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Energy and Resource Assessment  
Department of Planning, Industry & Environment  
GPO Box 39  
SYDNEY NSW 2001

Our ref: 10.121.046.

Your ref:

**Attention: Jessie Evans**

**Dendrobium Mine Extension Project- Environmental Impact Statement  
Areas 5 & 6**

**A. BACKGROUND**

The Dams Safety Committee (DSC) has reviewed the Environmental Impact Statement for the Dendrobium Mine Extension Project. The proposed longwall extractions (Areas 5 & 6) lie partly within the Avon and Cordeaux Notification Areas. Area 5 is next to the Avon Dam wall as well as its storage. While Area 6 is next to the Cordeaux Dam wall.

Avon Dam is a major water supply dam which is prescribed by the Dams Safety Committee. It is a 72m, concrete gravity rockfilled dam that supplies water to the Illawarra. The Dam is owned by WaterNSW. The Dam has a consequence category of Extreme for both sunny day and flood failures.

Cordeaux Dam is a major water supply dam which is prescribed by the Dams Safety Committee. It is a 56.5m, concrete gravity dam that supplies water to the Macarthur/Sydney area. The Dam is owned by WaterNSW. The Dam has a consequence category of Extreme for both sunny day and flood failures.

As both dams have Extreme Consequences should they fail, the DSC's requirements are for the safety of these dams.

**1 Subsidence**

The typical stratigraphic section for the Mine from MSEC856 (Fig. 1.7) shows that the Stanwell Park Claystone and Coalcliff Sandstone are not present in the proposed areas to be mined.

MSEC856 says *"it is also possible that higher subsidence has developed in Area 3B, as the Coalcliff Sandstone is not present in this area, with higher compression of the overburden occurring within the thicker Wombarra Formation above the chain pillars."*

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MSEC adjusted their prediction model using the latest subsidence data from Area 3B. This resulted in a 30% increase in predicted subsidence for Area 3B.

MSEC says that Area 5 width-to-depth ratios are similar to Area 3B LW9 & LW10 and then says “that the 30% increase in the incremental vertical subsidence has not been applied for the proposed longwalls in Area 5”.

**More explanation of the geology in Areas 5 & 6 and the method of subsidence prediction is required.**

## 2 Far Field Horizontal Movement

MSEC856 makes the following comment on far-field horizontal movement;

*“The impacts of far-field horizontal movements on the natural features and items of surface infrastructure within the vicinity of the Study Area are not expected to be significant, except where they occur at large structures which are sensitive to small differential movements.”*

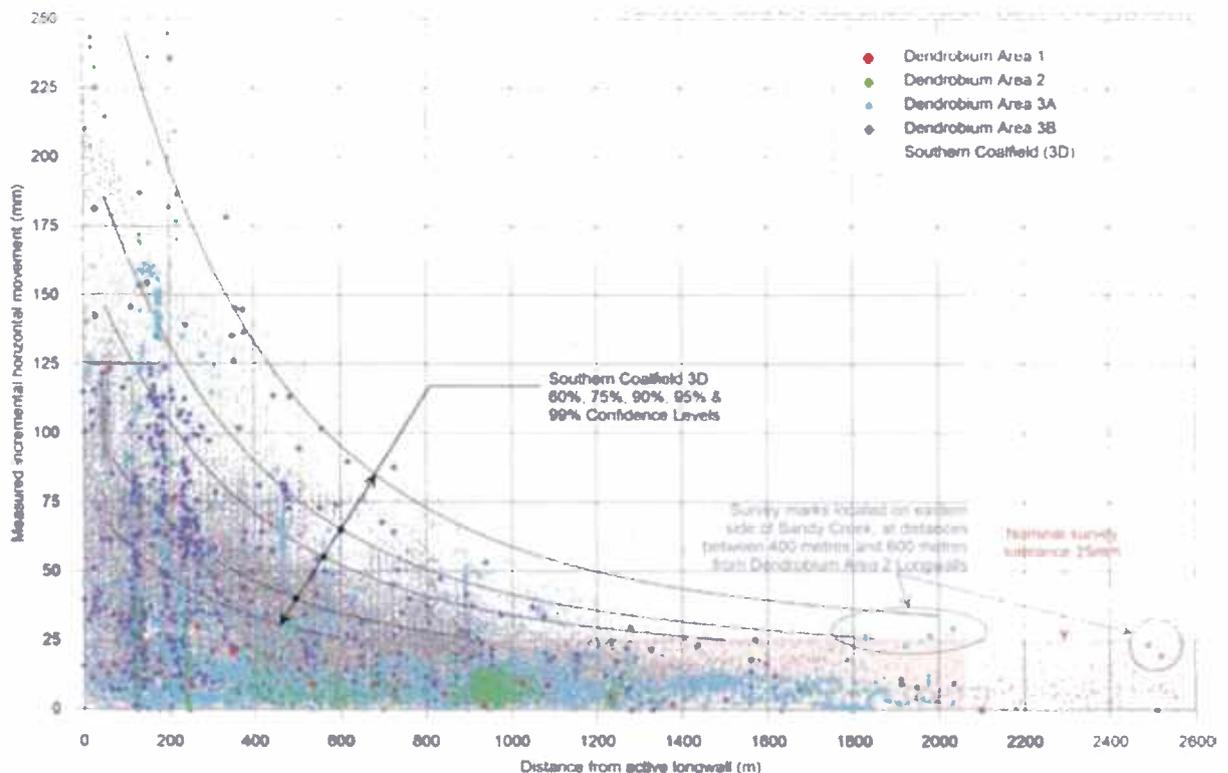
As discussed in MSEC856:

- Avon Dam wall is 72m high and dam crest is 223m long.
- Cordeaux Dam wall is 57m high and the dam crest is 405m long.

These large structures with extreme consequence categories are sensitive to differential movement, but the subject has not been addressed by the report.

Figure 4.4 of the MSEC856 report reproduced below shows horizontal movement plotted against distance from active longwall. Given the extreme consequence of the dams it is appropriate to use the 99% confidence level to predict movement at the dam wall for a set distance from the longwall goaf.

As the long axis for both dams are aligned with the long axis of the longwalls there is differential movement between the left and right abutments of the dam walls.



## 2.1 Differential Movement

For Avon Dam with a crest length of 223m at 1000m from Area 5 longwalls, the chart above predicts the right abutment moves 10mm more towards the goaf than the left abutment.

For Cordeaux Dam with a crest length of 405m at 1000m from Area 6 longwalls, the chart above predicts the right abutment moves 16mm more towards the goaf than the left abutment.

The differential movement on the dam walls could cause cracks to open in the dam walls.

**To reduce the likelihood of cracking the dam walls, longwall extraction should approach no closer than 1,500m to the dam walls.**

**An assessment by an appropriately qualified Dams Engineer is required to determine if the longwalls should be moved further away from the dam walls.**

## 2.2 Total Movement as a Result of Area 6 and Area 3C

Adding extraction of longwalls in Area 3C, at a similar time to extraction of Area 6, increases the potential movement at the Cordeaux dam wall. Area 6 is north of Cordeaux Dam wall while Area 3C is south of the Cordeaux Dam wall. At 1000m distance from the dam wall (as proposed by South32) to each extraction area, the far-field horizontal movement is 60mm towards each area (from chart above). That is, a potential to elongate the dam wall by 120mm. The potential for this amount of movement has not been addressed by the MSEC report.

**The potential to cause significant damage to an extreme consequence category dam needs assessment by a dams expert.**

**The amount of movement these extreme consequence dams can receive without impacting the safety of the dam needs assessment and a Management Plan needs to be developed.**

**Longwall extraction should approach no closer to Cordeaux Dam Wall than 1,500m.**

## 2.3 Dam Foundation Stability

### 2.3.1 *Geological Structures*

Geology plans in the EIS show two dykes below the Cordeaux Dam Wall. The above discussion of differential movement on the Cordeaux Dam Wall also applies to the foundation of the dam. This would place the dykes below the dam in tension. What impact will the proposed mining have on the stability of these dams with geological structures present in the foundations? This has not been addressed in the EIS.

### 2.3.2 *Basal Shear Planes*

Basal Shear Planes are a natural valley building phenomena which can be activated by caving above longwalls. Basal Shear Planes were activated at

Sandy Creek Waterfall valleys – above and below the waterfall. They are also present in the barrier pillar between Avon Reservoir and Area 3B longwalls. Movement on Basal Shear Planes at distances from longwall goaf areas in excess of 1000m has been documented.

An assessment of the potential for movement at the dam walls as a result of Basal Shear Plane movement triggered by the extraction of longwalls in Areas 5 & 6 is needed.

This movement may also impact the foundation of the dams and therefore needs assessment.

Uplift on the valley floor below the dam walls has not been addressed. Movement of the valleys that Avon and Cordeaux are located in may be triggered by Basal Shear Planes and Far-Field Horizontal Movement. This potential for adverse movement of the dam foundations needs assessment of the likely impact to the dams.

A Dams expert should then determine how close to the dam walls longwall extraction will be allowed.

### 3 Losses from Avon Reservoir

The Dams Safety Committee currently accepts that Dendrobium Area 3B longwall extraction (including LW18) will be approaching its Tolerable Limit for losses from Avon Reservoir.

It appears that the floor of Avon Reservoir is into the Bald Hill Claystone and the head of water is 70m, beside Area 5. The Bald Hill Claystone is at the level of the Basal Shear Plane in Area 3B and the head of water has increased from 35m (Area 3B) to 70m (Area 5).

Assuming the proposed mine layout is approved for Area 5 (i.e. 305m wide longwalls 300m from Avon FSL), the condition for loss from Avon Reservoir has deteriorated from that experienced in Area 3B. The hydraulic gradient has increased in Area 5. To reduce it to a level similar to Area 3B the distance between the Reservoir and the mine footprint needs to be increased.

As the risk to the storage is the horizontal flow from the Reservoir, in the Hawkesbury Sandstone, to the fracture zone above the goaf, a reduction in the height of connected fracturing would reduce this risk.

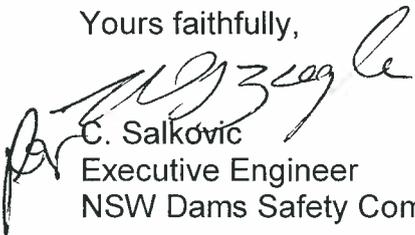
By reducing the width of longwall extraction and increasing the width of the chain pillars the height of connected fracturing can be reduced to the Lower Bulgo Sandstone. This method is being used successfully at Metropolitan Mine.

**Given the DSC's Tolerable Limit has already been approached by Area 3B at Dendrobium, the DSC can't endorse further longwall extraction within the Avon Notification Area which will cause further losses from the Reservoir.**

## RECOMMENDATIONS

1. That there is negligible differential horizontal movement of the Avon and Cordeaux Dam walls
  - a. The distance between the dam walls and the extracted longwalls needs to be a minimum of 1500m.
  - b. Management Plans and appropriate triggers are developed for the dam walls that will cease mining when the triggers are exceeded.
  - c. Dam foundations are investigated for geological structure and appropriate actions taken to avoid impact to the dams' foundations that would reduce the safety of the dams.
  - d. An investigation of the likely impact of Basal Shear Planes movement on the safety of the dams' foundations.
2. That there is negligible additional loss from Avon Reservoir above that already agreed as losses from the Reservoir as a result of Area 3B longwall extraction.
  - a. That there is no longwall extraction within the Avon Notification Area within Area 5 with the dimensions proposed in the EIS.
3. A subsidence assessment of possible impacts on the dams and development of a monitoring plan, in consultation with WaterNSW, similar to that used to protect Sandy Creek Waterfall.
4. A Risk Assessment concentrating on the safety of the dams and security of the stored waters, with input from a dams engineer.

Yours faithfully,

  
C. Salkovic  
Executive Engineer  
NSW Dams Safety Committee