## Cadia Community Sustainability Network (CCSN)

### (A) The impact on the health of local residents and mine workers, including through biomagnification and bioaccumulation

The community in the Cadia Valley has been concerned by the dust from the mine for several years. Whilst we had no specific information regarding actual deposition and had been told many times that the emissions from the vents were steam, anecdotally many of us experienced a different reality, dust on vehicles and outdoor furniture, visible dust hazes and clouds which enveloped us (Appendix A1 Dust Diary 2019-2023). Many complaints have been made to the regulators and the mine.

The Independent Air Quality Audit dated August 2022 (Appendix A2 - the "Zephyr Report") identified unfiltered emissions from vent 8 were being released at a rate of 360mg/$m^3$ compared to the license level of 20mg/$m^3$. The community received the Zephyr Report in October 2022 and began discussions with Assoc Prof Dr. Ian Wright regarding a preliminary round of water tank testing. The results of these tests and subsequent expanded round of testing are included in Appendix A3. In summary we identified that although the water tanks at the time were generally relatively full and very settled (after a couple of months of dry weather), there was in the sludge in the bottom of the tanks a significant cocktail of heavy metals which we would not ordinarily expect to be in rainwater.

The CCSN has consistently attempted to focus the EPA and NSW Health on the fact that there is something in the bottom of our tanks which should not be there and we did not put there. The issue was, at least initially, less about risk from the point of use (kitchen tap) and more about finding the polluter who has contaminated our tanks.

Following the Zephyr report, the EPA required Cadia Valley Operations (CVO) to commission a Human Health Risk Assessment (HHRA) (Appendix A4 – The Sage Report). This report was presented to the community on 4 September 2023. Although the CCSN believes this report is flawed in its fundamental dust distribution assumptions, it provided some significant information based upon ABS and PHIDU data.

| Statistical Area PHA name | Blayney | Orange Nrth/ Orange Region | Orange | Central West | NSW |
|---|---|---|---|---|---|
| Premature mortality (deaths) by selected cause (0-74 yrs) Avg annual ASR per 100,000 (2016 to 2020) | | | | | |
| All circulatory system diseases | 52.3 | 29.6 | 55.9 | 48.7 | 41.7 |
| Ischaemic heart diseases | 22.3 | 15.8 | 26.9 | 22.2 | 19.6 |
| All respiratory system diseases | 27.0 | 20.3 | 33.8 | 28.9 | 16.7 |
| COPD | 19.3 | 11.8 | 25.8 | 19.4 | 10.2 |

The community closest to the mine lives in the Blayney and Orange health districts. Premature deaths per 100,000 population from pulmonary disease are reported for the Blayney district as 19.3 and for Orange as 25.8. By comparison Orange North/ Region is only 11.8, NSW is 10.2.

- Why has this data, known to NSW Health, not triggered an investigation into the cause of the more than double premature death rate from respiratory disease in our district?

- When the community approached NSW Health this year with concerns regarding potential contamination following a preliminary series of blood tests, with this knowledge and in the context at that time of a potentially criminal dust pollution event under investigation, why did NSW Health issue a webinar (Appendix A5 – GP webinar) to local doctors which resulted in many local doctors refusing to test residents for heavy metal contamination unless they already had symptoms of heavy metal contamination?

- Was NSW Health attempting to impede the community from investigating what was actually happening in our district? This webinar has caused an extraordinary level of distress and anxiety in our community and has all but destroyed our trust in the regulatory system. (Refer Section (D) The adequacy of the response and any compliance action taken by the regulatory authorities…)

**Case Study 1**

**Cadia Valley Residents Health Survey**

During March and April 2023, a number of community members, as a result of concerns regarding test results from our water tanks, had blood tests taken. At this time, the group had no medical advisers to support us. Twenty-three (23) members of the community organised testing for various elements through their local GP's.

These tests, although taken by different pathologists and analysed for different elements appeared to identify a potential pattern of human contamination from heavy metals in the region.

Despite the relatively small number of elements tested for we noticed several potential patterns in our blood results:

- 22/23 samples had copper at high levels within the reference range, some over;
- 13/23 samples had selenium above the top of the reference range
- several samples were tested for creatinine, there was a 94% correlation between selenium and creatinine levels – several were well over the upper reference range, potentially indicating kidney stress
- 4/8 tests for Molybdenum were on the upper range or above
- 2/3 tests for cobalt were substantially above the upper reference range.
- 24-hour urine test for nickel indicated 5/9 samples were on or above the upper reference range.

## Case study 2

Child – 5 years lives 13 km from mine

| Element | Score | Ref range |
|---|---|---|
| **Urine test 19/3/23** | | |
| Nickel | 0.108 | 0.01-0.100 |
| Selenium | 1.6 | <0.40 umol/day |
| Creatinine | 19.9nmol/day | 1.1-8.0 |
| | | |
| **Urine test 15/5/23** | | |
| Nickel | 0.012 | 0.01-0.100 |
| Selenium | 0.2 | <0.40 umol/day |
| Creatinine | 2.5 | 1.1-8.0 |

- Parents have reported significant behaviour change in child

Adult male - lives and works within 8km of tailings dam

- **Blood test 01/04/23**

| Element | Score | Ref range |
|---|---|---|
| Selenium - plasma | 1.7 umol/l | 0.7-1.4 umol/l |
| Nickel | <0.04 umol/l | <0.05 umol/l |
| | | |
| **Blood test 7/08/23** | | |
| Selenium - plasma | 1.31umol/l | 0.89 – 1.90 umol/l |
| Nickel | 11nmol/l | <22nmol/l |
| | =0.011umol/l | |
| **Urine 24 hr test 1/5/23** | | |
| Creatinine | 18.2 nmol/day | 7-17.0nmol/day |
| Nickel | 0.294 umol/day | 0.10-0.100 umol/day |
| | | |
| **Urine 24 hr test 3/7/23** | | |
| Creatinine | 16.1 nmol/day | 7-17.0nmol/day |
| Nickel | <0.080 umol/day | 0.10-0.100 umol/day |

- This is a small data set, however drinking bottled water appeared to result in a significant reduction in nickel, selenium and creatinine for both residents.
- Is it possible that claims by NSW Health and the EPA, following point of use testing, that the water is safe to drink are incorrect?

On 19 June 2023 CCSN approached NSW Health, seeking assistance and advice for community testing. In view of significant pollution events at Cadia which had been happening for several years (resulting in several fines by the EPA, the most recent on 25 August 2022) and the test results received to date the group believed it would be prudent to test a broader section of the community.

On 14 June 2023, NSW Health conducted a webinar to local doctors (Appendix A5). This webinar resulted in many local GP's telling patients in the community that they could not be tested for heavy metal contamination, unless they had symptoms and then only for a very limited range of elements – lead. The community was not notified of the content of this webinar until sometime later.

This was after the group and community had repeatedly tried to alert NSW Health that there may be a problem. (Initial conversations 9 March 2023). All communications with NSW Health, staff have attempted to explain away individual exceedances, NSW Health appears to be unwilling to consider if there could be a pattern emerging from a group of people within the district.

**Case Study 3 – Community Blood and Hair Testing**

In August 2023, in preparation for this Inquiry the community undertook a more extensive program of blood and hair testing, a total of 47 blood and 45 hair samples were collected. The CCSN was advised by Dr Peter Bentivoglio and Pathology at Royal North Shore Hospital. The group created a GoFundMe page for this fundraising, to relieve the financial burden from local families. The CCSN also committed to pay for any child who came for testing with their parents' consent. To date we have spent almost $50,000 testing water, blood and hair, and thousands of hours of volunteer community time.

A control group of 44 was established in the Mudgee district. At the time of taking samples, the Cadia group had, for the most part, been drinking bottled/filtered water for about 5 months. Mudgee group has not been drinking bottled water. The results of this community testing are summarised as follows:

**Mudgee Regional Action Group** – Control Group Blood Tests 44 participants

| Lead | Arsenic | Copper | Selenium | Manganese | Cobalt | Molybdenum |
|---|---|---|---|---|---|---|
| <5.0 ug/dL | < 0.13 umol/L | 11.8-22.8umol/L | 1.19-2.53umol/L | 86-330umol/L | <31nmol/L | 3-16nmol/L |
| 0.4 - 6.0 | <0.01 – 0.15 | 13.5 – 25.2 | 1.42-2.81 | 51 – 25.7 | 4 - 160 | 3-30 |
| 2 | 1 | 3 | 1 | 0 | 1 | 2 |

Total exceedances = 10
Number of participants with 1 exceedance = 9
Proportion of participants with at least 1 exceedance = 20%

**Cadia Valley** – Blood Tests 47 participants

| Lead | Arsenic | Copper | Selenium | Manganese | Cobalt | Molybdenum |
|---|---|---|---|---|---|---|
| <5.0 ug/dL | < 0.13 umol/L | 11.8-22.8umol/L | 1.19-2.53umol/L | 86-330umol/L | <31nmol/L | 3-16nmol/L |
| 0.5-2.4 | <0.01 – 0.19 | 12.6 – 38.9 | 1.38-1.61 | 80 – 284 | 3 -22 | 7-33 |
| 0 | 3 | **9** | 0 | 0 | 0 | **7*** |

Total exceedances = 19
*An additional 7 samples recorded a reading of 15nmol, within the error range for testing.
Number of participants with at least 1 exceedance = 13
Proportion of participants with at least 1 exceedance = 28%

**Cadia Valley** – Children (<16 yrs.) Blood Tests 7 participants

| Lead | Arsenic | Copper | Selenium | Manganese | Cobalt | Molybdenum |
|---|---|---|---|---|---|---|
| <5.0 ug/dL | < 0.13 umol/L | 11.8-22.8umol/L | 1.19-2.53umoL | 86-330umol/L | <31nmol/L | 3-16nmol/L |
| 0.6-1.7 | <0.01-0.19 | 14.3-28.0 | 1.42-2.81 | 134-242 | 7-10 | 16-33 |
| 0 | 3 | 2 | 0 | 0 | 0 | **4** |

Note: Ref range for children is the same as for adults
Total exceedances = 8
Number of participants with at least 1 exceedance = 4
Proportion of participants with at least 1 exceedance = 50%

**Cadia Valley** –Hair Tests 45 participants

| Lead | Arsenic | Copper | Selenium | Manganese | Cobalt | Molybdenum |
|---|---|---|---|---|---|---|
| 1.1-36.2nmol/g | <12nmol/g | 0.13-1.51umol/g | 6.1-23.3nmol/g | 1.5-43.9nmol/g | <1.1nmol/g | <1.7nmol/g |
| 0.3-30.7 | <5 | 0.23-13.1 | 2-3005 | 1-249.5 | 0.1-15.9 | 0.3-1.2 |
| 0 | 0 | **15** | 4 | 3 | **15** | 0 |

Total exceedances = 37
Number of participants with at least 1 exceedance = 27
Proportion of participants with at least 1 exceedance = 73%

**Cadia Valley** – Children (<16 yrs.) Hair Tests 16 participants

| Lead | Arsenic | Copper | Selenium | Manganese | Cobalt | Molybdenum |
|---|---|---|---|---|---|---|
| 1.1-36.2nmol/g | <12nmol/g | 0.13-1.51umol/g | 6.1-23.3nmol/g | 1.5-43.9nmol/g | <1.1nmol/g | <1.7nmol/g |
| 2.1-30.7 | <5 | 0.81-12.9 | 5.5-25.9 | 1.9-38.9 | 0.1-5.3 | 0.3-1.2 |

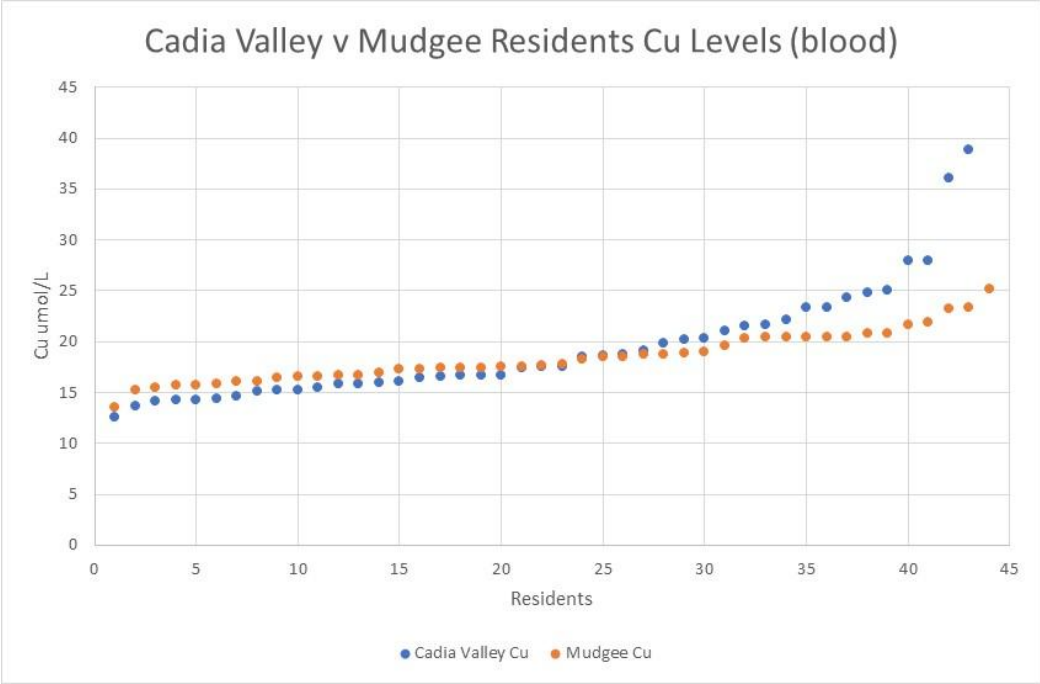
| | | | | | | |
|---|---|---|---|---|---|---|
| 0 | 0 | 7 | 1 | 0 | 4 | 0 |

Note: Ref range for children is the same as for adults
Total exceedances = 12
Number of participants with at least 1 exceedance = 10
Proportion of participants with at least 1 exceedance = 62%

**Blood Test Results**

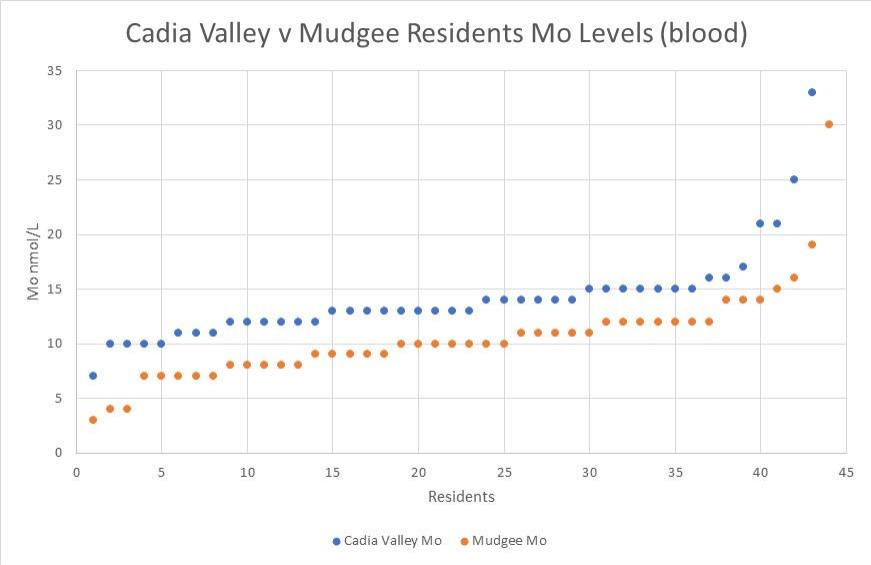
The CCSN believes the Mudgee and Cadia groups would have similar demographics and that both groups would have similar 'outside interferences' e.g., copper pipes. It is therefore appropriate to focus on the differences in trends between the two data sets.

Copper



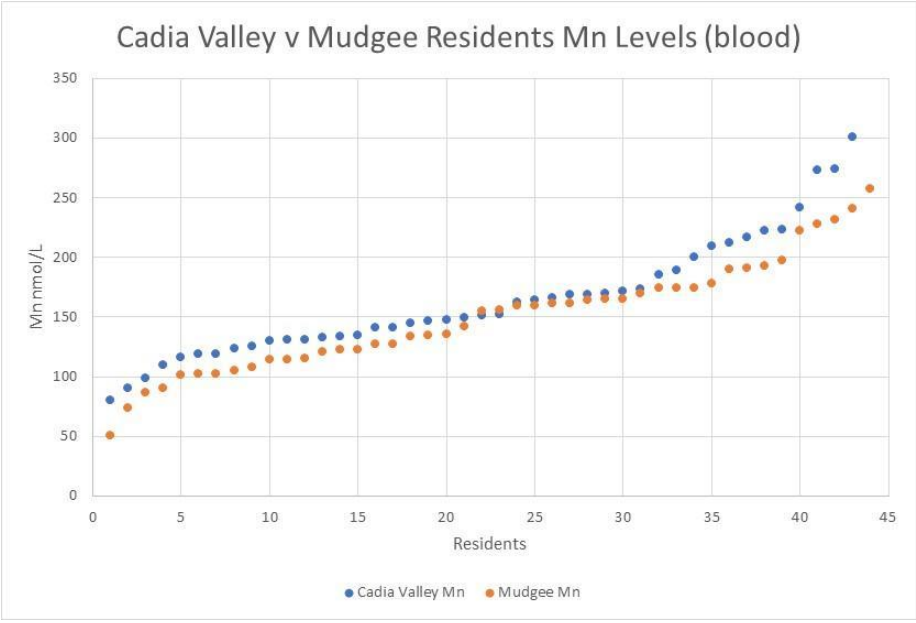

- Three times more exceedances (against health guidelines) for Cadia Valley residents than Mudgee residents
- Average measured copper levels within Cadia Valley residents' blood are 4.9% higher than Mudgee residents
- All the minimum, maximum and range values of copper in Cadia Valley residents' blood are greater than Mudgee residents.
- Higher standard deviation for Cadia Valley residents illustrates more variability and a greater spread in copper levels within blood.

Molybdenum



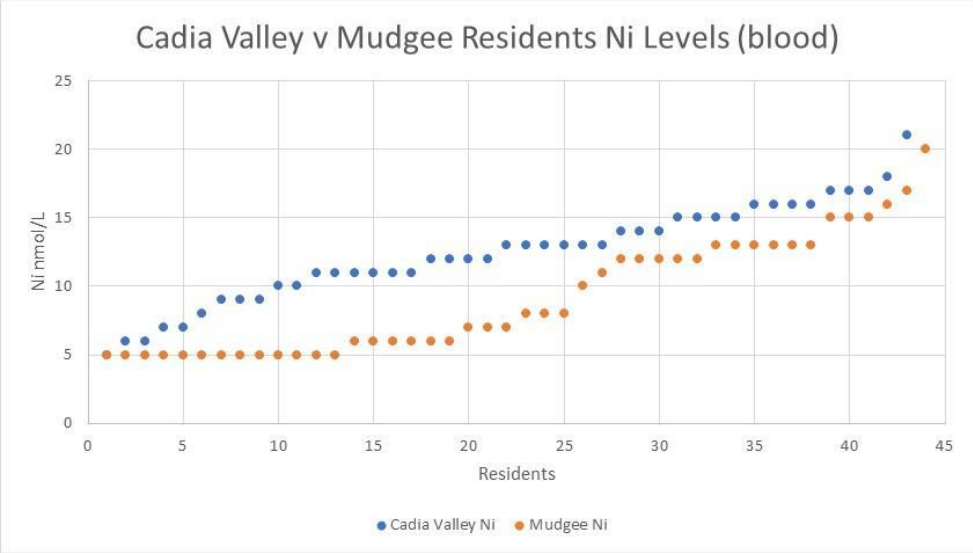

- Cadia Valley residents have higher measured Molybdenum levels in their blood
- Multiple times more exceedances (against health guideline) for Cadia residents than Mudgee residents
- Average measured Molybdenum levels within Cadia residents' blood is 34.4% higher than Mudgee residents
- All the minimum, maximum and range values of Molybdenum in Cadia residents' blood are greater than Mudgee residents.

Manganese



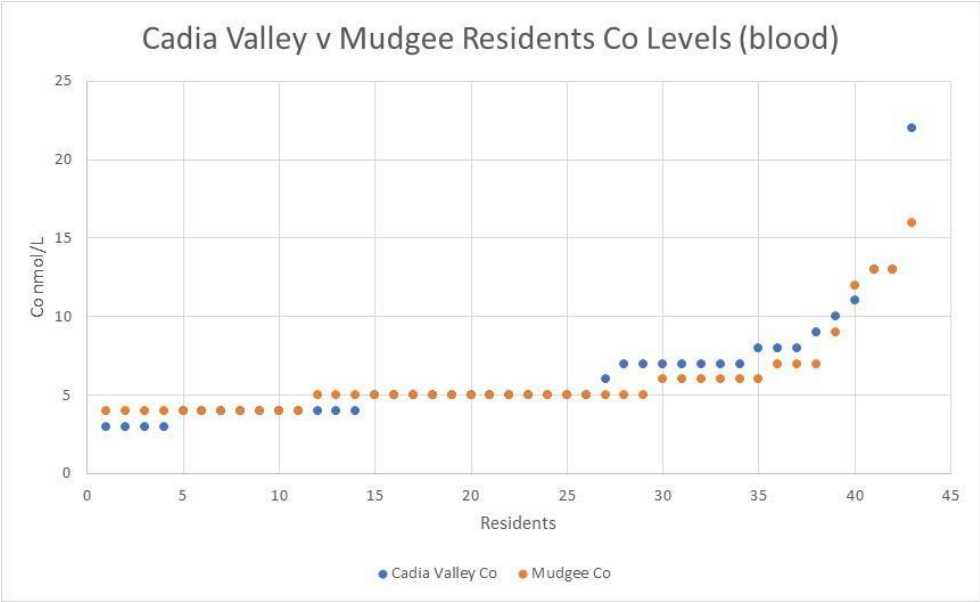
- Average measured Manganese levels within Cadia residents' blood is 9.2% higher than Mudgee residents
- All the minimum, maximum and range values of Manganese in Cadia residents' blood are greater than Mudgee residents.

Nickel




- Average measured Nickel levels within Cadia residents' blood is 35.6% higher than Mudgee residents. 24-hour urine is a more accurate test for nickel contamination.
- Comparison of earlier blood tests with this round of testing indicates that nickel levels have dropped since residents began drinking bottled water.
- Does this indicate that our tank water is not safe under all circumstances.

Cobalt



- One high value (outlier) from the Mudgee resident data set was removed from the graph only. Cadia Valley residents have higher measured levels of Cobalt in their blood than Mudgee for measured levels above 5 nmol/L.

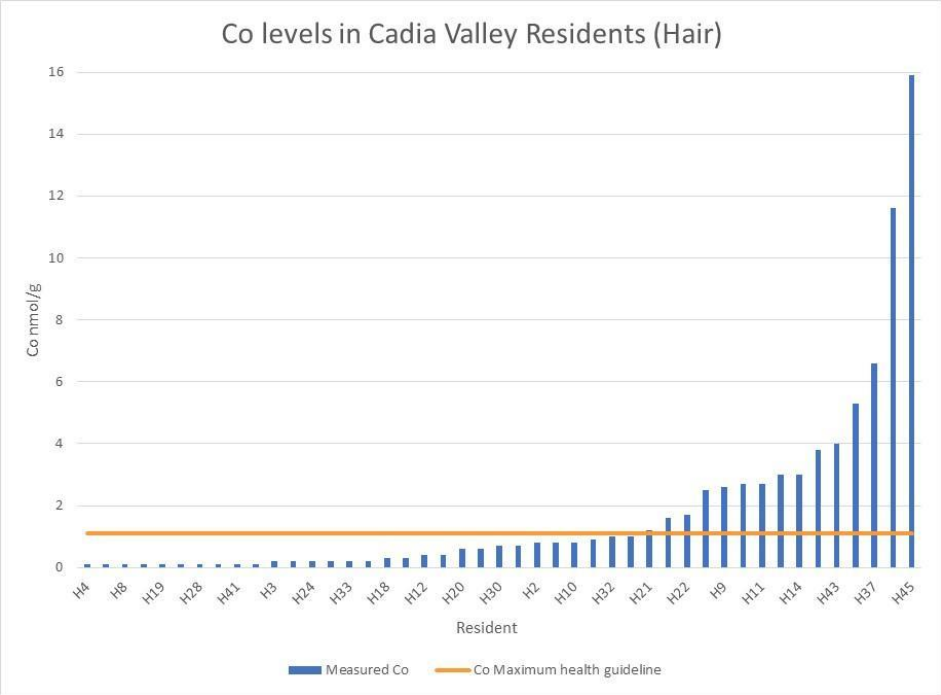
**Conclusions**

After 5 months of drinking bottled/filtered water we noticed:

- Cadia residents have almost double the number of exceedances of Mudgee
- Cadia residents reported higher levels for every element (except lead) tested than Mudgee, (is the lead discrepancy because the Mudgee group was centred around the Lue area, a known potential lead deposit?)
- Cadia residents' blood test exceedances appear to be focussed on a narrow set of elements, primarily Copper and Molybdenum. Whereas the Mudgee group is "scattered" across several elements. Is this a result of drinking bottled water? Have we flushed elements through our excretory systems such as liver and kidney? Is it possible there is a connection between the previously noted elevated creatinine levels and the additional work our excretory systems are doing to flush these elements?
- Selenium, Cadia residents' levels appear to have improved compared to earlier tests
- *Does this suggest that our drinking water was at least part of the problem?*
- Nickel, although Cadia recorded no exceedances, across the data set Cadia recorded significantly higher levels than Mudgee. The most appropriate test we are aware of for nickel is a 24hr urine test.

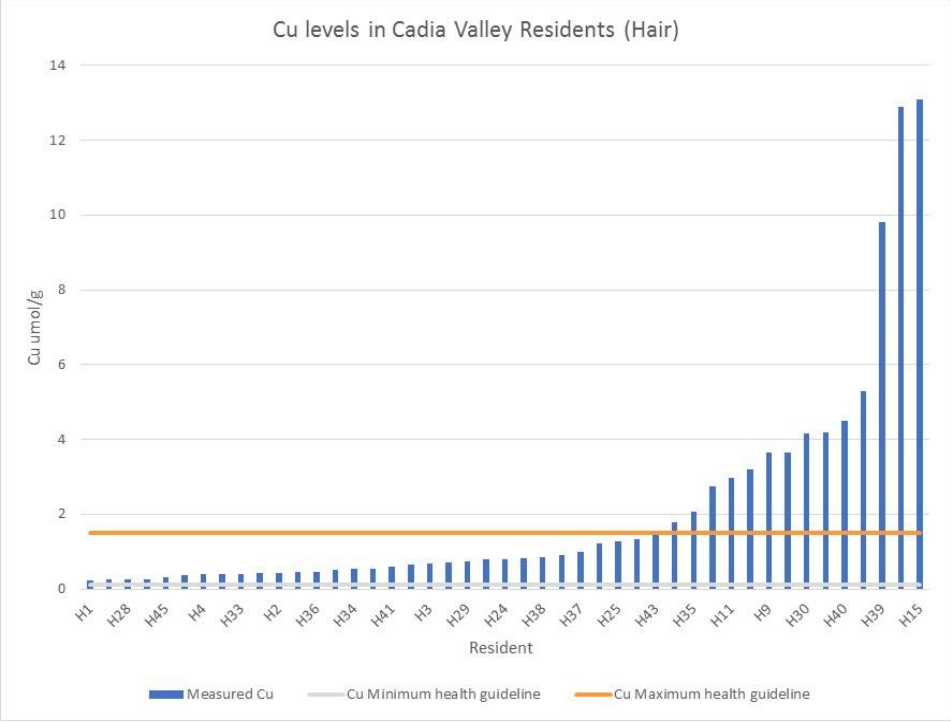
**Hair test results**

<u>Cobalt</u>



- One third (33.33% or 15 observations) of residents tested reported Co levels that exceed the health guidelines.
- The average Cobalt results (1.77 nmol/g) of residents tested is 61% greater than the maximum health guideline value (1.1 nmol/g) for Co within hair.

Copper




- Almost one third (31.11% or 14 observations) of residents tested reported Cu levels that exceed the health guidelines.
- The average Cu results (2.09 nmol/g) of residents tested is 38% greater than the maximum health. guideline value (1.51 nmol/g) for Cu within hair.

**In summary:**

- 33% of hair tests reported an exceedance of cobalt
- 31% of hair tests reported an exceedance of copper
- none of the tests reported an exceedance in hair of molybdenum although many had it in their blood. Is this because molybdenum does not bioaccumulate?
- Do these tests indicate the population has been exposed to cobalt?

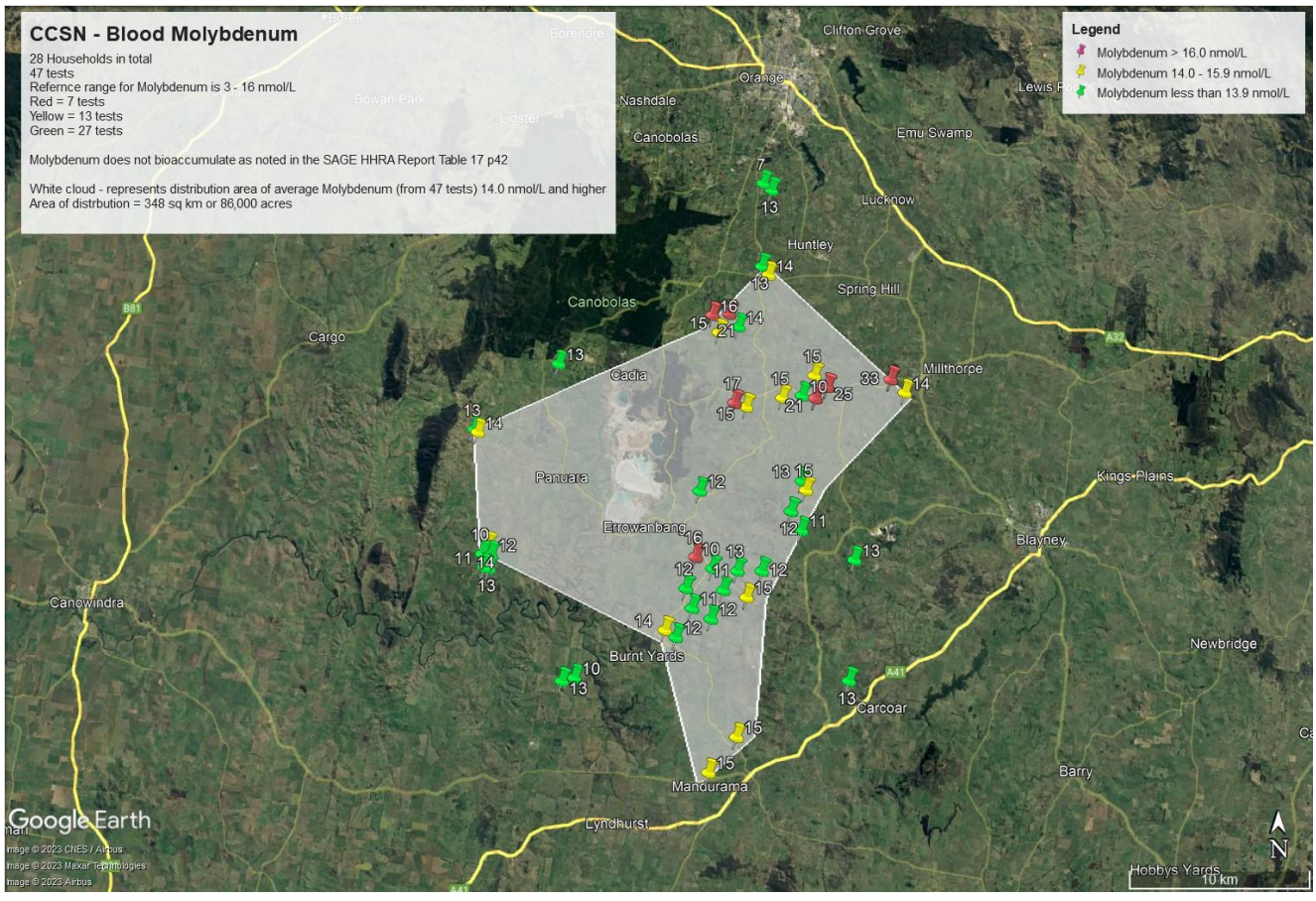
We acknowledge there is some uncertainty regarding the reliability of hair tests however the CCSN believes that where a significant proportion of a data set within a single district is reporting exceedances of very specific elements, this should **not** be ignored.

There is a developing area of research that suggests heavy metal contamination in human hair samples is linked to heavy metal contamination in blood and potential adverse health outcomes (Appendix A6 – *The effect of heavy metal contamination on humans and animals in the vicinity of a zinc smelting facility)*

**Distribution of Blood and Hair Test Exceedances**

Map 1 – Molybdenum

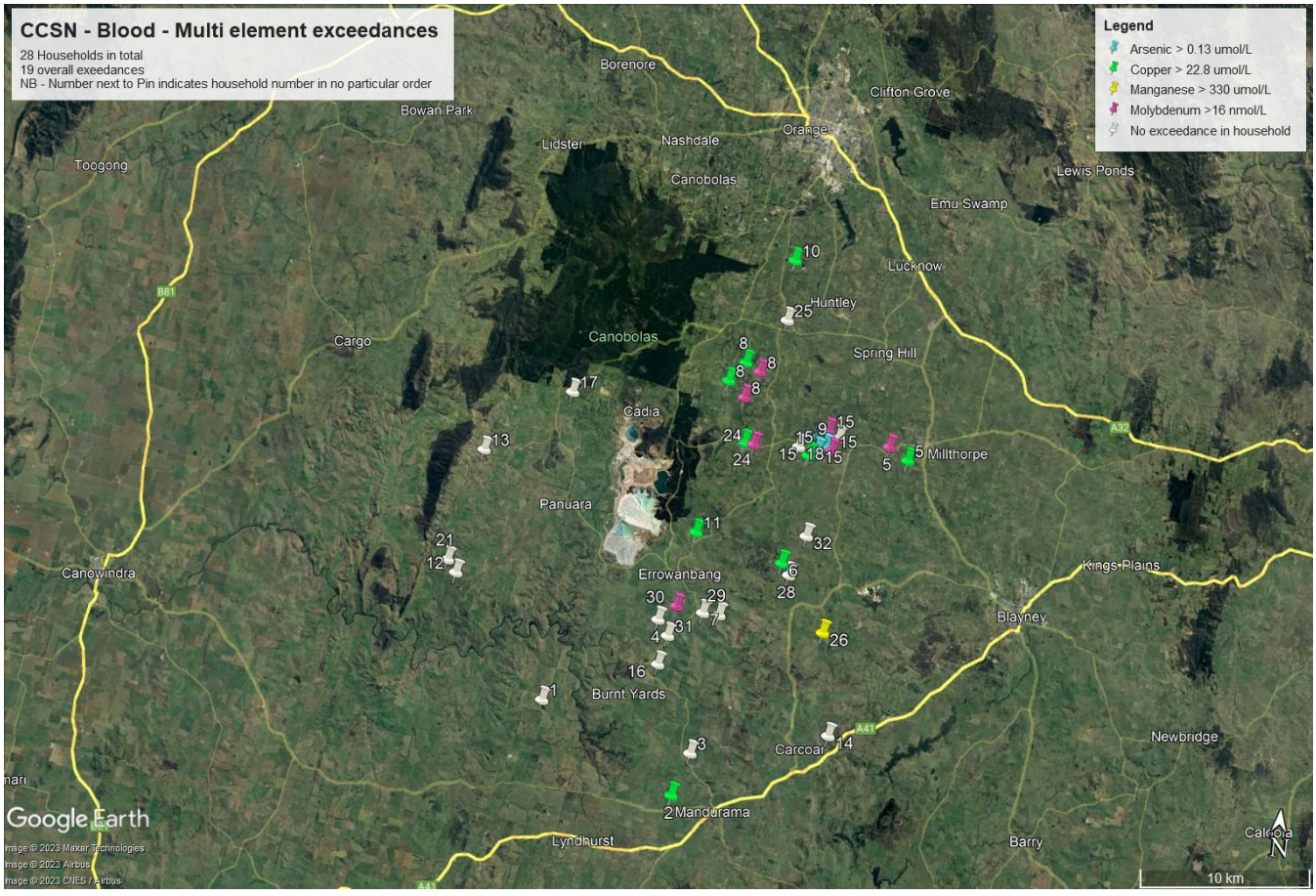
- Molybdenum is a relatively heavy element which we expect to decrease in blood tests as we move further away from a source.
- We may have identified the “drop out” zone to the North and West, it appears the distribution to the East and South East is yet to be determined.
- The distribution of Molybdenum appears to match the expected distribution of dust according to the Zephyr Report p36 of 101 (Appendix A2).
- Lead in the water tank for the residents closest to Millthorpe (Molybdenum levels 33 and 14) was isotope fingerprinted to match CVO ore.
- Copper distribution appears to match that reported in the ANSTO report.
- The estimated area of average distribution for the data set (14 nmol/L) is coloured white and is calculated as 348sqkm. That is equivalent to more than 6 x the area of Sydney Harbour.



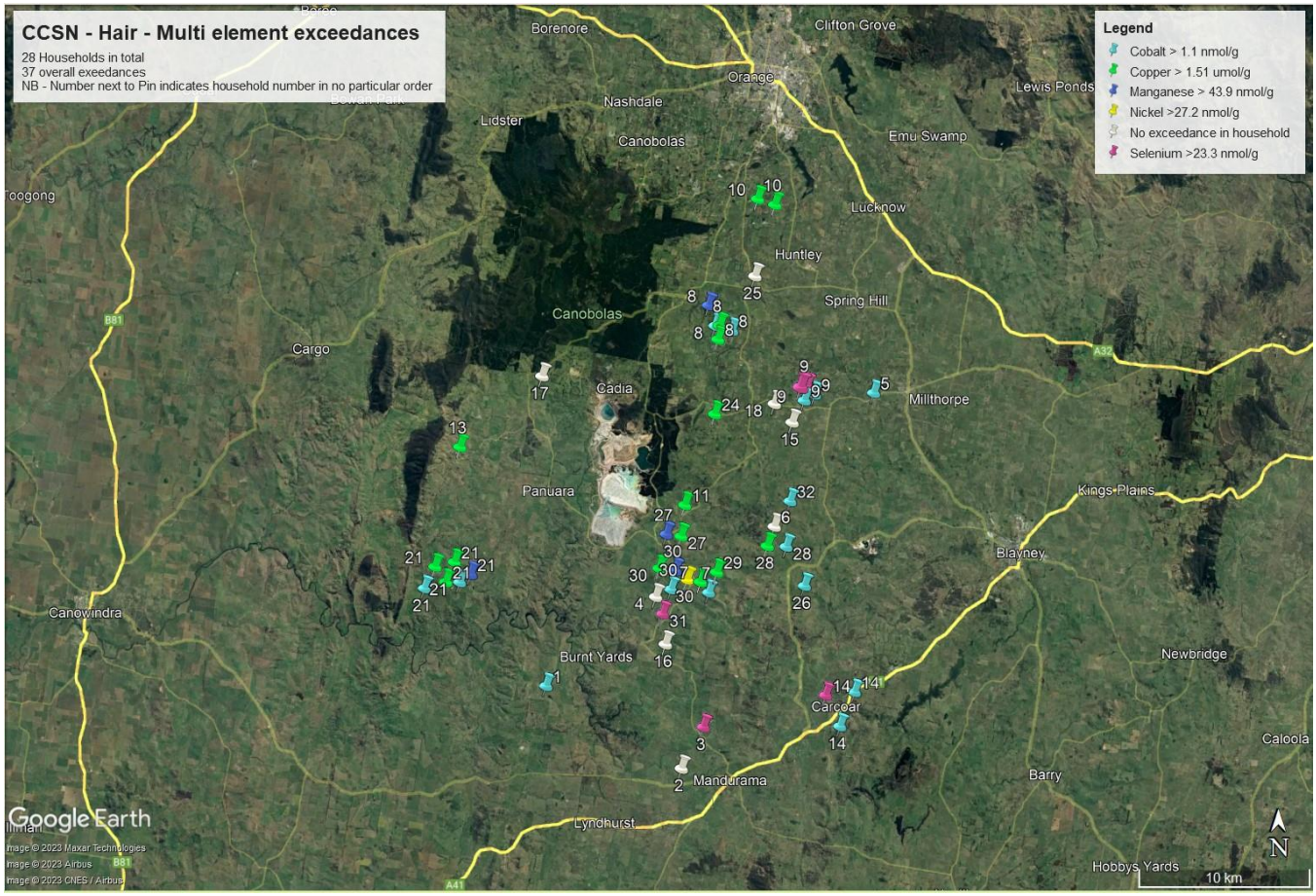
A4 size maps are included as Appendix A8

Map 2 Blood Multi Element Exceedances

- Similar distribution is consistent with the predicted distribution from the Zephyr report. Blood test exceedances are for a narrow range of elements, primarily copper and molybdenum.



Map 3 - Hair Multi Element Exceedances

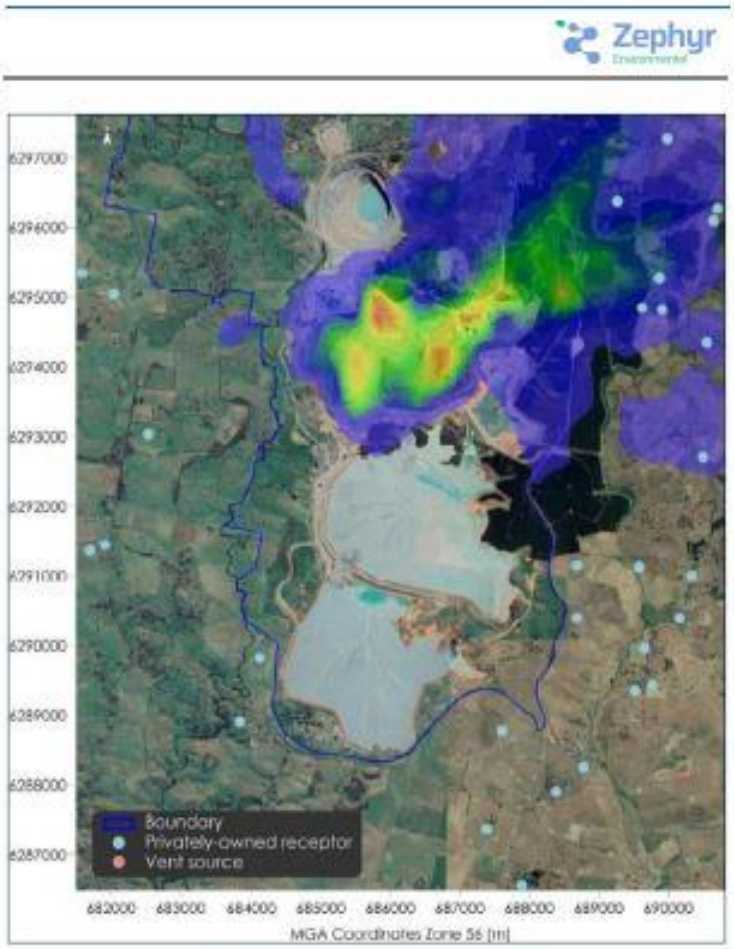



- Multiple exceedances exist across the entire district. Does this demonstrate that whilst there is some concentration towards the North / East the scale of the operation at CVO is such that uncontrolled dust from the tailings dams and the vent shaft will be distributed across a vast area?

The Zephyr Report was commissioned by both the Department of Planning and Environment (DPE) and Cadia Valley Operations (CVO) as a condition of Modification 14. An increase in production from 32Mtpa to 35Mtpa was conditional on a satisfactory Independent Air Quality Audit. This report deemed CVO extraction vents – VR8-1 and VR3-1 were non-compliant.

The Zephyr Report notes 'Regardless, CVO do not currently meet the requirements of the EPL and Clean Air Regulation and work is needed to reduce these in-stack concentrations to below in-stack criteria' p30 of 101 (Appendix A2).

The *Predicted 24-hour average dispersion pattern from CVO ventilation shafts* below shows a purple haze moving in a north easterly direction. A large proportion of hair and blood exceedances within the dataset, in addition to rainwater drinking tank sludge testing results conducted by the CCSN are geographically positioned under this purple haze. We believe the consistency of this dispersion pattern indicates a potential source for these elements.




Source: Figure 2 from TAS 2020b

**Figure 5-17: Predicted 24-hour average dispersion pattern from CVO ventilation shafts**



Appendix A2 p36 of 101 from https://media.caapp.com.au/pdf/tnwrjx/7d34220b-ce50-476e-8215-55ce5a160590/Cadia%20Independent%20Air%20Quality%20Audit%20August%202022.pdf

**Conclusions**

All elements tested for and found in exceedance in the Cadia community's blood and hair tests are found in the tailings (Appendix A7 – *Tailings dust environmental health assessment and monitoring*

*study review – Cadia Valley Operations* p54 specifically columns STSF2 and NTSF4 are surface samples. The impact can clearly be seen of efflorescent salts drawing elements to the surface and concentrating them) and the dust extracted from the vents (Appendix A2 p36). Hair and blood test information is available upon request.

Some elements, such as Molybdenum, are rare. Their relative abundance in our hair and blood tests suggests a local source.

Some elements, such as cobalt, are found deep in the earth's core and would not usually be found in local surface dusts. The high levels of cobalt in our hair tests suggests the population has been exposed to this element.

We expect copper to be in greater abundance in the vent dust than the tailings, Cadia is a gold and copper mine and has extracted most of the copper before placing waste in the tailings dams.

The distribution of copper in the community's blood tests appears to be consistent with the findings of the ANSTO report (Appendix I "the Soil fingerprint at Millthorpe, Panuara and Orange sites also included Cu as a correlated elemental driver" p74)

Lead in water tanks close to Millthorpe, approximately 13km from the Cadia site has been isotope fingerprinted to Cadia ore (Appendix A9 - *An Evaluation of Lead Isotopic and other Geochemical Information of Relevance to the Cadia Mine operations*).

A precautionary approach requires assessment of the impacts of contamination to take into consideration the following:

- there is no research available into the impact on human health of long term exposure to multiple metal elements.

- the residents of this district already have double the rate of premature mortality from pulmonary disease when compared to North Orange and NSW. Dust is a key contributor to pulmonary disease.

The reference range for children is the same as for adults. As a community we are concerned by the impacts of long term exposure of multiple elements on developing bodies and question if that is an appropriate standard.

**Recommendations**

1. *We believe there are sufficient heavy metal exceedances in our data set to require a full independent study of the extent and impact of this human contamination in our region. The EPA and NSW health have focussed their testing on proving if the point of use is safe at a given point in time. This does not address how did these elements get into our tanks and if the water is safe at the point of use how did we get contaminated blood?*

2. *Buffer zones around mines seem to be totally inadequate.*

    - *Lead from Cadia has been fingerprinted in water tanks 13km from the mine. Other heavy metals are being broadcast over the community.*

- *There is no guarantee tailings dams won't fail (CVO NTSF 2018). In order to be rehabilitated a tailings dam must be dried out, this will cause significant dust events.*
- *The approvals process has not properly recognised or considered the impact of a mine under all scenarios throughout the life of the mine.*

3. *Assumptions about risks associated with drinking water tanks are incorrect.*

    - *Drinking water tanks act as an accumulator and concentrator of air borne contaminants*
    - *A mine as a neighbour should not results in an entire district having to clean their tanks and filter their water. That is an impost on the community caused by the mine.*

4. *Regulators need to be given serious enforcement powers to ensure health situations such as this never happens again.*

5. *Health assessments of current mines and proposed mines should be determined based upon **actual** environmental health data and should take into account the pre mining health data of a community. Desktop analysis is inappropriate and inadequate.*

    a. *In the case of the proposed McPhillamys mine in Blayney, how can this development be approved without taking into account the already poor health outcomes in the district. Residents live within 1km of the pit.*
    b. *In the case of the proposed Bowden's mine at Lue, how can that be approved without taking into account the actual dust dispersion experienced in other districts. Lead in our district is travelling at least 13km, the drop out distance in this area is currently unknown and needs to be ascertained.*

6. *Environmental Health Assessments should be part of the Environmental Risk Assessment.*