderly adults. Furthermore, their calculations are based on the geometric mean of 34 soil samples collected in Lue and close rural areas rather than the concentrations in proximity to an elderly population. Moreover, the same geometric mean approach was used for lead in rainwater tanks (concentration of lead in rainwater tanks of 0.0009 mg/L, which is the geometric mean of lead in rainwater tanks as measured by Macquarie University in 2012 (25 samples). But again these calculations do not consider the effect on the elderly. Additionally, the rainwater sampling revealed wide variations in lead concentration so that further lead exposure on a background of baseline

elevations raises significant long term toxicity concerns.

I note that the Bowden report (Annexure – p10/74) relies upon the current advice/statement from NHMRC on the evidence of health effects from lead. However, it must be appreciated that this document has not been updated since its release in 2015. As noted previously, there is now a much greater concern for the cognitive risk in elderly and cognitively impaired patients. Nonetheless, the NHMRC stated that the average Australian blood lead level was less than 5 micrograms per decilitre ( $\mu\text{g}/\text{dL}$ ) and set this as the maximum. While acknowledging the health impact from lead levels above 10  $\mu\text{g}/\text{dL}$  are well established, it stated that levels below 10  $\mu\text{g}/\text{dL}$  had a less clear evidence base. However, the reference used dates to 2014 (Armstrong et al. 2014) and only relates to the potential effects on the cardiovascular system and pregnancy. Further, an elevated blood lead level for an adult is now defined as  $\geq 5\text{mcg}/\text{dL}$  by the National Institute for Occupational Safety and Health (NIOSH)/CDC's Adult Blood Lead Epidemiology and Surveillance (ABLES) program. The same documents emphasize that there is no known "safe" concentration of lead.

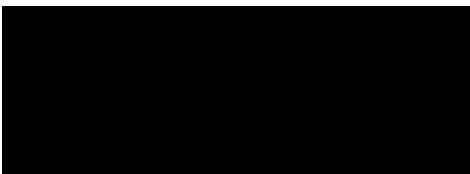
Similar concerns relate to the potential for lead and other minerals especially cadmium to cause a peripheral neuropathy.

### **Summary**

From a neurological perspective, the proposed silver mine raises five significant concerns:

1. The area surrounding the proposed mine has a sizeable elderly population
2. There is growing concern in the scientific and medical literature that chronic exposure to even mildly raised lead concentrations can accelerate Alzheimer's disease.
3. The literature in the Bowden report does not mention such issues in their calculations of risk.
4. Several rainwater tanks and other sources of drinking water in the area already have elevated lead concentrations that will be amplified by the proposed mine.
5. Modelling using the Bentivoglio property reveals potentially very significant elevations in their drinking water.

Yours sincerely



Bruce J. Brew AM  
Professor of Medicine (Neurology)

**References:**

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Bakulski KM, Seo YA, Hickman RC, Brandt D, Vadari HS, Hu H, Park SK. Heavy Metals Exposure and Alzheimer's Disease and Related Dementias. J Alzheimers Dis. 2020;76(4):1215-1242.

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