IMPACT OF BAUXITE MINING ON WATER YIELD

FRANK BATINI FIFA

WATER

- ENVIRONMENTAL VALUES

  STREAMS, BIOTA, ECOSYSTEMS, TREES

- ECONOMIC VALUES

  Domestic -$ 1250-$2500/ha/an (50-100 mmpa stream-flow)
  Some catchments have contributed for over 100 years

  As a comparison- bauxite royalty $ 100,000/ha as a once-off
  - timber, possibly $ 600/ha every 25 years
  - irrigation, $60-$120/ha/an

31 MILE BROOK IN EARLY AUGUST 2016, NO MINING

Average annual flow 1986-1998 was 150 mm, or 1.6 GL (DoW data).
However, with mining there is an even greater change

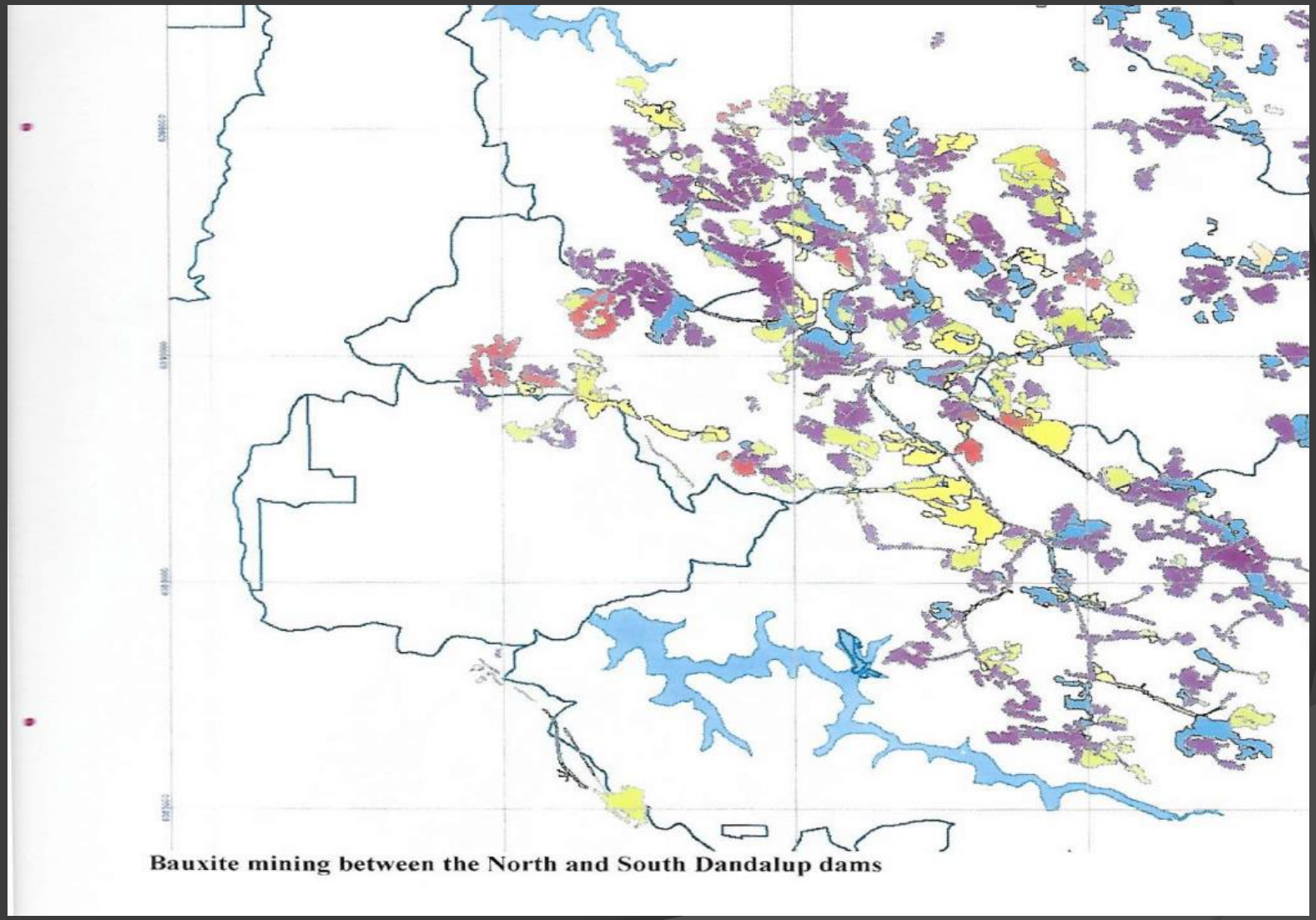
BULLICH, DIED FROM DROUGHT IN SUMMER 2011, SUCKERING FROM BASE

Stream-zone located below bauxite pits

A SHORT HISTORY- BAUXITE

- 1964, 4 ha/an, 400 ha in 100 years
- 2016, 600 ha/an, 25000 ha 50 years
- About 20-30 percent of each catchment is mined
- Therefore a much greater catchment area is impacted (75000 -125000 ha)
- Alcoa is considering direct export of bauxite. Area mined annually will increase substantially.

Mining by Alcoa on water-supply catchments



Map credit-Alcoa

Mining processes

Outline of processes undertaken

Initial emphasis-

- Successful rehabilitation with trees/shrubs
- Self-sustaining ecosystem
- To prevent erosion

My current emphasis for this talk-

- Water yield and ecological health

Original rehabilitation was clear-felled at age 35 and sold, area is now ready for sowing. Jarrahdale.

16 YEAR OLD PLOT REHABILITATED WITH NATIVE SPECIES

1800 stems/ha, 45 percent cover, leaf area index is 2, basal area 25m2/ha
estimated volume of biomass 104 m3/ha or 6.5 m3/ha/an
estimated water use 600-1200 m3/m3 of biomass- 6,000,000 litres/ha/an

Karri in bauxite pit planted at Jarrahdale about 36 years ago. Estimated biomass about 320 m3/ha. Total water used 290000 m3
Carbon Dioxide+Water+Energy= Biomass+ Oxygen+ Water vapour

Has rehabilitation been too successful?

- **Mining =**
  + logging and regeneration,
  + rehabilitation of mine pits
  + dieback forest rehabilitation
  + a reduced level of prescribed burning

- Between 1989 and 2007, leaf areas have increased after mining (CSIRO), even as rainfall has fallen.

- More than half of the **rehabilitated** areas are now above the desired tree density (Alcoa, 2007)

- As leaf cover doubles (25 - 50 % crown cover, LAI 1-2) stream-yield falls by 80 percent (Schofield et al)

REDUCTIONS IN STREAMFLOW BETWEEN CATCHMENTS THAT HAVE BEEN MINED FOR BAUXITE AND AREAS THAT WERE NOT MINED

Catchment Name	Flow volume 2010-2015 as a percent of flow pre-2000 (DoW)	Area mined as a percentage of the catchment (Alcoa)	Influences that affect flow
Waterfall gully	30 percent	Nil	Rainfall, growth of native forest and understorey
Del Park	10 percent	32 percent	+ rehabilitation of mined area and of dieback
Seldom Seen	12 percent	34 percent	As above
More Seldom Seen	6 percent	62 percent	As above

- Alcoa have thinned their catchment twice to increase yield
- Funding is not available for water-supply and irrigation catchments

DECLINE IN STREAMFLOW ATTRIBUTABLE TO BAUXITE MINING

- The decline in stream-flow from 7 mined catchments was 66 percent and, over the same period, catchments that were not mined declined by 40 percent (CSIRO, based on DoW data)
- As the percentage mined increases, the reduction in flow also increases
- The decline in yield from catchments that were mined is 40-50mm greater than in the control (Alcoa 2007)
- On the 75000 ha affected by mining a loss of 50 mm would reduce yield by 37Gl annually (if 125000 ha reduce by 62Gl)
- To produce 37Gl by desalination would cost the State $ 90 million
- Bauxite royalty (Alcoa + S32, 2014/15) was $82.5 million

Alcoa Completion Criteria 2016 (MMPLG)

- The Completion Criteria cover many pages
- There is no criterion that specifically addresses water yield post mining-why not ?
- Aspirational targets are set for desirable tree density over time but
- There is no money for implementation of thinning programs
- Language is passive

Bauxite rehabilitation with jarrah dying in summer 2011

WHAT CAN BE DONE ?

30 yo rehab in bauxite pit thinned by Water Corporation in 2010 to 7 m2 (75% reduction) Photographed 2016

WHAT CAN BE DONE?

70 yo jarrah forest thinned by Water Corporation in 2007 to 11m2
(66 percent reduction) Photographed 2016
Silviculture and water enhancement are compatible

WHAT CAN BE DONE?

Rehabilitate 30 percent of pits with low understorey species

WHAT CAN BE DONE?

More regular low-intensity burning

WHAT CAN BE ACHIEVED?

- Water Corporation data (Reed et al 2012) show that if 6000 ha a year are managed appropriately on a 10 year recurring cycle (say 60000 ha in all) the estimated ***annual increase*** in yield would be 22Gl in the first cycle and 45Gl in subsequent cycles.
- This is equivalent to the production from the original desalination plant at Kwinana
- It costs about $2.50 to produce a Kilolitre by desalination or $ 2.5 million for each Gigalitre
- The additional annual water yield from forests would cost some $55 to $110 million to produce by desalination
- The cost of implementation is estimated at $7 million pa
- There are additional benefits to streams, ecosystems, biota, trees, employment, forest products and biomass.

- THIS IS THE COMPLETE PACKAGE!!

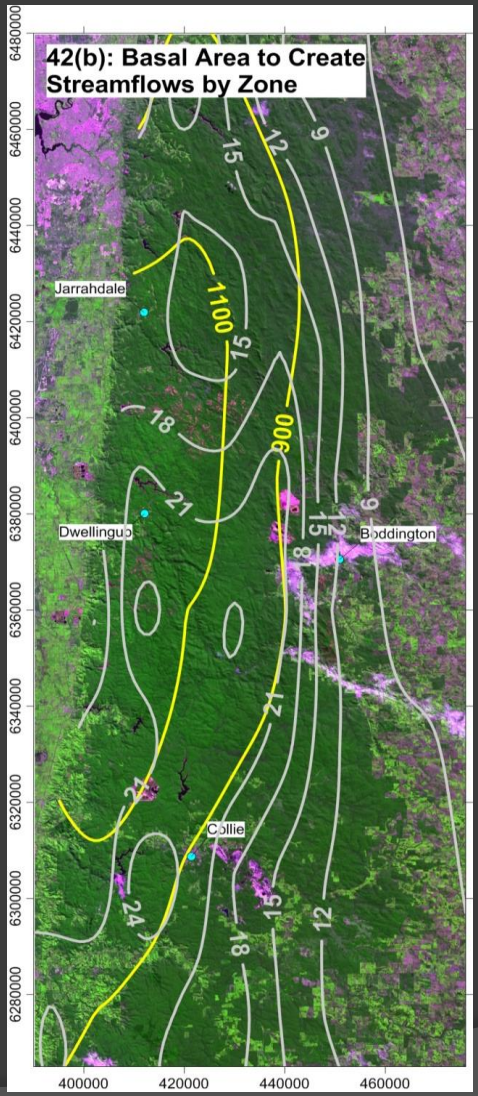
BUT

- Inertia
- Apathy
- Opposition
- Political concerns
- No action (when all is said and done……..)

Deaths in rehabilitated area, summer 2011, Wungong (Burt)

Jarrah thinned to 15 m2. Discovery forest 2016 (D Spriggins).

Basal area to generate stream-flows of 100 mm/yr for the HRZ, climate is the 2000-2012 repeated. (Croton et al 2014)



Streamflow 1965-2011.
62 percent of area was mined and rehabilitated 1975-1985.