



# DURALIE COAL MINE

## Giant Barred Frog Management Plan

**DURALIE COAL MINE**  
**GIANT BARRED FROG MANAGEMENT PLAN**  
**(GBFMP)**



**Revision Status Register**

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## 1 INTRODUCTION

### 1.1 MINE LOCATION AND APPROVAL

The Duralie Coal Mine (DCM), is an open cut coal mine situated approximately 35 kilometres (km) south of Gloucester in the Gloucester Valley, New South Wales (NSW) (Figure 1). Duralie Coal Pty Ltd (DCPL) (a wholly owned subsidiary of Yancoal Australia Limited) owns and operates the DCM.

The NSW Minister for Urban Affairs and Planning granted Development Consent (DA 168/99) for the Duralie Coal Mine<sup>1</sup> in February 1999, with coal production commencing in 2003. The approved mine development included (among other things) open cut mining, out of pit and in pit overburden emplacement, rail dispatch of run-of-mine (ROM) coal to the Stratford Coal Mine for processing and export, diversion of Coal Shaft Creek and water management including mine water storage dams and irrigation areas to minimise the potential for discharge of mine water to Mammy Johnsons River. DA 168/99 was modified on a number of occasions to make minor changes to the mine including coal extraction rate, disturbance and coal extraction extents, and water management infrastructure.

In November 2011, approval was granted by the NSW Land and Environment Court<sup>2</sup> for the continuation and extension of the coal mine operations – the Duralie Extension Project (DEP) (PA 08\_0203) (Figure 2). The DEP includes (among other things) continuation and extension of open cut mining, in pit overburden emplacement, rail dispatch of ROM coal to the Stratford Coal Mine (SCM), and water management, including increased mine water storage capacity and additional irrigation areas for disposal of excess mine water.

PA 08\_0203 was modified in November 2012 and December 2014 to (among other things) make changes to rail dispatch times, and, disturbance, coal extraction and overburden emplacement extents. A copy of PA 08\_0203 (as modified) is available on the Duralie Coal website (<http://www.duralie.coal.com.au>).

In December 2010 the DEP was granted approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act), (EPBC 2010/5396). A copy of EPBC 2010/5396 is available on the Duralie Coal website (<http://www.duralie.coal.com.au>).

### 1.2 GIANT BARRED FROG POTENTIAL IMPACT PATHWAYS

During the assessment of the DEP for both State and Commonwealth Approvals (including the Land and Environment Court proceedings) it was identified that rainfall runoff from the additional proposed mine water irrigation areas (when under irrigation) had the potential to adversely impact water quality in the Mammy Johnsons River, with a subsequent potential threat to the health of the local Giant Barred Frog population<sup>3</sup>. Further, that runoff from non-irrigated mine areas was not a relevant Giant Barred Frog impact pathway.

It was also acknowledged that the DCM had been operating next to the Mammy Johnsons River for over 7 years, with the irrigation system (approved under DA 168/99) operating for the last 5 years, without causing any adverse impacts on the water quality of the river.

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<sup>1</sup> The mine was originally granted consent in August 1997, however the development as approved was not commenced. A new application was subsequently submitted and approved in February 1999.

<sup>2</sup> The Land and Environment Court approved the Duralie Extension Project following an objector appeal against the Minister for Planning's determination of the Project in November 2010.

<sup>3</sup> The expert report prepared by Dr Arthur White for the Land and Environmental Court Proceedings (No. 10090 of 2011, Annexure A) identified that the only potential impact of the Duralie Extension Project on the Giant Barred Frog would be due to salinity level changes in Mammy Johnsons Creek associated with rainfall runoff from the proposed additional mine water irrigation areas (White, 2011).









This was demonstrated by extensive water quality and macro invertebrate monitoring of Coal Shaft Creek and the Mammy Johnsons and Karuah Rivers in addition to detailed soil analysis of existing irrigation areas.

Ecotoxicity testing of mine water applied to the irrigation areas approved under DA 168/99 further demonstrated that runoff from the additional proposed irrigation areas for DEP was unlikely to adversely affect the Giant Barred Frog population, provided that the runoff from the additional irrigation areas was appropriately controlled.

### **1.3 WATER MANAGEMENT**

The objectives of the water management system are to:

- protect the integrity of local and regional water resources;
- maintain separation between runoff from undisturbed areas and water generated within active mining areas;
- comply with the requirements of EPL 11701;
- continue the beneficial use of water collected from operational areas for on-site irrigation; and
- provide a reliable source of water for on-site mining and coal handling.

The water management system controls waters generated from surface development areas while controlling the capture of surface water runoff by diverting upslope water around such areas (DCPL, 2010). The water management system includes a combination of permanent structures that will continue to operate post closure and temporary structures that will only be required until the completion of rehabilitation works (e.g. sediment control structures) (DCPL, 2010).

The existing water management system includes the following components (DCPL, 2014):

- water management storages;
- diversions for runoff from catchment areas upslope of the mine disturbance area (i.e. upslope diversions);
- runoff control structures and devices on disturbed and rehabilitated areas at the mine;
- runoff control structures and devices on infrastructure areas;
- procedures, structures and devices for the control of erosion and sediment movement;
- open pit dewatering equipment;
- procedures and equipment for the disposal of excess water through on-site irrigation; and
- sewage treatment plant and a system for the disposal of effluent.

The water management system is described in further detail in the approved Water Management Plan (WMP).

## 1.4 MANAGEMENT PLAN PURPOSE AND SCOPE

DCPL prepared and implemented an approved Giant Barred Frog Management Plan (GBFMP) following the approval of the DEP, in accordance with the requirements of PA 08\_0203 and EPBC 2010/5396. The approved GBFMP was prepared by Dr. Arthur White (Biosphere Environmental Consultants) and DCPL, in consultation with the NSW Office of Environment and Heritage (OEH). Dr. Arthur White was endorsed by the Secretary of the NSW Department of Planning and Environment (DP&E) as a suitably qualified and experienced person to prepare the GBFMP.

Under EPBC 2010/5396, the GBFMP is required to be submitted to DotE for approval (and therefore subsequently implemented) following commencement of irrigation activities within the DEP irrigation areas. Although the GBFMP was approved by SEWPaC (now DotE) in August 2012, DCPL has yet to commence irrigation of the additional irrigation areas approved under the DEP (i.e. Duralie Extension Project irrigation areas). As a consequence DCPL in conjunction with Dr Arthur White has revised the GBFMP to reflect that monitoring of the Giant Barred Frog would recommence following commencement of irrigation activities within the DEP irrigation areas.

The purpose of the GBFMP is to describe:

- Baseline data for the Giant Barred Frog population on Mammy Johnsons River collected from monitoring programs over the last four years (2011 to 2015).
- Monitoring requirements for the Giant Barred Frog population and habitat on the Mammy Johnsons River immediately upstream and downstream of the confluence with Coal Shaft Creek.
- Water quality triggers and performance objectives for rainfall runoff from the DEP irrigation areas.
- Performance measures for evaluating the impact of rainfall runoff from the DEP irrigation areas on the Giant Barred Frog population in the immediate downstream areas of Mammy Johnsons River.
- Contingency measures if monitoring on the Mammy Johnsons River immediately downstream of Coal Shaft Creek confluence indicates that the Giant Barred Frog population is declining as a result of water quality changes due to rainfall runoff from the DEP irrigation areas.
- Measures to be implemented to minimise the potential spread of the Chytrid fungus.

This plan applies in the event that mine water irrigation of the DEP irrigation areas is implemented.

## 1.5 STRUCTURE OF THE GBFMP

The remainder of the GBFMP is structured as follows:

- Section 2: Outlines the statutory requirements applicable to the GBFMP.
- Section 3: Provides a brief outline of the biology, distribution and conservation status of the Giant Barred Frog.
- Section 4: Provides a brief outline of the local and regional hydrology.
- Section 5: Summarises the Giant Barred Frog Study.
- Section 6: Provides the detailed baseline data.

- Section 7: Describes the Giant Barred Frog monitoring program.
- Section 8: Details the measures and indicators that will be used to assess the performance of the Project in relation to the Giant Barred Frog.
- Section 9: Describes the management measures that will be implemented.
- Section 10: Provides a Contingency Plan to manage any unpredicted impacts and their consequences.
- Section 11: Describes the annual review and improvement of environmental performance.
- Section 12: Describes the review and update of the GBFMP.
- Section 13: Outlines the management and reporting systems.
- Section 14: Lists the references cited in this GBFMP.

## 2 STATUTORY REQUIREMENTS

DCPL's statutory obligations are contained in:

- (i) the conditions of PA 08\_0203;
- (ii) the conditions of EPBC 2010/5396;
- (iii) relevant licences and permits, including conditions attached to mining leases; and
- (iv) other relevant legislation.

Obligations relevant to this GBFMP are described below.

### 2.1 NSW PROJECT APPROVAL

Condition 32, Schedule 3 of PA 08\_0203 requires the preparation of a GBFMP. In addition, Condition 2, Schedule 5 of PA 08\_0203 outlines general management plan requirements that are applicable to the preparation of the GBFMP. **Table 1** presents these conditions and indicates where each component of the conditions is addressed within this GBFMP.

**Table 1**  
**NSW Project Approval Management Plan Requirements**

NSW Project Approval Condition	GBFMP Section
<b>Condition 32, Schedule 3</b> <b>BIODIVERSITY</b> <b>Giant Barred Frog</b>	
32. <i>The Proponent shall prepare and implement a Giant Barred Frog Management Plan to the satisfaction of the Director-General. This plan must:</i>	
(a) <i>be prepared in consultation with OEH by a suitably qualified and experienced person, whose appointment has been endorsed by the Director-General;</i>	Section 1.4
(b) <i>be submitted to the Director-General for approval within 3 months of the date of this approval;</i>	-
(c) <i>include a summary of the Giant Barred Frog Study;</i>	Section 5
(d) <i>establish performance measures for evaluating the impact of the project on the local Giant Barred Frog population;</i>	Section 8
(e) <i>describe the measures that would be implemented to minimise the potential spread of Chytrid fungus, including training of staff in site hygiene management in accordance with the NPWS Hygiene Protocol for the Control of Disease in Frogs 2001;</i>	Section 9.6
(f) <i>include a program to monitor the potential impact of the project on the local frog population, which includes:</i>	Section 7
<ul style="list-style-type: none"> <li>• <i>detailed performance indicators for the project, with reference to the performance measures established in (d) above;</i></li> </ul>	Section 8
<ul style="list-style-type: none"> <li>• <i>annual monitoring of the frog population and its habitat during the breeding season along Mammy Johnson River both upstream and downstream of the confluence of Mammy Johnsons River and Coal Shaft Creek;</i></li> </ul>	Section 7
<ul style="list-style-type: none"> <li>• <i>trigger levels for further investigation; and</i></li> </ul>	Section 8
(g) <i>a contingency plan that would be implemented if monitoring suggests the frog population downstream of the confluence of Mammy Johnsons River and Coal Shaft Creek is declining due to the project, which may include a revision of the first flush salinity trigger or the implementation of additional water quality controls.</i>	Section 10

**Table 1 (Continued)**  
**NSW Project Approval Management Plan Requirements**

NSW Project Approval Condition	GBFMP Section
<b>Condition 2, Schedule 5</b> <b>ENVIRONMENTAL MANAGEMENT</b> <b>Management Plan Requirements</b>	
2. <i>The Proponent shall ensure that the management plans required under this approval are prepared in accordance with any relevant guidelines, and include:</i>	
a) <i>detailed baseline data;</i>	Section 6
b) <i>a description of:</i>	
• <i>the relevant statutory requirements (including any relevant approval, licence or lease conditions);</i>	Section 2
• <i>any relevant limits or performance measures/criteria;</i>	Section 8
• <i>the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the project or any management measures;</i>	Section 8
c) <i>a description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;</i>	Sections 7, 8, 9 and 10
d) <i>a program to monitor and report on the:</i>	Sections 7, 8 and 11
• <i>impacts and environmental performance of the project;</i>	
• <i>effectiveness of any management measures (see c above);</i>	
e) <i>a contingency plan to manage any unpredicted impacts and their consequences;</i>	Section 10
f) <i>a program to investigate and implement ways to improve the environmental performance of the project over time;</i>	Sections 7, 8 and 11
g) <i>a protocol for managing and reporting any:</i>	
• <i>incidents;</i>	PIRMP & Section 13
• <i>complaints;</i>	EMS & Section 13
• <i>non-compliances with statutory requirements; and</i>	EMS & Section 13
• <i>exceedances of the impact assessment criteria and/or performance criteria; and</i>	Section 10
h) <i>a protocol for periodic review of the plan.</i>	Section 12
<u><i>Note: The Director-General may waive some of these requirements if they are unnecessary or unwarranted.</i></u>	

Of relevance to this GBFMP, Condition 30, Schedule 3 and Condition 31, Schedule 3 of the PA 08\_0203 also state:

30. *The Proponent shall ensure that the project has no more than a negligible impact on the local Giant Barred Frog population.*
31. *The Proponent shall prepare a Giant Barred Frog Study to the satisfaction of the Director-General. This study must:*
- (a) *be prepared, in consultation with OEH, by a suitably qualified and experienced person, whose appointment has been endorsed by the Director-General;*
  - (b) *be submitted to the Director-General for approval within 2 months of this approval;*
  - (c) *investigate the extent of the Giant Barred Frog population in the Mammy Johnson River Catchment;*
  - (d) *assess the condition of the Giant Barred Frog habitat where it is recorded within the Catchment, including the presence of any Chytrid fungus;*
  - (e) *analyse the age structure of the frog population and the health of tadpoles; and*



- (f) document the relevant hydrological conditions both prior to and during the study, including rainfall, water flows and quality in Mammy Johnsons River, both upstream and downstream of the confluence of Mammy Johnsons River and Coal Shaft Creek, and in Coal Shaft Creek.

Conditions 30 and 31 are addressed in Sections 8 and 5 of this GBFMP, respectively.

## 2.2 COMMONWEALTH PROJECT APPROVAL

Conditions 6 to 10 of EPBC 2010/5396 are of relevance to the Giant Barred Frog. Condition 8 requires the preparation of a GBFMP while Conditions 6, 7, 9 and 10 outline requirements of Giant Barred Frog Surveys and management. **Table 2** presents these conditions and indicates where each component of the conditions is addressed within this GBFMP.

**Table 2**  
**Commonwealth Project Approval Management Plan Requirements**

Commonwealth Project Approval Condition	GBFMP Section
<b>Giant Barred Frog Surveys and Management</b>	
6. By the end of April 2011 and prior to undertaking Irrigation Activities, the person undertaking the action must conduct baseline frog surveys in order to investigate the local population of the Giant Barred Frog in the Mammy Johnsons River (MJR). The surveys must:	
a) be undertaken by a qualified ecologist approved in writing by the Department;	Section 1.4
b) be conducted in accordance with DSEWPaC Survey guidelines for Australia's threatened frogs ( <a href="http://www.environment.gov.au/epbc/publications/pubs/survey-guidelines-frogs.rtf">http://www.environment.gov.au/epbc/publications/pubs/survey-guidelines-frogs.rtf</a> ) and/or DECCW survey guidelines (DECC 2009, Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna-Amphibians);	Section 5.1
c) be undertaken during the known breeding season (September to March);	Section 5.1
d) assess the condition of identified and potential Giant Barred Frog habitat on the MJR and control sites, including the riparian ecosystem condition, stream characteristics (pool, riffles) and water quality 500m upstream and downstream of the confluence of MJR and Coal Shaft Creek;	Section 5.1
e) provide analysis of the frog populations including tadpoles and any observations of amplexus/oviposition/egg masses; and,	Section 5.1
f) determine the presence of chytrid fungus within the MJR.. This may include locations at sites below the confluence of the MJR and Coal Shaft Creek, and at other sites accessed for Duralie Coal Pty Ltd activities situated on the MJR above the confluence of Coal Shaft Creek, such as water quality monitoring location.	Section 5.1
7. The surveys undertaken for Condition 6 must be repeated one year later between September 2011 and April 2012.	Section 6
8. In order to protect the Giant Barred Frog from impacts associated with the project, the person undertaking the action must within 3 months of the commencement of the Irrigation Activities, submit a Giant Barred Frog Management Plan. This plan must include:	
a) results of completed baseline surveys;	Section 6
b) description of the measures undertaken to control and prevent the spread of the amphibian chytrid fungus as a result of activities associated with the project;	Section 9.6
c) a mark-recapture monitoring program to measure and detect changes to Giant Barred Frog populations over the life of the mine. The monitoring methodology must have the ability to detect up to at least a 20 % decline in the frog population;	Section 7
d) management measures to mitigate and avoid adverse impacts to the Giant Barred Frog, including the management and reduction of identified threats to the species (such as feral animals), measures to monitor and manage relevant water quality parameters including pH, heavy metals and aromatic hydrocarbons, and measures to address and respond to the risk of overflow from the mine water voids and seepage of potentially contaminated groundwater;	Section 8

**Table 2 (Continued)**  
**Commonwealth Project Approval Management Plan Requirements**

Commonwealth Project Approval Condition	GBFMP Section
e) <i>analysis of all aquatic invertebrate monitoring data using the Australian Rivers Assessment System (AusRivAS), and integration of AusRivAS modelling results into monitoring and management activities for the Giant Barred Frog, and for water quality, where relevant; and</i>	Section 6.4
f) <i>a Giant Barred Frog contingency plan that would be implemented if monitoring indicates a decline of 20% or more (in comparison with the results of surveys conducted in 2009 and surveys required under Condition 6 and 7) in the frog population within 500m of the project area. This should include, for example, a revision of first flush salinity trigger levels or the implementation of additional or alternative water quality controls.</i>  <i>Note: to avoid doubt, this contingency plan is in addition to the requirement at Condition 5 regarding the reduction of salinity trigger levels for released water in the event of an identified frog population decline of 20% or more.</i>	Section 10
9. <i>The approved Giant Barred Frog management plan must be implemented. Any changes to the Giant Barred Frog management plan must be approved by the Minister and approved variations to the Plan must be implemented. The approved plan must be made publicly available on the internet by the person undertaking the action.</i>	Section 12
10. <i>The person undertaking the action must provide a report on the implementation of the Giant Barred Frog management plan annually for the first 5 years and then every 5 years thereafter.</i>  <i>Note: The management plan should include sufficient detail to inform field development decisions and ongoing management, to minimise adverse impacts on the Giant Barred Frog through the life of the project.</i>	Section 11

### 2.3 LICENCES, PERMITS AND LEASES

In addition to PA 08\_0203 and EPBC 2010/5396, activities at or in association with the DCM will be conducted in accordance with a number of licences, permits and leases which have been issued or are pending issue.

Key licences, permits and leases pertaining to the Duralie Coal Mine include:

- Mining Lease (ML) 1427 issued under Part 5 of the *Mining Act, 1992* and approved by the NSW Minister for Mineral Resources in April 1998.
- ML 1646 issued under Part 5 of the *Mining Act, 1992* and approved by the NSW Minister for Primary Industries in January 2011.
- Environment Protection Licence 11701 issued under Part 3 of the *NSW Protection of the Environment Operations Act, 1997* by the Environment Protection Authority in September 2002 (as modified by subsequent licence variations).
- Groundwater Licence – Duralie Coal Open Cut (20BL168404) issued under Part 5 of the *Water Act, 1912* by the Department of Land and Water Conservation (now NSW Office of Water) in September 2002 (renewed September 2007 and subsequently in September 2012).
- A Mining Operations Plan (MOP – 18 January 2016 - 31 December 2019) was submitted to NSW Department of Trade and Investment, Regional Infrastructure and Services (DTIRIS) Division of Resources and Energy) for approval on 8 January 2016 and was subsequently approved on 18 January 2016,
- Water Supply Works Approval (20WA202053) under the *Water Management Act, 2000* issued by the Department of Water and Energy (now NSW Office of Water) on 15 May 2009 for the Coal Shaft Creek diversion and various onsite water management structures<sup>4</sup>.

<sup>4</sup> This approval replaced the previous *Water Act, 1912* Licence 20SL060324 for these structures.

- Mining and occupational health and safety related approvals granted by DTIRIS and WorkCover NSW.

## **2.4 OTHER LEGISLATION**

DCPL will conduct the DCM consistent with PA 08\_0203, EPBC 2010/5396 and any other legislation that is applicable to an approved Part 3A Project under the EP&A Act.

In addition to those Acts referred to above (Section 2.3), the following NSW Acts may be applicable to the conduct of the Duralie Coal Mine (DCPL, 2010):

- *Contaminated Land Management Act, 1997;*
- *Dangerous Goods (Roads and Rail Transport) Act, 2008;*
- *National Parks and Wildlife Act, 1974;*
- *Noxious Weeds Act, 1993;*
- *Roads Act, 1993;*
- *Threatened Species Conservation Act, 1995;*
- *Work Health and Safety (Mines) Act, 2013;*
- *Crown Lands Act, 1989;*
- *Dams Safety Act, 1978;*
- *Fisheries Management Act, 1994;* and
- *Petroleum (Onshore) Act, 1991.*

### **3 GIANT BARRED FROG – BIOLOGY, DISTRIBUTION AND CONSERVATION STATUS**

A brief description of the biology, distribution and conservation status of the Giant Barred Frog is provided below. Further information is available in the various scientific literature and other publications referenced.

#### **3.1 BIOLOGY**

##### **3.1.1 Habitat**

The Giant Barred Frog is associated with permanent flowing drainages, ranging from shallow rocky streams in rainforest to slow-moving rivers in lowland open forest (NSW Scientific Committee, 1999). Giant Barred Frogs are not found in ponds or ephemeral pools (Ehmann, 1997).

The Giant Barred Frog is known to inhabit various vegetation types including rainforest, moist eucalypt forest and nearby dry eucalypt forest (Commonwealth Department of the Environment [DotE, 2015]). Populations of the Giant Barred Frog have also been found in disturbed areas within vegetated riparian strips on cattle farms (DotE, 2015). However, deep leaf litter provided by canopy vegetation and/or thick cover is necessary (Ehmann, 1997).

White (2008), conducted intensive surveys for the Giant Barred Frog to determine its current distribution in the greater Sydney Basin. The study recorded the Giant Barred Frog in second, third and fourth order streams, all permanent and slow flowing, that ranged in width from 1 to 5 metres (m) wide (White, 2008). At most of the sites, the riparian corridor of the stream was relatively narrow and varied between 5 and 25 m away from the banks (White, 2008).

Graded banks with undercuts and steep edges are typical of many known Giant Barred Frog sites (Ehmann, 1997).

##### **3.1.2 Breeding**

Male Giant Barred Frogs call in spring and summer (Anstis, 2002). A stream breeding species, the Giant Barred Frog breeds from late spring to summer around shallow, flowing, rocky permanent streams, where some riparian vegetation is present (Department of Environment, Climate Change and Water [DECCW], 2009; Lemckert and Brassil, 2000). Breeding is associated with rainfall events, however the Giant Barred Frog does not breed when streams are in full flow; rather at the time stream flow is receding.

Females lay eggs onto the moist creek banks or rocks above water level, from where tadpoles drop into the water when hatched (DECCW, 2009). The larval period of the Giant Barred Frog is from September to May (Goldingay *et al.* 1999; Mahony *et al.* 1997; in DotE, 2015). The Giant Barred Frog has a long tadpole stage that may last up to 18 months (White, 2008). Tadpoles are large, growing to over 100 millimetres (mm) in length (DotE, 2015).

##### **3.1.3 Foraging**

Adult Giant Barred Frogs feed primarily on large insects and spiders (National Parks and Wildlife Service [NPWS], 2000), and tadpoles feed on plant material.

### 3.1.4 Movement

Various studies have found the Giant Barred Frog usually stays within approximately 50 m of its habitat (i.e. stream/riparian vegetation) (Streatfield, 1999 in DotE, 2015; Lemckert and Brassil, 2000; Koch and Hero, 2007).

Streatfield (1999 in DotE, 2015) monitored the spatial movements of four male and four female Giant Barred Frogs at Coomera River in Queensland. Over six weeks, it was found that the individuals moved a maximum distance of 268 m along the stream and 50 m away from the stream. After a night of activity, the displacement distances between diurnal refuges were found to be small, suggesting a high degree of fidelity to the previous day's shelter (Streatfield, 1999 in DotE, 2015).

Lemckert and Brassil (2000) undertook a four year radio tracking study on the movements and habitat use of the Giant Barred Frog in the Coffs Harbour/Dorrigo area in NSW. The study found that frogs stayed within a 20 m band either side of the four streams monitored.

Koch and Hero (2007) radio tracked the Giant Barred Frog and demonstrated that males were found 7.2 m on average from the stream (range 0.5 to 32.0 m) and females were found on average 12.1 m from the stream (range 0 to 50 m).

Previous studies have shown that the Giant Barred Frog is not distributed evenly along streams; they cluster and reach highest densities around larger pools with overhanging banks (preferred breeding sites). In contrast they are not common near riffle zones. Studies have also found that adult males are territorial (i.e. they defend an area and exclude other males).

## 3.2 DISTRIBUTION

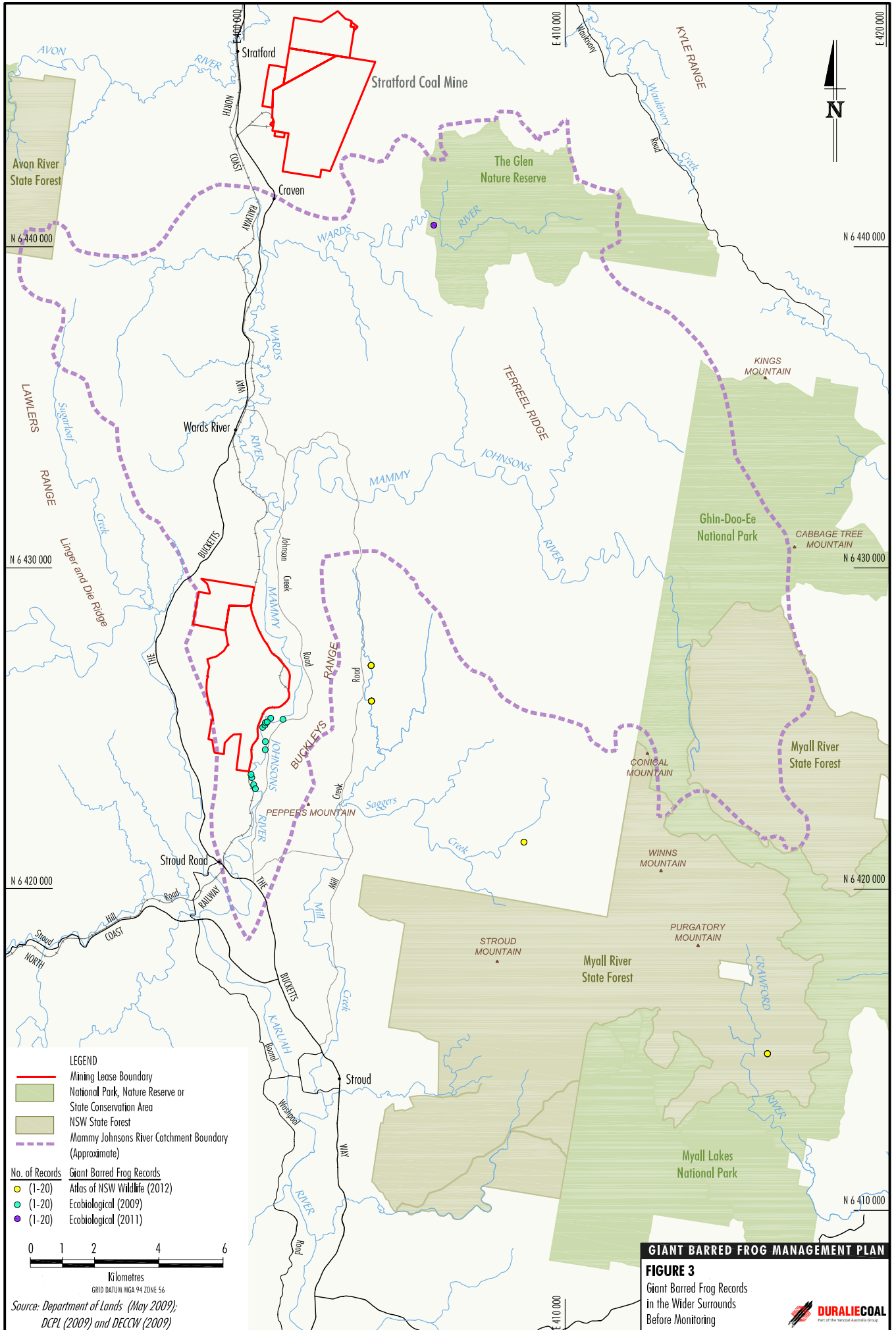
The general distribution of the Giant Barred Frog in Australia extends across the eastern coast and ranges from south-eastern Queensland to the Hawkesbury River in mid-eastern NSW (DECCW, 2009; Hines *et al.*, 1999).

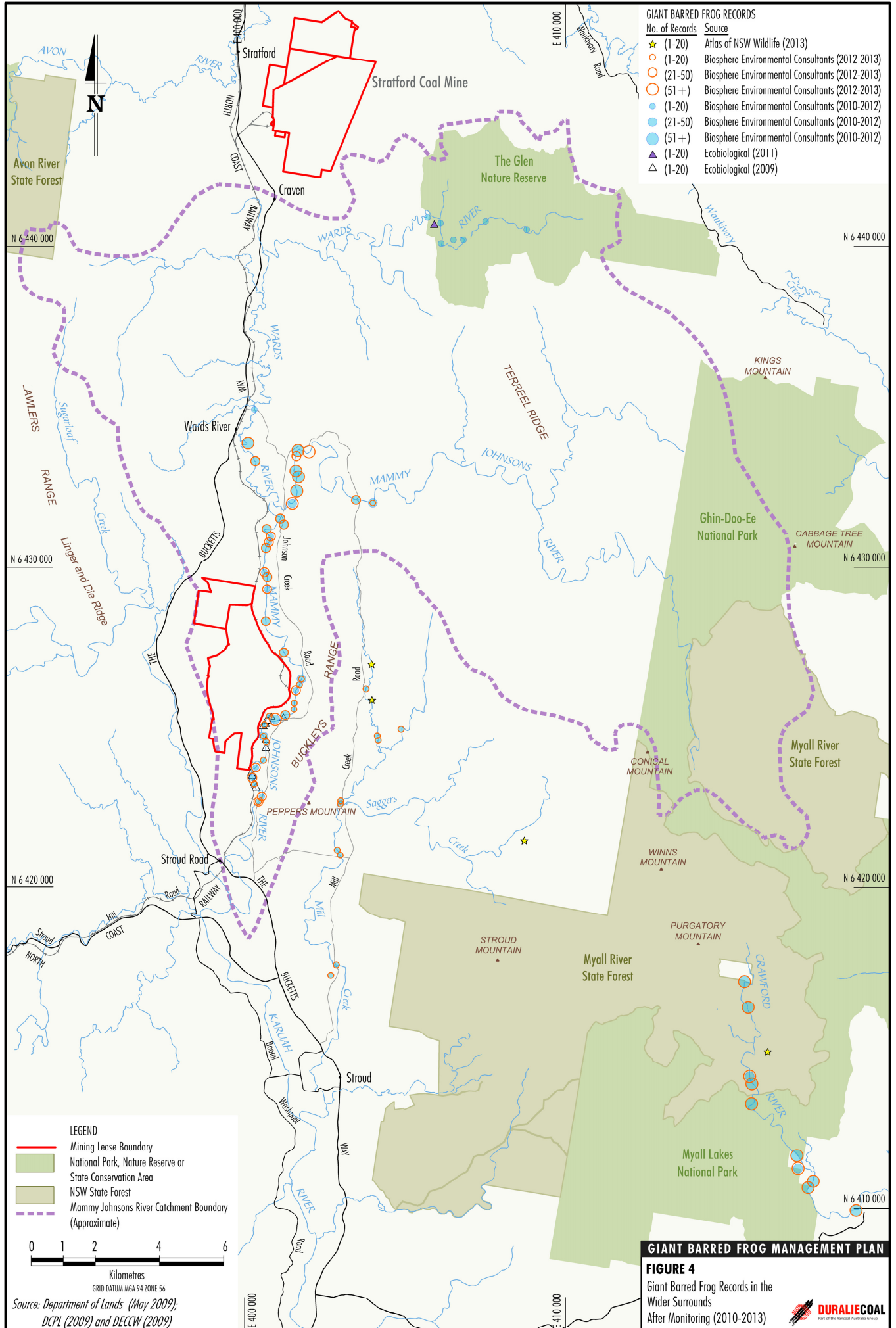
The Giant Barred Frog was first recorded in the Mammy Johnsons River catchment in January/February 2009 (EcoBiological, 2009). Prior to the Giant Barred Frog Study, the Giant Barred Frog was only known from two locations in the Mammy Johnsons River Catchment. However, the Giant Barred Frog is more widely distributed within the Mammy Johnsons River Catchment than previously thought (Figure 3). Following the Giant Barred Frog Study and subsequent baseline monitoring surveys, the Giant Barred Frog has been recorded in a number of locations in the catchment and surrounding areas (Figures 4 and 5).

## 3.3 CONSERVATION STATUS

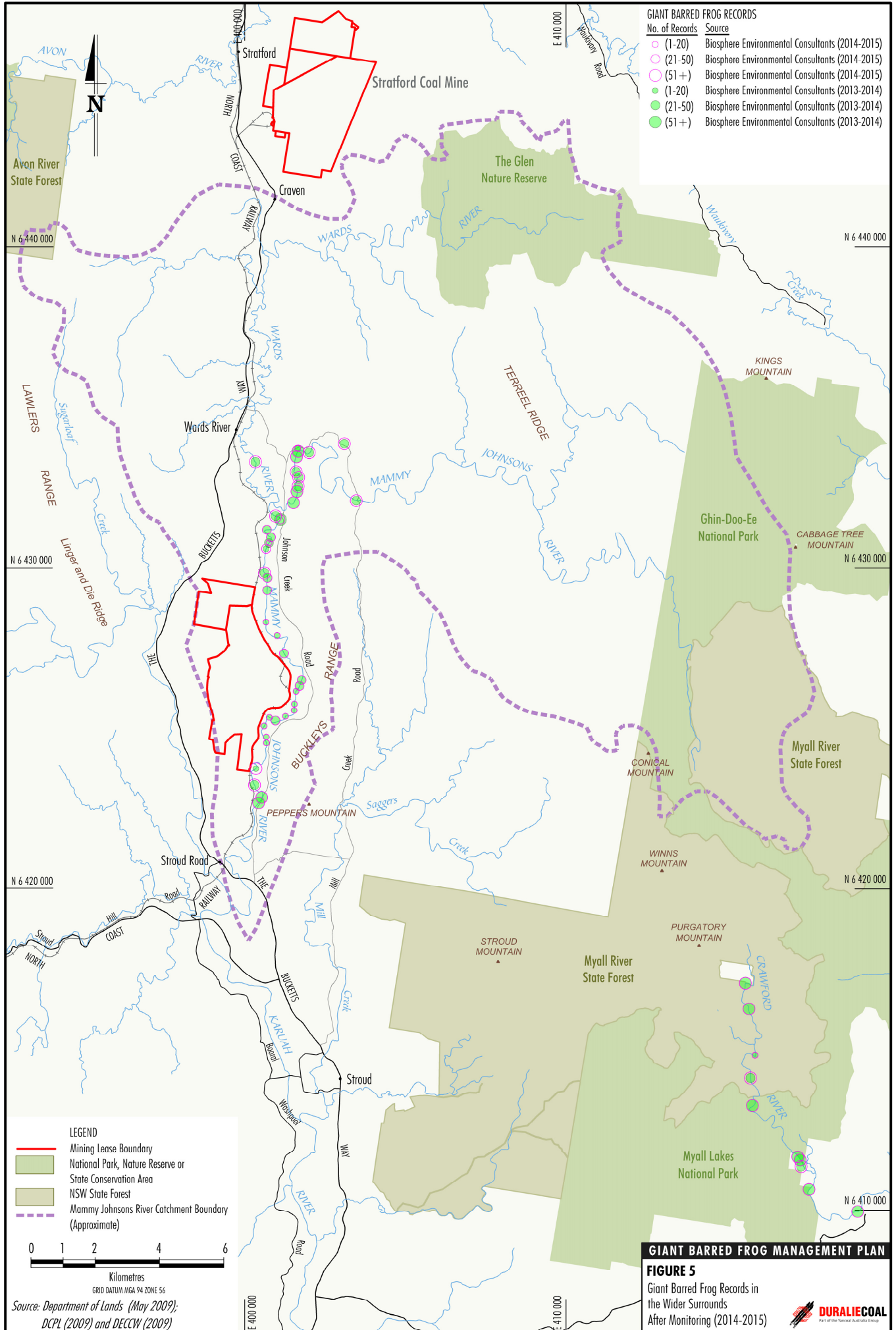
The Giant Barred Frog (*Mixophyes iteratus*) is listed as Endangered under the NSW *Threatened Species Conservation Act, 1995* and EPBC Act.

The distribution of the Giant Barred Frog in the Mammy Johnsons River catchment and wider surrounds (Mill Creek, Saggars Creek and Crawford River) is relatively isolated from other known populations to the south and north (Figure 4). Given the known distribution of the Giant Barred Frog, the population in the Mammy Johnsons River catchment is of regional significance.







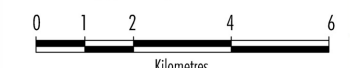


**GIANT BARRED FROG RECORDS**

No. of Records	Source
○ (1-20)	Biosphere Environmental Consultants (2014-2015)
○ (21-50)	Biosphere Environmental Consultants (2014-2015)
○ (51+)	Biosphere Environmental Consultants (2014-2015)
● (1-20)	Biosphere Environmental Consultants (2013-2014)
● (21-50)	Biosphere Environmental Consultants (2013-2014)
● (51+)	Biosphere Environmental Consultants (2013-2014)

**LEGEND**

- Mining Lease Boundary
- National Park, Nature Reserve or State Conservation Area
- NSW State Forest
- Mummy Johnsons River Catchment Boundary (Approximate)



GRID DATUM MGA 94 ZONE 56  
 Source: Department of Lands (May 2009);  
 DCPL (2009) and DECCW (2009)

**GIANT BARRED FROG MANAGEMENT PLAN**  
**FIGURE 5**  
 Giant Barred Frog Records in the Wider Surrounds After Monitoring (2014-2015)





## 4 LOCAL AND REGIONAL HYDROLOGY

A comprehensive description of the local and regional surface water resources is provided in Section 5.4 and Appendix D of the Duralie Open Pit Modification Environmental Assessment (DCPL, 2014). A summary of this information is provided below.

The DCM is situated in the Gloucester Valley which is bounded by Buckleys Range to the east and the Linger and Die Ridge to the west. The area surrounding the mine has been extensively cleared for grazing on native and improved pastures, and is also used for intensive poultry farming.

The DCM area is situated within the Mammy Johnsons River catchment, a tributary of the Karuah River. The Karuah River, which rises in the Chichester State Forest, drains to Port Stephens some 40 km south of the mine. The Karuah River is located to the north-west and south of the DCM.

Mammy Johnsons River has a similar catchment area and length to the Karuah River above their confluence near the village of Stroud Road (Gilbert & Associates Pty Limited, 2014). The Mammy Johnsons River rises in the Myall State Forest to the east of the mine and flows generally north out of the State Forest area and then west through the locality of Tereel to its confluence with Wards River some 2.5 km south-east of the township of the same name. From the Wards River confluence the Mammy Johnsons River flows in a generally southerly direction through an undulating landscape which has been extensively cleared for cattle grazing.

Streamflows in the Karuah River and Mammy Johnsons River are characterised by low to moderate flows for long periods, with periods of higher discharge following heavy rains, typical of small and medium sized upland catchments (Gilbert & Associates Pty Limited, 2010). The Karuah River appears to have stronger low flow persistence than Mammy Johnsons River, with zero flow recorded only on 0.8% of days, compared to 5.3% of days for the Mammy Johnsons River (Gilbert & Associates Pty Limited, 2010).

The DCM is situated in the catchment of Coal Shaft Creek, a small tributary which flows into the lower reaches of Mammy Johnsons River, and the catchment of an unnamed minor tributary stream that flows north and east to join the Mammy Johnsons River approximately 4 km upstream of the Coal Shaft Creek confluence.

Coal Shaft Creek has been diverted around the current mine workings. Tombstone Hill, at an elevation of approximately RL 130 m, and its associated ridgeline, divides the Coal Shaft Creek catchment from the Mammy Johnsons River to the east.

The Coal Shaft Creek diversion comprises an approved, purpose-built diversion channel, which rejoins the original Coal Shaft Creek alignment near the DCM rail spur. The confluence of Coal Shaft Creek with the Mammy Johnsons River is south of the DCM rail loading infrastructure and approximately 10 km upstream of the Mammy Johnsons River/Karuah River confluence.

The upper reaches of Coal Shaft Creek are ephemeral and baseflow contributions in these portions of the creek are likely to be small (Gilbert & Associates Pty Limited, 2014).

The northern parts of the mining operations extend beyond the Coal Shaft Creek catchment boundary and into the catchment of a small unnamed drainage which is referred to as the Unnamed Tributary. The Unnamed Tributary flows generally eastward into the Mammy Johnsons River (Gilbert & Associates Pty Limited, 2014).

## 5 GIANT BARRED FROG STUDY

A Giant Barred Frog Study (DCPL, 2012b) was prepared by Dr. Arthur White (Biosphere Environmental Consultants), a suitably qualified and experienced person endorsed by the Director-General of DP&I, and DCPL. The Giant Barred Frog Study was prepared in consultation with DECCW (now OEH) and approved by the Secretary DP&E (formerly DP&I) on the 6 March 2012.

The Giant Barred Frog Study (DCPL, 2012b) outlined methods to gather information on the Giant Barred Frog to address Condition 31, Schedule 3 of PA 08\_0203 and Condition 6 of EPBC 2010/5396. Surveys for the Giant Barred Frog Study were undertaken between 2010 and 2011. Since these initial surveys, additional baseline data on the Giant Barred has been collected as described in Section 6.

### 5.1 SCOPE OF THE GIANT BARRED FROG STUDY

In accordance with Condition 6(b) of EPBC 2010/5396, the Giant Barred Frog Study (DCPL, 2012b) included:

- an assessment of the condition of identified and potential Giant Barred Frog habitat on the Mammy Johnsons River and control sites, including the riparian ecosystem condition, stream characteristics (pool, riffles) and water quality 500 m upstream and downstream of the confluence of Mammy Johnsons River and Coal Shaft Creek;
- an analysis of the frog populations including tadpoles and any observations of amplexus/oviposition/egg masses; and
- a determination of the presence of Chytrid fungus within the Mammy Johnsons River.

In accordance with Condition 31 Schedule 3 of PA 08\_0203, the Giant Barred Frog Study (DCPL, 2012b) included:

- an investigation on the extent of the Giant Barred Frog population in the Mammy Johnsons River catchment;
- an assessment of the condition of the Giant Barred Frog habitat where it is recorded within the catchment, including the presence of any Chytrid fungus;
- an analysis of the age structure of the frog population and the health of tadpoles; and
- documentation of the relevant hydrological conditions both prior to and during the study, including rainfall, water flows and quality in Mammy Johnsons River, both upstream and downstream of the confluence of Mammy Johnsons River and Coal Shaft Creek, and in Coal Shaft Creek.

Habitat assessments for the Giant Barred Frog Study were undertaken between November 2010 and March 2011 as well as between January and March 2011 (within the known breeding season consistent with Condition 6(c) of EPBC 2010/5396) (DCPL, 2012a). The survey methods were consistent with the Department of the Environment, Water, Heritage and the Arts (2010) *Survey Guidelines for Australia's Threatened Frogs* and Department of Environment and Climate Change (2009) *Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna-Amphibians* (DCPL, 2012b).

## 5.2 RESULTS FROM THE GIANT BARRED FROG STUDY

A summary of results from the Giant Barred Frog Study (undertaken between 2010 and 2011) are described below (in accordance with Condition 32c). Additional baseline data on the Giant Barred has been collected since these initial surveys as described in Section 6.

### ***Extent of the Giant Barred Frog Population in the Mammy Johnsons River Catchment***

Prior to the Giant Barred Frog Study, the Giant Barred Frog was only known from two locations in the Mammy Johnsons River Catchment (Figure 3). However, the Giant Barred Frog is more widely distributed within the Mammy Johnsons River Catchment than previously thought (Figure 4).

### ***Condition of the Giant Barred Frog Habitat***

The Giant Barred Frog Study identified Giant Barred Frog habitat along the Mammy Johnsons River and Wards River within the Mammy Johnsons River Catchment, as well as along Mill Creek and the Crawford River (within the adjacent catchment). Habitat assessment data is provided in the annual monitoring reports.

### ***Chytrid Fungus***

The Giant Barred Frog Study confirmed that Chytrid fungus is present within the Mammy Johnsons River. Chytridiomycosis or Frog Chytrid Disease is a highly contagious, highly virulent disease of frogs. The disease has been implicated in the demise of several frog species in Australia as well as being partly or wholly responsible for the decline of many other species. Frog Chytrid Disease is listed as a key threatening process for frogs under the NSW *Threatened Species Conservation Act, 1995*.

### ***Age Structure of the Frog Population and the Health of Tadpoles***

Survey data for the Giant Barred Frog (including adult frogs and tadpoles) was collected between January to March 2011. The Giant Barred Frog monitoring data is provided in the annual monitoring reports.

### ***Hydrological Conditions***

Hydrological conditions (including rainfall, water flows and quality) were documented prior to and during the Giant Barred Frog Study and provided in DCPL (2012a).

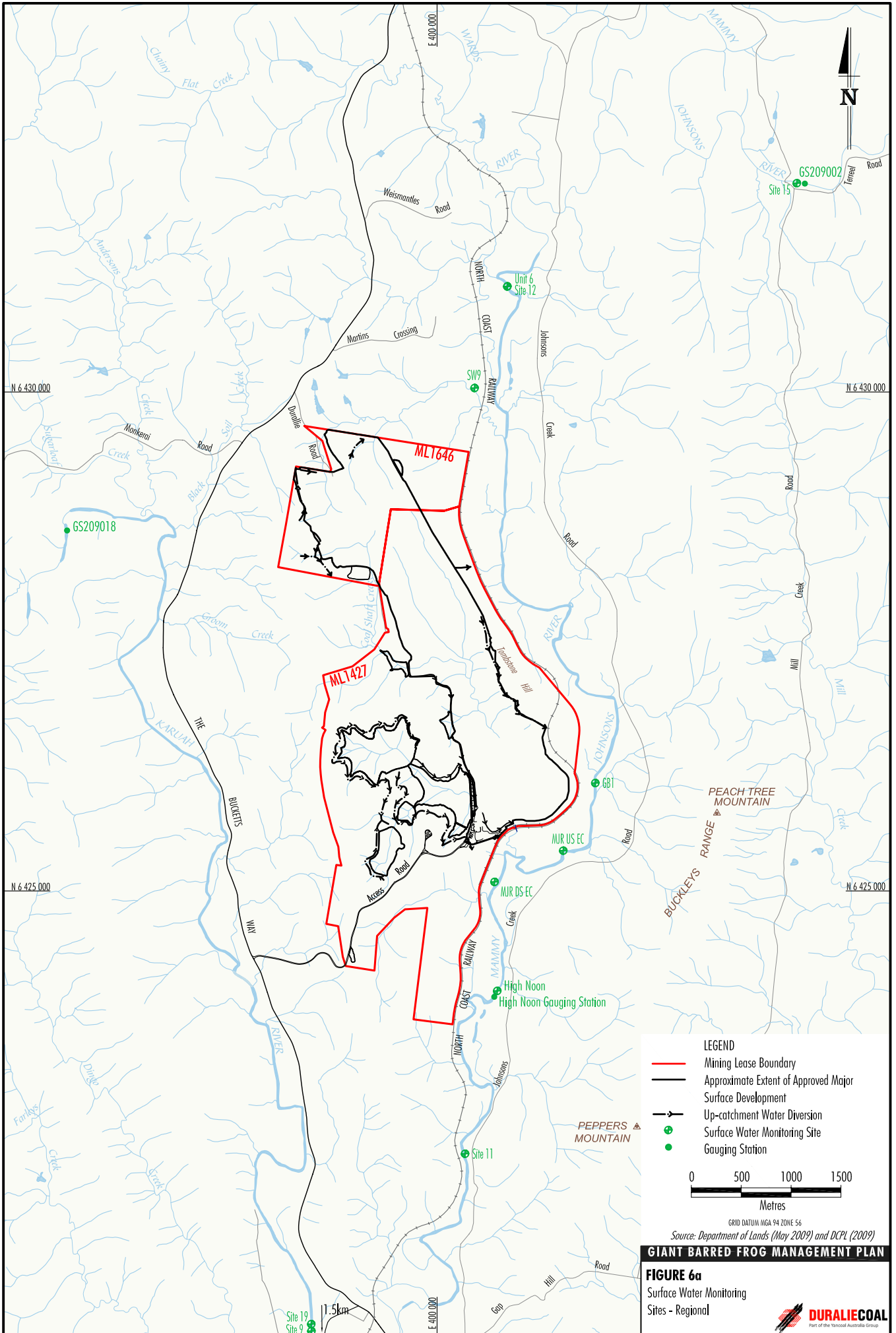
Rainfall, maximum and minimum temperature and relative humidity data is available from the on-site weather stations located at the Duralie Coal Mine and Stratford Coal Mine. A description of the weather conditions experienced during surveys is provided in the annual monitoring reports.

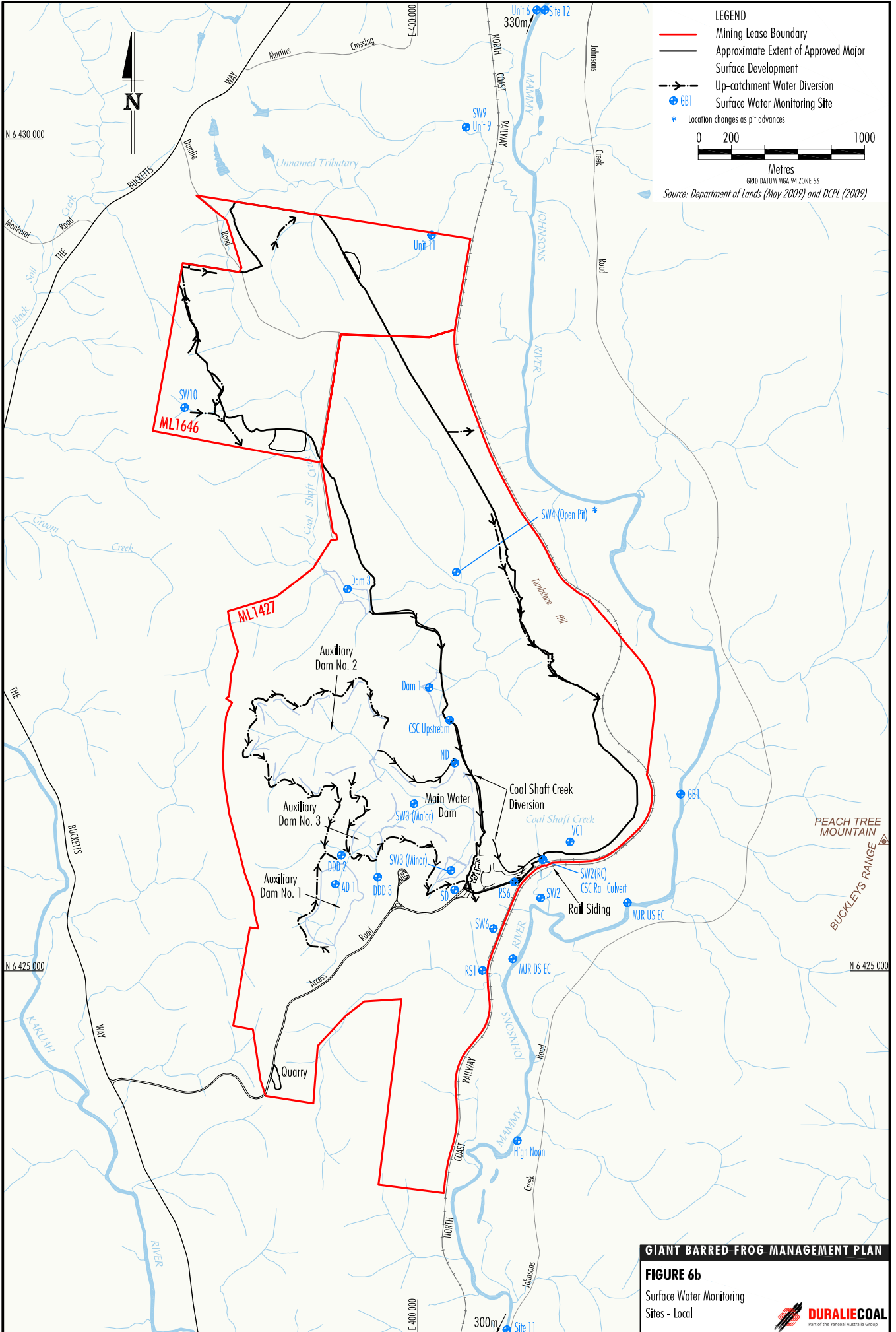
Biosphere Environmental Consultants collected water quality data at the habitat assessment sites from November 2010 to March 2011 using a Yeo-Kal portable water meter. Turbidity, dissolved oxygen content, percent oxygen saturation, oxidation-reduction potential, pH, salinity, conductivity and water temperature recorded. The results of the water quality sampling is provided in the annual monitoring reports.

Stream water temperatures recorded during the conduct of the nocturnal Giant Barred Frog surveys are also provided in the annual monitoring reports.

### **5.3 GIANT BARRED FROG LONG-TERM STUDY**

Within 3 months from commencement of the irrigation activities within the Duralie Extension Project irrigation areas, in accordance with Condition 31A Schedule 3 of PA 08\_0203, the Giant Barred Frog Study (DCPL, 2012b) will be reviewed and expanded into a longitudinal study to be implemented until 5 years after the mine ceases to operate (the Giant Barred Frog Long-term Study).





## 6 BASELINE DATA

As of October 2015, irrigation in areas approved under PA 08\_0203 have not been implemented<sup>5</sup>, hence rainfall runoff from the DEP irrigation areas has not presented a potential impact on the Giant Barred Frog population. Consequently, all Giant Barred Frog monitoring data collected prior to commencement of irrigation activities within the DEP irrigation areas is taken to be baseline data for the purposes of this management plan, and comprises:

- surveys for the Duralie Extension Project Environmental Assessment, undertaken between April 2007 and September 2009 (DCPL, 2010);
- surveys for the Giant Barred Frog Study undertaken between January and March 2011 (DCPL, 2012a);
- Annual monitoring carried out between:
  - September 2011 and March 2012 (Biosphere Environmental Consultants, 2012);
  - September 2012 and March 2013 (Biosphere Environmental Consultants, 2013);
  - October 2013 and January 2014 (Biosphere Environmental Consultants, 2014); and
  - October 2014 and February 2015 (Biosphere Environmental Consultants, 2015)

Note, the first annual monitoring event (i.e. between September 2011 and March 2012) satisfied Condition 7 of EPBC 2010/5396, as it was undertaken between September 2011 and March 2012).

Survey areas were nominated for the first monitoring season (September 2011 – March 2012) in the *Giant Barred Frog Management Plan* (DCPL, 2012a) and these sites were also largely adopted as a basis for the subsequent monitoring seasons. Areas 5, 6 and 8 were not surveyed during the third and fourth monitoring seasons because of lack of frog numbers (Biosphere Environmental Consultants, 2015; 2014). The survey areas and monitoring sites are indicated in Figure 7.

### 6.1 GIANT BARRED FROG AND TADPOLE DATA

The baseline surveys have demonstrated that the Giant Barred Frog has a much wider distribution in the catchment and surrounding areas than previously thought (Figures 3 to 5).

The population of Giant Barred Frogs in the Mammy Johnsons River catchment vary from year to year, generally in response to environmental conditions (e.g. drought) (Biosphere Environmental Consultants, 2015).

A summary of the Giant Barred Frog baseline population estimates is presented in Table 3. The frogs are in highest concentrations in the middle sections of the Mammy Johnsons River Catchment (in Survey Areas 3 and 4, upstream of the Duralie Coal Mine). The baseline data presented in **Table 3** is based on a statistical analysis of frog capture data for the 2011 to 2015 monitoring periods.

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<sup>5</sup> Irrigation activities continue to be undertaken in areas approved prior to the Duralie Extension Project. The management of these irrigation areas was assessed and approved as to not present a risk to the Giant Barred Frog population.

**Table 3**  
**Giant Barred Frog Population Estimates between Survey Periods**

Survey Area*	Location	Monitoring Period			
		2011-2012	2012-2013	2013-2014	2014-2015
1	Located on the Mammy Johnsons River, downstream of the confluence with Coal Shaft Creek (i.e. downstream of the Duralie Coal Mine).	51 (2)	50 (5)	30 (4)	39 (4)
2	Located on the Mammy Johnsons River, upstream of the confluence with Coal Shaft Creek and downstream of an unnamed minor tributary.	53 (3)	67 (5)	44 (4)	26 (5)
3	Located on the Mammy Johnsons River, upstream of the unnamed minor tributary to the confluence with Wards River.	96 (4)	75 (5)	67 (4)	78 (4)
4	Located on the Mammy Johnsons River, upstream of the confluence with Wards River.	110 (4)	125 (5)	88 (4)	128 (4)
7	Located on the Crawford River, outside of the Mammy Johnsons River Catchment.	202 (4)	140 (6)	178 (4)	267 (4)

Source: Biosphere Environmental Consultants (2015).

Note: The number in brackets refers to the number of estimates used in deriving the final population number.

The baseline data indicates that Mammy Johnsons River supports a viable population of Giant Barred Frogs. The frogs are not evenly distributed across the catchment; they are absent in sections or in low to medium densities in other sections. It is evident from **Table 3** that the lower parts of the Mammy Johnsons River (Survey Areas 1 and 2) contain fewer Giant Barred Frogs than equivalent areas further upstream (Survey Areas 3 and 4).

Survey Area 7 (Crawford River) was established to provide comparative data to authenticate (or disprove) climatic impacts on frog populations. Survey Area 7 (Crawford River) supports a higher number of Giant Barred Frogs at densities almost equivalent to those found in Survey Area 4 on the Mammy Johnsons River. The frog densities recorded in Survey Areas 4 and 7 are consistent with Giant Barred Frog densities recorded in northern NSW; that site was in land unaffected by agriculture similar to Survey Area 7. While more male frogs have been caught than female frogs, the baseline recapture data makes it clear that the two sexes are approximately equal in numbers in each of the survey areas. Male frogs are caught more often as they appear to be active on more nights and are more easily captured when they are calling. Female frogs are less active and do not call (Biosphere Environmental Consultants, 2015).

A total of 73 tadpoles were recorded during the 2012/2013 monitoring period, 56 tadpoles were recorded during the 2013/2014 monitoring period and 18 tadpoles were recorded during the 2014/2015 monitoring period (Biosphere Environmental Consultants, 2013 to 2015). All of the tadpoles captured appeared to be healthy. There were no signs of deterioration of the denticles associated with chytrid (Biosphere Environmental Consultants, 2013 to 2014). The number of tadpoles found is undoubtedly due to the difficulty in locating small tadpoles in a wide and flowing river (Biosphere Environmental Consultants, 2013).



## 6.2 CONDITION OF THE GIANT BARRED FROG HABITAT

The Giant Barred Frog population in the Mammy Johnsons River catchment is subject to a range of impacts unrelated to the DCM, many arising from the past and current agricultural uses of the river and the surrounding land. Biosphere Environmental Consultants (2014), describes the observable impacts on the Giant Barred frogs as habitat loss through land clearing, current or past agricultural practices, changes to river flow patterns and changes in the frequency of flash flooding, cattle trampling of riparian ground cover vegetation, cattle trampling of frogs and addition of agricultural chemicals to the river. Invasive weeds and predatory feral species (such as foxes and pigs) are also prevalent (Biosphere Environmental Consultants, 2014).

In relation to the condition of the Giant Barred Frog habitat downstream of the mine, Biosphere Environmental Consultants (2014) states:

*The deep scoring of the middle and lower sections of the Mammy Johnsons River (Survey Areas 1, 2 and 3) has removed pool and backwaters from the water course creating a single, deep channel that is prone to sudden rises and drops in water level. The surging nature of the river under these conditions makes the survival of Giant Barred Frog tadpoles in the lower and middle Mammy Johnsons River (including Survey Areas 1 and 2, near the Duralie Coal Mine) very difficult.*

## 6.3 HYDROLOGICAL CONDITIONS AND WATER QUALITY

An overview of the local and regional hydrology is provided in Section 5. Baseline data on the hydrological conditions of the Mammy Johnsons River is continually monitored in accordance with the DCM WMP. The hydrological parameters listed in **Table 4** are monitored.

**Table 4**  
**Hydrological Data Sources**

Parameter	Description
Stream flow data	Stream flow data is available for the gauging station located at Pikes Crossing* (GS209002) on the Mammy Johnsons River from 1973 onwards (Figure 6a).
Rainfall, maximum and minimum temperature and relative humidity data	Rainfall, maximum and minimum temperature and relative humidity data is available from the on-site weather stations located at the Duralie Coal Mine and Stratford Coal Mine.
Surface water quality data	Surface water quality data is available for the Mammy Johnsons River, Karuah River, Coal Shaft Creek and other tributaries of the Mammy Johnsons River (Figures 6a and 6b). This includes data recorded by continuous electrical conductivity (EC) sensors/loggers on the Mammy Johnsons River and its tributaries.

\* The gauging station site is referred to by OEH as Pikes Crossing. Pikes Crossing is known by DCPL as Mavis Tersteeg Crossing.

Biosphere Environmental Consultants (2012-2014) collected water quality data at the habitat assessment sites using a Yeo-Kal portable water meter. Turbidity, dissolved oxygen content, percent oxygen saturation, oxidation-reduction potential, pH, salinity, conductivity and water temperature are recorded (Biosphere Environmental Consultants, 2012-2014).

Invertebrate Identification Australasia undertake aquatic ecology monitoring within and around the DCM area, and have done so since the commencement of operations. Aquatic ecology data using the Australian Rivers Assessment System (AusRivAS) continue to be collected as described in the DCM WMP. Sampling of stream water quality occurs as part of this monitoring. Results from the aquatic ecology monitoring may be used to inform the likely causes of impacts on Giant Barred Frog (Section 10).

## 7 GIANT BARRED FROG MONITORING PROGRAM

A monitoring program has been established to assess the impacts of rainfall runoff from the DEP irrigation areas on the Giant Barred Frog population on the Mammy Johnsons River, in areas immediately downstream of the irrigation areas.

The results of the Giant Barred Frog Study (DCPL, 2012a) and baseline monitoring surveys have been used to inform the Giant Barred Frog monitoring requirements upon commencement of irrigation on the DEP irrigation areas. This includes an analysis of all monitoring data acquired up to and including the 2014-2015 annual monitoring survey and consideration of future potential initiation of irrigation on the DEP irrigation areas to inform the survey effort, intensity and duration required to monitor and assess rainfall runoff impacts on the Giant Barred Frog from these irrigation areas.

The timing and frequency of monitoring will be triggered upon commencement of irrigation within the DEP irrigation areas. The monitoring program will be reviewed subsequent to each September to March survey period (i.e. the breeding season) following the application of mine water onto these irrigation areas.

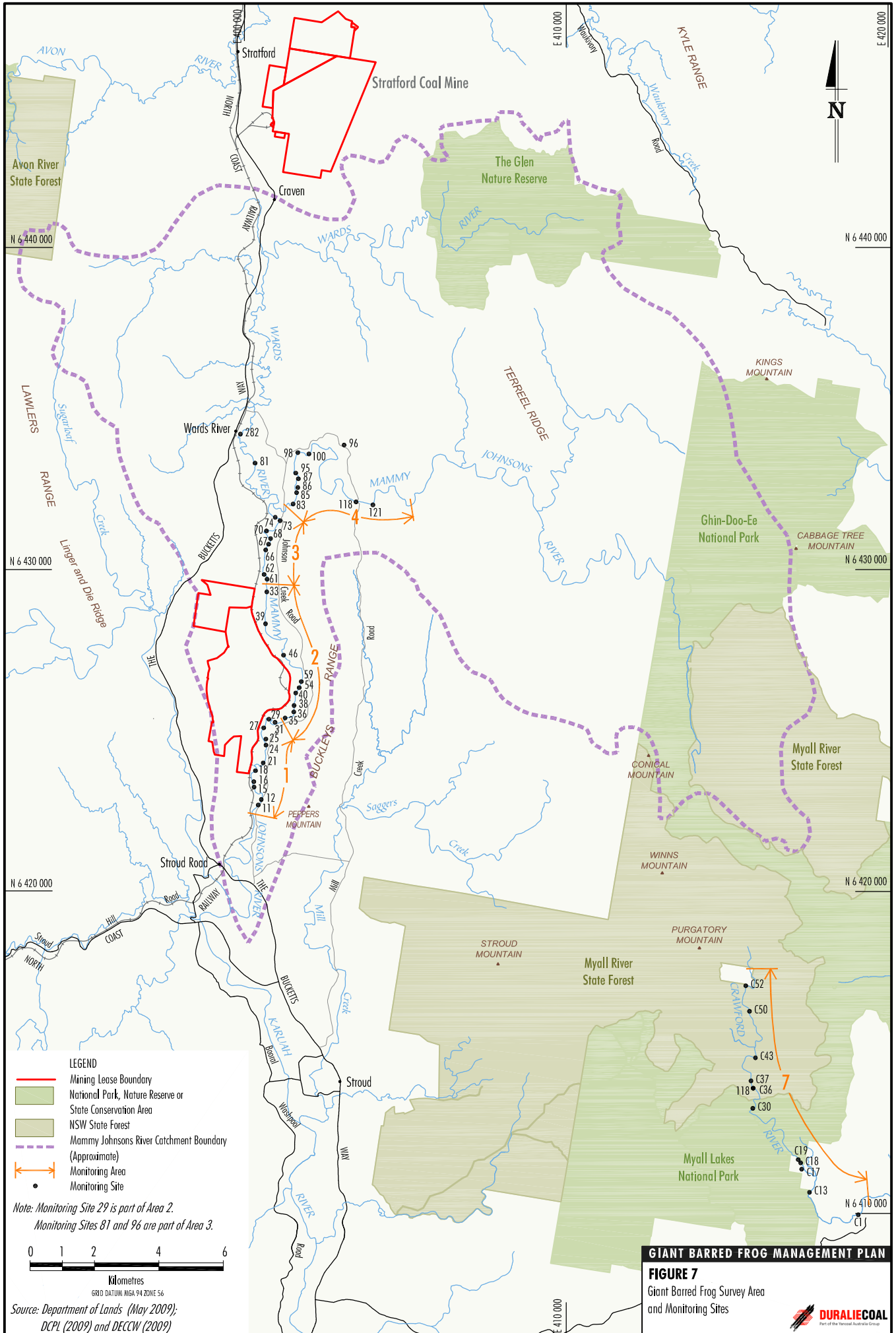
### 7.1 SURVEY AREAS AND MONITORING SITES

Survey areas and monitoring sites are listed in **Tables 3 and 5** and shown on Figure 7.

**Table 5**  
**Giant Barred Frog Survey Area and Monitoring Sites**

Survey Area*	Location	Number of Monitoring Sites (Figure 7)	Survey Area Type	Frequency
1	Located on the Mammy Johnsons River, downstream of the confluence with Coal Shaft Creek (i.e. downstream of the Duralie Coal Mine).	10 (11, 12, 15, 16, 18, 21, 24, 25, 27, 31)	Potential impact survey area.	4 nights on 4 occasions during the breeding season (October to March)
2	Located on the Mammy Johnsons River, upstream of the confluence with Coal Shaft Creek and downstream of an unnamed minor tributary.	10 (29, 33, 35, 36, 38, 39, 40, 46, 54, 59)	Potential impact survey area.	4 nights on 4 occasions during the breeding season (October to March)
3	Located on the Mammy Johnsons River, upstream of the unnamed minor tributary to the confluence with Wards River.	10 (61, 62, 66, 67, 68, 70, 73, 74, 81, 96)	Upstream 'control' survey area.	3 nights on 4 occasions during the breeding season (October to March)
4	Located on the Mammy Johnsons River, upstream of the confluence with Wards River.	10 (282, 83, 85, 86, 87, 95, 98, 100, 118, 121)	Upstream 'control' survey area.	3 nights on 4 occasions during the breeding season (October to March)
7	Located on the Crawford River, outside of the Mammy Johnsons River Catchment.	10 (C1, C13, C17, C18, C19, C30, C36, C37, C50, C52)	Survey Area 7 was established to provide comparative data to authenticate (or disprove) climatic impacts on frog populations.	3 nights on 4 occasions during the breeding season (October to March)

\* Following a review of the Giant Barred Frog monitoring programme in 2013, Dr Arthur White (Biosphere Environmental Consultants) and Ian Lenane (statistician at Gilbert & Associates) concluded that Study Areas 5, 6 and 8 do not warrant further monitoring. A comparatively low number of Giant Barred Frogs have been recorded in these Study Areas and data from Study Area 6 would not be able to be statistically analysed in the way that was originally intended (i.e. to be able to measure and attribute the impact of agriculture to any changes in Giant Barred Frog numbers).



**LEGEND**

- Mining Lease Boundary
- National Park, Nature Reserve or State Conservation Area
- NSW State Forest
- Mummy Johnsons River Catchment Boundary (Approximate)
- ⇄ Monitoring Area
- Monitoring Site

Note: Monitoring Site 29 is part of Area 2.  
Monitoring Sites 81 and 96 are part of Area 3.



GRID DATUM NGA 94 ZONE 56  
Source: Department of Lands (May 2009);  
DCPL (2009) and DECCW (2009)

**GIANT BARRED FROG MANAGEMENT PLAN**  
**FIGURE 7**  
Giant Barred Frog Survey Area and Monitoring Sites



## 7.2 SURVEY TIMING AND FREQUENCY

The Giant Barred Frog monitoring programme will begin in the breeding season following commencement of the irrigation activities within the DEP irrigation areas.

Survey Areas 1 and 2 (potential impact survey areas) will be monitored over four nights on four occasions during the breeding season (October to March) (Table 5). Survey Areas 3, 4 and 7 will be monitored over three nights on four occasions during the breeding season (October to March) (Table 5).

Where practicable, the surveys will not be conducted during periods of heavy rainfall or significant stream flow. Weather conditions will be recorded prior to and during the surveys as described in Section 7.5.

## 7.3 SURVEY METHODS

The survey methods that will be used for the Giant Barred Frog monitoring program are consistent with the Department of the Environment, Water, Heritage and the Arts (2010) *Survey Guidelines for Australia's Threatened Frogs* and Department of Environment and Climate Change (2009) *Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna-Amphibians*. The monitoring program will include nocturnal frog surveys and diurnal tadpole surveys as described below.

Personnel conducting amphibian surveys on behalf of DCPL or personnel undertaking any other work within known Giant Barred Frog habitat and where there is potential for transport of Chytrid Fungus will observe appropriate hygiene protocols in accordance with the NPWS (2008) *Hygiene Protocols for the Control of Disease in Frogs* and Department of Environment and Heritage (2006) *Threat Abatement Plan for infection of amphibians with chytrid fungus resulting in chytridomycosis*.

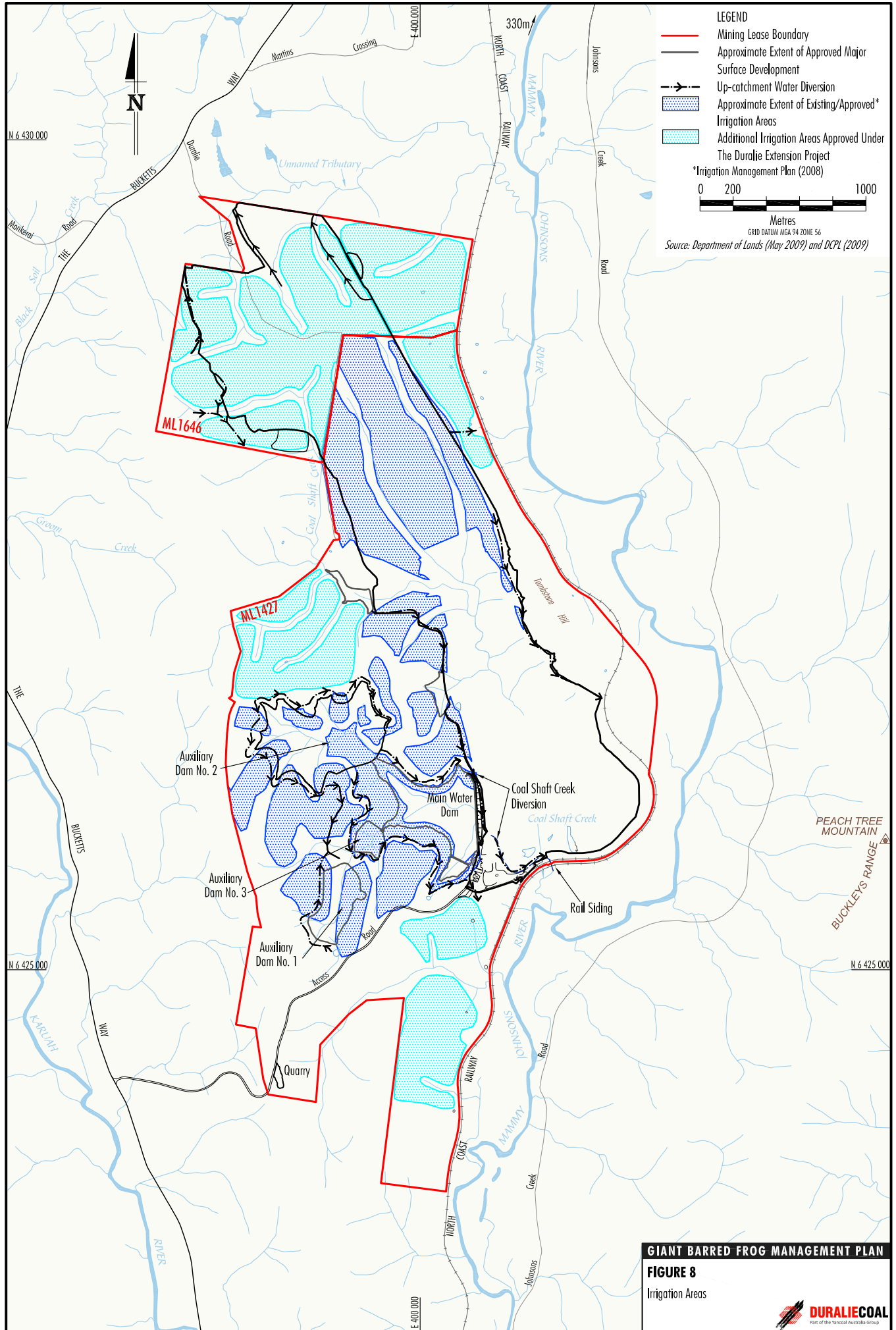
### **Nocturnal Frog Surveys**

A 200 m transect will be used to monitor the Giant Barred Frog monitoring sites. Each 200 m stream bank transect will be surveyed by two personnel. The survey will include 30 minutes per 200 m length (i.e. the total search time per site will be 1 person hour).

Upon arrival at each transect, the surveyors will listen for three minutes and record all calling frogs. The surveyors will then move slowly through the transect area using headlamps to detect calling and non-calling Giant Barred Frogs. Call imitation will be used at the start, near the middle and at the end of each transect to try to elicit calling by male Giant Barred Frogs.

Any Giant Barred Frogs detected will be caught if possible. Captured frogs will be:

- sexed (i.e. male or female);
- if female, examined to determine if the frog is gravid;
- classified as adult, sub-adult or juvenile;



- weighed (using spring balances);
- measured for snout-vent length (using dial callipers) and classified using a growth index, as described in Tables 6 and 7;
- micro-chipped<sup>6</sup>;
- visually inspected for signs of injury or disease;
- swabbed for Chytrid testing; and
- released at the site of capture.

**Table 6**  
**Growth Index for Giant Barred Frog Tadpoles**

Growth Index Category	Growth Stages	External Features	Age (Approximate Only)
A	1-23	Cornea transparent; external gills present	1-10 days
B	24-25	Cornea pigmented, no limb buds	10-20 days
C	26-42	Hind limbs present	20-120 days
D	43-46	Fore limbs present	80-300 days

**Table 7**  
**Growth Index for Giant Barred Frog Juveniles and Adults**

Growth Index Category	Snout-Vent Length Ranges (cm)
E	3-5
F	>5-7
G	>7-9
H	>9

Observations of behaviours including amplexus, oviposition and egg masses will also be noted.

In addition, each survey will record an estimate of the number of calling males at each site (both banks).

Other species of non-target riparian frogs will also be recorded including an estimate of the number of individuals of each species.

Each site will be surveyed over three nights (during the same survey period).

### ***Diurnal Tadpole Surveys***

Diurnal tadpole surveys will also be undertaken at each Giant Barred Frog monitoring site. Ten sweeps using a long-handled net on one occasion during the survey period will be used to sample the water along the stream bank for tadpoles.

<sup>6</sup> Only individuals classified as adults or sub-adults will be micro-chipped.

Tadpoles caught in the sweeps will be:

- measured for snout-vent length (using dial callipers);
- classified using a growth index (as described in Tables 6 and 7);
- visually inspected for external signs of injury (e.g. from fish or bird attack); and
- inspected using a magnifying glass to assess the condition of their buccal disc and denticles, including the possible early stages of Chytrid infection.

All tadpoles will be released at the site of capture.

During the diurnal tadpole surveys, observations of behaviours including amplexus, oviposition and egg masses will also be noted.

#### **7.4 CONDITION OF THE GIANT BARRED FROG HABITAT**

Habitat attributes recorded at each Giant Barred Frog monitoring site will include stream characteristics (e.g. stream width, stream depth, flow rate, the presence of pools and riffles), water quality observations (e.g. clarity and presence of algae), stream bank characteristics (e.g. profile, composition, vegetation cover and litter depth) and potential impacts (e.g. siltation/clearing, pollution sources and introduced species).

The Giant Barred Frog monitoring program will use the habitat assessment results compiled to date to assess changes in habitat at each site at the time of the surveys. Where a habitat assessment has not been completed for a particular site, a habitat assessment will be conducted.

#### **7.5 HYDROLOGICAL CONDITIONS**

The hydrological conditions of the Mammy Johnsons River will be documented prior to and during the Giant Barred Frog monitoring surveys<sup>7</sup>. In summary, this will include:

- rainfall, maximum and minimum temperature and relative humidity data obtained from the on-site weather stations located at the DCM and Stratford Coal Mine (SCM);
- a description of the weather and stream flow conditions experienced during each survey;
- stream flow monitoring data from Gauging Station 209002 and at the 'High Noon' site on the Mammy Johnsons River;
- surface water quality data for the Mammy Johnsons River, Karuah River, Coal Shaft Creek and other tributaries of the Mammy Johnsons River including data from continuous EC sensors/loggers on Mammy Johnsons River and on tributaries of the Mammy Johnsons River;
- the measurement of turbidity, dissolved oxygen content, percent oxygen saturation, oxidation-reduction potential, pH, salinity, conductivity and water temperature at the Giant Barred Frog monitoring sites using a Yeo-Kal portable water meter during the conduct of the tadpole surveys; and
- the measurement of water temperature during the conduct of the nocturnal Giant Barred Frog monitoring surveys.

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<sup>7</sup> A report outlining the results of the surveys (including hydrological conditions of the Mammy Johnsons River of relevance to the Giant Barred Frog) will be provided to the OEH and Department of Planning and Infrastructure by July 2012.

## 8 ASSESSMENT OF PERFORMANCE INDICATORS AND MEASURES

In accordance with Conditions 32(f) and 32(d), Schedule 3 of PA 08\_0203 and Conditions 8 (c) and (d) of EPBC 2010/5396, DCPL has:

- developed performance indicators (triggers) to monitor the potential impact of rainfall runoff from the DEP irrigation areas (following commencement of irrigation) on the local frog population; and
- established performance measures to evaluate the impact of rainfall runoff from the DEP irrigation areas (following commencement of irrigation) on the local Giant Barred Frog population.

DCPL will assess the use of irrigation and management of rainfall runoff associated with the DEP irrigation areas against the Giant Barred Frog performance indicators and measures outlined in **Table 8**.

**Table 8**  
**Summary of Project Giant Barred Frog Performance Indicators and Measures**

Project Performance Measure	Project Performance Indicators <sup>3, 4</sup>
The Project will have no more than a negligible <sup>1</sup> impact on the local Giant Barred Frog population <sup>2</sup> .	<p><i>Negligible change in the sub-population of the Giant Barred Frog downstream of the irrigation rainfall runoff areas following the commencement of the expanded irrigation when compared to sub-populations recorded in areas not subject to irrigation rainfall runoff.</i></p> <p><i>The sub-population of the Giant Barred Frog downstream of the irrigation rainfall runoff areas following commencement of the expanded irrigation activities is similar to the age class structure and population profile, or has enhanced proportions of sub-adult and young adult frogs present (i.e. the sub-population is not becoming senescent) prior to the commencement of the expanded irrigation activities.</i></p> <p><i>Juvenile and sub-adult recruitment rates are similar or are improved for the sub-population of the Giant Barred Frog downstream of the irrigation rainfall runoff areas following the commencement of expanded irrigation activities.</i></p>

<sup>1</sup> The term 'negligible' is defined in PA 08\_0203 as *small and unimportant, such as to be not worth considering*.

<sup>2</sup> This performance measure is consistent with the requirement of Condition 30, Schedule 3 of PA 08\_0203.

<sup>3</sup> The 'irrigation rainfall runoff areas' are represented by sites on the Mammy Johnsons River that are situated downstream of locations at which rainfall runoff from the mine's irrigation areas enters the Mammy Johnsons River (i.e. sites downstream of the Mammy Johnsons River - Coal Shaft Creek confluence, and as mining develops, at sites downstream of the Mammy Johnsons River - unnamed tributary confluence, Figure 8).

<sup>4</sup> The 'expanded irrigation' means the expansion of mine water irrigation associated with the Duralie Extension Project (i.e. the commencement of irrigation in areas that are additional to those approved at the Duralie Coal Mine prior to the receipt of the Duralie Extension Project approval).

As described in Section 7, monitoring of the Giant Barred Frog population will be conducted to monitor the potential impact of the DEP irrigation areas on the Giant Barred Frog population and whether a greater than negligible impact on the Giant Barred Frog population has occurred as a result of rainfall runoff from these irrigation areas.

The monitoring results will be used to assess the DEP against the performance indicators and performance measures detailed in **Table 9**. If data analysis indicates a performance indicator has exceeded a trigger level, an assessment will be made against the performance measure. If the Giant Barred Frog performance measure is considered to have been exceeded, the Contingency Plan will be implemented (Section 10). DCPL will implement suitable contingency measures (Section 10) and continue to monitor (Section 7). If data analysis indicates that the performance measure has not been exceeded, DCPL will review the monitoring requirements.



**Table 9  
Performance Indicators and Measures**

Performance Measure	Environmental Monitoring			Data Analysis to Assess against Performance Indicator(s)	Performance Indicator(s)	Trigger Level (Performance Indicator Exceedance)	Assessment of Performance Measure	Relevant Management and Contingency Measures	
	Sites	Parameters	Frequency						
<p><b>No more than a negligible impact on the local Giant Barred Frog population associated with rainfall run-off from Duralie Extension Project irrigation areas.</b></p>	<ul style="list-style-type: none"> <li>Sites on the Mammy Johnsons River, downstream of the Coal Shaft Creek – Mammy Johnsons River confluence (i.e. downstream of the Duralie Extension Project southern irrigation areas – Survey Area 1).</li> <li>Sites on the Mammy Johnsons River, upstream of the confluence with Coal Shaft Creek and downstream of the confluence with the unnamed tributary (i.e. downstream of the Duralie Extension Project northern irrigation areas – Survey Area 2).</li> </ul>	<ul style="list-style-type: none"> <li>Mark-recapture (i.e. micro-chip) data, along 200 m transects.</li> </ul>	<ul style="list-style-type: none"> <li>Nocturnal frog surveys - each site surveyed over three nights during the same survey period. Four sampling periods within the period September to March.</li> </ul>	<ul style="list-style-type: none"> <li>Use of population techniques to estimate the size of the Giant Barred Frog population (e.g. the model POPAN in the program MARK, Lincoln-Peterson Index or other suitable estimation technique)</li> </ul>	<ul style="list-style-type: none"> <li>20% decline (accounting for natural variation) in the sub-population of the Giant Barred Frog downstream of the irrigation rainfall runoff areas following the commencement of the Duralie Extension Project expanded irrigation when compared statistically to the baseline data for these sub-populations and control site sub-populations (i.e. in areas not subject to irrigation rainfall runoff).</li> </ul>	<ul style="list-style-type: none"> <li>This performance indicator will be considered to have been exceeded if data analysis indicates a greater than 20% decline (accounting for natural variation) in the Giant Barred Frog sub-population downstream of the confluence of Mammy Johnsons River and Coal Shaft Creek (and adjacent riparian areas), when compared statistically to the baseline data for these sub-populations and control site sub-populations (i.e. in areas not subject to irrigation rainfall runoff).</li> <li>If data analysis indicates the performance indicator has been exceeded, an assessment will be made against the performance measure.</li> </ul>	<ul style="list-style-type: none"> <li>The performance measure, <i>the Project will have no more than a negligible impact on the local Giant Barred Frog population</i>, will be assessed by considering the changes in the Giant Barred Frog sub-populations.</li> </ul> <p>Key assessment considerations in determining whether the Project has had a greater than negligible impact on the local Giant Barred Frog population will include:</p> <ul style="list-style-type: none"> <li>whether the change is due to the monitoring results obtained at one site or a number of sites, and the potential influence of the mine's irrigation activities on these sites;</li> <li>whether the change is consistent across all sampling sites or limited to sites upstream or downstream of Project irrigation activities;</li> <li>a review of electrical conductivity data including upstream and downstream of Project irrigation activities;</li> <li>a review of the site irrigation activities undertaken;</li> <li>consideration of the meteorological conditions prevailing and preceding the monitoring surveys; and</li> <li>consideration of other significant events that may have an influence on the Giant Barred Frog population (e.g. agricultural activities).</li> </ul> <ul style="list-style-type: none"> <li>The performance measure will be considered to have been exceeded if analysis of the monitoring results indicates that the Project has resulted in a greater than negligible impact on the local Giant Barred Frog population.</li> <li>The results will be reported to the OEH and DP&amp;I.</li> <li>If the performance measure has been exceeded, the Contingency Plan will be implemented (Section 10).</li> </ul>	<ul style="list-style-type: none"> <li>Additional monitoring (e.g. increase in monitoring frequency or additional sampling) and statistical analysis (where required) to confirm an exceedance of the performance indicator and that it is associated with rainfall run-off from the Duralie Extension Project irrigation areas.</li> <li>Adaptive management – modification of irrigation management and/or first flush irrigation water salinity levels.</li> <li>Investigation of offsets.</li> </ul>	
		<ul style="list-style-type: none"> <li>Snout-vent length measurements of captured frogs (using dial callipers).</li> </ul>	<ul style="list-style-type: none"> <li>Nocturnal frog surveys - each site surveyed over three nights during the same survey period. Four sampling periods within the period September to March each year.</li> </ul>	<ul style="list-style-type: none"> <li>Analysis of the age structure of the Giant Barred Frog population using a growth index (described in Tables 6 and 7).</li> </ul>	<ul style="list-style-type: none"> <li>The sub-population age class structure of the Giant Barred Frog downstream of the Duralie Extension Project irrigation rainfall runoff areas following commencement of the expanded irrigation activities in these areas is statistically similar to the age class structure and population profile, or has enhanced proportions of sub-adult and young adult frogs present (i.e. the sub-population is not becoming senescent), prior to the commencement of the expanded irrigation activities.</li> </ul>				<ul style="list-style-type: none"> <li>This indicator will be considered to have been exceeded if data analysis over two consecutive survey seasons indicates the sub-population of the Giant Barred Frog is not statistically similar (within 20%) to the age class structure and population profile, or has reduced proportions of sub-adult and young adult frogs present (i.e. the sub-population appears to be becoming senescent) after the commencement of the expanded irrigation activities.</li> <li>If data analysis indicates the performance indicator has been exceeded, an assessment will be made against the performance measure.</li> </ul>
		<ul style="list-style-type: none"> <li>Classification of captured frogs as adult, sub-adult or juvenile.</li> </ul>	<ul style="list-style-type: none"> <li>Nocturnal frog surveys - each site surveyed over three nights during the same survey period. Four sampling periods within the period September to March each year.</li> </ul>	<ul style="list-style-type: none"> <li>Analysis of the occurrence of adults, sub-adults and juveniles in the Giant Barred Frog population.</li> </ul>	<ul style="list-style-type: none"> <li>Juvenile and sub-adult recruitment rates are statistically similar or are improved for the sub-population of the Giant Barred Frog downstream of the Duralie Extension Project irrigation rainfall runoff areas following the commencement of expanded irrigation activities in these areas.</li> </ul>				<ul style="list-style-type: none"> <li>This indicator will be considered to have been exceeded if data analysis over two consecutive survey seasons indicates a statistically significant reduction (20%) in juvenile and sub-adult recruitment rates for the sub-population of the Giant Barred Frog downstream of the irrigation rainfall runoff areas following the commencement of expanded irrigation activities.</li> <li>If data analysis indicates the performance indicator has been exceeded, an assessment will be made against the performance measure.</li> </ul>

## **9 MANAGEMENT MEASURES**

### **9.1 MAMMY JOHNSONS RIVER WATER QUALITY**

Water quality data obtained to date shows that the irrigation of areas approved under DA 168/99 is not resulting in an increase in downstream salinity concentrations (i.e. electrical conductivity concentrations) in Coal Shaft Creek or the Mammy Johnsons River, nor deterioration in water quality in either waterway.

Notwithstanding, potential future expansion of irrigation into the DEP irrigation areas has the potential to result in an increase in salinity concentrations in the Mammy Johnsons River (via re-mobilisation of irrigated solutes in rainfall runoff).

#### **9.1.1 Site Water Management**

Water stored on-site includes groundwater inflows to the open pit and incident rainfall and runoff from mine disturbance areas. Water from sumps in the open pit is pumped to the Main Water Dam (Figure 6b). This dam and others (Auxiliary Dam No. 1 and Auxiliary Dam No. 2) are also used to store water collected from selected sediment dams and runoff from the main infrastructure area.

Dust suppression represents the only significant water requirement at the DCM, and as a result the water balance at the mine is generally in surplus. As a result, the water management system includes disposal of excess water through on-site irrigation.

#### **9.1.2 Irrigation System**

##### ***Monitoring of Soil Moisture Levels***

The DCM WMP includes the implementation of a soil moisture deficit strategy to manage the application of irrigation water such that no more water is applied than the soil can absorb. Day-to-day irrigation management is based on prevailing moisture levels within soils in areas under irrigation.

Soil moisture levels are determined from the use of soil moisture data loggers. Irrigation is not undertaken during rainfall or when soil moisture levels are above the required soil moisture range. Irrigation is managed so that the irrigation water percolates throughout the soil profile rather than running off. Runoff from the irrigation areas only occurs with rainfall events.

##### ***First Flush Protocol***

The DCM WMP includes a first flush protocol. The first flush protocol is designed to collect initial (or “first flush”) rainfall runoff from irrigation areas for the purpose of capturing runoff with potentially elevated salinity levels.

During rainfall events, irrigation area runoff is collected (via diversion drains). Continuous EC loggers located in the diversion drains monitor the salinity of runoff from the irrigation area. When the salinity levels of the irrigation area runoff exceed the first flush protocol trigger levels, automatic valves are opened which diverts the irrigation area runoff to the Main Water Dam or other relevant storage (i.e. it is not released into Coal Shaft Creek, unnamed tributary or the Mammy Johnsons River).

### ***Irrigation Management***

The monitoring and management of irrigation areas is described in the Irrigation Management Plan (IMP) contained within the WMP. Existing irrigation management measures include soil moisture monitoring and implementation of the first flush protocol, with operational augmentations as required.

### ***Monitoring and Management***

Surface water quality will be monitored in the Mammy Johnsons River, Coal Shaft Creek and other tributaries of the Mammy Johnsons River (Figures 6a and 6b). The monitoring program includes continuous EC sensors/loggers on Mammy Johnsons River and on tributaries of the Mammy Johnsons River. Details of the surface water quality monitoring program and water quality parameters is provided in the WMP.

As described in Section 10, contingency measures include a reduction in the EC triggers for rainfall runoff from the DEP irrigation areas into the Mammy Johnsons River.

#### **9.1.3 Mine Water Voids**

At the cessation of mining, final voids will remain in the Clareval North West open pit and Weismantel Extension open pit. Post-mining inflows to the Clareval North West and Weismantel Extension final voids will comprise incident rainfall, runoff and seepage from the sides of the voids and their adjacent contributing catchment, seepage from coal seam groundwater and waste rock emplacement infiltration. Water will be lost from the voids through evaporation. The surface catchment of the final voids will be reduced to a practicable minimum by maximising backfilling to the natural surface and the use of upslope diversions and contour drains around their perimeter.

A final void water balance has been prepared for the end of the mine life and is provided in Gilbert & Associates (2010) water balance assessment and further work in the DEP Environmental Assessment (2014). The final voids will not overflow to downstream watercourses (Gilbert & Associates, 2010). Mine water void management is described further in the Duralie Coal Mine Water Management Plan

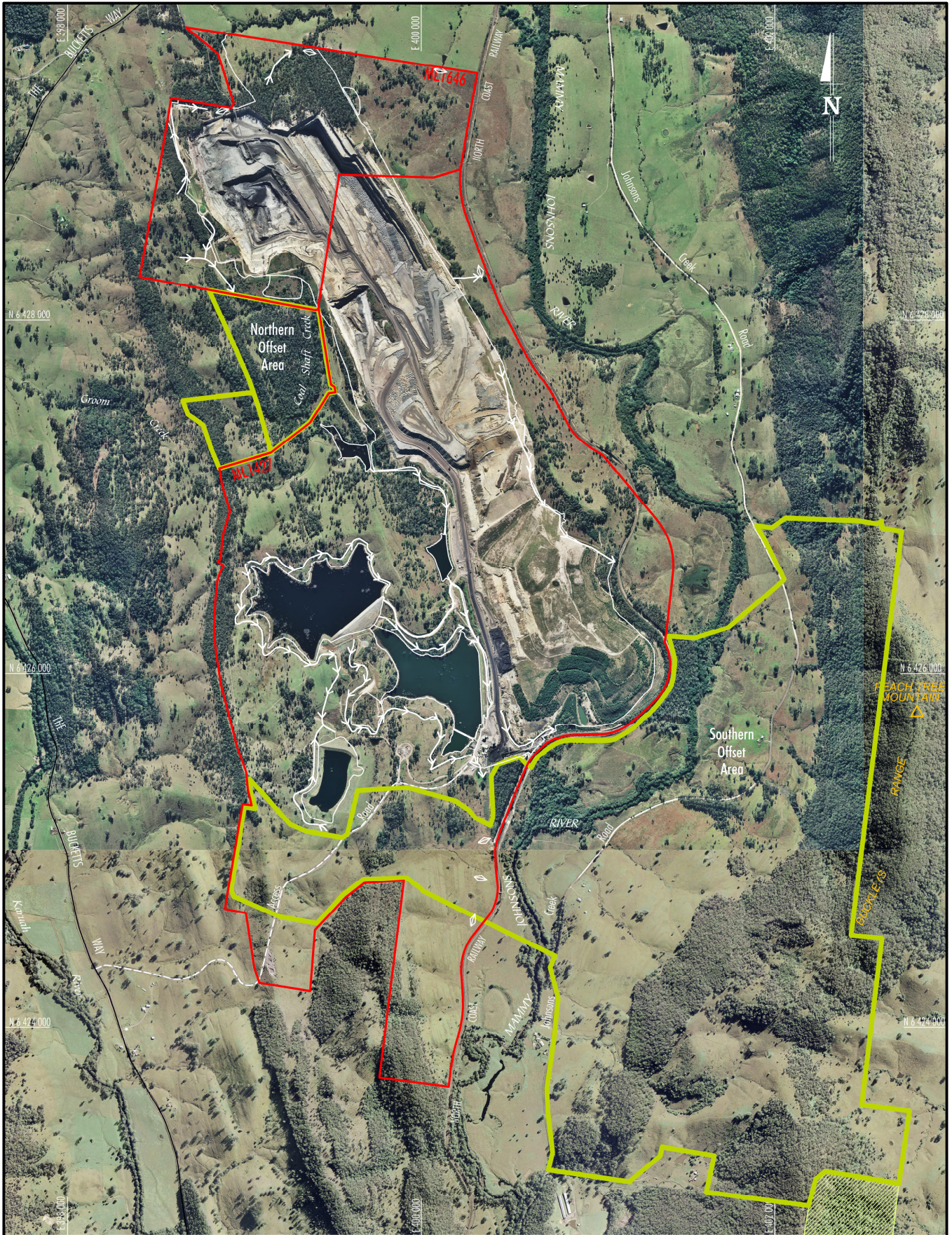
#### **9.1.4 Groundwater Seepage**

DCPL are going to investigate seepage as required under Schedule 3, Condition 29 (c) of PA08\_0203. Further details are included and explained in the WMP, primarily within the Groundwater Management Plan (GWMP).

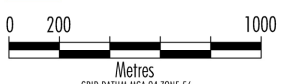
### **9.2 OFFSET STRATEGY**

In accordance with DCPL's commitments in the Duralie Extension Project Environmental Assessment (EA) (DCPL, 2010), Conditions 33 to 39, Schedule 3 of PA 08\_0203 and Conditions 13 to 16 of EPBC 2010/5396, an Offset Strategy has been implemented for the Project. The management of the Offset areas (Figure 9) is described within the Duralie Coal Mine Biodiversity Management Plan (BMP).





- LEGEND**
- Mining Lease Boundary
  - Approximate Extent of Project Major Surface Development
  - Land Under Existing Conservation Agreement
  - Offset Areas



Source: AAHatch - Aerial Photography flown April 2009 and June 2014; DCP (2009) and Cenwest Environmental Services & Resource Strategies (2009)

**GIANT BARRED FROG MANAGEMENT PLAN**

**FIGURE 9**

Location of the Offset Areas





### **9.3 WEED CONTROL**

Weed species are effective competitors for resources and have the potential to invade the habitat of the Giant Barred Frog.

Weed management measures to be implemented for the Project are described in the BMP.

Weed control measures will be implemented by DCPL within the mining lease and Offset area to limit the spread and colonisation of weeds, including:

- identification of weeds via regular site inspections and communication with leasees and regulatory authorities;
- irrigation areas will be managed such that a vegetation cover is maintained as much as possible to suppress the establishment of weeds;
- mechanical removal of identified weeds and/or the application of approved herbicides in authorised areas;
- control of noxious weeds in accordance with their DTIRIS control class;
- follow-up inspections to assess the effectiveness of the weed management measures implemented and the requirement for any additional management measures; and
- minimisation of seed transport from the site through the use of the site's vehicle wash bay.

With regards to weed management measures, physical removal and chemical application are the main weed control methods available. Due to the potential adverse impacts of herbicides on amphibians, weed control methods implemented at the mine will be restricted to mechanical removal and/or "environmentally friendly" products.

In areas in and immediately adjacent to the Mammy Johnsons River, a herbicide registered for use in aquatic situations by the National Registration Authority will be used for the control of weeds where physical control methods are not suitable. The National Registration Authority registration is indicated on the label of the herbicide.

The implementation of alternate measures that favour the restoration of healthy native vegetation is also considered an effective method of weed management. The use of mechanical slashers and other such machinery may be used to control weeds in an effective manner, and the use of such machinery available to DCM now and in the future shall be assessed on a case by case basis appropriate to the area in question in consultation with Dr White (or a suitably qualified person).

Other methods of weed control which may be utilised by the mine in appropriate areas in consultation with Dr White (or a suitable qualified person), may include activities such as crash/pulse grazing and the use of fire for burning off areas of vegetation and areas which are heavily infested by weeds.

Weed management activities are reported in the Annual Review (Section 11).

### **9.4 PEST CONTROL**

Some animal pests have the potential to impact on the habitat of the Giant Barred Frog or through predation. Pest management measures to be implemented for the Project will be described in the BMP.

Pest control measures will be implemented by DCPL within the mining lease and Offset area to minimise impacts of pest species, including:

- regular property inspections to assess the status of pest populations;
- implementation of pest control measures as required (e.g. the destruction of rabbit burrows, baiting of foxes, trapping of feral cats);
- follow-up inspections following the conduct of pest control measures to assess the effectiveness of the control measures and the requirement for any additional control measures; and
- maintenance of a clean, rubbish-free environment, in order to discourage scavenging and reduce the potential for colonisation of areas by non-endemic fauna.

Pest management activities are reported in the Annual Review (Section 11).

## 9.5 BUSHFIRE MANAGEMENT

Bushfire has the potential to impact on streamside habitats of the Giant Barred Frog, including the availability of moist leaf-litter.

Bushfire management measures to be implemented for the Project will be described in the BMP.

In the case of a bushfire incident, the RFS will be called upon as the primary response unit to contain, fight and manage bushfires. DCM personnel may provide secondary support roles, services and equipment where requested by the RFS and where practical as approved by the sites Operations Manager.

To reduce the risk of bushfire, management measures at the DCM will include:

- Controlled grazing – cattle will be grazed on portions of ML1427 and ML1646 upon which active mining operations are not occurring and appropriate fencing is available. Sustainable stocking levels result in minimal pasture presence and hence low residual fuel loads.
- Hazard reduction burns of vegetation (including weeds) or mechanical slashing in areas where controlled grazing is not possible or appropriate and fuel loads are high, hazard reduction burns may be undertaken.
- Fire fighting equipment – In the case of a bushfire incident, the RFS will be called upon as the primary response unit to contain, fight and manage bushfires. The Rural Fire Service, if required, may be assisted by mine personnel and mine resources on the approval of the mines Operation Manager.
- DCPL personnel will assist the NSW RFS with providing access as required to fight fires on the Mining Lease, Biodiversity Offset Area and mine owned property.
- Access tracks/firebreaks are to be maintained to ensure free access at all times.

## 9.6 HYGIENE PROTOCOLS

Infection of frogs by amphibian chytrid causing the disease Chytridiomycosis is listed as a key threatening process under the NSW *Threatened Species Conservation Act, 1995* and EPBC Act. A water-borne fungal pathogen *Batrachochytrium dendrobatidis*, commonly known as the amphibian or frog Chytrid fungus, is responsible for the disease Chytridiomycosis (Berger *et al.*, 1999). Chytridiomycosis has been detected in over 40 species of native amphibian in Australia (Mahony and Werkman, 2000 in NPWS, 2008).

Infection occurs through water-borne zoospores released from an infected amphibian in water (NPWS, 2008). Collection and handling of frogs and inadvertent transport of infected material between frog habitats may also promote the disease's spread (NSW Scientific Committee, 2003).

Personnel conducting amphibian surveys for DCPL or personnel undertaking any other work within known Giant Barred Frog habitat and where there is potential for transport of Chytrid Fungus will be required to observe the following hygiene protocols in accordance with the *Hygiene Protocols for the Control of Disease in Frogs* (NPWS, 2008):

- thorough cleaning and disinfecting of footwear;
- thorough cleaning and disinfecting of equipment (such as nets, callipers, headlamps and waders);
- wearing new disposable gloves (wetted previously) when handling every frog; and
- where necessary, cleaning of vehicle tyres in high-risk areas.

All personnel will be trained in site hygiene management prior to working in areas of known Giant Barred Frog habitat.

### 9.7 PROTOCOL FOR SICK OR DEAD FROGS

As described in Section 7, the Giant Barred Frog monitoring program will be conducted by a qualified ecologist.

Table 10 details the range of symptoms that may be exhibited by sick or dying frogs, while Table 11 provides diagnostic behaviour tests which can be used to determine if a frog is sick (NPWS, 2008).

**Table 10**  
**Symptoms of Sick and Dying Frogs**

Appearance	Behaviour
<ul style="list-style-type: none"> <li>• Darker or blotchy upper (dorsal) surface.</li> <li>• Reddish/pink-tinged lower (ventral) surface and/or legs and/or webbing or toes.</li> <li>• Swollen hind limbs.</li> <li>• Very thin or emaciated.</li> <li>• Skin lesions (sores, lumps).</li> <li>• Infected eyes.</li> <li>• Obvious asymmetric appearance.</li> </ul>	<ul style="list-style-type: none"> <li>• Lethargic limb movements, especially hind limbs.</li> <li>• Abnormal behaviour (e.g.. a nocturnal burrowing frog sitting in the open during the day and making no vigorous attempt to escape when approached).</li> <li>• Little or no movement when touched.</li> </ul>

**Table 11**  
**Diagnostic Behaviour Tests**

Sick frogs will fail one or more of the following tests:		
Test	Healthy	Sick
<ul style="list-style-type: none"> <li>• Gently touch with finger.</li> <li>• Turn frog on its back.</li> <li>• Hold frog gently by its mouth.</li> </ul>	<ul style="list-style-type: none"> <li>• Frog will blink.</li> <li>• Frog will flip back over.</li> <li>• Frog will use its forelimbs to try to remove grip.</li> </ul>	<ul style="list-style-type: none"> <li>• Frog will not blink above the eye.</li> <li>• Frog will remain on its back.</li> <li>• No response from frog.</li> </ul>

In the event a frog appears to be sick or dead, the guidelines contained in NPWS (2008) *Hygiene Protocols for the Control of Disease in Frogs* (NPWS, 2008) will be followed. In summary:

- Disposable gloves will be worn when handling sick or dead frogs. (When gloves are unavailable an instrument can be used to transfer the frog to a container rather than using bare hands.)
- To prevent cross-contamination, new gloves and a clean plastic bag will be used for each frog specimen.



- Frogs considered unlikely to survive transportation (i.e. death appears imminent) will be euthanased. Dead frogs will be kept cool and preserved as soon as possible.
- The recipient of the sick or dead frog will be contacted to confirm the appropriate procedure prior to transport.
- Containers will be labelled and will provide the following details: date, location and species (if known).
- A standardised collection form will be filled out and a copy sent with the specimen.
- Individual containers will be used for each specimen.

## 10 CONTINGENCY PLAN

In the event the Giant Barred Frog performance measure detailed in Section 8 is considered to have been exceeded, DCPL will implement the following Contingency Plan:

- The Environment and Community Manager (or delegate) will report the exceedance to the Operations Manager within 24 hours of assessment completion.
- DCPL will report the exceedance of the performance measure to the DP&E, DotE and OEH immediately after DCPL becomes aware of the exceedance.
- DCPL will identify an appropriate course of action with respect to the identified impact(s), in consultation with specialists and relevant agencies, as necessary. For example, identification of proposed contingency measure(s) and a program to review the effectiveness of the contingency measures. Contingency measures will be developed in consideration of the specific circumstances of the exceedance and the assessment of environmental consequences. Potential contingency measures are described in Section 10.1 below.
- DCPL will submit the proposed course of action to the DP&E and DotE for approval.
- DCPL will implement the approved course of action to the satisfaction of the DP&E and DotE.
- DCPL will report the exceedance of the Giant Barred Frog performance measure and the success of the approved course of action as a component of the Annual Review (Section 11).

Results from the aquatic ecology monitoring may be used to inform the likely cause of impacts on Giant Barred Frog.

### 10.1 POTENTIAL CONTINGENCY MEASURES

Potential contingency measures for an exceedance of the Giant Barred Frog performance measure include, but are not necessarily limited to:

- Temporary cessation of irrigation within the Duralie Extension Project irrigation areas.
- Alteration of soil moisture deficit triggers used in irrigation management.
- Modification of the first flush protocol used in irrigation management.
- Installation of additional water storage infrastructure.
- Treatment of Main Water Dam water used for irrigation, for example reverse osmosis treatment to reduce salinity.
- Provision of suitable offsets.

Prior to consideration or implementation of contingency measures additional monitoring (e.g. increase in monitoring frequency or additional sampling) and subsequent statistical analysis will be undertaken to:

- confirm the exceedance of the performance indicator;
- confirm the exceedance is the result of rainfall runoff from Duralie Extension Project irrigation areas; and
- inform development and implementation of the proposed contingency measure(s).

The potential contingency measures described above that are relevant to irrigation management and water quality, are consistent with those described in the WMP. The requirement for any contingency measures would be evaluated on a case-by-case basis considering any potential exceedance of the Giant Barred Frog performance measure and any potential exceedance of the water management or water resource performance measures described in the WMP.

The cause in Giant Barred Frog decline would determine the primary contingency measure to be implemented. Should any cause in decline be as a result of rainfall runoff from the DEP irrigation areas, remedial actions would be applied to alleviate that impact. The provision of offsets is considered a last resort and only as a result of permanent damage to frog habitat.

## **11 ANNUAL REVIEW AND IMPROVEMENT OF ENVIRONMENTAL PERFORMANCE**

In accordance with Condition 3, Schedule 5 of PA 08\_0203, DCPL will conduct an Annual Review of the environmental performance of the Duralie Coal Mine (including Duralie Extension Project) by the end of December 2011<sup>8</sup>, and annually thereafter.

The Annual Review will specifically address the environmental performance of the GBFMP and will:

- describe the development (including any rehabilitation) carried out in the past year, and the development proposed to be carried out over the next year;
- include a comprehensive review of the monitoring results and complaints records of the Project over the past year, including a comparison of these results against:
  - the relevant statutory requirements, limits or performance measures/criteria;
  - the monitoring results of previous years; and
  - the relevant predictions in the Project EA;
- identify any non-compliance over the past year, and describe what actions were (or are being) taken to ensure compliance;
- identify any trends in the monitoring data over the life of the Project;
- identify any discrepancies between the predicted and actual impacts of the Project, and analyse the potential cause of any significant discrepancies; and
- describe what measures will be implemented over the next year to improve the environmental performance of the Project.

As described in Section 12, the GBFMP will be reviewed within three months of the submission of an Annual Review, and revised where appropriate.

As described in Table 2 of Section 2.2 and in accordance with Condition 10 of EPBC 2010/5396, DCPL will provide a report to the DotE on the implementation of the GBFMP annually for the first five years (following commencement of irrigation activities within the Duralie Extension Project irrigation areas) and then every five years thereafter. Note that under Condition 8 and 9 of EPBC 2010/5396 the approved GBFMP is only required to be implemented following commencement of irrigation activities within the Duralie Extension Project irrigation areas.

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<sup>8</sup> The Duralie Coal Mine Annual Review (DCPL, 2011) was completed in September 2011. No changes to the current monitoring, management and mitigation measures for the Giant Barred Frog were proposed.

## **12 GBFMP REVIEW AND UPDATE**

In accordance with Condition 4, Schedule 5 of PA 08\_0203 this GBFMP will be reviewed, and if necessary revised, within three months of:

- (a) an Annual Review, in accordance with Condition 3, Schedule 5;
- (b) an incident report, in accordance with Condition 6, Schedule 5;
- (c) an audit, in accordance with Condition 8, Schedule 5; or
- (d) any modification to the conditions of approval.

The revision status of this GBFMP is indicated on the title page of each copy.

Any changes to the GBFMP will be approved by the Commonwealth Minister.

In accordance with Condition 10, Schedule 5 of PA 08\_0203 and Condition 9 of the EPBC 2010/5396, DCPL will make the GBFMP publicly available on the Duralie Coal website. A hard copy of the GBFMP will also be maintained at the Duralie Coal Mine.

## **13 REPORTING SYSTEMS**

In accordance with Condition 2 (g), Schedule 5 of PA 08\_0203, DCPL has developed protocols for managing and reporting the following:

- incidents;
- complaints;
- non-compliances with statutory requirements; and
- exceedances of the impact assessment criteria and/or performance criteria.

The management of incidents is described in the Pollution Incident Response Management Plan. The management of complaints and non-compliances is described in detail in the Environmental Management Strategy. The management of exceedances of performance criteria is described in Section 10.

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