Colliery Dam Summary

July 29th 2013

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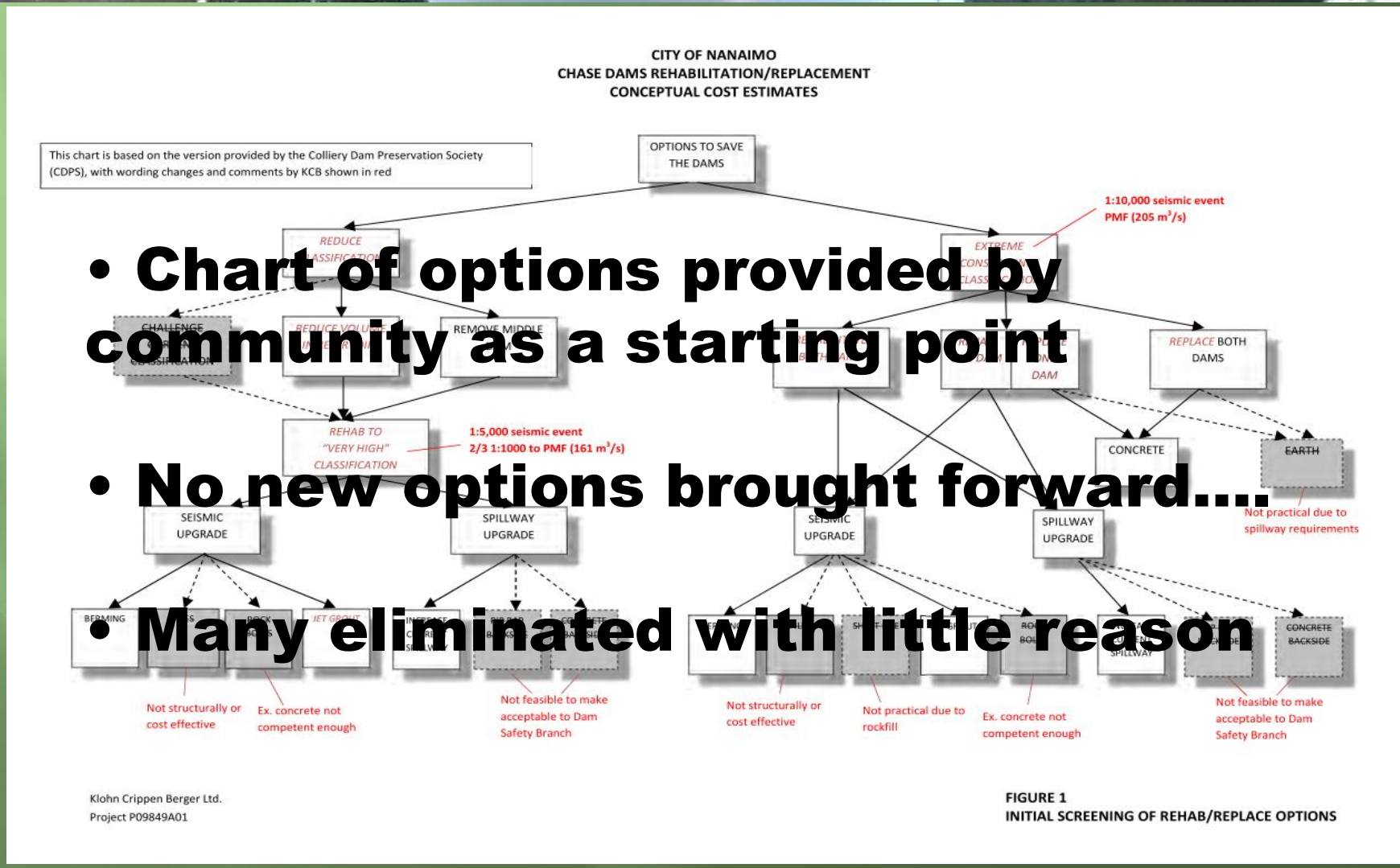
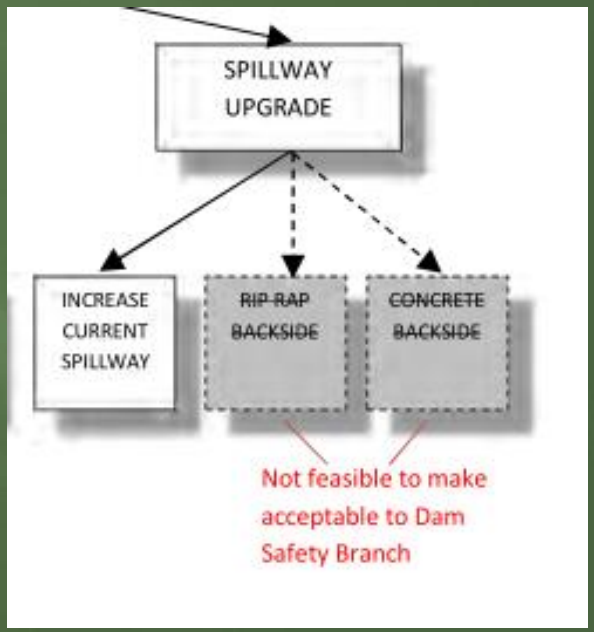
Were all the options explored?



- **Chart of options provided by community as a starting point**
- **No new options brought forward….**
- **Many eliminated with little reason**

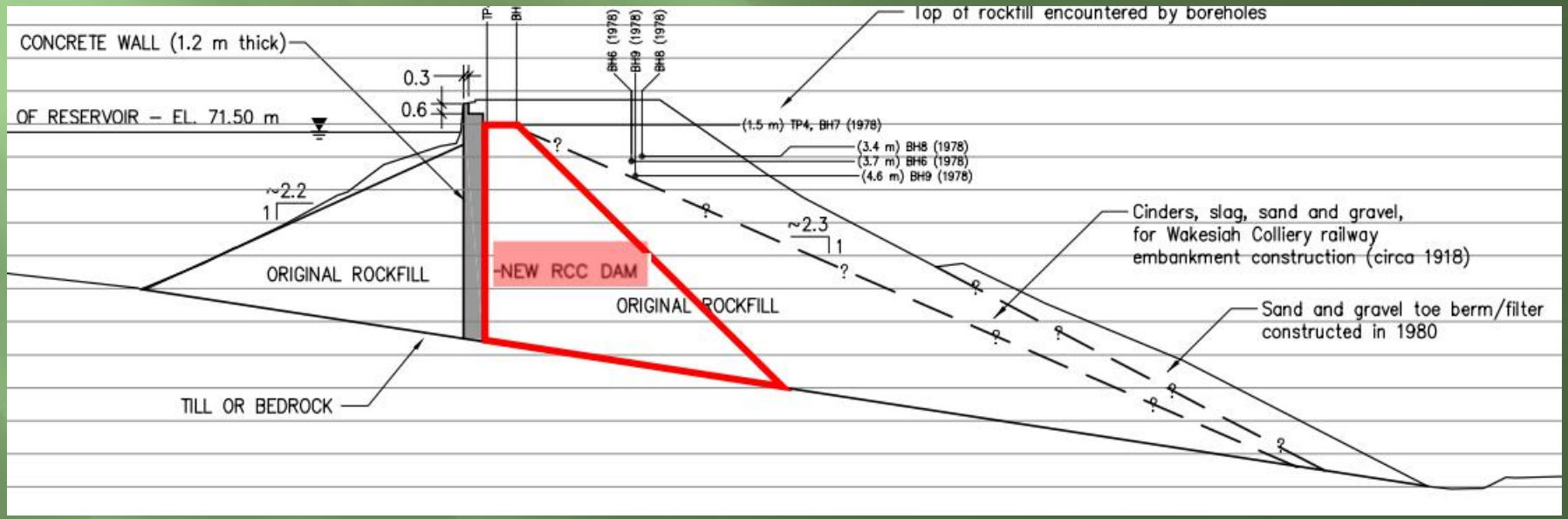
For example – "Armouring"

- 2010 Report said to do this!? (Pg 46 of EBA report)
- Now not acceptable?
- Confirmed with DSB last week that this *IS* acceptable……
- Possible method to deal with spillway deficiency and large flood events even for the interim



Another option

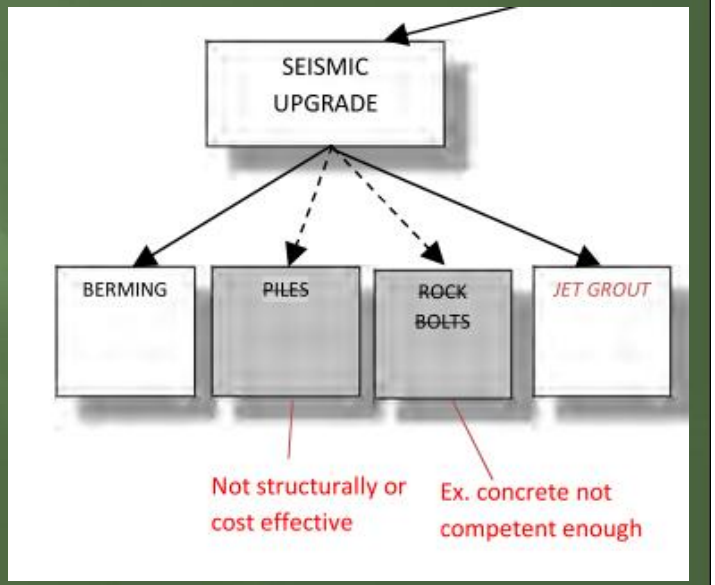
- If backfill is unknown and is the uncertainty then remove up to concrete wall and replace with roller compacted concrete.



OR…

- Or deepen spillways and install spill gates to deal with flood events

- Piles were also dismissed for dealing with seismic control



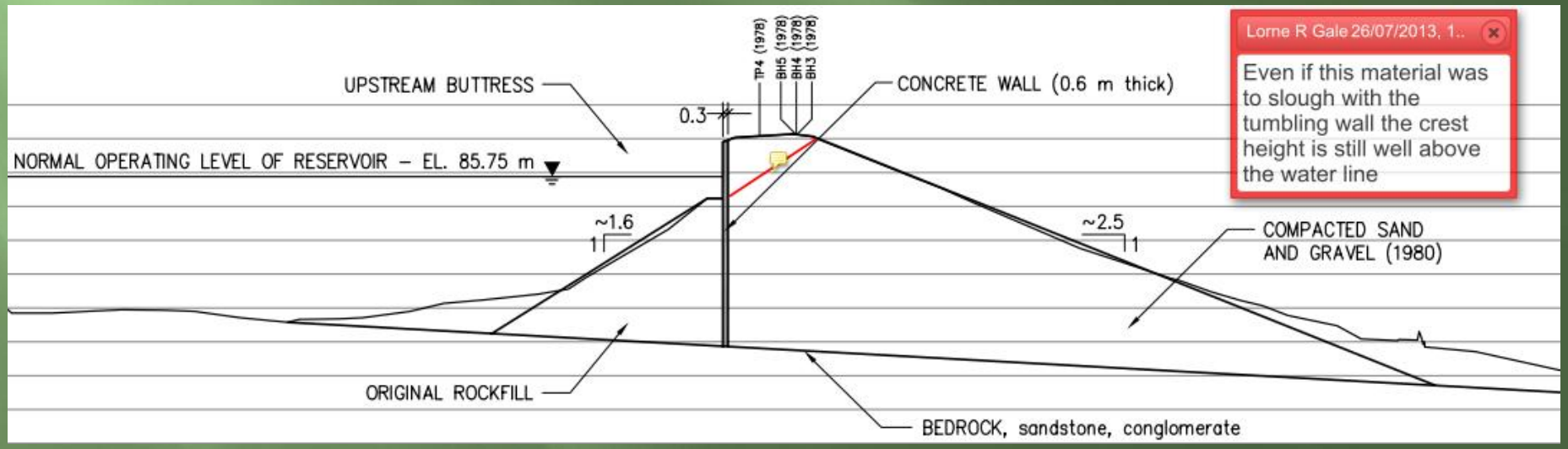
- Have all options been exhausted?

New information

- Originally assumed no rebar present in concrete
- *REBAR HAS SINCE BEEN LOCATED WITHIN CONCRETE*
- Originally concrete assumed to be in a poor state.
- *CONCRETE HAS SINCE FOUND TO BE EQUIVALENT IN STRENGTH TO CURRENT CONSTRUCTION STANDARDS*
- Originally the presence of bedrock was in question
- *BEDROCK HAS BEEN CONFIRMED AS THE FOUNDATION FOR BOTH DAMS*

Failure Summary

- Mode of failure defined as toppling of middle dam wall into lake and then overcresting
- Model doesn't appear to show crest becoming lower than water level…..

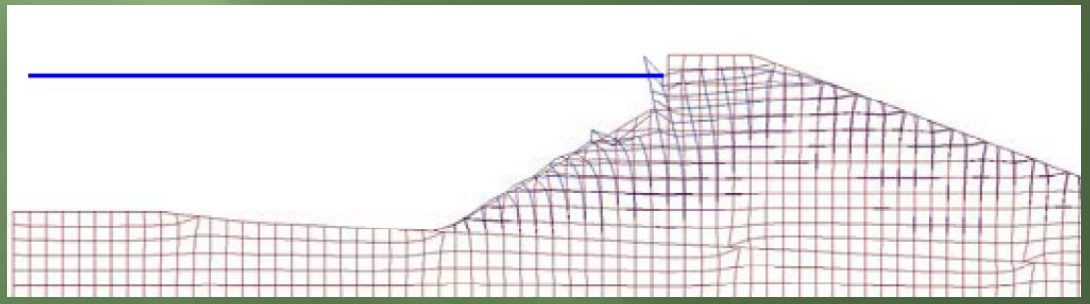


Failure Summary II

- Report (pg 36 EBA) indicates that this was not studied.

> Failure Mode #1 discussed in Section 6.1). The hydrodynamics of a breach and overtopping erosion were not modelled using the software used in this assessment. However, although

- What if water level was reduced then this mode will not occur…..?
- Or rockfill face so can't topple



- Flood model assumes both dams failing in a cascading fashion and yet the railway berm that may be backing up the flood waters remains intact….maybe run model with the berm failing. Also assumed that the public was unaware of what an earthquake might do to the dam…..

Fix the problem

- What happens if wall does not topple?
- What happens it we stop the wall from toppling? What if the water level was lower?
- Top dam not included in flood study. Same can be applied to the middle dam once it is fixed
- Eliminate cascading failure, then reassess the flooding effect. Only lower dam to then consider – half the water. Lowers classification and lowers requirement for seismic & flood events

Classification

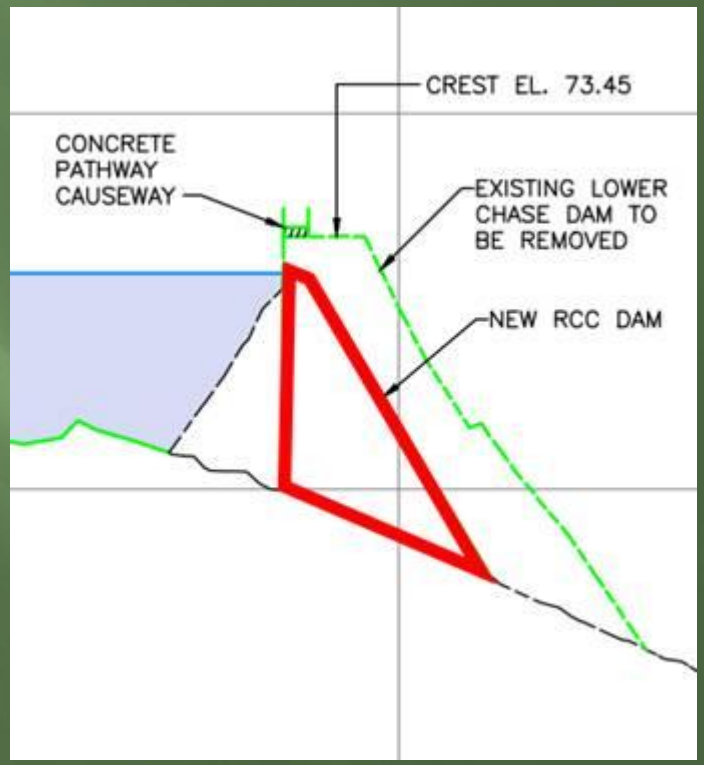
- CDA sets rules for new dams
- DSB regulates existing dams and follows the rules of CDA
- However DSB has discretionary power for existing structures and grandfathering may occur
- Risk is subjective and may be governed by acceptable societal risk

Another professional opinion

- Reports so far are the opinion of one engineering firm.
- Many assumptions have been made, many details have not been considered
- Get a second opinion.
- Chatwin Engineering has agreed to provide a second opinion. Due to time constraints Chatwin is not available until after the end of July.

New vs old

- Half the material…
- Vertical front face…
- Geometrically not as stable
- Cement impregnated gravel
- Conventional concrete on backside used permanently as a spillway



Interim Risk mitigation

- DSB originally accepted what CON was doing to reduce risk
  - Public Awareness, Early warning etc
- Dewater
  - Siphon most cost effective however acceptable design criteria must be arrived upon. Chatwin will provide. DSB not req'd for siphon
  - Low level conduit by via trenching or boring
  - Deepen spillways
  - Diversion
- Reduce level by 1m reduces volume by 20%
- What level is acceptable? Least effect on habitat and sediment disturbance yet reasonable risk reduction

Siphon Detail

- Winter flowrate 2.5cu.m/s
- Safety Factor of 2 or even 4.
- 5cu.m/s = Three 12" siphons per dam
- Limited to drawing 25' of water. Dams hold 30', last 5' is a minute volume. Reasonable?
- Material & install cost ~$200K (Material cost increase only if SF of 4 req'd)
- Full time monitoring (8mths) ~$200K

Recommendations

- Physical model, less assumptions….
- Exhaust options and combinations
- Reclassify through consideration of new information and elimination of probable mode of failure
- Armour backside of dams to allow for overcresting and flood events
- Explore more cost effective method to rehab seismically