LAND COURT OF QUEENSLAND

REGISTRY: BRISBANE
NUMBER: MRA428-14, EPA429-14
MRA430-14, EPA431-14
MRA432-14, EPA433-14

Applicant:	ADANI MINING PTY LTD
	AND
First Respondent:	LAND SERVICES OF COAST AND COUNTRY INC.
	AND
Second Respondent:	CONSERVATION ACTION TRUST
	AND
Statutory Party:	CHIEF EXECUTIVE, DEPARTMENT OF ENVIRONMENT AND HERITAGE PROTECTION

AFFIDAVIT OF BRUCE ALEXANDER WILSON

I, Bruce Alexander Wilson, Senior Ecologist, Eco Logical Australia Pty Ltd, Suite 1, Level 3, 471 Adelaide Street in the state of Queensland affirm as follows:

1 I am a senior ecologist employed by Eco Logical Australia and have been since 2013. I have over 25 years' experience in the management and delivery of major vegetation survey, mapping, monitoring and biodiversity assessment projects across Queensland and the Northern Territory.

2 I have been engaged by McCullough Robertson, on behalf of the Applicant, to appear as an expert witness in these proceedings in relation to issues raised in the objections to the Applicant's mining lease applications and environmental authority applications for the Carmichael Coal Mine project (**Objections**).

B Wilson

Deponent

Taken by:
Solicitor ~~/ Justice of the Peace~~

Affidavit
Filed on behalf of the Applicants
Form 46 R.431

McCullough Robertson Lawyers
Level 11 Central Plaza Two 66 Eagle Street
BRISBANE QLD 4000
Phone: (07) 3233 8888 Fax: (07) 3229 9949
GPO Box 1855, BRISBANE QLD 4001
Ref: CEM:PWS:159359-00022

3 My curriculum vitae is attached to the individual expert report referred to below. I refer to my curriculum vitae and say that I have provided expert evidence in relation to a number of matters of dispute relating to ecological matters and the clearing of regional ecosystems, wetlands, Threatened Ecological Communities and other biodiversity values. These include:

(a) expert witness for Environmental Protection Agency (Co-Respondent) in the Planning and Environment Court of Queensland, providing opinions on wetland delineation and definition at the site (*Titanium Enterprises Pty Ltd v Caloundra City Council & Anor* [2006] QPEC 106).

(b) investigations under the *Environmental Protection Act 1994* (Qld) by the *Department of Environment and Heritage Protection v Arrow Energy*, commencing in 2013 and in relation to the proceedings in the Mackay Magistrates Court.

(c) expert witness statements for prosecutions under the *Vegetation Management Act 1999* (Qld).

4 I have previously prepared a joint report with Dr Mike Olsen, dated 11 January 2015, in relation to issues relating to *Livistona lanuginosa* (**WCP Joint Report**).

5 I have also previously prepared a joint report with Dr Roderick Fensham, dated 15 January 2015, addressing issues relating to springs ecology (**Springs Ecology Joint Report**).

6 I have been further asked to prepare an individual report in relation to whether, in respect to springs ecology, and in respect to *Livistona lanuginosa*, good reason exists to favourably recommend the Application for this mining lease and any issues raised in the Objections within my field of expertise upon which there has not been agreement between experts (excluding in relation to black throated finch (southern) habitat, which will be the subject of a separate report). Exhibited to my Affidavit and marked '**BW-1**' is a true copy of my report to McCullough Robertson Lawyers dated 12 February 2015 (**Individual Report**).

Deponent

Taken by:
Solicitor ~~/ Justice of the Peace~~

7 Pursuant to rule 428(3) *Uniform Civil Procedure Rules 1999* (Qld), I confirm that:

(a) the factual matters stated by me in the WCP Joint Report, the Springs Ecology Joint Report and my Individual Report are, as far as I know, true;

(b) I have made all enquiries considered appropriate;

(c) I genuinely hold the opinions stated by me in the WCP Joint Report, the Springs Ecology Joint Report and in my Individual Report;

(d) my Individual Report contains reference to all matters that I considered significant; and

(e) I understand my duty to the court and I have complied with this duty.

8 Also exhibited to my Affidavit and marked '**BW-2**' is a true copy of a report prepared by me following a reconnaissance survey of the Carmichael Mine site and surrounding areas in November 2014, cited as Eco Logical Australia (2014) Waxy Cabbage Palm Survey: Upstream and downstream of the Carmichael Mine and referred to in section B of my Individual Report.

9 All the facts and circumstances deposed to in this affidavit are within my own knowledge except those stated to be on information and belief. I have, as required, set out the basis and source of my knowledge or information and belief.

All the facts affirmed in this affidavit are true to my knowledge and belief except as stated otherwise.

Affirmed by Bruce Wilson
at Brisbane
this 12th day of February 2015.

Before me:

~~A Justice of the Peace~~/Solicitor

LAND COURT OF QUEENSLAND

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CERTIFICATE OF EXHIBIT

Exhibit **BW-1** to the affidavit of Bruce Alexander Wilson affirmed 12th day of February 2015.

Signed:
Deponent

Taken by:
Solicitor / ~~Justice of the Peace~~ /
~~Commissioner for Declarations~~

Statement of Evidence

Springs Ecology

and

Livistona lanuginosa (Waxy Cabbage Palm)

Prepared for the Land Court of Queensland

Adani Mining Pty Ltd v Land Services of Coast and Country & Inc. & Anor

Prepared by
Bruce Wilson
Senior Ecologist
Eco Logical Australia Pty Ltd

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A Qualifications and Curriculum Vitae

I have a Bachelor of Science (Forestry) and Master of Science degrees.

I am currently a Senior Ecologist with the environmental consultancy firm Eco Logical Australia Pty Ltd (ELA). I have over 25 years' experience in the management and delivery of major vegetation survey, mapping, monitoring, research and assessment projects across Queensland and the Northern Territory. Before working for ELA I was the Science Leader at the Queensland Herbarium with responsibility for the delivery of a range of projects including the Regional Ecosystem, Wetland and Groundwater Dependent Ecosystem mapping.

My Curriculum Vitae is attached in **Appendix A** of this Statement.

B Material Relied on to Prepare this Statement

I have relied on the following information in preparing this statement

- CO_2 (2014) Biodiversity Offset Strategy, dated 29 October 2014 (**the Current BOS**).
- Coordinator-General of Queensland (2014) Carmichael Coal Mine and Rail Project. Coordinator-General's evaluation report on the environmental impact statement. May 2014. (**Coordinator-General's Report**)
- Department of Environment and Heritage Protection (2014) Draft environmental authority EPML014705153 – Carmichael Coal Mine (**Draft EA**)
- Department of the Environment (2013). Significant Impact Guidelines 1.1 - Matters of National Environmental Significance. EPBC Act Policy Statement. Australian Government, Canberra.
- Department of the Environment (2014). Decision under the *Environment Protection and Biodiversity Conservation Act 1999* – Approval – Carmichael Coal Mine and Rail Infrastructure Project, Queensland (EPBC 2010/5736) (**EPBC Approval, Attachment 2** to this statement)
- Environmental Defenders Office (Qld) Inc (2014) First Respondent's Preliminary Identification of Issues dated 2 December 2014 (**List of Issues**)
- Fatchen, T (2001) 'Vegetated wetland area as an index of mound spring flows', *Proceedings 4th Mound Spring Researchers Forum*. pp. 5–8.
- Fensham, R.J. and Fairfax, R.J. 2009 Development and trial of a spring wetland monitoring methodology in the Great Artesian Basin, Queensland. Department of Environment and Resource Management.
- Fensham, R., Ponder, W. and Fairfax, R. (2010) Recovery plan for the community of native species dependent on natural discharge of groundwater from the Great Artesian Basin. Department of Environment and Resource Management, Brisbane. Downloaded 6/1/2015.
- GHD (2013a) SEIS Appendix J1. Report for Updated Mine Ecology. 13 November 2013. (**SEIS Updated Mine Ecology Report**)
- GHD (2013b) SEIS Appendix J4. Report for Population Survey of Waxy Cabbage Palm. 16 July 2013. (**SEIS Waxy Cabbage Palm Survey Report**)

- GHD (2013c) SEIS Appendix K1. Report for Mine Hydrogeology Report. 13 November 2013. (**SEIS Mine Hydrogeology Report**)
- Kondo, T., Crisp, M. D., Linde, C., Bowman, D. M.J. S., Kawamura, K., Kaneko, S. & Isagi, Y. (2012) Not an ancient relic: the endemic Livistona palms of arid central Australia could have been introduced by humans. Proc. R. Soc. B 279, 2652–2661.
- Merrick, Noel (2015) Adani – Carmichael Coal Project: Assessment of potential Reduction in Spring Flow. (HC2015/5), dated 3 February 2015.
- Pettit N.E. and Dowe, J.L. (2003) Distribution and population structure of the vulnerable riparian palm *Livistona lanuginosa* A.N. Rodd (Arecaceae) in the Burdekin River catchment, north Queensland. *Pacific Conservation Biology* 9, 207-14.
- Webb, John (2015) Expert report on groundwater impact. Dated 6 February 2015.
- Werner, Adrian Deane (2015) Statement of Evidence – Analysis of Carmichael coal mine assessment. Version 6, dated 6 February 2015.

In addition:

- I carried out a reconnaissance survey of the Carmichael Mine site and surrounding areas in November 2014. This included observations and the collection of data including the data in the WCP survey upstream and downstream of the Carmichael Mine). Brad Dreis (Senior Ecologist at ELA) provided field assistance for this trip but all data compilation and interpretations were made by myself.
    - The details of the WCP including the data analysis are contained in the report ELA - Eco Logical Australia (2014) Waxy Cabbage Palm Survey: Upstream and downstream of the Carmichael Mine. Prepared as part of work as Expert Witness for the Carmichael Coal Project.
- James Dowdeswell (Senior Environmental Engineer, GHD) provided two figures showing the predicted operational and post-closure drawdown zones along the Carmichael River on 6 February 2015. This information is the same as that presented in figure 26 and 27 in the **SEIS Updated Mine Ecology** Report but in a different format and is included in this statement as **Figure 10** and **Figure 11**).
- Boris Laffineur (Queensland Herbarium) provided the excel spread sheet and Fatchen equations to calculate flow and area for Doongmabulla Springs on 3 February 2015 (attached in **Appendix B** of this statement). I have crosschecked all equations and am responsible for all calculations on these data.

I do not believe that access to any readily ascertainable additional facts would assist me in reaching a more reliable conclusion. As far as I am aware I have consulted all readily available information on the areas relevant to my statement.

C Background to Statement

- I have been directly involved in two projects that were used to support the development of the proposed Carmichael Mine.
    - I developed the updated regional ecosystem mapping and took part in the condition assessment field work as part of the ELA project "Carmichael Coal Mine Ecological Equivalence Assessment State 2" (report dated 30 January 2014). This project was led by Brad Dreis with the assistance of Alana Burley and Chays Ogston as well as myself.
    - I complied draft regional ecosystem mapping and other advice as part of the ELA project "Moray Downs West Ecological Equivalence Assessment Stage 2" (report dated 9 October 2014). This project was led by Brad Dreis with the assistance of Katrina Cousins and Chays Ogston as well as myself.
- I have provided ad hoc advice on a range of matters to consultants and government staff relating to the Carmichael Mine.
- Since carrying out the above work I have been engaged by McCullough Robertson, on behalf of Adani, to provide an expert report in the Land Court proceedings;
- In compiling this statement I have received and read the letter of instruction from McCullough Robertson that is included in the **Attachment 1** to this statement.
- These instructions included reference to requests for further information on hydrology made in the Springs Ecology and *Livistona lanuginosa* Joint Expert Reports (JER). The instructions were to use the hydrological information in the SEIS as this is considered reliable (Attachment 1, para. 16-19) to address *Livistona lanuginosa* issues and the report by Noel Merrick dated 3 February 2015 for the Springs Ecology issues.
- I understand my duties to the Land Court as an expert witness (see **Section F**).
- Notwithstanding my previous relationship with the Mine, I consider that I am able to provide an informed, independent opinion about the matters contained within this statement.

D Summary

Springs Ecology

Based on the predictions by Noel Merrick, there is unlikely to be a reduction in the ecological values at Doongmabulla Springs as a result of the mine, as measured by the extent of the associated wetlands, greater than 0.7 ha (7.2% of total area) and the reduction is more likely to be between 0.2 ha (2.1 % of total area) and 0.4 ha (3.6% of total area).

This loss in wetland area and associated ecological values is not substantial and would not be associated with the loss of any endemic species from the site. This loss could be readily offset, if required, by appropriate implementation of appropriate actions at appropriate Great Artesian Basin (GAB) springs.

Based on the opinion of John Webb and Adrian Werner there is a real possibility that up to 100% the ecological values associated with the springs will not survive at the site and/or the impacts on ecological values are uncertain. If this were the case it would be difficult to find an

area with equivalent values of the appropriate size to offset the loss of the entire Doongmabulla Springs.

The adaptive management and monitoring framework, to is required to be implemented under the Draft EA, includes the development and implementation of baseline monitoring programs and a Groundwater Dependent Ecosystem Management Plan (conditions, E3, E4, E10-E14 and I8-I11). This is an appropriate and effective way to manage the uncertainty associated with the potential impacts on the Doongmabulla Springs from the Carmichael Mine.

Livistona lanuginosa (Waxy Cabbage Palm)

The information on the distribution of *Livistona lanuginosa* (WCP) in the SEIS documentation is adequate to make an assessment of the Carmichael Mine Project.

There are areas in the both the Carmichael River and northern populations of *Livistona lanuginosa* (WCP) with a diversity of size classes. Based on the information available to me, I do not consider any differences between the northern and Carmichael River population structure to be significant or to influence my assessment of the impacts of the Carmichael Mine on *Livistona lanuginosa* (WCP).

Based on available information, the issue of the ancestral origins of the *Livistona lanuginosa* (WCP) is not relevant to an assessment of the impacts of the Carmichael Mine on *Livistona lanuginosa* (WCP),

Livistona lanuginosa (WCP) is more likely to be associated with groundwater than base flow in the western part and upstream of the Mine Lease. *Livistona lanuginosa* (WCP) may be more reliant on baseflows in the eastern part of the Mine Lease although its density in this area indicates marginal habitat for the species.

There is some uncertainty in relation to the impacts from the changes to groundwater predicted in the SEIS. However, my assessment shows that a total of 543 *Livistona lanuginosa* (WCP) including 35 adults in the eastern half of the Mine Lease and Cabbage Tree Creek, and small number of palms on the tributaries of the Carmichael River east of the Mine Lease, occurring in an area of about 50 ha, may be impacted by the changes in water table and base flow reductions predicted in the SEIS. This is potentially a significant impact to the *Livistona lanuginosa* (WCP) population in the area.

The current offset and associated management requirements set out in the Draft EA provide an effective mechanism to deal with the uncertainties in the potential impacts of the Carmichael Mine on the *Livistona lanuginosa* (WCP), Doongmabulla Springs, Mellaluka Springs and other Groundwater Dependent Ecosystems.

Specifically these include the requirements to develop a baseline monitoring programme (Draft EA Conditions including E3-E4) and a GDEMP (I8-I11) which includes the assessment of the results from the monitoring programme and where required updating of the offset requirements for any significant impacts not previously identified. The Biodiversity Offset Strategy required under the project approvals includes the development and implementation of management and monitoring plans to ensure required offsets are delivered and there is no net loss of ecological values. These conditions are further supported by the EPBC Approval for the project (**Attachment 2** to this statement).

The issues raised in the CAT submission are not considered relevant to issues dealt with in this statement or within my area of expertise.

E Opinion on Objections

E.1 Springs Ecology

This section has been prepared as a further of statement of evidence to address issues relating to springs ecology arising from the Springs Ecology Joint Expert Report (Springs JER) dated January 15 2015.

E.1.1 Predicted changes in flow rates and associated impacts on springs

The Springs JER (line 200) requested an assessment of the predicted change in flow rates to fully assess the impact of the Mine on ecological values of Doongmabulla Springs.

I have been supplied with an "assessment of the potential reduction in spring flow" at Doongmabulla Springs by Noel Merrick (dated 3 February 2015).

I have also been supplied with two separate statements of evidence on groundwater issues by Adrian Werner (version 6, dated 6 February 2015) and John Webb (dated 6 February 2015).

The relevant assessment by Noel Merrick concludes (page 3) that flow reductions are most unlikely to exceed 10 % and are more likely to be in the 3-5 % range at the Doongmabulla Springs.

The relevant assessment by John Webb (page 4, para. 12) is that the conclusion that there will be little impact of the proposed Carmichael mine on Doongmabulla Springs is unlikely to be correct and there is the real possibility that the dewatering for the mine could cause the springs to dry up.

The relevant assessment by Adrian Werner is that the prediction of impacts to springs is highly uncertain (page 6, para. 8a) and will be up to 100% of spring flow (page 29, para. 67f).

E.1.1.1 Opinion

Based on the predictions by Noel Merrick, there is unlikely to be a reduction in the ecological values at Doongmabulla Springs, as measured by the extent of the associated wetlands, greater than about 0.7 ha (7.2% of total area) and the reduction is more likely to be between about 0.2 ha (2.1 % of total area) and 0.4 ha (3.6% of total area). This is not a substantial reduction in area and no endemic species would be lost from the site.

Based on the predictions of John Webb and Adrian Werner, up to 100% of the ecological values associated with the springs will not survive at the site or the impacts on ecological values are uncertain.

E.1.1.2 Justification

The conclusion that if Doongmabulla Springs dry up the springs will become extinct follows directly from the agreement in the Springs JER (line 166), that if the Doongmabulla Springs dry either permanently or temporarily the endemic species will not survive and become extinct from the site.

The conclusion in relation to the predictions by Noel Merrick is based on the agreement in the Springs JER that a reduction in flow rates will reduce the extent of the wetlands associated with the Doongmabulla Springs. In addition I have used the mathematical relationship between flow rate and wetland area derived by Fatchen (2001). This equation is not likely to be accurate in all instances but I have found it gives a realistic estimate and is used here to indicate the order of magnitude of the reduction in ecological values associated with the reduced flow rate predictions.

The current wetland area at Doongmabulla Springs is 10.3 ha, as measured by the Queensland Herbarium and agreed to in the Springs JER (line 98). The current flow rate from the Doongmabulla Springs has been estimated by using the Fatchen equation as 2.68 ML/day[1] (**Appendix B**). I used this same data on the area and current flow rate of each individual spring to calculate a 10%, 5% and 3% reduction in flow rate and the corresponding associated reduced wetland area (see **Appendix B** for calculations).

These calculations are based on the assumption that any reduction in flow rates resulting from mining activities are beyond the natural variability in flows that are known to occur at Great Artesian Basin (GAB) springs including Doongmabulla Springs. If a reduction in flows was within the natural variability in flow rates that occurs at Doongmabulla Springs there would not be any significant reduction in the wetland area. However, in the calculations above, the wetland area is defined by perennial plants that grow where there is permanent or near permanent water[2]. This definition of wetland area is largely independent of shorter term fluctuations in spring flow and is also the main habitat for the endemic species, listed in the Springs JER (line 100), and other ecological values associated with Doongmabulla Springs.

These calculations do not include the unmapped wetlands that occur at the Doongmabulla Springs complex. Most of these unmapped springs are very small, often no more than 1-25m^2, and have an insignificant area compared to the total area of the spring wetlands at Doongmabulla Springs.

E.1.2 Provision of offsets for impacts

There was agreement in the Springs JER that an effective contribution for offsetting the loss of values at the Doongmabulla Springs may include the investment in recovery actions to address conservation problems at springs in other locations (line 194).

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[1] The assessment by Noel Merrick quoted a flow rate of 1.35 ML/day, which was referenced to the GHD (2012). This figure is based on an old estimate from Roderick Fensham and has since been updated with the 2.68 figure which provides a better estimate of flow rates. The total flow rate figure was not used by Noel Merrick in his calculations of % drawdown and therefore does not affect his conclusions.

[2] This definition of wetland area was developed by Fensham and Fairfax (2009) for use in monitoring GAB springs and has been included in the requirements for the Carmichael Mine specified in the Coordinator-General's Report (page 111, dot point 2).

There was a disagreement in relation to offsetting of Doongmabulla Springs. Roderick Fensham stated that offsetting the complete loss of Doongmabulla Springs was not feasible because enhancing existing values of other springs is not an effective offset for the loss of the exceptional values of the entire complex at the Doongmabulla Springs (line 178-184). I gave the different opinion that enhancing existing values of other springs was unlikely to be able to provide an effective offset for the entire Doongmabulla Springs complex because it would be difficult to find a large enough area of suitable existing springs (line 186-190), although enhancement of existing values at another spring site may be able to offset specified impacts at Doongmabulla Springs (line 190-192).

E.1.2.1 Opinion

The likely loss of wetland area associated with the predicted impacts by Noel Merrick is not substantial and, if required, could be readily offset by the implementation of appropriate management at appropriate GAB Springs.

It would be difficult to find an area with equivalent values of the appropriate size to offset the loss of the entire Doongmabulla Springs complex.

The adaptive management and monitoring framework, which includes the Biodiversity Offset Strategy (BOS) required to be implemented under the Draft EA (including conditions, E3, E4, E10-E14 and I8-I11) is an appropriate and effective way to manage the uncertainty associated with impacts on the Doongmabulla Springs.

E.1.2.2 Justification

The small loss of wetland area associated with the Noel Merrick predictions could be readily offset by appropriate implementation of appropriate actions at appropriate GAB Springs.

Appropriate actions could include the actions listed in the Recovery Plan for the community of native species dependent on natural discharge of groundwater from the Great Artesian Basin' (Fensham et al. 2010 – Springs Recovery Plan). These actions include:

- Establishment of appropriate fencing including the option to regulate stock use rather than exclude stock (priority level 1 action 3.1 from the recovery plan).
- Control of feral animals (priority level 1 action 3.2 from the recovery plan),
- Eradication of exotic plants from springs and ensuring no further deliberate introductions of exotic species occur (priority level 1 action 4.3 from the recovery plan).
- Monitoring of populations of endemic species and understanding their ecology and biology (priority level 3, action 6.2 from the recovery plan).

Offsetting the loss of the entre Doongmabulla Springs would be difficult because, although the values to be offset are the same as those required for a partial loss of the springs, a large enough area with equivalent values to provide the required additionality is unlikely to be available in this case. This is because the Doongmabulla Springs is one of the largest GAB springs in Queensland and many other GAB springs have become extinct or reduced in size due to drawdown of the aquifers that supply these springs with water.

Specified individual values at the Doongmabulla Springs, such as the loss of a particular endemic species, could be offset by enhancing values at another spring with the same values, such as the same endemic species. A number of such sites could be used to offset a number

of different values at Doongmabulla Springs. However, it might still be difficult to find enough different areas with equivalent values to offset the entire Doongmabulla Springs.

The loss of large areas of springs could be offset by the rehabilitation of springs that are extinct or where flows have been depleted, by returning GAB water to areas adjacent to springs. This action is consistent with the priority level 1 action 1.1 in the Springs Recovery Plan to control bores that will benefit flows to springs. I am unsure if this strategy could rehabilitate enough areas of GAB springs with equivalent values to offset large areas of Doongmabulla, but further implementation of the Springs Recovery Plan with appropriate monitoring may provide useful information in this regard. This action is partly addressed by the EPBC Approval for the Carmichael Mine project (Condition 11b), which requires the implementation of a GAB offset measure of returning at least 730 ML of water per year to the GAB which is to achieve measurable outcomes including the "protection and rehabilitation of GAB springs".

The Coordinator-General's Report sets out an adaptive management and monitoring framework that has been incorporated into the Draft EA for the Carmichael Mine. This includes the development of baseline datasets (Condition E3), ongoing monitoring and assessment (Condition E4) and the specification of trigger points (Condition E4). The trigger points include measures such as levels of ground water drawdown that initiate investigation, mitigation and offsetting procedures (Conditions E11-E14). In addition a GDEMP must be developed (Condition I8) which will include the Doongmabulla Springs (I10). The GDEMP must include an assessment of trigger baseline monitoring (specified in condition E9) and trigger levels (in E13) and a description of any correction actions including mitigation and offsets required. Condition I4 requires the BOS for the project to be updated if the investigations under E13-E14 indicate that additional offsets are required to address significant impacts to the Doongmabulla Springs that have not been previously identified in the BOS for the project.

The Coordinator-Generals Report made a recommendation to the Commonwealth Minister for the Environment under the EPBC Act. This included a condition for an offset management plan (Appendix 1, Section 2, Part A, Condition 2) which is included in condition 11 and 13 in the EPBC Approval for the project. The Current BOS (section 6.1.3) addresses these issues through measures that include the development of Offset Area Management Plans. These plans have not yet been developed in detail, but will include listing management objectives and outcomes, a detailed monitoring plan with criteria for assessing the success of management measures in meeting stated objectives and corrective actions required if objectives are not met.

In addition Condition 25 of the Commonwealth EPBC approval requires the development and implementation of a peer reviewed GAB springs research plan, which includes requirements to monitor springs ecology and develop research outcomes that can inform management, prevention, mitigation and offsetting of any impacts on the Doongmabulla Springs. The knowledge gained from the research will be an important input into the ongoing management of these springs which is required by the Draft EA.

E.2 *Livistona lanuginosa* (Waxy Cabbage Palm)

This section has been prepared as a further of statement of evidence to address issues relating to *Livistona lanuginosa* (Waxy Cabbage Palm, WCP) arising from the *Livistona lanuginosa* Joint Expert Report (*Livistona lanuginosa* JER) dated January 11, 2015.

E.2.1 The extent and abundance of *Livistona lanuginosa* outside the Mine Lease

Number 39 in the List of Issues addressed in the *Livistona lanuginosa* JER is "the EIS does not contain sufficient information about the extent and abundance of *Livistona lanuginosa* (WCP) in the Carmichael River and its tributaries outside of the proposed mining lease area."

There was agreement in the *Livistona lanuginosa* JER (line 205) that the survey of *Livistona lanuginosa* that I undertook as part of my field inspections relating to these proceedings has added to the existing knowledge on the distribution of the palm outside the proposed mine lease area.

E.2.1.1 Opinion

The information on the distribution of *Livistona lanuginosa* (WCP) in the SEIS documentation is adequate to make an assessment of Carmichael Mine Project.

Moreover the work carried out for the EIS and SEIS added substantially to the existing body of knowledge about *Livistona lanuginosa* (WCP) on the Carmichael River.

E.2.1.2 Justification

Appendix J4 of the SEIS, provides a report on the population survey of *Livistona lanuginosa* (WCP) by GHD. I have verified this data in my field inspection of the site in November 2014 and I am satisfied it provides comprehensive and accurate information on the extent of the species within the mine lease. Before this survey was carried out only a small number of *Livistona lanuginosa* (WCP) had been identified as occurring near Doongmabulla Springs. This survey which identified over 800 individuals along with their location and associated habitat added substantially to the existing body of knowledge about *Livistona lanuginosa* (WCP) on the Carmichael River.

The GHD survey did not include a comprehensive assessment of the area to the west of the Mine Lease, although predicted that about 800 *Livistona lanuginosa* (WCP) may occur in that area. This prediction has been verified by my sampling of this area (ELA, 2014) from which I have calculated that 741 palms occur along the Carmichael River and another 150 palms may occur on tributaries of the Carmichael River in the upstream area. Therefore the SEIS *Livistona lanuginosa* (WCP) survey in this area is adequate.

The GHD assessment did not survey the Carmichael River downstream of the Mine Lease. The low densities of palm in the eastern half of the Mine Lease found by GHD indicated that there was unlikely to be many palms in this downstream area and this has been confirmed by my survey which found no palms along the Carmichael River downstream of the Mine Lease. Therefore the SEIS *Livistona lanuginosa* (WCP) survey in this area is adequate.

My survey found areas of *Livistona lanuginosa* (WCP) on Cabbage Tree Creek downstream of the Mine Lease (**Figure 1**, reference point 5) and tributaries of the Carmichael River upstream of the Mine Lease (e.g. **Figure 1**, reference point 1). I have said in the *Livistona lanuginosa* JER (line 191) that further survey of these areas is required to refine the population estimate (line 191-192). This information is required for detailed assessment of offset areas and potential impacts, which can, if required, be incorporated into the updated BOS.

The Coordinator-Generals Report included conditions that require more detailed identification of the extent of *Livistona lanuginosa* (WCP) in the area and other conditions that identify additional impacts and, where required offset actions (ConditonsI8-I11). These conditions are

supplemented by commitments made by Adani, which include complete mapping of the palm across the greater Carmichael River area (Coordinator-Generals Report, page 52-53).

Therefore, the level of sampling of *Livistona lanuginosa* (WCP) in the SEIS is at or greater than the level normally undertaken at the impact assessment stage of major projects and adequate to assess the overall impacts of the Mine on *Livistona lanuginosa* (WCP). Conditions in the **Draft EA** will ensure that any additional information required is collected and used to update assessments of impacts and management action required.

E.2.1 The *Livistona lanuginosa* (WCP) populations in the Burdekin catchment compared to the Carmichael River population.

Number 37 in the **List of Issues** addressed in the *Livistona lanuginosa* JER is "on the basis of the existing knowledge the Carmichael River population is the largest single known population of the species".

Number 38 in the **List of Issues** addressed in the *Livistona lanuginosa* JER is "of the observed population on the Carmichael River and other populations within its known range within the Burdekin catchments, the Carmichael River population contains the greatest diversity of size classes from seedlings to reproducing adults."

There was agreement the *Livistona lanuginosa* JER (line 182) that the Carmichael River population is the largest single known population of the species.

There was not agreement (line 226-252) that the Carmichael River population had the greatest diversity of size classes.

E.2.1.1 Opinion

There are areas in the both the Carmichael River and northern populations of *Livistona lanuginosa* (WCP) with a diversity of size classes. Based on the information available to me, I do not consider any differences between the northern and Carmichael River population structure to be significant or to influence my assessment of the impacts of the Carmichael Mine on *Livistona lanuginosa* (WCP).

E.2.1.2 Justification

Figure 2 shows the distribution of *Livistona lanuginosa* (WCP) which includes the populations along the Carmichael River and at various locations on the Burdekin River and its tributaries (**Figure 2**). These latter localities are referred to collectively as "the northern populations" of *Livistona lanuginosa* (WCP).

Pettit and Dowe (2003) report on a survey of the northern populations. In this area *Livistona lanuginosa* (WCP) is spread across over 400km of drainage lines (**Figure 2**). However the distribution of *Livistona lanuginosa* (WCP) is not continuous across these northern areas and

is often absent or present as scattered individuals with some locations supporting denser stands of the palm. The Pettit and Dowe study surveyed "sub-populations"[3] at 8 locations where *Livistona lanuginosa* (WCP) occurred in relatively high densities (number 1-8 on **Figure 2).**

Across the 8 sites surveyed Pettit and Dowe recorded 5,179 palms of which 10% were adult, 11% were sub-adult and 79% were seedlings[4]. The numbers of *Livistona lanuginosa* (WCP) at each site ranged from 70 to 808 (Pettit and Dowe 2003, Figure 4). There was a reasonable spread of each growth form recorded at most sites, although the population structure varied across the sites. Some localities had a low proportion of seedlings while others were lacking older growth stages, while still other sites had a similar growth form structure to the Carmichael Mine population.

At the time of the Pettit and Dowe survey, the Carmichael River population was not recorded on any data-bases. Accordingly the northern populations of *Livistona lanuginosa* were the largest known populations. The Carmichael River population has now been recorded on the relevant databases as part of the EIS and SEIS survey work.

The survey by GHD in the SEIS (GHD 2013a) and my subsequent observations indicates the Carmichael River *Livistona lanuginosa* (WCP) population is about 2,095 of which about 13% are adults, 35% sub-adults and 53% seedlings. As the distribution of *Livistona lanuginosa* (WCP) is more or less continuus across the area this is considered the largest population rather than the various northern populations.

Dr Olsen has made the observation in the *Livistona lanuginosa* JER (line 228-229) that the juveniles and seedlings in the northern populations have not been maintained since the survey by Pettit and Dowe. I accepted (line 240-241) that these observations indicate that there may have been changes, although considered that more systematic survey was required to quantify the changes and that there was no adequate explanation as why these changes may have occurred. The large proportion of juveniles that occurs at both the Carmichael River and the northern populations (as reported by Pettit and Dowe) implies that a large proportion of the

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[3] For the purposes of the *Livistona lanuginosa* JER I assumed that the individual sites surveyed by Pettit and Dowe are different populations. The definition of a population can be context specific. For example, the significant impact guidelines under the Commonwealth EPBC Act define a population as an occurrence of a species in a particular area. A more useful ecological definition is to define a population as a group of individuals that can interbreed, although in the absence of detailed genetic information this can only be inferred from knowledge of pollination and seed dispersal mechanisms.

[4] The 7 different growth-forms recognised by Pettit and Dowe were combined into three broad categories in the GHD study: 1-Seedling (Seedling, Fan, Rosette from P&D) 2-Sub-adult (establishment, sub-adult, non-reproductive adult P&D) 3-Adult (adult P&D). The three broad categories are used here.

juveniles are not able to survive until adulthood. This is not unusual for a species that is likely to regenerate episodically, such is the case for *Livistona lanuginosa* (WCP) that appears to regenerate after flooding.

Therefore, based on the information available to me, I do not consider any differences between the northern and Carmichael River population structure to be significant or to influence my assessment of the impacts of the Carmichael Mine on *Livistona lanuginosa* (WCP).

E.2.2 Possible anthropogenic origins of *Livistona lanuginosa (WCP)*

Number 40 in the List of Issues addressed in the *Livistona lanuginosa* JER is "the Carmichael River population of WCP may well act as the main population from which other known populations have originated by natural or anthropogenic means."

Dr Olsen agreed with this issue (JER lines 226-237) and introduced the Kondo *et al.* study, which put forward the hypothesis that the observed genetic variation in *Livistona rigida/mariae* populations in the Northern Territory could be explained by the anthropogenic introduction of the species to one area. I have outlined my reasons why I think the Kondo *et al.* (2012) study is not applicable to *Livistona lanuginosa* (WCP) in lines 262-270 of the JER.

E.2.2.1 Opinion

Based on available information, the issue of the ancestral origins of the *Livistona lanuginosa* (WCP) is not relevant to an assessment of the impacts of the Carmichael Mine on *Livistona lanuginosa* (WCP),

E.2.2.2 Justification

Even if the Kondo *et al.* study applied to *Livistona lanuginosa* (WCP), the hypothesised introduction occurred 15,000 years ago, which would mean the northern populations would still be considered natural and requiring the same level of protection as the Carmichael River population.

If the Kondo *et al.* study applied to *Livistona lanuginosa* (WCP), the northern population may have a lower genetic diversity than the Carmichael River population. However, genetic studies could just as readily show the opposite given the geographic and environmental variation in the northern populations. Such genetic studies are rarely available and are not normally required under the Terms of Reference for an EIS.

Therefore I see no relevance of this issue to my assessment of the impacts of the Carmichael Mine on *Livistona lanuginosa* (WCP) or the adequacy of the conditions in the Draft EA.

E.2.3 Reliance of *Livistona lanuginosa* on base flow and groundwater

Number 42 in the List of Issues addressed in the *Livistona lanuginosa* JER is "if the base flows of the Carmichael River are derived from the underground water flow from the Doongmabulla Springs Complex, and the Doongmabulla Springs Complex is significantly adversely impacted by the proposed mining activity, the abundance of WCP in the Carmichael River is likely to be significantly reduced".

I expressed the opinion that *Livistona lanuginosa* (WCP) is unlikely to be solely reliant on base flows (*Livistona lanuginosa* JER, line 285), which I have expanded on below.

My opinion on the impacts of changes base flow on *Livistona lanuginosa* (WCP) is dealt with under Section E.2.4 of this statement.

E.2.3.1 Opinion

Livistona lanuginosa (WCP) is more likely to be associated with groundwater than base flow in the western part and upstream of the Mine Lease.

Livistona lanuginosa (WCP) may be more reliant on baseflows in the eastern part of the Mine Lease although its density and growth form structure in this area indicates the existing environmental conditions are marginal for the species.

E.2.3.2 Justification

In making this assessment I have relied on the hydrological information in the SEIS Hydrogeology Report and the SEIS Updated Mine Ecology Report.

I consider that the roots of an adult *Livistona lanuginosa* are not likely to extend more than 3 metres. This is consistent with the agreement in the *Livistona lanuginosa* JER (line 204) that the species is shallow rooted and my opinion (JER, line 294) that palms located more than a few metres from the river do not have access to base flow. Juveniles would be expected to have shallower roots than adults, possibly no more than one metre.

On and around the Mine Lease I observed many *Livistona lanuginosa* (WCP) located near enough to the water flowing in drainage lines for their roots to directly access water in the river or able to access parts of the banks where water supply was directly influenced by base flow (e.g. **Figure 3** and **Figure 4**). However, most of the palms growing in the western half and upstream of the Mine Lease were located more than a few metres from the flow in the river (e.g. **Figure 5**). This included individuals growing near the river but on the banks that are too high above the flow in the river for the shallow rooted palm, particularly juveniles, to access the river flow (e.g. **Figure 6** and **Figure 7**). Other palms are located adjacent to ephemeral streams such as Cabbage Tree Creek (e.g. **Figure 8)** and therefore also do not normally have access to base flow.

Livistona lanuginosa (WCP) is not evenly distributed along the Carmichael River. The densest populations of *Livistona lanuginosa* (WCP) occur in the western part and upstream of the Mine Lease (**Figure 1)**. In the eastern half of the Mine Lease the *Livistona lanuginosa* are much sparser and there is also a lower proportion of adults. The **SEIS Waxy Cabbage Palm Survey** reported about 127 palms to the east of a point close the reference point 3 on **Figure 1,** of which only 9 were adults. The palms in this area also seem to only be located directly adjacent to the river (**Figure 9**), unlike areas further to the west.

The depth to the water table appears to be correlated to the distribution of *Livistona lanuginosa* (WCP) along the Carmichael River. To the west of the Mine Lease the Carmichael River is “gaining” and the ground water is relatively close to the surface. The monitoring bore C027 (Mine Hydrology Report - Appendix K1 in the SEIS, Table 5, page 38) shows the groundwater is about 0.5m above the river bed at a point just to the east of the Mine Lease boundary (**Figure 1,** at about reference point 2). This bore data also shows that ground water levels are below the river bed towards the middle on the Mine Lease - about 4.4m below the level at the monitoring bore C025 (at about reference point 3 on **Figure 1)** and about 5.4m below the bed at monitoring bore C029 (at about reference point 4 on **Figure 1).**

Therefore, I conclude that the correlation between ground water and the distribution of *Livistona lanuginosa* (WCP) growing in the western half and upstream of the Mine Lease indicates that the palms are more likely to be reliant on ground water levels than base flow in these areas. The existing depth to the ground water in the eastern half of the Mine Lease is too deep for even adult *Livistona lanuginosa* (WCP) to access and therefore indicates that the palms are unlikely to be reliant on ground water in this area. The adult palms that grow adjacent to the river in this area may be reliant on baseflows, although the low density of palms indicates that this area is marginal habitat for the species and many of the juveniles present will have difficulty advancing to the adult stage.

There was agreement in the *Livistona lanuginosa* JER (line 332) that the detailed relationships between hydrology and the distribution of the palm were not yet determined. I also expressed the opinion that associations between the environment and the distribution of the palm do not verify causality. Therefore, while I believe the above relationships are the most likely explanation of the distribution of *Livistona lanuginosa* (WCP) on the Carmichael River, other explanations are possible. The palm's distribution could be the result of flooding from surface water replenishing moisture supplies in the sandy soils rather than groundwater. In any case it is likely that the establishment and early growth of seedlings are dependent on flooding from surface water, as their roots are too shallow to tap into groundwater or base flow in most of the situations I observed.

E.2.4 Impacts of predicted changes in hydrology on *Livistona lanuginosa* (WCP)

Number 43 in the List of Issues addressed in the *Livistona lanuginosa* JER is "if the hydrological conditions in the Carmichael River are significantly adversely impacted by the proposed mining activity, this is likely to significantly reduce the abundance of WCP in the Carmichael River."

I expressed the view in the *Livistona lanuginosa* JER (line 313-315) that if groundwater conditions of the Carmichael River are significantly adversely impacted by the proposed mining activities there is likelihood that parts of the *Livistona lanuginosa* (WCP) population would be significantly impacted, although there were uncertainties around the degree of impact.

E.2.4.1 Opinion

There is some uncertainty in relation to the impacts from the changes to groundwater predicted in the SEIS. However, my assessment shows that a total of 543 *Livistona lanuginosa* (WCP) including 35 adults in the eastern half of the Mine Lease and Cabbage Tree Creek, and small number of palms on the tributaries of the Carmichael River east of the Mine Lease, occurring in an area of about 50 ha, may be impacted by the changes in water table and base flow reductions predicted in the SEIS. This is potentially a significant impact to the *Livistona lanuginosa* (WCP) population in the area.

E.2.4.2 Justification

The predicted impacts of the Carmichael Mine on base flow and water table drawdown in relation the *Livistona lanuginosa* population on the Mine Lease are shown in Figures 26 and 27 of the SEIS Updated Mine Ecology Report. This information in relation to draw down of the water table is re-presented here in **Figure 10** and **Figure 11.**

These figures show that impacts to the water table are greatest towards the centre of the Mine Lease where drawdown is predicted to be 4m, and decrease towards both the eastern and

western boundaries of the Mine Lease. The predicted drawdown on the western half of the Mine Lease where the *Livistona lanuginosa* (WCP) is densest, is < 0.2m and often close the zero (**Figure 10** and **Figure 11**). As most of the *Livistona lanuginosa* (WCP) population in this area is more likely to be reliant on the water table than base flow and this level of draw down is very small compared to the root depth of adult palms, it follows that the *Livistona lanuginosa* (WCP) population is likely to persist in this area. An exception to this is the upper reaches of tributaries of the Carmichael River to the west of the Mine Lease (e.g. **Figure 12**, reference point 1) which appear to fall outside the < 0.2 m drawdown zone**.** From my survey of the area in November 2014, I consider that these areas include only a small proportion of the 150 palms I estimate occur on these tributaries (ELA, 2014).

The *Livistona lanuginosa* (WCP) on the eastern half of the Mine Lease are likely to suffer impacts from the predicted changes in water table but also base flow. This follows from my opinion that the palms in this area may be more reliant on base flow and the predicted impacts on base flow are high (Figure 26 and 27 from the Updated Mine Ecology Report). It is also because the dominant tree species in this area, such as *Eucalyptus camaldulensis* (River Red Gum) are likely to be reliant on ground water and likely to be impacted by the predicted large water table drawdown in these areas. These changes are likely to cause indirect impacts to the whole riparian vegetation community in this area including the *Livistona lanuginosa* (WCP). I have estimated a net area of 40 ha (**Figure 1**) containing about 170 palms (including 9 adults) may be impacted by the predicted changes in water table and base flow on the Carmichael River in the eastern half of the Mine Lease.

In addition, to the above impacts, another 373 *Livistona lanuginosa* (WCP individuals including 26 adults) occurring over about 9 ha in the Cabbage Tree Creek area may also be impacted based on the predicted 0.2-1.0m drawdown to the water table in this area (**Figure 12**, reference point 5).

The potential impacts on the above areas are not likely to result in complete death of all the *Livistona lanuginosa* (WCP) individuals in the areas highlighted. Drawdown of the water table above 0.2m, particularly when it is less than 1.0m, may result in a thinning out of *Livistona lanuginosa* (WCP) and a loss in condition of the palms and supporting habitat. These impacts could be mitigated by appropriate management in some cases, such as weed control.

There are some uncertainties in the above assessment stemming from the uncertainties in the relationships between hydrology and the distribution of the palm mentioned above. If the distribution of *Livistona lanuginosa* (WCP) is related to surface flooding rather than groundwater (see **Section E2.3** above), then there is likely to be much lower impacts as there does not appear to be any significant impacts from the mine on river flooding.

Although there is some uncertainty, a total of 543 palms including 35 adults in the eastern half of the Mine Lease and Cabbage Tree Creek, and small number of palms on the tributaries of the Carmichael River east of the Mine Lease, are likely to be impacted by the changes in hydrology predicted in the SEIS. This is potentially a significant impact to the *Livistona lanuginosa* (WCP) population in the area.

E.2.5 Biodiversity Offsets Strategy

I expressed the opinion in the *Livistona lanuginosa* JER (line 342) that the current offset and associated management requirements included in the approvals for the project are a reasonable way to address the uncertainties in the potential impacts of the proposed mine on the *Livistona lanuginosa* (WCP). Furthermore (JER, line 362) the protection of an existing

Livistona lanuginosa (WCP), population is potentially an effective way to provide an offset for impacts, although further details on the proposed management are required as part of ongoing development of the Current BOS.

E.2.5.1 Opinion

The current offset and associated management requirements set out in the Draft EA (Conditions I8-I11) are an effective way to deal with the uncertainties in the potential impacts of the Carmichael Mine on the *Livistona lanuginosa* (WCP).

Specifically these include the requirements to develop a Groundwater Dependent Ecosystem Management Plan to manage any future impacts to *Livistona lanuginosa* (WCP) and a BOS which includes mechanisms to ensure any and all additional impacts are identified, addressed and required offsets are delivered.

E.2.5.2 Justification

The Coordinator-General's Report sets out an adaptive management and monitoring framework that has been incorporated into the Draft EA for the Carmichael Mine. This includes the development of baseline groundwater datasets (Condition E3) with ongoing management and monitoring including the specification of trigger points (Condition E4). The trigger points include measures such as levels of ground water drawdown that require the initiation of review, mitigation and offsetting procedures (Conditions E11-E14). In addition a Groundwater Dependent Ecosystem Management Plan must be developed (Condition I8) which will include the population of Waxy Cabbage Palm (I10). The Groundwater Dependent Ecosystem Management Plan must include an assessment of trigger baseline monitoring (specified in condition E9) and trigger levels (in E13) and a description of any correction actions including mitigation and offsets required. Condition I4 requires the BOS for the project to be updated if the investigations under E13-E14 indicate that additional offsets are required to address significant impacts to the *Livistona lanuginosa* (WCP) population above what are identified in the BOS**.**

The Current BOS proposes an offset for *Livistona lanuginosa* (WCP) in an area to the west of the Mining lease (Figure 12 in The Current BOS, which is shown on **Figure 12** in this statement). I expressed the opinion on the *Livistona lanuginosa* JER (line 375-377) that this area was less likely to be impacted by water table drawdown than areas on to the east. My assessment using the information in the SEIS Updated Mine Ecology Report is that this proposed offset area will not be impacted by the predicted draw down in water table, with the exception of some areas around the upper reaches of the tributaries shown on **Figure 12.** These areas require more detailed assessment and may require modification to their boundaries. However, my understanding is that the Current BOS is still subject to refinement and approvals from the appropriate jurisdiction. From my assessment there are ample areas of *Livistona lanuginosa* (WCP) habitat in the upstream area that are not subject to excessive water table drawdown and therefore available to meet the minimum offsets area required in the Current BOS. Therefore this is not a difficult issue to address and does not require consideration for approval of the mine as it can be readily carried out as part of the ongoing development of the BOS**.**

The Current BOS proposes that the *Livistona lanuginosa* offsets required in the Draft EA (or associated EPBC Approval in this case) will be based on the protection of existing populations of the species in areas upstream of the mine, by implementation of specific management measures that will include (but are not restricted to) management of grazing and fire. These

issues, along with the control of weeds and feral animals, are appropriate measures to take for this site.

The Current BOS (section 6.1.3) proposes to address management of the offset sites through measures that include the development of Offset Area Management Plans. These plans will include listing management objectives and outcomes, a detailed monitoring plan with criteria for assessing the success of management measures in meeting stated objectives and corrective actions required if objectives are not met. Thus, while the Current BOS provides no details of how management will deliver the required offsets, the above process will require this to be done and also require that the offsets sites deliver the specified values. These requirements are adequate to ensure that the offsets of residual impacts to the *Livistona lanuginosa* (WCP) from the Carmichael Mine Project are delivered ensuring there will be no net loss of ecological values. They are also standard and appropriate at the approval stage of a project the size of the Carmichael Mine.

E.3 CAT submission

The *Livistona lanuginosa* JER (Line 137) stated that the issues raised in the CAT submission were not relevant to the JER.

The issues raised in the CAT submission are also not relevant to the issues that I have considered in relation to Springs Ecology.

E.4 MLA and EA objections

I have concluded in relation to *Livistona lanuginosa* (WCP) that the impacts of the mine will be managed to ensure there is no net loss of associated ecological values. I have reached a similar conclusion in relation to Doongmabulla Springs, on the condition that dewatering of the mine does not dry up the springs.

In relation to these issues I conclude that the approval and construction of the mine:

- will not result in severe and permanent environmental impacts,
- will not cause serious environmental harm.
- Is consistent with my understanding of the principles of ecological sustainable development, intergenerational equity, the precautionary principle, the conservation of biological diversity and ecological integrity and sound land management.

If the dewatering of the mine leads to 100% of the Doongmabulla Springs drying up, then it may be difficult or unlikely to ensure that the above is achieved.

Although not considered in detail in this statement, the other Groundwater Dependent Ecosystems (Mellaluka Springs and Riparian vegetation) in the Carmichael River area that may be impacted by the Mine and assessed in the SEIS are required by the Draft EA to be included in the Groundwater Dependent Ecosystem Management Plan and the BOS in the same manner as the Doongmabulla Springs and *Livistona lanuginosa* (WCP). Therefore the above conclusions also relate to any impacts of the Mine on these ecosystems.

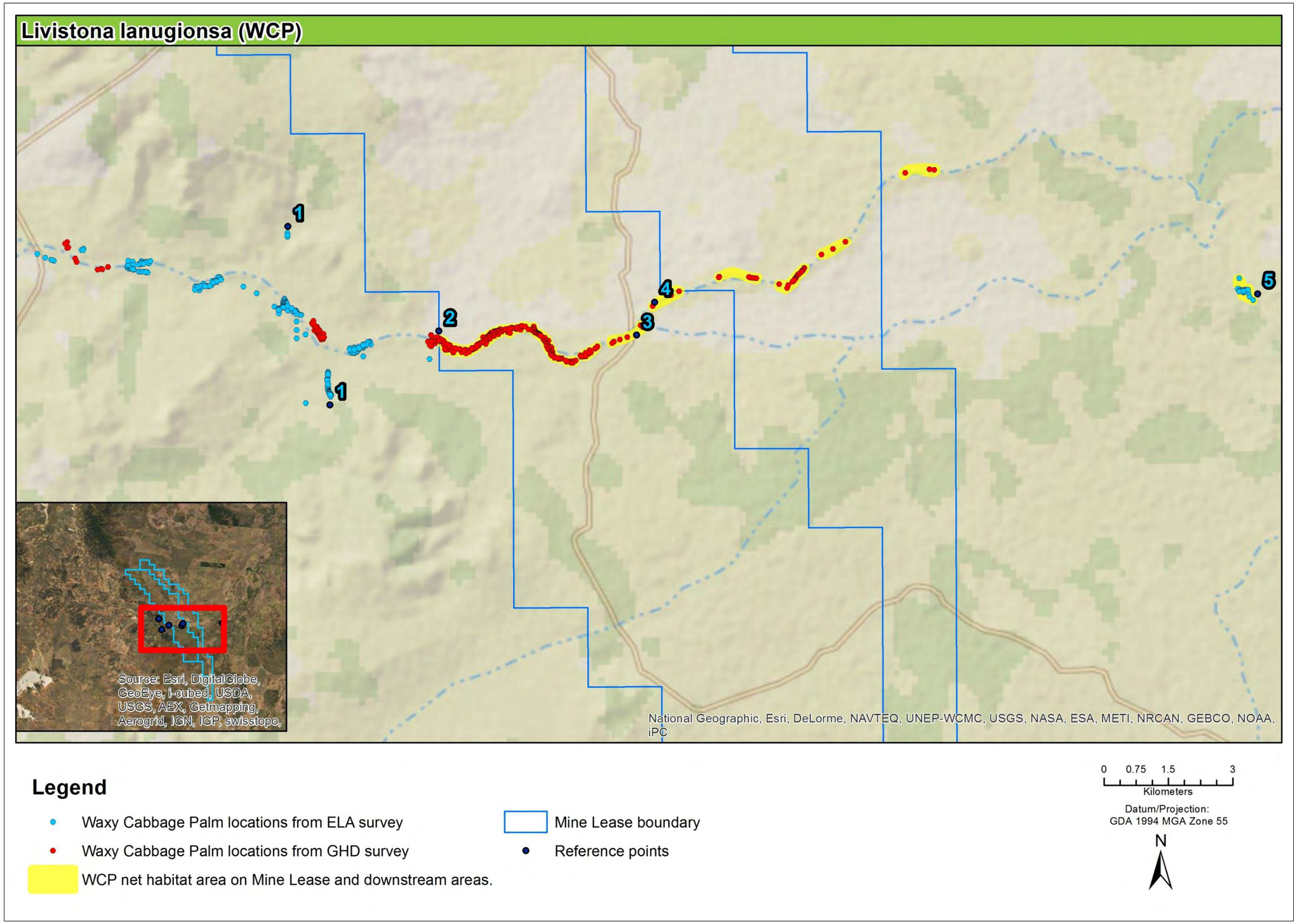


Figure 1 Map of *Livistona lanuginosa* (WCP) distribution on the Mine Lease and adjacent areas.

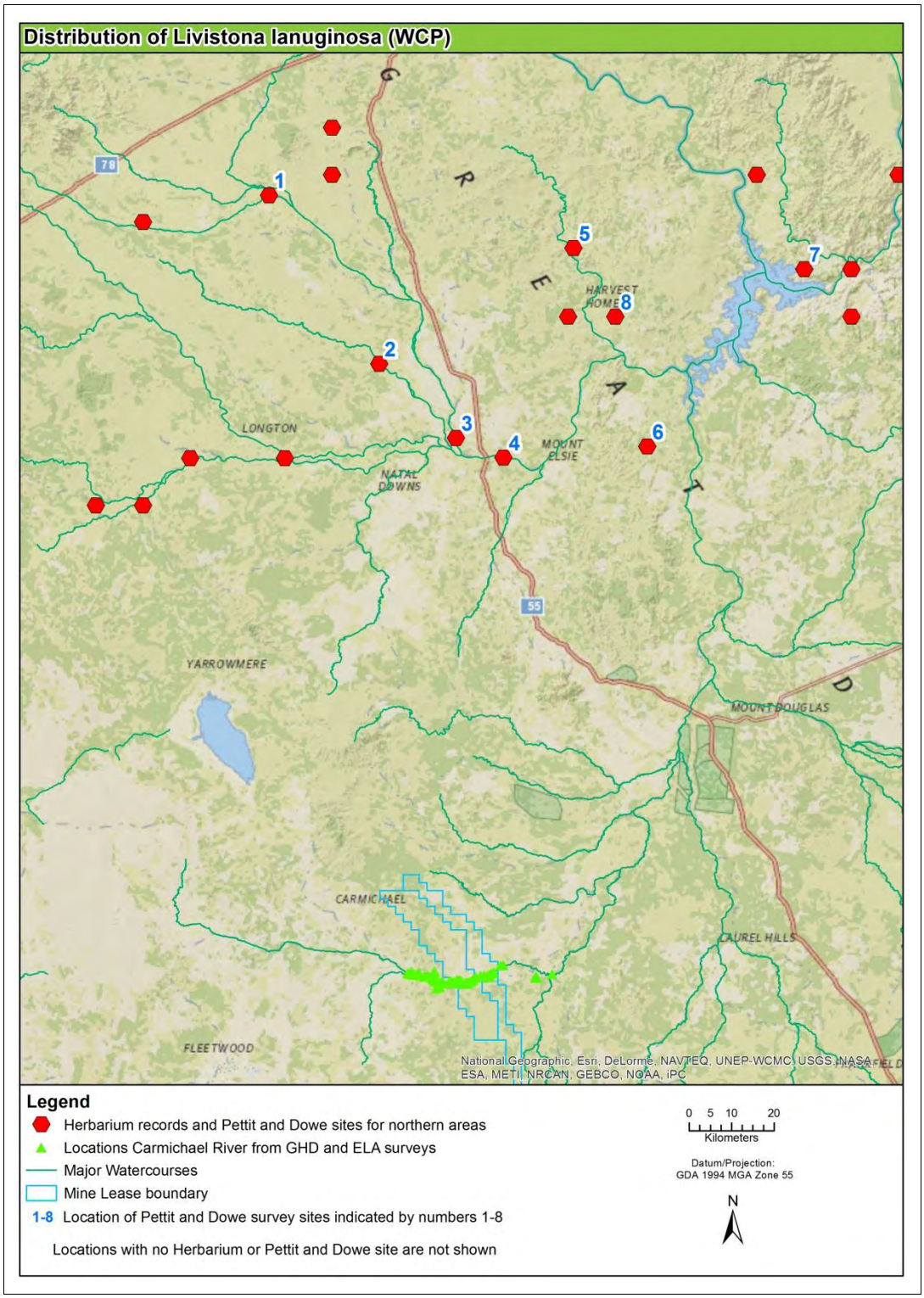


Figure 2: Map of *Livistona lanuginosa* (WCP) distribution across Queensland

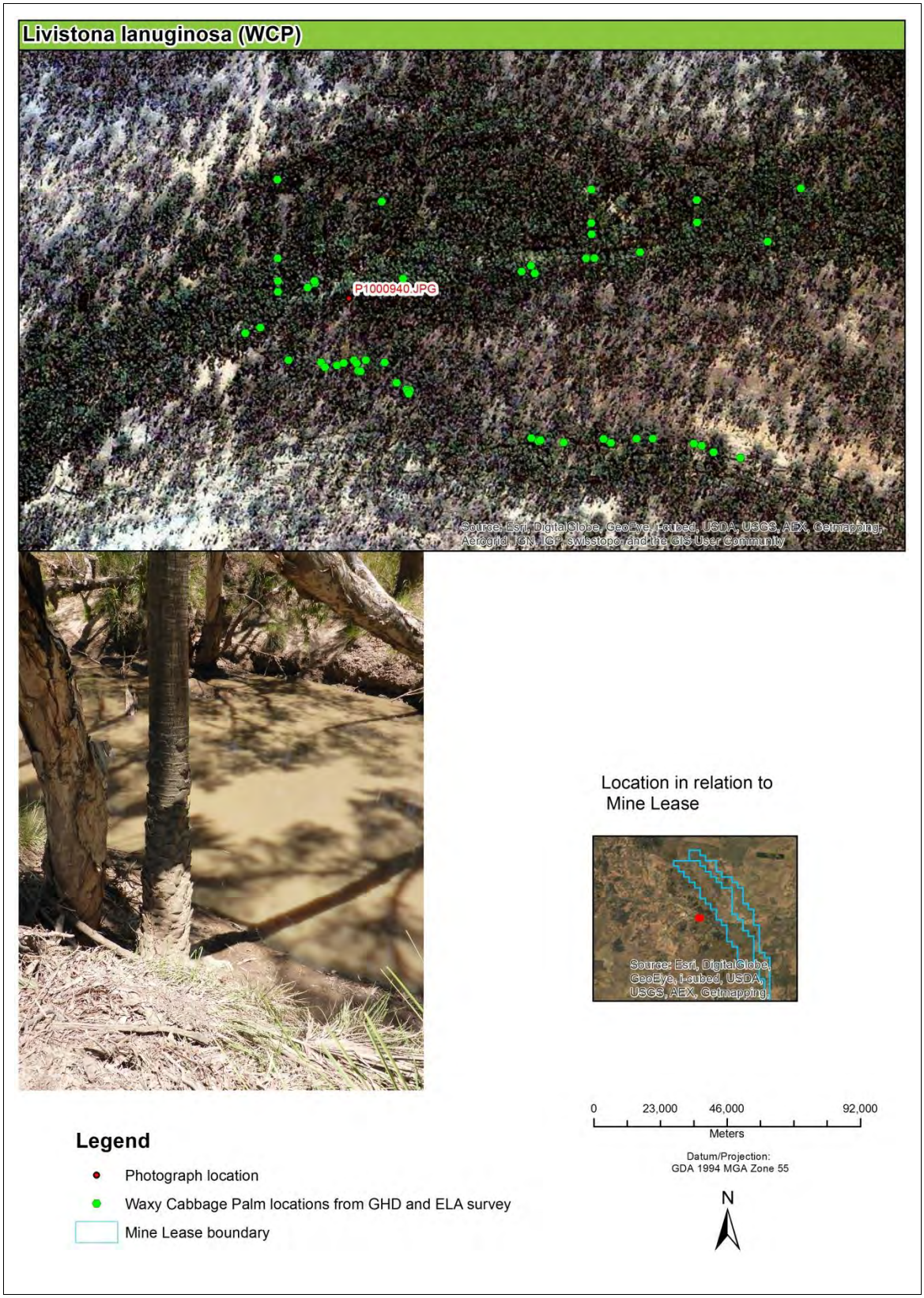


Figure 3 Adult *Livistona lanuginosa* (WCP) growing adjacent to water flow in a tributary of the Carmichael River (940)

Photograph100940.jpeg (bottom left) was taken by Bruce Wilson (19 November, 2014) facing in a northerly direction and from the location indicated on the map (top).

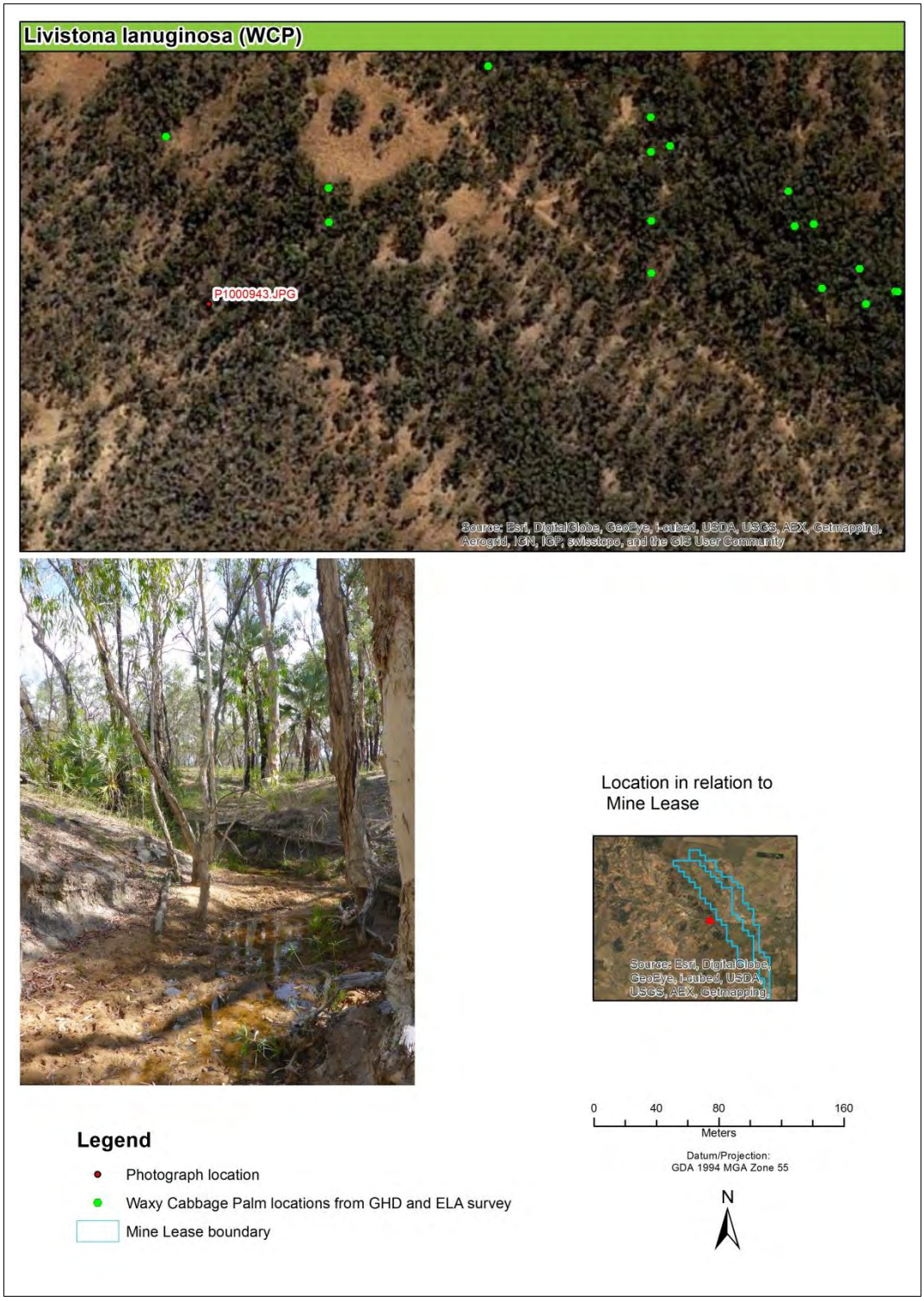


Figure 4 Adult *Livistona lanuginosa* (WCP) growing adjacent to water flow in a tributary of the Carmichael River (943)

Photograph100943.jpeg (bottom left) was taken by Bruce Wilson (19 November 2014) facing in a southerly direction from the location indicated on the map (top).

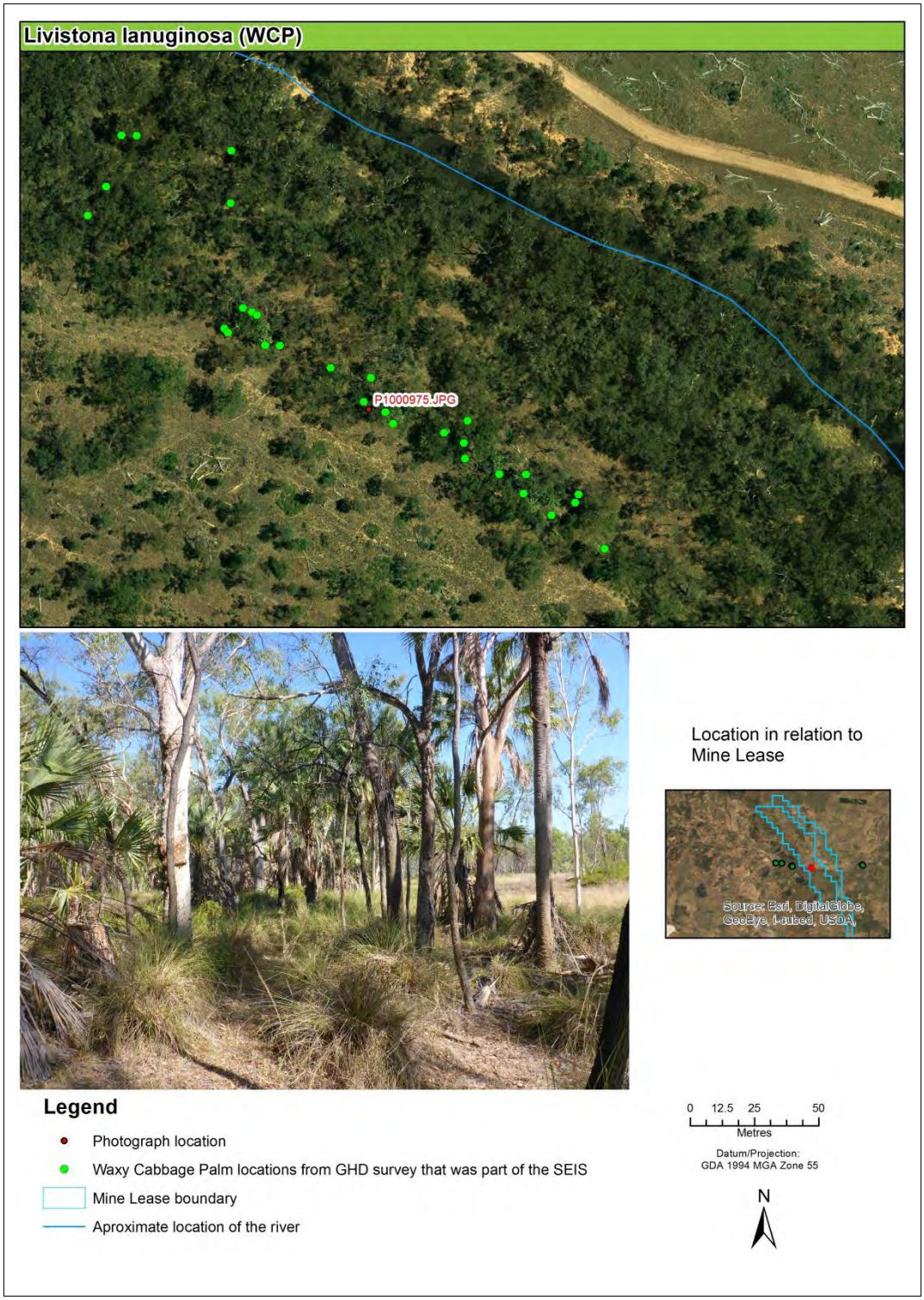


Figure 5 *Livistona lanuginosa* (WCP) growing well away from the water flow in the Carmichael River (975)

Photograph100975.jpeg (bottom left) was taken by Bruce Wilson (20 November 2014) facing in a south-easterly direction from the location indicated on the map (top).

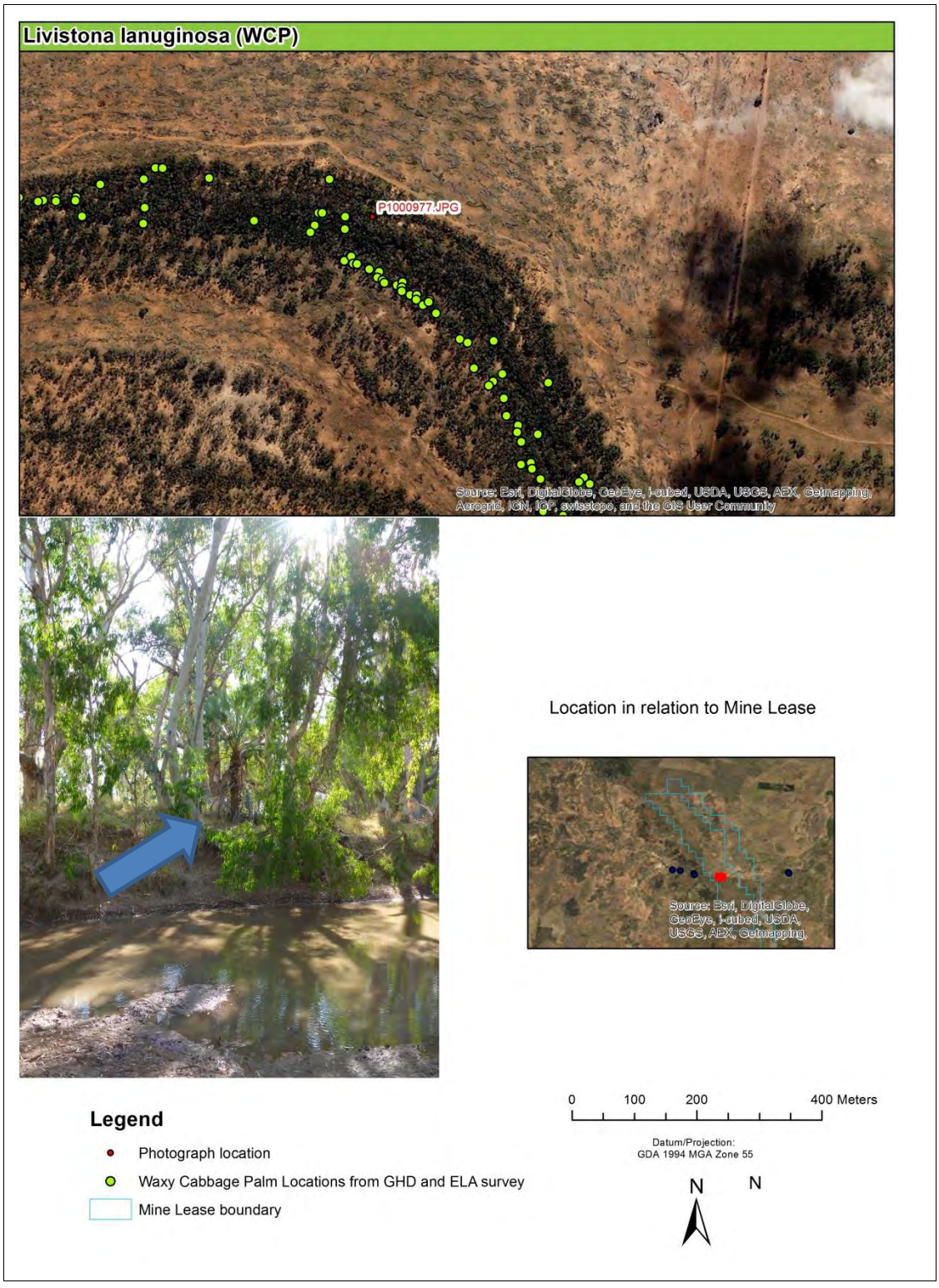


Figure 6 *Livistona lanuginosa* (WCP) growing on a bank elevated above the water flow in the Carmichael River (977)

Blue arrow points to palm. Photograph100977.jpeg (bottom left) was taken by Bruce Wilson (20 November 2014) facing in a southerly direction from the location indicated on the map (top).

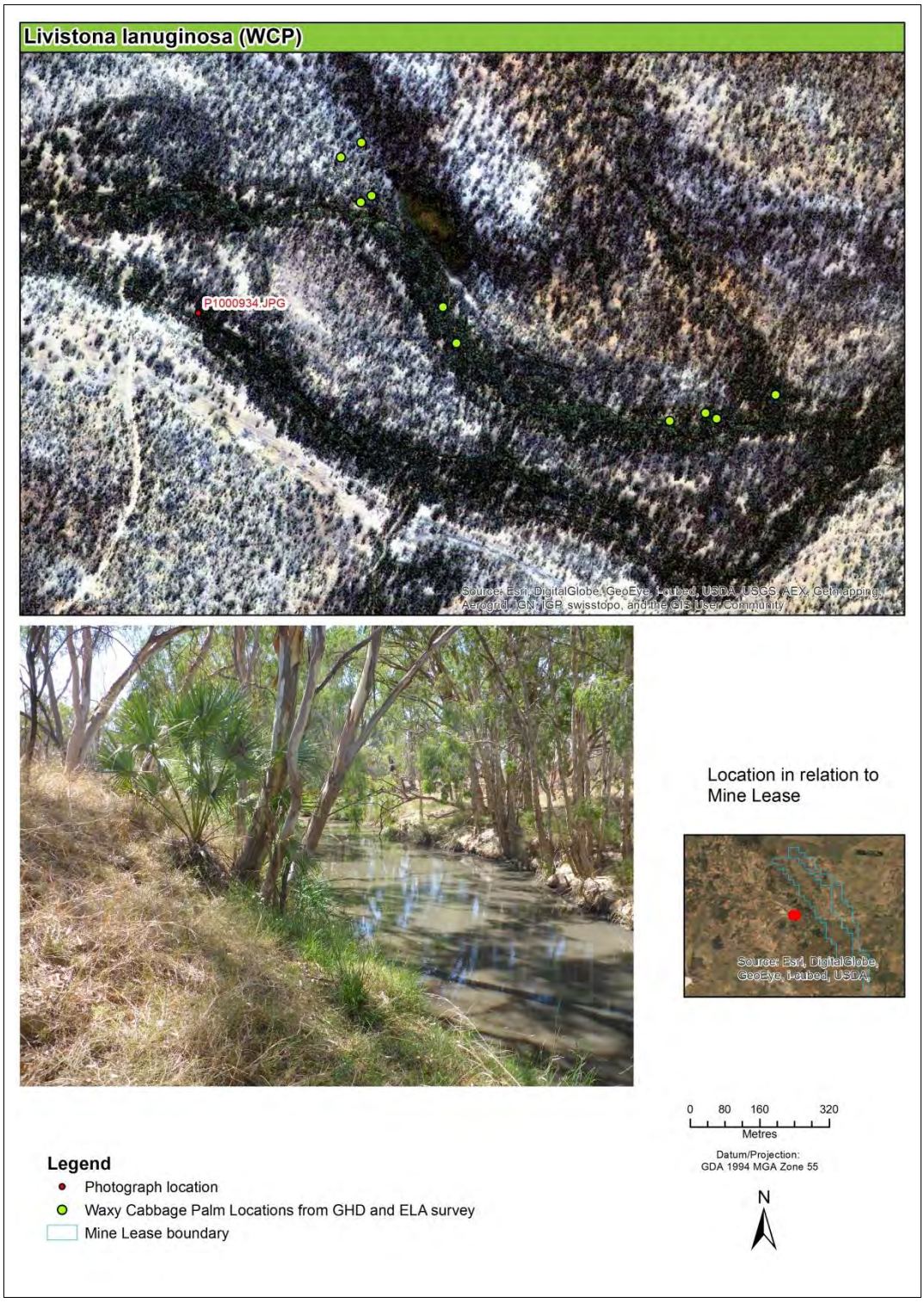


Figure 7 Two metre high *Livistona lanuginosa* (WCP) growing on a bank elevated above the water flow in a tributary of the Carmichael River (934)

Photograph 100934, to the left, was taken by Bruce Wilson on November 2015, from the location indicated on the above map.

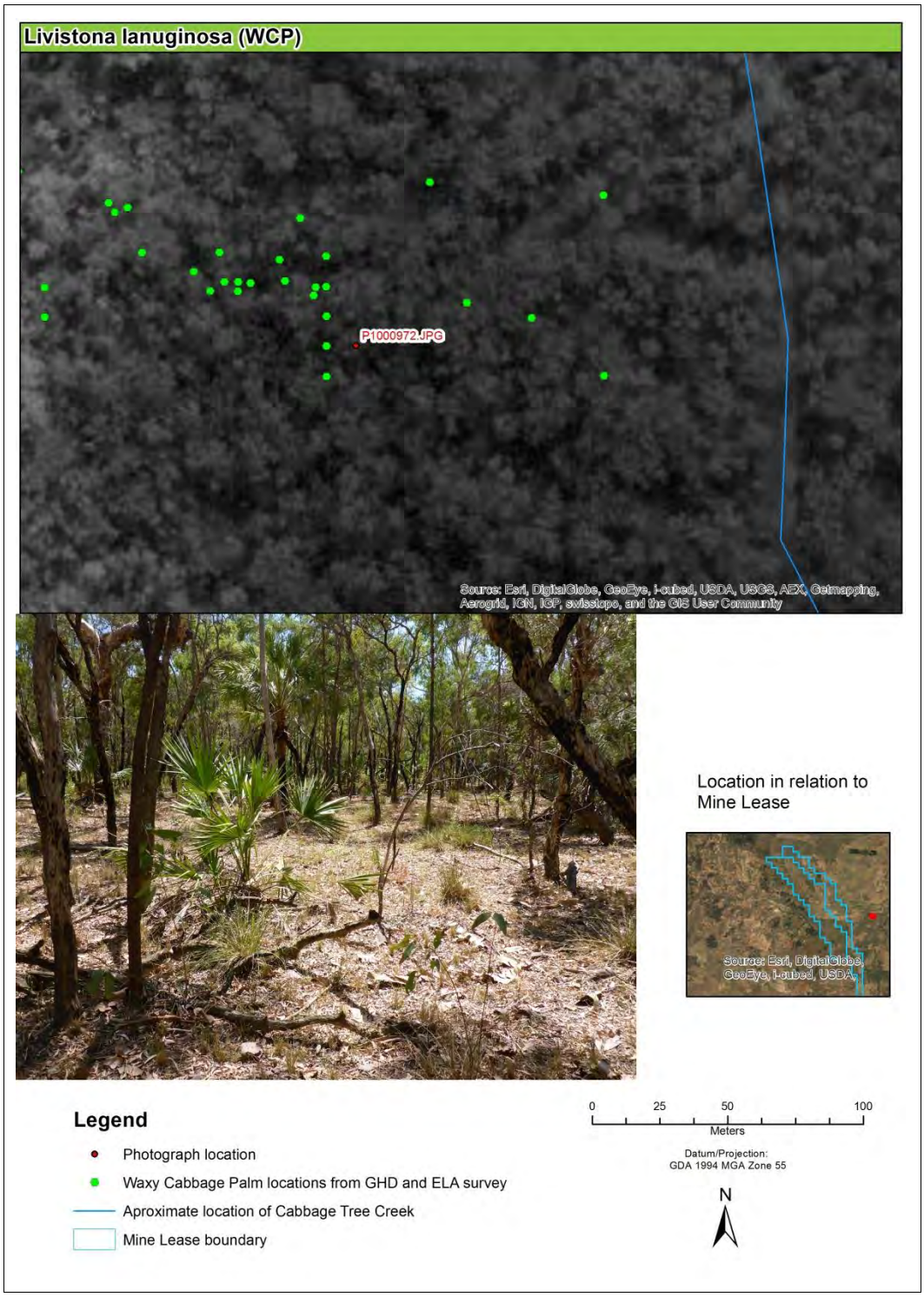


Figure 8 *Livistona lanuginosa* (WCP) growing on the alluvial plain near Cabbage Tree Creek (933)

Photograph100973, to the left, was taken by Bruce Wilson on November 21 2014 facing in a westerly direction from the location indicated on the above map.

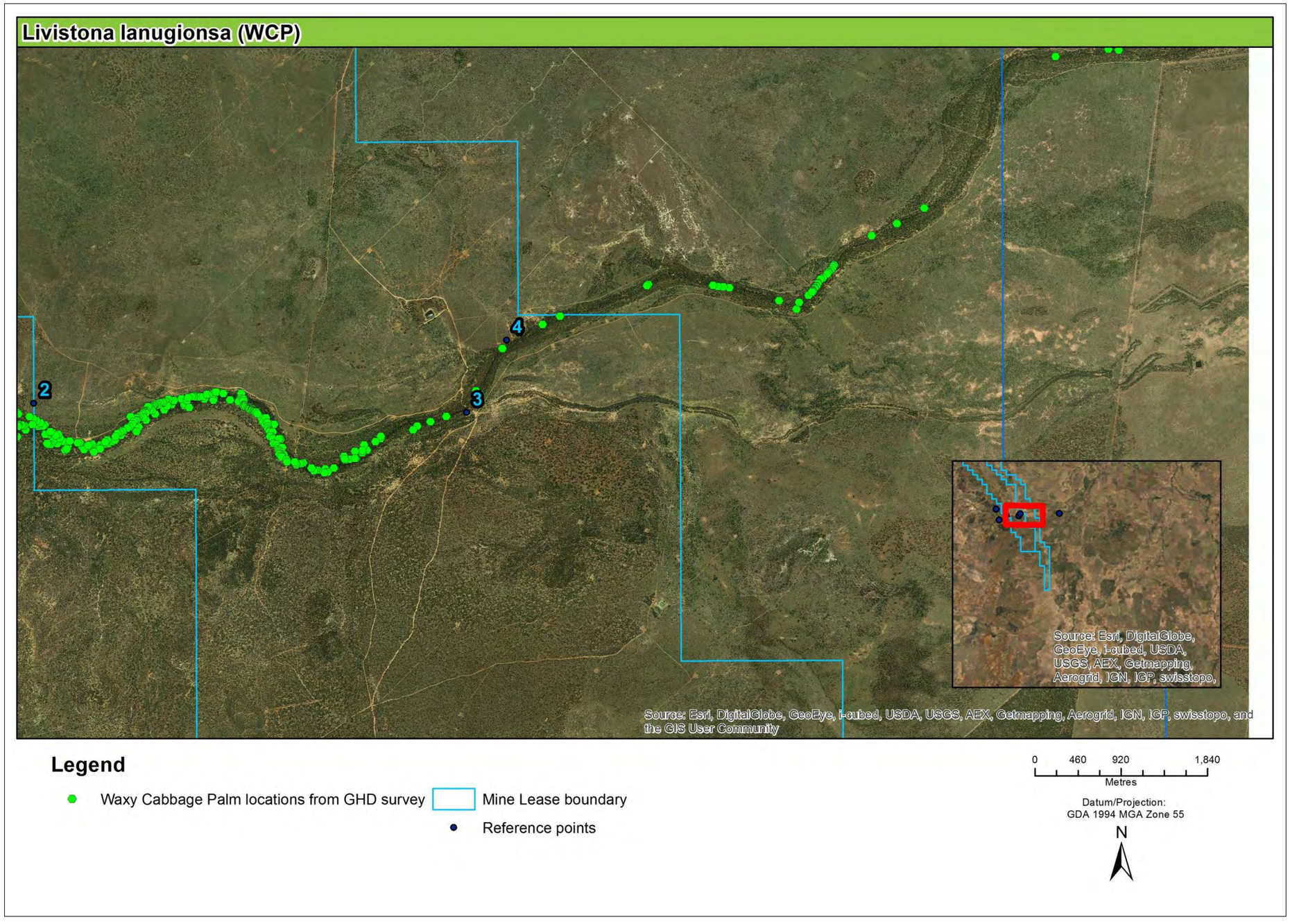


Figure 9 Map of *Livistona lanuginosa* (WCP) on the Carmichael River in the eastern part of the Mine Lease

The WCP in the east of this area are much sparser and confined to a narrower band along the river compared to those in the west.

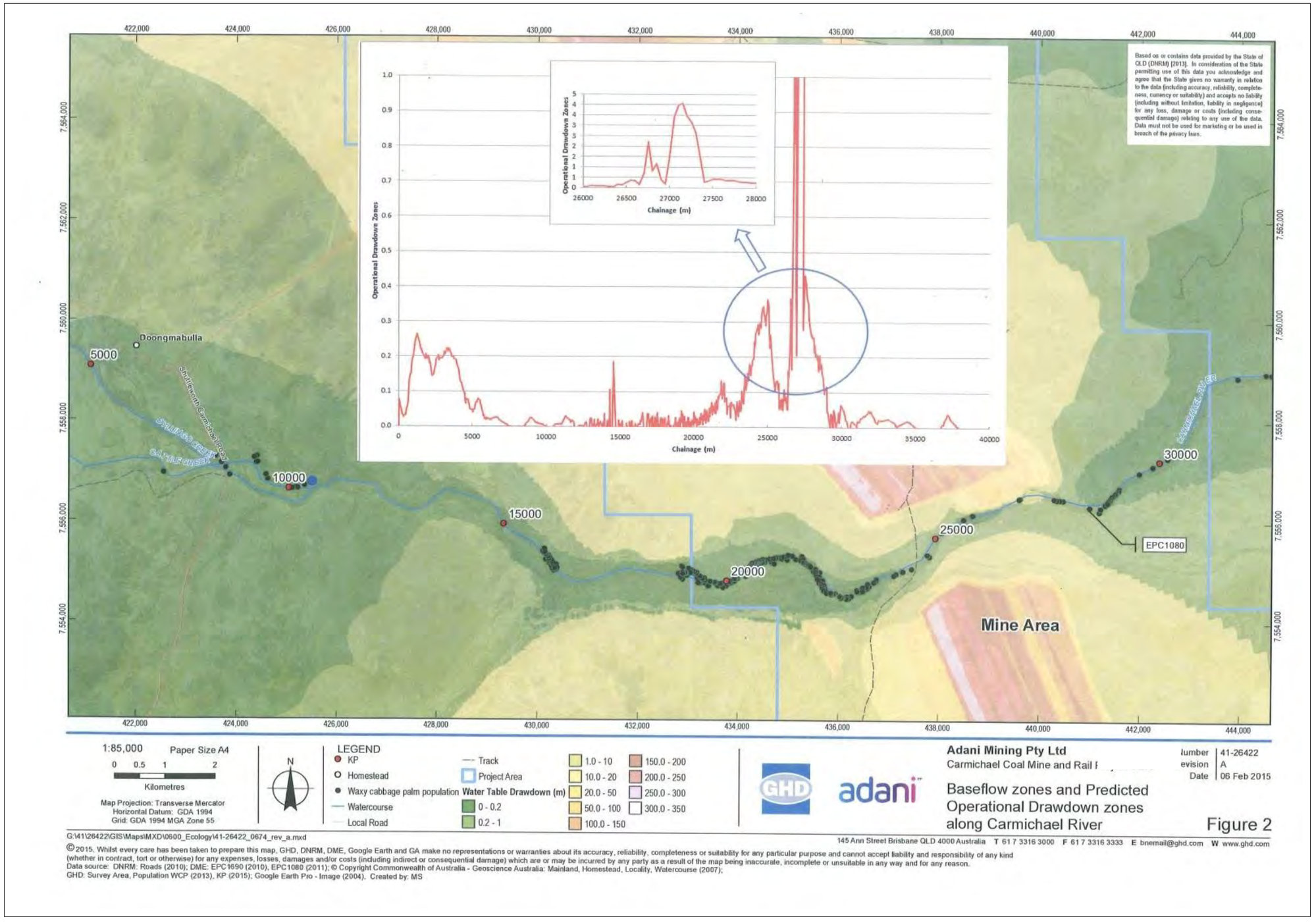


Figure 10 Map of predicted operational water table drawdown

This map was supplied by James Dodeswell (Senior Environmental Engineer GHD) and is a representation of Figure 26 in the **SEIS Updated Mine Ecology Report**. The graph show the actual water table drawdown along the Carmichael River at the chainage (distances in metres) indicated on the map.

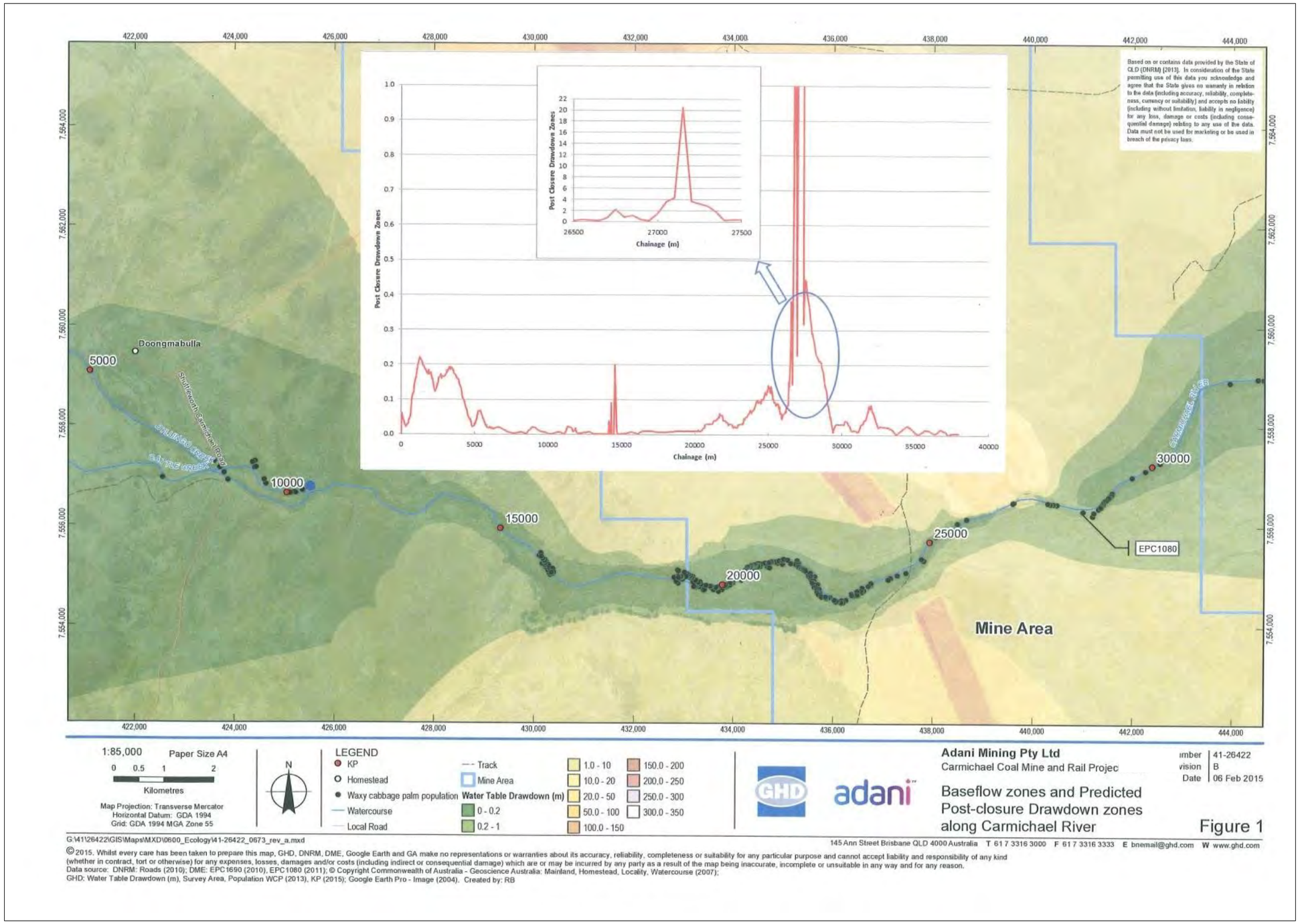


Figure 11 Map of predicted post closure water table drawdown

This map was supplied by James Dodeswell (Senior Environmental Engineer, GHD) and is a representation of Figure 27 in the **SEIS Updated Mine Ecology Report**. The graph show the actual water table drawdown along the Carmichael River at the chainage (distances in metres) indicated on the map.

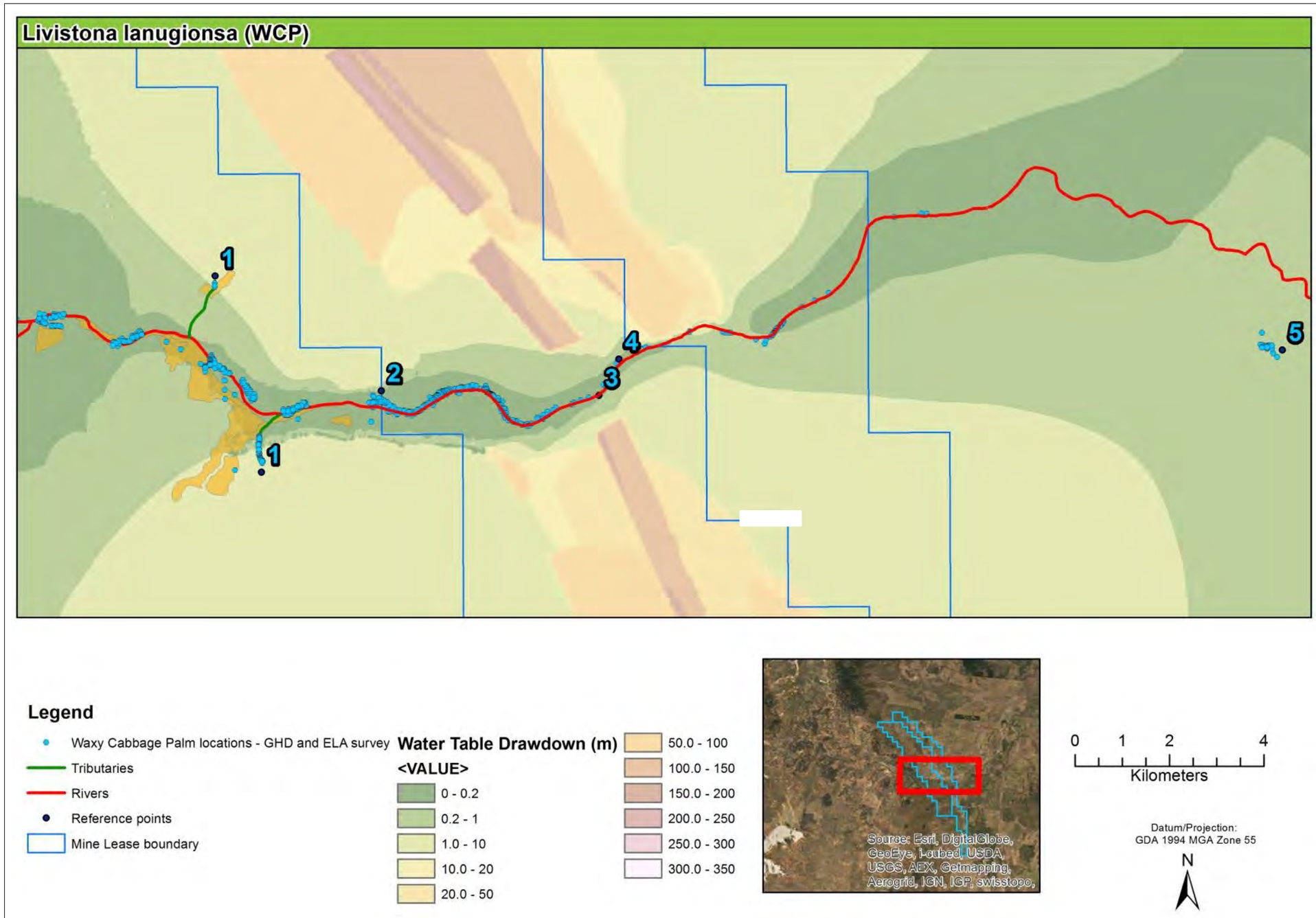


Figure 12 Map of predicted post closure water table draw down in relation a tributaries to the east of the mine lease and Cabbage Tree Creek

F Confirmation

In preparing this report

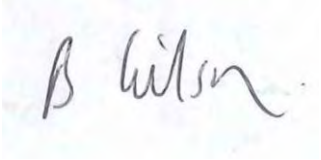
a) I have read and understood relevant extracts of the Land Court Rules 2010 (Qld) and the Uniform Civil Procedure Rules 1999 (Qld). I acknowledge that I have an overriding duty to assist the Court and state that I have discharged that duty.

b) I have provided within my report:

- details of my relevant qualifications;
- details of material that I relied on in arriving at my opinions; and
- other things as required by the Land Court Rules.

c) I confirm that:

- the factual matters included in the statement are, to the best of my knowledge, true;
- I have made all enquiries I consider appropriate for the purpose of preparing this statement;
- the opinions included in this statement are genuinely held by me;
- this statement contains reference to all matters I consider significant for its purpose;
- I have not received or accepted any instructions to adopt or reject a particular opinion in relation to an issue in dispute in the proceeding.
- If I become aware of any error or any data which impact significantly upon the accuracy of my report, or the evidence that I give, prior to the legal dispute being finally resolved, I shall use my best endeavours to notify those who commissioned my report or called me to give evidence.
- I shall use my best endeavours in giving evidence to ensure that my opinions and the data upon which they are based are not misunderstood or misinterpreted by the Land Court.
- I have not entered into any arrangement which makes the fees to which I am entitled dependent upon the views I express or the outcome of the case in which my report is used or in which I give evidence.



Bruce Wilson

Dated: 12 February 2015

Appendix A Curriculum Vitae

Bruce Wilson

SENIOR ECOLOGIST, ECO LOGICAL AUSTRALIA PTY LTD

QUALIFICATIONS

- Master of Science, University of Tasmania, Hobart. 1992. Research thesis on Vegetation studies across a shrubland - forest boundary, Melville Island, Northern Territory, Australia.
- Bachelor of Science (Forestry), Australian National University, 1979.

Bruce is an ecologist with over 25 years' experience in the management and delivery of major vegetation survey, mapping, monitoring, research and assessment projects across Queensland and the Northern Territory.

Before working for Eco Logical Australia, Bruce was Science Leader at the Queensland Herbarium with responsibility for the delivery of the Regional Ecosystem, Wetland and Groundwater Dependent Ecosystem mapping. These products underpin many land use management initiatives across the state including impact assessments of coal seam gas and large coal mine developments. Bruce has also completed a vegetation map of the Northern Territory, a survey of Top End floodplain wetlands and many other applied research and monitoring projects across northern Australia.

Bruce is recognised as an Australian expert on survey and mapping methodologies and vegetation/ecosystem classification and has regularly provided expert scientific advice to State, Local and Commonwealth governments, industry and the community about the development and implementation of legislation and policy. Bruce has an extensive proven track record in design and execution of ecological surveys, impact assessments, the development of management plans, literature reviews and the initiation, management and delivery of multiple projects and work teams.

RELEVANT PROJECT EXPERIENCE

Ecological Survey & Mapping

- Completed regional ecosystem surveys and mapping for numerous Queensland map sheets - Brigalow Belt, Mulga Lands, Mitchell Grass Downs and Channel Country (Queensland Herbarium)
- Technical lead and management in the completion of regional ecosystem survey and mapping for remaining map sheets of Queensland (Queensland Herbarium)
- Technical lead, in collaboration with others, in the development of the regional ecosystem framework in Queensland (Queensland Herbarium)

- Developed wetland delineation guidelines for Queensland. (Department Environment and Heritage)
- Technical lead in the development of methods of state-wide survey and mapping of regional ecosystem, wetland and Ground Water Dependent Ecosystems (Department Environment and Heritage)
- Project leader of the state-wide Queensland wetland mapping and Groundwater Dependent Ecosystem mapping for parts of the state (Department Environment and Heritage)
- Vegetation monitoring of the Gwydir wetlands (Department of the Environment)
- Floristic survey and monitoring of endangered Great Artesian Basin springs in the Surat Basin and input into the development of conceptual models (CSG companies)

Ecological and Impact Assessments

- Vegetation map and targeted threatened plants survey Pinedale East Expansion (Energy Australia)
- Weed survey and risk assessment Eagle Downs Mine (Eagle Downs Coal)
- Pre-clearance survey EREs Eagle Downs South (Eagle Downs Coal)
- Condition assessment of Carmichael Mine site using Ecological Equivalence and other methods (Adani)
- Advice on monitoring methods for Great Artesian Basin Springs: Queensland Office Groundwater Impact Assessment (Office of Groundwater Impact Assessment)
- Assessment of clearing of Endangered Ecosystems in the Moranbah area (Department Environment & Heritage Protection)
- Contributed to the development of Biocondition assessment and Ecological Equivalence method
- Delineation and survey of regional ecosystems, wetlands, vegetation condition and biodiversity values of individual properties for tree-clearing or other development applications
- Conservation strategy for the Channel Country Bioregion
- Design and implementation of vegetation monitoring programme for National Parks in the Mulga Lands

Approvals/Appeals/Expert Witness

- Advice to the Commonwealth, state and local governments, on the definition and assessment guidelines for proposed and listed EPBC communities in Queensland
- Assessment and delineation of EPBC listed grasslands and Brigalow communities in central Queensland (Commonwealth Government)
- Expert witness statements on the definition of regional ecosystems, wetlands and ecological communities for courts. expert witness for Environmental Protection Agency (Co-Respondent) in the Planning & Environment Court of Queensland, providing opinions on wetland delineation and definition at the site (Titanium

Enterprises Pty Ltd v Caloundra City Council & Anor [2006] QPEC 106).

- Investigations under the Environmental Protection Act 1994 (Qld) by the Department Environment & Heritage Protection v Arrow Energy, commencing in 2013 and in relation to the proceedings in the Mackay Magistrates Court.
- Expert witness statements for prosecutions under the Vegetation Management Act 1999 (Qld).

SELECTED PUBLICATIONS/REPORTS

Survey, mapping monitoring projects

Neldner, V.J., Niehus, R.E., Wilson, B.A., McDonald, W.J.F. and Ford, A.J. (2014). *The Vegetation of Queensland. Descriptions of Broad Vegetation Groups*. Version 1.1. Queensland Herbarium, Department of Science, Information Technology, Innovation and the Arts.)

Kerr-Shires K, Tomlinson M., Muriuki G, Pollett A., Wilson B., Ronan M. (2012) *Groundwater Dependent Ecosystem Mapping and Classification Method: a method for providing baseline mapping and classification of groundwater dependent ecosystems in Queensland*. Brisbane: Department of Science, Information Technology, Innovation and the Arts, Queensland Government.

Neldner, V.J., *Wilson, B. A.,* Thompson, E.J. and Dillewaard, H.A. (2012) *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland*. Version 3.2. Queensland Herbarium, Environmental Protection Agency, Brisbane. 113 pp.

Eyre, T.J., Kelly, A.L, Neldner, V.J., *Wilson, B.A.* and Ferguson, D.J. (2010). *BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland. Assessment Methodology Manual. Version 2.0.* Department of Environment and Resource Management (DERM), Biodiversity and Ecosystem Sciences, Brisbane.

Department of Environment and Resource Management (2010) *Queensland Wetland Definition and Delineation Guideline, Part B: Delineation and Mapping Guideline.* Queensland Government, Brisbane. Major author

Wilson, B.A. and Ryan, T. (2010) Regional ecosystem mapping and habitat values of a proposed car park on McLeay Island A report prepared for the Redland City Council. March 2010. Queensland Herbarium, Brisbane.

Environmental Protection Agency (2005) Wetland Mapping and Classification Methodology – Overall Framework – A Method to Provide Baseline Mapping and Classification for Wetlands in Queensland, Version 1.2, Queensland Government, Brisbane. A major contributor

Wilson, B.A., (1996-1999). Regional Ecosystem Survey and Mapping in the Mitchell Grass Downs, Brigalow Belt and Mulga Lands, Dalby and Tambo 1:250 000 map sheets. Queensland Herbarium, Brisbane.

Wilson, B.A., Dunlop, C.R., Brocklehurst, P.S., Clark, and Barrett, M.J. (1989). The

Vegetation of an Area of Mt Bundy Station - Proposed Training Area for the Second Cavalry Regiment. Conservation Commission of the Northern Territory Technical Memorandum 89/6.

Wilson, B.A., Brocklehurst, P.S., Clark, M.J. and Dickinson, K.J.M. (1990). *Vegetation Survey of the Northern Territory.* Technical Report No. 49, Conservation Commission of the Northern Territory, Darwin.

Wilson B.A. and Clark M.J. (1990*). The vegetation of an area surrounding the proposed Mt Todd Gold Mine.* Technical Memorandum 90/2, Conservation Commission of the Northern Territory, Darwin.

Wilson B.A., Brocklehurst P.S. and Whitehead, P.J. (1991). *Classification, distribution and environmental relationships of the wetland vegetation of major floodplains. Northern Territory, Australia.* Technical Memorandum 91/2, Conservation Commission of the Northern Territory, Darwin.

Research, literature review

Pisanu, P., Kingsford, R.T., Wilson, B.A. and Bonifiacio, R. (2015) Status of connected wetlands of the Lake Eyre Basin, Australia. *Austral Ecol*, in press.

Nicholson E., Regan T.J., Auld T.D., Burns E., Chisholm L.A., English V., Harris S., Harrison P., Kingsford R.T., Leishman M.R., Metcalfe D.J., Pisanu P., Watson C.J., White M., White M.D., Williams R.J., Wilson B. & Keith D.A. (2014). Towards consistency, rigour and compatibility of risk assessments for ecosystems and ecological communities.*Austral Ecol*, in press.

Wilson, B.A., Neldner, V.J. and Accad, A. (2002) The extent and status of remnant vegetation in Queensland and its implications for statewide vegetation management and legislation. *Australian Rangeland Journal **24(1)**:* 6-36.

Boulter S.L., Wilson, B.A., Westrup J., Anderson E.R., Turner E.R. and Scanlan J.C. (eds.) (2000). *Native vegetation management in Queensland: Background, science and values*. Department of Natural Resources, Brisbane.

Wilson, B.A**.** (1999a). Mulga Lands, Channel Country, Mitchell Grass Downs. In: P. Sattler and R. Williams (eds.), *The conservation status of Queensland's bioregional ecosystems.* Environmental Protection Agency, Brisbane.

Wilson, B.A., Russell-Smith, J. and Williams, R (1997). Terrestrial Vegetation In: M. Finlayson & J. Werger (eds.), *Biogeography of the Alligator Rivers region* (W. Junk: The Hauge).

Wilson, B.A**.** (1995). A vegetation monitoring program for the national parks in Queensland's' Mulga Lands. In: M. Page & T. Beutel (eds.), *Research and management in the Mulga Lands.* Proceedings of a workshop held at University of Queensland, Gatton, May 1994.

Wilson, B.A**.** and Bowman, D.M.J.S. (1994). Factors influencing tree growth in tropical savanna: studies of an abrupt *Eucalyptus* boundary at Yapilika, Melville Island, northern Australia. *Journal of Tropical Ecology* **10:**103-1 20.

Wilson B.A. and Fensham, R (1994). A comparison of classification systems for the conservation of sparsely wooded plains on Melville Island, northern Australia. *Australian Geographer* **25** (1): 1 8-31.

Wilson, B.A. and Young, P.A.R. (1993). *Conservation strategy, Channel Country biogeographic region, Queensland.* Unpublished report prepared for Australian National Parks and Wildlife Service, Endangered Species Program Project No. 14, Canberra.

Wilson, B.A. and Bowman, D.M.J.S. (1987). Fire, storm, flood and drought: the vegetation ecology of Howard's Peninsula, Northern Territory, Australia. *Australian Journal Ecology* ***12:***1 65-74.

Appendix B Calculation of flow rate and area

Information supplied by the Queensland Herbarium (Boris Laffiner, February 3, 2015)							Calculation by Bruce Wilson							
							Current estimated flow rates		less 10% flow		less 5% flow		less 3% flow	
							l / sec	litres / min	flow rate (l/sec)	area (m2)	flow rate (l/sec)	area (m2)	flow rate (l/sec)	area (m2)
Site Number	Name	Visit Number	Spring wetland area (square meters)	Estimated spring flow (L/min)	Flow derivation	Notes	equation 1	column H*60	H-(.1*H)	equation 2	H-(.05*H)	equation 2	column H-(.03* column H)	equation 2
74	Doongmabulla	25-Jun-13	11941.67451	210.28	Fatchen		3.50	210.28	3.15	11084.46	3.33	11516.38	3.40	11687.26
74.2	Doongmabulla	16-Mar-14	11427.99	197.60	Fatchen	Not observed in field	3.29	197.60	2.96	10607.65	3.13	11020.99	3.19	11184.52
74.3	Doongmabulla	16-Mar-14	1500.66	11.19	Fatchen	Not observed in field	0.19	11.19	0.17	1392.94	0.18	1447.21	0.18	1468.69
75	Moses	24-Jun-13	20420.73	449.13	Fatchen		7.49	449.13	6.74	18954.87	7.11	19693.45	7.26	19985.68
75.1	MosesA	24-Jun-13	792.374672	4.53	Fatchen		0.08	4.53	0.07	735.50	0.07	764.15	0.07	775.49
75.2	MosesB	24-Jun-13	327.71	1.30	Fatchen		0.02	1.30	0.02	304.19	0.02	316.04	0.02	320.73
75.3	MosesC	24-Jun-13	119.38	0.31	Fatchen		0.01	0.31	0.00	110.81	0.00	115.13	0.01	116.84
75.4	MosesD	24-Jun-13	175.735089	0.54	Fatchen		0.01	0.54	0.01	163.12	0.01	169.48	0.01	171.99
77	Keelback	24-Jun-13	17414.67	358.55	Fatchen		5.98	358.55	5.38	16164.59	5.68	16794.45	5.80	17043.66
77.1	Little Keelback	16-Mar-14	918.5	5.59	Fatchen		0.09	5.59	0.08	852.57	0.09	885.79	0.09	898.93
78	Isaiah	24-Jun-13	11553.78	200.68	Fatchen		3.34	200.68	3.01	10724.41	3.18	11142.30	3.24	11307.63
154	Little Moses	25-Jun-13	14312.75	271.68	Fatchen		4.53	271.68	4.08	13285.34	4.30	13803.01	4.39	14007.82
1130	Geschlichen	25-Jun-13	6514.58	89.24	Fatchen		1.49	89.24	1.34	6046.94	1.41	6282.57	1.44	6375.79
1131.1	Lot's Wives 1	16-Mar-14	176.721358	0.54	Fatchen		0.01	0.54	0.01	164.04	0.01	170.43	0.01	172.96
1131.2	Lot's Wives 2	16-Mar-14	78.157262	0.17	Fatchen		0.00	0.17	0.00	72.55	0.00	75.37	0.00	76.49
1131.3	Lot's Wives 3	16-Mar-14	356.58326	1.47	Fatchen		0.02	1.47	0.02	330.99	0.02	343.88	0.02	348.99
1131.4	Lot's Wives 4	16-Mar-14	214.347612	0.71	Fatchen		0.01	0.71	0.01	198.96	0.01	206.71	0.01	209.78
1131.5	Lot's Wives 5	16-Mar-14	284.298374	1.06	Fatchen		0.02	1.06	0.02	263.89	0.02	274.17	0.02	278.24
1131.6	Lot's Wives 6	16-Mar-14	4598.111913	54.52	Fatchen		0.91	54.52	0.82	4268.05	0.86	4434.35	0.88	4500.15
1131.7	Lot's Wives 7	16-Mar-14	109.543144	0.28	Fatchen		0.00	0.28	0.00	101.68	0.00	105.64	0.00	107.21
1131.8	Lot's Wives 8	16-Mar-14	164.965059	0.49	Fatchen		0.01	0.49	0.01	153.12	0.01	159.09	0.01	161.45
TOTAL			103403.2623	1859.86		2.678196377	31.00	1859.86	27.90	95980.65	29.45	99720.59	30.07	101200.31

Area in ha 10.34

Equation 1 FLOW =10^(((LOG(AREA))-3.692)/0.707)

Equation 2 AREA=10^(((LOG(FLOW))*0.707)+3.692)

flow in litres per second, area in m^2

Summary								
litres / min	1859.86	1859.86	1673.87		1766.87		1804.06	
litres / hour	111591.52	111591.52	100432.36		106011.94		108243.77	
litres / day	2678196.38	2678196.38	2410376.74		2544286.56		2597850.49	
ML / day	2.68	2.68	2.41		2.54		2.60	
Loss of area (ha)				0.7		0.4		0.2
Loss of area (%)				7.2		3.6		2.1

Appendix C Abbreviations

BOS	Biodiversity Offset Strategy
EPBC	Environment Protection and Conservation Protection Act 1999
GDEMP	Groundwater Dependent Ecosystem Management Plan
OAMP	Offset Area Management Plan
WCP	Waxy Cabbage Palm

ATTACHMENT 1

Partner Peter Stokes
Writer Claire Meiklejohn
Direct line 07 3233 8760
Email cmeiklejohn@mccullough.com.au
Our reference CEM:PWS:159359-00022

Lawyers McCullough Robertson

3 February 2015

Mr B Wilson
Senior Ecologist - Technical
Eco Logical Australia Pty Ltd

Email brucew@ecoaus.com.au

Dear Bruce

Adani Mining Pty Ltd v Land Services of Coast & Country Inc. & Anor
Land Court of Queensland Proceedings no. MRA428-14, EPA429-14, MRA430-14, EPA431-14, MRA432-14 and EPA433-01

We refer to:

1 Mining Lease Applications (**MLAs**) 70441, 70505 and 70506 made by Adani Mining Pty Ltd (**Adani**);

2 the associated environmental authority application, as re-made on 14 April 2014;

3 the Environmental Impact Statement (**EIS**), Supplementary EIS (**SEIS**) and Additional Information to the EIS (**AEIS**) prepared for Adani and made publicly available under the *State Development and Public Works Organisation Act 1971* (Qld);

4 the draft Environmental Authority (**EA**) issued by the Statutory Party on 28 August 2011;

5 the Objection of Land Services of Coast and Country Inc (**LSCCI**) to the MLAs dated 16 June 2014;

6 the Objection of LSCCI to the EA made 10 September 2014;

7 the submission (dated 17 June 2014) and objection (dated 25 September 2014) about the EA made by Debi Goenka of the Conservation Action Trust (**CAT**);

8 the Preliminary List of Issues for the LSCCI dated 2 December 2014;

9 your joint report, with Mike Olsen, dated 11 January 2015 in relation to Waxy Cabbage Palm (**WCP Joint Report**)

10 your joint report, with Dr Fensham, dated 15 January 2015 in relation to Springs Ecology (**Springs Ecology Joint Report**);

11 Orders 13 and 14 made by the Court on 30 January 2015 (**attached**), which modify the LSCCI objectios and Preliminary List of Issues; and

12 our letter of instruction to you dated 3 February 2015.

Instructions

13 We require you to provide a further statement of evidence under the *Land Court Rules 2000* (Qld) (**Rules**).

14 In accordance with orders made by the Court, your further statement of evidence is required by **Friday, 6 February 2015**.

Request for further information – Springs ecology

15 **Attached** is a memorandum prepared by Dr Noel Merrick in relation to the flow rate changes at Doongmabulla Springs related to the Mine. A copy of this document is being provided to the solicitors for the LSCCI.

Request for further information – base flow impacts

16 We note the requests for information contained in the WCP Joint Report. Much of the relevant information is contained in the EIS and SEIS material.

17 We have confirmed with our client's nominated groundwater experts that in their opinion the impacts predicted in the EIS and SEIS work are reliable, and significant changes to the predicted impacts are not expected to be the subject of evidence put before the Land Court on behalf of the applicant.

18 Accordingly, you are instructed to rely on that work as you see fit.

19 The memo from Dr Merrick dated 3 February 2014 may also be relevant to your opinions in respect of the waxy cabbage palm.

Format of report

20 When preparing the further statement of evidence, and responding to the questions dealt with in section E below, please deal with the following:

SECTION A - Qualifications and Curriculum Vitae

21 Please attach your curriculum vitae to the report.

SECTION B - Material relied on in preparing the statement

22 Lists are sufficient for the statement, it would be useful to ensure that you (and we) have a copy of all the listed material when finalising your report. In particular, you should list:

(a) all material facts, written or oral, on which the statement of evidence is based; and

(b) reference to any literature or other material relied on by you to prepare the statement.

23 You do not need to list material you have **not** relied on.

24 Any inspection, examination or experiment conducted, initiated or relied on by you to prepare the statement must also be described. This can be done by reference to the calculation methodology as set out in your joint report, with any further explanation or clarification if necessary.

SECTION C – Background to Report

25 Please set out the extent of your previous involvement with the Mine. Specifically, we would like you to:

(a) indicate whether you were involved in the preparation of any material in support of the proposed Mine and, if so, provide details of that work;

(b) confirm that you have since been engaged by McCullough Robertson, on behalf of Adani, to provide an expert report in the Land Court proceedings;

(c) confirm that you have read this letter of instruction (and attach a copy of this letter of instruction to your report), and confirm that you understand your duties to the Land Court as an expert witness;

(d) confirm that, notwithstanding your previous relationship with the Mine (if any), you consider you are able to provide an informed, independent opinion about the matters contained within your Report.

SECTION D – Opinion on objections

26 Please review the objections and respond to any issues within your field of expertise which concern the MLAs and EAs.

27 It may be useful to divide this section of your report into two parts, one dealing with springs ecology and one dealing with the waxy cabbage palm. In this way it will assist the court to distinguish between each experts and his different opinions.

28 In particular, we draw your attention to the grounds of each objection, which are set out below for convenience.

MLAs objection

The application for the mining leases under the Mineral Resources Act 1989 (Qld) (MRA) for the Carmichael Coal Mine (the mine) should be refused on the basis of the considerations stated in section 269(4)(c), (f), (i), (j), (k), (l) and (m) of the MRA:

1. *If the mine proceeds, there will be severe and permanent adverse impacts caused by the operations carried out under the authority of the proposed mining leases.*

2. *If the mine proceeds, the public right and interest will be prejudiced.*

3. *Good reason has been shown for a refusal to grant the mining leases due to the risk of severe environmental impacts and the lack of scientific certainty regarding those impacts.*

4. *Taking into consideration the current and prospective uses of the land, the proposed mining operation is not an appropriate land use.*

5. *There is an unacceptable risk that will there will not be an acceptable level of development and utilisation of the mineral resources within the area applied for because the mine, if it proceeds at all, is likely to cease to be economically viable within the term of the lease, resulting in some or all of the environmental impacts without realising the full economic benefits predicted.*

6. *The Applicant does not have the necessary financial capabilities to carry on mining operations under the proposed mining leases.*

7. *If the mine proceeds, the operations to be carried on under the authority of the proposed mining leases will not conform with sound land use management.*

8. *In the alternative to grounds 1-7 above, if the applications are not refused, conditions should be imposed to address the matters raised in grounds 1-7.*

EA application objection

The application for the environmental authority for the Carmichael Coal Mine (the mine) should be refused under the Environmental Protection Act 1994 (Qld) (EPA) on the basis of the considerations stated in ss 3, 5, 171 and 191 of the EPA and other relevant considerations having regard to the subject-matter, scope and purpose of the EPA:

1. *Approval of the mine is contrary to the object of the EPA stated in s 3 because approval and construction of the mine will not protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (ecologically sustainable development).*

2. *Approval of the mine would be contrary to the requirement in s 5 of the EPA for the administering authority and the Land Court to perform a function or exercise its power under the Act in a way that best achieves the object of the Act.*

3. *Approval and construction of the mine would be contrary to the precautionary principle, which is a principle of environmental policy as set out in the Intergovernmental Agreement on the Environment and, therefore, part of the standard criteria for the decision.*

4. *Approval and construction of the mine would be contrary to intergenerational equity, which is a principle of environmental policy as set out in the Intergovernmental Agreement on the Environment and, therefore, part of the standard criteria for the decision.*

5. *Approval and construction of the mine would be contrary to the conservation of biological diversity and ecological integrity, which is a principle of environmental policy as set out in the Intergovernmental Agreement on the Environment and, therefore, part of the standard criteria for the decision.*

6. *Approval and construction of the mine will cause environmental harm to the character, resilience and value of the receiving environment.*

7. *Approval and construction of the mine would be contrary to the public interest.*

8. *Approval and construction of the mine will cause material and serious environmental harm.*

9. *In the alternative to grounds 1-8 above, if the application is not refused, conditions should be imposed to address the matters raised in grounds 1-8 above.*

29 We also ask you to again review and consider those 'Facts and Circumstances' relied on in support of each objection that are relevant to your field of expertise, namely:

(a) paragraphs 11 to 14 and 34 of the Facts and Circumstances in the MLAs objection; and

(b) paragraphs 11 to 14 and 29 of the Facts and Circumstances in the EA objection.

30 Your further statement of evidence should also build on each of the Springs Ecology Joint Report and the WCP Joint Report, which sets out in detail those notified issues relevant to your field of expertise.

31 Please note that, pursuant to the Rules, your further statement may not:

(a) contradict, depart from or qualify an opinion in relation to an issue the subject of agreement in the relevant Joint Report; or

(b) raise a new matter not already mentioned in the relevant Joint Report.

32 Accordingly, we anticipate that your further statement of evidence in respect of Springs Ecology will essentially deal with:

(a) the implications of the response to the request for further information provided with these instructions; and

(b) the differences in opinion between yourself and Dr Fensham in relation to effective offsetting for the loss of Doongmabulla Springs, if relevant.

33 In terms of the waxy cabbage palm, we also ask that you also address the following specific questions (either separately, or as part of the responses to the issues in the objections):

(a) in relation to issue no. 39, notwithstanding the recent survey, do you agree that the EIS does not contain sufficient information about the extent and abundance of WCP in the Carmichael River and its tributaries outside the mining lease area? Does what is 'sufficient' information vary having regard to the purpose of the document? If the EIS contains insufficient information, does that mean that the project should not be granted approval, say, until further information is obtained?

(b) in relation to issue no. 38:

(i) can a map of WCP in the Burdekin catchment be provided?

(ii) is the Carmichael River population of WCP currently the largest and most diverse in the catchment?

(iii) in 2003, at the time of Pettit and Dowe's study, would the northern population have been, or have been considered to be, the largest and most diverse?

(c) in relation to issue no. 40, please explain the relevance or otherwise of the Kondo studies to the matters being considered by the Court.

(d) in relation to the Biodiversity Offsets Strategy and management discussion, please identify relevant parts and sections of the strategy and particular management mechanisms relevant to your opinion. Provide an explanation of any scope for improvement to the strategy, and whether the conditions of the draft EA allow for this.

34 In discussing those areas of disagreement noted in the Springs Ecology Joint Report and WCP Joint Report, as they primarily obtain to LSCCI's notified issues, we ask that you expand on and relate your opinion back (by reference for example to its number) to any relevant Facts and Circumstances and Grounds of the objections.

35 This discussion may occur in the context of, or by reference to, the areas of agreement in the Springs Ecology Joint Report or WCP Joint Report.

36 In your further statement of evidence, the Rules also require that where:

(a) there is a range of opinion on matters dealt with, a summary of the range of opinion and the reasons why you have adopted a particular opinion be provided; and

(b) access to any **readily ascertainable** additional facts would assist you in reaching a more reliable conclusion, a statement to that effect be included.

37 In dealing with the points of disagreement in each Joint Report, and responding to the relevant Facts and Circumstances and grounds of the objections, please also specifically identify any relevant conditions of the draft EA and express your opinion as to the appropriateness of the draft condition or its relevance to the grounds of the objections.

38 Please also address the CAT submission and objection to the extent they are relevant to your field of expertise.

SECTION E – Summary of conclusions

39 The Rules require your further statement to provide a summary of the conclusions you have reached. In our view, this is often best presented in a separate, concluding section (or at the start of the statement).

SECTION F – Expert's confirmation

40 It is important that the report you prepare be an independent report prepared bearing in mind an expert witness' overriding duty to the court. The overriding duty encompasses the following points:

(a) You have an overriding duty to assist the Court on matters relevant to your area of expertise;

(b) You are not an advocate for a party, even when giving testimony that is necessarily evaluative rather than inferential; and

(c) Your paramount duty is to the Court and not to the person retaining you.

41 An example of the type of thing that might be said in this section is as follows:

(a) *I have read and understood relevant extracts of the Land Court Rules 2010 (Qld) and the Uniform Civil Procedure Rules 1999 (Qld). I acknowledge that I have an overriding duty to assist the Court and state that I have discharged that duty.*

(b) *I have provided within my report:*

(i) *details of my relevant qualifications;*

(ii) *details of material that I relied on in arriving at my opinions; and*

(iii) *other things as required by the Land Court Rules.*

(c) *I confirm that:*

(i) *the factual matters included in the statement are, to the best of my knowledge, true;*

(ii) *I have made all enquiries I consider appropriate for the purpose of preparing this statement;*

(iii) *the opinions included in this statement are genuinely held by me;*

(iv) *this statement contains reference to all matters I consider significant for its purpose;*

(v) *I have not received or accepted any instructions to adopt or reject a particular opinion in relation to an issue in dispute in the proceeding.*

(d) *If I become aware of any error or any data which impact significantly upon the accuracy of my report, or the evidence that I give, prior to the legal dispute being finally resolved, I shall use my best endeavours to notify those who commissioned my report or called me to give evidence.*

(e) *I shall use my best endeavours in giving evidence to ensure that my opinions and the data upon which they are based are not misunderstood or misinterpreted by the Land Court.*

(f) *I have not entered into any arrangement which makes the fees to which I am entitled dependent upon the views I express or the outcome of the case in which my report is used or in which I give evidence.*

Confidentiality

42 Any report generated by you should remain in draft until such time as we are in a position to discuss the contents of the report with you. We ask that the report be kept strictly confidential as it is to be used for the purpose of obtaining legal advice or for use in legal proceedings. You are not authorised to provide these instructions or your report to any other person or party.

If you would like any further material, or have any questions, please contact us.

Yours sincerely

Peter Stokes
Partner

attachment

ATTACHMENT 2

Australian Government
Department of the Environment

Approval

Carmichael Coal Mine and Rail Infrastructure Project, Queensland (EPBC 2010/5736)

This decision is made under sections 130(1) and 133 of the *Environment Protection and Biodiversity Conservation Act 1999*.

Proposed action

person to whom the approval is granted	Adani Mining Pty Ltd
proponent's ACN (if applicable)	27 145 455 205
proposed action	To develop an open cut and underground coal mine, 189 km rail link and associated infrastructure approximately 160 km north west of Clermont in central Queensland [See EPBC Act referral 2010/5736].

Approval decision

Controlling Provision	Decision
World Heritage properties (sections 12 & 15A)	Approved
National Heritage places (sections 15B & 15C)	Approved
Wetlands of international importance (sections 16 & 17B)	Approved
Listed threatened species and communities (sections 18 & 18A)	Approved
Listed migratory species (sections 20 & 20A)	Approved
Great Barrier Reef Marine Park (sections 24B & 24C)	Approved
A water resource, in relation to coal seam gas development and large coal mining development (sections 24D & 24E)	Approved

conditions of approval

This approval is subject to the conditions specified below.

expiry date of approval

This approval has effect until 30 June 2090.

Decision-maker

name and position	The Hon Greg Hunt MP Minister for the Environment
signature	
date of decision	24 July 2014

Conditions attached to the approval

1. **The Minister** may determine that a plan, strategy or program approved by the Queensland Government satisfies a plan, strategy or program required under these conditions.

Project area

2. For the purpose of the action, the **approval holder** must not clear vegetation outside the **Project Area** shown at Appendix A unless targeted surveys have demonstrated that **Matters of National Environmental Significance** are unlikely to be impacted.

Groundwater management and monitoring plan

3. At least three months prior to **commencing excavation of the first box cut**, the **approval holder** must submit to **the Minister** for approval a Groundwater Management and Monitoring Plan (GMMP). The GMMP must contain the following:

    a) details of a groundwater monitoring network that includes:

        (i) control monitoring sites

        (ii) sufficient bores to monitor potential **impacts** on the Great Artesian Basin (GAB) aquifers (whether inside or outside the **Project Area**)

        (iii) a rationale for the design of the monitoring network with respect to the nature of potential **impacts** and the location and occurrence of **Matters of National Environmental Significance** (whether inside or outside the **Project Area**).

    b) baseline monitoring data

    c) details of proposed trigger values for detecting **impacts** on groundwater levels and a description of how and when they will be finalised and subsequently reviewed in accordance with **state approvals**

    d) details of the timeframe for a regular review of the GMMP in accordance with the requirements of the environmental authority issued under the *Environmental Protection Act 1994* (Qld), and subsequent updates of the GMMP, including how each of the outcomes of the following will be incorporated:

(i) independent review and update of the **groundwater conceptual model**, as well as the **numerical groundwater model** and water balance calculations (if recommended by the independent auditor), to incorporate monitoring data

(ii) future baseline research required by the Queensland Coordinator-General into the **Mellaluka Springs Complex** (Appendix 1, Section 3, Condition 1 of the **Coordinator-General's Assessment Report**)

(iii) the GAB Springs Research Plan (Conditions 25 and 26)

(iv) the Rewan Formation Connectivity Research Plan (Conditions 27 and 28).

e) provisions to make monitoring data available to **the Department** and Queensland Government authorities (if requested) on a six monthly basis for inclusion in any cumulative impact assessment, regional water balance model, bioregional assessment or relevant research required by the **Bioregional Assessment of the Galilee Basin sub-region and the Lake Eyre Basin and any subsequent iterations**

f) provisions to make monitoring results publicly available on the **approval holder**'s website for the life of the project

g) a peer review by a **suitably qualified independent expert** approved by **the Minister** in writing, and a table of changes made in response to the peer review.

4. The **approval holder** must not **commence excavation of the first box cut** until the GMMP has been approved by **the Minister** in writing. The approved GMMP must be implemented.

Note: *Many elements of the GMMP are also required under the state approval for the project. Where possible, a combined document should be prepared that addresses both state government and EPBC Act approval conditions.*

Matters of National Environmental Significance management plan/s

5. At least three months prior to **commencement** of **mining operations**, the **approval holder** must submit to **the Minister** for approval **Matters of National Environmental Significance** plan/s for the management of direct and indirect **impacts** of **mining operations** on (MNESMP).

Note: *If the MNESMP does not address any specific future activities (eg possible additional seismic surveys or specific mining stages) it should be updated in accordance with Condition 33.*

6. The MNESMP must be consistent with relevant recovery plans, threat abatement plans and approved conservation advices and must include:

a) a description of **environmental values** for each of the **Matters of National Environmental Significance** addressed in the plan

b) details of baseline and **impact** monitoring measures to be implemented for each of the **Matters of National Environmental Significance** including control and **impact** sites to be monitored throughout the life of the project. The monitoring must provide sufficient data to quantify likely **impacts** resulting from **mining operations**, including **subsidence** and changes in groundwater levels, to set habitat management goals (Conditions 6e) and 6f))

c) details of potential **impacts**, including area of **impact**, on each of the **Matters of National Environmental Significance** from **mining operations**, including **impacts** from:

   (i) vegetation clearing

   (ii) **subsidence** from underground mining, including **subsidence** induced fracturing and any changes to groundwater or surface water flow

   (iii) mine dewatering

   (iv) earthworks

   (v) noise and vibration

   (vi) emissions (including dust)

   (vii) light spill and other visual **impacts**

   (viii) stream diversion and flood levees

   (ix) weeds and pests.

d) measures that will be undertaken to mitigate and manage **impacts** on **Matters of National Environmental Significance** resulting from **mining operations**. These measures must include but not be limited to:

   (i) the use of fauna spotters prior to and during all vegetation clearing activities to ensure **impacts** on **Matters of National Environmental Significance** are minimised

   (ii) measures to avoid **impacts** on **Matters of National Environmental Significance** and their habitat located in the **Project Area**, but outside areas to be cleared, constructed upon and / or undermined, including adjacent to cleared areas

   (iii) measures to rehabilitate all areas of **Matters of National Environmental Significance** habitat

   (iv) habitat management measures including but not limited to management of **subsidence** and groundwater **impacts** of the project.

e) goals for habitat management for each relevant **Matters of National Environmental Significance**

f) a table of specific criteria for assessing the success of management measures against goals, and triggers for implementing corrective measures if criteria are not met within specified timeframes. This table must include but not be limited to measures relating to **subsidence** and groundwater **impacts**, including early warning triggers for **impacts** on groundwater at the **Doongmabulla Springs Complex** and the **Carmichael River**. Goals and triggers must be based on the baseline condition of the relevant **Matters of National Environmental Significance** as determined through baseline monitoring (see Conditions 3b) and 6b)). Corrective measures must include provision of offsets where it is determined that corrective management measures have not achieved goals within specified timeframes (see Conditions 11m) and 11o))

g) an ongoing monitoring program to determine the success of mitigation and management measures against the stated criteria in Condition 6f), including monitoring locations, parameters and timing. Monitoring for water resource **Matters of National Environmental Significance** must include hydrogeological, hydrological and ecological parameters

h) details of how compliance will be reported

i) details of how the MNESMP will be updated to incorporate and address outcomes from research undertaken for **Matters of National Environmental Significance** under this and any **state approvals**, including updating of goals, criteria and triggers (as required under Conditions 6e) and 6f))

j) details of qualifications and experience of persons responsible for undertaking monitoring, review, and implementation of the MNESMP

k) In the event that the future baseline research required by the Queensland Coordinator-General (Appendix 1, Section 3, Condition 1 of the **Coordinator-General's Assessment Report**) identifies that the **Mellaluka Springs Complex** provides high value habitat for the **black throated finch**, the **approval holder** must include management measures to address **impacts** resulting from drawdown at the **Mellaluka Springs Complex** in the MNESMP

l) details of how, where habitat for an **EPBC Act listed threatened species or community** not previously identified and reported to **the Department** is found in the **Project Area**, the **approval holder** will notify **the Department** in writing within five business days of finding this habitat, and within 20 business days of finding this habitat will outline in writing how the conditions of this approval will still be met (refer Condition 11j)).

7. **Mining operations** must not **commence** until the required MNESMP have been approved by **the Minister** in writing. The approved plan/s must be implemented.

Note: *Management plans (such as the Black Throated Finch Management Plan and the Groundwater Dependent Ecosystems Management Plan) may also be required under* ***state approvals****. Whenever possible a combined document should be prepared to address both state government and EPBC Act approval conditions.*

Note: Impacts *of the action other than* ***mining operations*** *will be offset as required in accordance with Conditions 8 to 11, but will be otherwise managed in accordance with* ***state approvals*** *– this is of particular relevance when* ***impacts*** *may occur prior to approval of the MNESMP.*

Offset requirements

8. The **approval holder** must **legally secure** the minimum offset areas detailed in Table 1 within two years of **commencement** of the **specified component** of the action.

Table 1. Minimum offset areas required for **impacts** on **EPBC Act listed threatened species and communities** and initial contribution to offsets for **subsidence impacts** from underground mining.

Environmental value	*Offset for **mining operations** north of **Carmichael River** (hectares)*	*Offset for **mining operations** south of **Carmichael River** (hectares)*	*Initial offset for underground mining component (hectares)*	*Offset for off-lease infrastructure (hectares)*	*Offset for **rail east** component (hectares)*	*Offset for **rail west** component (hectares)*
Black throated finch (southern)	18 204.06	10 739.39	2,000.00	7.62	2.44	46.48
Brigalow ecological community	15.12	721.11		0.00	6.26	72.50
Ornamental snake*	96.39	38.61		0.00	0.00	0.00
Squatter pigeon (southern)*	1598.00	902.00		0.00	0.00	0.00
Waxy cabbage palm	90.00	0.00		0.00	0.00	0.00
Yakka skink*	3770.48	1815.42		1.87	0.60	11.63

***Note:** Offsets for different species may overlap where they share the same habitat requirements.*

Biodiversity Offset Strategy and biodiversity funding

9. To compensate for authorised unavoidable **impacts** on **Matters of National Environmental Significance**, the **approval holder** must submit a Biodiversity Offset Strategy (BOS) to **the Minister** for approval at least three months prior to **commencement** of **mining operations**.

10. Offsets for authorised unavoidable **impacts** (defined in Table 1), and water resource **impacts** must be managed in accordance with the BOS.

General requirements

11. The BOS must be consistent with the **Galilee Basin Strategic Offset Strategy**, relevant recovery plans, threat abatement plans, conservation advices and MNESMP (see Condition 6), including the Black Throated Finch Management Plan (Appendix 1, Section 1, Schedule I, condition I6 of the **Coordinator-General's Assessment Report**) and must include:

    a) location of species and communities habitat offset areas including maps in electronic Geographic Information System (GIS) format

    b) implementation of an annual GAB offset measure, of returning at least 730 megalitres per annum for a minimum five year period from **commencement** of **excavation of the first box cut**, to offset the predicted annual **water take** associated with the action. This offset measure is to achieve a measurable outcome in accordance with one or more of the following principles:

        (i) reduce current extraction rates from the GAB to increase hydraulic pressure

(ii) increase pressure in the GAB

(iii) protect and rehabilitate the GAB springs

(iv) other measures consistent with government policies and strategies to protect and manage the GAB.

c) the offset measure described in Condition 11b) is to be developed and delivered in consultation with the Queensland Government department administering the authorisation of the **water take**

d) details of how offset sites have been or will be **legally secured** within required timeframes to ensure their long-term protection

e) a monitoring program for the offset site/s suitable to measure the success of the management measures against stated performance criteria including monitoring locations, parameters and timing

f) a description of the potential risks to the successful implementation of the BOS, and details of contingency measures that will be implemented to mitigate these risks

g) details of how the BOS will be updated to incorporate outcomes from research undertaken for **Matters of National Environmental Significance** under this and any **state approvals**, including updating of goals, criteria and triggers (as outlined at Conditions 6e) and 6f)). This must include outcomes of baseline research required by the Queensland Coordinator-General to identify whether the **Mellaluka Springs Complex** provides high value habitat for the **black throated finch** (Appendix 1, Section 3, Condition 1 of the **Coordinator-General's Assessment Report**)

h) an outline of how compliance will be reported

i) details of persons responsible for undertaking monitoring, review, and implementation of the BOS

j) detailed processes for any residual **impacts** on **Matters of National Environmental Significance**, (see Condition 6f)) to be offset in accordance with the **EPBC Act Offsets Policy** including a process for offset requirement to be developed in consultation with **the Department** and relevant Queensland Government agencies

k) a detailed process for any significant residual **impact** on any **EPBC listed threatened species or ecological community** not identified in Table 1 to be offset in accordance with the **EPBC Act Offsets Policy** (refer Condition 6l))

l) in the event that the future baseline research required by the Queensland Coordinator-General (Appendix 1, Section 3, Condition 1 of the **Coordinator-General's Assessment Report**) identifies that the **Mellaluka Springs Complex** provides high value habitat for the **black throated finch**, the **approval holder** must:

(i) revise **black throated finch** offset requirement in the BOS in accordance with the **EPBC Act Offsets Policy** and submit the revised BOS to **the Minister** for approval

(ii) management of any additional **black throated finch** offsets in accordance with Conditions 13 and 14 must commence prior to hydrological **impacts** on

the **Mellaluka Springs Complex**, with sites being **legally secured** within two years of that time.

*Requirements for offsets for potential **subsidence**, groundwater and water resource **impacts***

m) details of how staged **subsidence**, groundwater and water resource **impacts** in the **Project Area** will be addressed in the BOS, including:

(i) description and map of the proposed stages of underground mining. The **approval holder** must advise **the Minister** of any changes to these staging details. **Underground mining Stage 1** must be consistent with the corresponding definition in these conditions

(ii) description of how actual **subsidence**, groundwater and water resource **impacts** for all completed stages (as defined through Condition 11m)(i)) will be assessed at each stage

(iii) description of the extent, magnitude and timing of actual **subsidence impacts** observed in completed stages (as defined through Condition 11m)(i))

(iv) description of how actual **subsidence** and groundwater **impacts** from completed stages (as defined through Condition 11m)(i)) will be used to revise and update predicted **impact** areas for future stages

(v) table of predicted **impact** areas for each **EPBC Act listed threatened species and community** in Table 1 within the underground mining area (consistent with Condition 6c)) that allows comparison of actual **impact** areas with initial **impact** area predictions and updated **impact** area predictions. If additional **impacted** areas are identified as a result of the predictions, additional offsets must be implemented in line with Condition 11j)

(vi) written commitments from the **approval holder** that the balance of offset requirement at each stage (as defined through Condition 11m)(i)) will be implemented prior to **commencement** of that stage.

n) rationale for the balance of offset required for underground mining **impacts** to be updated at each underground mining stage (as defined through Condition 11m)(i)) that includes detailed comparison of the ecological status of **EPBC Act listed threatened species and communities** within the **subsidence impact** area between baseline conditions and the end of the most recent underground mining stage

o) details of how groundwater and water resource **impacts** on the **Matters of National Environmental Significance** will be addressed in the BOS including identification of additional potential offsets (see Condition 6f)) for the **Carmichael River** and **Doongmabulla Springs Complex**, to be developed in consultation with **the Department** and relevant Queensland Government agencies

p) detail of how the BOS will be revised and provided to **the Minister** for approval prior to **commencement** of each underground mining stage (as defined through Condition 11m)(i)) including timeframes for revision that allow three months for review and approval of the plan.

12. **Mining operations** must not **commence** until the BOS is approved by **the Minister** in writing. The approved BOS must be implemented.

Note: *A Biodiversity Offset Strategy is also required under the State Government approval for the project. A combined document should be prepared to address both State Government and EPBC Act approval conditions where possible.*

Offset area management plans

13. Within three months of identifying any offset area in accordance with Conditions 6, 8, 11 or 20, the **approval holder** must submit to **the Minister** for approval a management plan for that offset area. Each offset area management plan must address the relevant requirements of the BOS, and contain:

    a) detailed baseline description of offset areas, including surveys undertaken, condition of existing **Matters of National Environmental Significance** and their habitats, relevant **environmental values**, area of primary habitat for each **EPBC Act listed threatened species and community**, connectivity with other habitat areas and biodiversity corridors

    b) management measures and offset plans for each offset area to improve the habitats of **Matters of National Environmental Significance**

    c) a table of specific goals and associated timeframes for habitat management measures for each offset area with criteria for assessing the success of habitat management measures and corrective measures to be implemented if criteria are not met

14. Once approved, offset area management plans must be implemented.

Biodiversity Funding

15. The **approval holder** must establish and/or contribute to a pool of funds established for the better protection and long term conservation of **EPBC Act listed threatened species and communities** listed in Table 1.

16. The mechanism to establish and/or contribute to a pool of funds, including terms of reference to support a regional approach, funding mechanisms and an initial work plan, must be provided to **the Minister** for approval three months prior to **commencement** of **mining operations**. The mechanism may be in the form of a trust fund, or other mechanism/s as agreed by **the Minister** in writing.

17. The **approval holder** must contribute $100 000 (GST exclusive) per annum for 10 consecutive years to the pool of funds beginning from **commencement** of **mining activities**. The **approval holder** must provide notice of the establishment of and/or contribution to the pool of funds to **the Department** in writing prior to **commencement** of **mining activities**. Documentary evidence must be provided to **the Department** showing that the annual financial contributions to the pool of funds have been provided within 30 calendar days of each payment.

18. These funds must facilitate the development and implementation of research programs consistent with priorities to manage development **impacts** on **EPBC Act listed threatened species and communities** listed in Table 1 which are consistent with, and take into consideration, any relevant recovery plans, threat abatement plans and/or conservation advices. Research programs should identify measures to mitigate and manage the **impacts** on **EPBC Act listed threatened species and communities** listed in Table 1 and should address:

    a) methodologies for a baseline survey that will report on each species' life history, movement patterns, habitat requirements and population dynamics. Survey methodologies must be in accordance with **the Department's survey guidelines** or alternative best practice methodologies that are agreed to in writing by **the Minister** prior to **commencement** and endorsed by a **suitably qualified independent expert**. The baseline survey must begin with the first year of the date of this approval

    b) an ongoing monitoring program (developed from the baseline monitoring) for each species, to continue for the duration of the project approval, with annual reporting to **the Department**

    c) commitments, including financial commitments and associated timeframes, that will be implemented by the **approval holder** to support the undertaking of research

    d) the time frames for undertaking each research component

    e) timing and methods of reporting research outcomes to **the Minister**, the scientific community and the public

    f) outcomes of consultation with **the Department** on how the proposed Research Programs align with other studies for **EPBC Act listed threatened species and communities** listed in Table 1

    g) identification of priority actions for funding must be decided in consultation with the Queensland Department of Environment and Heritage Protection and members of relevant Recovery Teams.

19. A review of funding must be undertaken five years after the establishment of the pool of funds and/or the **commencement** of the action or as otherwise agreed by **the Minister** in writing. This review must take into account progress of the research programs and any subsequent on ground actions, as well as the involvement of other holders of approvals under **the EPBC Act** in funding and administrative arrangements. The review must be provided to **the Department** within six months after the five year period.

3D Seismic Survey Management Plan

20. The **approval holder** must submit a 3D Seismic Survey Management Plan to **the Minister** for approval, allowing at least one month for approval. The Seismic Survey Management Plan must include the following information in relation to the 2014 program of **seismic survey activities**:

    a) a description of **seismic survey activities**

    b) a description of **impacts** of **seismic survey activities** on **Matters of National Environmental Significance**

c) mitigation measures for **seismic survey activities**

d) identification of offsets for residual **impacts** on at least 115 ha of **black throated finch** habitat, to be **legally secured** within two years of **commencement** of **seismic survey activities**.

Note: *Offset areas identified are not intended to duplicate offset areas identified in accordance with Condition 11l).*

21. **Seismic survey activities** must not **commence** until the 3D Seismic Survey Management Plan has been approved by **the Minister** in writing. The approved 3D Seismic Survey Management Plan must be implemented.

Groundwater Flow Model Review

22. The **approval holder** must undertake a peer review of the adequacy of the current groundwater flow model to characterise groundwater **impacts**. This review must consider the parameters used into the groundwater flow model, the required additional modelling information and the model re-runs outlined in Condition 23. The peer review must be undertaken by a **suitably qualified independent expert**, approved by **the Minister** in writing. The peer review report must be submitted to **the Minister** within four months of this approval and should identify any additional information requirements

23. The **approval holder** must re-run the groundwater flow model. These model revisions and re-runs must incorporate the following parameters in the scenarios and address the following additional information requirements:

    a) re-define the current General Head Boundary (GHB) arrangement, as agreed by **the Department** in writing, including the following:

        (i) remove the GHB from its current location in all layers to the western edge of the model domain

        (ii) review and justify the GHB conductance values used in the model to reflect the differences between aquifers and aquitards and also between aquifers (e.g. Clematis and Colinlea Sandstones), and modify if required

        (iii) GHB cell elevations to be re-set using data as agreed by **the Department** in writing

        (iv) report on the **impacts** on groundwater levels and net flows between the model domain for the revised GHB boundaries and compare with previous modelling results.

    b) review and justify the recharge parameters for the Clematis Sandstone to represent the flux into the recharge beds of the GAB, and modify if required

    c) document outflow mechanisms used in the model for the **Doongmabulla Springs Complex** and individual model layers, using maps to show the spatial distribution of model discharges

    d) document and incorporate known licensed groundwater extractions within the model domain

    e) document and justify any other changes made as part of the model re-runs that are not outlined above

f) as per the **IESC information guidelines** provide an assessment of the quality of, and risks and uncertainty inherent in, the data used in the background data and modelling, particularly with respect to predicted potential scenarios

g) provide adequate data (spatially and geographically representative) to justify the conceptualisation of topographically driven flow from south to north (and west to east) in both shallow and deeper aquifers.

24. The outcomes of the model re-runs are to be reviewed in order to inform the review of the GMMP and the Rewan Formation Connectivity Research Plan, and to correct any subsequent inaccuracies in the **Matters of National Environmental Significance** management plan/s, prior to submitting to **the Minister** for approval.

Research and management requirements

GAB springs research plan

25. At least three months prior to **commencing excavation of the first box cut**, the **approval holder** must submit for the approval of **the Minister** a GAB Springs Research Plan that investigates, identifies and evaluates methods to prevent, mitigate and remediate ecological **impacts** on the **EPBC** listed **community of native species dependent on natural discharge of groundwater from the Great Artesian Basin**, including the **Doongmabulla Springs Complex**, in the Galilee Basin. The GAB Springs Research Plan must include but is not limited to the following:

a) research aims and rationale with reference to existing scientific research on GAB spring hydrogeology and ecology

b) identify priority actions for potential offsets to protect and manage the GAB springs

c) personnel responsible for conducting research and their qualifications

d) timeframes for research and reporting

e) methods, including but not limited to, conceptualisation of the hydrogeology of the springs, ecological surveys to determine the composition of the GAB spring community, an assessment of transferability of approaches to prevent and mitigate hydrological **impacts** on springs in the Surat Basin, determination of water requirements (including ecological response thresholds) of the GAB spring community, and development and evaluation of methods to prevent, remediate and mitigate ecological **impacts**

f) an analysis of potential mitigation activities, such as but not limited to, re-injection to the groundwater source aquifer to maintain pressure head, flows and ecological habitat at the **Doongmabulla Springs Complex**

g) an explanation of how research outcomes will directly inform the monitoring, management, prevention, mitigation and remediation of **impacts** on the **Doongmabulla Springs Complex**

h) a peer review of the draft GAB Springs Research Plan, by a **suitably qualified independent expert**, approved by **the Minister** in writing, and a table of changes made in response to the peer review

i) The GAB Springs Research Plan must be published on the proponent's website for the life of the project, submitted to **the Minister** within ten business days of completion, and be made available for the **Bioregional Assessment of the Galilee Basin sub-region and the Lake Eyre Basin and any subsequent iterations**

26. The **approval holder** must not **commence excavation of the first box cut** until the GAB Springs Research Plan has been approved by **the Minister** in writing. The approved GAB Springs Research Plan must be implemented.

Rewan Formation Connectivity Research Plan

27. At least three months prior to **commencing excavation of the first box cut**, the **approval holder** must submit for the approval of **the Minister** a Rewan Formation Connectivity Research Plan ('Rewan Research Plan') that characterises the Rewan Formation within the area **impacted** by the mine. The Research Plan must include but not be limited to the following:

    a) research aims

    b) personnel responsible for conducting research and their qualifications

    c) timeframes for research and reporting

    d) methods, including, but not limited to, seismic surveys to determine the type, extent and location of fracturing, faulting and preferential pathways (including any fracturing induced by longwall mining **subsidence**) and an examination of the hydraulic properties (including but not limited to petrophysical analysis and facies mapping) of the Rewan Formation, to better characterise the Rewan Formation and the contribution of fracturing, faulting and preferential pathways to connectivity, including a description of how research will be undertaken in a manner that does not cause **impacts** on **Matters of National Environmental Significance** (unless the activities will be undertaken in accordance with a plan approved pursuant to conditions of this approval)

    e) an explanation of how research will inform the GMMP, any regional groundwater and surface water monitoring and assessment program, or **Bioregional Assessment for the Galilee Basin sub-region and the Lake Eyre Basin and any subsequent iterations**

    f) a peer review of the Rewan Research Plan, by a **suitably qualified independent expert**, approved by **the Minister** in writing, and a table of changes made in response to the peer review

28. The **approval holder** must not **commence excavation of the first box cut** until the Rewan Research Plan has been approved by **the Minister** in writing. The approved Rewan Formation Connectivity Research Plan must be implemented.

Standard conditions

29. Within 30 days of the **commencement** of the action, the person taking the action must advise **the Department** in writing of the actual date of **commencement**.

30. The person taking the action must maintain accurate records substantiating all activities associated with or relevant to the conditions of approval, including measures taken to implement the management plans, reports, and programs required by this approval, and make them available upon request to **the Department**. Such records may be subject to audit by **the Department** or an independent auditor in accordance with section 458 of **the EPBC Act**, or used to verify compliance with the conditions of approval. Summaries of audits will be posted on **the Department**'s website. The results of audits may also be publicised through the general media.

31. Within three months of every 12 month anniversary of the **commencement** of the action, the person taking the action must publish a report on their website addressing compliance with each of the conditions of this approval, including implementation of any management plans as specified in the conditions. Documentary evidence providing proof of the date of publication and non-compliance with any of the conditions of this approval must be provided to **the Department** at the same time as the compliance report is published.

32. Upon the direction of **the Minister**, the person taking the action must ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to **the Minister**. The independent auditor must be approved by **the Minister** prior to the **commencement** of the audit. Audit criteria must be agreed to by **the Minister** and the audit report must address the criteria to the satisfaction of **the Minister**.

33. If the person taking the action wishes to carry out any activity otherwise than in accordance with the management plans, reports, and programs as specified in the conditions**,** the person taking the action must submit to **the Department** for **the Minister**'s written approval a revised version of that management plans, reports, and programs. The varied activity shall not **commence** until **the Minister** has approved the varied management plans, reports, and programs in writing. **The Minister** will not approve a varied management plans, reports, and programs unless the revised management plans, reports, and programs would result in an equivalent or improved environmental outcome over time. If **the Minister** approves the revised management plans, reports, and programs, that management plans, reports, and programs must be implemented in place of the management plans, reports, and programs originally approved.

34. If **the Minister** believes that it is necessary or convenient for the better protection of World Heritage properties, National Heritage places, Wetlands of international importance, listed threatened species and communities, listed migratory species, the Great Barrier Reef Marine Park or a water resource, in relation to coal seam gas development and large coal mining development to do so, **the Minister** may request that the person taking the action make specified revisions to the management plans, reports, and programs specified in the conditions and submit the revised management plans, reports, and programs for **the Minister**'s written approval. The person taking the action must comply with any such request. The revised approved management plans, reports, and programs must be implemented. Unless **the Minister** has approved the revised management plans, reports, and programs, then the person taking the action must continue to implement the management plans, reports, and programs originally approved, as specified in the conditions.

35. If, at any time after 10 years from the date of this approval, the person taking the action has not **substantially commenced** the action, then the person taking the action must not substantially **commence** the action without the written agreement of **the Minister**.

36. Unless otherwise agreed to in writing by **the Minister**, the person taking the action must publish all management plans, reports, and programs referred to in these conditions of approval on their website. Each management plan, report, and program must be published on the website within one month of being approved.

Definitions

Approval holder: The person to whom the approval is granted.

Bioregional Assessment for the Galilee Basin sub-region and the Lake Eyre Basin and any subsequent iterations: will be conducted in conjunction with relevant state and territory government agencies and natural resource management bodies and entails a scientific analysis of the ecology, hydrology and geology for the purpose of assessing the potential risks to water resources in the area as a result of the direct and indirect **impacts** of coal seam gas development and large coal mining development.

Black throated finch: means the black throated finch (southern) (*Poephila cincta* subsp. *cincta*) listed as a threatened species under **the EPBC Act**

Brigalow ecological community: means Brigalow (*Acacia harpophylla* dominant and co-dominant), listed as a threatened ecological community under **the EPBC Act**.

Carmichael River: the Carmichael River and its riparian zone between the Doongmabulla Springs and the Belyando River.

Commencement / commence / commenced / commencing: is the first instance of any specified activity. Unless the activity is specifically defined for the purposes of these conditions, commencement of an activity includes any physical disturbance including clearing of vegetation, earthworks, new road works, new rail works, construction of new camps, development of mining associated infrastructure and **mining operations**. Commencement does not include:

a) erection of signage or fencing

b) minor physical disturbance necessary to undertake pre-clearance surveys or establish monitoring programs or associated with the mobilisation of the plant, equipment, materials, machinery and personnel prior to the start of railway and road development or construction; or

c) activities that are critical to commencement that are associated with mobilisation of plant and equipment, materials, machinery and personnel prior to the start of railway or road development or construction only if such activities will have no adverse impact on MNES, and only if the **approval holder** has notified **the Department** in writing before an activity is undertaken.

Community of native species dependent on natural discharge of groundwater from the Great Artesian Basin: means the community of native species dependent on natural discharge of groundwater from the Great Artesian Basin, listed as a threatened ecological community under **the EPBC Act**.

Coordinator-General's Assessment Report: The Queensland Coordinator-General (2014) *Carmichael Coal Mine and Rail Project: Coordinator-General's evaluation report on the environmental impact statement May 2014*. Department of State Development, Infrastructure and Planning, Brisbane, Queensland

The Department: is the Australian Government Department administering the *Environment Protection and Biodiversity Conservation Act 1999*.

Doongmabulla Springs Complex: the groundwater-fed springs located approximately 8 kilometres from the western edge of the mining lease boundary and consisting of Moses Spring, Little Moses Spring and Joshua Spring (refer pp. 106-108 of the Coordinator-General's Assessment Report).

Environmental values: includes but is not limited to habitat for **EPBC Act listed threatened species and communities** and hydrology of identified water resources.

EPBC/ EPBC Act: means the *Environment Protection and Biodiversity Conservation Act 1999* (Cth)

EPBC Act Offsets Policy: means the *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy* (October 2012).

EPBC Act listed threatened species and/or community/ies: means a threatened species or community, or a migratory species listed under **the EPBC Act**.

Excavation of the first box cut: means bulk earthworks excavating the first box cut required for either underground or open cut mining, which for the avoidance of doubt does not include clearing or topsoil stripping.

Galilee Basin Strategic Offset Strategy: is the Queensland Government Department's Galilee Basin Strategic Offset Strategy (2013) or any future updated version.

Groundwater conceptual model: is the conceptual groundwater model developed for the project as described in the Adani Mining Pty Ltd (2013) *Carmichael Coal Mine and Rail Project Supplementary Environmental Impact Statement* at Appendix K6.

Impact/s/ed: as defined in section 527E of **the EPBC Act**.

IESC Information Guidelines: are *Information Guidelines for Independent Expert Scientific Committee advice on coal seam gas and large coal mining development proposals*, April 2014.

Legally secure: means to secure a covenant or similar legal agreement in relation to a site, to provide enduring protection for the site against developments incompatible with conservation.

Matters of National Environmental Significance: in the context of this approval includes the following:

Listed Threatened Species and Communities
Black throated finch (southern) (*Poephila cincta* subsp. *cincta*)
Brigalow ecological community
Ornamental snake (*Denisonia maculata*)
Squatter pigeon (southern) (*Geophaps scripta* subsp. *scripta*)
Waxy cabbage palm (*Livistona lanuginosa*)
Yakka skink (*Egernia rugosa*)
Community of native species dependent on discharge from the Great Artesian Basin (**Doongmabulla Springs Complex**)
Water Resources
Carmichael River (Carmichael River and its riparian zone between the Doongmabulla Springs and the Belyando River)
Mellaluka Springs Complex
Community of native species dependent on discharge from the Great Artesian Basin (**Doongmabulla Springs Complex**)
Waxy cabbage palm (*Livistona lanuginosa*)

Mellaluka Springs Complex: the groundwater-fed springs located to the south-eastern section of the mine area and consisting of Mellaluka Spring, Stories Spring and Lignum Spring (refer pp. 168-169 of the Coordinator-General's Assessment Report).

Mining operations: are the extraction of ore from the ground as well as any immediately associated activities, including initial clearing of vegetation, removal and storage of overburden, storage of ore and dewatering, but not including exploratory surveys or the construction or operation of transport, accommodation or power generation infrastructure.

The Minister: is the Minister responsible for administering the *Environment Protection and Biodiversity Conservation Act 1999* and includes a delegate of the Minister.

Numerical groundwater model: means any computational method that represents an approximation of an underground water system that simulates hydraulic heads (and watertable elevations in the case of unconfined aquifers) and groundwater flow rates within and across the boundaries of the system under consideration.

Ornamental Snake: means the ornamental snake (*Denisonia maculata*), listed as a threatened species under **the EPBC Act**.

Project Area: all disturbance areas as defined in the maps at Appendix A. It is noted that minor alterations may be made in order to avoid **Matters of National Environmental Significance** or State Significant Biodiversity Values found during pre-clearance surveys. These are permitted only where they will result in a lower level of impact to these matters.

Rail (west): is a 120 km dual gauge greenfield rail line connecting the mine as far east as Diamond Creek, to provide for the export of coal via the Port of Hay Point (Dudgeon Point expansion) and the Port of Abbot Point.

Rail (east): is a 69 km narrow gauge portion of greenfield rail line running east from Diamond Creek to the existing Goonyella and Newlands rail systems, to provide for the export of coal via the Port of Hay Point (Dudgeon Point expansion) and the Port of Abbot Point.

Seismic survey activities: includes any activity involving ground disturbance associated with 3D seismic survey over an area of 2304 ha within mining lease EPC 1690.

Specified component: is any part of the approved action that **the Minister** has agreed in writing to consider individually for the purposes of these conditions, and also includes the six components specified in Table 1.

Squatter Pigeon: means the squatter pigeon (Southern) (*Geophaps scripta* subsp. *scripta*), listed as a threatened species under **the EPBC Act**.

State approvals: include any permits, licences or other authorisations, including any associated conditions, issued in relation to the action by any Queensland Government agency.

Subsidence: means the totality of subsidence effects and subsidence **impacts**; where 'subsidence effects': means deformation of the ground mass due to mining, including all mining-induced ground movements, such as vertical and horizontal displacement, tilt, strain and curvature; and 'subsidence **impacts**': means physical changes to the ground and its surface caused by subsidence effects, including tensile and shear cracking of the rock mass, localised buckling of strata caused by valley closure and upsidence and surface depressions or troughs.

Suitably qualified independent expert: means a person who has professional qualifications, training, skills or experiences related to the nominated subject matter and can give authoritative

assessment, advice and analysis on performance relative to the subject matter using the relative protocols, standards, methods or literature

Survey Guidelines: include the following:

Matters of National Environmental Significance, Significant Impact Guidelines 1.1, *Environment Protection and Biodiversity Conservation Act 1999:*
http://www.environment.gov.au/epbc/publications/nes-guidelines.html

Survey Guidelines for Australia's Threatened Frogs, Threatened Mammals, Threatened Reptiles and Threatened Bats: http://www.environment.gov.au/epbc/guidelines-policies.html

Survey Guidelines for Australia's Threatened Birds:
http://www.environment.gov.au/resource/survey-guidelines-australias-threatened-birds-guidelines-detecting-birds-listed-threatened

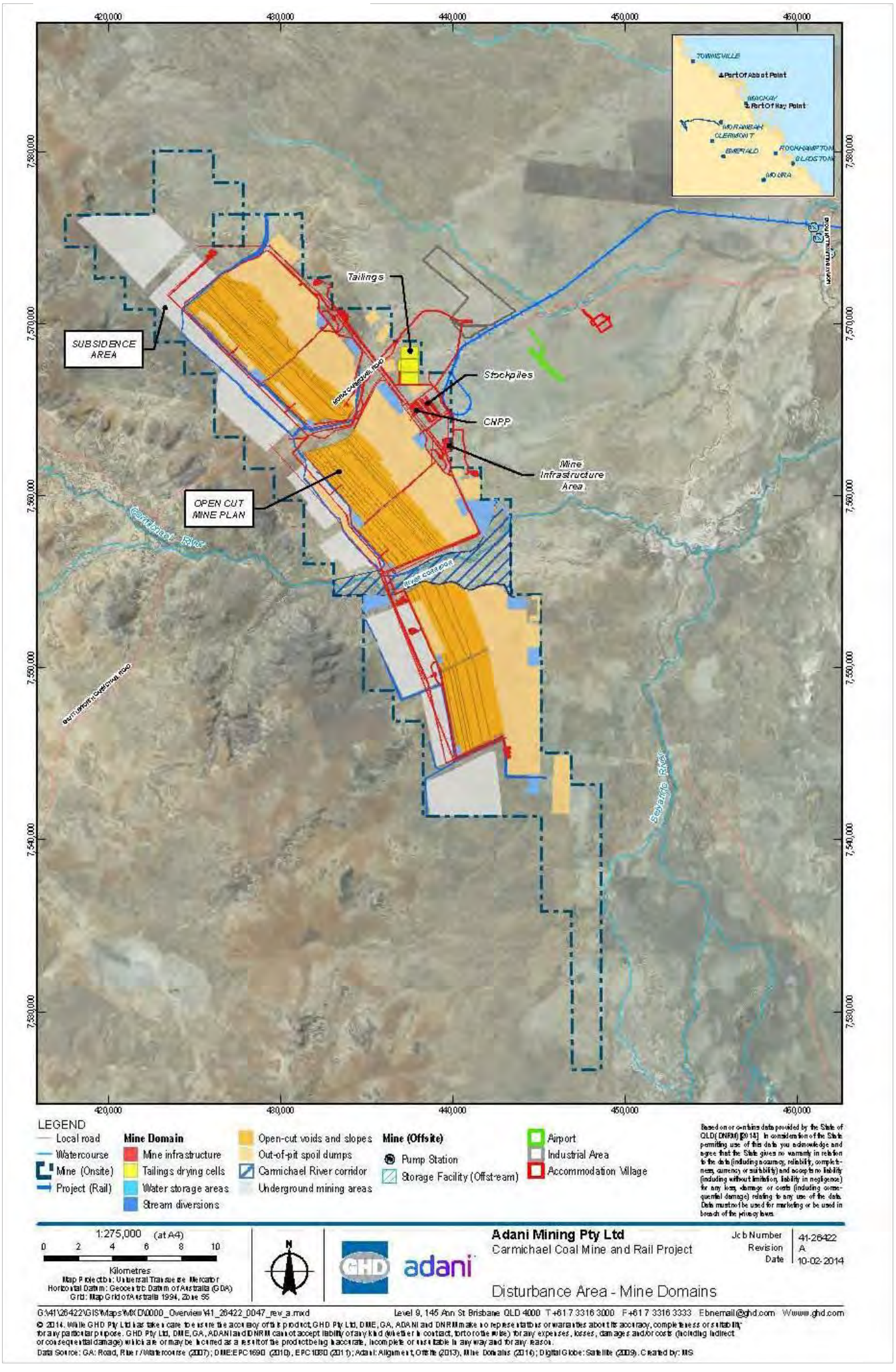
Underground mining Stage 1: means years 1-10 of underground mining including all associated activities including box cut excavation, portal construction, long wall construction and longwall panel mining. Multi seam mining within the first underground mine will occur during this time period. This definition and timing provides certainty and confidence in regards to the assessment of actual **subsidence** related **impacts** versus predicted **subsidence** related **impacts** that is required to be undertaken at the conclusion of underground mining Stage 1.

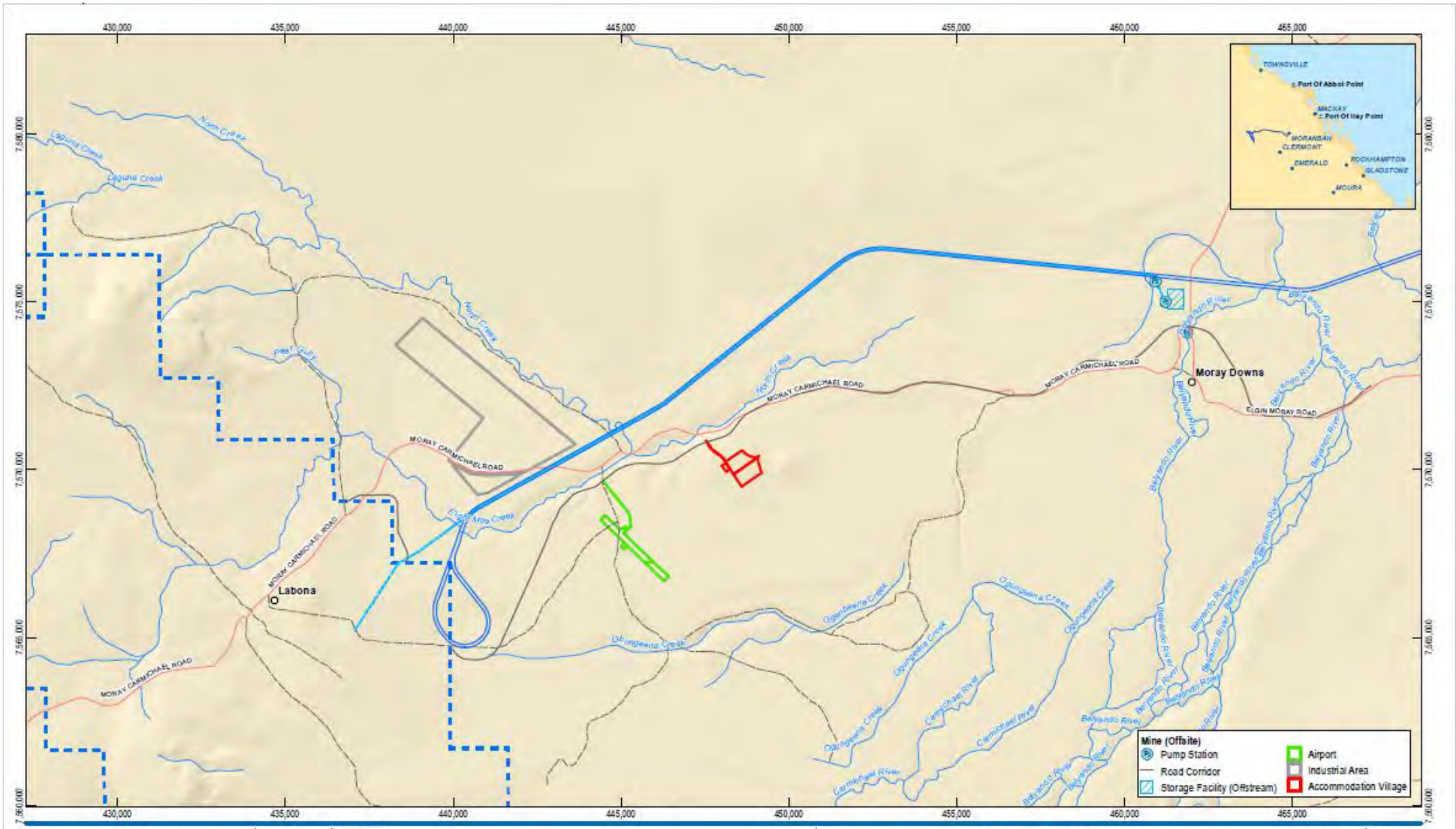
Water take: is extraction of water from a regulated water resource, in accordance with an authorisation by the regulating body.

Waxy Cabbage Palm: means the waxy cabbage palm (*Livistona lanuginosa*) listed as a threatened species under **the EPBC Act**.

Yakka Skink: means the yakka skink (*Egernia rugosa*), listed as a threatened species under **the EPBC Act**.

Appendix A





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0 2.5 5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Homestead
- Local Road
- Track
- Watercourse
- Rail Corridor
- Water Supply Pipeline
- Mine (Onsite)

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

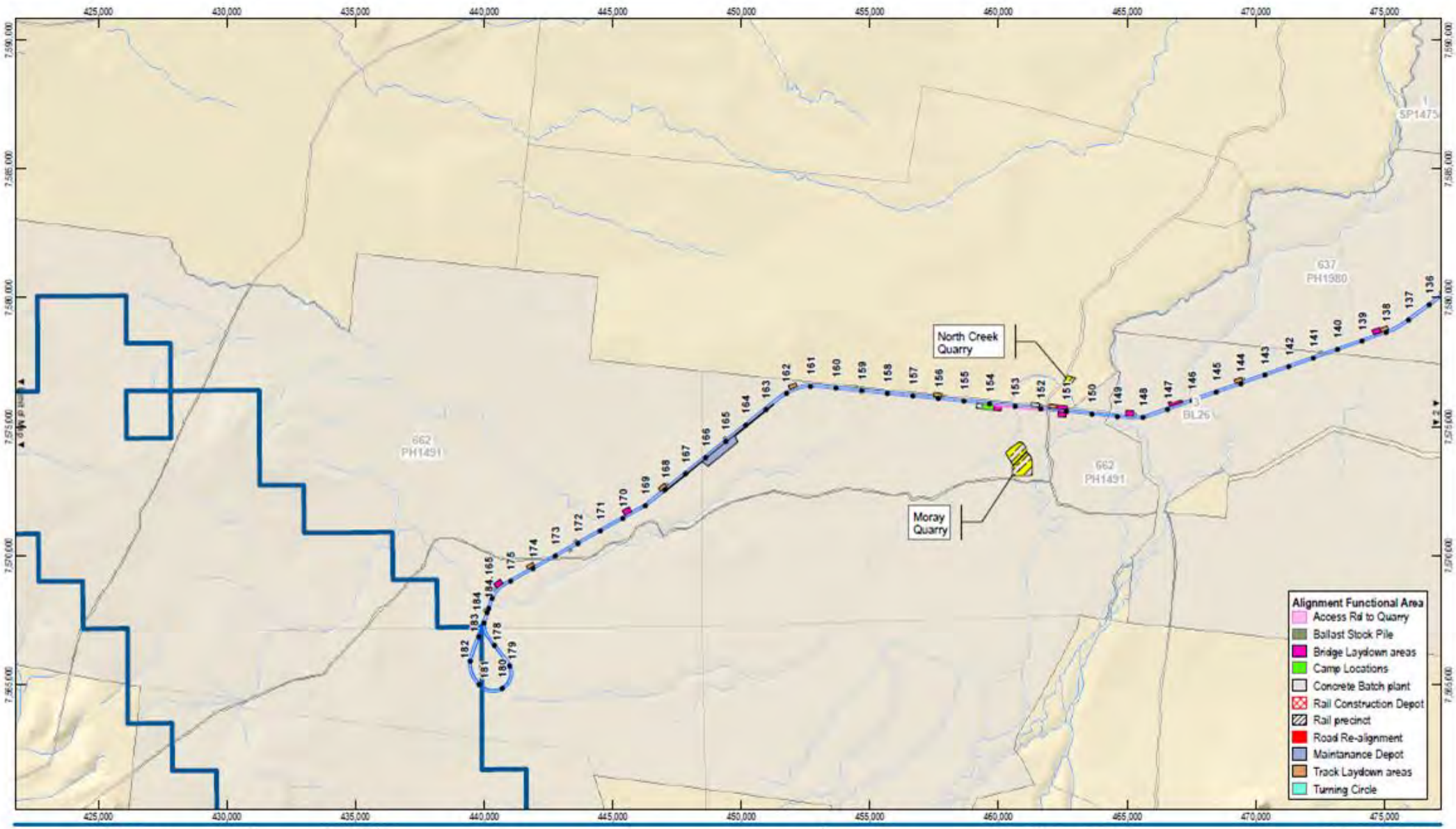
Job Number	41-26422
Revision	B
Date	10-02-2014

Disturbance Area - Offsite Infrastructure

G:\41\26422\GIS\Maps\MXD\01000_Project_Description\41_26422_01016_rev_b.mxd

Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DME: EPC1690 (2010)/EPC1080 (2011); DNRM: Bioregion Boundary (2011); © Commonwealth of Australia (Geoscience Australia): Watercourse, Tracks (2007); Adani: Alignment Opt11 Rev 2 (SP1 and 2)(2013); Offsite Infrastructure (2013). Created by: AJ



1:200,000 (at A4)

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Project (Rail) Chainage
- Town
- Road
- Other Railway
- Watercourse
- Rail (West)
- Rail (East)
- Project (Mine)
- Quarry
- Property Boundary
- Impacted Property

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Job Number	41-26422
Revision	C
Date	10-02-2014

Disturbance Area - Project (Rail)

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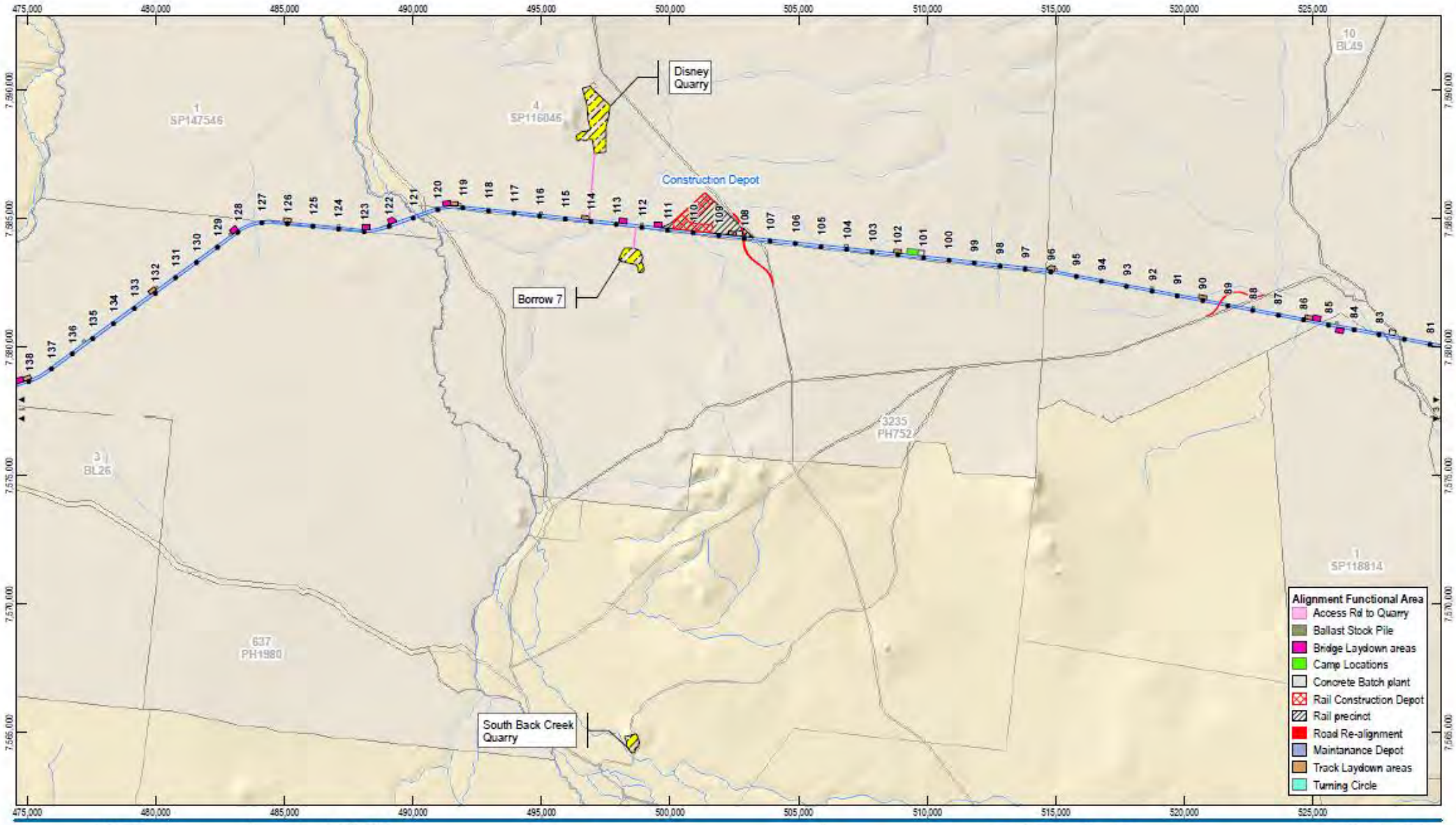
Data source: DNRM: DEM (2008), DCDB (2013), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); Adani: Project changes, Functional Areas, Alignment SP1 Opt11 Rev2, SP2 Opt 9 Rev 3 (2013); DME: EPC1690 (2010) / EPC1080 (2011). Created by: MS



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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Project (Rail) Chainage
- Town
- Road
- Other Railway
- Watercourse
- Rail (West)
- Rail (East)
- Project (Mine)
- Quarry
- Property Boundary
- Impacted Property

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Job Number 41-26422
Revision C
Date 10-02-2014

Disturbance Area - Project (Rail)

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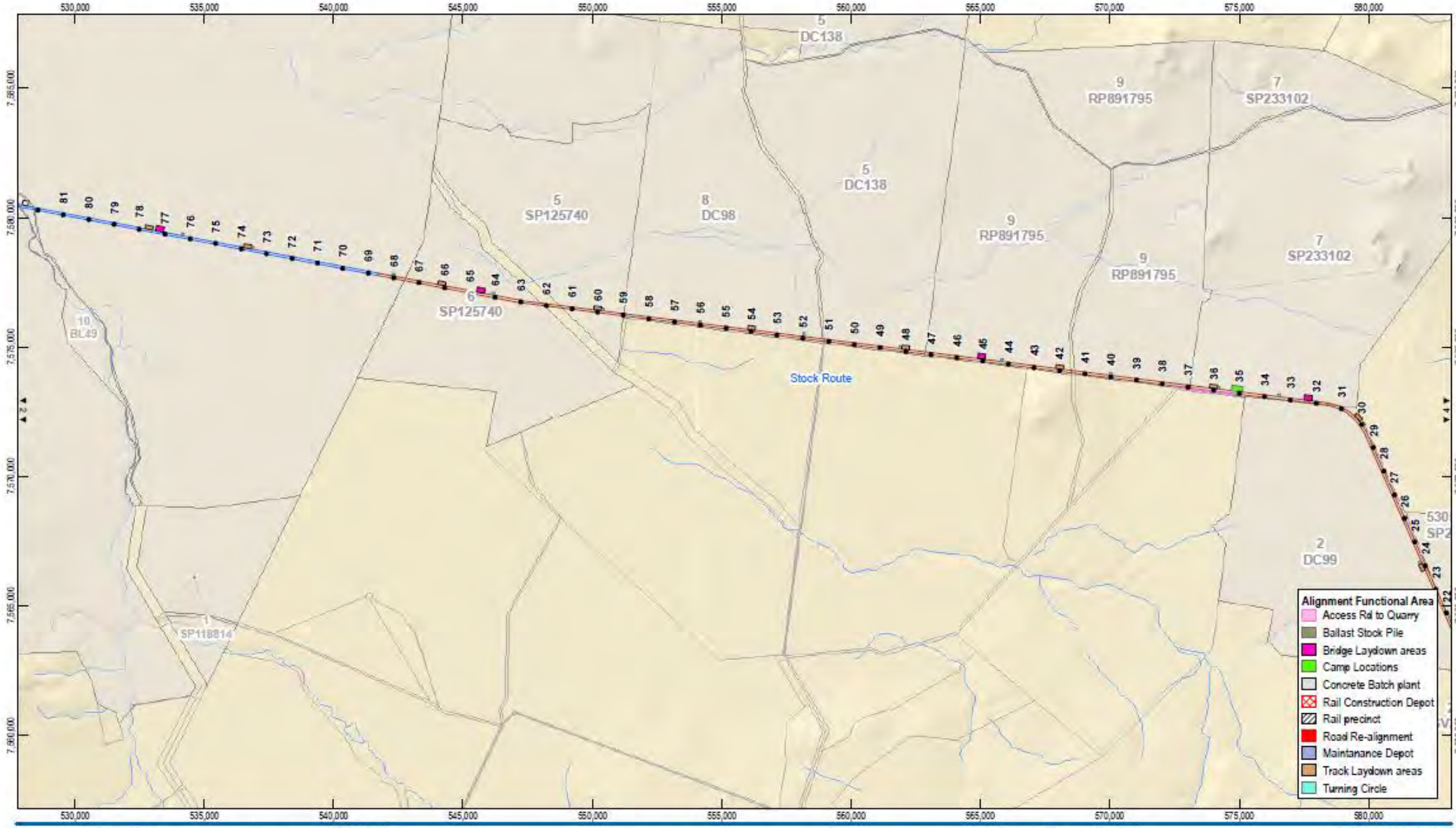
Data source: DNRM: DEM (2008), DCDB (2013), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); Adani: Project changes, Functional Areas, Alignment SP1 Opt11 Rev2, SP2 Opt 9 Rev 3 (2013); DME: EPC1690 (2010) / EPC1080 (2011) Created by: MS



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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Project (Rail) Chainage
- Town
- Road
- Other Railway
- Watercourse
- Rail (West)
- Rail (East)
- Project (Mine)
- Quarry
- Property Boundary
- Impacted Property

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Job Number	41-26422
Revision	C
Date	10-02-2014

Disturbance Area - Project (Rail)

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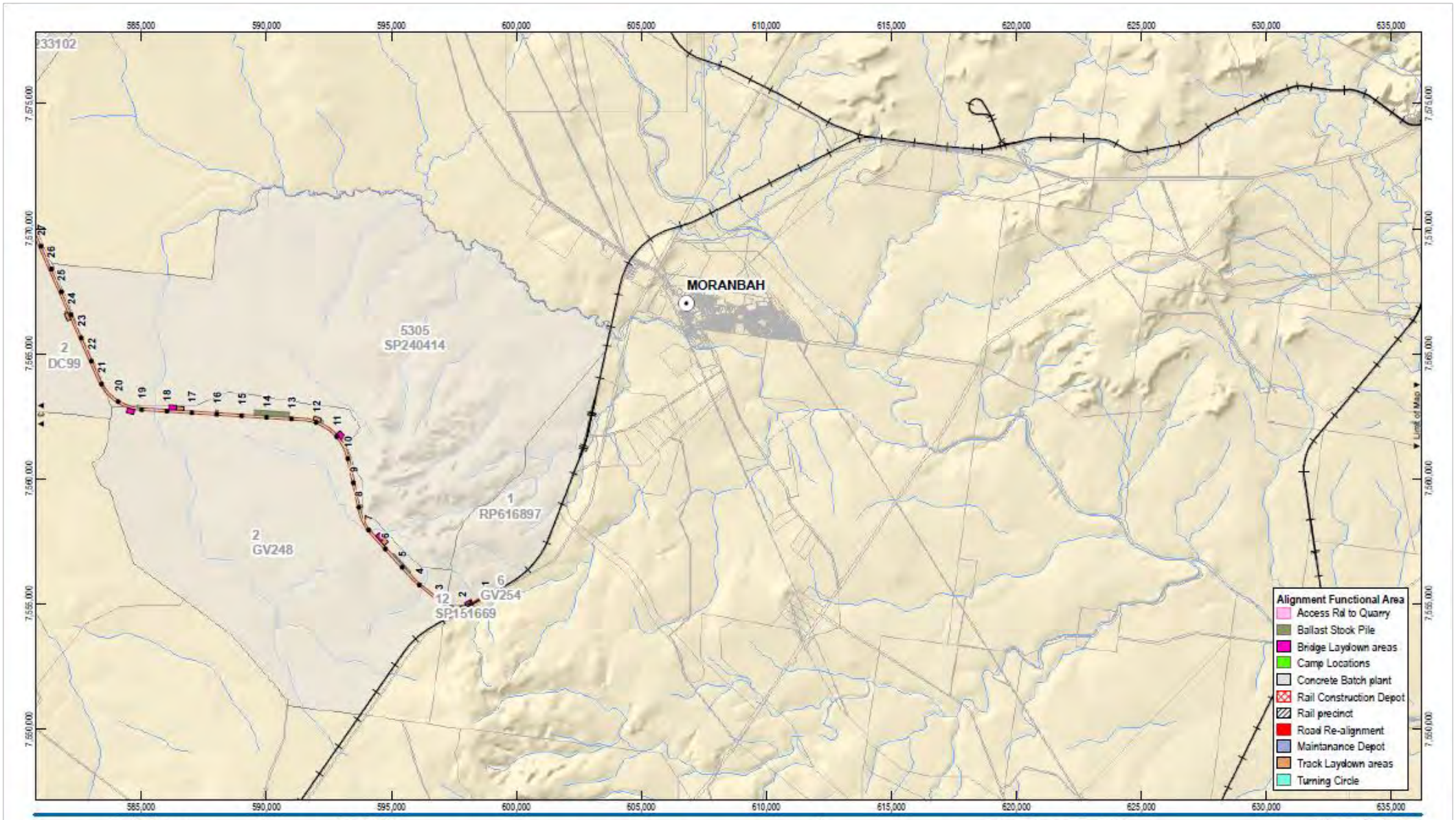
Data source: DNRM: DEM (2008), DCDB (2013), © Commonwealth of Australia (Geoscience Australia); Localities, Railways, Roads, Watercourse (2007); Adani: Project changes, Functional Areas, Alignment SP1 Opt11 Rev2, SP2 Opt 9 Rev 3 (2013); DME: EPC1690 (2010) / EPC1080 (2011). Created by: MS



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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Project (Rail) Chainage
- Town
- Road
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- Watercourse
- Rail (West)
- Rail (East)
- Project (Mine)
- Quarry
- Property Boundary
- Impacted Property

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Job Number 41-26422
Revision C
Date 10-02-2014

Disturbance Area - Project (Rail)

G:\41\26422\GIS\Maps\MXD\0000_Overview\41_26422_0030_rev_c.mxd Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E brmail@ghd.com W www.ghd.com

Data source: DNRM: DEM (2008), DCDB (2013), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); Adani: Project changes, Functional Areas, Alignment SP1 Opt11 Rev2, SP2 Opt 9 Rev 3 (2013); DME: EPC1690 (2010) / EPC1080 (2011). Created by: MS

LAND COURT OF QUEENSLAND

REGISTRY: BRISBANE
NUMBER: MRA428-14, EPA429-14
MRA430-14, EPA431-14
MRA432-14, EPA433-14

Applicant:	ADANI MINING PTY LTD
	AND
First Respondent:	LAND SERVICES OF COAST AND COUNTRY INC.
	AND
Second Respondent:	CONSERVATION ACTION TRUST
	AND
Statutory Party:	CHIEF EXECUTIVE, DEPARTMENT OF ENVIRONMENT AND HERITAGE PROTECTION

CERTIFICATE OF EXHIBIT

Exhibit **BW-2** to the affidavit of Bruce Alexander Wilson affirmed 12th day of February 2015.

Signed:
Deponent

Taken by:
Solicitor / ~~Justice of the Peace~~ / ~~Commissioner for Declarations~~

ecological AUSTRALIA

Waxy Cabbage Palm Survey

Upstream and Downstream of the Carmichael Mine

Prepared as part of expert witness work for the Carmichael Coal Project

14 December 2014

DOCUMENT TRACKING

Item	Detail
Project Name	Project Name
Project Number	14BRIECO-0030
Project Manager	Bruce Wilson Phone 0417 225 976 Office address 441 Adelaide Street, Brisbane QLD 40001
Prepared by	Bruce Wilson
Reviewed by	Katrina Cousins
Approved by	Brad Dreis
Status	FINAL
Version Number	1
Last saved on	14 December 2014
Cover photo	*Livistona lanuginosa* Cabbage Tree Creek (left) and Carmichael River (right)

This report should be cited as 'Eco Logical Australia 2014, Waxy Cabbage Palm Survey: Upstream and downstream of the Carmichael Mine. Prepared as part of work as Expert Witness for the Carmichael Coal Project'

ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd for the purpose of Land Court of Queensland proceedings regarding the application for mining leases and environmental authority for the Carmichael Coal Mine.

Contents

List of figures

List of tables

Executive summary

This report documents quantitative data on Waxy Cabbage Palm (WCP), *Livistona lanuginosa*, populations collected in the areas near the Carmichael Coal Mine proposed by Adani Pty Ltd.

The data was collected on a recent reconnaissance survey which was carried out as part of the work by Bruce Wilson as an expert witness for the Carmichael Coal Project, to verify previous information collected on springs and WCP in the area.

The information reported is derived from quantitative WCP surveys of areas of the Carmichael River upstream of the Carmichael Mine lease (the Project Area) and the area of the Carmichael River and Cabbage Tree Creek (CTC) downstream of the Project Area.

A total of 1114 WCP including 159 adults were estimated to occur in the areas assessed. These palms were located along the Carmichael River and some of its tributaries upstream of the Project Area and in an 8.7 ha area on the alluvial plain around CTC downstream of the Project Area. These WCP are associated with a wide range of environments including alluvial plains and ephemeral streams as well as the beds, banks, scroll plains, benches and bars associated with the Carmichael River.

The total number of WCP plants in the greater Carmichael River area is estimated to be 1945 including 259 adults. This estimate includes information from previous survey of the Project Area by GHD but does not include palms that are known to occur in tributaries of the Carmichael River to the west of the Project Area, where there could be another 150 palms, including 25-30 adults.

1 Introduction

This report documents the collection of quantitative data on Waxy Cabbage Palm (WCP), *Livistona lanuginosa*, populations in the area surrounding the Carmichael River near the proposed Carmichael Coal Mine.

The data was collected on a recent reconnaissance survey carried out over November 18-21, 2014 by Bruce Wilson, with the assistance of Brad Dreis from Eco Logical Australia Pty Ltd. The main objective of this survey was to verify previously collected information about springs and WCP in the area as part of the work by Bruce Wilson as an expert witness for the Carmichael Coal Project. However, the survey also provided an opportunity to collect quantitative information on WCP populations to the west of the Carmichael Mine lease (the Project Area). These populations were noted in the previous WCP study of the Project Area by GHD (2013) and in the biodiversity offset assessment of Moray Downs by Eco Logical Australia (reported in CO_2, 2014) but not documented in detail. In addition, previously unsurveyed areas downstream of the Project Area on Carmichael River and Cabbage Tree Creek (CTC) were also assessed.

2 Methods

2.1 Survey area

The survey area for this study included the Carmichael River and tributaries between Joshua Springs and the Belyando River but excluded areas previously surveyed in the GHD (2013) study. Three separate areas were assessed:

1. The “upstream area” which extends from the western edge of the Project Area to the Doongmabulla springs area on Cattle Creek. In addition tributaries of the Carmichael River in this upstream area were also surveyed as the recent biodiversity offsets assessment by ELA (reported in CO_2, 2014) identified WCP records in these areas.
2. The “downstream area” which extends from the eastern boundary of Moray Downs property to the Belyando River junction. This area was not included in the GHD survey, and no WCP records have previously been recorded from this area.
3. The “Cabbage Tree Creek area” which includes CTC to the east of Moray Downs property. No records were previously known from this area although the name of the creek suggests otherwise.

The location of the three survey areas are shown on **Figure 1** and **Figure 2**.

2.2 Methods

The survey of the Carmichael River was carried out by dividing each stretch of river surveyed into 500m transects running parallel to the river and searching all suitable habitat, no matter how far from the river, along the transect. The following attributes were collected at each WCP encountered in the searches:

- spatial location using a GPS
- number of individuals within a 5 m radius
- height (m)

- life-stage category (seedling, sub-adult or adult)
- landform category (bed, channel bar, bank, channel bench, scroll plain, alluvial plain or tributary).

A 500m transect was established every 2 km (measured by the car speedometer along a track which ran parallel with the river) along the upstream and downstream sections of the Carmichael River. One tributary of the river, located in the upstream section, was systematically surveyed along a 500 metre transect. Observational notes were made where WCP were observed on other tributaries.

The WCP population on the Cabbage Tree Creek area was spread out across a wider area on the alluvial plain surrounding the creek. Therefore the WCP population in the area was estimated by walking around the site and delineating the boundaries of the total extent of the population with a GPS and recording the density of the population in five 50 x 40 m (1 ha in total) belt transects located in what were visually assessed as typical of WCP density across the entire area.

2.3 WCP population estimate

The total WCP population for the greater Carmichael River area was estimated from four sources:

1. The total number of WCP from the systematic transects completed in this study (the “ELA transects”).
2. The total number of WCP in the unsurveyed stretches of Carmichael River between the ELA transects which was calculated by interpolating the densities from the adjacent surveyed transects to the length of each section of unsurveyed river (the “ELA interpolated transects”).
3. The number of WCP in the Cabbage Tree Creek area was calculated for the delineated area using the densities from the 50 x 40 m transects.
4. The total number of WCP from the GHD study for other areas.

3 Results

The location of the areas surveyed in this study is shown in **Figure 1** and **Figure 2**. These maps show the ELA transects and ELA interpolated transects as well as the location of other WCP records recorded in the GHD study.

The total number of WCP recorded in each ELA transect is listed in **Appendix A**, the number of WCP calculated for each ELA interpolated transect and the CTC area is listed in **Appendix B** and the number of WCP recorded in each area from the GHD survey is listed in **Appendix C**.

A summary of the total number of WCP from all sources for the greater Carmichael River area is listed in **Table 1**. This is broken down by the life stages and the sources of the figures (ELA transects, ELA interpolated transects, CTC and GHD transects).

A summary of the landforms associated with the ELA records is presented in **Figure 3.**

A summary of the major results are:

- No WCPs were recorded on the downstream section of the Carmichael River.
- 242 WCP plants were recorded along the 3.8 km of ELA transects in the upstream section of the Carmichael River, which included 50 (15% of total) adult trees.
- The preceding figures include a 0.6 km transect on a tributary (transect 6**, Figure 1**) where 49 (8 adult) WCP plants were recorded.
- A further 499 WCP plants were calculated from the ELA interpolated transects for the 7.5 km of unsurveyed upstream areas of the Carmichael River.
- The 8.7 ha area of WCP habitat delineated on CTC was calculated to support 373 plants of which 26 are adults.
- The total number of WCP in the greater Carmichael River area, between Joshua Springs and the Belyando River, was calculated to be 1945, of which 259 plants were adults. These figures include all ELA survey (ELA transects, ELA interpolated transects, CTC area) and GHD and results.
- A range of landforms were associated with the ELA WCP records including alluvial plains and ephemeral streams that are tributaries of the Carmichael River as well as the beds, banks, scroll plains, benches and bars associated with the Carmichael River.

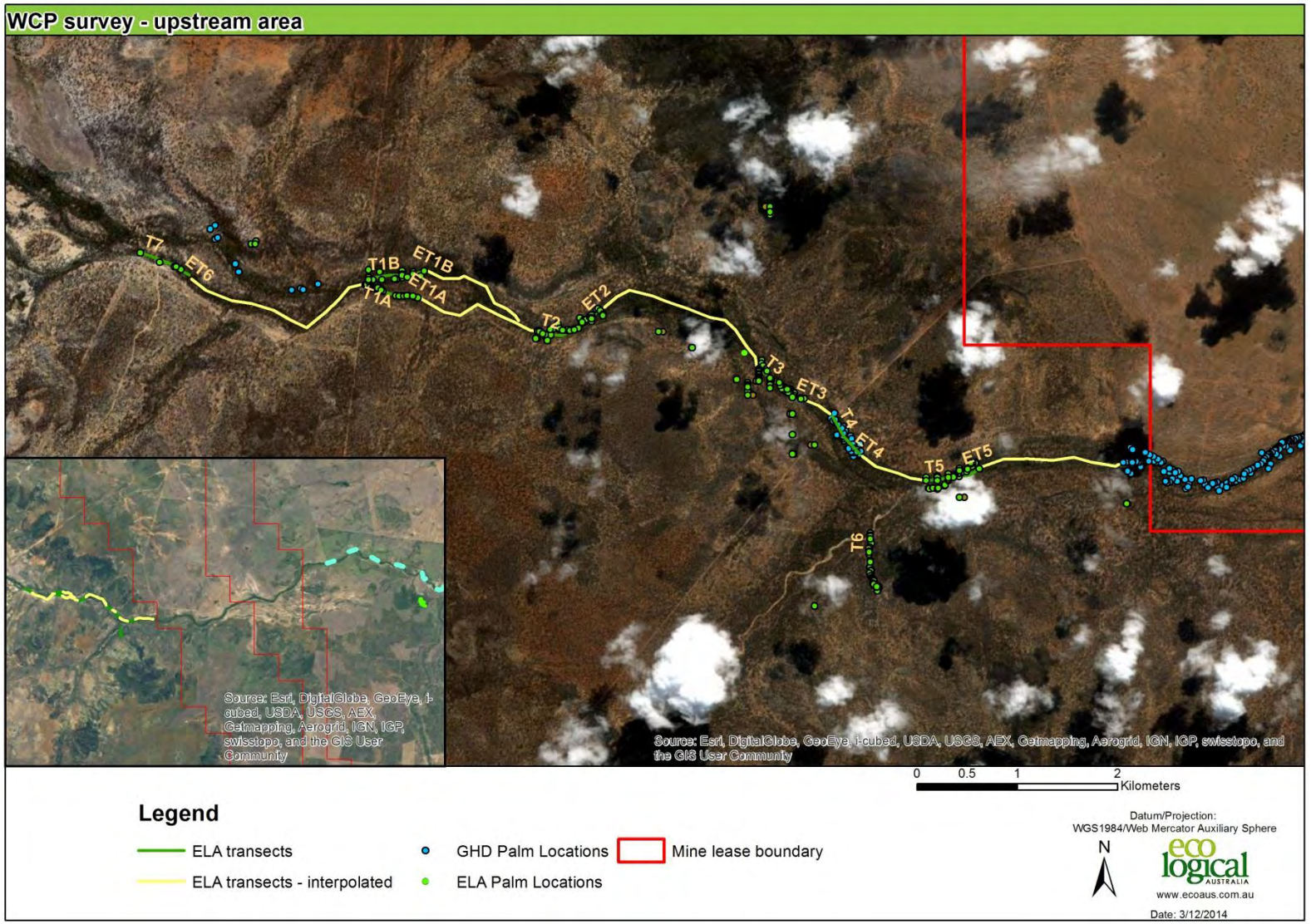

Figure 1. WCP up-stream survey area

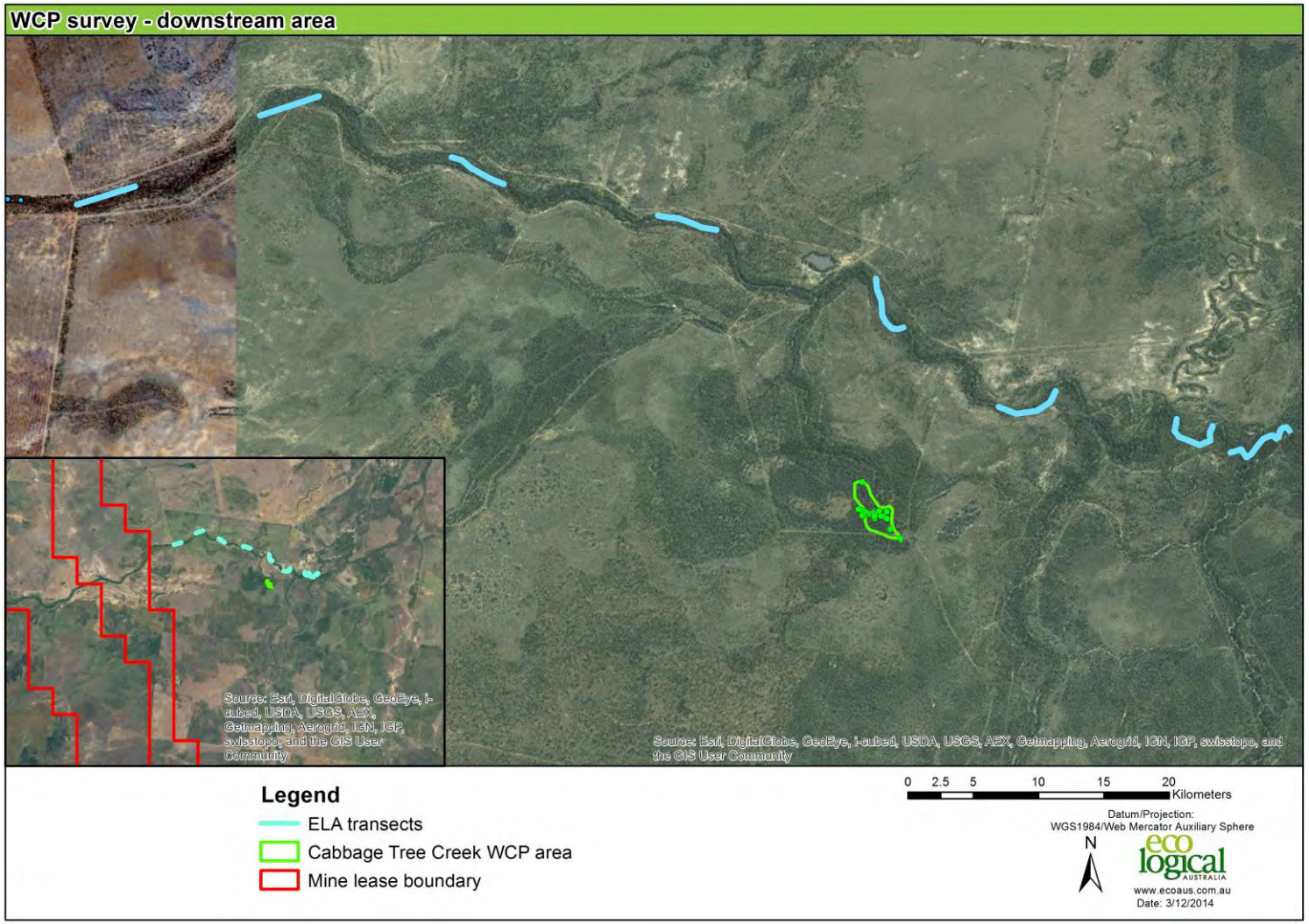

Figure 2. WCP down-stream survey area including Cabbage Tree Creek

Table 1 Summary of WCP from all sources for the greater Carmichael River area

Area	River front (km)	Area (ha)	Number				% of total		
			Seedlings	Sub-adult	Adult	Total	Seedlings	Sub-adult	Adult
ELA transects upstream (Appendix A)	3.8	-	125	67	50	242	52	28	20
ELA interpolated transects (**Appendix B)**	7.5	-	248	168	83	499	50	34	17
Cabbage Tree Creek (**Appendix B)**	-	8.7	165	182	26	538	44	49	7
GHD transects (**Appendix C)**	18.3	3.6	499	232	100	831	60	28	12
TOTAL	29.6	16.1	1037	649	259	1945	53	35	13

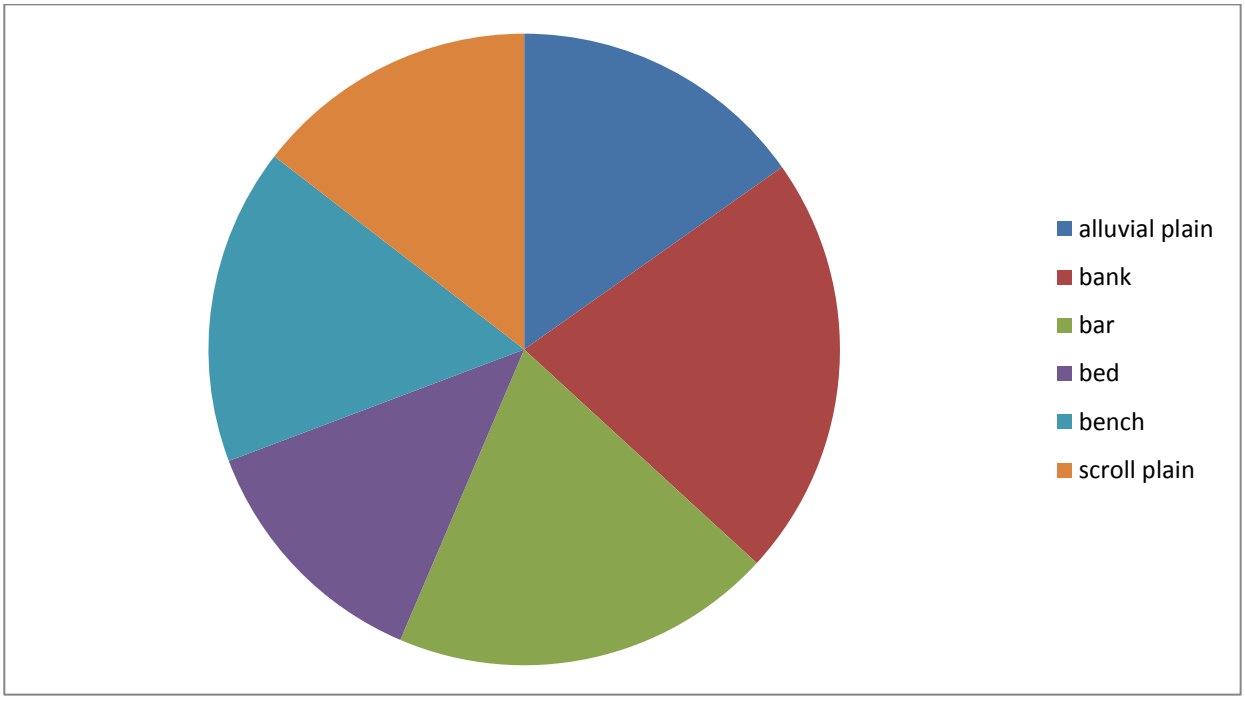

Figure 3 Landforms associated with WCP on ELA transects

4 Discussion

4.1 WCP population

A high degree of confidence can be placed on the absence of WCP along the downstream section of the Carmichael River. This is due to both a large sampling area (>20% of the river) and the lack of WCP habitat in this section of the river. The river in the downstream section was generally associated with steep deep sides (**Figure 4**) and little benches and scroll plains which were the favoured WCP upstream. Also the landholder from the surrounding property confirmed that no palms occur in this stretch of the river, while pointing out the location of the WCP population on the CTC area (Lloyd Appleton pers. comm. 20/12/2014).

The CTC population estimate is considered to be a good estimate, although there was a wide range of densities observed across the area, including patches that appeared to be denser than any other part of the greater Carmichael River area (**Figure 5**).

The estimates of the population in the upstream section of the river can also be considered accurate, within an acceptable level of confidence. This is because over 30% of the area has now been sampled.

These figures do not include the unsurveyed tributaries in the upstream area of the Carmichael River. There could be 3 - 4 more such tributaries which may support another 150 plants of which 25 - 30 may be adults.

The proportion of adults in the current survey (20%) is slightly higher than that reported in the GHD 2013 survey and the study by Petit and Dow (2003). It is unclear if this is within normal variation or if there is a higher proportion of adults in the upstream areas. However, there were some patches in the upstream area observed in this study, where a high density of adults were recorded, particularly associated with the small tributaries (**Figure 6**). GHD (2013) also commented on the relatively high proportion of WCP adults observed at Moses Springs in the upstream area.

4.2 Habitat

Many of the WCP recorded in this study were associated with similar habitats to those recorded in the GHD study which included the beds, banks, scroll plains, benches and bars associated with the Carmichael River. However, there were also a larger proportion of WCP recorded in this study on alluvial plains and tributaries than the previous GHD study.

Many of the WCP associated with alluvial plains were recorded in the CTC area. The CTC is an ephemeral stream that was dry at the time of the survey and mainly flows when it rains. The WCPs in this area were growing across the alluvial plain associated with a *Eucalyptus camaldulensis* (River Red Gum) woodland away from the creek channel which was poorly defined or absent in places.

The tributaries associated with the WCP in the upstream area were also different to the previous WCP habitat reported in the GHD survey. These tributaries were often dry, although one tributary appeared to be fed by groundwater as there was a small amount of flowing water at the time of the survey (**Figure 7**). In addition some WCP observed in the upstream area were associated with a C*orymbia dallachiana* woodland on an alluvial plain well away (>100m) from the Carmichael River (**Figure 8**).

4.3 Threatening processes

The WCP population in the upstream area was observed to be subject to similar threatening processes to those documented by GHD (2013) for areas on the mine lease. This includes damage to palm seedlings by fire, rubber vine and feral pigs and cattle.

The invasive weed rubber vine (*Cryptostegia grandiflora*) was observed in several spots during the survey including adjacent to WCP plants (**Figure 10**)**.** This weed is a declared Class 2 pest species under Queensland legislation and classed as a Weed of National Significance (WONS) due to its ability to invade and smother riparian vegetation.

While the WCP plants are often not damaged by fire, fire was observed to kill seedlings as shown in **Figure 9**. Numerous cattle and pigs were also observed throughout the area during the survey. While little damage directly attributable to these animals was observed, pig rooting has previously been associated with WCP seedling death (GHD 2013), and damage to WCP populations by stock grazing and trampling has been recognised as a threatening process to the species (Petit and Dowe 2003).

5 Conclusion

The total number of WCP in the greater Carmichael River area is estimated to be 1945, including 259 adults.

The WCP in this area are associated with a wide range of environments including alluvial plains and ephemeral streams that are tributaries of the Carmichael River tributaries as well as the beds, banks, scroll plains, benches and bars associated with the Carmichael River.

There could be another 150 WCP, including 25-30 adults, along tributaries of the Carmichael River to the west of the Project Area that were not included in this survey.

Figure 4 Carmichael River downstream with steep deep gully and little WCP habitat.

Photo 965, -22.089894, 146.543053

Figure 5 High density of WCP in the Cabbage Tree Creek area

photo 973, -22.09641, 146.5315

Figure 6 High density of adult WCP on a tributary in the upstream area.

Photo 944, -22.102175, 146.314614

Figure 7 WCP growing in a tributary in the upstream area

Photo 943, 22.102467, 146.314253

Figure 8 WCP growing with *Corymbia dallachiana* on an alluvial plain away from the Carmichael River in the upstream area

Photo 953, - 22.110058, 146.333769

Figure 9 WCP seedling killed by fire

Photo 942, -22.097014, 146.2981

Figure 10 Rubber vine growing near a WCP

Photo 953, - 22.110058, 146.333769

References

CO_2 2014. Biodiversity Offsets Strategy Carmichael Coal Mine and Rail Project. Prepared for Adani Mining Pty Ltd.

GHD 2013. Report for Population Survey of Waxy Cabbage Palm. Carmichael Coal Mine and Rail project SEIS, 16 July 2013. Adani Mining Pty Ltd.

Pettit N.E. and Dowe, J.L. 2003. Distribution and population structure of the vulnerable riparian palm *Livistona lanuginosa* A.N. Rodd (Arecaceae) in the Burdekin River catchment, north Queensland. *Pacific Conservation Biology* 9, 207-14.

Appendix A WCP population from ELA transects.

A1. Upstream of the mine lease

Transect name	Longitudes on River	River front (km)	Number				% of total		
			Seedlings	Sub-adult	Adult	Total	Seedlings	Sub-adult	Adult
T1A	146.281 E to 146.285 E	0.5	20	2	8	30	67	7	27
T1B	146.281 E to 146.286 E	0.5	17	5	1	23	74	22	4
T2	146.296 E to 146.302 E	0.7	24	10	13	47	51	21	28
T3	146.316 E to 146.32 E	0.5	24	13	8	45	53	29	18
T5	146.331 E to 146.336 E	0.5	20	21	10	51	39	41	20
T6	146.326 E to 146.327 E	0.6	18	16	7	41	44	39	17
T7	146.26 E to 146.265 E	0.5	2	0	3	5	40	0	60
Total		3.8	125	67	50	242	52	28	21

Appendix B WCP population calculated from ELA interpolated transects and for the CTC area

Transect name	Interpolated from	Location	Longitudes on River	River front (km)	Area (ha)	Number				% of total		
						Seedlings	Sub-adult	Adult	Total	Seedlings	Sub-adult	Adult
ET1A*	T1A	Upper reaches	146.286 to 146.266	1.2		48	5	19	72	67	7	26
ET1B*	T1B	Upstream	146.286 to 146.266	1.1		37	11	2	51	74	22	4
ET2*	T2, T3	Upstream	146.302 to 146.316	1.2		49	24	21	94	52	26	22
ET3*	T3, GHD5	Upstream	146.32 to 146.322	0.2		11	11	2	24	45	45	10
ET4*	GHD5, T5	Upstream	146.325 to 146.331	0.6		30	37	9	76	40	49	11
ET5*	T5, GHD5	Upstream	146.336 to 146.348	1.3		65	80	19	164	40	49	11
ET6*	T7	Upstream	146.265 to 146.28	1.9		8	0	11	19	40	0	60
Total interpolated transects				7.5		248	168	83	499	50	34	17
CTC		Cabbage Tree Creek	146.531 E to 22.101 S		8.7	165	182	26	373	44	49	7

Appendix C WCP population from GHD study

Source: GDH (2013, Table 1)

Location	Longitudes on River	River front (km)	Area (ha)	Number				% of total		
				Seedlings	Sub-adult	Adult	Total	Seedlings	Sub-adult	Adult
Joshua Spring/ Carmichael River	146°14'3.34" E to 146°14'23.10" E	1		0	0	0	0	0	0	0
Moses Spring	Within 100m of 22° 5'46.07"S, 146°14'58.88"E		3.6	1	9	9	19	5	47	47
Cattle Creek	146°14'57.28"E to 146°15'46.76"E	1.3		1	3	1	5	20	60	20
Little Moses Spring/ Carmichael River	146°15'56.60" E to 146°16'41.27" E	1.5		16	1	1	18	89	6	6
West of project area	Area A: 46°19'18.90" E to 146°19'29.94" E	0.5		50	26	4	80	63	33	5
	Area B: 46°20'53.43" E to 146°20'47.54"E			13	6	1	20	65	30	5
Within Project Area	146°21'3.80" E to 146°24'36.09" E	6.5		258	184	75	517	50	36	15
Within Project Area	146°24'36.09" E to 146°27'15.10" E	5		158	3	8	169	93	2	5

East of project area	146°27'15.10" E to 146°28'11.40" E	2.5		2	0	1	3	67	0	33
Total		18.3	3.6	499	232	100	831	60	28	12

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