BIG ISLAND MINING PTY LTD
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Response to NSW Office of Water Submission dated 16 December 2010

for the

Dargues Reef Gold Project

Major Project Application No.
PA 10_0054

December 2010

Prepared by:

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Ref No. 752/06 - NOW

Date: December 2010

CONTENTS

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1. INTRODUCTION

This document has been prepared to provide a response to issues raised by the NSW Office of Water (NOW) in a letter dated 16 December 2010 in relation to the Dargues Reef Gold Project following the public exhibition of that Project. The issues raised are reproduced in *italics* and a response is provided in normal text. The order of issues raise has been adjusted so that groundwater and surface water-related issues are addressed together.

The following specialist consultants assisted with the preparation of this document. Where a response has been prepared by one of those consultants, the response is prefixed with the abbreviated name of that consultant.

- Surface water, soils and land capability – SEEC.
- Groundwater – Australasian Groundwater & Environmental Consultants Pty Ltd (AGE).

A range of documents have been prepared to support the application for project approval. These include the following. This document should be read in conjunction with the above documents.

- *Environmental Assessment for the Dargues Reef Gold Project* dated September 2010.
- A two volume *Specialist Consultant Studies Compendium* dated September 2010.
- *Response to Government Agency and Public Submissions* dated December 2010.
- Two emails to George Mobayed of the Department of Planning dated 16 December 2010.

It is noted that the Proponent arranged a meeting with NOW on 16 July 2010. At that meeting NOW was provided with an overview of the surface water and groundwater assessments and feedback was sought in relation to the methodology of the assessment and whether there were any issues further that the Proponent should consider or address. At that time and subsequent to the meeting, no feedback in relation to undertaking further groundwater monitoring or pump tests was provided. If it had been, the Proponent would have been happy to undertake the further assessments at that time.

Finally, it is noted that a draft of this document has been provided to NOW and that comments and recommendations received following that consultation have been incorporated into the final document.

2. GROUNDWATER

The model applied to assess the groundwater impacts and baseflow impacts to surface water systems is predominantly theoretical with an inadequate level of supporting measured data.

Response: (AGE): The model can hardly be considered predominantly theoretical as has been developed using the following.

- A detailed knowledge of the geology based on regional and local-scale geological maps and, more importantly, from approximately 250 exploration holes;

- Fault locations as determined from exploration drilling and an aeromagnetic survey.
- Geological mapping of the extent of the alluvium/colluvium.
- Installation of monitoring bores in the regolith, bedrock and alluvium.
- Falling and/or rising head permeability tests.
- Groundwater levels measured in 52 open exploration holes and eight monitoring bores.
- Studies undertaken by NOW from a similar groundwater regime at Araluen.

It is acknowledged in Section 14.0 of the Groundwater Assessment (AGE, 2010) that there was no long term monitoring data on which to calibrate the model to transient conditions; however this is not unusual for a "green field" project. AGE have undertaken impact assessment studies for projects which were granted approval in NSW and Queensland where there was no long term monitoring data to undertaken a transient calibration. The most notable of these was Cadia East Project, NSW which was based on a steady state model even though there was long term monitoring data. It is noted that the anticipated groundwater impacts for that project are significantly more extensive than the anticipated groundwater impacts associated with the Dargues Reef Gold Project.

In developing the model for the Project, recognition was given to the fact that there was no long term monitoring data to obtain a transient calibration by running predictions using specific yields (storativity) with an order of magnitude difference, that is 0.01 and 0.001. That is a sensitivity analysis was undertaken on specific yield to account for the fact that there was no data to undertake a transient calibration**.**

The impact assessment is highly dependent on the groundwater model and its predicted outcomes. Due to identified inadequacies in the modelling there is a lack of certainty in the impacts.

Response: (AGE) Section 14 of AGE (2010) identifies a range of uncertainties and limitations associated with the groundwater model prepared for the *Environmental Assessment*. However, as AGE note in that section,

> "Despite the current level of uncertainty the model is considered sufficiently accurate to gain an understanding of the impacts of the project on the groundwater regime and is therefore suitable for the purposes of the [EA]."

AGE notes that the Project Site is located on a massive granodiorite pluton. Granodiorite is not considered to be an aquifer in the true sense of the definition, with groundwater only being obtained in limited quantities from open fractures, which are random and sparse in occurrence, and the regolith. The vast majority of the granodiorite is essentially an impermeable rock mass.

As stated previously, the groundwater model is based on a significant amount of data with the principal fractures being identified from airborne magnetics and exploration drilling. **Where there are unknowns, the model was developed using a conservative approach.** For example all fractures were considered to be open fractures that transmit groundwater. In reality many are probably infilled with clay and form barrier boundaries to groundwater flow. This is likely to result in actual impacts that will be less than the modelled impacts. The rainfall recharge to the regolith simulated by the model is also considered conservative in that values ranged from 0.5% to 6.3% of rainfall, compared to 10% used by the then Department of Land and Water Conservation (now NOW) in their Araluen groundwater resource study.

The conservatism built into the model suggests that the predicted radius of influence and impact on discharge to the creeks is likely to be greater than will actually occur.

AGE stand by their statement in Section 14.0 of the Groundwater Assessment that "despite the current level of uncertainty, the model is considered sufficiently accurate to gain an understanding of the impacts of the project on the groundwater regime and is therefore suitable for the purposes of the (EA)"

The complete loss of baseflow from Spring Creek during the mine operations and for an undefined period post mine completion represents a significant and unmitigated impact. The proposal to address the reduction in baseflows via the purchase of groundwater entitlement and the use of a compensatory flow at Majors Ck requires further consideration by the Office. The Office does not have a policy in regard to return flows and there is concern over the appropriateness of a groundwater entitlement to mitigate impacts to Spring Ck which will not result in additional flows to the area of impact.

Response: The Proponent notes that Spring Creek is a deeply incised, highly disturbed drainage line that passes over the Dargues Reef deposit. Section 6.1 of Gaia (2010) identifies that no groundwater dependant ecosystems exist within the Project Site. In addition, the Proponent notes that due to the deeply incised nature of the creek, surrounding vegetation does not rely on base flows within the Spring Creek.

(AGE) Figure 17 of the Groundwater Assessment (AGE, 2010) (reproduced below as **Figure 1**) indicates that groundwater levels at the Dargues Reef Mine recover within 5 years of mine closure. However, the Proponent acknowledges that the information presented in Table 4.20 of the *Environmental Assessment* indicates that base flow in Spring Creek would not recover during the five years post-mining presented in that table. **Table 1** presents the estimated Project-related reduction in groundwater discharge to Spring and Majors Creeks for a period of nine years following the completion of mining operations. That data indicates that base flows within Spring Creek would recover within approximately 8 years of the completion of mining operations. AGE, however, note that the flows are so low they are within the limitations of the model.

The recovery contours for Year 15, that is, 10 years after mine closure are shown in **Figure 2**. That information indicates that there is approximately 0.5m of drawdown in the northern section of the Project Site 10 years after the completion of mining operations. However, AGE note again that the reality of this is uncertain as groundwater levels will fluctuate by more than 1m.

In addition, the Proponent notes that there is no proposal to purchase groundwater entitlement for water to be extracted from the granodiorite aquifer because it is understood that water within that aquifer is not the subject of an embargo.

The Proponent notes that NOW also has concerns in relation to the proposal to release compensatory flows for water that would cease to flow into Spring Creek at the confluence of Spring and Majors Creeks. The Proponent did consider releasing compensatory flows into the upper section of Spring Creek in the vicinity of the spring. However, given that the majority of Spring Creek would be within the estimated extent of groundwater drawdown, it was determined that a proportion of the water released would be lost through infiltration. As a result and in light of the fact that there are no groundwater dependent ecosystems within Spring Creek, the Proponent proposes to release water downstream of the anticipated extent of groundwater drawdown.

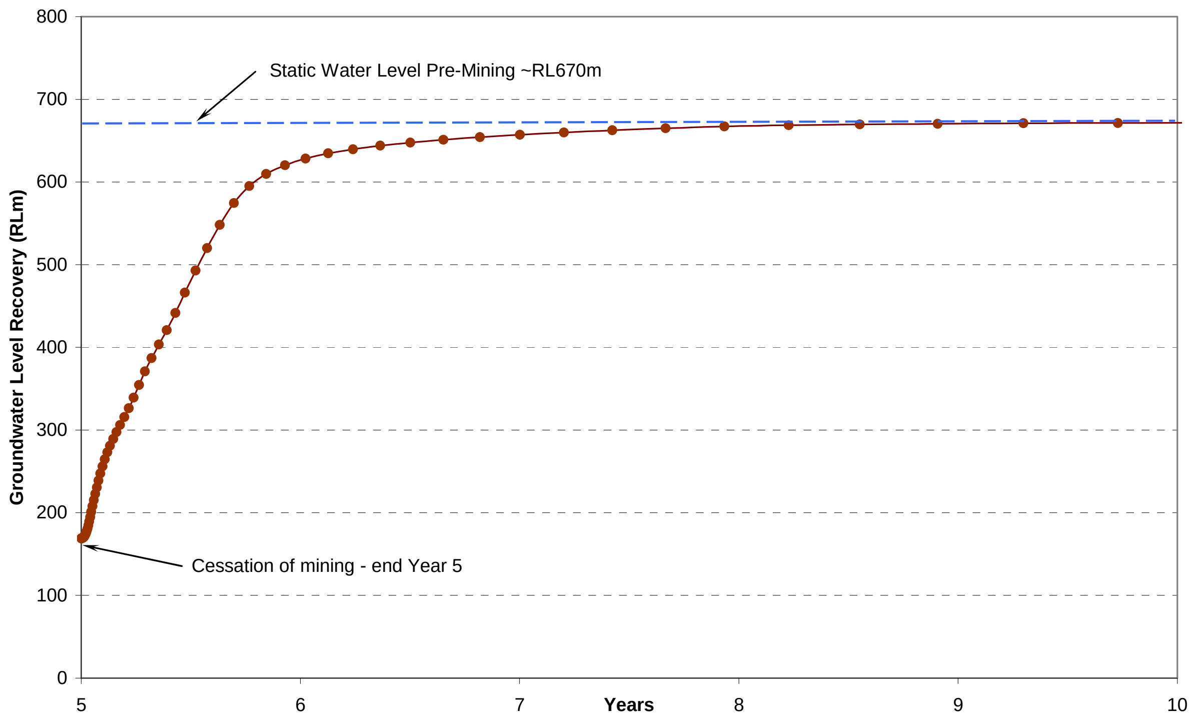

Figure 1 Predicted Recovery of Groundwater Level in Dargues Reef Mine

Table 1
Estimated Project-related Reduction in Groundwater Discharge

From	To	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14
Moruya Catchment (L/s)							←End of mining operations								
Granodiorite aquifer	Spring Creek	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.1	0.1	0
Granodiorite aquifer	Majors Creek	0.7	1.2	1.5	1.6	1.7	1.2	0.6	0.3	0.1	0.05				
Alluvial aquifer	Granodiorite aquifer	0.05	0.1	0.1	0.1	0.1	0	0	0	0	0				
Total	**L/s**	**1.05**	**1.6**	**1.9**	**2.0**	**2.1**	**1.5**	**0.9**	**0.6**	**0.4**	**0.35**				
	ML/year	**33.1**	**50.4**	**59.9**	**63.0**	**66.2**	**47.3**	**28.3**	**18.9**	**12.6**	**11.0**				
Proposed Environmental Release (ML/year)		**33.1**	**50.4**	**59.9**	**63.0**	**66.2**	**47.3**	**28.3**	**-**	**-**	**-**				
Shoalhaven Catchment (L/s)															
Granodiorite aquifer	Shoalhaven Catchment	0	0.1	0.2	0.31	0.42	0.42	0.4	0.32	0.22	0.1				

Source: AGE

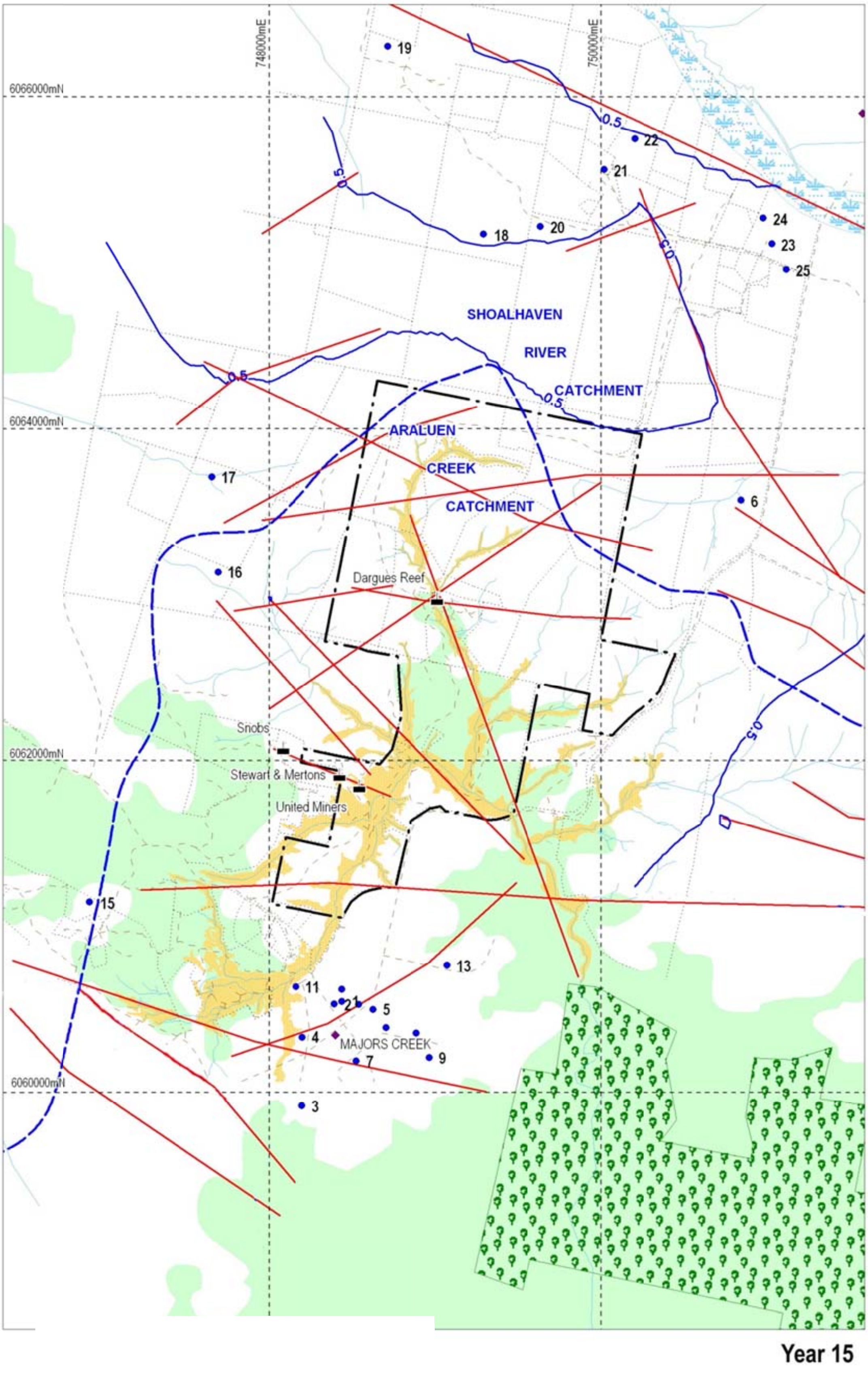

Figure 2 Simulated Piezometric Drawdown – End Year 15

In addition, the Proponent notes that it proposes to cease the compensatory flow program when the anticipated loss of groundwater discharge is less than 1L/s because it is likely that this level is a level at which the anticipated impacts would be neither measurable nor significant.

Finally, the Proponent notes that given that Spring Creek passes over the Dargues Reef Deposit, any proposal to extract material from the deposit would have an adverse impact on groundwater discharge to the Creek.

To support the required water licence application to intercept water within the mine workings and to extract water from the historic workings the proponent will need to address the Office's "Test Pumping Groundwater Assessment Guidelines". These guidelines are included as an attachment and require a 70 day pump test and up to 70 day recovery monitoring period for applications over 100ML/yr.

Response: (AGE) The "Test Pumping Groundwater Assessment Guidelines" for Coastal Groundwater states that a 7-day pumping test is required if an application is for 50-100ML/year and a 70-day pumping test if the application is for >100ML/year.

The Groundwater Assessment report indicated that a supply of 2.5L/s (79ML/year) could sustainably be extracted from the historic workings. This supply is available if needed to augment the other sources of water available to the Project, that is groundwater from dewatering of the mine (predicted to be about 220ML/year), and surface water from harvestable rights.

While it may be practical to undertake a 7-day pumping test at 2.5L/s on the historic mine shafts, the suggestion from NOW that a 70-day pumping test be undertaken to obtain a licence to extract water from the proposed Dargues Reef Mine at the predicted dewatering rate of 7L/s (220ML/year) is totally impractical for the following reasons.

- the "aquifer" is a fractured granodiorite and it would be extremely fortunate to be able to pump 1L/s for 70 days from a narrow diameter borehole; and
- the Dargues Reef Mine is 500m deep and of considerable area compared to a narrow diameter borehole and therefore inflows will be much higher to the mine than to a borehole that is tested for 70 days and on which data an allocation is granted.

This issue has been discussed with NOW and the relevant offices have acknowledged the validity of this point. They did, however, indicate that it would be NOW's preference that some pump testing be undertaken. This issue is discussed further in Section 4.

The groundwater modelling has been undertaken with a minimum of measured/observed information and hydraulic parameters. The lack of monitoring data (water level logging, baseflow measurements in Majors Ck etc) or extended pumping tests appropriate to the proposed extraction is of concern. Negligible investigation of the nature of the fracture zones and a minimal discussion of the how the model fits into the broader hydrogeologic context of recharge, throughflow and discharge. Overall, the reliability of the model and the prediction of impacts are not adequately supported with a detailed understanding/investigation of the existing surface and groundwater system.

Response: (AGE) As discussed in response to previous NOW comments, AGE consider that a significant amount of data has been used to develop the numerical model, but acknowledge that there is no long term monitoring data.

The statement that there is a lack of *"extended pumping tests appropriate to the proposed extraction is of concern"* is not practical, as discussed previously,.

With respect to investigation of the nature of the fracture zones, AGE have incorporated the fracture zones identified from the exploration drilling and an aero-magnetic survey in the model, and to err on the conservative, have assumed all fractures to be open to groundwater flow, as previously stated.

The granodiorite "aquifer" is highly heterogeneous. The nature of a fracture can be investigated at one location and 10m away it can be entirely different. As stated in the Groundwater Assessment "strong" or "high" groundwater flows were only intercepted by exploration drilling in fractures system related to the orebody and/or in proximity to flooded underground workings; however all fracture zones have been represented in the model as groundwater bearing zones.

AGE are of the opinion that the model is reliable and that sufficient investigation has been undertaken given that the "aquifer" is a highly heterogeneous, generally extremely low permeability granodiorite mass, and that where assumptions are made they are on the conservative side, that is the model is likely to over-predict impacts.

With respect to how the model fits into the broader hydrogeological regime, the Project area and model is a small part of a massive granodiorite pluton as discussed, occupying an area of 1000km^2. The hydrogeological properties of the larger granodiorite mass is unlikely to differ significantly from the properties included in the groundwater model.

Pumping tests. Groundwater licenses will be required for extraction/I nterception and should be supported with pump test information consistent with the NOW guideline: "Coastal groundwater - Test pumping groundwater assessment guidelines for bore licence applications

Response: (AGE) Pumping tests have been discussed previously.

The model and its' predicted impacts should be placed in a broader regional context by assessing expected rates of recharge/ through flow and discharge. And compared to baseflow, water level fluctuations and climatic data.

Response: (AGE) As discussed the model forms part of a massive granodiorite pluton that is about 1000km2 in area. It is assumed that the NOW comment relates to potential impacts at Araleun which is 20km to the south-east of the Project site and about 500m lower in elevation. There is a large, very steep escarpment approximately 3km to the south-east of the proposed Dargues Reef Mine and 1km east of the township of Majors Creek where the topography declines rapidly to the elevation of Araluen. If the groundwater in the Project Area were hydraulically connected by fracture zones to the groundwater in the Araluen Valley, the groundwater level in the Project Site would be expected to be at a much lower elevation than the observed elevation of between 1m and 10m below ground level. That is, the groundwater levels within the Project Site are elevated 500m above the Araluen valley floor.

In placing the groundwater regime in a broader regional context, the Project Site is at the very top of the Araluen Creek Catchment and straddles the divide with the Shoalhaven River Catchment. In addition, the Project Site is within a massive granodiorite pluton which is highly heterogeneous and of generally very low permeability. The impact of the Project is quite limited in aerial extent and will not have a broader regional impact. On a local scale the fractures are important but on a regional scale they are not.

Modelling calibrated against an enhanced understanding of surface and groundwater hydrology.

Response: (AGE) As discussed the aquifer is highly heterogeneous and further investigations are not likely to enhance the model reliability due to the fact that any data obtained will apply to a very localized area. Long term monitoring data of groundwater level fluctuations in response to rainfall would enable transient calibration but this data is not available and would take 12 months or longer to obtain. It is emphasized that where assumptions have been made AGE have erred on the conservative to over, rather than under predict impact. A sensitivity analysis was undertaken on specific yield in the absence of obtaining this value from a transient calibration.

The protection of other groundwater users, basic landholder rights, baseflows and groundwater dependent ecosystems (GDE) is a basic premise of groundwater policy and guidelines. The EA has addressed some of these issues in a relatively simple manner. The potential modification of sections of Majors Creek and the connected alluvials from a gaining stream to a losing channel is a significant impact requiring further investigation including an improved understanding of baseflows though monitoring/measurement.

Response: (AGE) The groundwater model indicates that Spring Creek will be impacted and this has been addressed in the Environmental Assessment and previously in this document.

In addition the model indicates that a 1.5km section of Major Creek will become a losing rather than a gaining stream section with a predicted loss of about 0.1L/s. A loss of 0.1L/s could hardly be considered a significant impact on the alluvial lands of Majors Creek which have been highly disturbed in the past by alluvial gold mining. In addition, it is noted that the annual losses at 0.1/s would be approximately 3.1ML/yr. This compares with surface water licences for single orchard operations in the Araluen valley of more than 150ML/yr.

The project and its' associated dewatering will clearly have a significant impact on the surface and groundwater hydrology surrounding the project area. Investigation, monitoring and modelling is required to anticipate these impacts and develop measures to address impacts. The level of investigation and monitoring in the EA is minimal as identified in the Groundwater Assessment, Section 14 - Model Uncertainty and Limitations; however the Office does not agree that it is sufficient to adequately understand the potential impacts of the development.

Response: (AGE) As discussed in previous responses, AGE consider that the model is sufficient to adequately understand the potential impacts given the groundwater regime of the area. Overall groundwater flows and discharge are very small and it is considered that extensive investigations could be undertaken without improving the reliability of the model. The Dargues Reef mine is a relatively small mine of limited life and compared to most mines the impact on the groundwater regime can hardly be described as significant, particularly considering the volumes of water used for other industries with lower economic benefits per megalitre of water used, such as orchards.

Where assumptions are made they have erred on the conservative to ensure that the model over-predicts, rather than under-predicts impacts.

3. SURFACE WATER

The model applied to assess the availability of surface water in the harvestable right dams has included 100 years of rainfall data however it has not included data from the last 8 years. This data is considered critical due to the extreme drought conditions.

Response: (SEEC) The Braidwood (Wallace St, station 69010) rainfall data was selected over Majors Creek (The Old School, station 70061) because it is a longer record (123 years vs 112 years) and is significantly more complete (98% complete vs 68% complete). Both data sets are of high quality (99% and 100% respectively).

In conducting the modelling, we identified that 1981 was the worst year on record in terms of water availability in the harvestable-right dams. This does not imply that 1981 was also the lowest rainfall year on record. Water supply from harvestable-right dams is determined by a number of factors, not just the total amount of rain in any given year. The pattern of that rainfall has a significant bearing on how much water can be drawn from dams. So while 1981 was not the driest year on record, during that year the dams were unable to supply water on 182 days, most likely due to the pattern that rainfall occurred at that time.

The modelling was re-run to include the most up-to-date and quality-checked data available from the Bureau of Meteorology, using a 100-year record from 1910 to 2009 (note that the model is limited to a 100-year record). Rainfall data was from the Braidwood (Wallace St, 69010) station. The results of that modelling are detailed in **Table 2** and graphs showing dam levels and dry periods are in **Figures 3** and **4**. This re-modelling demonstrates the following.

- The average annual rainfall during the modelling period was 732mm/yr. This compares to an average annual rainfall from 1903 to 2002 of 728mm/yr.
- The worst year on record for supply from the dams remains 1981, when they were dry for 182 days.
- A four-year dry period from 1981 to 1984 resulted in a total of 357 days within those four years when the dams would have been dry.
- A three-year dry period from 2003 to 2005 resulted in a total of 193 days within those three years when the dams would have been dry.

From this modelling we presume that, although the drought of the most recent decade was a significant climatological event and might have resulted in numerous lower-than-average rainfall years, the dams did not suffer as many dry days as in the early 1980's because the overall pattern of rainfall was more favourable.

Table 2
Results of Modelling Using 1910 to 2009 Rainfall Data

Parameter	Results[1]
Percent of time during the modelling period that demand for water return to Majors Creek was met by the harvestable right dams.	96.6% (97%)
Average amount of water required from the historic workings per year to make up the average 3.4% shortfall.	Approx 2.2ML/yr (Approx 2ML/yr)
Worst year in the model record - number of days the harvestable right dams were dry.	182 days (in 1981) (182 days (in 1981))
Worst year in the model record - amount of water that would be required from the historic workings in that year.	33ML/yr (approx.) (33ML/yr (approx.))
Number of years in the model record when the harvestable right dams ran dry for at least one day	28 years (29 years)
Median number of days the harvestable right dams ran dry within those 28 years	18 days - equates to approximately 3.3ML of water demand
Note 1: Results in parenthesis = results using the 1903 to 2002 data set	
Source: SEEC	

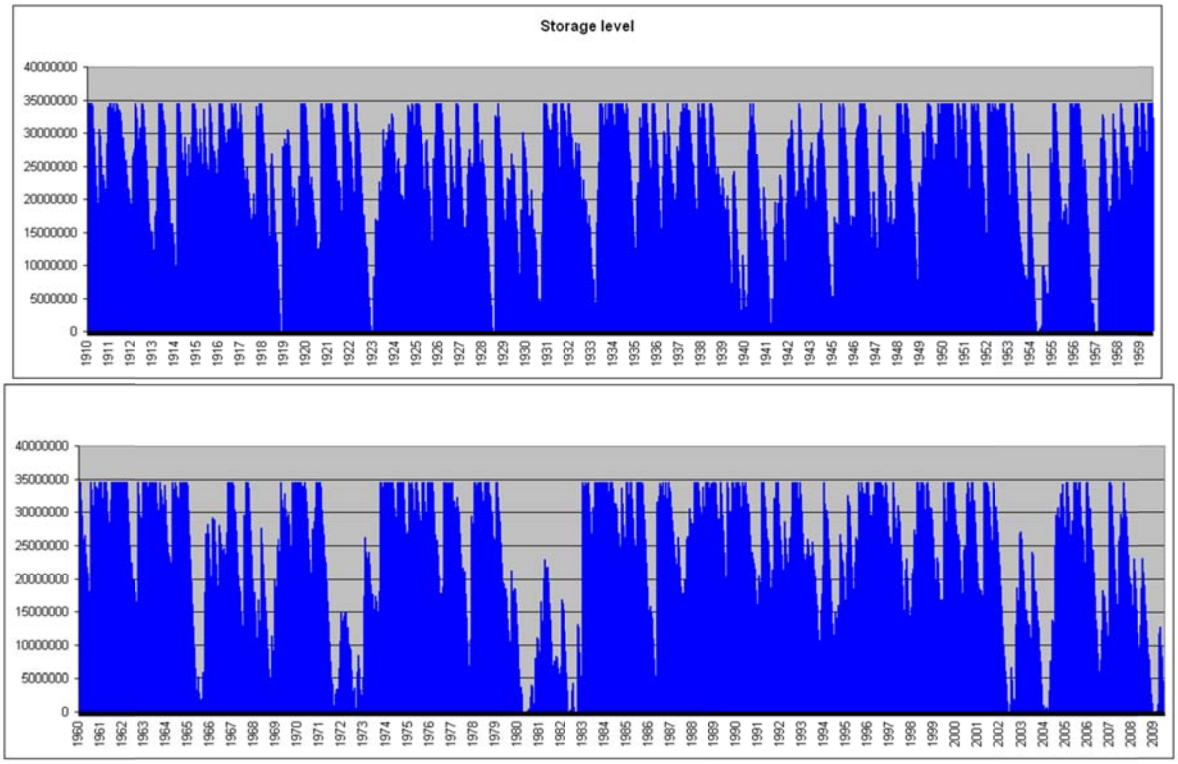

Figure 3 **Graph showing storage levels of the harvestable-right dams, using 1910 to 2009 rainfall data**

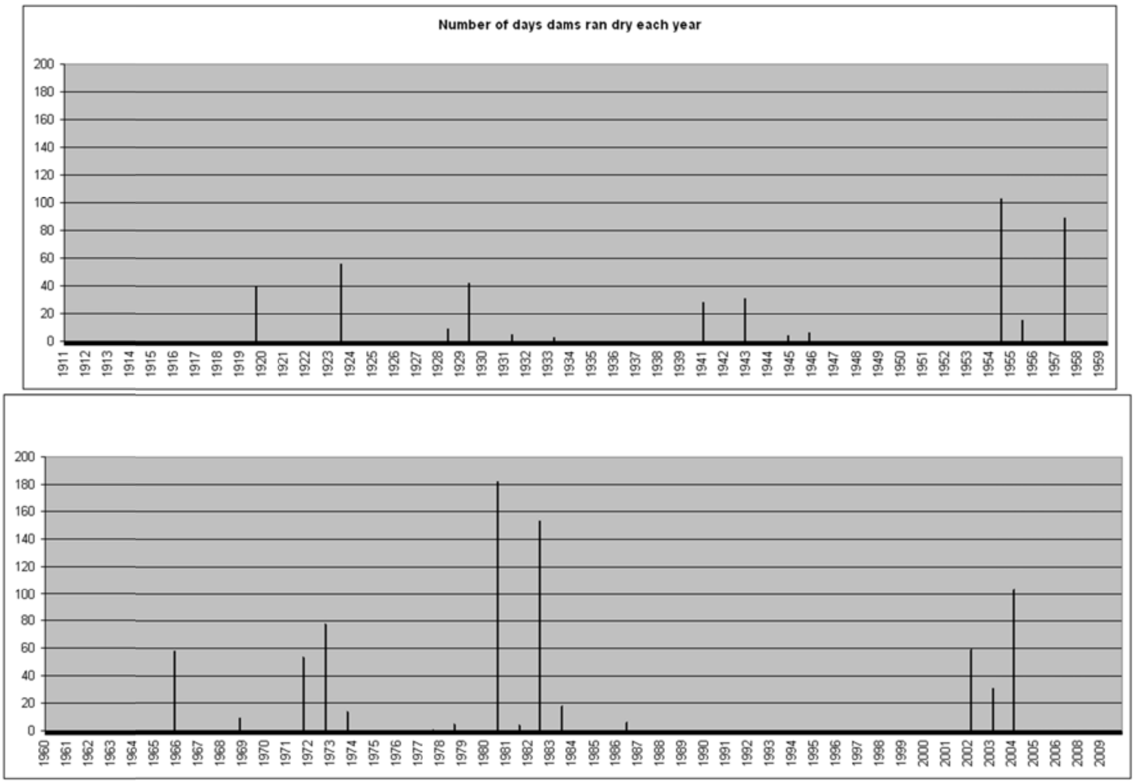

Figure 4 **Graph showing the number of days the harvestable-right dams ran dry each year in the modelling record 1910 to 2009**

To assess what impacts climate change in the past four decades might have on the modelling results, a separate model was set up using only data from 1969 to 2009, again using rainfall from Braidwood (69010). During this period the average rainfall was 725mm/yr. This compares with an average annual rainfall of 732mm/yr and 728mm/yr for the 1903 to 2002 and 1903 to 2002 datasets. The results of modelling are summarised in **Table 3**.

Table 3
Results of Modelling Using 1969 to 2009 Rainfall Data

Parameter	Results
Percent of time during the modelling period that demand for water return to Majors Creek was met by the harvestable right dams.	94.7%
Average amount of water required from the historic workings per year to make up the average 5.3% shortfall.	3.4ML/yr (approx.)
Worst year in the model record - number of days the harvestable right dams were dry.	182 days (in 1981)
Worst year in the model record - amount of water that would be required from the historic workings in that year.	33ML/yr (approx.)
Number of years in the model record when the harvestable right dams ran dry for at least one day	13 years
Median number of days the harvestable right dams ran dry within those 13 years	31 days (equates to approximately 5.5ML of water demand)
Source: SEEC	

Table 3 shows that, although the overall supply confidence was slightly lower than for the long-term rainfall model (94.7% vs 96.6%), this represents a change of less than 2%. This is despite the relative number of years in which a dry-dam spell occurred being higher (13 years in 40, or 33% vs 28 years in 100, or 28%). We conclude that, although the rainfall record for the last 40 years is slightly lower than that for the longer term, this does not have a significant impact on the reliability of the proposed surface water management strategy.

The proposed management of the harvestable right dams will result in a significant increase in the volume of runoff removed within the site. The Office requires an impact assessment of this management on the downstream water users and the environment.

Response: (SEEC) The Proponent plans to construct dams with a total capacity not exceeding their current and ongoing harvestable right. This is no more than would currently be allowed for on the property. The harvestable right provisions do not dictate how much of the detained water can be used nor what it can be used for, providing the harvestable right dams do not also receive water gained by licence (e.g. from a bore or river pump). The Proponent does not plan to store any water in the harvestable right dams from a licenced point.

In addition, a significant proportion of the water detained in the harvestable right dams would be returned to the downstream system to compensate for baseflow losses in Majors Creek as a result of local groundwater decline. As a result, the likely impact to downstream users and the environment is likely to be minimal. **Figure 3** shows that the harvestable right dams would regularly overtop during rain events, providing typical stormflow volumes to downstream reaches.

Inadequate assessment of the water quality impacts to downstream surface waters from the proposed compensatory flow which is to be sourced from surface water and groundwater.

Response: (SEEC) That proportion of compensatory flows sourced from harvestable right dams is not expected to contain significant loads or concentrations of potential pollutants beyond those presently experienced. All of the harvestable right dams are positioned so their upstream catchments remain much the same as at present, with similarly benign land uses. Where mine-related infrastructure occurs in the catchment for a harvestable-right dam, runoff would drain first into a sediment control dam to retain the bulk of any suspended sediment before reaching the harvestable right dam. As such, SEEC do not anticipate any adverse water quality impacts to downstream surface waters as a result of compensatory flows from harvestable right dams.

Harvestable right dams would be designed, constructed and managed in accordance with current best-practice to minimise the risk of algal blooms, weed infestation and other potential water-quality-related issues. All harvestable right dams would be fenced off. Periodic water quality monitoring would be conducted by the Proponent both in the harvestable right dams and in the receiving waters for compensatory flows (Majors Creek) to ensure appropriate water quality. In the event that harvested water was found to be unsuitable for release, appropriate investigations and action would be taken to address this issue.

Response (RWC) Figure 5 presents an overview of the results of surface water quality monitoring undertaken between 2006 and April 2010 at a range of locations within the Project Site (**Figure 6**). In summary, the results indicate the following.

- The pH of surface water within the Project Site is consistently between 6.5 and 8.0.
- The electrical conductivity of surface water within Spring Creek is typically between 1 000µS/cm and 1 200µS/cm. Samples taken in September 2009 were collected following a rainfall event and the lower electrical conductivities recorded during that sampling program are the result of dilution by surface water flows. All other sampling programs are likely to be representative of low or base flow conditions. These results indicate that electrical conductivities within Spring Creek significantly exceeds the ANZECC (2000) water quality guidelines for upland rivers of 30-350µS/cm.
- The electrical conductivity of surface water within Majors Creek is typically between 200µS/cm and 400µS/cm. These results indicate that electrical conductivities within Majors Creek are at the upper end or exceed the ANZECC (2000) water quality guidelines for upland rivers of 30-350µS/cm.

It is noted that water to be released to Majors Creek through the compensatory flow program would be sourced principally from the harvestable rights dams and that water quality within those dams is likely to be within the relevant ANZECC (2000). It is also noted that the surface water modelling identified that based on a maximum rate of release of 66.2ML per year, 100 years of rainfall data and a range of conservative assumptions, that the harvestable rights dams could provide sufficient water for the compensatory release program on 97% of all days modelled.

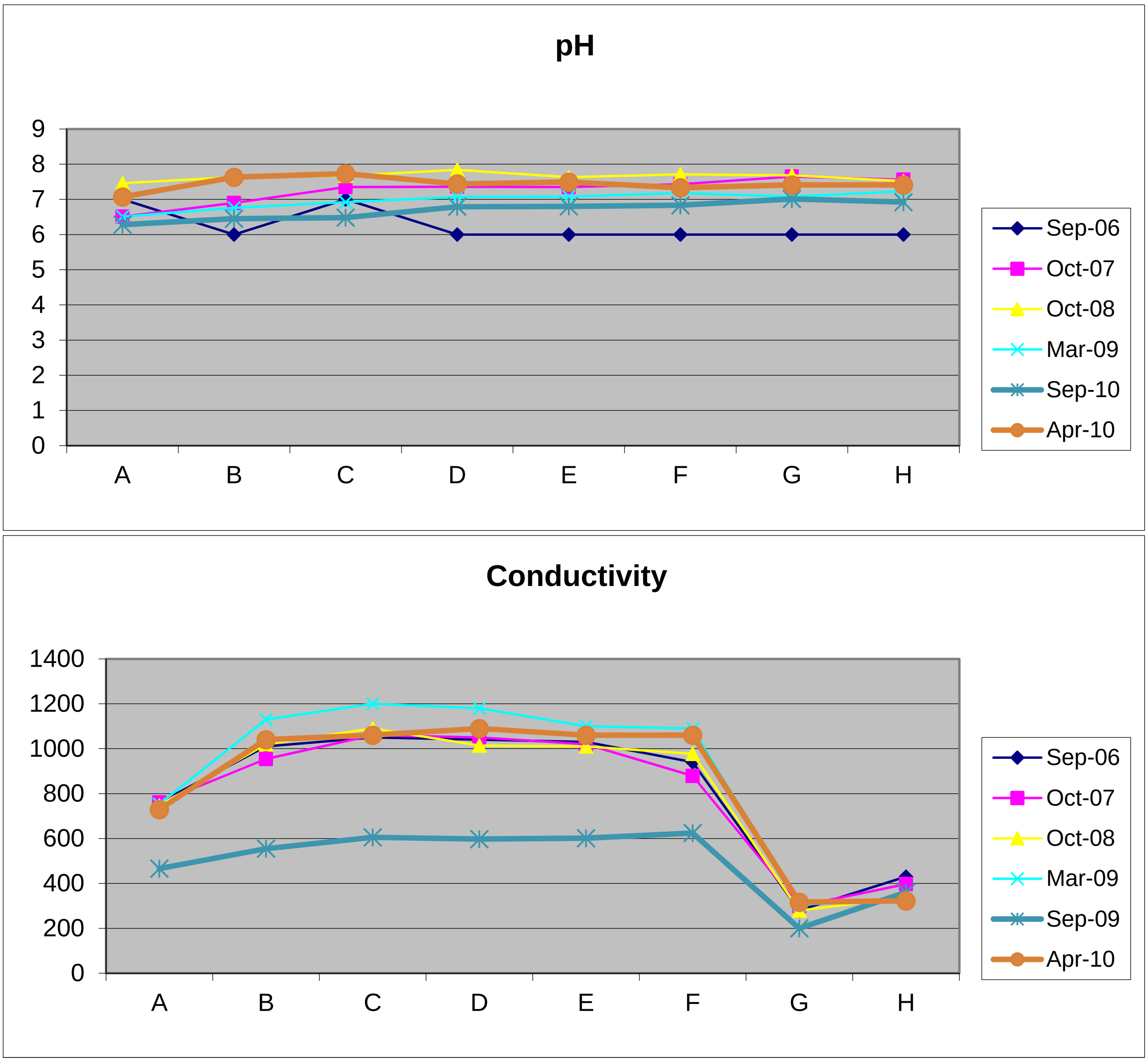

Figure 5 Surface Water Quality Results

As indicated in Section 2.10.2.6 of the *Environmental Assessment*, the Proponent would, if required, source water for the from the historic Snobs, United Miners or Stuart and Mertons workings for compensatory flows should the harvestable rights dams not be able to provide the required water. Table 4.19 of the *Environmental Assessment* provides an overview of the quality of water within the monitoring bores constructed for the groundwater assessment.

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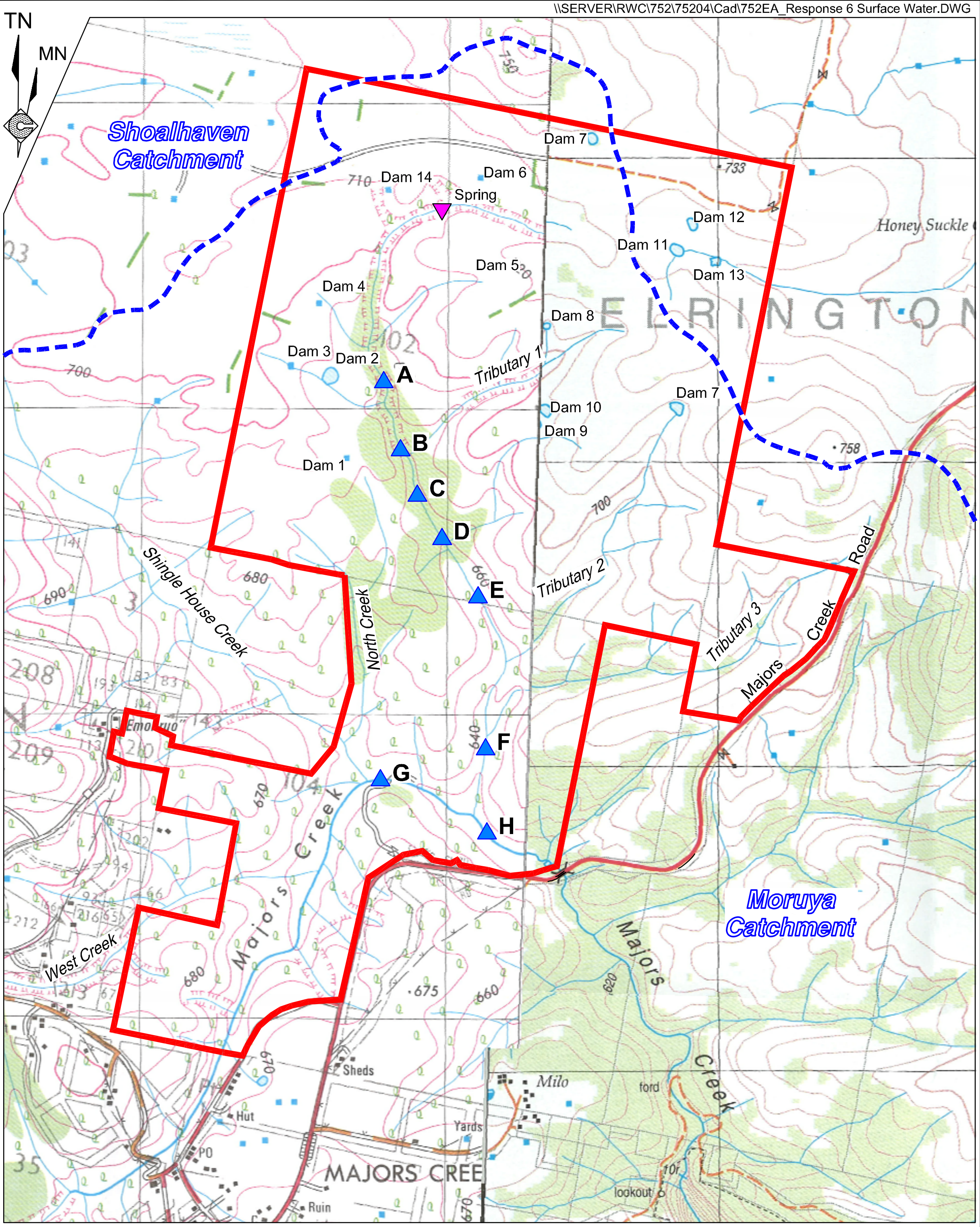

REFERENCE
Project Site Boundary
Catchment Boundary
Dam / Water Storage
Spring
A 2006 - 2010 Surface Water Monitoring Location

SCALE 1:20 000

200 0 200 400 600 800 1000 m

Base Map Source: Bendoura and Monga 1:25 000 Topographic Maps

Figure 6
SURFACE WATER MONITORING LOCATIONS

Given that electrical conductivities of water within Spring Creek significantly exceed the ANZECC (2000) guidelines and that water within Majors Creek is at the upper end or exceed those guidelines, the Proponent contends that the proposed compensatory release program does not "represent a real risk to downstream water quality and the users of this water" for the following reasons.

- The compensatory flow program is designed to compensate for reduced groundwater discharge to Spring and Majors Creeks. Table 4.19 of the *Environmental Assessment* identifies the quality of groundwater within the Project Site. In summary, water within the granodiorite aquifer typically has electrical conductivities in the range of 530µS/cm to 1 300µS/cm.
- Water within the harvestable rights dams would be likely to have electrical conductivities significantly lower those measured in groundwater within the Project Site. As a result, the compensatory flow program would result in improved water quality within Majors Creek.
- In the unlikely event that water would be required to be drawn from the historic workings for the compensatory flow program, the quality of the water that would be discharged would be equivalent to the quality of the water that the program is designed to replace. As a result, the program would result in a negligible change in groundwater quality within Majors Creek.

Monitoring of baseflows to provide a measure of groundwater input/discharge to the system. The hydrology of Majors Creek needs to be more thoroughly investigated and understood.

Response: (SEEC) Baseflows in Majors Creek are derived from subsurface input. The potential losses to this system as a result of the Project are addressed in the Groundwater Assessment, with compensatory flows proposed commensurate with those losses.

Section 13.7 of the Groundwater Assessment states that the impact of the Project on groundwater discharge to the Majors Creek Catchment will be to reduce the sustainable yield of the catchment by 0.8%. While this figure is not considered to be significant, these losses would be compensated for through the proposed compensatory flow program.

Response: (RWC) Finally, it is noted that to enable direct monitoring of base flows within Majors Creek, an approval under the *Water Management Act 2000* for construction of a v-notch weir within the creek would be required. This approval would be unlikely to be granted without significant assessment of the impacts of the proposed weir such as has being prepared to support the application for project approval. Undertaking such an assessment at the exploration stage of a Project such as the Dargues Reef Gold Project cannot be justified.

4. MONITORING AND TRIGGER LEVELS

It is recommended that additional investigation of the surface and groundwater systems include:

- *Monitoring of water level variations (loggers are recommended). Within the various groundwater zones identified. Monitoring/Investigation drilling should be representative of the proposed extent of the development. This is in reference to the depth of development and all relevant hydrogeologic units.*

Response: (AGE) The Section 17.0 of the Groundwater Assessment provides a comprehensive groundwater monitoring plan that consists of monitoring all hydrogeological units and includes the use of data loggers. The maximum depth of monitoring of the massive granodiorite is 216m (Table 12 of Groundwater Assessment); however if the drawdown declines below the depth of the granodiorite monitoring bores, the monitoring bores can always be deepened by the Proponent. The model indicates a very steep cone of depression around the mine and that the predicted drawdown will not extend below the base of the selected monitoring bores. In addition, the Proponent has committed to undertake monitoring on request at a range of bores well outside the anticipated extent of groundwater impacts. Finally, the Proponent would commence the groundwater (and surface water) monitoring as soon as practicable before project approval is granted (see Section 4).

An additional consideration in addressing environmental impacts is the identification of thresholds within which the development will operate. (For example levels and extent of water table drawdown, minimum environmental flows etc). Beyond these thresholds contingency plans should be prepared identifying measures which will be implemented should the impacts exceed the accepted levels.

Response: Sections 4.4.6 and 4.5.7 of the Environmental Assessment and Commitments 6.1, 6.2 and 7.1 describe the indicative groundwater and surface water monitoring that would be undertaken for the Project. As is normal practice in preparation of applications for project approval, that information is indicative that this stage. The Proponent anticipates that the project approval, should it be granted, would include a requirement to prepare a consolidated Water Management Plan and Monitoring Program or similar document. That document would include detailed thresholds or trigger levels for both surface water and groundwater, including water quality, standing water levels and water flow thresholds, as well as a detailed description of the contingency plans that would be implemented should the identified thresholds be achieved. The Proponent anticipates that that document would be prepared in consultation with NOW and other relevant government agencies to the satisfaction of the Director-General.

5. ADDITIONAL COMMITMENTS

Following discussions with NOW, the Proponent would implement the commitments identified in **Table 4**, commencing as soon as practicable prior to determination of the application for project approval and continuing during the life of the Project. These commitments are presented and numbered in a manner that is consistent with the Final Statement of Commitments presented in Section 6 of the *Response to Government Agency and Public Submissions* dated December 2010. These commitments would replace Commitment 6.4.

Table 4
Water-related Commitments

Desired Outcome	Commitment	Timing
6.6 GROUNDWATER		
Confirm the accuracy of the groundwater model and anticipated impacts.	6.4a Undertake preliminary groundwater monitoring within and surrounding the Project Site during preparation of the *Water Management Plan* and adjust the monitoring to be consistent with that plan once it has been approved by the relevant government agencies.	As soon as practicable and during the life of the Project
	6.4b Undertake, in consultation with NOW, a pump test to confirm the assumed hydrological parameters used in the groundwater model	
	6.4c Undertake a review of the numerical groundwater model based on the above. In the event that the actual impacts are significantly greater than those presented in AGE (2010), then the Proponent would consult with NOW in relation the revised modelling results and would develop appropriate management and mitigation measures to address those impacts	Prior to commencement of mining operations and every two years following commencement of those operations.
	6.4d Present the results of the review of the numerical groundwater model to the relevant government agencies.	With 3 months of the completion of each review