

THE MT GORDON CHALLENGE: IMPACTS OF HISTORIC LEGACIES, HIGHLY VARIABLE CLIMATIC CONDITIONS AND TOUGH ECONOMIC CONDITIONS ON MANAGEMENT OF ACID MINE DRAINAGE

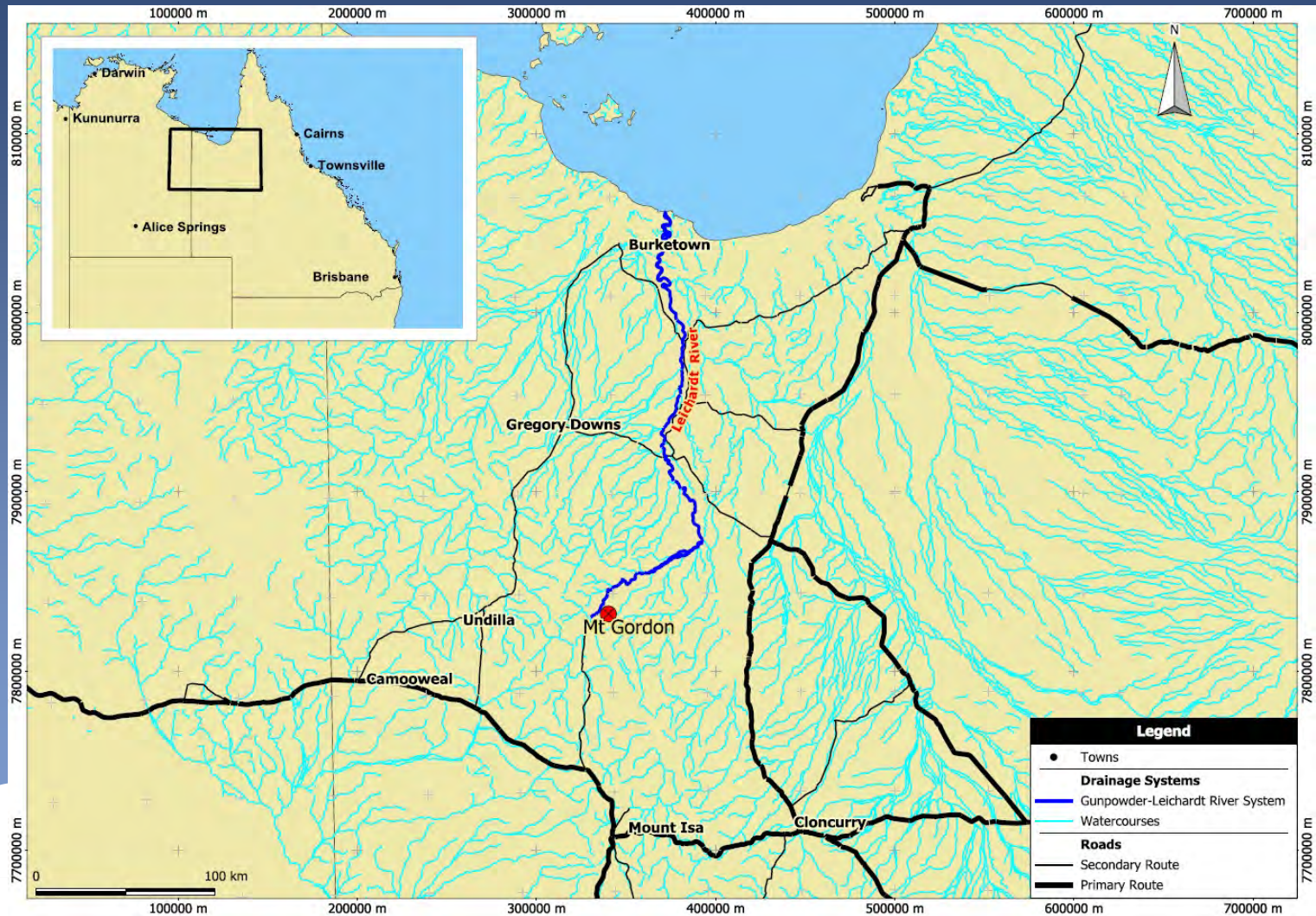
Kristy Sell (MBS Environmental)
David Allen (MBS Environmental)
Jonathan Cowie (Birla Mt Gordon Pty Ltd)



PRESENTATION OUTLINE

- Mining History at Mt Gordon
- Environmental Setting and Site Description
- 2008/09 Wet Season Events
- Water Reduction Strategy and Implementation
 - Political and Regulatory Framework
 - Water Treatment Options
 - Water Discharge Options
 - Implementation

ENVIRONMENTAL SETTING



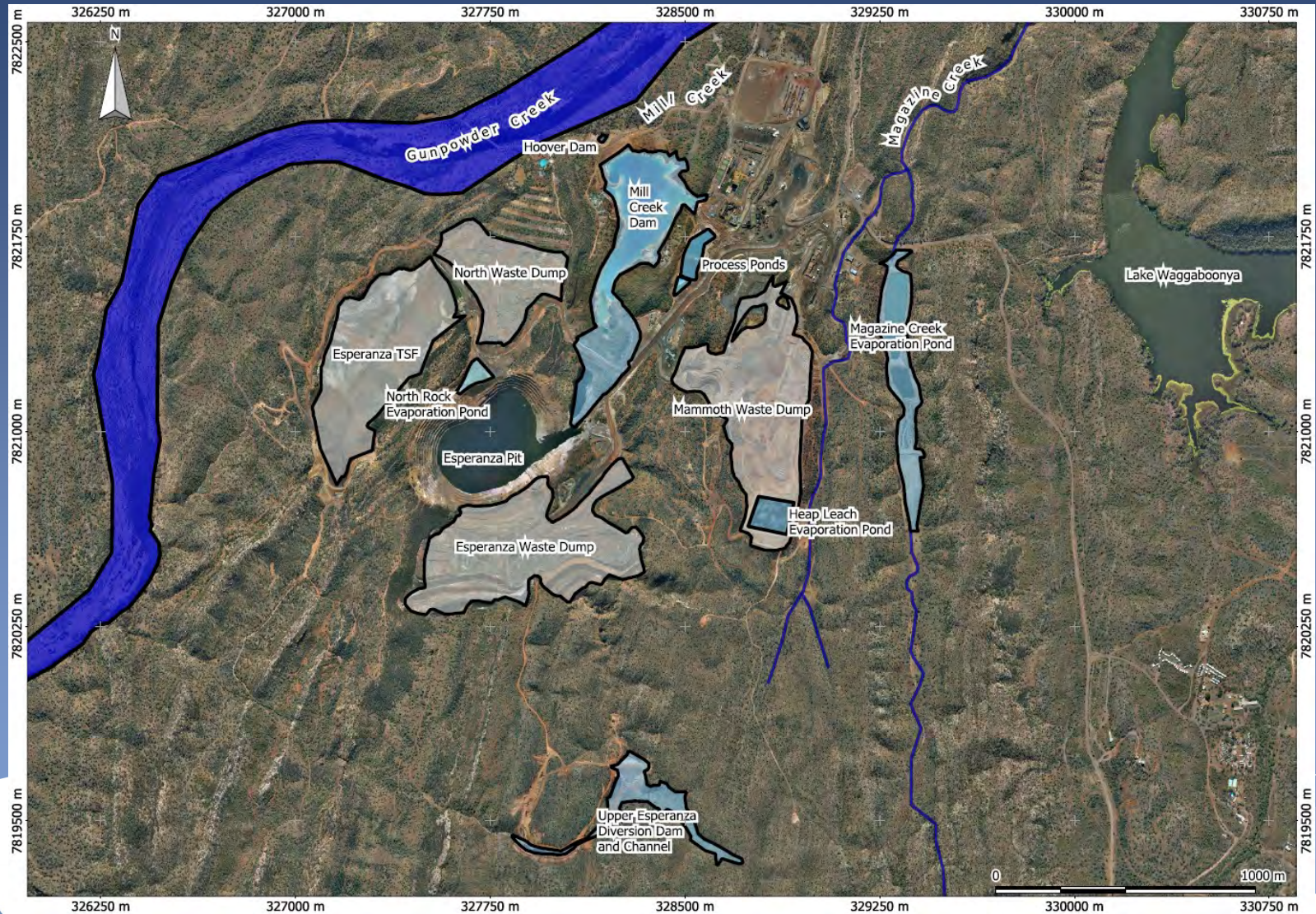
MINING HISTORY AT MT GORDON

- 1927 First recorded mining by Afghans – Mammoth open cut.
- 1939-70 Mining by various groups.
- 1971 Mt Oxide open cut production ceased.
- 1972 Mammoth open cut ceased, U/G commenced.
- 1977 Mammoth U/G put on care and maintenance.
- 1984 Site auctioned.
- 1990 In Situ leaching and SX/EW commence.
- 1992 Redevelopment of Mammoth orebodies.
- 1995 First Heap Leach Pad developed.

MINING HISTORY AT MT GORDON

- 1997 Development of Esperanza open cut.
Expansion of SX/EW plant.
- 1998 Commence use of Esperanza tailings storage facility.
- 1999 Heap leaching ceased.
“Mt Gordon SX/EW” process commissioned.
- 2000 Major overflow of Mill Creek storages to Gunpowder Creek.
- 2003 Owners went into administration.
- 2004 VEMP to dispose excess mine water following 279 mm of rainfall received over 40 hours on 14-15 January.
- 2007 Mill Creek Dam upgraded to provide 1.4 GL storage capacity.
- 2009 Extreme weather conditions in northwest Queensland.

SITE LAYOUT



WATER STORAGES

- **Major:**
 - Mill Creek Dam = 1.4 GL (poor quality and treated water)
 - Esperanza Pit = 6.4 GL (poor quality water)
 - Lake Waggaboonya = 5.8 GL (high quality raw water)
 - Upper Esperanza Diversion Dam = 200 ML (high quality raw water)
- **Minor:**
 - Hoover Dam = 13 ML (treated Water)
 - Process Ponds = 35 ML (treated water)
 - Magazine Creek Evaporation Ponds = 31 ML (Poor quality water)



2008/09 WET SEASON EVENTS

- Higher than average rainfall regionally.
- Birla Mt Gordon rainfall = 1,310 mm:
 - Majority recorded early and late January 2009.
 - Significant events also late December 2008 and early February 2009.
 - Seven days of rainfall > 50 mm.
 - Four days of rainfall >100 mm.
 - One day of rainfall >200 mm.
- Two major rainfall events separated by 16 days of lighter rainfall in Jan 2009:
 - 521 mm over eight days.
 - 434 mm over nine days.
 - Insufficient time for the catchment to dry out giving a combined effect.

2008/09 WET SEASON EVENTS

- DERM facing political and stakeholder pressure:
 - 9 other mines in region reported discharge of poor quality water.
 - Birla Mt Gordon no discharge, but large volume of stored water.
 - Mt Oxide discharging contaminated water (abandoned mine 30 km downstream of Mt Gordon).
 - Flooding issues also affecting mines in Bowen Basin and Fitzroy Valley.
- Volume of poor quality water requiring treatment and discharge as of 1 November 2009 = 4,435 ML.



Copper contamination from the abandoned Mt Oxide mine near Mount Isa is turning local waterways bright blue

By: *Brian Williams and Petrina Berry*

From: *The Courier-Mail*

HEAVY metals from an abandoned mine are polluting north Queensland creeks for the third time in two years.

Brussie Spreadborough and his sister Georgia, of Chidna Station, say their creeks remain contaminated despite State Government attempts to clean up the mess which began after major floods over-ran the nearby Mt Oxide mine in January 2009.

Creeks have been turned bright blue by copper at the 260sq km property near Camooweal, 150 km northwest of Mount Isa.



ESPERANZA PIT

Before



After



Esperanza Creek flowing to Mill Creek Dam

LAKE WAGGABOONYA



Before (late 2008)



After (early 2009)



After (mid 2010)

REGULATORY FRAMEWORK

- Site Specific Environmental Authority specifies conditions for discharge (location, volume, quality timing):
 - Discharge at 1 location in Gunpowder Creek.
 - Maximum discharge of 500 ML.
 - Flow rate must be 10 times discharge rate.
- Environmental Protection Order issued by DERM April 2009.
- Birla submitted a number of TEPs seeking approvals for water treatment and reduction programs:
 - **TEP Early Wet Season discharge of treated water to Gunpowder Creek.**
 - **TEP discharge of treated water to Lake Waggaboonya.**
 - **TEP Discharge of treated water to Gunpowder Creek.**

POLITICAL AND REGULATORY FRAMEWORK

- TEP Scientific Issues:
 - Protection of water quality values for Livestock vs Ecosystem protection.
 - Application of ANZECC 2000 trigger values for slight to moderate disturbed fresh water ecosystems.
 - Lake Waggaboonya considered pristine ecosystem.
 - Application of sulfate limits on water discharge.
 - Volume that could be safely stored in Esperanza Pit.
- Court Order issued in September 2011 after negotiation with DERM:
 - Prime water reduction mechanism release of treated water during wet season.
 - Flows in Gunpowder Creek must exceed 25th percentile for wet season flows.
 - Treated water quality to meet stipulated requirements.
 - Volume of creek flow at time of discharge must be 20 times discharge volume.

WATER QUALITY

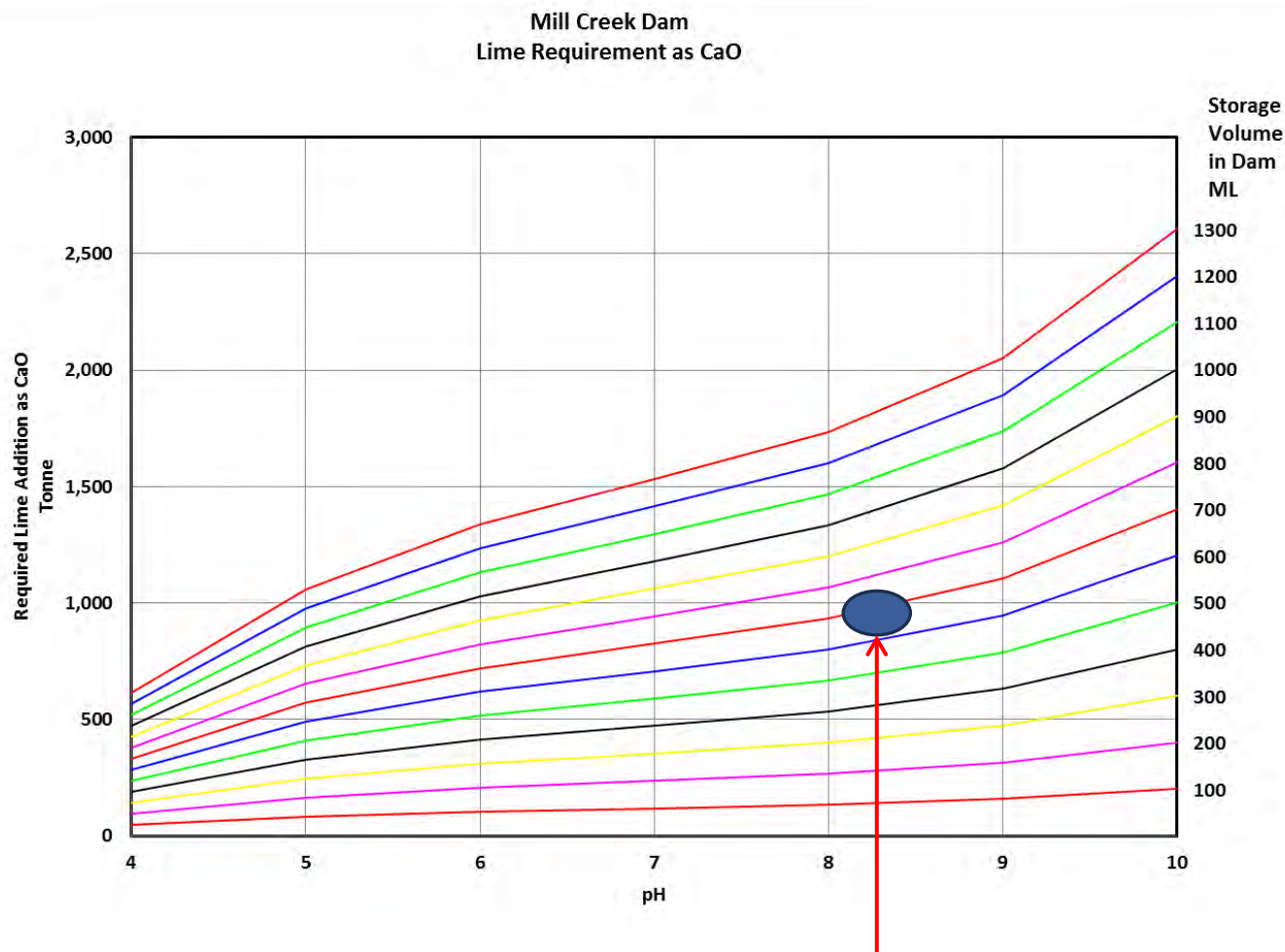
Parameter	Units	Esperanza Pit	Mill Creek Dam	EA Limits	Court Order Limits
pH	pH units	2.7	2.8	6.5 – 8.5	7.0 - 9.0
Acidity	mg CaCO ₃ /L	3,200	2,400		
TDS	mg/L	8,600	8,900	7,000	9,000
Sulfate	mg/L	5,500	5,200	3,500	6,000
Arsenic	mg/L	0.007	<0.003	0.25	0.25
Copper	mg/L	250	250	2.5	2.5
Cobalt	mg/L	28	16	5.0	5.0
Lead	mg/L	<0.005	0.004	0.05	0.05
Zinc	mg/L	5.2	5.9	10	10
Cadmium	mg/L	0.0023			0.002
Chromium	mg/L	0.014			0.001
Iron	mg/L	130			
Manganese	mg/L	110			

WATER TREATMENT OPTIONS

- Reverse Osmosis – treated water
- Reverse Osmosis – untreated water
- Nanofiltration
- Bioteq®
- Chemical treatment:
 - Caustic soda
 - Magnesium hydroxide
 - Hydrated lime – direct dosing
 - High Density Sludge



LIME DOSING IN MILL CREEK DAM



Approximately 1,000 t of CaO required to achieve pH 8.0-8.5 for 700 ML of water

CHEMICAL PRINCIPLES OF LIME DOSING

- Mill Creek Dam had pH = 2.8 and sulfate = 5,000 mg/L
- pH adjustment to pH 4.5:
 - Neutralised “free acidity” provide by Fe^{3+} , Al^{3+} , H^{+} and Mn^{2+} .
 - Soluble calcium concentration increase with lime addition until the solubility product of gypsum is reached.
 - Sulfate concentrations decrease to 2,800 - 3,500 mg/L.
- pH adjustment to pH 8.5 :
 - Neutralisation of “carbonic acidity” and precipitation of divalent metals as hydroxides.
 - The order of precipitation is copper followed zinc followed by cobalt.
- pH >8.5 results in dissolution of aluminium, copper and zinc.
- pH >10.0 precipitates magnesium as $\text{Mg}(\text{OH})_2$ and sulfate concentrations reduce to 1,600 mg/L.

LIME DOSING MILL CREEK DAM



LIME DOSING MILL CREEK DAM

Lime Neutralisation Tank

A purpose built lime neutralisation tank with agitation and aeration.

Capable of treating 5 - 6 ML per day.



“Bat Cave” System

Treats acidic water from Esperanza Pit utilising natural features on the edge of Mill Creek Dam.

Capable of treating 15 ML per day.

WATER VOLUME REDUCTION STRATEGIES

- Controlled discharge of treated water to Gunpowder Creek
- High capacity evaporators.
- Low pressure sprinkler irrigation system.
- Dust suppression.
- Reuse in the plant.
- Lined evaporation ponds.
- Evaporation modules.
- Trial land disposal (pasture irrigation).



HIGH CAPACITY EVAPORATORS

- Installed on pit edge.
- Initial 3 month trial (2010):
 - Unit capacity 2 ML/day (nominal).
 - Dry season utilisation of 80%.
 - Evaporation efficiency of 20%.
 - Overall effectiveness 16%.
- Initial feed was treated water – significant scaling issues.
- Changed feed to untreated water .
- 9 units ultimately installed.



IRRIGATION SYSTEMS

- Low tech irrigation systems.
- Use treated water.
- Located on banks of water storages.
- Estimated water reduction = 16 ML/year.



ROAD WATERING / DUST SUPPRESSION

- Increased road watering above operational demands.
- Use treated water.
- 40 kL truck for 20 movements per day.
- Estimated water loss = 0.8 ML/day.

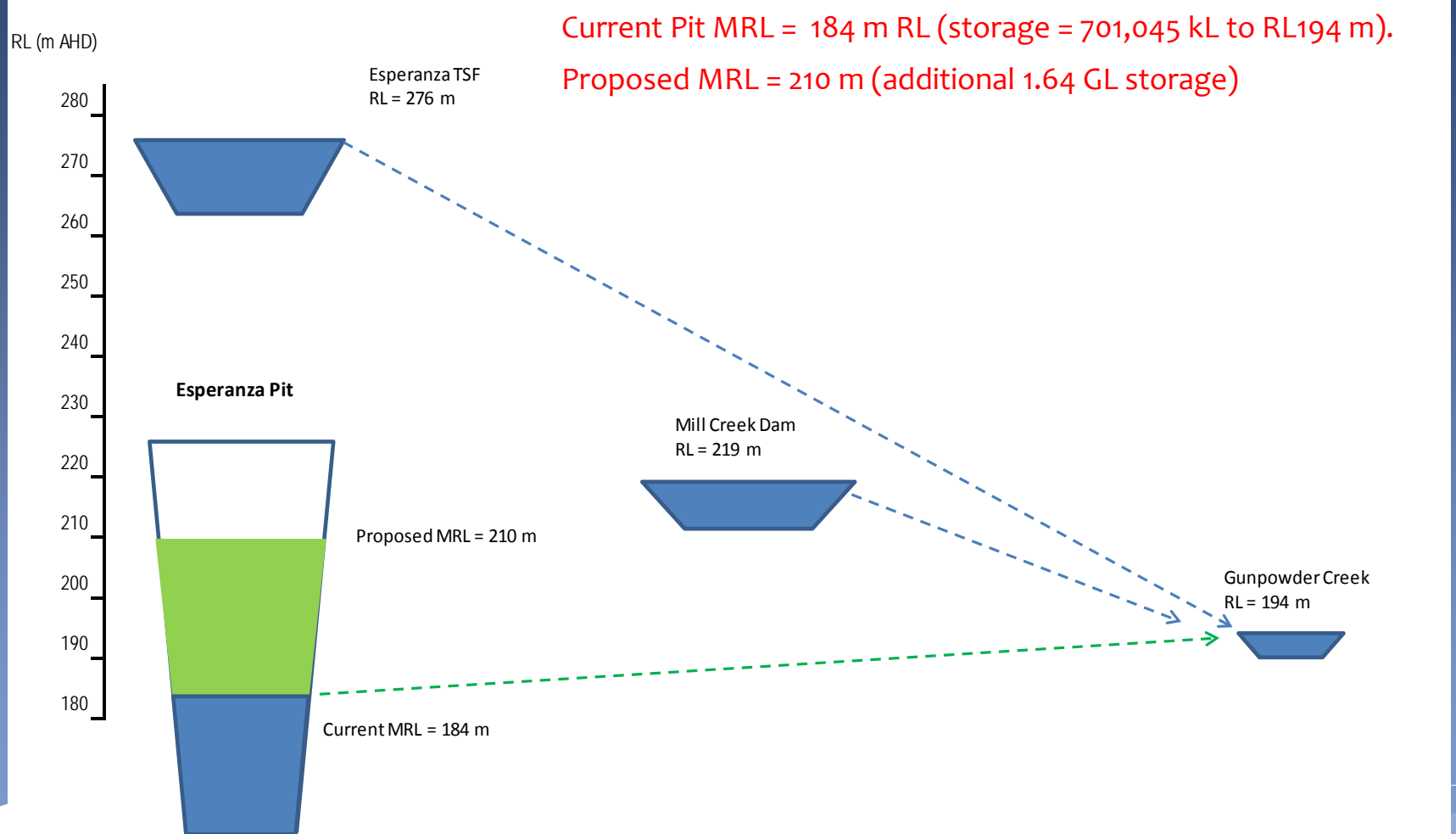


PLASTIC LINED EVAPORATION PONDS

- Two ponds constructed as per Court Order condition.
- Combined surface area of 2.6 ha.
- Average monthly evaporation from each pond = 2.25 ML.

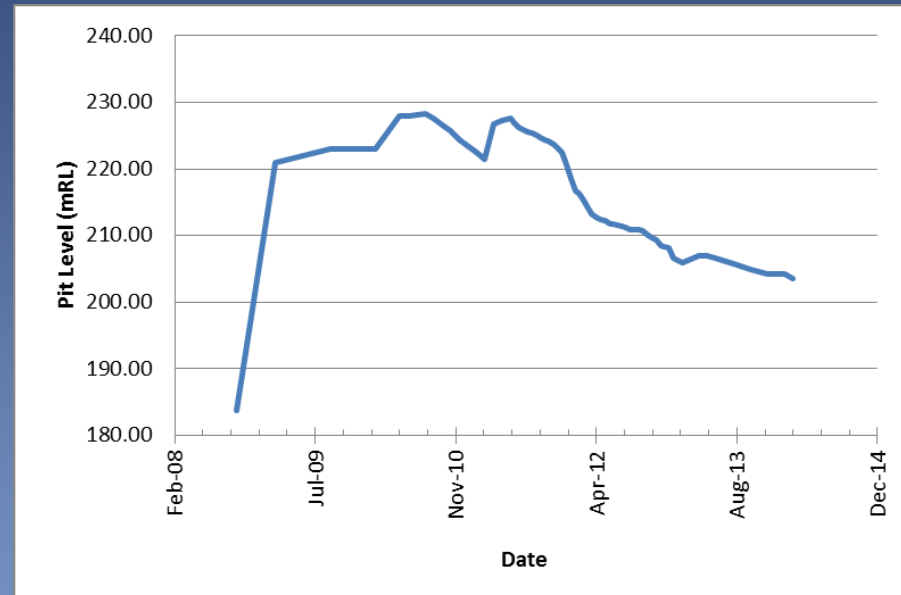


HOW MUCH WATER CAN YOU STORE??



WATER REDUCTION PROGRESS

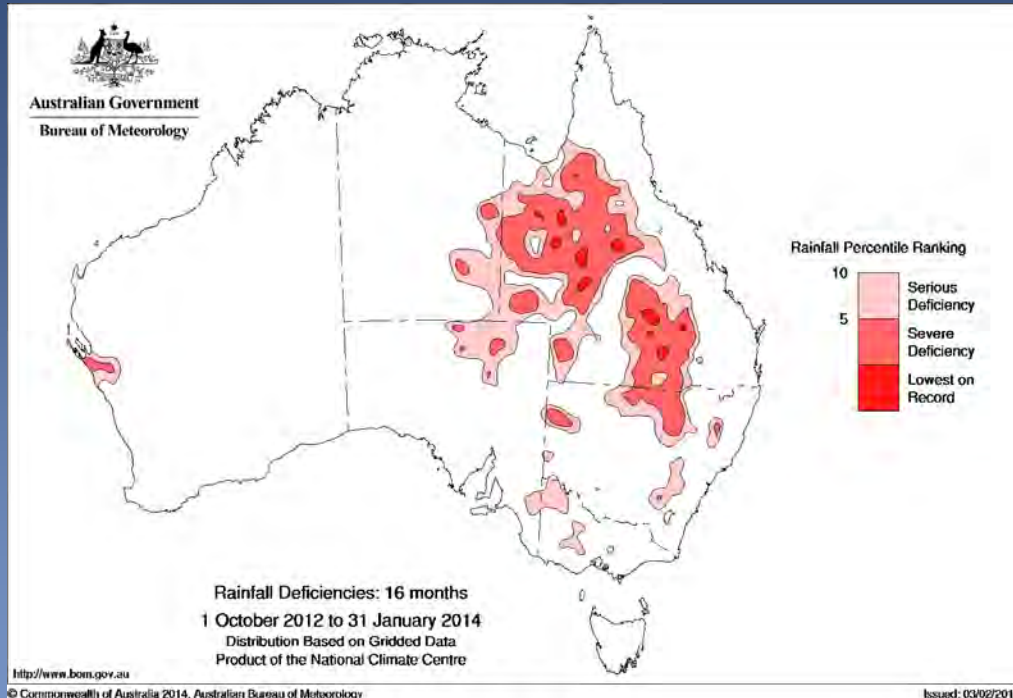
Wet Season	Gunpowder Creek Discharge Volume (ML)
2008/09	0
2009/10	97
2010/11	1,097
2011/12	1,903
2012/13	163



Esperanza Pit Level

\$20 Million spent to date

2013/14 “WET SEASON” CONDITIONS



- 2014 rainfall = 179 mm to 14 March.
- 1 event >50 mm in late Feb.

CONCLUSIONS

- Legacies result from 80+ years mining
- Current regulatory expectations imposed on historic site approved under different regimes.
- Site has a long history of water excess and more recently water shortages.
- AMD issues exacerbated by climatic extremes.
- No quick fix for AMD and water management issues at Birla Mt Gordon.
- Challenge is complicated by current care and maintenance status.

CONCLUSIONS

- No unplanned water releases from Birla Mt Gordon since 2004 despite a significant number of events greater than 1 in 100 year ARI.
- Successfully stored water from a 1 in 500 year ARI event despite being on care and maintenance.
- Controlled discharge of 3,260 ML to Gunpowder Creek since January 2009.
- Reduced onsite water storage by 2,449 ML since April 2009.
- Reduced risk of future uncontrolled discharge by completing significant upstream water diversions.
- Complied with TEP provisions.
- Complying with Court Order requirements.
- Continuing to challenge Esperanza Pit MRL to allow increased water storage.

THANK YOU

