



DRAFT BURRUP ROCK ART STRATEGY

A monitoring, analysis, and decision-making framework to protect Aboriginal rock art located on Murujuga (Burrup Peninsula)

Department of Water and Environmental Regulation

Report: Draft

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Opportunity to comment

The release of this draft strategy provides an opportunity for stakeholders to respond with views and contribute to the development of a long-term framework to guide the monitoring and protection of Aboriginal rock art located on the Burrup Peninsula (Murujuga).

Written submissions are encouraged from all stakeholders and interested community members. To ensure that your submission is as effective as possible, please:

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Written submissions must be received by 5pm (WST) on **1 December 2017**.

Submissions may be lodged by email (preferred) to burruprocart@dwer.wa.gov.au or hard copies can be mailed to:

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Contents

Opportunity to comment	_____
Executive Summary	_____ 1
1.0 Purpose	_____ 2
2.0 Introduction	_____ 2
2.1 Monitoring of the Burrup Rock Art	_____ 6
2.2 Senate Inquiry into the protection of Aboriginal rock art of the Burrup Peninsula	_____ 8
3.0 Scope	_____ 8
4.0 Monitoring and analysis	_____ 9
4.1 Colour change and spectral mineralogy	_____ 9
4.1.1 Methods for monitoring and analysis	_____ 9
4.1.2 Collection and reporting of annual monitoring data and analysis program	_____ 10
4.2 Other studies	_____ 11
4.2.1 Air quality	_____ 11
4.2.2 pH	_____ 12
4.2.3 Microbiology	_____ 12
4.2.4 Source of pollutants	_____ 13
5.0 Management responses	_____ 13
5.1 Joint management – Murujuga National Park	_____ 13
6.0 Governance	_____ 14
7.0 Funding	_____ 14
8.0 Stakeholders and consultation	_____ 15
9.0 Custodian	_____ 15
10.0 Communication	_____ 15
11.0 Evaluation and review	_____ 16
12.0 References	_____ 17
13.0 Appendices	_____ 18
Appendix A - Senate Inquiry into the protection of Aboriginal rock art of the Burrup Peninsula Terms of Reference	_____ 18
Appendix B - Burrup Rock Art Stakeholder Reference Group - Terms of Reference	_____ 19
Appendix C – Summary of industry licences and approvals	_____ 21

Executive Summary

This strategy outlines a long-term framework to guide the protection of Aboriginal rock art located on the Burrup Peninsula (Murujuga).

This area of the Pilbara is privileged to have one of the largest collections of engraved rock art anywhere in the world. The rock art (petroglyphs) are of immense cultural and spiritual significance to Aboriginal people, and of national and international heritage value. A number of state and Commonwealth mechanisms are in place to protect the unique ecological and archaeological features of the Burrup Peninsula. The Murujuga National Park created in January 2013 also recognises the cultural heritage value of the rock art and its environment.

The Burrup Peninsula and surrounds is host to industry that contributes to the local, state, and national economy and provides employment in the area. In response to concerns that industrial emissions may be impacting the rock art, a range of scientific studies have been conducted over the past 15 years. These studies have included measurements of air quality, microclimate, dust deposition, colour change, mineral spectrometry, microbiological analyses, accelerated weathering studies, and air dispersion modelling. The conclusions of some of these studies have been contested, and recent independent reviews commissioned by the Department of Water and Environmental Regulation (DWER) have identified a range of improvements that could be made to provide robust, reliable results about emissions and their impact on the rock art in which stakeholders and the public can have confidence.

This strategy aims to build on the previous work on the Burrup Peninsula to deliver a scientifically rigorous approach to monitoring and management that will provide an appropriate level of protection to the rock art. It provides the monitoring and analysis required to determine whether accelerated change is occurring to the rock art; outlines other studies required to determine the causes and conditions that may result in deterioration of the rock art; and describes a risk-based approach for the management of impacts to the rock art that is consistent with the Government's responsibilities under the *Environmental Protection Act 1986*. Principles and governance arrangements detailed in the strategy will ensure that scientific studies are undertaken with rigour and that review mechanisms are in place to provide assurance that the best scientific information is available to guide management actions.

The development and implementation of this strategy will be consultative and collaborative with stakeholders, including Traditional Owners, community groups and industry.

1.0 Purpose

The purpose of this strategy is to provide a long-term framework for the monitoring and analysis of changes to the Aboriginal rock art located at the Burrup Peninsula and to describe a process by which management responses will be put in place to address any changes to the rock art.

2.0 Introduction

The Burrup Peninsula is an island in the Dampier Archipelago located in the Pilbara region of Western Australia. It is a unique ecological and archaeological area containing one of the largest collections of engraved rock art in the world. The images have been created by Aboriginal people over many thousands of years by pecking and/or engraving into the surface-weathered coat of the rocks. Murujuga is the Aboriginal name for the island in the Dampier Archipelago generally known as the Burrup Peninsula.

Aboriginal people throughout the Pilbara believe that rock engravings are the work of creation spirit-beings known as Marrga who during the Dreaming times formulated the rules of social conduct for human beings to follow. The Marrga left the engravings behind as permanent visual reminders of how the Law should be followed. As well as being a constant reminder of the Law, they were also places of continuing spiritual power¹.

¹ Western Australian Department of Environment and Conservation, 2013, *Murujuga National Park management plan* 78. Available at: <https://www.dpaw.wa.gov.au/images/documents/parks/management-plans/decarchive/murujuga-national-park-management-web-final.pdf>

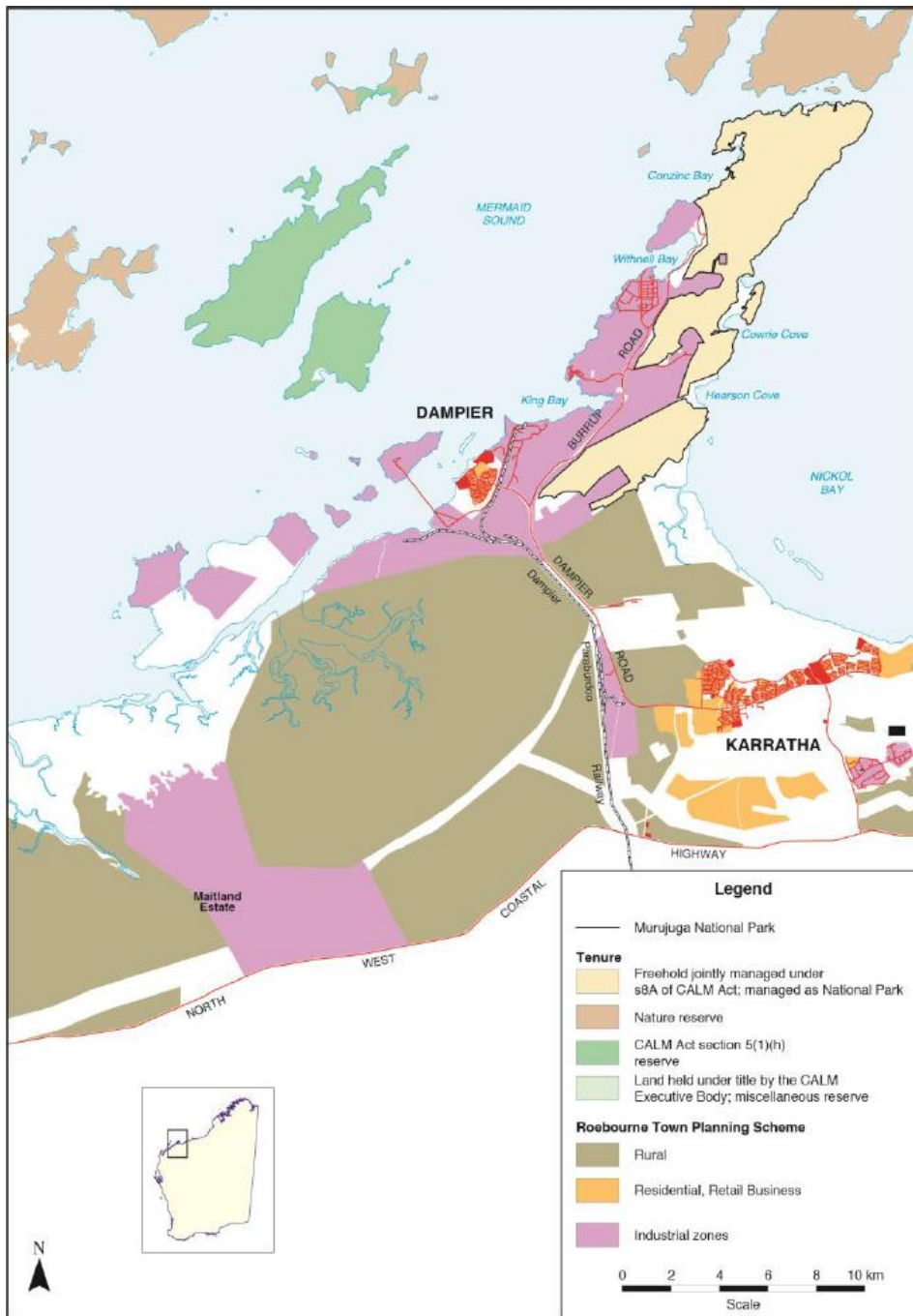


Figure 1: Map of the Burrup Peninsula location, tenure and land use²

Some of the rock art has been estimated by archaeologists to be over 30,000 years old. It has cultural and historical importance, depicting flora, fauna (including species no longer found in the area and others that are extinct), Aboriginal reactions to the arrival of Europeans and Asians, and the first known depiction of a human face. The Burrup Peninsula and its rock art provide important tourism value to the Pilbara. Visitors to the area are able to access the rock art as well undertake guided tours. The Murujuga Aboriginal Corporation (MAC) has plans

² <https://www.dpaw.wa.gov.au/images/documents/parks/management-plans/decarchive/murujuga-national-park-management-web-final.pdf>

for the creation of a Living Knowledge Centre with the purpose of promoting the conservation, protection and interpretation of cultural values and sites on the Burrup Peninsula.

A range of industry is also located on the Burrup Peninsula, including, salt, iron ore, liquefied natural gas export and ammonia production.

Several mechanisms have been established to protect the Burrup rock art from potential impacts. These are summarised in Table 1.

Table 1: Summary of State and Commonwealth Protection

Mechanism (and responsible government)	Date	Protections
Murujuga National Park established, covering the Northern Burrup Peninsula (WA)	17 January 2013	<p>Increased protection of rock art by applying the provisions of the Conservation and Land Management Act 1984 (CALM Act).</p> <p>The focus of the Murujuga National Park Management Plan (2013) is to ensure protection and awareness of the cultural and natural values of the area.</p> <p>Management of Murujuga National Park is administered by the Department of Biodiversity, Conservation and Attractions (DBCA) in accordance with the policy direction provided by the Murujuga Park Council (MPC). MPC comprises representatives from the Murujuga Aboriginal Corporation, the Department of Biodiversity, Conservation and Attractions, and a representative appointed by the Minister for Aboriginal Affairs.</p> <p>The Rangers of Murujuga Land and Sea Unit (MLSU) conduct the practical management of the Park and the surrounding sea country and islands along with DBCA staff.</p>
<i>Aboriginal Heritage Act 1972</i> (WA)	Various	<p>Specific localities on the Burrup have been declared Protected Places under the <i>Aboriginal Heritage Act 1972</i>.</p> <p>Consent is required from the Western Australian Minister for Aboriginal Affairs for any activity which will negatively impact Aboriginal heritage sites.</p>
Burrup and Maitland Industrial Estates Agreement (WA)	January 2003	<p>The State Government entered into the Burrup and Maitland Industrial Estates Agreement (the Burrup Agreement) with three Aboriginal groups (Ngarluma-Yindjibarndi, the Yaburara-Mardudhunera and the Woon-goo-tt-oo). This agreement enabled the State Government to compulsorily acquire native title rights and interests in the area of the Burrup Peninsula and certain parcels of land near Karratha.</p> <p>The Burrup Agreement allows for industrial development to progress across southern parts of the Burrup Peninsula, provides for the development of a conservation estate (Murujuga National Park) and ensures the protection of Aboriginal heritage.</p> <p>The Department of Jobs, Tourism, Science and Innovation is the lead agency for the development of the Burrup</p>

		Strategic Industrial Area and LandCorp is the estate manager.
Burrup Maitland Industrial Estates Agreement Additional Deed (WA)	16 January 2003	<p>The State Government committed to organise and fund a minimum four-year study into the effects of the industrial emissions on rock art within and in the vicinity of part of the industrial estate on the Burrup Peninsula.</p> <p>The four-year scientific rock art monitoring program, included:</p> <ul style="list-style-type: none"> - two studies for the monitoring of ambient concentrations of air pollutants and microclimate and deposition undertaken by CSIRO Atmospheric Research; and - two further programs for artificial fumigation of rock surfaces and fieldwork on rock surface colour changes undertaken by CSIRO Manufacturing and Infrastructure Technology. <p>Following completion of these studies, in 2009 the Burrup Rock Art Monitoring Management Committee (see below) recommended that the studies on ambient air quality and rock microbiology monitoring be suspended and only recommenced if warranted by a major increase in emissions or if evidence becomes available to require further monitoring.</p>
<i>Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) – Listing of the Dampier Archipelago as a National Heritage place</i> (Cth)	3 July 2007	<p>Any proposed action that could have a significant impact on the National Heritage listed portion of the Burrup Peninsula must be referred to the Australian Government Minister for the Environment and Energy as a matter of national environmental significance for assessment and decision.</p> <p>Actions that commenced prior to 16 July 2000 (being the commencement date of the EPBC Act) are exempt from the assessment and approval provisions of the EPBC Act.</p>
EPBC Act Conservation Agreements (Cth)	Various	<p>At the time of listing on the National Heritage List, EPBC Act Conservation Agreements were signed by the then Commonwealth Minister for the Environment and Water Resources with Woodside Energy Ltd and with Hamersley Iron Pty Ltd and Dampier Salt Ltd (Rio Tinto). Under the Conservation Agreements, these companies provide funding for research, management and monitoring of the National Heritage values of the place.</p>
Yara Pilbara Nitrates Pty Ltd EPBC Act approval (EPBC 2008/4546) for construction of the Technical Ammonium Nitrate Facility (Cth)	14 September 2011	<p>Approval includes conditions related to:</p> <ul style="list-style-type: none"> - contributing funds to implementation of the rock art monitoring program and reporting of results; - providing the Department of the Environment and Energy (DotEE) with a management plan in the event that accelerated changes in the rock art are detected; and - air quality monitoring and emissions limits.

<p>Woodside Energy Ltd approval for Pluto Liquefied Natural Gas Development</p> <p>(WA)</p>	<p>December 2007</p>	<p>Offsets package for Pluto LNG required the rehabilitation/restoration of degraded areas that fall both outside of the lease and outside of areas of potential industrial development.</p> <p>The program initiated as a result of this requirement aims to rehabilitate and restore degraded areas on the Burrup Peninsula. The program includes rock art site rehabilitation and restoration.</p>
<p>Licences and approvals to industry located on the Burrup Peninsula under the EPBC Act and <i>Environmental Protection Act 1986</i> (EP Act)</p> <p>(Cth and WA)</p>	<p>Various</p>	<p>Air quality monitoring and emissions limits as shown in summary of rock art licence conditions at attachment C.</p>

2.1 Monitoring of the Burrup Rock Art

In 2002, the Western Australian Government established the Burrup Rock Art Monitoring Management Committee³ (BRAMMC) in response to concerns about possible adverse impacts on the rock art from industrial air emissions. BRAMMC commissioned investigations to establish whether industrial emissions were having adverse impacts on the rock art. These studies included measurements of air quality, microclimate, dust deposition, colour change, mineral spectrometry, microbiological analyses, accelerated weathering studies, and air dispersion modelling studies. The results of these studies are available on the Department of Water and Environmental Regulation (DWER) website at www.der.wa.gov.au/our-work/major-initiatives/36-burrup-rock-art-monitoring-program.

In 2009, after reviewing the evidence in these study reports, BRAMMC concluded that there was no scientific evidence of any measurable impact of industrial emissions on the rate of deterioration of the Burrup rock art. The study reports were also provided to scientists in the United States and Europe for peer review. BRAMCC recommended a technical working group replace BRAMCC, and that colour contrast and spectral mineralogy monitoring of rock art continue on an annual basis for ten years and be reviewed after five years.

The Burrup Rock Art Technical Working Group⁴ (BRATWG) was established to oversee the colour change and spectral mineralogy monitoring program and other studies between September 2010 and June 2016. The monitoring program was funded with contributions from industry on the Burrup Peninsula - Yara Pilbara, Woodside Energy and Rio Tinto Iron Ore. The then Department of Environment Regulation (DER) managed the monitoring program from the expiry of BRATWG's tenure in June 2016 until the formation of DWER.

³Membership of BRAMMC included representatives in atmospheric science, archaeology, chemistry, land conservation and mineral science from the WA Museum, the Chemistry Centre, Department of Environment and Conservation, Department of Indigenous Affairs, Aboriginal Representatives, Professionals, Local Government representatives, Department of State Development (observer and secretariat). Associate Professor Frank Murray of Murdoch University was the chairman of the Committee.

⁴Membership of BRATWG included an expert in the rock art monitoring field and representatives from the Western Australian Museum, Burrup industries, Department of Indigenous Affairs, and Department of Parks and Wildlife. Associate Professor Frank Murray of Murdoch University was the chairman of the working group. DER provided secretariat services to the group.

Annual monitoring to detect changes in the condition of the rock art has been undertaken since 2004. The monitoring and analysis for all this time has been conducted by CSIRO. Annual monitoring reports for each year can be found on DWER's website at www.der.wa.gov.au/our-work/major-initiatives/36-burrup-rock-art-monitoring-program. The latest report submitted by CSIRO to the Western Australian Government in June 2017 entitled *Burrup Peninsula Aboriginal Petroglyphs: Colour Change & Spectral Mineralogy 2004-2016* is also available on the website.

The conclusions of CSIRO's 2004-2016 monitoring report indicate that there has been some small but statistically significant change to the rocks in some dimensions of colour. CSIRO further concluded that there has been no difference in the rate of change between the control sites and those sites closer to industry. It was noted by the report authors that further observations would assist to determine whether the colour of the rocks has changed with a clearer trend emerging over time or whether the variation was random fluctuations. CSIRO considered that the conclusion of colour change would be clearer if change was detected across all three dimensions of colour and not only in one or two.

There are few studies around the world comparable with the Burrup rock art monitoring program. There are limitations and complexities with monitoring the Burrup rock art, including the paramount requirement to use non-invasive techniques to ensure the rocks are not marked; and problems associated with the collection of data in remote, exposed locations, often at high temperatures, with rocks that have uneven and rough surfaces with a range of orientations.

A number of shortcomings in the design, data collection and analysis elements of the monitoring program were raised by Dr John Black on behalf of the Friends of Australian Rock Art. Independent reviews conducted by Data Analysis Australia, which were commissioned by DER in 2016 and 2017, confirmed that considerable improvements could be made to the existing monitoring design and analysis.

Data from one of the three main instruments used for monitoring over the 13 years were considered to be unreliable for drawing any conclusions on colour change in the rock art. Data Analysis Australia (the independent reviewer), concluded that there were significant problems with cross-calibration between instruments, inconsistent error-prone data management, and clear errors in the data.⁵ Data Analysis Australia also determined that the analysis methodology could be significantly improved by using different models and undertaking further analysis. Some of these issues were remedied in CSIRO's 2004-2016 monitoring report.

The lessons of the past 13 years of monitoring will inform future monitoring and management of the Burrup rock art.

The framework outlined in this strategy is intended to address the limitations of the past monitoring and analysis program, and provide advice to Government where a management response is recommended.

⁵ Data Analysis Australia, November 2016, *Review of Statistical Aspects of Burrup Peninsula Rock Art Monitoring*.

2.2 Senate Inquiry into the protection of Aboriginal rock art of the Burrup Peninsula

On 30 November 2016, the Australian Government Senate referred a range of matters concerning the protection of Aboriginal rock art of the Burrup Peninsula to the Senate Environment and Communications References Committee for inquiry. Submissions to the inquiry raised a number of issues relating to the adequacy of the Western Australian government monitoring program.

The terms of reference for the inquiry are at Appendix A.

The findings of the Senate Inquiry are due to be handed down in a report on 18 October 2017.

3.0 Scope

This strategy has been developed having regard to the principles of ecologically sustainable development, including the precautionary principle and principle of intergenerational equity, to ensure that *"where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation"*; and *"the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations"*⁶.

Importantly, the precautionary principle (as outlined in section 4A of the *Environmental Protection Act 1986*) requires that management decisions should be guided by —

- (a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and
- (b) an assessment of the risk-weighted consequences of various options.

Accordingly, this strategy focuses on:

- areas of monitoring and analysis required to determine whether change is occurring to the rock art located on the Burrup Peninsula;
- undertaking monitoring and analysis with suitable scientific rigour to deliver reliable results;
- new studies to determine the current pollution load on the Burrup Peninsula, the source of that pollution and the pollution load that may result in deterioration of the rock art; and
- governance arrangements to ensure that:
 - monitoring and reporting is undertaken in such a way as to provide confidence to the community, Traditional Owners, industry and scientists about the integrity, robustness, and effectiveness of the monitoring data and results; and

⁶ *Environmental Protection Act, 1986.*

- Governments are provided with accurate and appropriate recommendations regarding the protection of the rock art, consistent with legislative responsibilities.

This strategy has been informed by the findings of the following reports and reviews:

- Black, J., Box, I., Diffey, S., Inadequacies of research used to monitor change to rock art and regulate industry on Murujuga (Burrup Peninsula), Australia: Rock Art Research, Volume 34, No. 2. (in Press)
- Data Analysis Australia, May 2017, Review of CSIRO Report on Burrup Peninsula Rock Art Monitoring.
- Data Analysis Australia, November 2016, Review of Statistical Aspects of Burrup Peninsula Rock Art Monitoring.
- Duffy, N., Ramanaidou, E., Alexander, D., Lau, D., June 2017, Burrup Peninsula Aboriginal Petroglyphs: Colour Change & Spectral Mineralogy 2004-2016, CSIRO Mineral Resources.

This strategy has been designed to provide a long-term framework for the protection of the rock art. It will need to be regularly reviewed and updated as studies are completed, knowledge is gained and conditions on the Burrup Peninsula potentially change. All changes to the strategy will be published in a timely way in consultation with key stakeholders.

Some of the actions outlined below are intended to be short to medium-term strategies and some will provide longer-term guidance.

4.0 Monitoring and analysis

Industry has grown on the Burrup Peninsula since some of the studies were undertaken in the early 2000s. It is timely that further studies into issues including air quality, microbiology, and accelerated weathering are undertaken.

The continuation of annual colour change and spectral mineralogy monitoring is also key to enable a reliable long-term picture of the condition of the petroglyphs on the Burrup Peninsula to be determined.

4.1 Colour change and spectral mineralogy

Improved monitoring of colour contrast and spectral mineralogy should be continued on an annual basis with review after five years. The following principles will govern this monitoring and analysis to ensure transparency in the process and confidence that it will be undertaken to a high standard.

4.1.1 Methods for monitoring and analysis

The independent reviews conducted by Data Analysis Australia in 2016 and 2017 recommended that the monitoring and analysis program be redesigned to:

- incorporate more robust and contemporary statistical analyses;
- include the monitoring of more sites, in particular control sites; and
- review the number of replicate measurements at each point.

The State Government will develop a revised method for the collection and analysis of data incorporating these recommendations. The methods will be developed by qualified persons contracted by DWER, taking into account the following principles:

- Individuals and organisations that have been involved with the monitoring and analysis of rock art colour change and spectral mineralogy to date will be consulted together with additional experts as needed.
- Guidance will be sought from Traditional Owners on appropriate access to land, the design of the monitoring program and other matters as required⁷.
- International practices and standards developed for the monitoring and management of rock art will be reviewed for relevance to the Burrup rock art.
- Published papers and government commissioned reports will be considered, including the reports listed in this strategy under Section 3.0 Scope.
- Research questions will be defined in consultation with key stakeholders.
- Equipment and procedures used for the monitoring program will be reviewed to ensure that best practice techniques and processes are used.
- The number of measurement sites will be calculated to ensure that statistically significant conclusions may be drawn from analysis of the data.
- Additional control sites away from all major sources of emissions including from industry and shipping will be incorporated to the greatest extent practicable, and to discern between both those emission sources where possible.
- The sampling method and analysis will be reviewed at least every five years by experts that are independent of key stakeholders.
- Statistical analysis will support the examination of long-term trends to understand whether there are issues affecting multiple sites and to contrast sites near and far from pollutant emission sources.
- Data analysis will be certified by a suitably qualified statistician.

4.1.2 Collection and reporting of annual monitoring data and analysis program

The contract for the monitoring and analysis program will be managed by DWER in accordance with State Supply Commission policies. It would be desirable for the data collection and analysis to be undertaken by separate parties. If data collection and analysis are undertaken by separate parties, the statisticians undertaking the analysis will need to acquire and maintain an adequate understanding of the data collection process, techniques and equipment.

The following principles should be used for the annual monitoring program.

⁷ Research will be undertaken according to the Murujuga Research Protocols (2015).

- Data collection should follow a documented and detailed protocol (developed as part of the method above) and ensure that any departures from this protocol are documented.⁸
- All data should be systematically archived and held by DWER, with consistent naming conventions, both to provide a baseline record and to facilitate comparisons with future data. The archival data format should enable ready access to the data via standard statistical software.⁹
- The methods and results should be published on the DWER website to enable interested third parties to be informed about the monitoring program and its findings and to allow review and comment.
- The annual monitoring and analysis report should be reviewed by an independent third party commissioned by DWER.

4.2 Other studies

To protect the rock art, an understanding of the sensitivity of the rock art to pollutant loads needs further examination.

Understanding the resistance of Burrup rocks to acid deposition will assist in the implementation of appropriate management actions. A 2008 report written by CSIRO¹⁰ outlines the results of measuring acid deposition fluxes in the Burrup area; however, it uses a global assessment of ecosystem sensitivity to acidic deposition contained in a report by Cinderby *et al.*¹¹ to assert that the Burrup area is in a critical load class that can cope with an acid deposition flux of about 200 meq m⁻² yr⁻¹. The applicability of this figure has since been questioned, and one of the Cinderby report authors has indicated that it is not relevant to the Burrup rocks¹².

The monitoring of colour change and spectral mineralogy will determine if change is occurring to the condition of the rock art. However, in order to protect the rock art, a better understanding of the current and likely future pollutant load of the Burrup Peninsula, the source of these pollutants and the impact of the pollutants on the rock art is required. Further studies in the following areas should be undertaken to inform the recommendation of management responses to government.

4.2.1 Air quality

⁸ Recommendation from *Data Analysis Australia, 2016, Review of Statistical Aspects of Burrup Peninsula Rock Art Monitoring*

⁹ Recommendation from *Data Analysis Australia, 2016, Review of Statistical Aspects of Burrup Peninsula Rock Art Monitoring*

¹⁰ Gillet, R., September 2008, *Burrup Peninsula Air Pollution Study: Report for 2004/2005 and 2007/2008*, CSIRO Marine and Atmospheric Research

¹¹ Cinderby, S., Cambridge, H.M., Herrera, R., Hicks, W.K., Kuylenstierna, J.C.I., Murray, F. and Olbrich, K., 1998, *Global Assessment of Ecosystem Sensitivity to Acidic Deposition*. 20 p. + map. ISBN: 91 88714 58 6

¹² Dr Johan Kuylenstierna, Australian Government Senate Inquiry into the Protection of Aboriginal rock art of the Burrup Peninsula Submission No. 1, *Expert advice to the Environment and Communications References Committee Inquiry into the Protection of Aboriginal rock art of the Burrup Peninsula*, Available at: www.aph.gov.au/Parliamentary_Business/Committees/Senate/Environment_and_Communications/BurrupPeninsula/Submissions.

Current air and meteorological monitoring in the Burrup Peninsula is reliable and targeted, but improvement would inform a detailed cumulative spatial analysis. Ambient air monitoring has been undertaken by Woodside Energy Limited since 2009. This monitoring has included oxides of nitrogen, ozone, hydrocarbons (benzene, toluene and xylenes) and collection of meteorological data. Most industrial activities in the area are included in the National Pollution Inventory (NPI) which provides annually aggregated estimates of emissions based on reporting methodologies rather than measurement.

The introduction of a long-term and coordinated monitoring network across all industries would expand the knowledge base to manage the air quality in the region and result in more informed decision-making. The network should measure exposure of the rock art to air pollutants.

4.2.2 pH

Extreme weathering experiments were undertaken by CSIRO in 2016¹³ to simulate the effect of air pollution on the rock art and surrounding weathered rocks. Samples of the rocks were immersed in solutions of four pollutants including nitric acid, sulfuric acid, ammonia and ammonium nitrate. The results of this study indicate the pH at which dissolution of the weathered gabbros and granophyres is triggered for aluminium, magnesium and iron.¹⁴

Reports commissioned by the then DER and other published scientific literature show that changes to pH levels on rock surfaces would accelerate the erosion of the petroglyphs on the Burrup peninsula. Any changes (not just a threshold level) to rock surface pH will therefore need to be a focus of future monitoring.

Regular measurements of the pH of the surface of gabbro and granophyre rocks on the Burrup Peninsula will assist to provide an early indication of conditions that may impact the rock art. Monitoring stations including rainwater gauges should be installed on the Burrup Peninsula to measure rainfall, pH, cations and anions as well as deposition flux of nitrogen and sulfur.

4.2.3 Microbiology

Microbial action may increase weathering of rock art. Between 2004 and 2008, an assessment was undertaken of microorganisms on rock surfaces at the Burrup Peninsula.¹⁵ The objectives of the monitoring were to assess the microbiology of rock surfaces, monitor microbiological difference (if any) of rock art sites from low and high emissions risk areas, and characterise the gross number and diversity of microorganisms on rock surfaces.

This study found that there were no differences evident in the gross number and broad diversity of microorganisms associated with samples collected from sites close to and distant from industrial emissions on the Burrup Peninsula.

As industry has expanded since 2008, a further study to assess microbiological numbers and composition (particularly as the Technical Ammonium Nitrate plant becomes operational) would

¹³Ramanadiou, E., Walton, G., Winchester, D., August 2017, Extreme Weathering Experiments on the Burrup Peninsula /Murujuga weathered gabbros and granophyres, CSIRO Mineral Resources.

¹⁴ Any figures used to determine critical load estimates for pollutants that may impact the rock art will be subject to expert review.

¹⁵ O'Hara, G., September 2008, *Monitoring of microbial diversity of the Burrup Peninsula*, School of Biological Sciences and Biotechnology, Murdoch University

be valuable. Repetition of this study from time to time would ensure that up-to-date knowledge of microorganisms on rock surfaces at the Burrup Peninsula is maintained.

4.2.4 Source of pollutants

Studies that assist in determining the source of pollutants which may impact on the rock art will support the development of targeted management recommendations to Government. Monitoring to measure levels of pollutants at particular sites should enable a determination of the source of the pollution and link any change in the condition of the rock art to critical loads for pollutants and their source (industry, shipping or another cause). In addition to industrial and shipping emissions, other possible causes of change to the rock art, for example, guano (bird droppings), should also be investigated.

5.0 Management responses

The application of the precautionary principle outlined in the objects of the *Environmental Protection Act 1986* is relevant to the consideration of a management response.

The precautionary principle provides that where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. As stated previously, when applying the precautionary principle in decision-making, decisions should be guided by careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and an assessment of the risk-weighted consequences of various options.

In line with this, monitoring and analysis of previously collected data and any new data collected under the framework outlined above will inform the development of a range of management options. DWER will work with the Burrup Rock Art Stakeholder Reference Group (BRASRG) to recommend a range of management options to Government for consideration.

5.1 Joint management – Murujuga National Park

The Murujuga National Park is jointly managed by the Department of Biodiversity, Conservation and Attractions (DBCA), representatives of the Murujuga Aboriginal Corporation (MAC) and the Department of Planning, Lands and Heritage. Park planning and strategic management is the responsibility of the Murujuga Park Council. The Murujuga Park Council is comprised of representatives from MAC, DBCA, and a representative nominated by the Minister for Aboriginal Affairs. The Murujuga National Park Management Plan¹⁶ identifies collaborative approaches between government agencies (federal, state and local), the MAC and industry partners to protect and promote the cultural values of Murujuga. The plan describes how National Heritage listed values will be protected, how research can be conducted, and how access and facilities for visitors, tourism opportunities, education and interpretation of the cultural values can be provided.

Some of the most easily observed adverse impacts on the rock art are from vandalism and

¹⁶ Available at: www.dpaw.wa.gov.au/images/documents/parks/management-plans/decarchive/murujuga-national-park-management-web-final.pdf

graffiti. Strategies implemented under the Murujuga National Park Management Plan to manage visitor access and activities, have the potential to reduce damage to the rock art from people.

The Murujuga Land and Sea Unit (MLSU) consists mostly of local language group Aboriginal people employed by MAC and engaged by DBCA to provide land management services for the Murujuga National Park. The mission of the MLSU is to protect the cultural, natural, and marine values of Murujuga, including the surrounding waters of the Dampier Archipelago, and to identify, protect and monitor the rock art for future generations.¹⁷ The MLSU may be able to assist with data collection for some of the monitoring studies outlined in Section 4 Monitoring and Analysis above.

6.0 Governance

DWER has responsibility for day-to-day implementation of this strategy, including contracting of data collection and analysis; reviews; commissioning of other scientific investigations and additional studies; and facilitating consultation with key stakeholders.

DWER will provide an annual report on the implementation of this strategy to the Minister and publish it on the Department's website.

DWER will ensure key stakeholders have opportunities to provide input through targeted consultation as required.

To assist with communication and stakeholder engagement, a Burrup Rock Art Stakeholder Reference Group is proposed to be established which will include representatives from state and local government, the Murujuga Aboriginal Corporation, industry and community. The proposed terms of reference for the Burrup Rock Art Stakeholder Reference Group are at Appendix B.

DWER will manage the commissioning of studies and ensure these are reviewed by an expert in the relevant field. This includes reports that provide key evidence used to support the implementation or otherwise of management strategies.

Annual monitoring reports, review reports and other scientific studies will continue to be published on DWER's website. These reports will also be provided to the Minister for Environment and the Burrup Rock Art Stakeholder Reference Group.

7.0 Funding

DWER will support the development and implementation of this strategy including secretariat support to the stakeholder reference group, contract management and oversight.

¹⁷ Murujuga Land and Sea Unit Strategic Plan 2015-2017. Available at: www.murujuga.org.au/murujuga-land-sea-unit/mlsu-strategic-plan/

Historically, the monitoring program and scientific studies have been funded by Yara Pilbara, Rio Tinto and Woodside. It is recommended that prescribed premises located on the Burrup Peninsula and near surrounds provide reasonable annual funding as a requirement of a licence condition and based on emissions. This money would be put into a special purpose account to fund ongoing monitoring (including review) and scientific studies.

8.0 Stakeholders and consultation

DWER will consult key stakeholders in the development and implementation of this strategy and as part of the five-year review process¹⁸ or any other review carried out more frequently.

Key stakeholders include:

- Murujuga Aboriginal Corporation
- Western Australian Minister for Environment
- Commonwealth Minister for the Environment
- Friends of Australian Rock Art
- Western Australian government agencies including DWER; the Department of Biodiversity, Conservation and Attractions; the Department of Planning, Lands and Heritage; the Department of Jobs, Tourism, Science and Innovation.
- Western Australian Museum
- Commonwealth Department of the Environment and Energy
- City of Karratha
- Pilbara Ports Authority
- Occupiers of licensed prescribed premises on the Burrup Peninsula

Ongoing engagement and information sharing with key stakeholders will also be facilitated through a Burrup Rock Art Stakeholder Reference Group as required (Appendix B).

9.0 Custodian

DWER has the primary responsibility for the development and implementation of the strategy.

10.0 Communication

Information on monitoring of the Burrup rock art will be published on DWER's website at www.der.wa.gov.au/our-work/major-initiatives/36-burrup-rock-art-monitoring-program. Information includes this strategy, annual reports detailing the results of data collection and analysis, and progress in implementing this strategy, reviews and other scientific investigations.

¹⁸ See Section 11.0 Evaluation and review for an explanation of the five-yearly review.

11.0 Evaluation and review

This document will be reviewed every five years from the date of final publication, or earlier as determined by DWER. Five yearly reviews will ensure that the strategy remains relevant, supports appropriate governance procedures, and reflects the best available scientific knowledge and management practices applicable to protecting the rock art located on the Burrup Peninsula.

Draft for consultation

12.0 References

Black, J., Box, I., Diffey, S., 2017, *Inadequacies of research used to monitor change to rock art and regulate industry on Murujuga (Burrup Peninsula), Australia*. Rock Art Research, Volume 34, No. 2. (in Press)

Data Analysis Australia, May 2017, *Review of CSIRO Report on Burrup Peninsula Rock Art Monitoring*.

Data Analysis Australia, November 2016, *Review of Statistical Aspects of Burrup Peninsula Rock Art Monitoring*.

Duffy, N., Ramanaidou, E., Alexander, D., Lau, D., June 2017, *Burrup Peninsula Aboriginal Petroglyphs: Colour Change & Spectral Mineralogy 2004-2016*, CSIRO Mineral Resources.

Gillet, R., September 2008, *Burrup Peninsula Air Pollution Study: Report for 2004/2005 and 2007/2008*, CSIRO Marine and Atmospheric Research.

Murujuga Aboriginal Corporation, *Murujuga Research Protocols (2015)*.

O'Hara, G., September 2008, *Monitoring of microbial diversity of the Burrup Peninsula*, School of Biological Sciences and Biotechnology, Murdoch University.

Ramanadiou, E., Walton, G., Winchester, D., August 2017, *Extreme Weathering Experiments on the Burrup Peninsula / Murujuga weathered gabbros and granophyres*, CSIRO Mineral Resources.

Western Australian Department of Environment and Conservation, 2013, *Murujuga National Park management plan 78*. Available at www.dpaw.wa.gov.au/images/documents/parks/

13.0 Appendices

Appendix A - Senate Inquiry into the protection of Aboriginal rock art of the Burrup Peninsula Terms of Reference

The Commonwealth's responsibility under the Environment Protection and Biodiversity Conservation Act 1999 to protect the globally significant and National Heritage listed Aboriginal rock art of the Burrup Peninsula in Western Australia, with particular reference to:

- a. the total industrial pollution load from existing industrial activities and port zone on the Burrup Peninsula in Western Australia, and its existing impacts on Aboriginal rock art;
- b. the projected additional pollution load from the Yara Pilbara Fertilisers Pty Ltd ammonium nitrate plant, including the likely impacts on the Aboriginal rock art, human health and the environment;
- c. the accuracy and adequacy of reports used by the Western Australian and Commonwealth governments when setting the relevant technical, environmental and cultural conditions regulating the construction and operation of the Yara Pilbara Fertilisers Pty Ltd ammonium nitrate plant in an area of highly significant Aboriginal rock art;
- d. the rigour and adequacy of the monitoring, analysis, compliance and enforcement performed by the Western Australian and Commonwealth government agencies in carrying out their legislated responsibilities in overseeing industries on the Burrup Peninsula;
- e. the projected level of fugitive gas and nitric acid leaks from the Yara Pilbara fertiliser and ammonium nitrate plants, their effects on human health, likely effects on rock art and the general environment, and the adequacy of the company responses;
- f. the failure by Yara Pilbara Fertilisers Pty Ltd, the Western Australian Government or the Federal Government to include risk analysis of establishing an ammonium nitrate plant in close proximity to the rock art, a gas hub and major port and in a cyclone surge zone;
- g. the adequacy of the Yara Pilbara plans to protect the communities of Dampier and Karratha and the rock art sites from the consequences of any explosion caused by 'sympathetic detonation' or other factors, including the ability to douse the nitrate stores with sufficient water to prevent a spontaneous explosion; and
- h. any related matters.

Appendix B - Burrup Rock Art Stakeholder Reference Group - Terms of Reference

The Department of Water and Environmental Regulation (DWER) has the primary responsibility for the day-to-day implementation of the Burrup rock art strategy, including contracting of experts to undertake data collection and analysis, independent reviews; and commissioning of other scientific studies. DWER also provides advice to government on the progress of the strategy and to inform decision making.

DWER recognises the benefit of seeking informed discussion from a diverse group of stakeholders to inform the development and implementation of the Burrup rock art strategy.

Terms of Reference

The Burrup Rock Art Stakeholder Reference Group has an informal liaison role which is intended to facilitate engagement between key government, industry and community representatives on the development and implementation of the Burrup rock art strategy.

The role of the stakeholder reference group is to:

1. consult, inform and educate other stakeholders on matters referred by DWER for input or comment; this includes input into strategy development, implementation and 5 yearly reviews.
2. share information with the group on issues of relevance to the Burrup rock art strategy; and
3. contribute constructively to the monitoring and management of rock art, being considerate of the views of other stakeholders.

Proposed Membership

- One representative from the Murujuga Aboriginal Corporation
- Dr John Black
- One representative of industry on the Burrup Peninsula
- One representative from the Western Australian Museum
- One representative from the UWA Centre for Rock Art Research and Management
- One representative from Department of Jobs, Tourism, Science and Innovation
- One representative from the Department of Biodiversity, Conservation and Attractions
- One representative from the Department of Planning, Lands and Heritage
- One representative from the Pilbara Development Commission in the Department of Primary Industry and Regional Development
- One representative from the City of Karratha
- One representative from the Department of Water and Environmental Regulation (Chair)

Members of the stakeholder reference group will be appointed by the Minister for Environment. DWER will also provide secretariat support. Sitting fees are not applicable.

Tenure and meeting arrangements:

The term of appointment of the Chair and members of the committee is three years.

The committee will meet at least annually, or as determined by the Chair.

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Appendix C – Summary of industry licences and approvals

Activity on the Burrup Peninsula and conditions imposed under Parts IV and V of the *Environmental Protection Act 1986* and *Environment Protection and Biodiversity Conservation Act 1999* relevant to the Burrup rock art strategy

Project name	Company	Approvals ⁱ	Conditions relating to rock art	Conditions relating to air
Technical Ammonium Nitrate Facility	Yara Pilbara Nitrates Pty Ltd (previously Burrup Nitrates Pty Ltd)	EPBC 2008/4546	EPBC 2008/4546: contribute funding to the program and include additional monitoring sites	EPBC 2008/4546: Condition 9: Minimum of 24 months baseline data for Ammonia, Nitrogen Oxides, Sulphur Oxides; and Total Suspended Particulates (TSP) at three locations near the rock art followed by a further five years.
Yara Pilbara Fertilisers	Yara Pilbara Fertilisers Pty Ltd	Licence L7997/2002/11	-	Licence L7997/2002/11 limits point source emissions to air for NO _x : <ul style="list-style-type: none"> • Limit of 130mg/m³ (60 minute average) stack test at Primary Reformer stack (36m height, fitted with low NO_x burner) • Limit of 360mg/m³ (60 minute average) stack test at Package Boiler stack (30m height, 50tph and 150tph package boilers)
Pluto LNG	Woodside Energy Ltd	EPBC 2006/2968 Ministerial Statement 850 Ministerial Statement 757 Ministerial Statement 747 Ministerial Statement 733 Licence L8752/2013/2	-	Ministerial Statement 757 Condition 11: requires a Front End Engineering Design Report which sets out base emission rates for major sources for the plant and design and emission standards followed by an Air Quality Management Plan which includes modelling, proposed targets and standards and an emissions monitoring programme which includes nitrogen compounds, butane, toluene, ethylene, xylene, ozone, acrylene and hydrogen sulphide emissions from the plant; and an ambient air monitoring programme and a nitrogen deposition monitoring programme. Licence L8752/2013/2 provides the following limits: <ul style="list-style-type: none"> • 100mg/m³ of oxides of nitrogen stack test average over a period not less than 30 minutes from gas turbines (40 to 50m height); • 140mg/m³ of oxides of nitrogen stack test average over a period not less than 30 minutes from gas turbines (40 to 50m height); • No dark smoke emissions of a shade of Ringelmann 3 or greater over a continuous 30 minute period from flares. Also requires monitoring for oxides of nitrogen, dark smoke emissions and volumes of hydrocarbons flared.
Woodside Onshore Gas Treatment Plant	Woodside Energy Ltd	EPBC 2006/3191 Licence L5491/1984/18	-	Licence L5491/1984/18 limits emissions of oxides of nitrogen: <ul style="list-style-type: none"> • 350mg/m³ from gas turbines and furnace exhaust stacks; • 100mg/m³ at LNG 4 and 5.

Methanol manufacturing	Methanex Australia Pty Ltd	EPBC 2001/528 Ministerial Statement 619	-	Ministerial Statement 619 Condition 8: Prior to submitting a Works Approval application for the second methanol plant, submit a comprehensive report detailing the engineering design details for gaseous emissions, estimated emissions of oxides of nitrogen and any other significant gaseous pollutants, air dispersion modelling to predict ground level concentrations.
Methanol Plant and Product Export	Australian Methanol Company Pty Ltd	Ministerial Statement 617	-	Ministerial Statement 617 Condition 9: Prior to submitting a Works Approval, confirm engineering design details of gaseous pollutants, estimates the concentration of oxides of nitrogen other major gaseous pollutants, demonstrate best practicable oxides of nitrogen control and measures to reduce oxides of nitrogen emissions from the plant, remodel oxides of nitrogen emissions. Identify preliminary warning indicators and “trigger levels” to indicate impacts of acid gases on systems, including soil condition, rockpools, vegetation and mangal communities, and petroglyphs.
Ammonia-Urea Plant	Dampier Nitrogen Pty Ltd	Ministerial Statement 614	-	Ministerial Statement 614 Condition 8 proposes a limit of 0.07g/m3 of NOx from gas turbines, requires monitoring of urea emissions.
Nickol Bay Quarry / Works-Emoleum-Karratha Nickol Bay Asphalt Plant	Holcim Australia Pty Ltd / Downer EDi Works Pty Ltd	EPBC 2013/6915 Ministerial Statement 713 Licence L4741/1982/12 Licence L8498/2010/2 Works approval W5766/2014/1	-	Licence L8498/2010/2 limits point source emissions of TSP to 50mg/m3 (60 minute average test) at the stack (12m height). Also requires point source monitoring of TSP and stack velocity biennially. Works approval W5766/2014/1 Condition 3.1.4 requires point source monitoring at the plant stack at the drum dryer via baghouse (12m height) for volumetric flow rate, particulates, sulfur dioxide, nitrogen oxides, carbon monoxide, VOC.
Construction and operation of LNG and Domestic Gas Plant and Onshore and Offshore Facilities (Wheatstone)	Chevron Australia Pty Ltd	EPBC 2008/4469	-	-
Stages 1 & 2 Port of Dampier Security Upgrade & Associated Works	Dampier Port Authority	EPBC 2004/1751	-	-
Development of Industrial Land, Port of Dampier	Dampier Port Authority	EPBC 2003/1293	-	-
MOF Road Widening and Resurfacing Works	Dampier Port Authority	EPBC 2011/5843	-	-
Widening of MOF road	Woodside Energy Ltd	EPBC 2005/2305	-	-

Methanol plant	GTL Resources	EPBC 2001/521	-	-
Dimethyl ether plant	Japan DME Pty Ltd	EPBC 2001/509	-	-
King Bay East Rock Quarry & Industrial Estate Development	Stephen Nicholson	EPBC 2003/1150	-	-
Site preparations	Woodside Energy Limited	EPBC 2005/2391	-	-
Quarry and Industrial site King Bay	BGC Contracting Pty Ltd and Dampier Port Authority	Ministerial Statement 634	-	-
Adjustment of alignment of Product Services Corridor near the Dampier Public Wharf	LandCorp and Department of Mineral and Petroleum Resources	Ministerial Statement 616	-	-
Marine Load Out Facility	Jan De Nul (Australia) Pty Ltd and Tideway B.V	Works Approval W5662/2014/1	-	-
SLC Bulk Materials Facility	Leighton Contractors Pty Ltd	Licence L8677/2012/1	-	-
Toll Energy Yards - Dampier Supply Base	Toll Energy Logistics Pty Ltd	Licence L8511/2010/2	-	-
Parker Point Wastewater Treatment Plant	Pilbara Iron Pty Ltd	Licence L8139/2007/2	-	-

ⁱ Approvals made under the *Environment Protection and Biodiversity Conservation Act 1999* can be accessed from the Department of the Environment and Energy's website:

<http://epbcnotices.environment.gov.au/referralslist/>

Ministerial Statements can be accessed from the Environmental Protection Authority's website: <http://www.epa.wa.gov.au/all-ministerial-statements>

Licences and works approvals can be accessed from the Department of Water and Environmental Regulation's website: <https://www.der.wa.gov.au/our-work/licences-and-works-approvals/current-licences>

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