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
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

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

- 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.