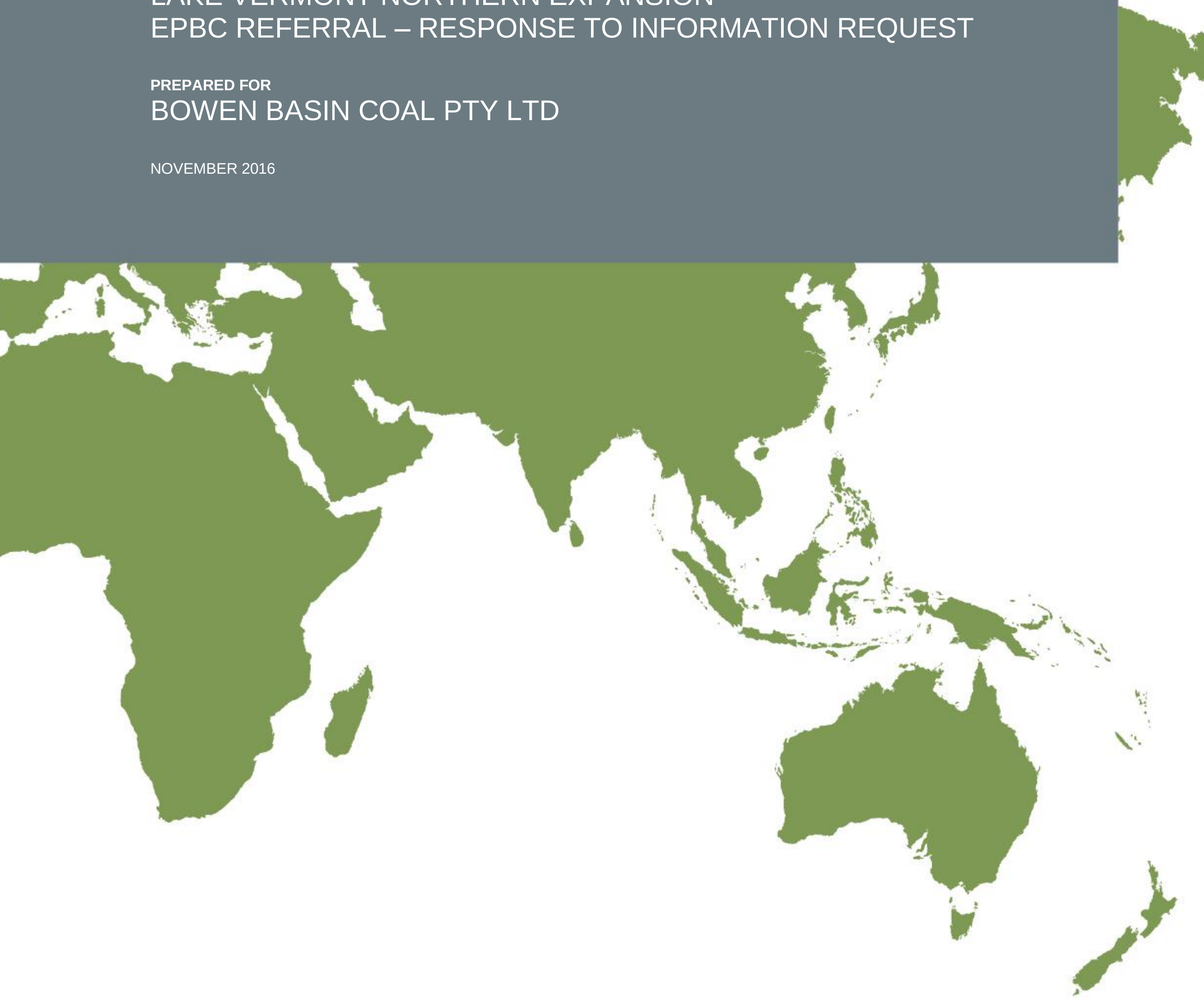
ENVIRONMENTAL SOLUTIONS

LAKE VERMONT NORTHERN EXPANSION
EPBC REFERRAL – RESPONSE TO INFORMATION REQUEST

PREPARED FOR

BOWEN BASIN COAL PTY LTD

NOVEMBER 2016



BRISBANE OFFICE
Suite 5, 1 Swann Road
Taringa, QLD 4068
P +61 7 3217 8772

CAIRNS OFFICE
PO Box 4887
Cairns, QLD 4879
P +61 7 4057 9402

E info@aarc.net.au
AARC.NET.AU

ACN. 077 456 074
ABN. 96 077 456 074

AustralAsian Resource Consultants Pty Ltd

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Author:	Heath Carney
Project Manager:	Gareth Bramston
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ENVIRONMENTAL SOLUTIONS

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LIST OF ABBREVIATIONS

AARC	AustralAsian Resource Consultants Pty Ltd
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
BOM	Bureau of Meteorology
DoEE	Department of the Environment and Energy
EPBC	Environmental Protection and Biodiversity Conservation Act
HCC	Hard Coking Coal
MBGL	Metres Below Ground Level
MNES	Matters of National Environmental Significance
PCI	Pulverised Coal Injection
SWMS	Surface Water Management System
VWP	Vibrating Wire Piezometer

1.0 INTRODUCTION

AustralAsian Resource Consultants Pty Ltd (AARC) was commissioned by Bowen Basin Coal Pty Ltd (BBC) to prepare this Response to Information Request document. This document supports the Matters of National Environmental Significance Assessment Report submitted as part of the *Environmental Protection and Biodiversity Conservation (EPBC) Act* referral for the Lake Vermont Northern Extension (May 2016).

This report provides the additional supporting information in response to an information request issued by the Department of the Environment and Energy (DoEE) on August 22, 2016.

1.1 BACKGROUND

The Lake Vermont Coal Mine is a medium size open-cut coal mine producing hard coking coal (HCC) and pulverised coal injection (PCI) coal for the export market to be used in steel production. Mining operations at the Project site commenced in September 2008 with first coal production in January 2009.

The purpose of the proposed Project is to extend current mining activities at the Lake Vermont Mine into new resource areas located directly to the north within ML 70528, covering an area of approximately 3,700 hectares (ha). No change in the approved mining or production rate is proposed. An application to amend the Mine's Environmental Authority (EA) (EPML00659513), pertaining to a new ML application by BBC over the subject land, was submitted to the Queensland Department of Environment and Heritage Protection (EHP) for assessment and approval in October 2014. An Information Request was received in January 2015 and a subsequent Information Response was submitted to EHP in May 2015. EHP approved the EA amendment application on 28th September 2015.

The EPBC Referral, to which this document relates, proposes an extension of the existing Lake Vermont Coal Mine into new resource areas located to the north. No change in the approved mining or production rate has been proposed as part of the application. The Northern Extension Project site is located immediately north of the existing mine within ML 70528, covering an area of approximately 3,700 hectares (ha).

As the proposed Project had potential to impact on Matters of National Environmental Significance (MNES), nationally threatened species and ecological communities, migratory species, and water resources in relation to a large coal mining development, it was determined by the proponent that the Project would be referred to the Commonwealth Department of the Environment to determine whether they constituted controlled actions. A pre-referral meeting was held with the Commonwealth Department of the Environment on 26th June 2014. Assessment of potential impacts on MNES determined that a significant impact on water resources was likely to be triggered by the Project. In response, a referral, accompanied by an MNES Assessment Report was submitted to the DoEE on 6th May, 2016.

In June 2016, DoEE confirmed that the Project does constitute a controlled action, specifically due to the potential for impacts on a water resource in relation to a large coal mining development. In August 2016, DoEE issued a Request for Further Information, focussed on issues including surface water hydrology, interaction between surface water and groundwater, and surface water quality impacts.

1.2 SCOPE OF DOCUMENT

The purpose of this Response to Information Request document is to give DoEE all the information requested in the Request for Further Information letter of August 22, 2016.

To achieve this each issue and information request raised by DoEE is summarised and a response to each individual request provided. Responses refer to the section of the MNES Assessment Report where the issue has been addressed, with additional information necessary to address the department's questions included where required.

2.0 RESPONSE TO INFORMATION REQUEST

2.1 SURFACE WATER

2.1.1 Issue

"The proposed action is likely to reduce surface water inputs to Lake Vermont and two creeks because of the reduction of catchment areas and water drawdown. This will have impacts on the lake (water volume or levels) and the creeks (flow regimes, such as volume and timing). It may also interact with other coal mining activities in the project area (i.e. the existing Lake Vermont Coal Mine, Saraji Coal Mine and the closed Norwich Park Coal Mine) and contribute cumulative impacts on the lake and the creeks. These impacts may further affect relevant ecosystems around the lake and along the banks of Phillips Creek (additional to the direct clearing for its diversion)."

2.1.2 Information Request

"Information about current situation of the lake (e.g. average water volume or water levels) and creeks (e.g. average annual flow volume and seasonal change);"

2.1.3 Response

Lake Vermont wetland is an ephemeral waterbody experiencing long periods of dry conditions between periods of rainfall. The wetland is relatively shallow, and is less than 2% full about half of the time and around or above 50% full only 5% of the time.

In response to this information request, WRM Water & Environment were engaged to undertake additional investigations and modelling of surface water balance in the Project area. This modelling is reported in Appendix A, and summarised in relevant sections below.

Interpretations of LiDAR data obtained in July 2014 show that the Lake Vermont wetland is relatively shallow – approximately 1.9 m deep at its deepest point when full, with a surface area of 72.4 ha and total storage capacity of approximately 690 ML.

Although long-term water level monitoring in Lake Vermont has not been undertaken, aerial photographs (Figure 1 and Figure 2), show the variability of water levels in the wetland. Figure 1 shows the wetland empty in November 2003, and Figure 2 shows water at surface elevations of approximately 161m AHD in June 2013.

Geoscience Australia's Water Observations from Space tool indicates the number of times that water is noted in a given water body based on a total number of observations. From this tool, observations indicate that over the period between 1987 and 2014 (which was a wetter than average period of time), water was observed in the centre of the wetland to an elevation of approximately 160.4 m AHD (0.15 m deep - and about 2% of full capacity) about 50% of the time. Elevations of 161.43 m AHD (about 50% full), were exceeded about 5% of the time.

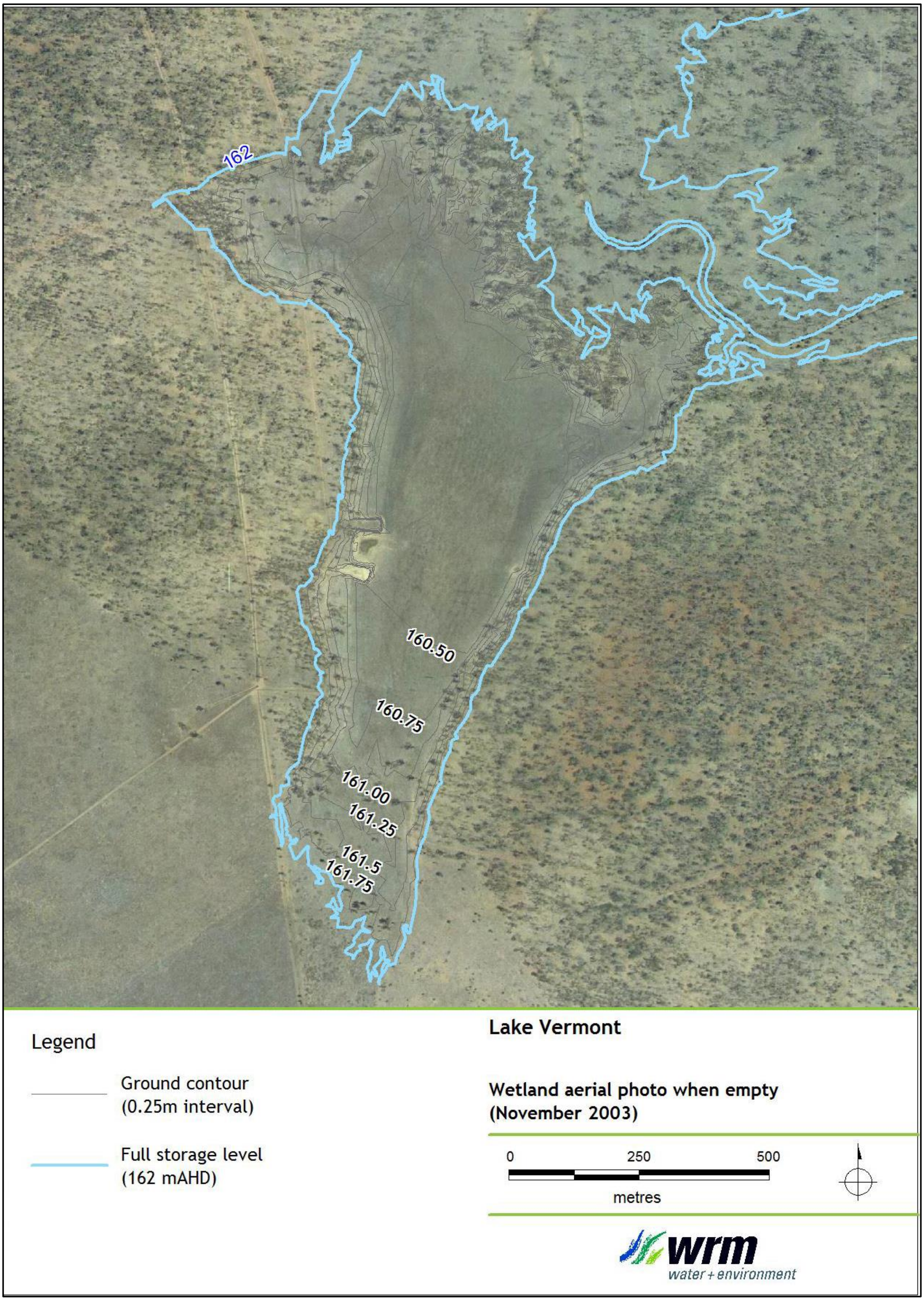

Figure 1 Lake Vermont aerial photo captured when empty in November 2003

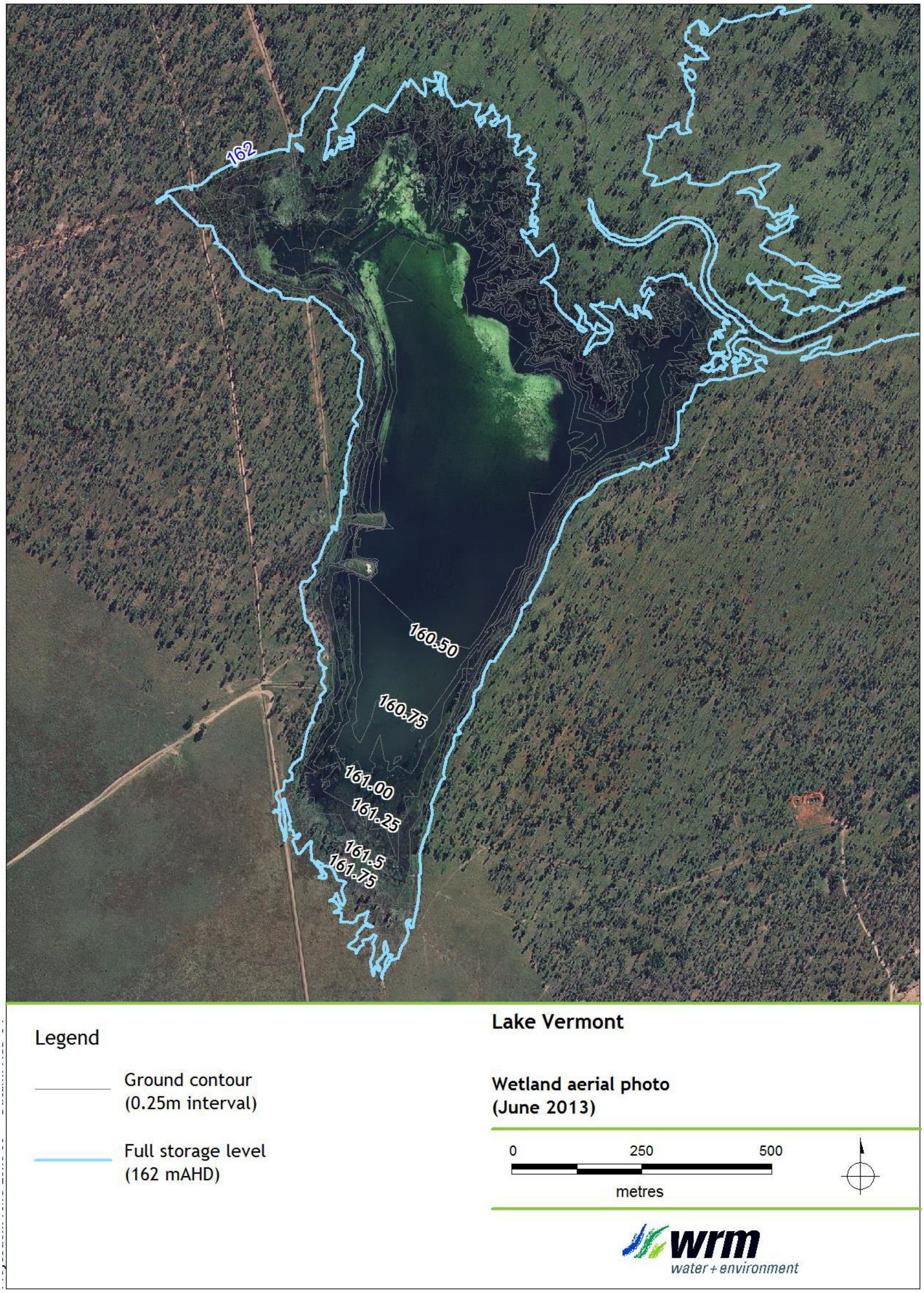

Figure 2 Lake Vermont aerial photo captured in June 2013

Based on the results of flood modelling undertaken for the Project, flood water could be expected to enter the wetland when the Phillips Creek flow rate exceeds approximately 250 m3/s, which is less than the 1 in 5 Annual Exceedance Probability peak flood flow. This implies the wetland could be expected to filled by Phillips Creek floodwater every 2 to 5 years**.**

Additionally, modelling results suggest the wetland would be expected to hold water to a depth exceeding 0.5 m (i.e. at about 3.2% of the total storage capacity) about 50% of the time. Stored water volumes would be at less than 25% capacity 80% of the time.

2.1.4 Information Request

“Relevant data or prediction of the proposed action effects from sufficient modelling about the potential impacts on the lake and creeks;”

2.1.5 Response

The Project has the potential to impact on surface water flows in Phillips Creek and into the Lake Vermont wetland, due to the loss of catchment area both during the operation and after closure of the mine. However, modelling of the catchment characteristics, surface water flows and flooding, combined with investigations into the existing flow regimes in the catchment and the wetland, show that these impacts will not be significant.

Section 3.11.3.2 of the MNES Assessment Report describes changes in the nature of water availability and catchment inputs as a result of the Project. The Surface Water Management System (SWMS) report assessed the cumulative impact of the Northern Extension with the existing Lake Vermont Mine.

At the peak of mining disturbance, the maximum captured catchment area during mining operations consists of approximately:

- 49% of the Lake Vermont wetland catchment area, attributable to the Northern Extension Project;
- 4% of the Phillips Creek catchment to the confluence of the Isaac River (half of which is due to the Northern Extension);
- 37% of the Lumpy Gully catchment to the confluence of Downs Creek (10% of which is due to Northern Extension Project); and
- 1% of the Downs Creek catchment to the confluence of the unnamed tributary (due to approved operations).

The impact of the change in Lake Vermont’s catchment area on the frequency of filling the lake is shown in Section 4.1 of WRM’s Surface Water Balance Modelling Report (Appendix A to this report). In summary, the likelihood at the peak of mining disturbance of stored water levels exceeding 160.4 m AHD (approximately 0.15 m deep – i.e. at about 2% of full capacity) would temporarily decrease from approximately 60% to 42%. The likelihood of exceeding an elevation of 161.4 m AHD (1.15 m depth - i.e. at about 47% of the total storage capacity) would reduce from approximately 12% to 8%.

Post-mining, the permanently changed topography as a result of the final landform will have the following impacts on catchment areas:

- A reduction of 5.9 km2 in the catchment area draining to Phillips Creek compared to pre-mining conditions. This represents a decrease of less than 1.2%;

- A reduction of 2.6 km2 in the catchment area draining to Lumpy Gully compared to pre-mining conditions. This represents a reduction of approximately 2%; and

- A reduction of 1.3 km2 in the catchment area draining to the Lake Vermont wetland compared to pre-mining conditions, representing a decrease in catchment area of approximately 12%.

Table 1 Catchment Area Loss

Receiving Watercourse	Pre-Mining Catchment Area (km^2)	Post-Mining Catchment Area (km^2)	Post-Mining Captured Catchment Area (km^2)
Phillips Creek	506.1	500.2	5.9
Unnamed Tributary	128.8	126.2	2.6
Lake Vermont	10.8	9.5	1.3

As outlined in Section 4.1 of WRM's Surface Water Balance Modelling Report (Appendix A to this report), post-mining, the likelihood of stored water levels exceeding 160.4 m AHD (approximately 0.15 m deep – i.e. at about 2 % of the total storage capacity) would decrease from approximately 60% to 55%. The likelihood of exceeding an elevation of 161.4 m AHD (1.15 m deep – i.e. at about 47% of the total storage capacity) would reduce from approximately 12% to 11%.

From the information provided in both the initial Surface Water Impact Assessment and the subsequent Surface Water Balance Modelling Report, it can be concluded that the impact of the Project on the flow regimes within the wetland and its catchment is insignificant, with only slight decreases in the likelihood and frequency of water entering the lake as a result of lost catchment area.

2.1.6 Information Request

"Potential contribution to cumulative impacts in the project area"

2.1.7 Response

Cumulative surface water impacts associated with the proposed Project could include impacts on water quality, flooding and surface water flows, and were assessed taking into consideration both existing and new or proposed projects in the region. The nineteen relevant existing projects considered in the cumulative impact analysis for surface water are listed in Table 2, and seven new or proposed projects are shown in Table 3.

Table 2 Existing Projects Considered in the Cumulative Impact Assessment

Project - Proponent	Description	Operational Status	Relationship to the Project Mining Lease	
			Timing	Location
Burton Mine – Peabody Energy Australia	Open cut coal mine with a yield of 2.1 Mtpa	Operating	May have overlapping operational phases with the construction and operations of the project.	90 km to the north-northwest of the project area. Located within Isaac River catchment.

Project - Proponent	Description	Operational Status	Relationship to the Project Mining Lease	
			Timing	Location
Coppabella Mine – Peabody Energy Australia	Open cut coal mine with a yield of 3.1 Mtpa	Operating	May have overlapping operational phases with the construction and operations of the project.	60 km to the north of the project area. Located within Isaac River catchment.
Moorvale Mine – Peabody Energy Australia	Open cut coal mine with a yield of 2.1 Mtpa	Operating	May have overlapping operational phases with the construction and operations of the project.	45 km to the north of the project area. Located within Isaac River catchment.
Eaglefield Mine – Peabody Energy Australia	Open cut coal mine with a yield of 0.9 Mtpa	Operating	May have overlapping operational phases with the construction and operations of the project.	95 km to the north-northwest of the project area. Located within Isaac River catchment.
North Goonyella Mine – Peabody Energy Australia	Open cut coal mine with a yield of 1.7 Mtpa	Operating	May have overlapping operational phases with the construction and operations of the project.	95 km to the north-northwest of the project area. Located within Isaac River catchment.
Millennium Mine – Peabody Energy Australia	Open cut coal mine with a yield of 5.5 Mtpa	Operating	May have overlapping operational phases with the construction and operations of the project.	45 km to the north-northwest of the project area. Located within Isaac River catchment.
Goonyella Riverside Mine – BMA	Open cut coal mine	Operating	May have overlapping operational phases with the construction and operations of the project.	80 km to the northwest of the project area. Located within Isaac River catchment.
Moranbah North Mine – Anglo Coal	Underground coal mine with a yield of 4.5 Mtpa	Operating	May have overlapping operational phases with the construction and operations of the project.	75 km to the northwest of the project area. Located within Isaac River catchment.

Project - Proponent	Description	Operational Status	Relationship to the Project Mining Lease	
			Timing	Location
Carborough Downs Mine – Vale Australia	Underground coal mine with a yield of 2.4 Mtpa	Operating	May have overlapping operational phases with the construction and operations of the project.	55 km to the north-northwest of the project area. Located within Isaac River catchment.
Poitrel Mine – BMC	Open cut coal mine	Operating	May have overlapping operational phases with the construction and operations of the project.	45 km to the north-northwest of the project area. Located within Isaac River catchment.
Peak Downs Mine – BMA	Open cut coal mine	Operating	May have overlapping operational phases with the construction and operations of the project.	30 km to the northwest of the project area. Located within Isaac River catchment.
Saraji Mine – BMA	Open cut coal mine	Operating	May have overlapping operational phases with the construction and operations of the project.	15 km to the west of the project area. Located within Isaac River catchment.
Norwich Park Mine - BMA	Open cut coal mine	Ceased production indefinitely	May have overlapping operational phases with the construction and operations of the project.	15 km to the southwest of the project area. Located within Isaac River catchment.
Daunia Coal Mine Project - BMA	Open cut coal mine with a yield of 4Mtpa	Operating	May have overlapping operational phases with the construction and operations of the project.	40 km to the north-northwest of the project area. Located within Isaac River catchment.
Eaglefield Expansion Project –Peabody Energy Australian Coal Pty Ltd	Underground coal mine expansion with a yield of 10.2 Mtpa	Expansion in construction phase	May have overlapping operational phases with the construction and operations of the project.	95 km to the northwest of the project area. Located within Isaac River catchment.

Project - Proponent	Description	Operational Status	Relationship to the Project Mining Lease	
			Timing	Location
Grosvenor Coal Mine Project – Anglo Coal	Underground coal mine with a yield of 5 Mtpa	In construction phase	May have overlapping operational phases with the construction and operations of the project.	60 km to the northwest of the project area. Located within Isaac River catchment.
Integrated Isaac Plains Project –IP Coal Pty Ltd and Vale Australia	Expansion to existing open cut coal mine, with a yield of 4 Mtpa.	Existing mine operating, expansion in construction phase	May have overlapping operational phases with the construction and operations of the project.	60 km to the northwest of the project area. Located within Isaac River catchment.
Caval Ridge Mine Project - BMA	Open cut mine with a yield of 5.5 Mtpa and associated infrastructure.	Operating	May have overlapping operational phases with the construction and operations of the project.	45 km to the northwest of the project area. Located within Isaac River catchment.
Eagle Downs Coal Project – Bowen Central Coal Joint Venture Parties	Underground coal mine with a yield of 7 Mtpa and associated infrastructure.	In construction phase	May have overlapping operational phases with the construction and operations of the project.	35 km to the northwest of the project area. Located within Isaac River catchment.

Table 3 New or Developing Projects Considered in the Cumulative Impact Assessment

Project - Proponent	Description	Operational Status	Relationship to the Project Mining Lease	
			Timing	Location
Red Hill Mining Lease Project - BMA	Underground coking coal mine with a yield of 14 Mtpa and expansion of two existing coking coal mines (Broadmeadow and Goonyella Riverside)	EIS active	May have overlapping operational phases with the construction and operations of the project.	85 km to the north-northwest of the project area. Located within Isaac River catchment.
Grosvenor West Project – Carabella Resources	Open cut or underground mine with a yield of 3.5 Mtpa and associated infrastructure.	Final ToR issued – EIS in preparation	May have overlapping operational phases with the construction and operations of the project.	75 km to the northwest of the project area. Located within Isaac River catchment.

Project - Proponent	Description	Operational Status	Relationship to the Project Mining Lease	
			Timing	Location
Moranbah South Project – Anglo Coal and Exxaro Australia Pty Ltd	Underground coking coal mine with a yield of 18 Mtpa and associated infrastructure.	EIS lodged, public notice period completed	May have overlapping operational phases with the construction and operations of the project.	55 km to the northwest of the project area. Located within Isaac River catchment.
New Lenton Coal Project – New Hope Corporation Ltd	Open cut mine with a yield of 5 Mtpa and associated infrastructure.	Final ToR issued – EIS in preparation	May have overlapping operational phases with the construction and operations of the project.	100 km to the north- northwest of the project area. Located within Isaac River catchment.
Carborough Downs Mine Expansion Project - CDJV	Expansion to existing underground coal mine, with a yield of 5 Mtpa.	EIS completed.	May have overlapping operational phases with the construction and operations of the project.	55 km to the north-northwest of the project area. Located within Isaac River catchment.
Codrilla Coal Mine Project – Coppabella and Moorvale Joint Venture	Open cut coal mine with associated infrastructure.	EIS completed.	May have overlapping operational phases with the construction and operations of the project.	35 km to the north-northeast of the project area. Located within Isaac River catchment.
Ellensfield Coal Mine Project – Ellensfields Coal Management Pty Ltd	Open cut coal mine with associated infrastructure.	EIS completed.	May have overlapping operational phases with the construction and operations of the project.	75 km to the north-northwest of the project area. Located within Isaac River catchment.

Cumulative impacts on Surface Water are discussed in the MNES Assessment Report section 3.11.3.2 – Potential Impacts on Surface Water, which includes descriptions of cumulative impacts on Water Quality, Flooding and Surface Water Flows.

For Water Quality, given that the Northern Extension is simply an extension of existing mining activities, and that mine water releases will be managed within an overarching strategic framework for management of cumulative impacts of mining activities, the proposed management approach for mine water from the Project is expected to have negligible cumulative impact on surface water quality and associated environmental values.

For flooding, none of the known projects in the planning or development phase in the vicinity of the Project are expected to result in additional structures on the floodplain. Therefore, cumulative impacts on flooding are not expected to lead to any adverse impacts on human populations, property or other environmental or social values.

For surface water flows, the Project does not require any additional raw water allocations and therefore does not contribute to cumulative impacts in relation to extraction of surface water resources from other catchments. The Project will locally impact flows in the minor tributaries of Downs Creek and the Isaac River due to water being captured within the SWMS. The impacts of these changes are expected to be minimal. No other projects have been identified which would further increase these impacts.

2.1.8 Information Request

"Prediction of effects of these impacts on ecosystems around the lake and along the banks of Phillips Creek."

2.1.9 Response

The potential water related impacts to ecosystems associated with Lake Vermont and Phillips Creeks include drawdown, altered surface water catchment, altered flow characteristics and the potential release of contaminants. The likely impact of these changes has been assessed in the following sections of the MNES Assessment report and associated appendices.

As demonstrated by the Surface Water Impact Assessment Report, and the subsequent Surface Water Balance Modelling Report (Appendix A), Phillips Creek and the Lake Vermont wetland are surface water fed and ephemeral, subject to long periods of dry conditions. Phillips Creek only flows to the wetland when the flow rate exceeds approximately 250 m^3/s, which is less than the 1 in 5 Annual Exceedance Probability peak flood flow. This implies the wetland is only filled by Phillips Creek floodwater every 2 to 5 years. As such, the terrestrial ecosystems in the wetland and along Phillips Creek are tolerant of extended dry periods, with little or no inflow. Due to the insignificant impact from the Project on storage volumes and fill-empty cycles in the Lake Vermont wetland, changes in Phillips Creek flooding are unlikely to have impact on aquatic / ecological values of the wetland.

Section 3.11.3.2 of the MNES Assessment Report outlines the loss of catchment area as a result of mining and onsite water management and the resulting impacts on water levels, which will be insignificant. Post-mining, for the Lake Vermont wetland, the likelihood of stored water levels reaching about 2% of the total storage capacity would only decrease from approximately 60% to 55%. The likelihood of the wetland filling to about 47% of the total storage capacity would only reduce from approximately 12% to 11%. With these minor changes in flow regimes, and the existing vegetation's tolerance of dry conditions, the impact on ecosystems is expected to be minor.

Additionally, Section 3.11.3.2 describes potential hydraulic impacts, which may result in an elevated erosion risk while banks of the diversion are unvegetated following construction. These impacts will be managed through revegetation, although the relatively cohesive nature of local soils provides some natural mitigation.

The Aquatic Ecology and Stream Morphology Assessment Report discusses potential for drawdown, but, with reference to the Groundwater Impact Assessment, concludes that the risk to groundwater dependent ecosystems will be low due to the depth of the regional groundwater table from the surface and the limited extent of drawdown impacts from mining.

2.2 INTERACTION BETWEEN SURFACE WATER AND GROUNDWATER

2.2.1 Issue

"Water drawdown and the reduction of catchment area may have some impacts on the interaction between surface water and groundwater in the project area, such as recharge rates to groundwater, groundwater table and potentiometric surface levels. This may also interact with other coal mining activities and contribute cumulative impacts on the interaction between surface water and groundwater.

The dry condition found in the relevant geological and hydrogeological units (i.e. quaternary alluvium and tertiary sediments) within the project area when drilled could be potentially due to the recharge fluctuation from available surface water (rainfall or flooding). If these data had been used in groundwater modelling, it would be unlikely to estimate the groundwater contours correctly."

2.2.2 Information Request

"Data or information to support the assumption that Lake Vermont is not connected to groundwater"

2.2.3 Response

Groundwater data obtained for the MNES Assessment report included data from:

- Groundwater monitoring bores constructed within the proposed extension area specifically for the assessment;
- Observations from the existing Lake Vermont pit, from a site inspection undertaken in June 2013;
- Geological sections obtained from the site geological model;
- Data available from site exploration drilling (lithology, stratigraphy, groundwater observations from drilling); and
- Publicly available data from registered groundwater bores and nearby projects and operations.

JBT Consulting produced a Groundwater Summary Report (MNES Assessment Report – Appendix E), which concludes that the Lake Vermont wetland is a topographic depression that is maintained by surface water runoff under certain climatic conditions and is not groundwater fed.

The closest groundwater monitoring bore to Lake Vermont is bore 1235C-VWP, which is a vibrating wire piezometer (VWP) installation containing 4 VWP's. The uppermost VWP measures groundwater levels in Permian sandstone, which is the shallowest groundwater unit at that location. Review of monitoring data from November 2015 indicates that the shallow groundwater unit records a depth to water of approximately 36 m below ground level (mbgl), which equates to a relative water level of approximately 130 mAHD. Monitoring data also confirms that the Tertiary sediments are dry at this location, as the depth to base of Tertiary is 20 m (i.e. the groundwater level is approximately 16 m below base of Tertiary).

The ground elevation at Lake Vermont is approximately 160 m AHD at the lake margins, therefore by extension of data from 1235C-VWP the groundwater level could be expected to be approximately 30 to 35 m below the level of the lake. This would place the groundwater level below the base of the Tertiary sediments (which are approximately 18 m thick at the location of Lake Vermont, based on drilling data from exploration bore LV1232, which is located approximately 60 m from the western edge of the lake). This is consistent with observations from the exploration drilling program that the Tertiary sediments are generally dry throughout the Lake Vermont area.

It is therefore concluded that the Lake Vermont wetland could not be maintained by groundwater baseflow.

2.2.4 Information Request

"Long term annual rainfall data and the sampling time for the relevant geological and hydrogeological units within the project area"

2.2.5 Response

Long-term average annual rainfall, measured at the nearby Clermont Post Office Bureau of Meteorology (BOM) station since 1871, is 667.3 mm/year. Daily rainfall data is also collected from the existing mine site, and is summarised for the 2010 – 2015 period in Table 4.

Table 4 Lake Vermont Rainfall Data

Month	2010	2011	2012	2013	2014	2015
Jan	177.0	192.1	179.5	219.1	186.5	266.2
Feb	255.0	67.5	93.8	84.7	64.2	22.0
Mar	60.5	150.6	251.5	62.2	17.7	2.6
Apr	85.0	38.6	26.3	78.8	60.7	6.0
Jun	6.5	50.2	52.6	109.8	8.3	1.5
Jul	3.0	37.4	43.5	2.3	10.3	3.5
Aug	13.0	10.5	97.2	1.1	1.5	0.4
Sep	58.0	48.8	0.4	0.0	46.4	6.0
Oct	136.0	0.0	5.0	0.0	62.5	6.5
Nov	40.8	17.1	11.3	2.0	9.0	1.1
Dec	273.1	20.8	47.1	193.6	43.9	98.4
Total	**1439.5**	**738.9**	**822.8**	**769.5**	**730.6**	**424.8**

Construction and monitoring of groundwater bores for the assessment project was undertaken in late 2013. At this time, alluvium sediments in all holes were observed to be dry. Of the three bores drilled into tertiary sediments, only one (closest to Phillips Creek) has water for any period of time. As the rainfall data above shows, each year leading up to this time was significantly wetter than the long-term average.

Additional monitoring undertaken at bore 1235C-VWP in November 2015 also confirms that the Tertiary sediments are dry at this location, as the depth to base of Tertiary is 20 mbgl and depth to water is approximately 36 mbgl (i.e. the groundwater level is approximately 16 m below the base of Tertiary sediments). As can be seen in Table 4, 2015 was a relatively dry year, with annual rainfall of 424.8mm.

Since groundwater monitoring and geological assessments have consistently found dry conditions in the quaternary alluvium and tertiary sediments following long periods of wetter than average years, and in a drier than average year, it is clear that these dry groundwater conditions are consistent, and not due to fluctuations in rainfall at the time that drilling and monitoring was undertaken.

2.2.6 Information Request

"Additional information about current situation of the interaction (e.g. recharge rates to ground water and groundwater table) and prediction on the change of this interaction as a result of the construction of the mining pits, e.g. the pit immediately south of Phillips Creek and the Satellite Pit on the other side"

2.2.7 Response

In the areas of the proposed Project, the most relevant hydrogeological units in terms of recharge are the Triassic Sediments of the Rewan Group and the Permian Strata of the Fair Hill Group. Current groundwater occurrence and recharge for these hydrogeological units is described in Section 5.3 of the Groundwater Impact Assessment Report (MNES Assessment Report – Appendix D).

Both the Rewan and Fair Hill formations are of low permeability and therefore receive little direct recharge (these sediments tend to be dry when drilled, irrespective of the season, and it tends to be only the coal seams of the Rangal Coal Measures that contain water, albeit at low yields).

The Lake Vermont northern extension is not located within a defined groundwater recharge area (e.g. GAB intake beds or similar). Due to the conditions described above, and because the area where the Project will occur is not regarded as a significant groundwater recharge zone, any reduction in groundwater level due to mining could be expected to have limited impact on recharge rates.

2.2.8 Information Request

"Potential contribution to cumulative impacts in the project area."

2.2.9 Response

To assess cumulative groundwater impacts, JBT Consulting used the following sources to identify existing projects that may combine with the proposed Project to impact groundwater resources:

- The Queensland Coordinated Projects Map (DSDIP 2014);
- Queensland's Mineral, Petroleum and Energy Operations and Resources map (State of Queensland 2012); and,
- Publicly available documentation (e.g. EIS documents that exist within the public domain).

Based on review of this documentation it was concluded that the projects with the potential to contribute to cumulative groundwater impacts include:

- The existing Lake Vermont operation, of which the proposed Lake Vermont Northern Extension Project will be an extension; and
- The existing Saraji Coal Mine, which is located approximately 6 km to the west of Lake Vermont

Cumulative impacts on Groundwater are discussed in the MNES Assessment Report section 3.11.3.3 – Potential Impacts on Groundwater.

At the end of mining, the 5 m drawdown extent was modelled to be approximately 2 km west of the Lake Vermont and Northern Extension pits. Based on the presence of similar geology, it is assumed that the 5 m drawdown extent resulting from the nearby Saraji Coal Mine extends over a similar distance. Consequently, given that the Saraji Mine is situated approximately 6 km from the closest extent of mining at the Project, coalescence of the two 5 m drawdown cones is not expected to occur at the end of mining.

At 100 years post mining, however, the 5 m drawdown contour is predicted to extend to approximately 4 km west of the pits. Assuming a similar drawdown extent for the Saraji Mine, there is potential for cones of groundwater drawdown to coalesce following the cessation of mining in the area between the

Saraji and Lake Vermont Mines. However, groundwater levels in the region are approximately 20 mbgl (i.e. 20 m below the level that would provide baseflow to existing alluvium or to the root zone of plants). Additional groundwater drawdown from the Project, occurring predominantly within the Permian coal strata, is therefore not considered likely to impact surface ecosystems.

In addition, groundwater bores in the region (of which there is a limited number) are predominately located in areas potentially impacted by either the existing Lake Vermont or Saraji Coal Mines. Consequently, groundwater drawdown caused by the Project is considered unlikely to contribute further impacts to groundwater users in the region.

2.3 WATER QUALITY OF A WATER RESOURCE

2.3.1 Issue

"In the referral, it was concluded that the proposed action is not expected to significantly affect quality of surface water or groundwater in the area. However, overflow of water from sediment dams may occur during inflows exceeding the sediment dam capacity (such as during or after significant rainfall events). The overflow will potentially have impacts to environmental values of the Isaac River if it occurs.

It was anticipated in the referral that aquifers surrounding the Project site are unlikely to be contaminated since the proposed action, with the existing Lake Vermont Coal Mine, will generate a cone of depression generating flow towards the mining pits. The long-term water levels in the voids would be below the regional groundwater levels and void water salinity will increase over time. However, water levels in the voids will fluctuate due to water input from groundwater inflow, rainfall and flooding. Some extreme weather events (e.g. heavy rain and flooding) may significantly increase the water levels in the voids. Therefore, the groundwater contamination could not be excluded because of the potential water exchange between the void and aquifers surrounding the Project site."

2.3.2 Information Request

"Further information about potential impact to environmental values of the Isaac River if overflow occurs from sediment dams"

2.3.3 Response

The design of both the on-site Surface Water Management System, to ensure mine-affected water is not discharged through the stormwater system, and the sizing of the proposed and existing sediment dams ensures that the downstream impacts from these structures will not be significant.

As outlined in Section 4.10.6 of the Surface Water Impact Assessment (MNES Assessment Report – Appendix C) the proposed sediment dams will be designed and sized for a 1 in 10 year AEP, 24-hour duration design storm runoff volume and an additional 25% capacity for sediment storage. This design is in line with the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland (Technical Guidelines) prepared by the former Department of Minerals and Energy (DME) in 1995 (the DME Guidelines) for the discharge of low toxicity waste. These design guidelines generally exceed the volumetric requirements for sediment basins sized in accordance with the International Erosion Control Association's (IECA) Best Practice Erosion and Sediment Control Guidelines. The sediment dams have been sized for their maximum catchment area over mine life, for catchments that include disturbance.

As a result of this design, which aims to allow sediment to settle and reduce downstream loads, the only release from sediment dams would be during significant rainfall events. Given there relatively large capacity, the sediment dam overflows are likely to occur when there is widespread Isaac River rainfall. The Isaac River has a catchment area of 6195 km^2 immediately downstream of the Downs Creek confluence. The total catchment area of all sediment dams in the extended Project is 30 km^2, or less than 0.5% of the Isaac River catchment area – so significant dilution is likely.

Additionally, sediment dams have been located to only receive runoff from overburden dumps and undisturbed catchments. Water coming into contact with coal and rejects will be separated as detailed in the proposed SWMS. As outlined in Section 2.5.2 of the Surface Water Impact Assessment, non-mine-affected water in the existing sediment dams on the Lake Vermont site is generally of good quality:

- Stormwater dams' water quality is typically slightly to moderately alkaline, ranging from 7 to 9 pH units.
- Salinity levels are fresh and typically range between 200 and 500 µS/cm.
- Turbidity is typically excellent to fair (<30 NTU), with only occasional poor readings recorded.
- Sulphate levels are very low (<10 mg/L) in all Stormwater dams, with the exception of a high sulphate reading of 91 mg/L recorded in Sediment Dam 1.

2.3.4 Information Request

"Further data or information to support the assumption of water levels in the voids always below the regional groundwater levels"

2.3.5 Response

Section 6.3.1 of the Surface Water Impact Assessment (MNES Assessment Report – Appendix C) describes the long-term water level behaviour in the voids. In summary, due to the limited catchment area around each void, the input of surface water into the voids will essentially be limited to direct rainfall, and the voids will not fill to a level above surrounding groundwater.

As shown in Figure 3, modelling of water levels, based on groundwater inflows and surface water inputs (which will be minimal as the voids do not have a significant catchment beyond their own boundaries), indicates that long term water levels in the Central, North, B and East Pits would be expected to stabilise between 82m AHD and 101m AHD after approximately 120 years. For the Satellite Pit void, the level stabilises at a higher level – around 121m AHD after approximately 60 years.

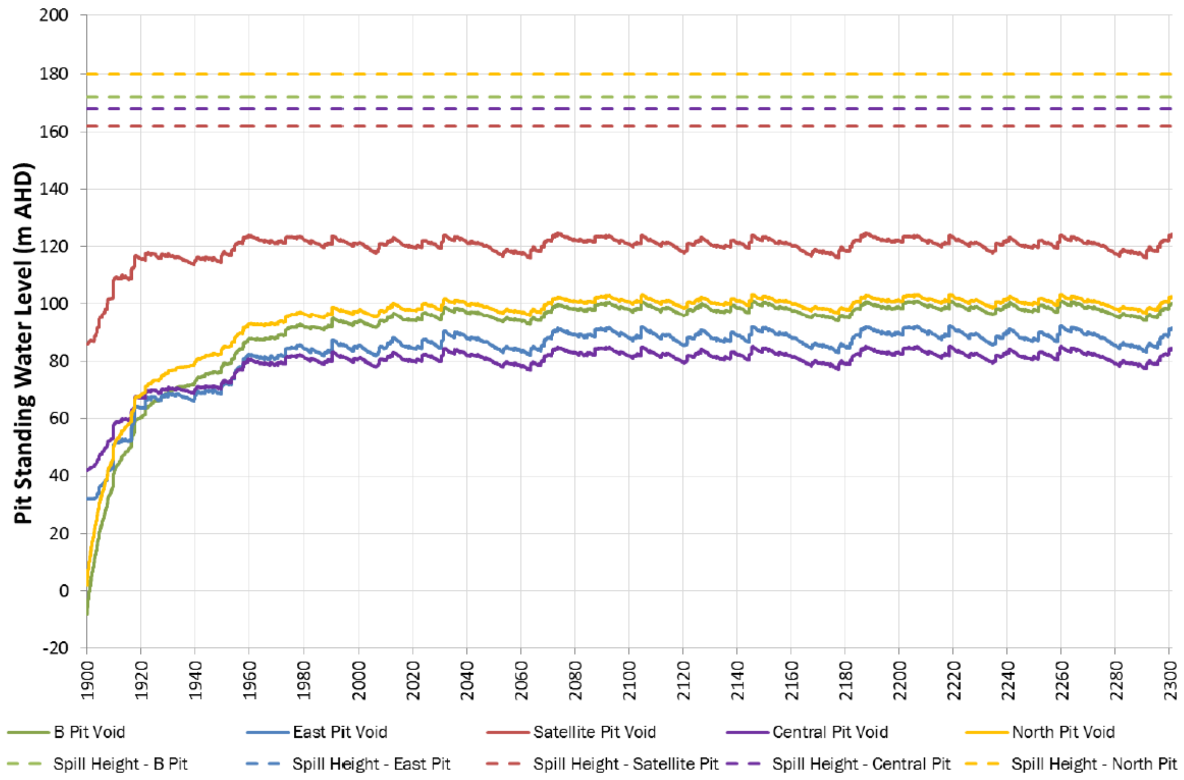

Figure 3 Simulated Final Void Storage Water Level

When compared to regional groundwater levels, it can be concluded that void water levels will remain below groundwater levels, leaving the pits to act as a sink. These comparisons are shown in Table 5 below:

Table 5 Predicted Void Water Levels

Final Void	Regional Groundwater Level (m AHD)	Modelled Long-Term Water Level (m AHD)
Central Pit	130	82
North Pit	138	101
B Pit	143	98
East Pit	140	88
Satellite Pit	146	121

2.3.6 Information Request

"Prediction of impacts on groundwater quality if water levels in the voids equal to or higher than the regional groundwater levels under some extreme weather events (e.g. heavy rain and flooding)."

2.3.7 Response

As demonstrated by the modelling described above, which used data including the extreme rainfall events of 2010-2011, void water levels are expected to remain below groundwater levels, even during extreme rainfall events.

Appendix A Surface Water Balance Modelling Report

Lake Vermont Mine Northern Extension Project

Surface water balance modelling for Lake Vermont wetland

Lake Vermont Resources

0622-19-A2, 9 November 2016

For and on behalf of WRM Water & Environment Pty Ltd
Level 9, 135 Wickham Tce, Spring Hill
PO Box 10703 Brisbane Adelaide St Qld 4000
Tel 07 3225 0200

Michael Batchelor
Principal Civil Engineer

Contents

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1 Introduction

The Lake Vermont Mine Northern Extension Project (LVNEP) Surface Water Impact Assessment identified that during operations, runoff from parts of the catchments draining to the downstream environment will be intercepted in the expanded water management system.

As a result, there will be some additional short-term changes to downstream flows to the Lake Vermont wetland, an ephemeral lake located adjacent to Phillips Creek.

The maximum captured catchment areas during mining operations (all of which is due to the LVNEP) make up approximately 49 % of the Lake Vermont wetland catchment area.

The changed topography as a result of the project final landform will reduce the catchment draining to Lake Vermont wetland by 1.3 km^2 (compared to pre-mining conditions). This represents a reduction in catchment area of about 12 %.

This report has been prepared in response to a request from the Independent Expert Scientific Committee (IESC) for further information on the potential impacts of the LVNEP on the hydrology of the wetland.

The impacts of the LVNEP on the frequency of inundation of the Lake Vermont wetland were assessed using a water balance model of the surface water characteristics of the wetland.

2 Lake Vermont wetland water storage behaviour

2.1 OBSERVED WATER LEVEL BEHAVIOUR

Anecdotally, the Lake Vermont wetland is reported to be highly ephemeral, rarely holding significant quantities of water.

As it was not anticipated that the Lake Vermont wetland would be affected by the originally proposed activities at the Lake Vermont Mine, water levels in the wetland have not been monitored as part of the Lake Vermont Mine surface water monitoring program.

In the absence of such data, aerial photographs and satellite imagery were used to infer the existing surface water behaviour in the Lake Vermont wetland.

2.2 AERIAL PHOTOGRAPHS AND LIDAR DATA

The aerial photographs in Figure 2.1 and Figure 2.2 show the wetland empty in November 2003, and with water a surface elevation at approximately 161 mAHD (maximum depth of approximately 0.9 m) in June 2013.

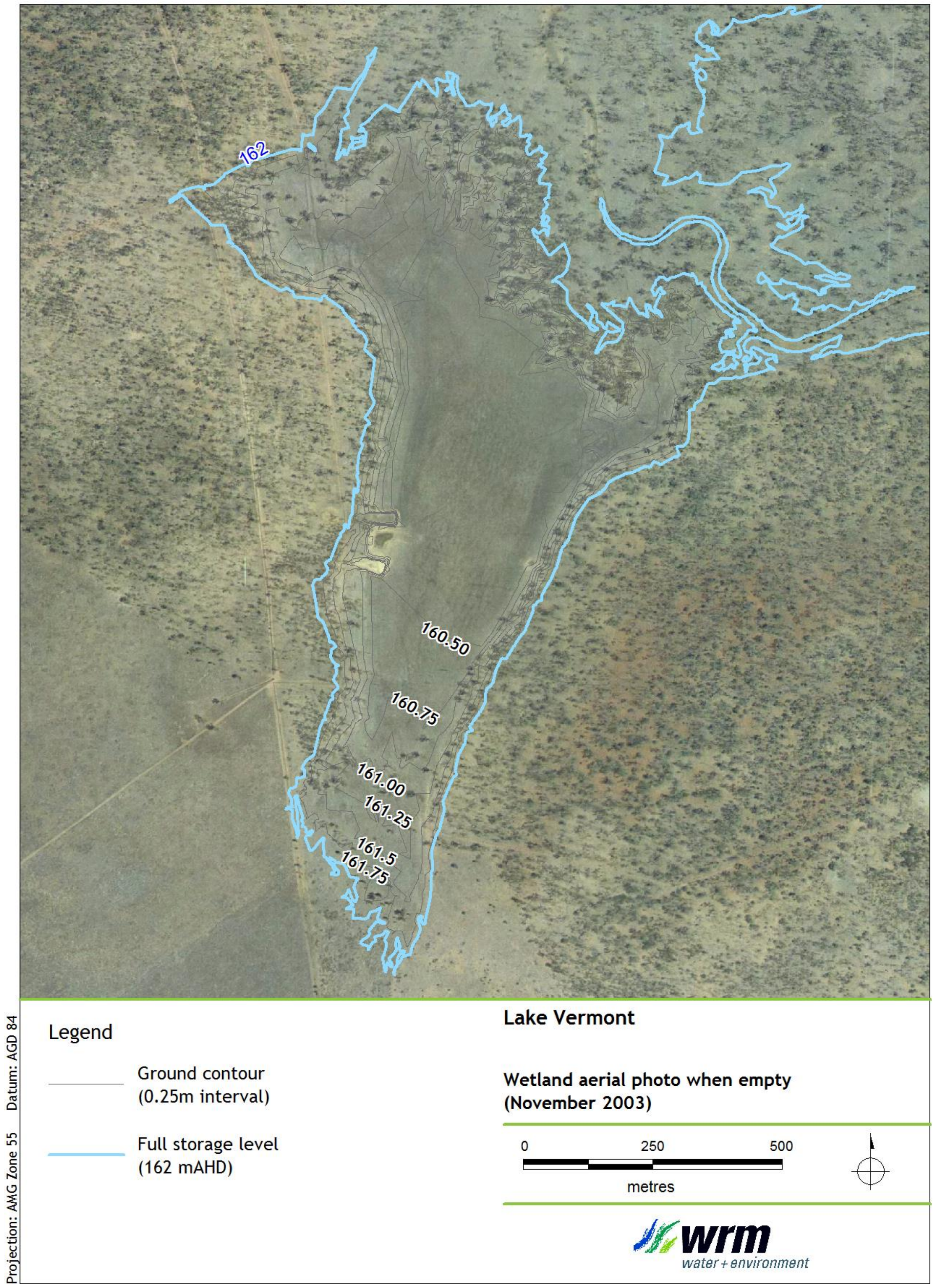

Figure 2.1 – Lake Vermont wetland – aerial photo captured when empty in November 2003

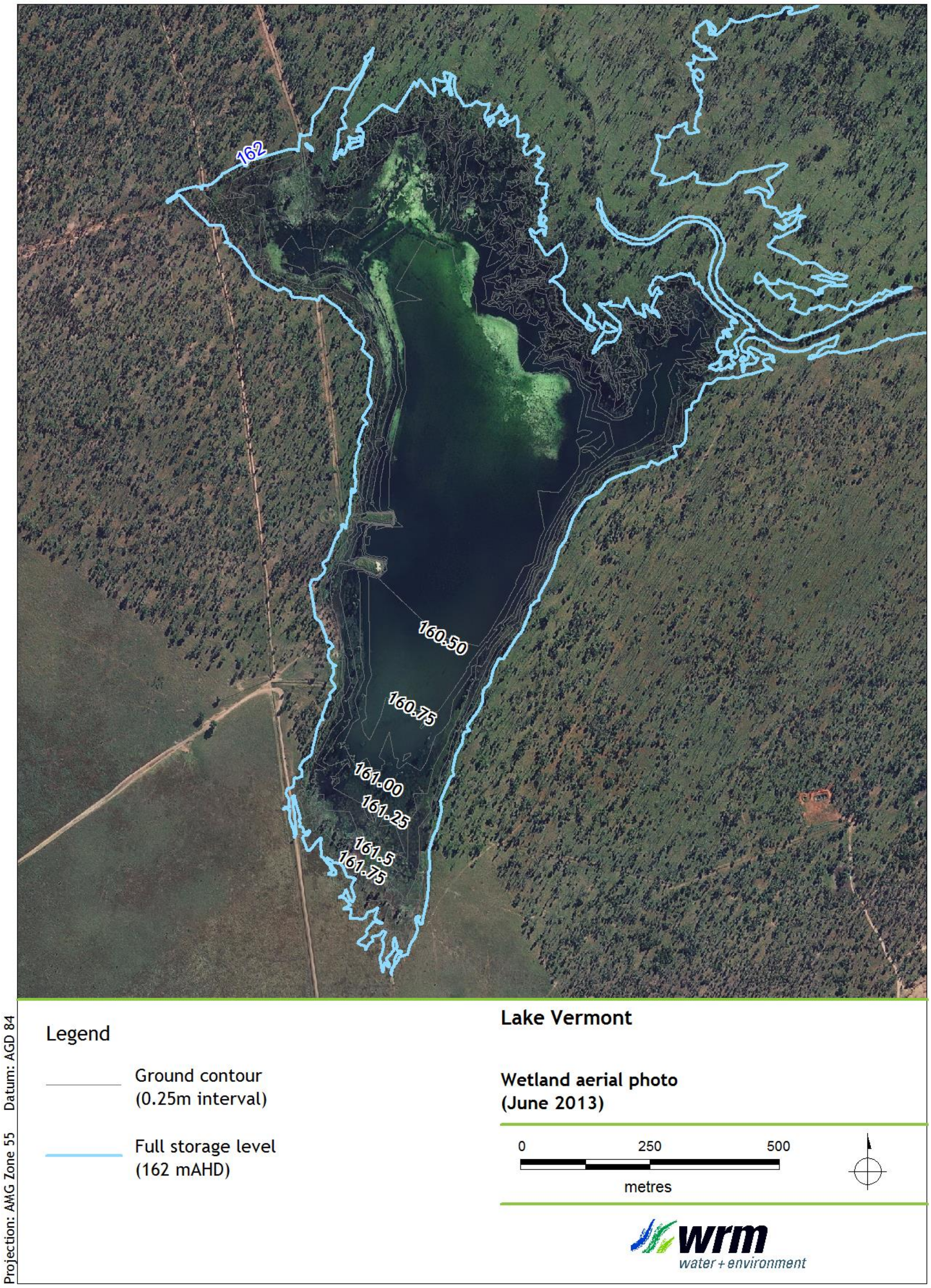

Figure 2.2 – Lake Vermont wetland – aerial photo captured in June 2013

The storage curve of the wetland (elevation vs area and stored volume) shown in Figure 2.3 was derived from LiDAR data obtained in July 2014, when the wetland was empty. The lake is relatively shallow. When full (water level at 162 mAHD), it is approximately 1.9 m deep at its deepest point, and has a surface area of 72.4 ha. The total storage capacity is approximately 690 ML.

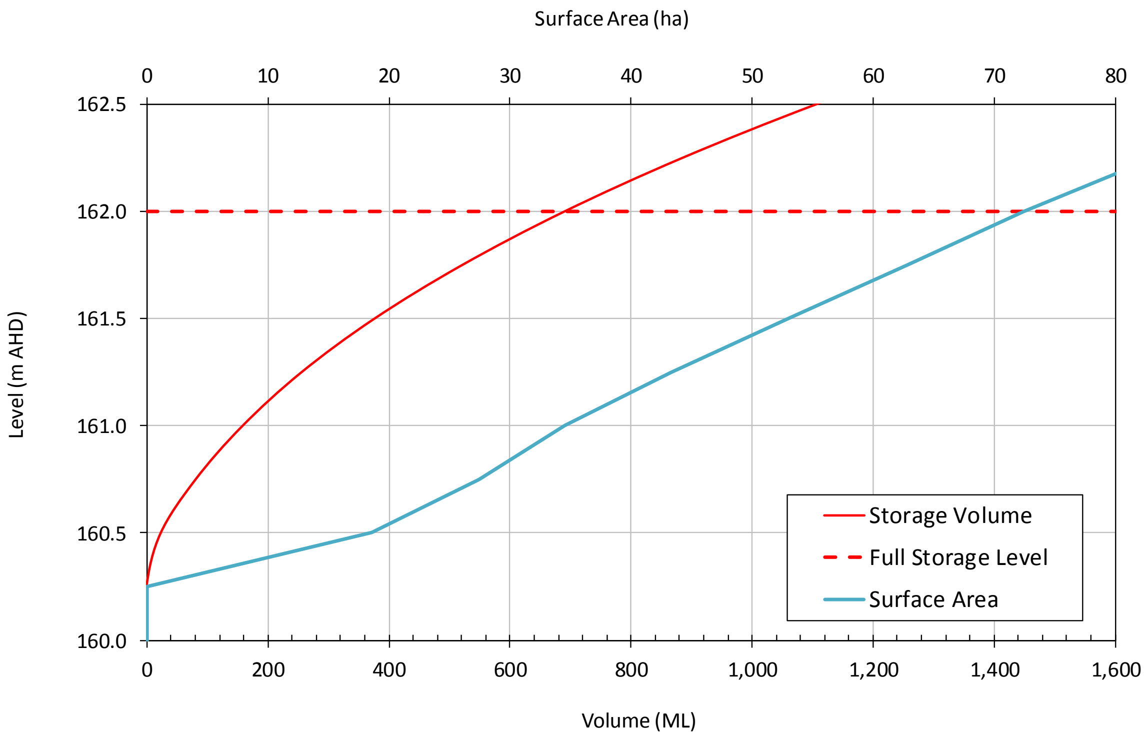

Figure 2.3 – Storage curves – Lake Vermont wetland

2.3 LANDSAT SATELLITE IMAGERY

Geoscience Australia's Water Observations from Space (WOfS) service provides some information regarding the frequency of inundation at the wetland. The data is derived from Landsat-5 and Landsat-7 satellite imagery acquired over Australia between 1987 and 2014. The detection process is based on spectral analysis of each pixel in each Landsat scene. The water detection for a pixel through time is combined to produce a total number of water observations for each pixel. This is compared to a total number of clear observations for the same pixel. The ratio is expressed as a percentage water recurrence. Figure 2.4 shows the "Water Summary Filtered" output from the service for Lake Vermont wetland.

A height vs frequency curve was approximated from the data, by overlaying the available LiDAR data. The results indicate that over the period between 1987 and 2014 (which was a wetter than average period of time), water was observed in the centre of the wetland to an elevation of approximately 160.4 mAHD (0.15 m deep – and about 2% of full capacity) about 50% of the time. Elevations of 161.43 mAHD (about 50% full), were exceeded about 5% of the time.

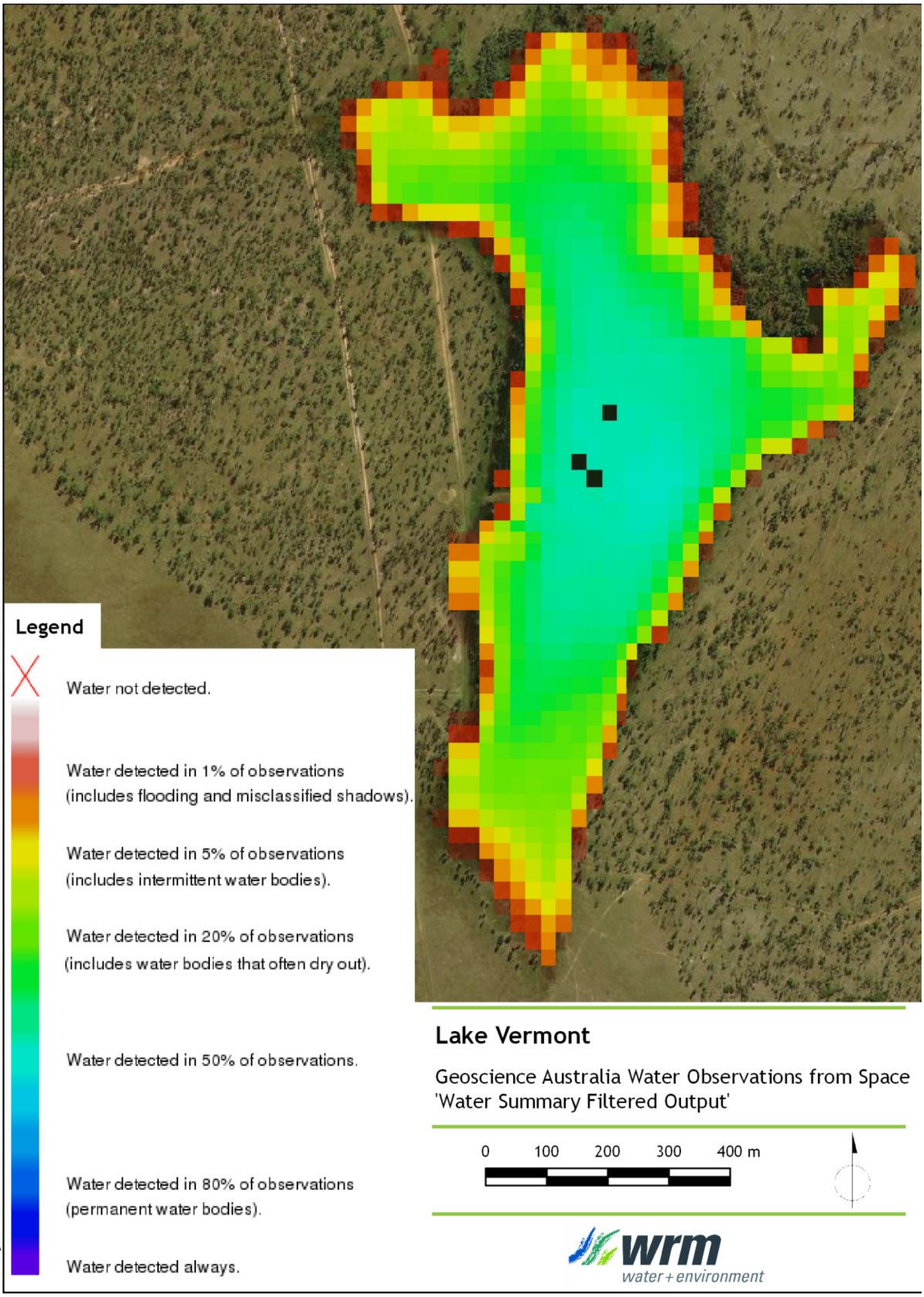

Figure 2.4 – Water Observations from Space data (source: Geoscience Australia)

3 Water balance modelling

3.1 METHODOLOGY

A surface water balance model was prepared for the wetland and its catchment using the GoldSim software. The model comprises a single water storage, with the following processes simulated on a daily timestep using climate data from the Data Drill over the period 1889 to 2016:

- Surface runoff from the upstream catchment using the AWBM rainfall-runoff model. The AWBM model parameters were adopted from the site water balance model calibration;
- Evaporation from and direct rainfall to the water surface;
- Overflows from the wetland when its capacity is exceeded;
- Losses due to seepage and or water rural water use;
- Inflows due to flooding in Phillips Creek.

Groundwater inflows were assumed to be nil.

The surface water catchment to the Lake Vermont wetland is shown in Figure 3.1. The total existing catchment area to the wetland is 1,070 ha.

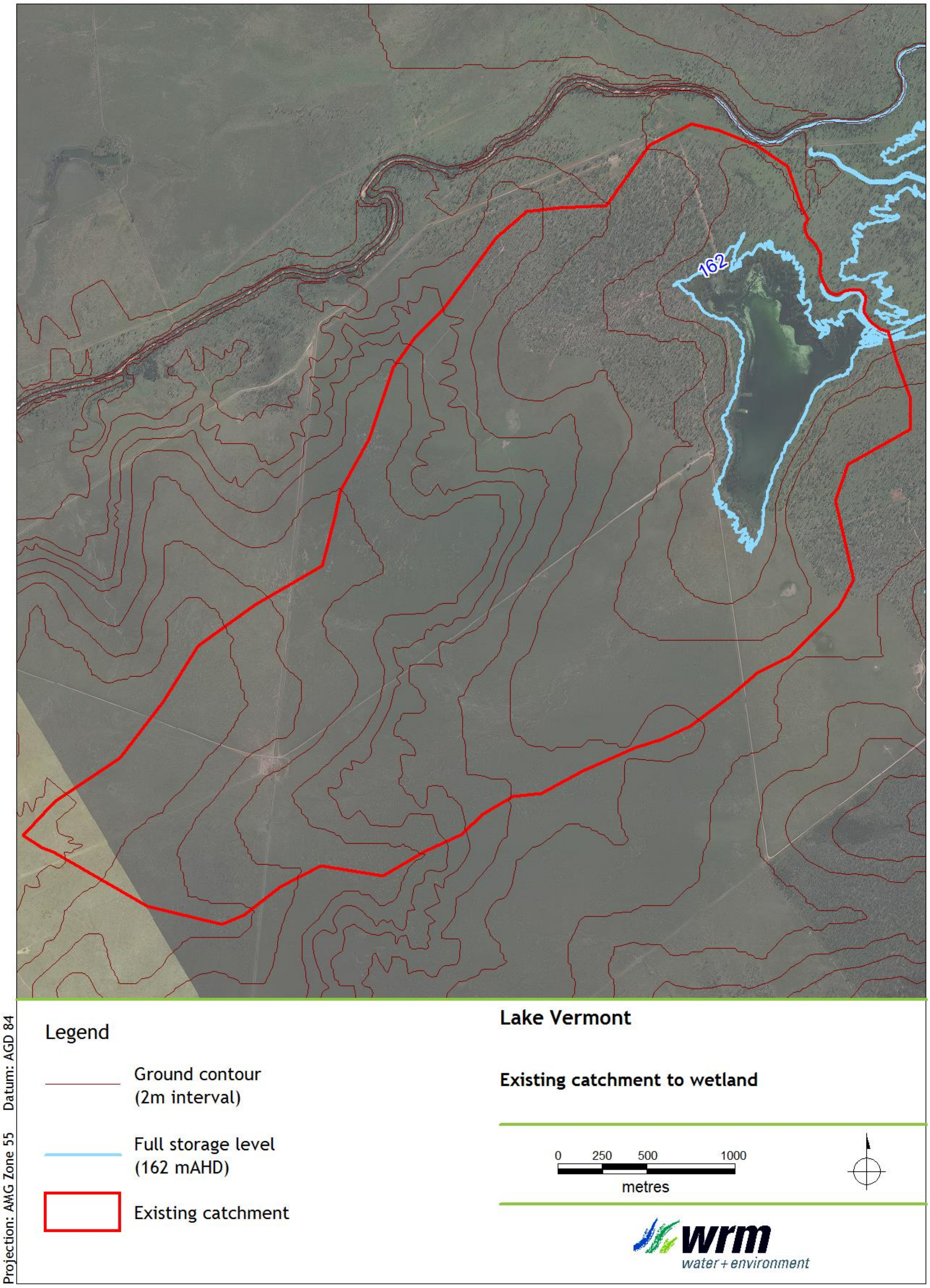

Figure 3.1 – Lake Vermont wetland catchment

Based on the results of the flood modelling for the project (shown in Figure 3.2) flood water could be expected to enter the wetland when the Phillips Creek flow rate exceeds approximately 250 m^3/s, which is less than the 1 in 5 Annual Exceedance Probability peak flood flow. This implies the wetland could be expected to filled by Phillips Creek floodwater every 2 to 5 years.

The influence of flooding was modelled by directing an additional inflow sufficient to fill the storage every time the 3-day rainfall total exceed 180 mm. This resulted in modelled flood inflows occurring approximately 30 times over the 128 years of simulation (once every 4 years).

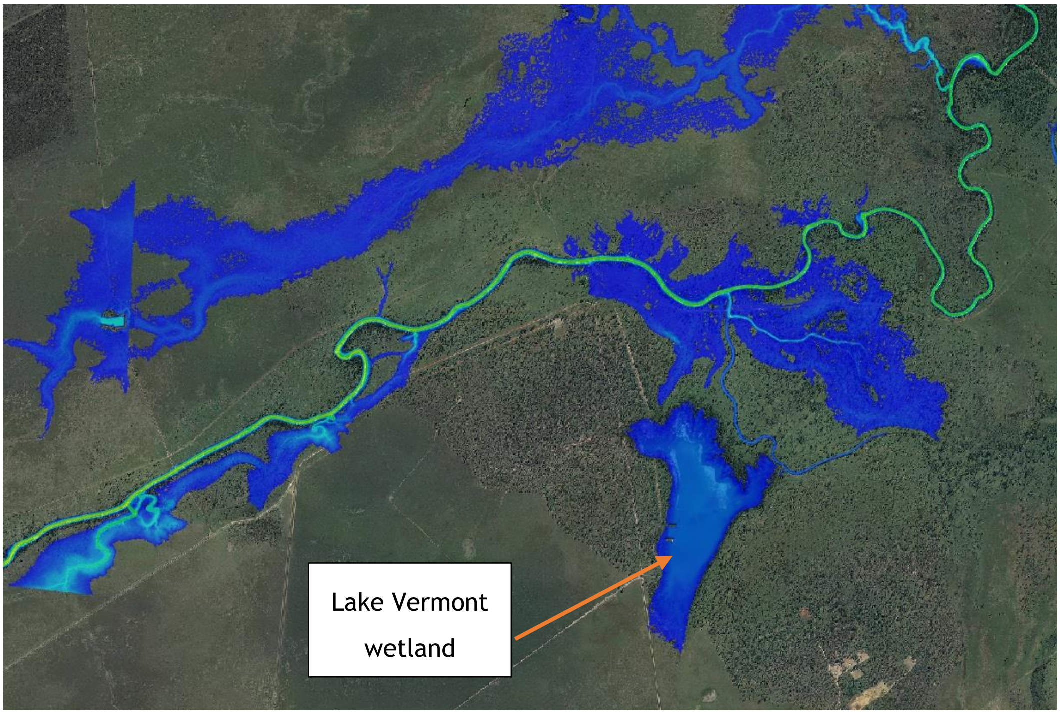

Figure 3.2 – Phillips Creek flood inundation at point of overtopping into Lake Vermont during flood of 250 m^3/s.

3.2 EXISTING WETLAND BEHAVIOUR

The modelled behaviour of the existing wetland is illustrated in the following depth time series from the model. The results show occasional filling of the wetland, followed by a gradual reduction in water levels due to evaporation over dry periods. Figure 3.3 shows the model reproduces the recorded empty conditions in November 2003 and July 2014, and provides a good representation of the stored volume in June 2013. In the absence of rainfall, losses would typically empty the lake from full over a period of approximately seven months.

The results of the modelling for the period 1987 to 2014 are also presented in the frequency curve shown in Figure 3.4. Modelled loss rates were chosen to achieve a reasonable comparison with the frequency curve approximated from the WOfS data also shown in Figure 3.4. To achieve this, the storage pan factor was increased to 1.2, and a loss rate of 1.4 ML/d was applied when stored water volumes exceeded 150 ML.

The results suggest the wetland would be expected to hold water to a depth exceeding 0.5 m (i.e. at about 3.2% of the total storage capacity) about 50% of the time. Stored water volumes would be at less than 25% capacity 80% of the time. The figure also illustrates the influence of including estimated flood inflows on the frequency of inundation.

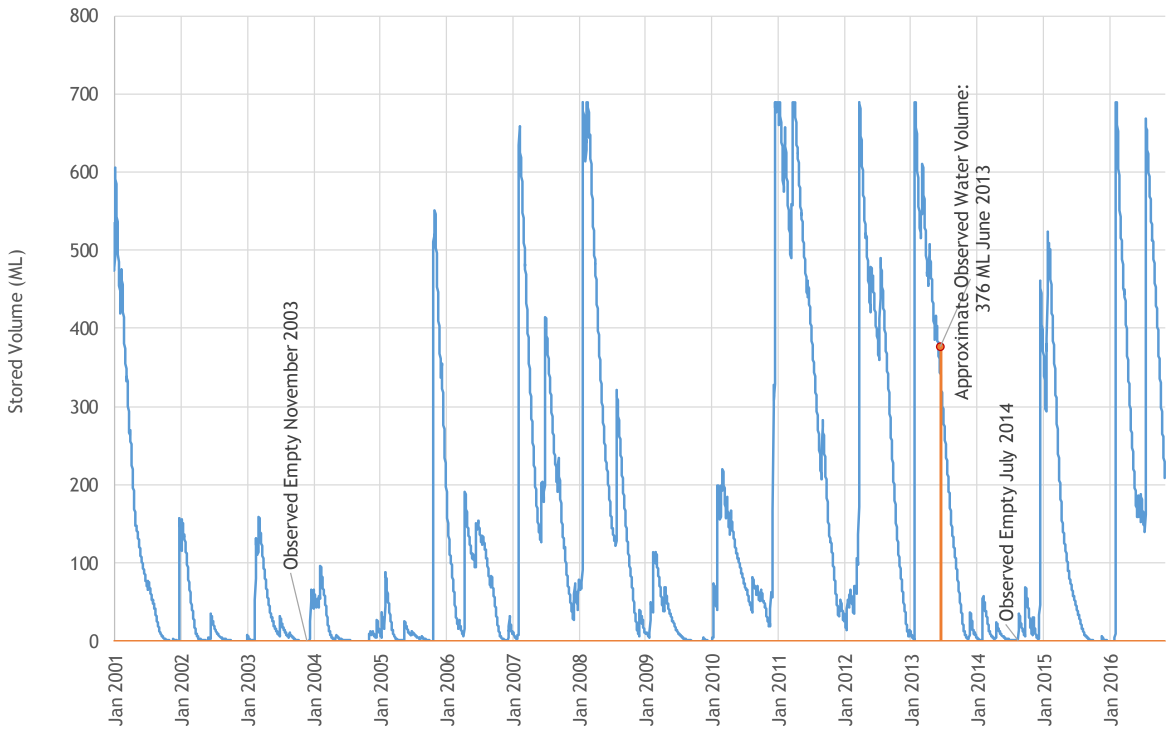

Figure 3.3 - Modelled behaviour of wetland under existing conditions 2001-2016

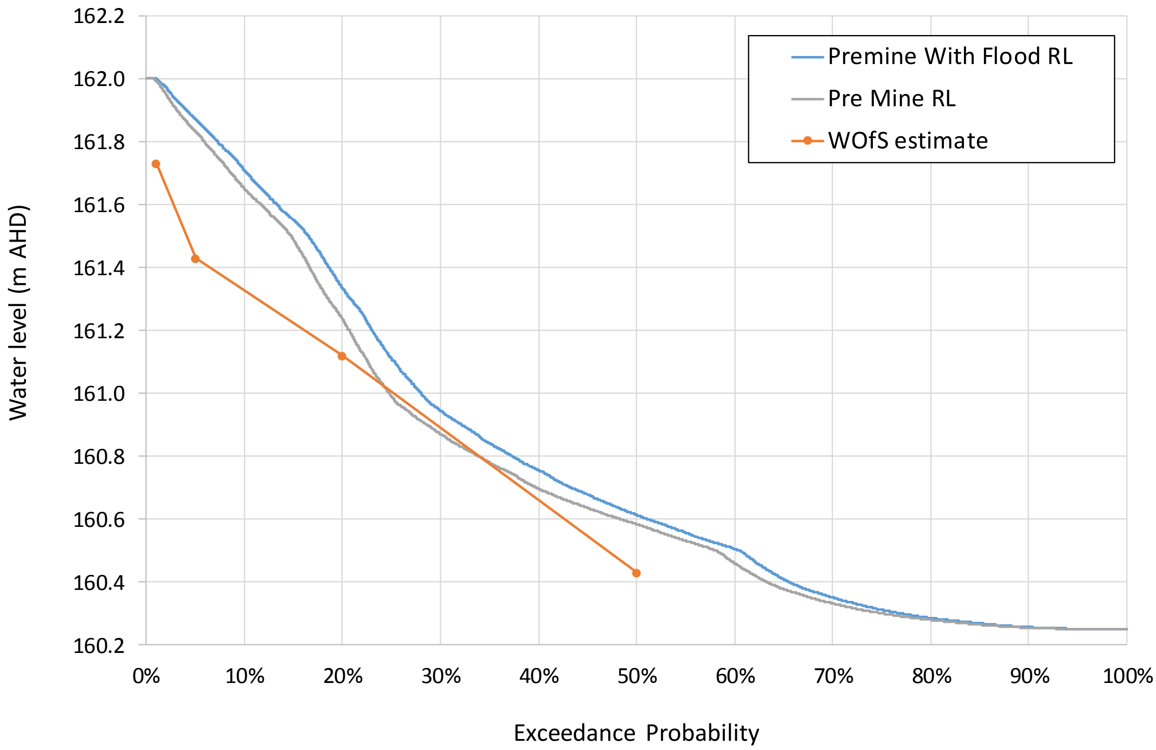

Figure 3.4 - Modelled inundation frequency compared to WOfS analysis - 1987-2014

4 Impact assessment

The LVNEP will result in the capture of runoff from areas that currently flow to Lake Vermont wetland. There will be a temporary impact due to disturbed area runoff being captured in the site water management system, and a smaller permanent impact at the end of mining due to water being captured in the final void.

The model was used to assess the impact of both these changes on the expected frequency of inundation in the wetland by reducing the catchment in the Lake Vermont wetland water balance model.

4.1 PEAK TEMPORARY IMPACT AT MAXIMUM MINING EXTENT

At the peak extent of mining, the catchment area to the wetland will be temporarily reduced by approximately 5.2 km^2 or 49%. This is illustrated in Figure 4.1.

The impact of this change on the frequency of filling the Lake Vermont wetland is illustrated in Figure 4.2 which shows that the likelihood of stored water levels exceeding 160.4 mAHD (approximately 0.15 m deep - i.e. at about 2 % of the total storage capacity) would temporarily decrease from approximately 60% to 42%. The likelihood of exceeding an elevation of 161.4 mAHD (1.15 m deep – i.e. at about 47 % of the total storage capacity) would reduce from approximately 12% to 8%.

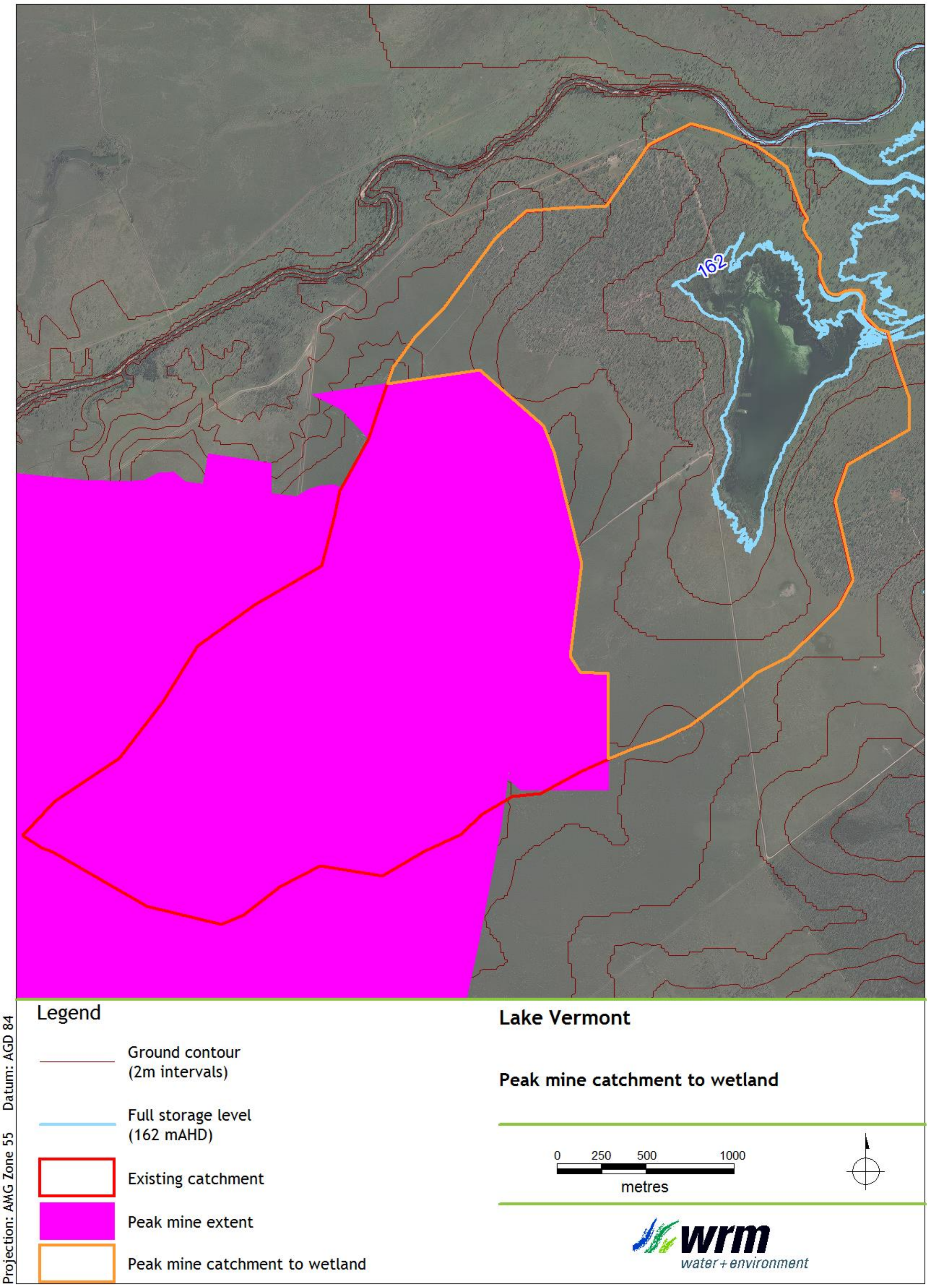

Figure 4.1 – Temporary loss of catchment area at maximum extent of mining disturbance

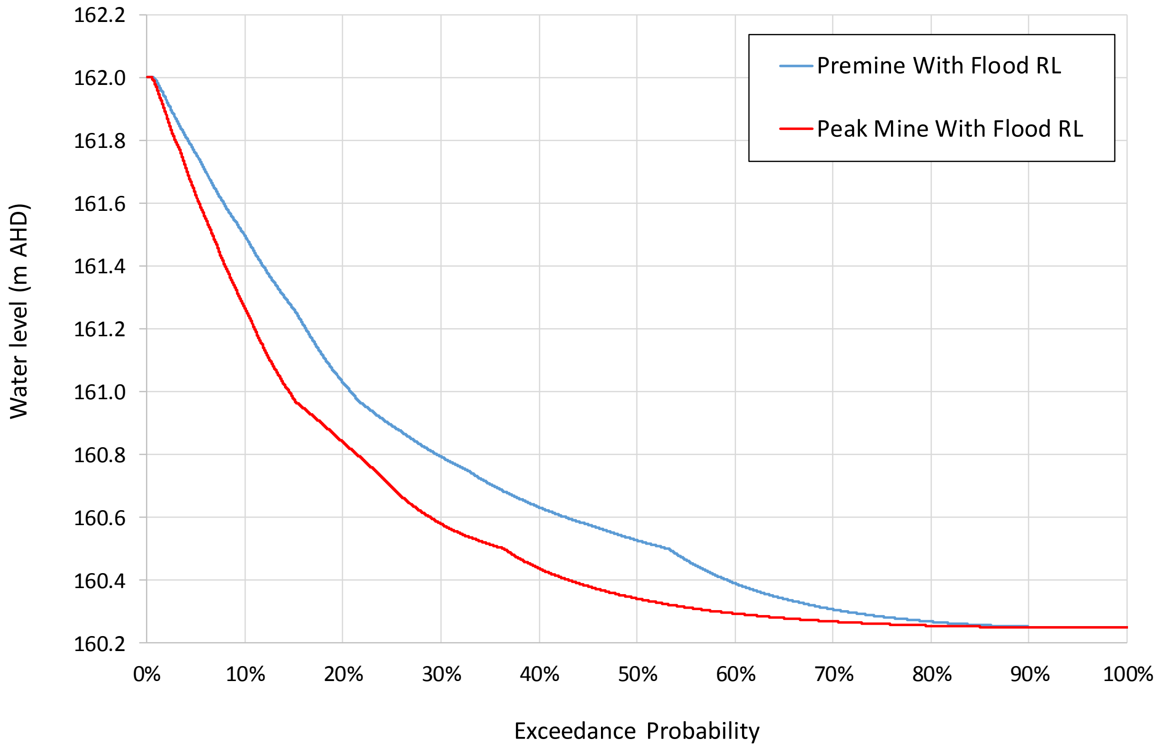

Figure 4.2 - Impact of temporary loss of catchment on frequency of inundation at Lake Vermont wetland

4.2 PERMANENT IMPACT AT COMPLETION OF MINING

At the completion of mining, surface runoff from rehabilitated overburden emplacement areas will be released from the site. It has been assumed that permanent drainage of overburden emplacement areas will be installed to minimise capture of surface runoff in the final void. An area of approximately 3.3 km² will continue to drain to the final voids. The catchment draining to Lake Vermont wetland will reduce by 1.3 km² (compared to pre-mining conditions) or about 12 %. This is illustrated in Figure 4.3.

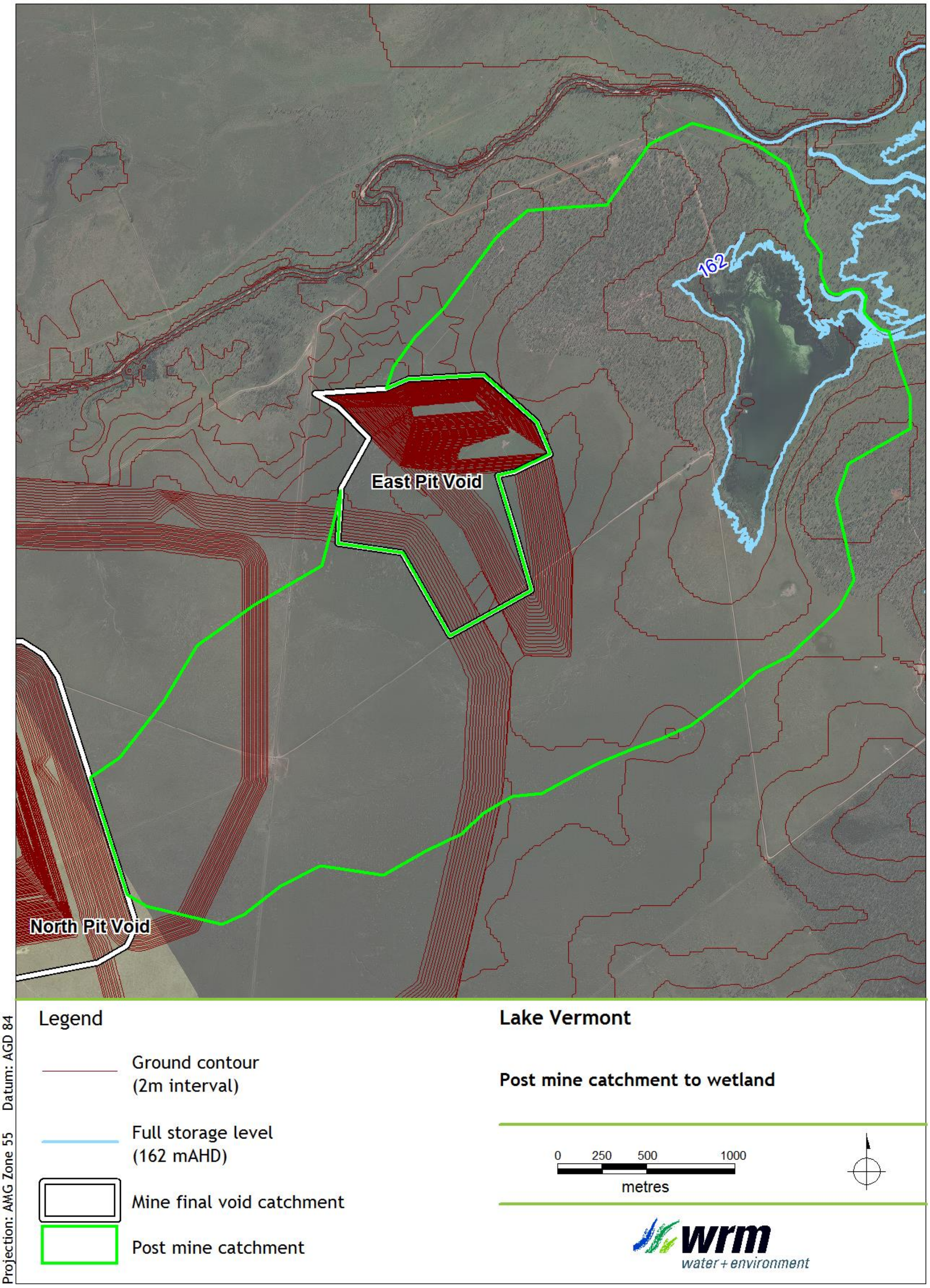

Figure 4.3 – Permanent loss of catchment area at completion of mining

The long-term impact of this change on the frequency of filling the Lake Vermont wetland is illustrated in Figure 4.4, which shows that the likelihood of stored water levels exceeding 160.4 mAHD (approximately 0.15 m deep - i.e. at about 2 % of the total storage capacity) would decrease from approximately 60 % to 55 %. The likelihood of exceeding an elevation of 161.4 mAHD (1.15 m deep - i.e. at about 47 % of the total storage capacity) would reduce from approximately 12 % to 11 %.

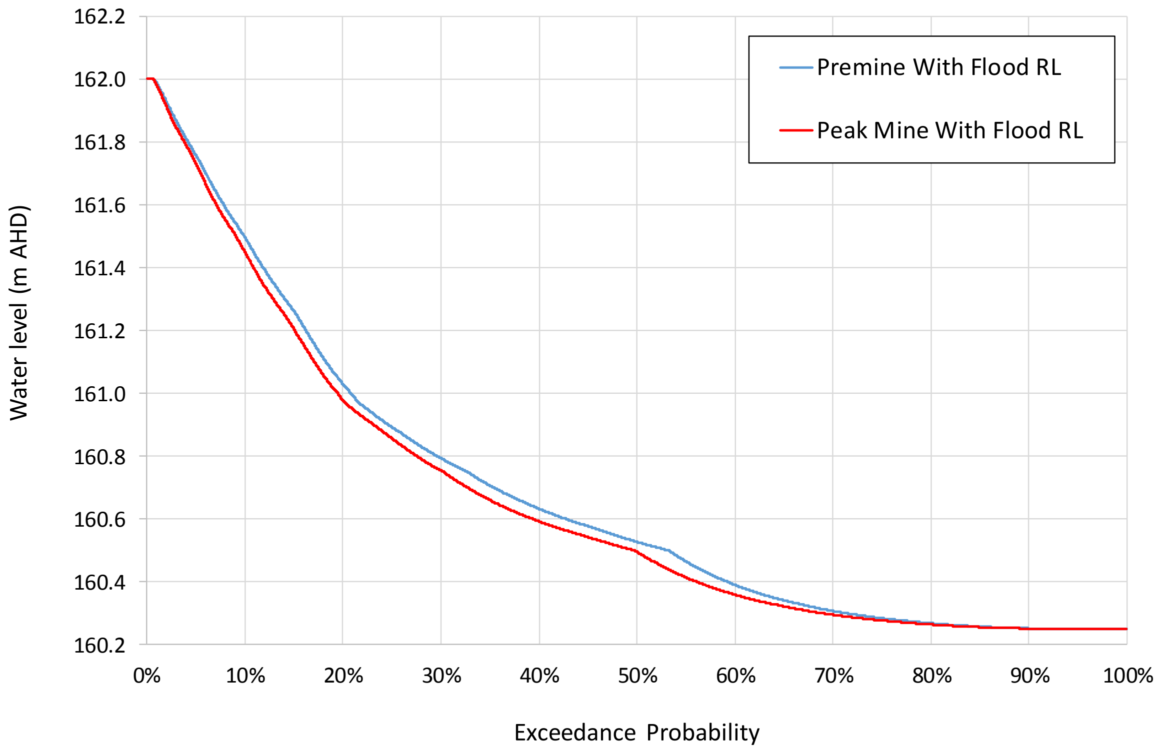

Figure 4.4 - Impact of permanent loss of catchment on frequency of inundation at Lake Vermont wetland

5 Conclusions

The Lake Vermont Mine Northern Extension Project Surface Water Impact Assessment identified that during operations, runoff from parts of the catchment draining to the downstream environment will be intercepted in the expanded water management system.

As a result, there will be some additional short-term changes to downstream flows to the Lake Vermont wetland. The maximum captured catchment area during mining operations make up approximately 49 % of the Lake Vermont wetland catchment area.

The changed topography as a result of the project final landform will reduce the catchment draining to Lake Vermont wetland by 1.3 km^2 (compared to pre-mining conditions). This represents a reduction in catchment area of about 12 %.

The impacts of these proposed changes on the frequency of inundation of the Lake Vermont wetland were assessed using a water balance model of the surface water characteristics of the wetland.

In the absence of water monitoring data for the wetland, the modelling parameters derived for undisturbed catchments within the site operational water balance model were adopted for the analysis. Additional losses were applied so that the results were consistent with observations of inundation based on satellite monitoring and aerial photographs, which show that the wetland is ephemeral, and generally contains only small volumes of water. The modelling suggests the wetland would be expected to hold water to a depth exceeding 0.5 m (i.e. at about 3.2% of the total storage capacity) about 50% of the time. For about 80% of the time, stored water volumes would be at less than 25% capacity.

Flood inflows from Phillips Creek were assumed to fill the storage following prolonged heavy rainfall at a frequency of about once every 4 years, which is consistent with the results of previous flood modelling of Phillips Creek. This has the effect of mitigating the impacts of the loss of local surface water catchment. The results of the impact assessment summarised in Table 5.1 show that:

- During the period of maximum disturbance, the likelihood of wetland water levels exceeding 160.4 mAHD (approximately 0.15 m deep – i.e. at about 2 % of the total storage capacity) would temporarily decrease from approximately 60 % to 42 %. The likelihood of exceeding an elevation of 161.4 mAHD (1.15 m deep– i.e. at about 47 % of the total storage capacity) would reduce from approximately 12 % to 8 %.
- The long-term impact on the frequency of filling the Lake Vermont wetland is relatively small. The likelihood of stored water levels exceeding 160.4 mAHD (approximately 0.15 m deep – i.e. at about 2 % of the total storage capacity) would decrease from approximately 60 % to 55 %. The likelihood of exceeding an elevation of 161.4 mAHD (1.15 m deep – i.e. at about 47 % of the total storage capacity) would reduce from approximately 12 % to 11 %.

Table 5.1 – Water balance model results – frequency of filling Lake Vermont wetland

Development stage	Catchment Area km^2	Frequency of exceeding water level (% of days)	
		160.4 mAHD 2% full	161.4 mAHD 47% full
Existing	10.7	60	12
Peak mining disturbance (temporary)	5.5	42	8
Post mining (permanent)	9.4	55	11