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# ACID MINE DRAINAGE - COMMUNITY PERCEPTIONS

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## ABSTRACT

A case history describing a recent occurrence at the site of the abandoned Brukunga pyrite mine in which tenants of the South Australian Government's Housing Trust (which currently owns and operates the mine township as rental accommodation) expressed concerns about risks to their health arising from the operations of a plant designed to treat mine drainage water (pH 2.5).

Concerns arose when, after an extremely wet winter, crystals appeared in the soil around and beneath houses. Some tenants claimed that the crystals were a health risk and alleged that they were the result of seepage from the nearby mine tailings dam.

Investigation carried out under instructions from the South Australian Health Commission showed that the crystals and other minor geochemical anomalies were due to weathering of the naturally occurring pyritic schist with pyrite veins beneath the township. Low level health risks associated with skin or eye/nose contact and ingestion of soil are considered to be present at any site where similar geological conditions exist

Clearly, in the minds of the general public, the tailings dam and acid treatment plant were identified as the cause of the problem regardless of the scientific facts.

## BRUKUNGA PYRITE MINE

The Brukunga Pyrite Mine and township are located in the Southern Mount Lofty Ranges, approximately 35 km east of Adelaide (fig. 1). The mine was established in the early 1950s as a source of sulphur for the manufacture of superphosphate fertilisers.

A glut of sulphur on world markets forced the closure of the mine in 1971-72. The mine was abandoned without site rehabilitation and under the terms of the mining

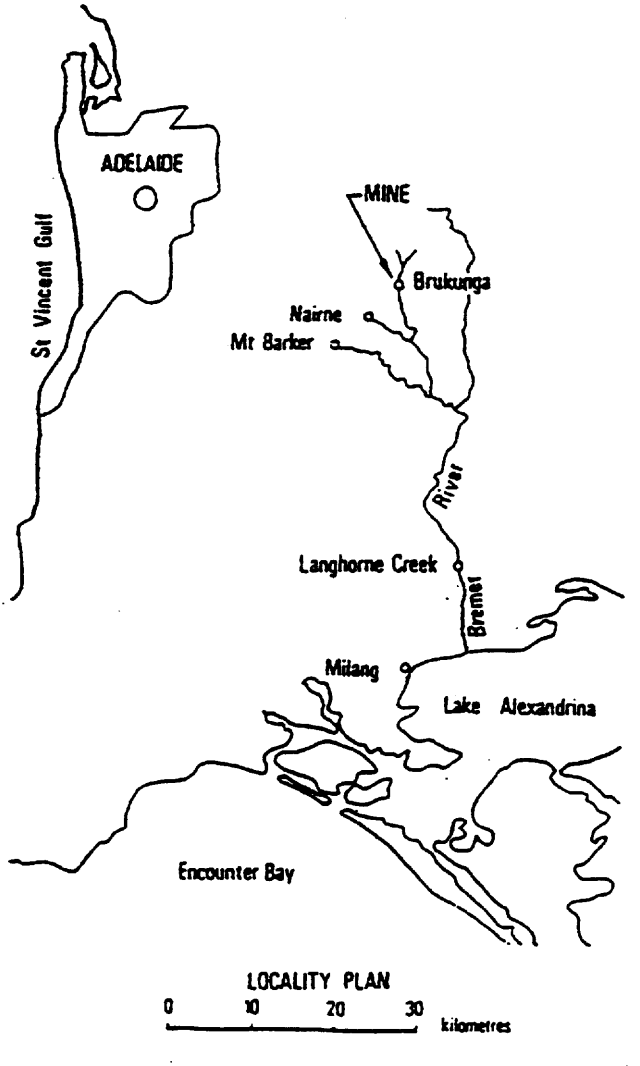


Figure 1. Map of The Brukunga Pyrite Mine in Southern Mount Lofty Ranges

lease, the operating company had no obligations to fund clean-up and pollution prevention measures.

The mine and tailings dam have been a major source of acid mine drainage (Smith and Hancock 1992) into Dawsley Creek which enters the Bremer River, a source of irrigation water for the Langhorne Creek grape growing area. The Bremer River flows into Lake Alexandrian which provides water supplies for pasture irrigation and several townships.

Shortly after the closure of the mine the estimated annual heavy metals load entering Dawsley Creek was: Fe 200 tonnes; Al 150 tonnes; Zn 20 tonnes; Mn 15 tonnes; Ni 1 tonne; Co 1 tonne; Cu 0.5 tonne; Cd 0.1 tonne; and in summer (dry season) the pH of seepage water was around 2.5 reflecting a very high level of sulphate.

Concerns over the water quality led to the State- Government accepting responsibility for rehabilitation works in 1976. An acid treatment plant was commissioned in 1980 to treat water collected from the mine and tailings dam. Three seepage collection ponds were installed in 1982 and all water from these ponds is passed through the treatment plant (fig. 2) which has a maximum capacity of 140 megalitres per year. Many other trial remediation measures are in place including revegetation to reduce water entry to the tailings and quarry benches and the use of sewage sludge on quarry benches to provide a means of reducing the amount of oxygen available for oxidation of pyrite.

By 1985 the treatment plant had largely eliminated pollution loads to Dawesly Creek but diffuse seepage from the mine and waste dumps continues. The plant continues to operate, and unless remedial measures can effectively control acid drainage impacts, will continue to do so into the foreseeable future at considerable cost to the taxpayer.

## BRUKUNGA TOWNSHIP

When the mine was established, 57 houses were constructed by the South Australian Housing Trust (SAHT). Upon closure of the mine the houses reverted to SAHT as part of their stock of rental accommodation. During the life of the mine the township expanded to include 70 houses, some of which were privately owned. SAHT currently retain 52 houses within the township.

The township was constructed to the east of the Dawsley Creek whilst the mine quarry is on the western side of the creek (fig. 3). The tailings dam occupies a broad valley on the eastern side immediately to the south of the township and does not represent any threat to the safety of the houses in the event of a catastrophic failure.

Brukunga township offers low rental accommodation in a predominantly rural setting and many families are happy to live there.

## GEOLOGY OF THE SITES

Brukunga mine and township are situated on outcropping rocks of the Kanmantoo Group (Cambrian) which occur extensively throughout the eastern part of the Mt Lofty Ranges. The rocks strike north south, dip steeply towards the west and consist of greywakes, metasiltstones and metasandstones. The metasiltstones are pyritic and contain many thin pyrite bands throughout in addition to the massive Brukunga Pyrite horizon which occurs at the top (western side) of the sequence and forms the orebody at the Brukunga Mine.

Elsewhere, the same formation hosts orebody grades of copper (Kamnantoo Mine) and silver-lead (Aclore Mine now abandoned) (fig. 4). Copper, lead, zinc, manganese, nickel, cobalt and cadmium occur in minor amounts associated with the pyritic metasediments.

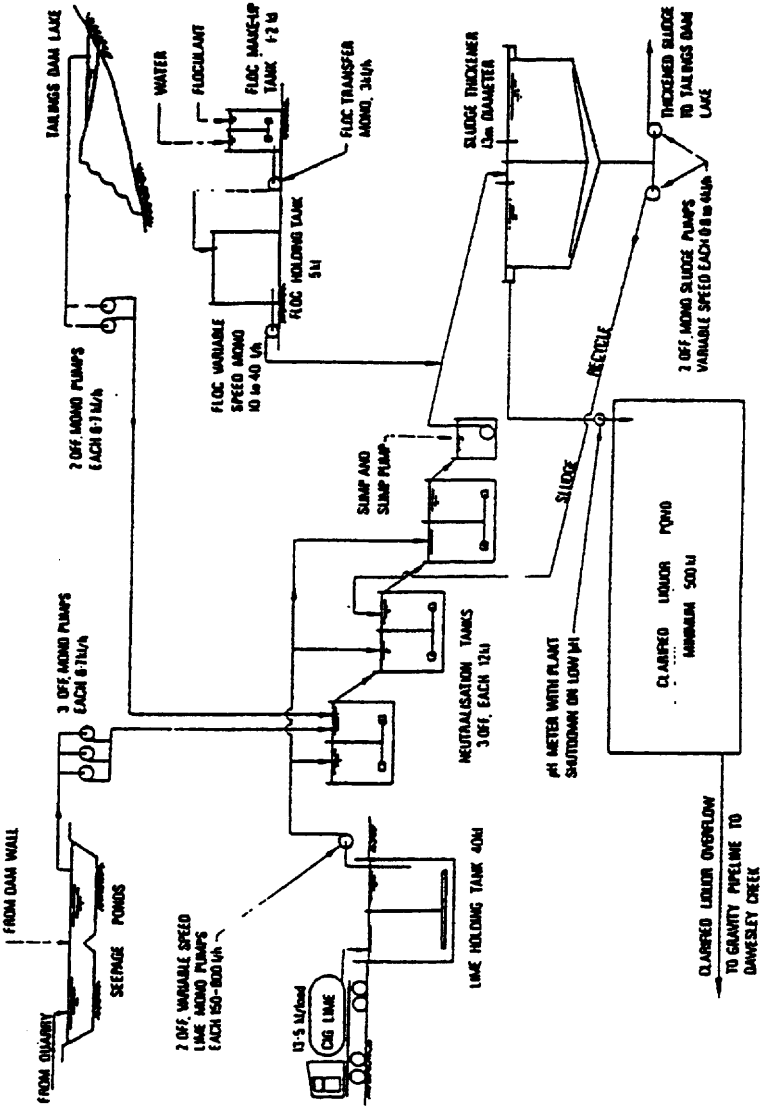


Figure 2. Neutralisation Plant Flowsheet

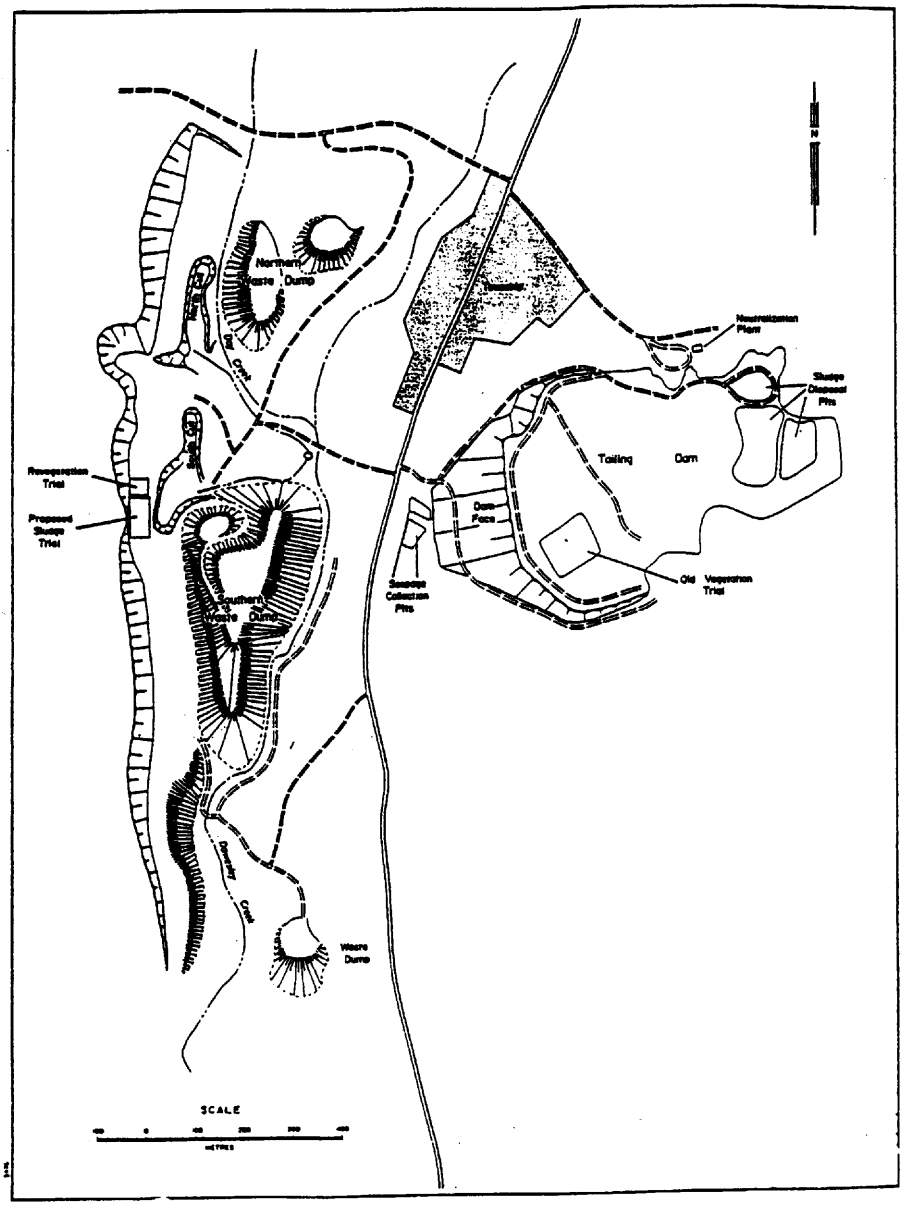


Figure 3. Site Plane of the Township.

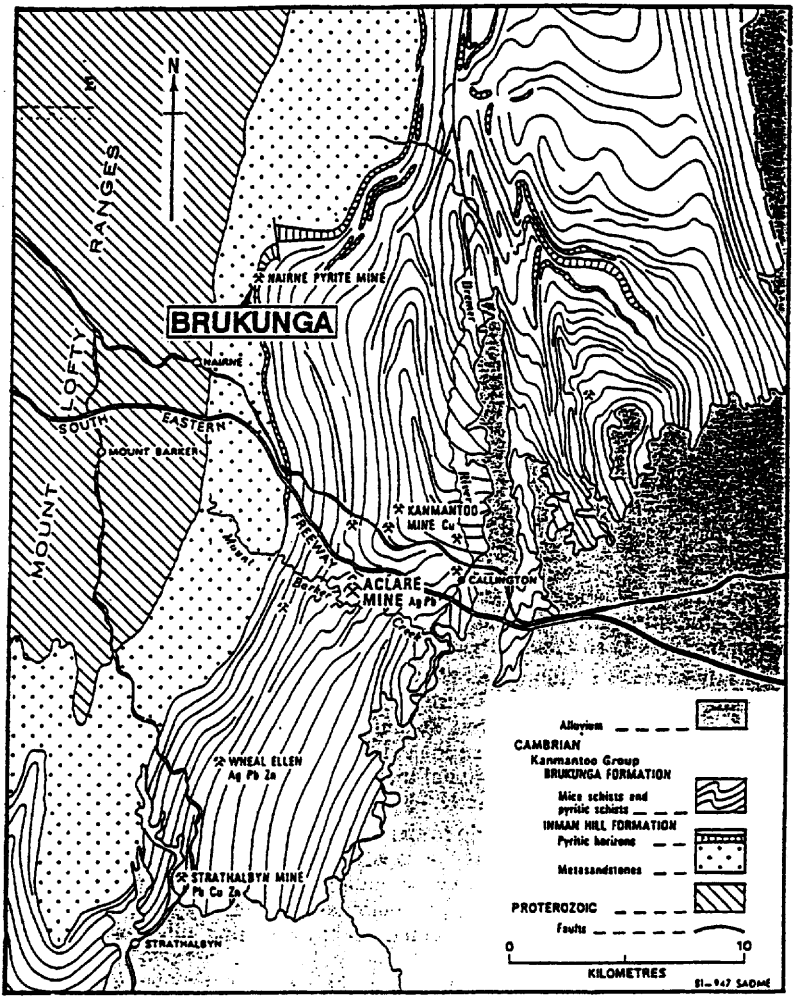


Figure 4. Geology of The Mine.

The township is thus located within a geological environment which has a high potential for generating acidic groundwater with relatively elevated heavy metals, by natural weathering processes.

## THE CURRENT PROBLEM

The closest long term rainfall station is at Mt Barker, some 10 km to the southeast of Brukunga.

The 50 per centile annual rainfall at Mt Barker is 751mm. Records are only available for the years from 1985 onwards for Brukunga. The figures indicate that for the seven year period 1985/91 the average rainfall at Brukunga was 580mm (fig. 5).

In 1992 an exceptional 855mm was recorded at Brukunga, most of the excess falling between August 1992 and January 1993. The majority of recharge to groundwater occurs during the winter months, May to October, in normal years. Vegetation and seepage to surface drainage help maintain an equilibrium, fairly deep, groundwater level.
In 1992 the winter provided roughly double the normal rainfall and the recharge period was prolonged into summer resulting in rising groundwater levels.

Weathering products from the pyritic sub-soil zone were dissolved and carried into the near surface soils and concentrated at the surface during the summer, in the form of crystalline encrustations in areas which had been damp during the winter, such as areas beneath houses. (The majority of Brukunga dwellings are of timber frame construction built on timber stumps).

Late in 1992 a relatively new tenant reported that the family dog was losing hair after contact with 'crystals' under the house and concerns were expressed regarding the threat to the health of small children playing in the vicinity of the crystals. As a result of media coverage a number of State Government departments became involved in the investigation of the occurrence, medical effects and remediation of the 'crystals'.

The departments involved were: SAHT; South Australian Health Commission (SAHC); Environmental Health Branch, Engineering and Water Supply (E&WS) who operate the Acid Treatment plant; Department of Environment and Land Management (DELM); Department of Mines and Energy (DME) responsible for rehabilitation at the mine and tailings dam.

The main concerns expressed to SAHC were that a child had ulcers in the inner part of her lower lip on three occasions during January 1993. The mother attributed this to contact with the 'crystals' in the soil. Another resident complained of an eye problem over the past two years, but the problem had become worse recently. Three dogs (belonging to three different homes) had been sick recently with symptoms such as dropping of hair, vomiting and loss of weight, and the residents of two houses complained of an odour resembling 'rotten eggs' or 'sulphur' in their homes after rains.

An intensive programme of investigation was initiated which included soil and air sampling, testing samples for aqua-regia soluble and saliva soluble heavy metals, research into the toxicity of the levels detected and interviews with veterinary surgeons in the area.

The Commonwealth Scientific and Industrial Research Organisation (CSIRO), Division of Soils, was engaged to provide an unbiased assessment of the analytical results.

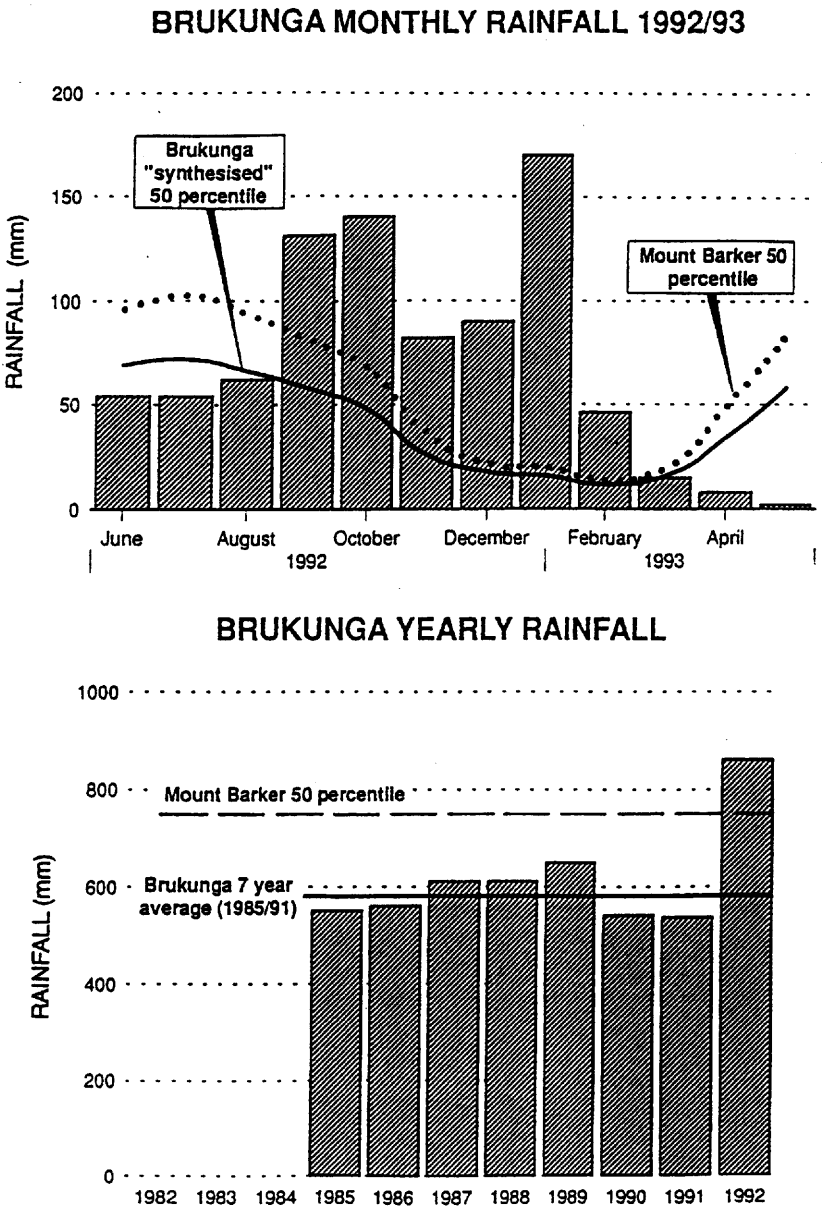


Figure 5. Brukunga Monthly Rainfall 1992/93

In the course of interviewing complaining residents it became apparent that their perception of the situation was coloured by panic over the threat to theirs and their children's and pet animals health, misunderstandings about the function of the acid treatment plant, and in some cases a desire to be relocated to the city.

At least one family believed that the acid treatment plant was treating waste acid from all over Australia since they had seen a tanker truck making regular deliveries to the plant. (The tanker truck was actually making the regular delivery of lime, the major reagent in the process).

The same family, and several others, attributed their perceived problems to the presence of the tailings dam and treatment plant, alleging that 'spillages' from the plant or leakage of contaminated groundwater from the tailings dam must be responsible for the appearance of the crystals which were only a visible symptom of the totally unhealthy environment at Brukunga

These are the people who were most anxious to expose the situation to the media aided by a trades union official who wished to see justice done.

The detailed investigation revealed that the 'crystals' were all of the Alum group ie hydrated alumino-sulphates of sodium, magnesium or iron, all of which are produced by oxidation of pyrite in the presence of alumino-silicates. SAHC found that the crystals, due to their potential to produce acid solution on reaction with saliva or perspiration, have a potential to produce irritant effects and skin contact eye-nose contact and ingestion should be avoided. It is interesting to note that a veterinary surgeon who treated one of the dogs considered that the skin and hair loss problems were due to mange caused by a seasonal flea problem.

Soils beneath the houses (pH 3.4 to 7.3 av. 5.0) and to a lesser extent in the gardens (pH 4.4 to 9.2 av. 6.3) are considered to have a potential to cause skin irritation after short term or prolonged contact.

Air samples failed to reveal the presence of $H_2S$ or $SO_2$ gas above the limit of detection of the equipment (0.002 ppm) at the time of sampling. In such a sulphur rich environment it is likely that these gasses may be present in the atmosphere under suitable weather conditions.

All of the phenomena associated with potential health risks at Brukunga township are believed to be due to natural processes occurring in a pyritic geological setting. If they are a health risk at Brukunga then they are also likely to be hazardous at any location where the subsoil materials are rich in pyrite.

The habit of the general pubic (and the media) to link APPARENT CAUSE and OBSERVED EFFECT results in the mining sector frequently being blamed for all environmental problems in the vicinity of a mine. In the case of Brukunga this has resulted in a certain degree of panic amongst long term residents, strong polarisation of the community, and fears of falling property values in the minds of those people who have purchased their own homes in the township.

The perception, by the general public, of Brukunga as an unhealthy environment due to its proximity to the mine, tailings dam and acid treatment plant has been heightened by media reporting of emotional views expressed by people who do not understand the complexities of the situation and may have ulterior motives.

Authorities such as SAHT are becoming aware that they must explain the environmental circumstances very clearly to new and existing tenants thus attempting to establish an open relationship in which the government has nothing to hide.

In some parts of the world, especially in developing countries, MINING COMPANIES could easily be substituted for GOVERNMENT in the previous paragraph.

Failure to be honest with the public over environmental issues will only lead to confrontation and possibly costly litigation.

## REFERENCES

Smith & Hancock. 'Brukunga - the Acid Test' in Waste Disposal and Water Management in Australia Dec. 1992.