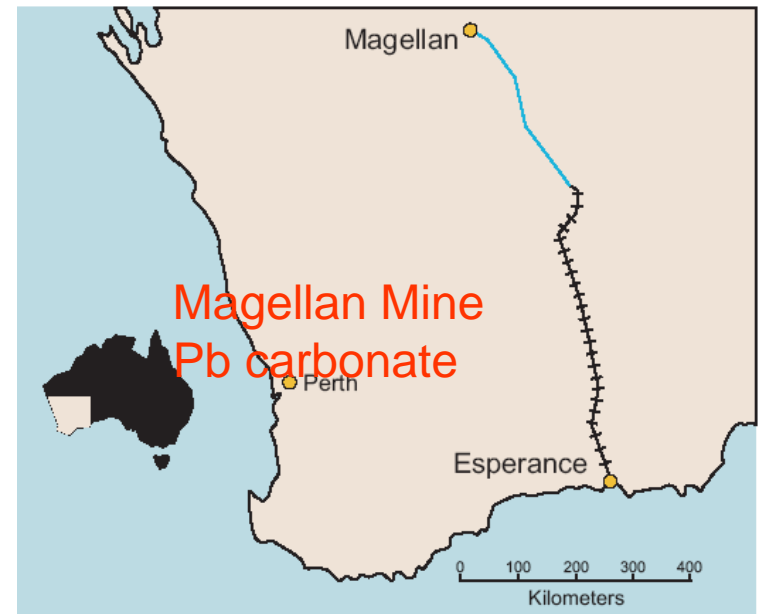


Bird Kills in Esperance WA: a case of "canaries in the mine"

**Brian Gulson & Collaborators from CSIRO, WA DoH, WA DEC
and Esperance Community**



Outline of presentation

- Background
- Questions to be answered
- Lead isotope results
- XRD and particle size analyses
- Community involvement
- Conclusions

Whitest Sand in Australia!



But faces Great Southern Ocean – i.e. towards Antarctica -
and so very strong winds

Esperance Town ~14,000 people



The Port



- Through which:
 - Pb carbonate (April 2005-
ceased Jan 2007),
 - Ni ore (>40yr),
 - Fe ore, and
 - grains are transported



> 9,500 dead birds since Dec 2006 and still dying - not avian flu

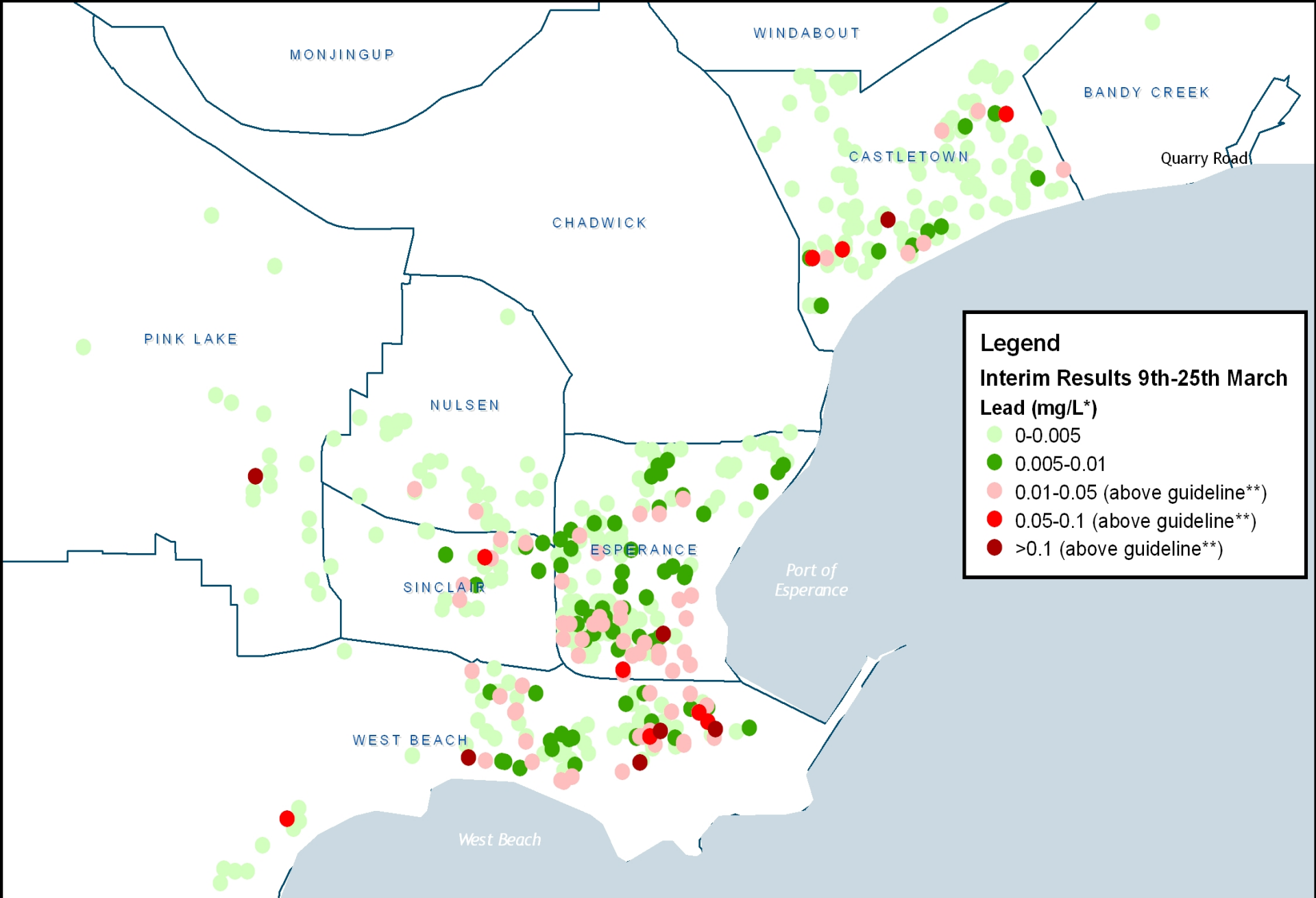


Is this the pathway of Pb for the birds?



Rainwater tanks contaminated with Pb & Ni






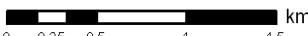
Legend

Interim Results 9th-25th March

Lead (mg/L*)

- 0-0.005
- 0.005-0.01
- 0.01-0.05 (above guideline**)
- 0.05-0.1 (above guideline**)
- >0.1 (above guideline**)


 Projection: GDA_1994
 Data Source: Dept. of Health, Landgate
 Filename: Esp_exceeding_9-19_v3.mdx


 0 0.25 0.5 1 1.5 km

Shire of Esperance

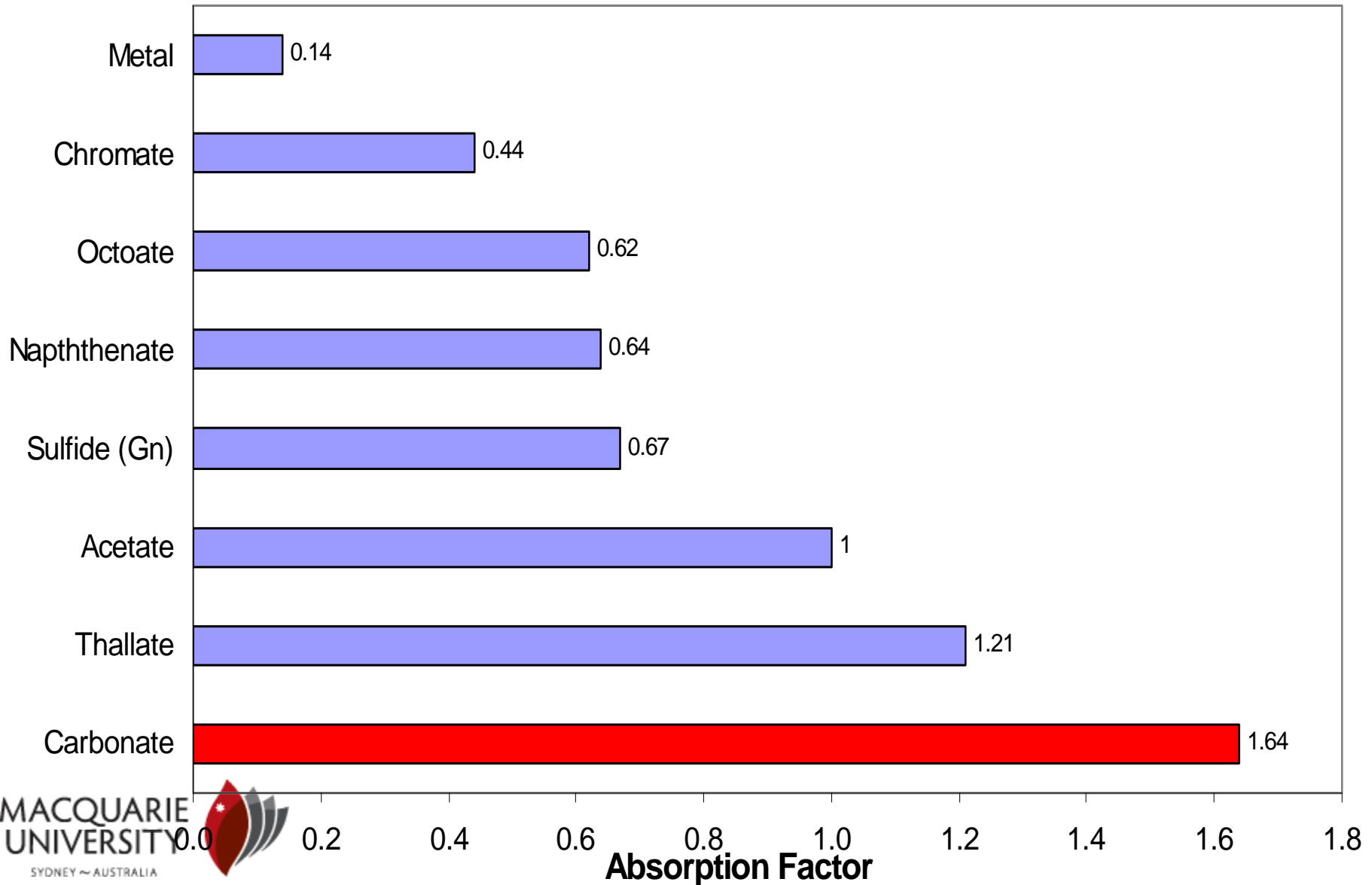
Rainwater Tank Sample Locations

* mg/L = milligrams per litre ** NH&MRC Drinking Water Guideline Values

Produced by:
 Environmental Health Directorate,
 Health Protection Group,
 Department of Health, Western Australia

Date: 30th March 2006

Absorption Factors -- Form of Lead (Barltrop&Meek 1975)



Uptake of Pb in Individual

Not only dependent on Pb species but also, for example:

- Age (adult vs child)
- Particle size
- Nutritional status (fasting vs with food; contents of Ca, Fe, Zn, Cu)
- Hand-to-mouth activity in children
- Life style

Research Questions?

- Is the Pb in the bird livers derived from the Magellan concentrate?
- If so, what is the pathway from the concentrate to the birds, especially as they were dominantly nectar feeders (i.e. was the Pb adsorbed on the vegetation)?
- Are the elevated Pb levels in rainwater derived from the Magellan concentrate?
- What are the sources of Pb in soil and harbour sediments?
- What is the contribution of Magellan Pb to PbB of children and adults in Esperance?

Samples Analysed

Pb isotopes

- Blood
- Bird livers
- Plant material
- Harbour sediments
- Soils
- Waters (rain water tanks)

Other

- X-Ray diffraction
- Malvern Laser particle sizing

Isotopes 101

Pb Isotopes

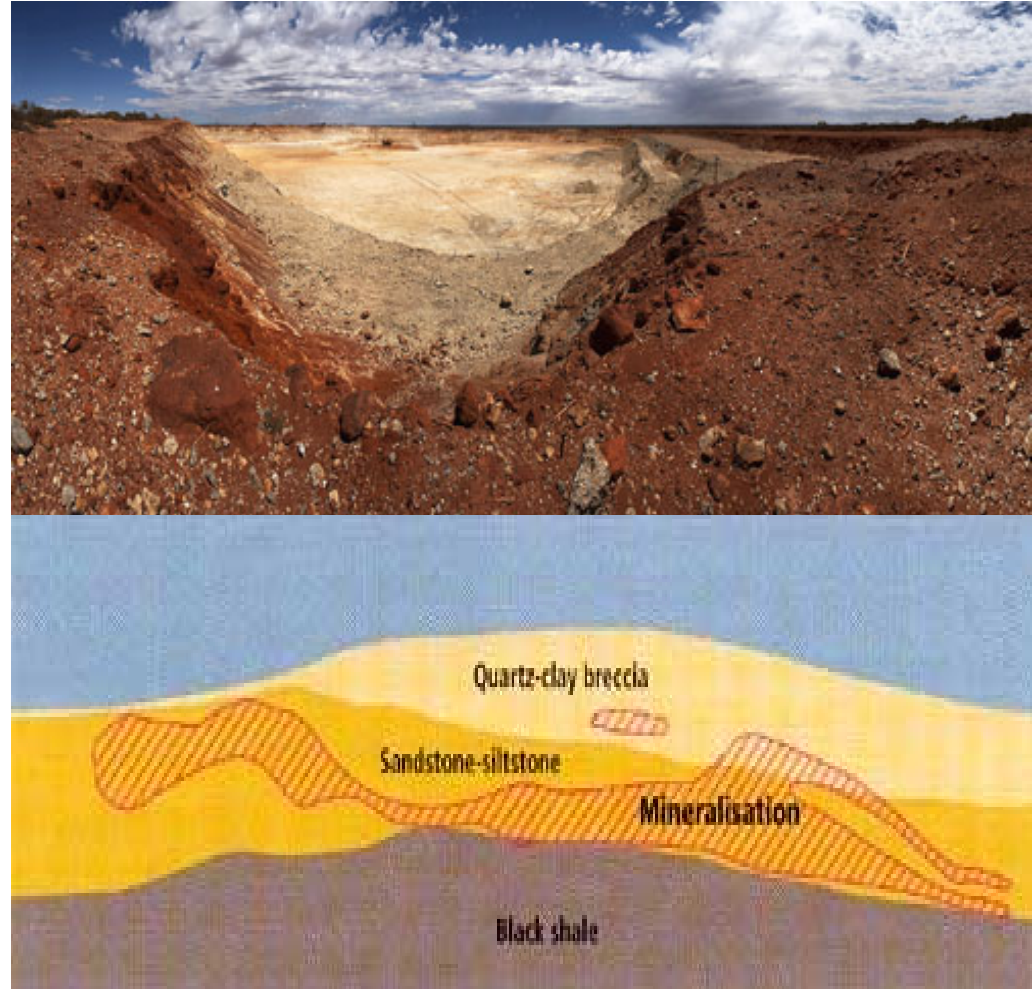


**Same chemical properties but
slightly different weights**

Parent orphan ^{238}U ^{235}U ^{232}Th

Magellan Pb

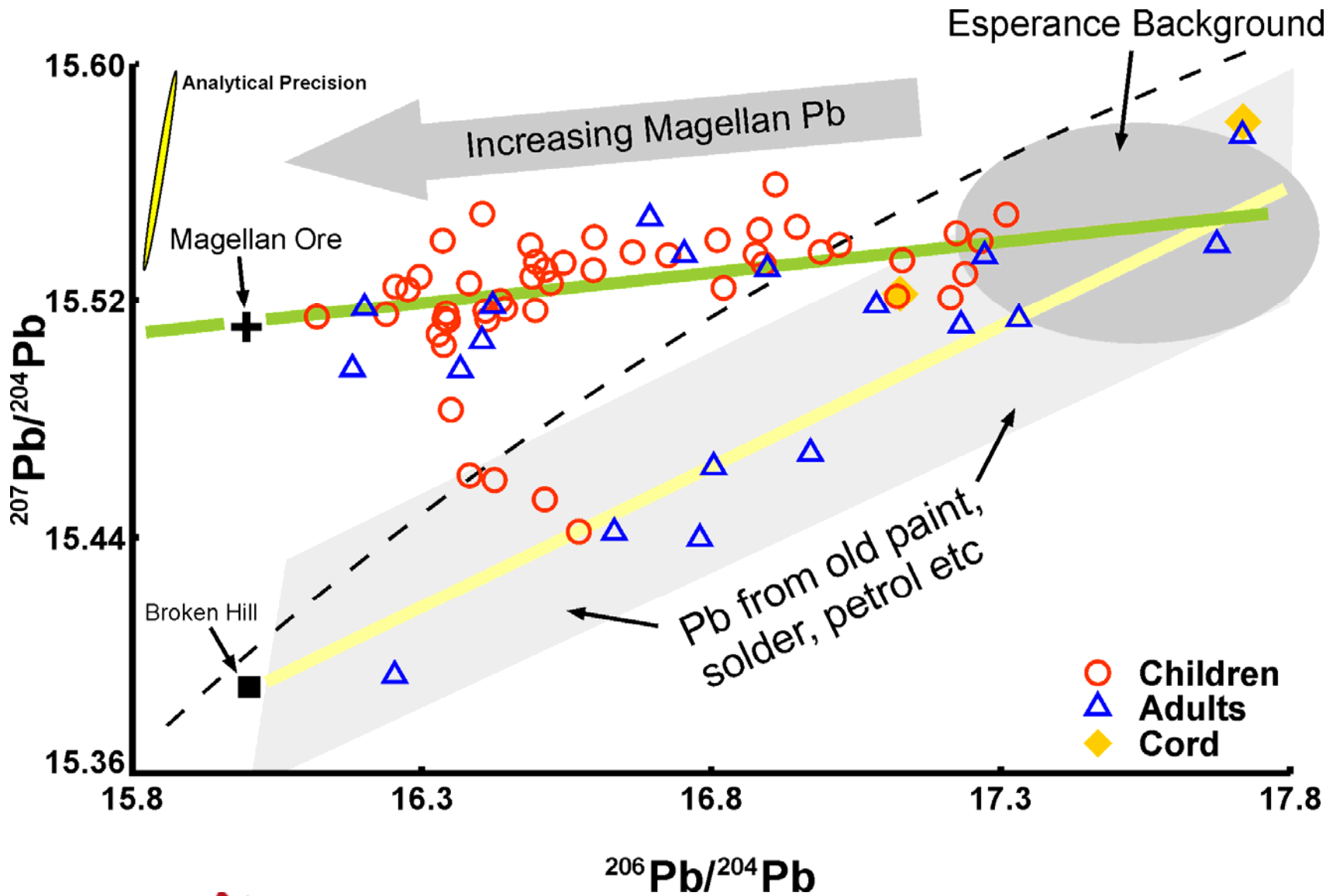
- Magellan Mine - example of a Sandstone Type deposit.
- Formed about 1650 million years ago.
- Unique Pb isotopic composition in Australian context.
- Allows for diagnostic source apportionment



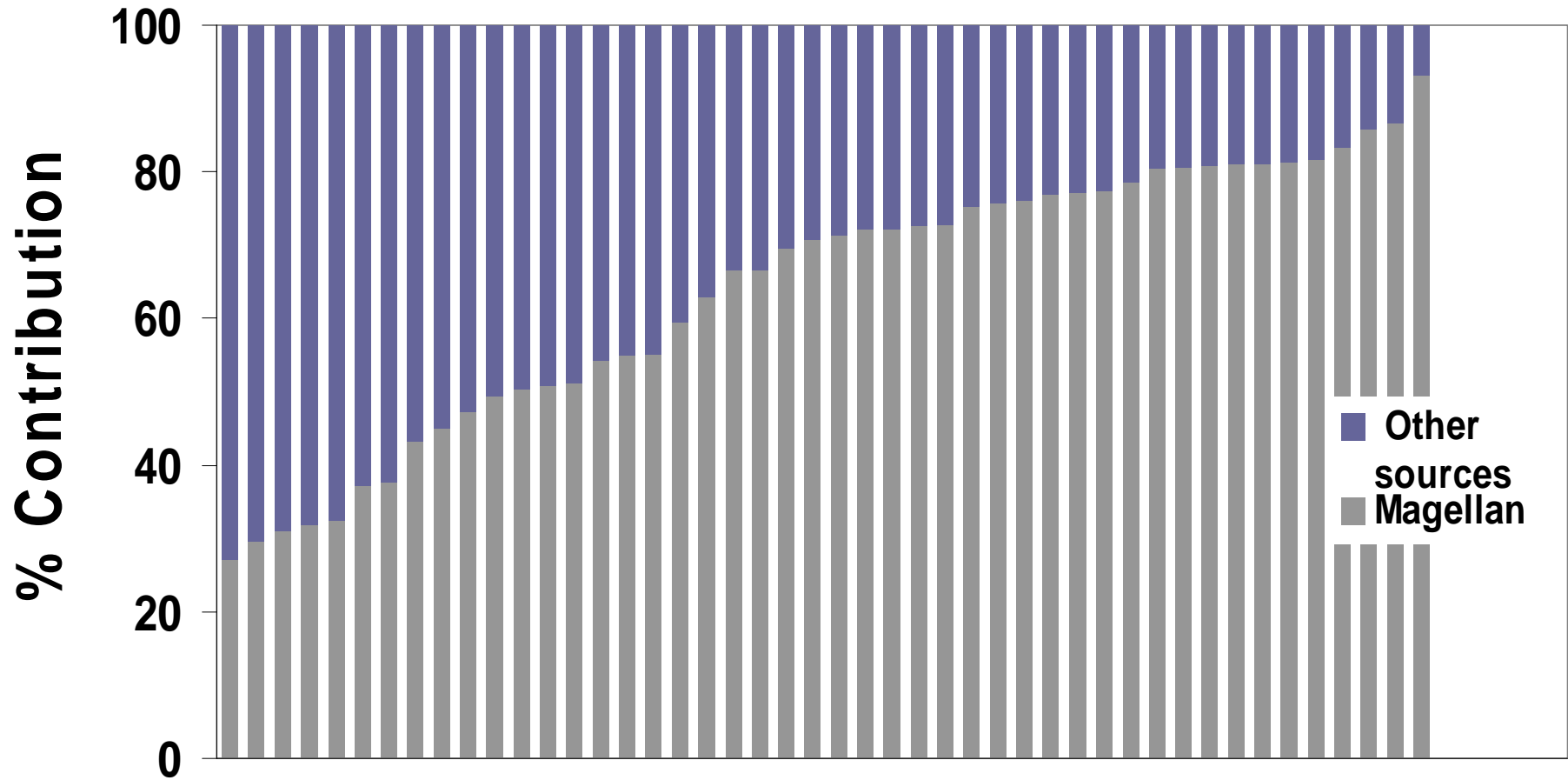
Results for Bloods

- Mean PbB level of the children was $7.5\mu\text{g/dL}$ (range 1.5 to $25.7\mu\text{g/dL}$; $n=49$, geometric mean $6.6\mu\text{g/dL}$); 4 children PbB $>12\mu\text{g/dL}$
- Subtraction of the ore component gave a mean background blood lead (PbB) of $2.3\mu\text{g/dL}$
- Compared with the mean value of $3.2\mu\text{g/dL}$ for 370 children (0-5 yr) in a wider Western Australian Department of Health survey

-
- Following slide just to show are isotopic differences
 - From simple 2-component mixing can estimate proportions of Magellan Pb and Pb from other sources



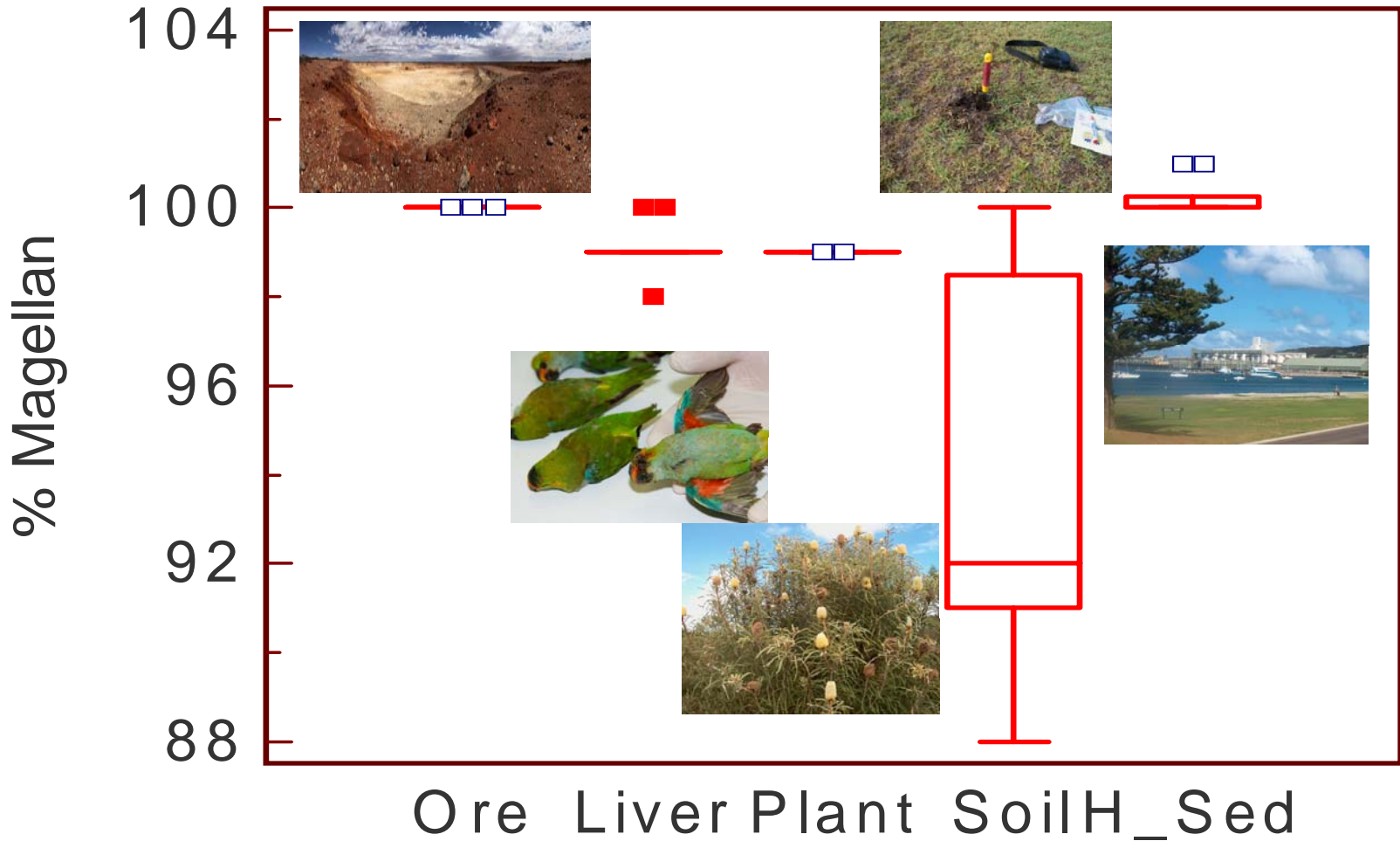
Source of Lead in Children Aged ≤ 6 yrs



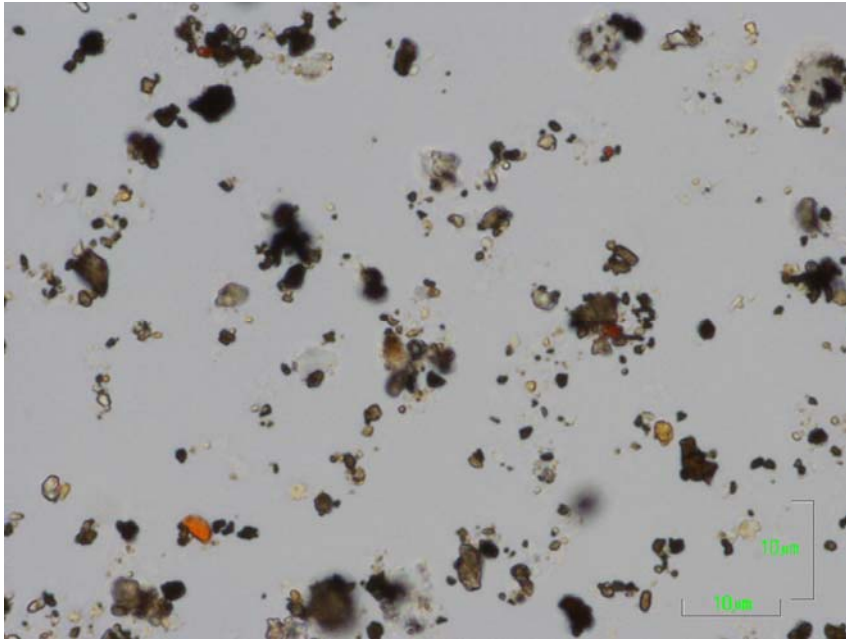
Individual

All children have some Magellan Pb

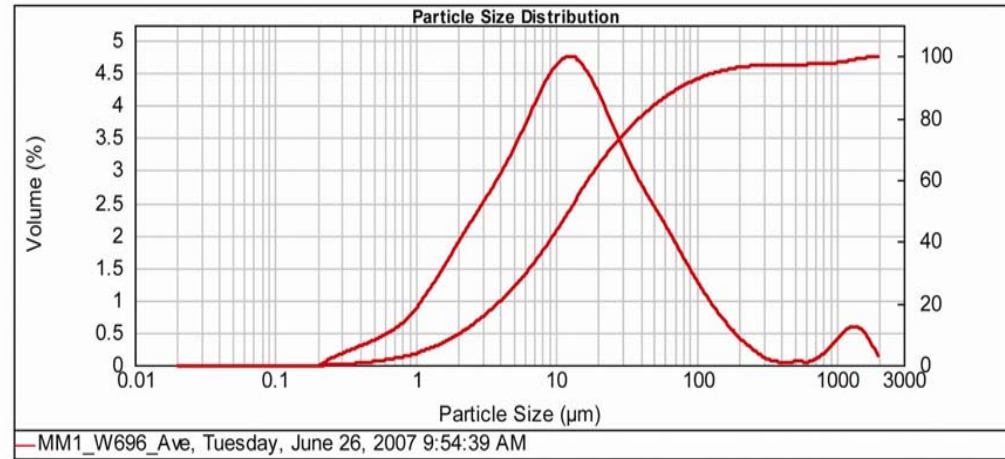
Environmental Samples



Concentrate particle size



(Green) Bar 10 µm



>40% <10 µm, 13% <2.5 µm
Such particles can penetrate into the alveolar region of the lungs where the rate of absorption of Pb particles is very high

XRD analysis

~76% cerussite (Pb carbonate),
~5% Gn,
rest Pb sulfate.



Community Pressure - Outcomes

- Lead isotope investigations
- Blood lead surveys
- Soil sampling
- House dust sampling
- Government inquiry
- DoH sampled fish
- Conservation Council WA sampled shellfish and ants (in addition to the birds)
- Rainwater tank sampling and cleaning- DoH and Shire and EsPA (Esperance Port Authority)
- EsPA distributed water filters
- EsPA cleaned up the port at the direction of the DEC
- EsPA cleaned the homes of children with elevated blood leads
- The government installed about 10 reverse osmosis units to filter water for the families with children with elevated blood leads
- Extra resources to schools to improve educational outcomes for children affected (eg. extra teachers aids up to Yr 3)- this never happened.
- Greatly improved monitoring system and strengthened licence at the EsPA (with DEC)
- DoH supplied free hire HEPA vacuums and produced a DVD on how to rid your home of lead
- Cord blood monitoring (discontinued after no elevated levels were detected)
- Govt have committed to clean the town (proper sampling, cleaning and validation) - has started
- DEC commissioned Golder Risk Assessment- yet to be released/ due after EsPA sentencing
- Record fine for EsPA (\$525K)
- Magellan have contributed \$10 million to the cleanup and \$1 million to a community fund

Conclusions - 1

- All children have some Magellan Pb in their blood, highest contribution in child before crawling - ? inhalation pathway
- Parents of children also highest contribution from Magellan
- Some children and adults Pb from other sources – paint, hobbies, etc
- All environmental samples including low Pb soils contain high amounts of Magellan Pb

Conclusions - 2

- This incidence of avian Pb poisoning in a pristine environment came as a shock to the community of Esperance.
- Although the deaths of so many native birds is a tragedy, their role as “canaries in the coal mine” is fortunate for the community, who may otherwise have been left with a legacy so common in many mining and smelting environments.
- Also fortunate is the unusual Pb isotopic signature of the Pb concentrate which has allowed unequivocal identification of the source and contribution of the Pb concentrate to the blood of children and adults in the community, as well as for the birds and environmental samples. Were the signature to be less distinct, it would not be possible to apportion sources of the Pb with any certainty where PbB are at levels less than 5µg/dL.