



# **Macedon Gas Development Ministerial Statement 844 2023 Compliance Assessment Report**

Woodside Energy Global Pty Ltd

January 2024

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# 1. Introduction

The Macedon gas project develops natural gas from the Macedon field in production lease WA-42-L for Western Australia's domestic gas market.

The project comprises a pipeline from subsea production wells to an onshore gas processing facility, located in the Ashburton North Strategic Industrial Area (ANSIA), approximately 17 kilometres southwest of Onslow. After the gas is processed, it is transferred via a sales gas pipeline to the Dampier to Bunbury Natural Gas Pipeline (DBNGP, Figure 1).

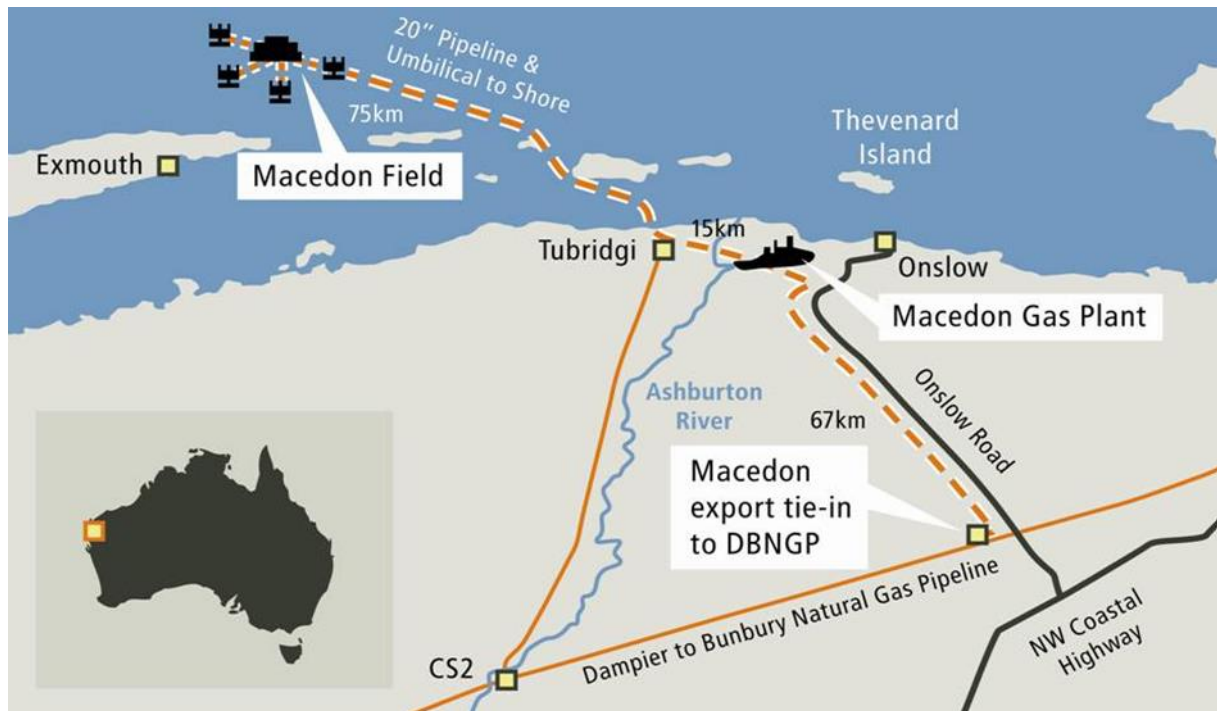


Figure 1 - Macedon Gas Development Location

The Macedon Gas Plant lease area for the gas processing facility and associated infrastructure, including the ground flares and evaporation pond areas are shown in Figure 2.

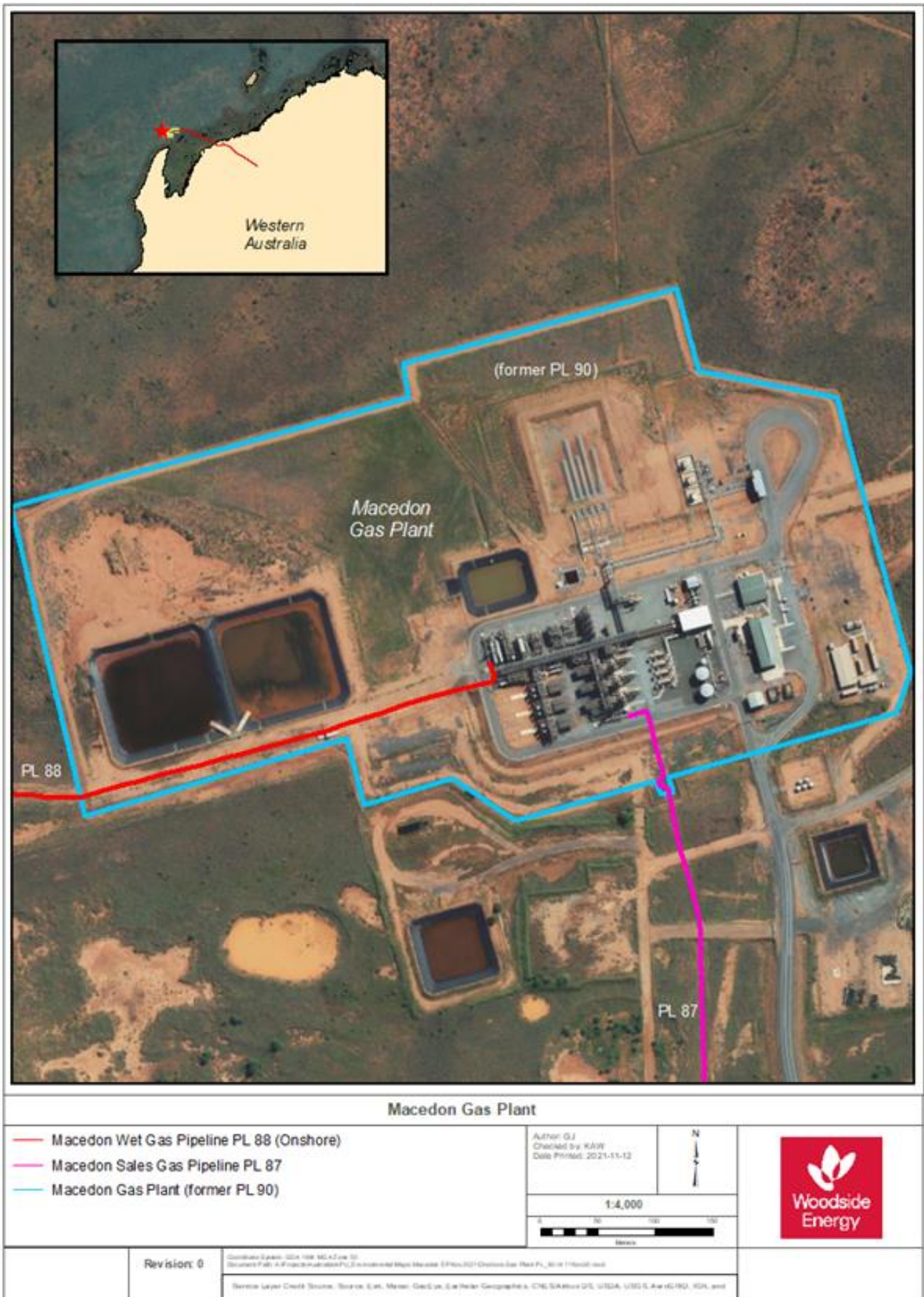


Figure 2 - Macedon Gas Development leases and layout

## **1.1 Purpose of the compliance assessment report**

The purpose of this compliance assessment report (CAR) is to assess compliance at the Macedon Gas Plant with the Environment Protection Authority (EPA) Statement 844 dated 28 October 2010 in accordance with the compliance assessment plan, version 13 dated 27 January 2023.

This CAR covers activities undertaken during the period 1 January 2023 to 31 December 2023.

## **1.2 Compliance assessment reporting requirements**

This report meets the intent of the compliance reporting requirements as defined in the Macedon Gas Project Compliance Assessment Plan (PMA-BHP-EN-EIA-0002), version 13 dated 27 January 2023.

## **1.3 Endorsement of the compliance assessment report**

This compliance assessment report has been endorsed by Francis Bolzan, Vice President FPSO & Macedon, Australian Operations.

# **2. Project Status**

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## **2.1 Current status of project (construction, operation, etc.)**

The project is currently in the operational phase.

## **2.2 Project activities covered by period of compliance assessment report**

This CAR covers the following project activities undertaken in the period 1 January 2023 to 31 December 2023:

1. Operations, 1 January 2023 to 31 December 2023.

## 3. Compliance with Ministerial Statement 844

### 3.1 Compliance with conditions

Operation of the Macedon Gas Project is compliant with Ministerial Statement No. 844 as reported in Table 1.

### 3.2 Rehabilitation monitoring

In March 2012, BHP Petroleum Pty Ltd (now Woodside Energy Global Pty Ltd) as Operator commenced rehabilitation of 285 hectares of an area approved for clearing for gas pipelines. Monitoring of the rehabilitation was required to demonstrate that, within three years of commencement of rehabilitation, the reinstated vegetation had species diversity not less than 60 percent of the known original species diversity and weed coverage which was equal to or less than the pre-clearing levels (Condition 8 of Ministerial Statement 844).

Monitoring of transects along the Macedon Gas Pipeline was completed by Astron in 2010 (the baseline survey prior to clearing) and then post-rehabilitation in 2013, 2014 and 2015 by Astron, and by Biota Environmental Sciences in 2017, 2019, 2021, 2022 and 2023.

For the 2023 reporting year, the field survey was completed between 12 and 14 April 2023 (Biota, 2023; Appendix A). Ten rehabilitation sites were assessed in historically disturbed areas, with seven of these also having an associated analogue site located in a nearby undisturbed area. Monitoring was completed according to the methodology established by Astron (2012). To summarise the development of vegetation along the rehabilitation transects, each transect was also ranked according to a predefined rehabilitation scale. A summary of the results from the 2023 Rehabilitation Monitoring Survey is provided below and the full report is provided in Appendix A.

A total of 66 native vascular flora species were recorded from the 17 transects resampled in 2023. Two weed species were recorded from the study area (*Cenchrus ciliaris* and *C. setiger*).

With regards to the criteria for the rehabilitation areas listed for Condition 8 of MS844:

**(1) Species diversity is not less than 60 per cent of the known original species diversity.**

This criterion has been met for species richness (native species count) in all the monitored transects. In the absence of threatening factors such as weed invasion, revegetation in the study area is 'Excellent' in the north-western transects but 'Poor' in the south-eastern transects. It would be expected to continue to develop towards a floristic community and composition more aligned with pre-clearing levels in the longer term.

**(2) Weed coverage is equal to or less than that of pre-cleared levels.**

The criterion for condition 8-1(2) in MS844 has again not been met for rehabilitation transects BHPPD-29, BHPPD-30 and BHPPD-31 in 2023 with regard to the introduced tussock grasses *Cenchrus ciliaris* (Buffel Grass) and *C. setiger* (Birdwood Grass). Additionally, the criterion has also not been met for the transects BHPPD-23 and BHPPD-28 in 2023.

When comparing the 2023 result to that of 2022, *Cenchrus ciliaris* and *C. setiger* have decreased in abundance (as measured by their percent cover along the line transect) at BHPPD-31 but increased significantly at BHPPD-23, BHPPD-28, BHPPD29, and BHPPD-30. Provided that continued spraying of these species within the rehabilitated areas is undertaken at the appropriate times and intensity of effort over the course of the next several seasons, it would be expected that the cover of *Cenchrus spp.* will at the very least decrease and begin to trend towards pre-clearing levels.

A weed treatment program involving targeted application of herbicide to the introduced tussock grasses occurred in April and August 2023. The weed treatment program will continue in 2024.

### **3.3 Greenhouse gas**

#### **3.3.1 GHG emissions and intensity**

Annual GHG emissions for the period 1 January 2023 to 31 December 2023 were 80,395 tonne equivalent of carbon dioxide (t CO<sub>2</sub>-e); carbon emissions intensity for the period was 7.27 t CO<sub>2</sub>-e per 1,000 barrels of oil equivalent production. Recorded emissions were slightly lower than those recorded for the previous two years and lower than those provided in the Final Environmental Performance Standard (EPS) (85,000 t CO<sub>2</sub>-e); variance between predicted and actual emissions is due to higher production rates used to estimate carbon emissions in the EPS when compared to current operations.

#### **3.3.2 GHG reduction measures investigated**

Details of improvements in equipment, technology or procedures were investigated prior to development of the Macedon Project in 2010 through an energy optimisation study. The aim of the study was to identify cost effective projects, which would reduce energy and greenhouse gas emission across all operations of the Macedon Gas Project and incorporate these into the design of the Macedon Gas Project.

Woodside Energy continues to identify and evaluate GHG reduction opportunities through internal processes designed to evaluate and where viable, implement greenhouse gas abatement measures, in addition to routine tracking of emissions against targets to further identify opportunities for reduction.

#### **3.3.3 GHG reduction measures implemented**

Recent emissions reduction and investigation initiatives implemented at the Macedon Gas Plant include:

- Change of compressor discharge setpoints to minimise fuel gas usage.
- An independent expert consultant conducted a survey of small-bore tubing at multiple modules, including compressors and metering stations, at the facility. Woodside is progressing towards closing out the recommendations of the survey.
- In May 2023, a light aircraft survey using high-resolution Airborne visible/infrared imaging spectrometer (AVIRIS) technology was conducted to measure methane emissions at the Macedon Gas Plant. The survey did not detect any material sources of emissions at the facility.

## 4. Audit Table

Audit Code	Subject	Action (from Ministerial Statement 844)	How	Evidence	Satisfy	Advice	Phase	When	Status	Further Information
844:M1.1	Implementation	The proponent shall implement the proposal as documented and described in schedule 1 of this statement subject to the conditions and procedures of this statement.	Project implemented in accordance with these criteria	Compliance Assessment Report (CAR)	Min for Env		Overall		C	2023 CAR (this document)
844:M2.1	Proponent Nomination and Contact Details	The proponent for the time being nominated by the Minister under sections 38(6) or 38(7) of the Act is responsible for the implementation of the proposal.			Min for Env		Overall		C	Proponent is Woodside Energy Global Pty Ltd
844:M2.2	Proponent Nomination and Contact Details	The proponent shall notify the CEO of any change of the name and address of the proponent for the serving of notices or other correspondence within 30 days of such change.	Letter notifying CEO of any change in proponent details	Letter notifying CEO of any change in proponent details	CEO		Overall	Within 30 days of such change	C	No change during the reporting period
844:M3.1	Time Limit of Authorisation	The authorisation to implement the proposal provided for in this statement shall lapse and be void five years after the date of this statement if the proposal to which this statement relates is not substantially commenced.	Implement project		Min for Env		Overall	Commence implementation by 27 October 2015	CLD	Implementation commenced in 2011 OEPA Desktop Audit report 31.08.2012
844:M3.2	Time Limit of Authorisation	The proponent shall provide the CEO with written evidence which demonstrates that the proposal has substantially commenced on or before the expiration of five years from the date of this statement.	Letter notifying CEO that proposal has substantially commenced	Letter to the CEO demonstrating that the proposal has substantially commenced	CEO		Overall	Within one month of commencement	CLD	Letter sent to CEO dated 16.01.2012 OEPA Desktop Audit report 31.08.2012
844:M4.1	Compliance Reporting	The proponent shall prepare and maintain a compliance assessment plan (CAP) to the satisfaction of the CEO.	CAP will be developed prior to implementation and maintained	CAP	CEO		Overall	Prior to implementation and ongoing	C	OEPA accepted 18.03.2011 (CAP latest version 13 dated 27.01.2023, submitted to OEPA on 28.01.2023)
844:M4.2	Compliance Reporting	The proponent shall submit to the CEO the CAP required by condition 4-1 at least six months prior to the first compliance report required by condition 4-6, or prior to implementation, whichever is sooner.  The CAP shall indicate: <ol style="list-style-type: none"> <li>1. the frequency of compliance reporting;</li> <li>2. the approach and timing of compliance assessments;</li> <li>3. the retention of compliance assessments;</li> <li>4. the method of reporting of potential non-compliances and corrective actions taken;</li> <li>5. the table of contents of compliance assessment reports; and</li> <li>6. public availability of compliance assessment reports.</li> </ol>	CAP will be developed prior to implementation and submitted to CEO	CAP	CEO		Pre-construction	At least six months prior to the first CAR required by Condition 4-6, or prior to implementation, whichever is sooner	CLD	OEPA accepted 18.03.2011
844:M4.3	Compliance Reporting	The proponent shall assess compliance with conditions in accordance with the CAP required by condition 4-1.	Prepare Compliance Assessment Report (CAR)	CAR	Min for Env		Overall	When requested by the CEO	C	2011 CAR, 2012 CAR, 2013 CAR, 2014 CAR, 2015 CAR, 2016 CAR, 2017 CAR; 2018 CAR, 2019 CAR, 2020 CAR, 2021 CAR, 2022 CAR 2023 CAR (this document)
844:M4.4	Compliance Reporting	The proponent shall retain reports of all compliance assessments described in the CAP required by condition 4-1 and shall make those reports available when requested by the CEO.	CAR to include compliance assessments (audit table), retain CAR for the life of the project in electronic and hard copy format	CAR	CEO		Overall	Annual	C	2011 CAR, 2012 CAR, 2013 CAR, 2014 CAR, 2015 CAR, 2016 CAR, 2017 CAR, 2018 CAR, 2019 CAR, 2020 CAR, 2021 CAR, 2022 CAR 2023 CAR (this document)
844:M4.5	Compliance Reporting	The proponent shall advise the CEO of any potential non-compliance within seven days of that non-compliance being known.	Advise CEO of potential non-compliance in writing	Log of phone call, email or letter	CEO		Overall	Within seven days of that non-compliance being known	C	Non-compliance related to condition 8 (below).
844:M4.6	Compliance Reporting	The proponent shall submit to the CEO the first CAR fifteen months from the date of issue of this Statement addressing the twelve month period from the date of issue of this	CAR will be issued	CAR	CEO		Overall	Annually by 28 January each year with the first CAR due 28 January 2012	C	2011 CAR, 2012 CAR, 2013 CAR, 2014 CAR, 2015 CAR, 2016 CAR, 2017 CAR; 2018



Audit Code	Subject	Action (from Ministerial Statement 844)	How	Evidence	Satisfy	Advice	Phase	When	Status	Further Information
		Statement and then annually from the date of submission of the first CAR. The CAR shall: 1. be endorsed by the proponent's Managing Director or a person delegated to sign on the Managing Director's behalf; 2. include a statement as to whether the proponent has complied with the conditions; 3. identify all potential non-compliances and describe corrective and preventative actions taken; 4. be made publicly available in accordance with the approved CAP; and 5. indicate any proposed changes to the CAP required by condition 4-1.	Make CAR publicly available in accordance with 'Proposal Implementation Monitoring Branch – Draft Fact Sheet 1 – Making Documents Publicly Available – April 2010'							CAR, 2019 CAR, 2020 CAR, 2021 CAR, 2022 CAR. Documents are publicly available via <a href="https://www.woodside.com/wh-at-we-do/operations/macedon">https://www.woodside.com/wh-at-we-do/operations/macedon</a> 2023 CAR (this document).
844:M5.1	Non-Indigenous Marine Species	Prior to mobilisation of vessels and submersible equipment for the construction of the Macedon Gas Project marine pipeline and umbilical, the proponent shall update the Introduced Marine Pest Management Procedure contained in Appendix Q of the Final EPS to be consistent with the Commonwealth and State guidelines approved and published at that time, to the satisfaction of the CEO on advice from the Department of Fisheries.	Revise and obtain approval of Introduced Marine Pest Management Procedure (IMP MP)	IMP MP	CEO	DPIRD	Pre-construction	Prior to mobilisation of vessels and submersible equipment for the construction of the Macedon Gas Project marine pipeline and umbilical	CLD	Letter of Approval from CEO of EPA received 28.11.2011
844:M5.2	Non-Indigenous Marine Species	The proponent shall implement the updated Introduced Marine Pest Management Procedure for the construction and maintenance of the Macedon Gas Project marine pipeline and umbilical.	Offshore pipelay and maintenance implemented in compliance with IMP MP	Inspection of IMP MP vessel risk assessments, certificates of vessel cleanliness	Min for Env		Overall	For the construction and maintenance of the Macedon Gas Project marine pipeline and umbilical	C	IMP MP implemented during construction phase. Pipeline maintenance survey completed in accordance with IMP MP
844:M6.1	Marine Fauna	The proponent shall not cause physical damage to turtles, disrupt turtle nesting behaviour or cause a change to hatchling orientation in waters and/or beaches adjacent to the pipeline shore crossing during construction.	Implement Marine Turtle Impacts Management Protocol (MTI MP)	Implementation of MTI MP, Marine Fauna Observer logs	Min for Env		Construction	During construction	C	Shore crossing complete, no impacts to marine turtles recorded
844:M6.2	Marine Fauna	If the pipeline shore crossing is to take place between 1 November and 30 April the proponent shall prepare a MTI MP to the satisfaction of the CEO on advice from the DEC prior to undertaking the shore crossing. The protocol shall include: 1. employment of a suitably qualified marine fauna observer; 2. indicators for determining if and when there is potential for impacts on turtle nesting or hatchling emergence; 3. management responses to evidence of turtle activity; and 4. triggers for stopping construction activities pending further consultation with the DEC; and 5. when resumption of activities can take place, on advice of the DEC.	Prepare MTI MP	Approval of MTI MP	CEO	DWER	Construction	Prior to undertaking the shore crossing, if the pipeline shore crossing is to take place between 1 November and 30 April	CLD	Letter of Approval from CEO of EPA received 31.10.2011
844:M6.3	Marine Fauna	The proponent shall implement the MTI MP if undertaking the pipeline shore crossing between 1 November and 30 April.	Implement MTI MP	Marine Fauna Observer logs	Min for Env		Construction	If undertaking the pipeline shore crossing location between 1 November and 30 April	CLD	Pipeline shore crossing complete. MTI MP implemented for shore crossing
844:M6.1A	Pipeline Route – State waters	Subject to complying with the separation distances in condition 7-1, the pipeline within State waters shall be laid/constructed within the corridor delineated by the coordinates specified in Schedule 2.	Install pipeline in corridor delineated in Schedule 2	Pipelay vessel logs, as-built survey of route	Min for Env		Construction	During offshore pipeline construction	CLD	Pipeline installed within corridor
844:M7.1	Benthic Primary Producer Habitat	The proponent shall undertake all works in a manner that ensures that the loss of Benthic Primary Producer Habitat (BPPH) within the Local Assessment Area, as defined in Figure 3, does not exceed 1% for any habitat type and is minimised by maintaining the following separation distances during construction of the marine pipeline and umbilical: (1) pipeline to primary feature – 700 metres; (2) pipeline to secondary feature – 600 metres;	Maintain separation distance during offshore pipelay as per Condition 7-1	Pipelay vessel logs, as-built survey of route, BPPH survey and loss calculations	Min for Env		Construction	During offshore pipeline construction	CLD	Letter of Approval from CEO of EPA received 23.09.2013

Audit Code	Subject	Action (from Ministerial Statement 844)	How	Evidence	Satisfy	Advice	Phase	When	Status	Further Information
		(3) vessel movement/anchor to primary feature – 200 metres; and (4) vessel movement/anchor to secondary feature – 100 metres.  Note: "loss" is loss that does not recover within 5 years, "primary feature" and "secondary feature" are as defined in Figure 18 of the Final EPS and not a feature for which proposed impacts are described in section 8.4.4.5 of the Final EPS.								
844:M7.2	Benthic Primary Producer Habitat	The proponent shall survey the direct loss of BPPH against the criteria in condition 7-1 starting within one month of completion of the marine pipeline and umbilical.	Survey and calculate loss of BPPH	Post construction as built survey of route, BPPH survey and loss calculations	Min for Env		Overall	Commencing within one month of completion of the marine pipeline and umbilical	CLD	Letter of Approval from CEO of EPA received 23.09.2013
844:M7.3	Benthic Primary Producer Habitat	Notwithstanding condition 7-1, if monitoring detects that construction activities have contributed to a loss of greater than 1% in any habitat type within the management unit, as defined in Figure 3, the proponent shall notify the CEO of the strategies to be implemented to enhance recovery and rehabilitate the impacted BPPH.	Develop strategies for recovery and rehabilitation of BPPH	Post construction as-built survey, strategies	CEO		Overall	If monitoring detects that construction activities have contributed to a loss greater than 1% in any habitat type within the management unit, as defined in Figure 3	C	No exceedance of loss >1% in any habitat type
844:M8.1	Terrestrial Vegetation	Within two months following completion of construction of the gas plant and associated pipelines, the proponent shall commence rehabilitation of the temporarily cleared areas of the site that are no longer being utilised to achieve re-establishment of vegetation, such that the following criteria are met across the distribution of the disturbance footprint within three years of commencement of rehabilitation:  (1) Species diversity is not less than 60 percent of the known original species diversity; (2) Weed coverage is equal to or less than that of pre-cleared levels.  Note: The original species diversity and weed coverage must be determined prior to clearing or from analogue sites approved by the CEO on advice from the DEC.	Undertake rehabilitation of temporarily cleared areas (gas plant and pipelines) as per Condition 8-1	Rehabilitation monitoring reports, rehabilitation completion criteria:  Species diversity greater than 60% of pre-disturbance Weed coverage less than pre-disturbance levels	CEO	DWER	Overall	Commence rehabilitation within two months following completion of construction of the gas plant and associated pipelines and meet criteria within three years of commencement of rehabilitation	NC	Rehabilitation has been completed of temporary disturbed areas.  Results from the recent rehabilitation survey undertaken in April 2023 indicated the criterion for condition 8-1(1) in MS844 was met during the reporting period, however condition 8-1(2) was not (but is expected to be met longer term).  All 17 monitored transects met the criterion of condition 8-1(1).  Five of the 17 monitored transects did not meet the criterion of condition 8-1(2).  Refer to the 2023 Rehabilitation Monitoring Report (Appendix A of this document)
844:M8.2	Terrestrial Vegetation	In liaison with the DEC, the proponent shall monitor progressively the performance of rehabilitation for a range of sites against the criteria in condition 8-1 based on appropriately timed surveys after rain, until the completion criteria are met. The surveys shall be conducted annually unless otherwise agreed by the CEO.	Monitor rehabilitation success against rehabilitation completion criteria, conduct surveys in accordance with Condition 8-2	Rehabilitation monitoring report, rehabilitation completion criteria:  Species diversity greater than 60% of pre-disturbance Weed coverage equal to or less than pre-disturbance levels  Correspondence with DPAW	CEO	DWER	Overall	Appropriately timed after rain on an annual basis unless otherwise agreed by the CEO until the completion criteria are met	C	2023 Rehabilitation Monitoring Report (Appendix A of this document)
844:M8.3	Terrestrial Vegetation	The proponent shall include a rehabilitation monitoring report in the CAR referred to in condition 4-6 commencing from the date rehabilitation was commenced. The report shall address in the report the following:  1. The progress made towards meeting the criteria required by condition 8-1; and  2. Contingency management measures in the event that the criteria required by condition 8-1 are unlikely to be met.	Submit rehabilitation monitoring report	Rehabilitation monitoring report, rehabilitation completion criteria:  Species diversity greater than 60% of pre-disturbance Weed coverage equal to or less than pre-disturbance levels	Min for Env		Overall	Commencing from the date rehabilitation was commenced and on an annual basis	C	2023 Rehabilitation Monitoring Report (Appendix A of this document)

Audit Code	Subject	Action (from Ministerial Statement 844)	How	Evidence	Satisfy	Advice	Phase	When	Status	Further Information
844:M9.1	Terrestrial Fauna	The proponent shall prevent the death of fauna that becomes entrapped in the onshore pipeline trenches by employing a fauna clearing person or persons to remove trapped fauna from any open pipeline trench.	Fauna clearing person(s) to remove fauna from open pipeline trench	Employment of fauna clearing person(s), daily logs	Min for Env		Construction	Until all trenching is completed and no open pipeline trenches remain	CLD	Trenching complete
844:M9.2	Terrestrial Fauna	The length of open trenches shall not exceed a length capable of being inspected and cleared by a fauna clearing person within the time frame specified in condition 9-4.	Clear open trench within identified timeframes specified in Condition 9-4	Employment of fauna clearing person(s), daily logs	Min for Env		Construction	Until all trenching is completed and no open pipeline trenches remain	CLD	Trenching complete
844:M9.3	Terrestrial Fauna	Fauna refuges providing suitable shelter from the sun and predators for trapped fauna shall be placed in the trench at intervals not exceeding 50 metres.	Fauna refuges installed in open trench at intervals < 50m	Daily logs	Min for Env		Construction	Until all trenching is completed and no open pipeline trenches remain	CLD	Trenching complete
844:M9.4	Terrestrial Fauna	Inspection and clearing of fauna from trenches by a fauna clearing person shall occur twice daily and not more than half an hour prior to the backfilling of trenches, with the first daily inspection and clearing to be undertaken no later than 3.5 hours after sunrise, and the second inspection and clearing to be undertaken daily between the hours of 3:00 pm and 6:00 pm.	Clear open trench within identified timeframes	Employment of fauna clearing person(s), daily logs	Min for Env		Construction	Twice daily and not more than half an hour prior to the backfilling of trenches, with the first daily inspection and clearing to be undertaken no later than 3.5 hours after sunrise, and the second inspection and clearing to be undertaken daily between the hours of 3:00 pm and 6:00 pm	CLD	Trenching complete
844:M9.5	Terrestrial Fauna	In the event of rainfall, the proponent shall, following the clearing of fauna from the trench, pump out significant pooled water in the open trench (with the exception of groundwater) and discharge it to adjacent vegetated areas in a manner that does not cause erosion.	Pump out significant pooled water in open trench	Daily logs	Min for Env		Construction	In the event of rainfall, following the clearing of fauna from the trench	CLD	Trenching complete. No loss of fauna during pipeline construction. Small losses due to groundwater flooding in trenches.
844:M10.1	Emissions to Air	The proponent shall install equipment and manage ongoing operations such that best practice for a petroleum gas/condensate facility in respect to volatile organic compounds and oxides of nitrogen emissions is achieved.	Install equipment as detailed in Air Emissions Best Practice Report (AEBPR) and manage ongoing operations	Approved AEBPR, CAR	Min for Env		Overall	Construction and ongoing operations	C	Equipment identified in AEBPR installed and operated.  Emission testing demonstrates effective management of VOC and NOx
844:M10.2	Emissions to Air	The proponent shall provide reports showing the basis on which 'best practice' was determined, to the satisfaction of the CEO, as follows:  1. for plant and equipment – prior to applying for a Works Approval under Part V of the Act; and  2. for ongoing management of operations – prior to applying for a Licence under Part V of the Act.	Prepare AEBPR for selection of equipment and ongoing management of operations	Approved AEBPR, CAR	CEO		Overall	Prior to applying for a Works Approval (for plant and equipment) and prior to applying for a Part V licence (for ongoing management of operations)	CLD	Approval of AEBPR received from CEO of EPA in letter dated 07.07.2011
844:M11.1	Greenhouse Gas Abatement	For the life of the project, the proponent shall include in the CARs referred to in Condition 4-6 the following:  1. annual greenhouse gas (GHG) emissions and intensity resulting from the operation of the project in comparison to the annual emissions predicted in the Final EPS and reasons for any variance;  2. details of improvements in equipment, technology or procedures investigated by the proponent that would reduce greenhouse gas emissions; and  3. details of improvements in equipment, technology or procedures implemented by the proponent that will reduce greenhouse gas emissions.	CAR to include GHG emissions and intensity (including comparison to annual emissions predicted in the Final EPS and reasons for any variance) and proposed and implemented GHG reduction methods	CAR	Min for Env		Operation	For the life of the project	C	2018 CAR, 2019 CAR, 2020 CAR, 2021 CAR, 2022 CAR, 2023 (this document, see <b>Section 3.3</b> on GHG)
844:M12.1	Decommissioning	At least six months prior to the anticipated date of closure, the proponent shall submit a Final Decommissioning Plan designed to ensure that the site is suitable for future land uses, for approval of the CEO. The Final Decommissioning Plan shall set out procedures and measures for:  1. removal or, if appropriate, retention of plant and infrastructure; and	Submit Final Decommissioning Plan	Approval of Final Decommissioning Plan	CEO		Operation	At least six months prior to the anticipated date of closure	NR	

Audit Code	Subject	Action (from Ministerial Statement 844)	How	Evidence	Satisfy	Advice	Phase	When	Status	Further Information
		2. remediation or rehabilitation of all disturbed areas to a standard suitable for the agreed new land use(s).								
844:M12.2	Decommissioning	The proponent shall implement the Final Decommissioning Plan required by condition 12-1 from the date of closure until such time as the Minister determines, on advice of the CEO, that the proponent's decommissioning responsibilities have been fulfilled.	Implement Final Decommissioning Plan	Decommissioning and rehabilitation monitoring reports	Min for Env	CEO	Decommissioning	From the date of closure until such time as the Minister determines, on advice of the CEO, the proponent's decommissioning responsibilities have been fulfilled	NR	
844:M12.3	Decommissioning	The proponent shall make the Final Decommissioning Plan required by condition 12-1 publicly available in a manner approved by the CEO.	Make Final Decommissioning Plan publicly available	Final Decommissioning Plan available as directed by CEO	CEO		Overall	Within two weeks of receiving approval for the final Decommissioning Plan	NR	

Note:

- Phases that apply in this table = Pre-construction, Construction, Operation, Decommissioning, Overall (several phases)
- This audit table is a summary and timetable of conditions and commitments applying to this project. Refer to the Minister's Statement for full detail/precise wording of individual elements
- Code prefixes: M = Minister's condition; P = Proponent's commitment; A= Audit specification; N= Procedure
- Any elements with status = "Audited by proponent only" are legally binding but are not required to be addressed specifically in compliance reports, if complied with
- Acronyms list:- Min for Env = Minister for the Environment; CEO = Chief Executive Officer of OEPA; OEPA = Office of the Environmental Protection Authority; EPA = Environmental Protection Authority; DWER = Department of Water and Environmental Regulation (formerly Department of Environment and Conservation (DEC)); DEMIRS = Department of Energy, Mines, Industry Regulation and Safety (formerly Department of Mines, Industry Regulation and Petroleum (DMIRS)); DoH = Department of Health; DPIRD = Department of Primary Industries and Regional Development, formerly (Department of Fisheries (DoF))

## 5. Non-compliance and corrective/preventative actions

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### 5.1 Non-compliance

One non-compliance occurred during the reporting period. These are non-compliance with conditions 8-1(2).

**Terrestrial Vegetation condition 8-1(2)** During the reporting period, rehabilitation monitoring was conducted in accordance with condition 8-1. Following the results of this monitoring, it was concluded that five transects had not achieved weed coverage equal to or less than pre-cleared levels, with regards to the tussock grasses \**Cenchrus ciliaris* (Buffel Grass) and \**C. setiger* (Birdwood Grass). Therefore a non-compliance with condition 8-1(2) was identified. Details of the rehabilitation monitoring is presented in section 3.2 and Appendix A.

### 5.2 Corrective/preventative actions

**Terrestrial Vegetation condition 8-1(2)**

Rehabilitation monitoring is ongoing on a yearly basis, with no additional actions required to improve species diversity. Annual weed spraying will continue to target areas identified in the 2023 monitoring report, post wet season. Additional weed spraying to be implemented in 2024 based on consultant recommendations.

## 6. Changes to the Compliance Assessment Plan

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There is one update to the existing Compliance Assessment Plan in 2023 (Revision 13, January 2023), relating to the key contacts for the Macedon Gas Development is:

Joe Cowan  
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Corporate Affairs: 1800 442 977

## References

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Macedon Gas Project Compliance Assessment Plan, (PMA-BHP-EN-EIA-0002).  
Astron (2012) Pipeline Rehabilitation Monitoring and Evaluation Plan

# **APPENDIX A: Macedon Gas Pipeline Rehabilitation Survey 2023**

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# Macedon Gas Pipeline Rehabilitation Survey 2023







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Sciences



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# Macedon Pipeline Rehabilitation Survey 2023

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# 1.0 Summary

## 1.1 Background

On 1<sup>st</sup> June 2022, BHP Petroleum and Woodside merged and on 11<sup>th</sup> July 2022, BHP Petroleum Pty Ltd changed its company name to Woodside Energy Global Pty Ltd (Woodside).

In 2012, Woodside commenced the rehabilitation of a 285 ha area that had been cleared along the Macedon Gas Pipeline, south of Onslow. As part of a condition of the environmental approval of the Macedon project (Condition 8 of Ministerial Statement 844 (MS844); Minister for Environment 2010), monitoring was required to demonstrate that the reinstated vegetation met the following criteria within three years of commencement of rehabilitation:

- (1) *Species diversity is not less than 60 per cent of the known original species diversity.*
- (2) *Weed coverage is equal to or less than that of pre-cleared levels.*

A monitoring program was developed by Astron Environmental Services (Astron 2012). Annual monitoring was subsequently undertaken by Astron in May 2013, July 2014, September/October 2015 (collectively reported in Astron 2016), and then by Biota Environmental Sciences (Biota) in 2017, 2019, 2021 and 2022 (Biota 2017, 2019, 2021 and 2022 respectively).

In 2023, Biota were again commissioned to undertake the annual monitoring survey of the Macedon Gas Pipeline, which was completed between 12 and 14 April 2023.

## 1.2 Methodology

During the field survey ten rehabilitation sites were assessed in historically disturbed areas, with seven of these also having an associated analogue site located in a nearby undisturbed area. Monitoring was completed according to the methodology established by Astron (2012). To summarise the development of vegetation along the rehabilitation transects, each transect was also ranked according to a predefined rehabilitation scale.

## 1.3 Results and Conclusions

A total of 66 native vascular flora species were recorded from the 17 transects resampled in 2023. Two weed species were recorded from the study area (*\*Cenchrus ciliaris* and *\*C. setiger*).

### 1.3.1 Satisfaction of Completion Criteria

With regards to the criteria for the rehabilitation areas listed for Condition 8 of MS844:

#### 1) ***Species diversity is not less than 60 per cent of the known original species diversity.***

This criterion has been met for species richness (native species count) in all the monitored transects. In the absence of threatening factors such as weed invasion, revegetation in the study area is 'Excellent' in the north-western transects but 'Poor' in the south-eastern transects. It would be expected to continue to develop towards a floristic community and composition more aligned with pre-clearing levels in the longer term.

#### (2) ***Weed coverage is equal to or less than that of pre-cleared levels.***

The criterion for Condition 8 in MS844 has again not been met for rehabilitation transects BHPPD-29, BHPPD-30 and BHPPD-31 in 2023 with regard to the introduced tussock grasses *\*Cenchrus ciliaris* (Buffel Grass) and *\*C. setiger* (Birdwood Grass). Additionally, the criterion has also not been met for the transects BHPPD-23 and BHPPD-28 in 2023.

When comparing the 2023 result to that of 2022, *\*Cenchrus ciliaris* and *\*C. setiger* have decreased in abundance (as measured by their percent cover along the line transect) at



BHPPD-31 but increased significantly at BHPPD-23, BHPPD-28, BHPPD29, and BHPPD-30. Provided that continued spraying of these species within the rehabilitated areas is undertaken at the appropriate times and intensity of effort over the course of the next several seasons, it would be expected that the cover of *\*Cenchrus* spp. will at the very least decrease and begin to trend towards pre-clearing levels.

### 1.3.2 Rehabilitation within the Mt Minnie Conservation Area

While most of the rehabilitation transects sampled in the Mt Minnie conservation area show Good to Excellent vegetation development, with few or no weeds, three transects remain in relatively Poor condition, with a fourth considered to be fair:

- Transect BHPPD-23 is considered Fair, with a somewhat moderate cover of *\*Cenchrus ciliaris* tussock grasses (22.6%). Development of spinifex and perennial shrubs remains steady over the last two phases of monitoring.
- Transect BHPPD-29 is considered Poor, with a high cover of *\*Cenchrus ciliaris* tussock grasses (48.5%) and no development of spinifex or perennial shrubs over the course of monitoring. Importantly, *\*Cenchrus* cover increased by 40% since the last phase.
- Transect BHPPD-30 is considered Poor. It shows a reasonable development of both spinifex and perennial shrub cover, but the cover of *\*Cenchrus* has remained high (33-38%) since 2017 with an increase of 5.5% since the last monitoring phase.
- Transect BHPPD-31 is considered Poor in 2023: spinifex cover has increased by approximately 4% to less than pre-clearing levels, with *\*Cenchrus* cover decreasing by 38.5%.

### 1.3.3 Likely Progression of Vegetation along Rehabilitation Transects

Prior to the 2019 survey, DBCA requested discussion of the likely progression of revegetation in the rehabilitation areas situated within the Mt Minnie conservation area in the short term (2-5 years), medium term (5-10 years) and long term (10-20 years). Based on the data recorded from the monitoring transects in these areas to date, vegetation development is clearly variable in different areas, and would be expected to progress differently over time.

Transects ranked as 'Excellent' in Table 5.5 comprise **BHPPD-22, BHPPD-24, BHPPD-25, BHPPD-26** and **BHPPD-27**. Vegetation at these transects is relatively comparable to that which existed prior to clearing, with a similar or sometimes greater amount of vegetation cover and no weeds. This vegetation would be expected to continue to develop in the short term, with additional species recruiting from the soil seed bank and adjacent areas. In the medium and long term, vegetation at the rehabilitation transects would be expected to remain stable over time, with major changes arising only due to disturbance events such as fire, or long-term shifts in the amount of rainfall received.

Transects ranked as 'Good' in Table 5.5 comprise **BHPPD-28**. The cover of native perennial vegetation along these transects is generally approaching the percentage recorded prior to clearing in 2010, although the proportions of shrubs and spinifex are often dissimilar (typically more shrubs and less spinifex). A notable increase was recorded in *\*Cenchrus* at **BHPPD-28** in 2023 at 7.5% cover, increasing from 0.2% cover in 2022. It would be expected that the native vegetation cover would increase to reach the pre-clearing levels within 5 years and would then remain stable over time. Unless spot spraying is undertaken at **BHPPD-28**, it would be expected that *\*Cenchrus* spp. levels would continue to increase over the short term.

Transects ranked as 'Fair' in Table 5.5 comprise **BHPPD-23**. Spinifex has re-established on the transect and is continuing the trend towards pre-clearing levels, remaining at a steady 40-50% since 2015; perennial shrubs (*Acacia*'s and *Senna*) have decreased since the last phase and annual herbs are absent all together; the cover of *\*Cenchrus* increased to 22.6% in 2023, resulting in the rating of this transect being downgraded from 'Good' to 'Fair'. It would be expected that the native vegetation cover, specifically perennial woody shrubs, would only re-establish at higher

levels if the population of *\*Cenchrus* spp. in the surrounding vegetation is controlled in the medium to long-term.

Transects ranked as 'Poor' in Table 5.5 comprise **BHPPD-29, BHPPD-30, BHPPD-31**.

- Although there is a lack of development of perennial vegetation at **BHPPD-29** (no hummock grassland of *Triodia glabra* and no shrubland of *Acacia synchronicia* and *A. xiphophylla* that existed prior to clearing), the current cover of *\*Cenchrus* spp. at this transect (40.35%) has increased greatly from the 8.15% recorded in 2022. It is expected that in the short term, with continued spraying, that the level of *\*Cenchrus* spp. may well decline. It would only be expected that the perennial *Acacia* shrubs and *Triodia* hummocks would become established in the long term given favourable conditions and the absence of competition from *\*Cenchrus* spp.
- At **BHPPD-30**, hummock grasses are at almost pre-clearing levels, whilst perennial woody shrubs are at 8.95% (15% less than the 23.5% recorded in 2010). The cover of *\*Cenchrus* has remained consistently steady over the last five phases (ranging between 27-45%). As at **BHPPD-29**, it would only be expected that the perennial *Acacia* shrubs would become established in the long term given favourable conditions and the absence of competition from *\*Cenchrus* spp.
- At **BHPPD-31**, it is unlikely that the cover of *Acacia xiphophylla* will return to pre-clearing levels of 72%, with colonisation of *A. bivenosa* shrubs along this transect only likely in the very long-term. Spinifex cover has remained steady since 2021 but still 22% less than pre-clearing levels, and the cover of *\*Cenchrus* has in fact decreased significantly from 73.65% in 2022 to 35.15% in 2023. The greater area surrounding **BHPPD-31** continues to support large, permanent populations of *A. xiphophylla*, and as whole presents as a stable, healthy vegetation unit.

For transects **BHPPD-29, BHPPD-30, and BHPPD-31**, the presence of relatively substantial amounts of *\*Cenchrus* spp. is likely to influence the development of native vegetation, through competition for resources and allelopathy. In the short to medium term, it is expected that the cover of native vegetation may still increase, however it is also likely that the cover of *\*Cenchrus* spp. will continue to remain steady or increase unless continued herbicide spraying is undertaken.

The presence of *\*Cenchrus* spp. is not the only factor influencing slow revegetation, however it is likely to be a significant factor over time, particularly for transects at which the cover of weeds is still moderate or high following herbicide spraying. Given the amount of *\*Cenchrus* spp. cover currently recorded at **BHPPD-29, BHPPD30** and **BHPPD-31**, these infestations would be expected to increase again in the short to medium term, and would likely suppress the regeneration of native perennial vegetation. It is unlikely that native vegetation would be able to re-establish to a similar state as was present prior to clearing, without continued weed control efforts.

To ameliorate the current long-term trend of a relatively stable, or increasing, *\*Cenchrus* population (specifically in the south-eastern end of the study area), it is recommended that the **herbicide treatment plan is a bi-annual occurrence for at least seven years** to eradicate the species from the soil seedbank.

### 1.3.4 DBCA (2018) Recommendations

With regards to meeting the four recommendations outlined by the DBCA (2018):

- Recommendation 1 (continual rehabilitation activities and weed monitoring) has been met by continual activities (herbicide application, last weed treatment occurring in May 2022), and by both the survey and content of this rehabilitation monitoring report.
- Recommendations 2 (identification of contingency management measures to be implemented), 3 (contingency management measures to date), and 4 (recognition of the access track acting as a potential weed vector) have been addressed within this rehabilitation monitoring report.

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## 2.0 Introduction

### 2.1 Project Background

On 1<sup>st</sup> June 2022, BHP Petroleum and Woodside merged and on 11<sup>th</sup> July 2022, BHP Petroleum Pty Ltd changed its company name to Woodside Energy Global Pty Ltd (Woodside).

Woodside constructed and operates the Macedon Gas Pipeline, which is associated with its Macedon Gas Development near Onslow. In 2010, prior to the commencement of vegetation clearing along the Macedon Gas Pipeline, Astron completed a baseline monitoring survey (Astron 2010) with the purpose of establishing permanent monitoring sites, determining baseline levels of diversity and weed cover, and acquiring vegetation data against which to assess completion criteria contained in Condition 8 of Ministerial Statement 844 (MS844) (Minister for Environment 2010).

In 2012, Woodside commenced the rehabilitation of a 285 ha area that was cleared along the Macedon Gas Pipeline. As part of a condition of the environmental approval of the Macedon project (Condition 8 of Ministerial Statement 844 (MS844); Minister for Environment 2010), monitoring was required to demonstrate that revegetation met the following criteria within three years of commencement of rehabilitation:

- (1) *Species diversity is not less than 60 per cent of the known original species diversity.*
- (2) *Weed coverage is equal to or less than that of pre-cleared levels.*

A monitoring program was developed by Astron (2012), and annual monitoring was subsequently undertaken by Astron in May 2013, July 2014, September/October 2015 (collectively reported in Astron 2016), and then by Biota in 2017, 2019, 2021 and 2022 (Biota 2017, 2019, 2021 and 2022 respectively).

Following comment on the 2017 results and requests for further information received from the DBCA regarding the infestations of *\*Cenchrus* spp. within the ex-Mt Minnie pastoral exclusion, Woodside appointed a contractor to complete weed spraying of *\*Cenchrus* spp. in Q3 of 2018 along the section of ROW within the Mt Minnie conservation area. Woodside then commissioned an additional phase of monitoring in 2019 to assess whether both Condition 8 of MS844 had been met, and if the level of *\*Cenchrus* spp. within the Mt Minnie conservation area has decreased. Results from the 2019 survey indicated that the two criteria above had not been met.

### 2.2 DBCA Review of 2017 Monitoring Phase

Prior to 2019 survey, the DBCA reviewed the results of the 2017 monitoring report (Biota 2017), and provided the following four recommendations regarding the rehabilitation and ongoing monitoring of the project:

- (1) *That the proponent continues rehabilitation activities and weed monitoring along the section of the Macedon gas pipeline within the former Mount Minnie pastoral lease.*
- (2) *That the rehabilitation monitoring report identifies contingency management measures to be implemented to meet the completion criteria, particularly given that some areas along the gas pipeline disturbance corridor within the former Mount Minnie pastoral lease do not appear to be meeting completion criteria required by Condition 8-3 under MS 844.*
- (3) *That the rehabilitation monitoring report includes information on the rehabilitation and weed contingency management measures implemented to date.*
- (4) *That the rehabilitation monitoring report recognises that the existing pipeline access track is likely to be providing a potential vector for weed introduction along the pipeline disturbance corridor, particularly in areas that are currently weed free or where vegetation has not become established (DBCA 2018).*

## 2.3 Scope and Objectives

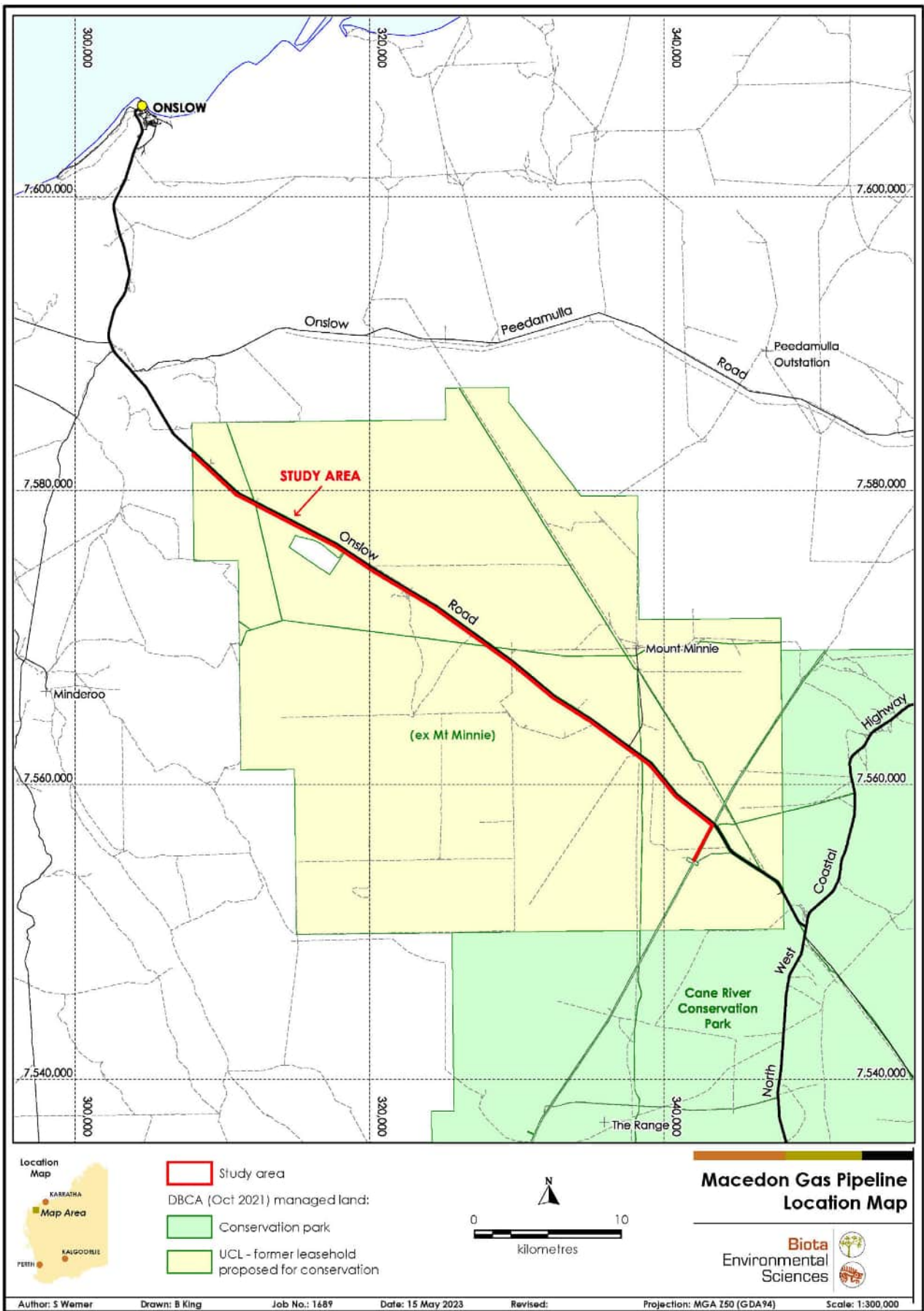
Biota was commissioned to undertake an additional monitoring survey of the Macedon Gas Pipeline situated within the proposed Mt Minnie conservation area (hereafter referred to as the 'study area') in 2023 (Figure 2.1). The principal aims of the study, as identified by Woodside, were to:

1. conduct the annual rehabilitation monitoring in 2023 (timed appropriately after rainfall) to measure spatial and temporal changes of vegetation in both analogue and rehabilitated transects located within the Mt Minnie conservation area; and
2. complete subsequent reporting and statistical analyses in accordance with Section 3.10 of the BHP guidance document (BHP Iron Ore 2016) and the *BHP Macedon Gas Project Pipeline Rehabilitation Monitoring and Evaluation Plan* (Astron 2012).

These aims were met by conducting a desktop study of existing reports and supporting data sets (Astron 2009, 2013, 2014, 2016, Biota 2017, 2019, 2021, 2022), together with information available for the locality (see Section 4.0). This was followed by a field survey in April 2023 to repeat the monitoring following appropriate rainfall conditions (Section 3.0).

The approach and methodology used for the 2023 rehabilitation monitoring survey was carried out with consideration of the following:

- the monitoring methodology as outlined in the *BHP Macedon Gas Project Pipeline Rehabilitation Monitoring and Evaluation Plan* (Astron 2012) (hereafter referred to as the 'current monitoring procedure');
- *Document Review Comments Sheet: Macedon Gas Pipeline Rehabilitation Survey – 2017* (DBCA 2018)
- *BHP Iron Ore Guidance for Vegetation and Flora Surveys* (0124627) (BHP Iron Ore 2016);
- *BHP Iron Ore Biodiversity Survey Spatial Data Requirements* (SPR-IEN-EMS-015) (BHP 2020); and
- Environmental Protection Authority (EPA) "*Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*" (EPA 2016).



**Figure 2.1:** Location of the Macedon Gas Pipeline study area in which the current rehabilitation monitoring survey was completed.

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## 3.0 Methodology

### 3.1 Survey Team and Timing

The field survey was conducted by Scott Werner (Principal Biologist) and Aster Braxton-Smith (Senior Botanist), both of whom have experience conducting biological surveys in the Pilbara region (Table 3.1).

Monitoring of the analogue and rehabilitation transects was conducted between 12-14 April 2023 and followed appropriate rainfall to ensure that adequate survey information was collected (see Section 3.1.1).

**Table 3.1: Summary of Biota personnel involved in the 2023 Macedon Gas Pipeline rehabilitation monitoring.**

Name	Position	Years of Experience	Flora Licence No.†
Scott Werner	Principal Biologist	12	FB62000038-2
Aster Braxton-Smith	Senior Botanist	5	FB62000390

† Flora Taking (Biological Assessment) Licence under Regulation 62 of the *Biodiversity Conservation Regulations 2018* (previously *Wildlife Conservation Act 1950*) (required to collect flora specimens).

#### 3.1.1 Climate

Seasonal timing, particularly the amount of rainfall received prior to a survey, can have a significant influence on the species abundance and diversity recorded during a field survey. Rainfall data for the locality were compiled and compared to long-term monthly data (Figure 3.1). Data from the Bureau of Meteorology weather recording station at Onslow Airport (#5017)<sup>1</sup> show that rainfall in the six months prior to the current monitoring survey (November 2022 to April 2023) totalled 97.6 mm, which is 50.2 mm more than the total of the long-term monthly medians<sup>2</sup> for the locality during those months (47.4 mm). The last substantial rainfall events prior to the 2023 rehabilitation monitoring survey was recorded on the 30<sup>th</sup> of March (8.8 mm), with a month without rainfall before and after this date.

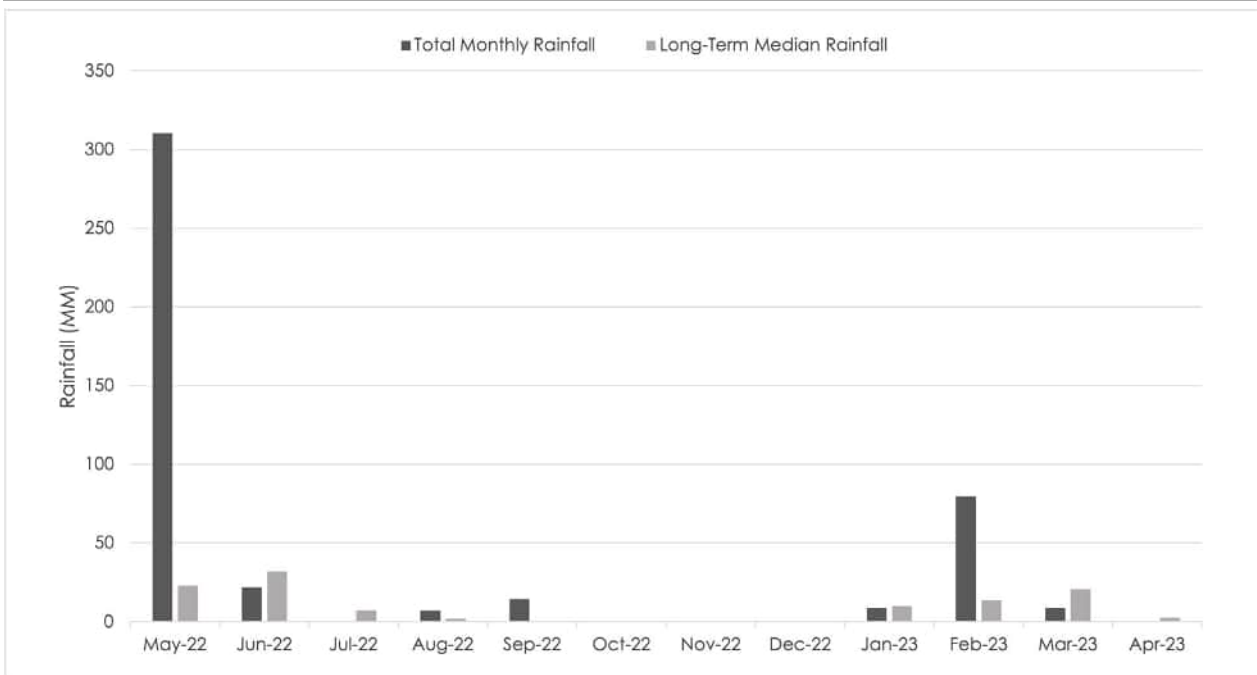
Since the commencement of monitoring in 2010, the amount of rainfall received prior to each phase has varied (Table 3.2). While the baseline survey in 2010 was completed during dry conditions, the first two post-rehabilitation surveys in 2013 and 2014 were undertaken following adequate rainfall. The 2015 survey was completed following three months of below average rainfall, which is typical for spring in the Pilbara region. The survey in 2017 was undertaken following the third wettest period experienced over the course of the program, and approximately three to six weeks after significant rainfall events. The survey in 2019 was undertaken four to five weeks following the first significant rainfall event received in the Onslow locality for the 2018/2019 "wet season", with additional rainfall received leading up to the survey. The 2021 survey was undertaken following the second wettest period experienced over the course of monitoring. The survey in 2022 was undertaken following one of the wettest periods experienced over the course of the program, with 191.4 mm of rainfall within a week of commencing the survey.

The current survey in 2023 commenced approximately 6-7 weeks following the first significant rainfall event received in the Onslow locality in 2023. The survey was therefore undertaken during a period that would be considered optimal for general collection of flora and ideal for the determination of *Cenchrus* spp. in the field.

<sup>1</sup> The Onslow Airport weather recording station is located approximately 23 km north-northwest of the closest transect, and 62 km northwest of the farthest transect.

<sup>2</sup> From a meteorological perspective, the median is usually the preferred measure of 'typical' rainfall due to the high temporal variability of rainfall in most regions.





**Figure 3.1:** Total monthly rainfall at Onslow Airport recording station (#5017) for the 12 months preceding the survey, compared to the long-term monthly median (2022-2023).

Data supplied by the Bureau of Meteorology (<http://www.bom.gov.au>).

**Table 3.2:** Summary of timing and seasonal conditions for the Macedon Gas Pipeline rehabilitation monitoring surveys completed to date.

Survey Timing	Rainfall in the Six Months Preceding the Survey	Rainfall in the Three Months Preceding the Survey
<b>Baseline Survey</b>		
14 – 19 October 2010	28.0 mm (Apr – Sep 2010)	14.8 mm (Jul – Sep 2010)
<b>Post-Rehabilitation Surveys</b>		
3 – 8 May 2013	131.6 mm (Nov 2012 – Apr 2013)	72.2 mm (Feb – Apr 2013)
8 – 12 July 2014	97.6 mm (Jan – Jun 2014)	83.2 mm (Apr – June 2014)
30 September – 4 October 2015	89.2 mm (Apr – Sep 2015)	13.4 mm (Jul – Sep 2015)
13 – 17 March 2017	218.2 mm (Sep 2016 – Feb 2017)	215.2 mm (Dec 2016 – Feb 2017)
30 March – 2 April 2019	62.8 mm (Oct 2018 – Mar 2019)	40.8 mm (Jan 2018 – Mar 2019)
5 – 7 May 2021	251.6 mm (Nov 2020 – Apr 2021)	50.2 mm (Feb 2021 – Apr 2021)
18 – 20 May 2022	275.2 mm (Dec 2022 – May 2022)	265.0 mm (Mar 2022 – May 2022)
12 – 14 April 2023	97.6 mm (Nov 2022 – Apr 2023)	88.6 mm (Feb 2023 – Apr 2023)

## 3.2 Monitoring Methodology

The survey methodology for the 2023 rehabilitation monitoring survey was consistent with that outlined in the current monitoring procedure (Astron 2012) and the most recent survey completed (Biota 2022).

### 3.2.1 Rehabilitation and Analogue Transects

In 2010, Astron established and assessed 56 line-intercept transects along the Macedon Gas Pipeline to provide baseline monitoring data, consisting of 31 rehabilitation transects established within the 30 m wide pipeline construction corridor and 25 analogue transects located outside the pipeline corridor. Each 20 m transect was installed perpendicular to the pipeline corridor and marked with a fence dropper at each end. The spatial distribution of transects was selected to sample eight geomorphic units spanning the length of the Macedon Gas Pipeline (Astron 2010). In 2013, an additional 1 m x 20 m 'fixed-point strip transect' was monitored for each transect to ensure uncommon species were detected. This strip transect was positioned along the left side of each line intercept transect, and has been monitored during each subsequent monitoring survey. Monitoring sites consist of both an analogue and rehabilitation transect, with the exception of three sites that solely consist of rehabilitation transects without a paired analogue (see Table 3.3).

Ten of the monitoring sites in the southern section of the study area (sites 22 to 31) are located within the Mt Minnie pastoral lease. This lease was purchased by the State Government in 1996 for the purposes of conservation and is now managed by DBCA. It is proposed to be added to the Cane River Conservation Park in future (see Section 4.1). For the purposes of this report, we have referred to this area as the "Mt Minnie conservation area". Given its management interest in the area, DBCA is particularly interested in the progress of the rehabilitation in the 10 sites at the southern end of the study area.

The current survey comprised resampling of 17 transects along the Macedon Gas Pipeline corridor that are situated within the Mt Minnie conservation area (comprising 10 rehabilitation and seven analogue transects) (see Table 3.3). Sites situated outside of the Mt Minnie Pastoral Lease were not required to be monitored in 2021. Locations of all transects monitored in 2022 are presented in Figure 3.2 to Figure 3.4, with transect coordinates listed in Appendix 1.

**Table 3.3: Summary of monitoring sites assessed in 2022.**

Monitoring Sites <sup>§</sup>	Line-Intercept Transects Reassessed in 2023 (Total Number of Transects)	
	Rehabilitation	Analogue
22, 23, 24, 26, 28, 29, 30	Yes (7)	Yes (7)
25, 27, 31	Yes (3)	No
<b>Total</b>	<b>10</b>	<b>7</b>

§ Monitoring site labels as per Appendix A of Astron (2016).

### 3.2.2 Assessment of Transects

Rehabilitation and vegetation assessments were conducted for each of the 17 line-intercept transects (10 rehabilitation and seven analogue). The following data were collected:

- all vascular plant species (including weeds) present along the transect, and also within the adjacent 1 m x 20 m fixed-point strip transect;
- the length of intercept for each flora species recorded along the transect; and
- two photographs (one from each end of the transect, oriented along the length of the transect).

### **3.2.3 Flora Specimen Identification, Nomenclature and Data Entry**

Common taxa that were well known to the survey botanists were identified in the field, with voucher specimens of all other species collected. Plant specimens were identified in Perth using published and unpublished taxonomic keys and resources available at the WA Herbarium.

Nomenclature used in this report is consistent with the current listing of WA flora recognised by the WA Herbarium on FloraBase<sup>3</sup> at the time of preparation of this report.

All flora data were entered into Excel spreadsheets, maintaining consistency with the data format from previous phases, and that established by Astron during the initial phase of monitoring (Astron 2010).

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<sup>3</sup> <http://florabase.dpaw.wa.gov.au>

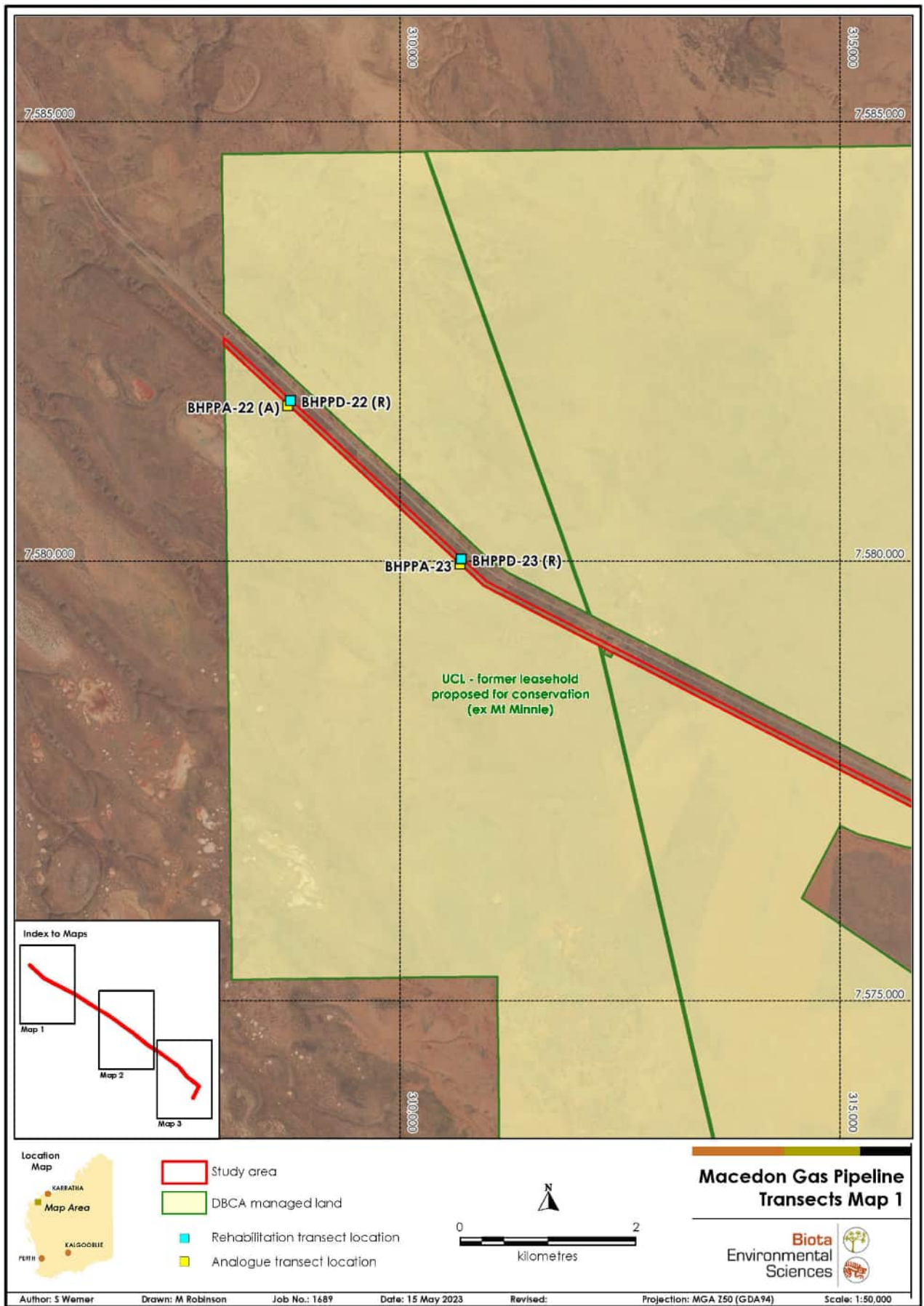


Figure 3.2: Monitoring transect locations (Map 1).

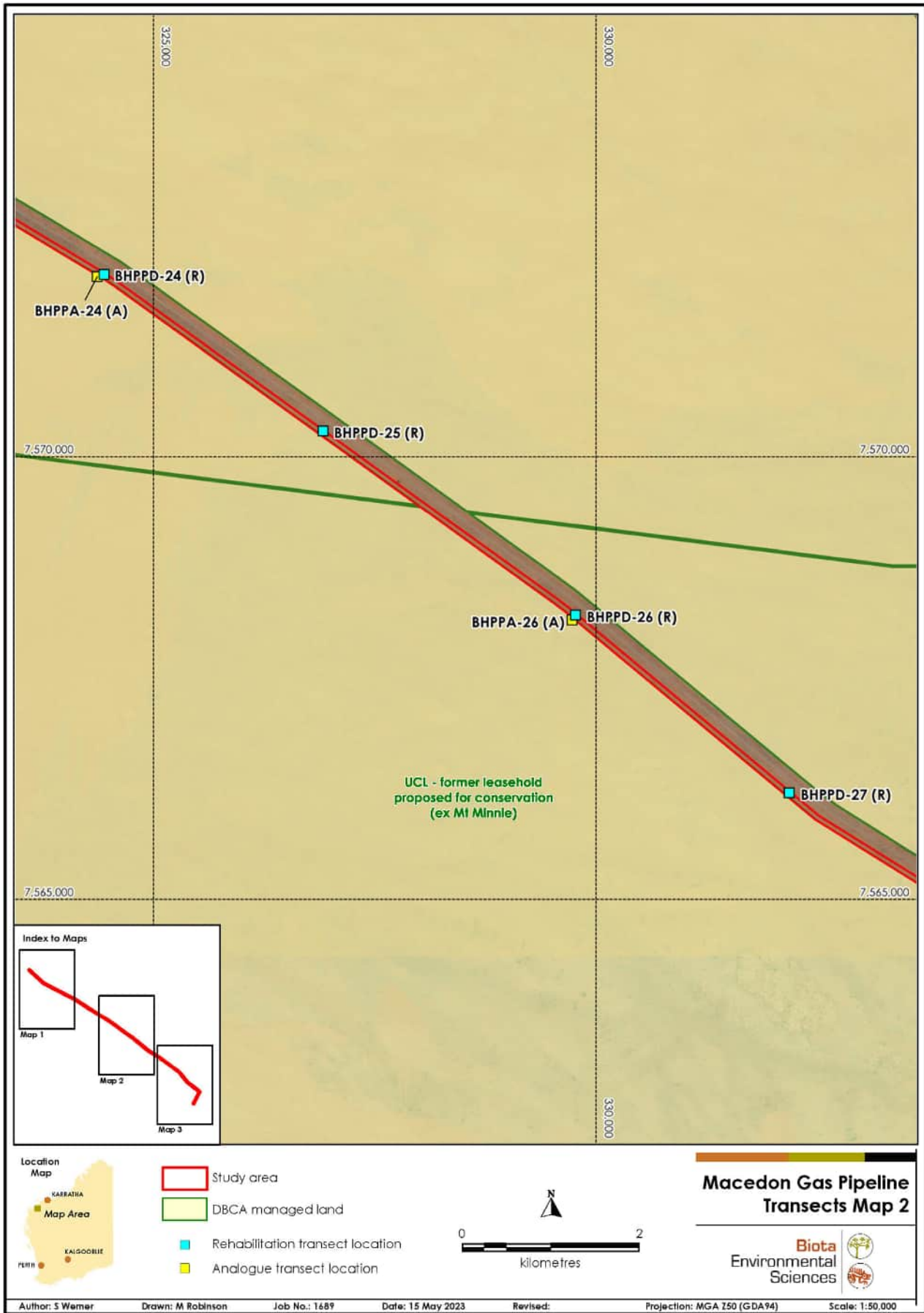


Figure 3.3: Monitoring transect locations (Map 2).

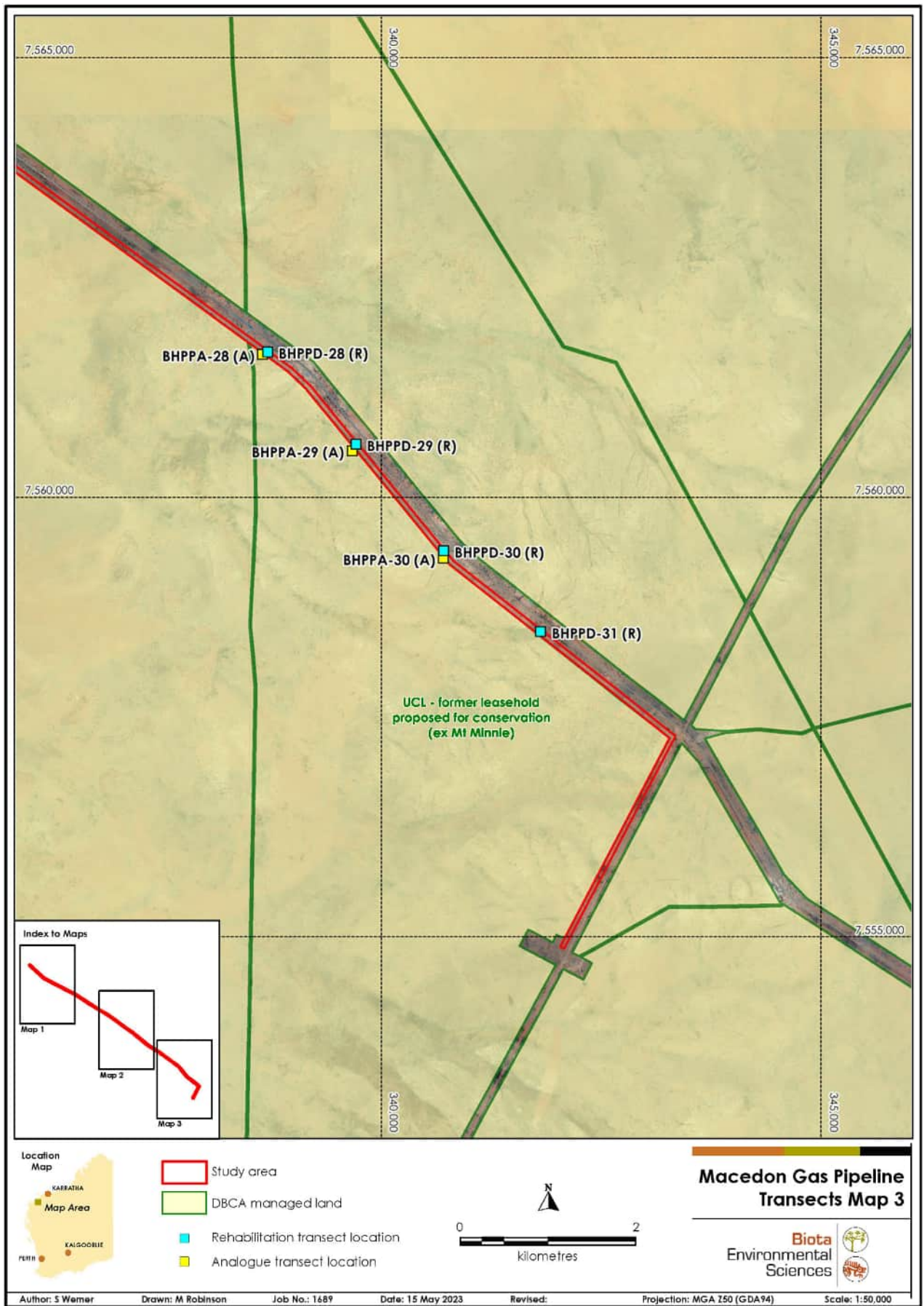


Figure 3.4: Monitoring transect locations (Map 3).

### 3.3 Data Analysis and Presentation

The *BHP Billiton Macedon Gas Project Pipeline Rehabilitation Monitoring and Evaluation Plan* (Astron 2012) specifies two statistical analyses to be undertaken:

1. The average percent covers for native species along the analogue and rehabilitation transects should be tested for significant differences using a non-parametric Multivariate Analysis of Variance (MANOVA); the same analysis should also be completed for the average percent cover of weeds along the analogue and rehabilitation transects.
2. Change in the vegetation community over time should be evaluated through a two-way Analysis of Similarity (ANOSIM) of the species percentage foliar cover (presumably comprising the line transect data), using transect type (rehabilitation / analogue) nested within the survey year.

Results in the Astron (2016) monitoring report were analysed in this way. Data were also tabulated and presented graphically, with transect data always separated by treatment (rehabilitation or analogue) but typically averaged across either the treatment or three broad habitat classes: clay pan/floodplain, open plain or sand dune.

The size of the error bars on some of these graphs indicated a large amount of variability in the data around the calculated means, suggesting that the transects were dissimilar for some values and may not have been developing equivalently. The significant "site" interaction values presented for some of the statistical analyses also suggested this. In addition, averaging of transect data prevented any close inspection of the results that applied specifically to the Mt Minnie conservation area. For this study we have therefore elected to present the data for individual transects separately wherever possible and for all sampling events, so as not to obscure any differences between transects. We also applied a more rigorous analysis of trends over time, including floristic clustering analyses, rather than the multivariate analysis of variance suggested by Astron (2016).

Clustering analyses were carried out using PRIMER v6 and used to examine the relationships between both the floristic composition of the individual transects in 2010 vs. 2023, and of each transect compared to its paired analogue. The following protocols were used:

- All native species (both perennial and annual) present at each site were included in the data set; weeds were removed.
- The data were prepared as a matrix of the presence / absence of each species at each site in 2010 and 2023; this was based on the combined data from the line transect (for 2010 and 2023) and the strip transect (2023 only).
- The Bray-Curtis coefficient was used to produce a similarity matrix, and a cluster analysis was then performed using the group average method. The clusters were tested for significance using the similarity profile permutation test (SIMPROF).

Representative outputs from the clustering analyses are presented as both floristic dendrograms and non-metric, multi-dimensional scaling (NMDS) ordination plots in Section 5.2.2.

To broadly summarise the current development of vegetation along the rehabilitation transects, each transect was also ranked according to the scale presented in Table 3.4 (see Section 5.5). Note that the criteria were developed with particular consideration of the requirements of the current study and the vegetation types being sampled, and would not necessarily be directly relevant to other areas (for example, vegetation types that have a naturally low level of cover provided by perennial species, or that are substantially invaded by other weed species).

**Table 3.4: Ranking categories for overall development of vegetation along the rehabilitation transects.**

Ranking	Criteria
Excellent	The cover of perennial vegetation along the transect is equivalent to the pre-clearing cover, floristic composition is similar to the original, AND the cover of * <i>Cenchrus</i> is negligible (<0.5%).
Good	The cover of perennial vegetation along the transect is approaching the pre-clearing cover, AND floristic composition is similar to the original OR the cover of * <i>Cenchrus</i> is negligible to low (<10%).
Fair	There is limited re-establishment of perennial vegetation along the transect (<20% cover) AND the cover of * <i>Cenchrus</i> is negligible to very low (<5%).
Poor	A moderate amount of perennial vegetation has established on the transect (<45% cover), however the floristic composition is dissimilar to the original AND the cover of * <i>Cenchrus</i> is low to high (10-45%) and increasing.
Very Poor	Minimal perennial vegetation has established on the transect (<5% cover), the floristic composition is dissimilar to the original AND the cover of * <i>Cenchrus</i> is high to very high (>35%).

### 3.4 Study Limitations

The aims of the current monitoring survey were to provide a reliable post-rehabilitation comparison of the ecological attributes of the analogue and rehabilitation transects. However, there are potential constraints and limitations to this study (specifically the current phase) that must be considered when reviewing and interpreting the results:

1. In 2022, and all previous monitoring phases from 2017-2021, some fence-droppers marking the start and end points of each transect were missing due to works conducted along the ROW track situated within the study area. These points were located as accurately as possible using supplied GPS coordinates, however the fence droppers were not re-established in this monitoring phase. Considering the accuracy of handheld GPS units, missing fence droppers at sites have implications for repeated sampling and subsequent analyses (repeatability).
2. Fire history varies for some transects. While most have not been burnt since 2010, three analogue transects (BHPPA-24, BHPPA-26 and BHPPA-28) and two rehabilitation transects (BHPPD-25 and BHPPD-26) have been burnt at some point since the monitoring programme began (see Section 5.2.1 and Appendix 2). These disturbance events have affected the flora data recorded, and this needs to be taken into consideration when interpreting the results.
3. Some combinations of landform setting, hydrological function, and vegetation within the rehabilitation corridor were not replicated within analogue areas. Assessment of change relies largely on comparing post-impact data to that of the baseline phases, or to paired analogue transects. Three of the rehabilitation transects surveyed in 2023 do not have a paired analogue, as was the case in 2017, 2019, 2021 and 2022.
4. There was relatively low rainfall in the weeks preceding the survey, the opposite to what was observed in the previous phase of monitoring in 2022. The most recent rainfall event was 6-7 weeks prior to the survey, this is considered optimal for general collection of flora and, as such, climate was not considered a limitation to the survey.



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## 4.0 Background to the Study Area

### 4.1 Conservation Reserves in the Locality

The main conservation reserve in the locality is the Cane River Conservation Park, situated approximately 100 km southeast of Onslow. This reserve includes several landforms and vegetation types of particular significance that are not found in other conservation reserves in the Pilbara.

The current extent of the Cane River Conservation Park is proposed to be increased through the addition of two areas: an exclusion including the Nanutarra pastoral lease to the south, and the Mt Minnie conservation area to the north (see Figure 2.1). This is part of a broader State-wide process of pastoral lease exclusions for public purposes, specifically conservation, which has the intention of providing a more comprehensive, adequate and representative reserve system (EPA 2014).

Approximately 48 km of the Macedon Gas Pipeline runs parallel to Onslow Road through a development corridor that traverses the proposed Mt Minnie conservation area (see Figure 2.1). The 10 rehabilitation transects in this section (BHPPD-22 to BHPPD-31) are situated within the development corridor, while the seven paired analogue transects (BHPPA-22 to BHPPA-24, BHPPA-26, and BHPPA-28 to BHPPA-30) are located within the Mt Minnie conservation area (and thus within the proposed Cane River Conservation Park). DBCA is particularly interested in the presence of weeds through this section of the Macedon Gas Pipeline, given the potential for spread into the adjacent proposed reserve.

### 4.2 Surface Hydrology

The surface hydrology within the study area varies considerably, given that it intersects three separate land systems. The broader area is characterised by extensive sandy plains, longitudinal dunes, and numerous round and elongated claypans varying in extent from 20 m to 400 m situated between these dunes (Payne et al. 1988).

Broad, usually unchannelled, drainage floors occupy the majority of the sandy plains in the area, with these soils susceptible to water erosion. The deep loam and clay soils of the area are subject to irregular flooding, with the loams becoming very powdery when dry, resulting in susceptibility to erosion (Payne et al. 1988).

Drainage throughout the length of the study area is typically broad and diffuse across areas consisting mainly of colluvial sediments (Payne et al. 1988). The land systems occurring in the study area generally exhibit the following drainage characteristics (from Payne et al. 1988, van Vreeswyk et al. 2004):

- Uaroo land system – mainly depositional surfaces with occasional stony rises and low hills; some through drainage by broad unchannelled tracts receiving sheet flow.
- Giralia land system – broad non-saline plains with no organised drainage, however through-flow areas receive more concentrated sheet flow than the adjacent plains.
- Stuart land system – gently undulating plains with minor hills, and drainage tracts that experience through-flow.

## 4.3 Vegetation and Flora

Vegetation of the study area was described and mapped by Astron (2009) and largely reflects the array of vegetation types typically seen in the locality. Previous surveys completed in the Onslow area have identified a diverse suite of native flora, as well as a number of introduced flora species (Biota 2010, ENV 2011).

A total of 39 vegetation associations were identified by Astron (2009) within the Macedon Gas Pipeline corridor, 15 of which occur in the current study area. The 39 vegetation associations were grouped according to their occurrence on 11 landforms, and subsequently termed 'vegetation types'. The representation of transects surveyed during the current phase across each vegetation type is shown in Table 4.1.

**Table 4.1: Distribution of transects resampled during current phase of monitoring based on vegetation types identified by Astron (2009).**

Vegetation Type & No. of Vegetation Associations (Astron 2009)		Current Study	
		No. of Analogue Transects	No. of Rehabilitation Transects
Crests and upper slopes of inland sand dunes supporting <i>Grevillea eriostachya</i> or <i>Hakea stenophylla</i> shrubs, <i>Acacia</i> sp., <i>Crotalaria cunninghamii</i> over mixed low shrubs over <i>Triodia epactia</i> 'sens. lat.' or <i>T. glabra</i> hummock grasslands.	2 (13%)	1 (14%)	1 (10%)
Sandy/loamy plains supporting <i>Eucalyptus</i> and <i>Corymbia</i> low trees in patches over mixed shrubs over <i>Triodia glabra</i> hummock grasslands; some vegetation types characterised by an upper storey of <i>Hakea chordophylla</i> or <i>Grevillea wickhamii</i> .	9 (60%)	2 (29%)	3 (30%)
Lower, often stony plains supporting <i>A. xiphophylla</i> and other <i>Acacia</i> species shrublands over <i>Triodia</i> hummock grasslands, occasionally with a <i>Corymbia</i> isolated low trees overstorey.	3 (20%)	3 (43%)	5 (50%)
Internal, undirected drainages supporting <i>*Prosopis</i> , <i>Acacia</i> or <i>Eucalyptus victrix</i> shrubland/low woodland over mixed shrubs and mixed tussock grassland, occasionally <i>Triodia</i> hummock grassland.	1 (7%)	1 (14%)	1 (10%)
<b>Total</b>	<b>15</b>	<b>7</b>	<b>10</b>

NB. Percentages reflect proportion of the total for each column.

## 5.0 Results and Discussion

Summarised data for each transect across all phases of monitoring (2010 – 2023) are presented in Appendix 2, with a list of vascular flora species recorded during each year of monitoring presented in Appendix 3 and summarised in Table 5.1.

### 5.1 Overview of Flora Recorded in 2023

A total of 66 native vascular flora species were recorded from the 17 transects resampled in 2023. Two weed species were recorded from the study area (*Cenchrus ciliaris* and *C. setiger*).

The mean species per transect (as a way of accounting for varying survey effort) is comparable across years given the rainfall received at the time of each monitoring phase (see Table 3.2). The low number of species recorded in 2010 reflects the lack of sampling along the strip transects, which were implemented in 2013, and may have also been affected by the dry conditions in that year. In 2023, only the section of gas pipeline situated within the Mt Minnie conservation area was surveyed (17 transects in total).

**Table 5.1: Number of species recorded from the current study area in each year of monitoring (includes opportunistic records of weeds).**

	2010	2013	2014	2015	2017	2019	2021	2022	2023
Number of Native Species	39	117	144	136	104	29	98	72	66
Number of Weed Species	3	3	3	4	4	2	2	2	2
Number of Transects	56	56	56	56	56	17	17	17	17
Mean Species/Transect	0.70	2.09	2.57	2.43	1.86	1.70	5.76	4.23	3.88

#### 5.1.1 Species of Conservation Significance

One Priority 1 species was recorded from the study area in the current phase of monitoring: *Abutilon* sp. Onslow (F. Smith s.n. 10/9/61). This taxon was recorded as a presence from within the strip-transect at analogue site BHPPA-23.

## 5.2 Species Diversity

Results from the monitoring program are discussed below against the relevant criterion from Condition 8 of MS844:

**(1) Species diversity is not less than 60% of the known original species diversity.**

#### 5.2.1 Species Richness

As in previous phases, one measure of diversity used to assess this criterion was species richness, with only native species considered. To compare the 2023 species richness against the baseline values, only those species recorded along the line transect were considered, as the extra sampling along the strip transect was not implemented until 2013. Two baseline species diversity values were considered: the 2010 species richness from the rehabilitation transect, and the 2010 species richness from the equivalent analogue. These values are shown in Table 5.2, Figure 5.1 and Figure 5.2.

When using the simple number of native species as the measure of diversity, all 17 rehabilitation transects and analogue transects met the criterion of “not less than 60% of the known original species diversity”, with transects equalling or exceeding the original native species count.

It should be noted that, depending on the nature of the habitat, high species richness is not necessarily indicative of the development of a satisfactory level of vegetation. Some intact vegetation types naturally have very low species richness (less than five species in a 50 m<sup>2</sup> area; e.g. some wetlands, spinifex plains, and samphire vegetation).

The relatively high number of mean species per transect observed in 2021, 2002, and 2023 can be attributed to both a development of perennial vegetation in certain transects, and the amount of rainfall received in the six months preceding the surveys (see Table 3.2, Appendix 2). The conditions set out in MS844 rely on a simplified indicator of species diversity (number of species recorded), and as such should be viewed with a consideration of all floristic values associated with rehabilitation and analogue transects.

**Table 5.2: Native species richness of rehabilitation line transects in 2023 compared to 2010 for both the same transect and for the paired (or equivalent) analogue.**

Richness calculated for the line transect only, as the strip transect was not sampled in 2010.

Rehabilitation Transect	2023 Species Richness	Rehabilitation Transect Compared to Itself		Rehabilitation Transect Compared to Paired (or Equivalent †) Analogue		
		2010 Species Richness	Criterion Met? (2023 Species Richness as % of Original)	Analogue Transect	2010 Species Richness	Criterion Met? (2023 Species Richness as % of 2010 Analogue)
BHPPD-22	8	6	Yes (133%)	BHPPA-22	3	Yes (267%)
BHPPD-23	18	6	Yes (300%)	BHPPA-23	4	Yes (450%)
BHPPD-24	4	4	Yes (100%)	BHPPA-24 β	3	Yes (133%)
BHPPD-25 β	9	5	Yes (180%)	BHPPA-26 †, β	3	Yes (300%)
BHPPD-26 β	6	3	Yes (200%)	BHPPA-26 β	3	Yes (200%)
BHPPD-27	7	3	Yes (233%)	BHPPA-26 †, β	3	Yes (233%)
BHPPD-28	17	3	Yes (567%)	BHPPA-28 β	3	Yes (567%)
BHPPD-29	7	3	Yes (233%)	BHPPA-29	3	Yes (233%)
BHPPD-30	9	2	Yes (450%)	BHPPA-30	2	Yes (450%)
BHPPD-31	17	4	Yes (425%)	BHPPA-30 †	3	Yes (567%)

† Selected as the closest analogue transect in a similar topographic position and vegetation type.

β Transect has been burnt approximately <10 years prior to 2023 survey.

Long undisturbed spinifex hummock grasslands are frequently species poor and, particularly where spinifex cover is high, species numbers may not vary substantially in different seasons. However, following ground clearing or post-fire, species richness typically increases dramatically with the establishment of "pioneer" colonising species, such as members of the Malvaceae and Fabaceae families; annual herbs and grasses are also typically more abundant in the early stages of regeneration. Species richness then typically declines as the vegetation matures, with the senescence of the early seral species, and annuals becoming crowded out as the spinifex hummocks occupy more of the available ground. These trends are apparent in analogue sites following fire (BHPPA-24, BHPPA-26, BHPPA-28; Table 5.2).

The fact that all transects exceeded 60% of the original species richness is expected given the age of the rehabilitation areas.

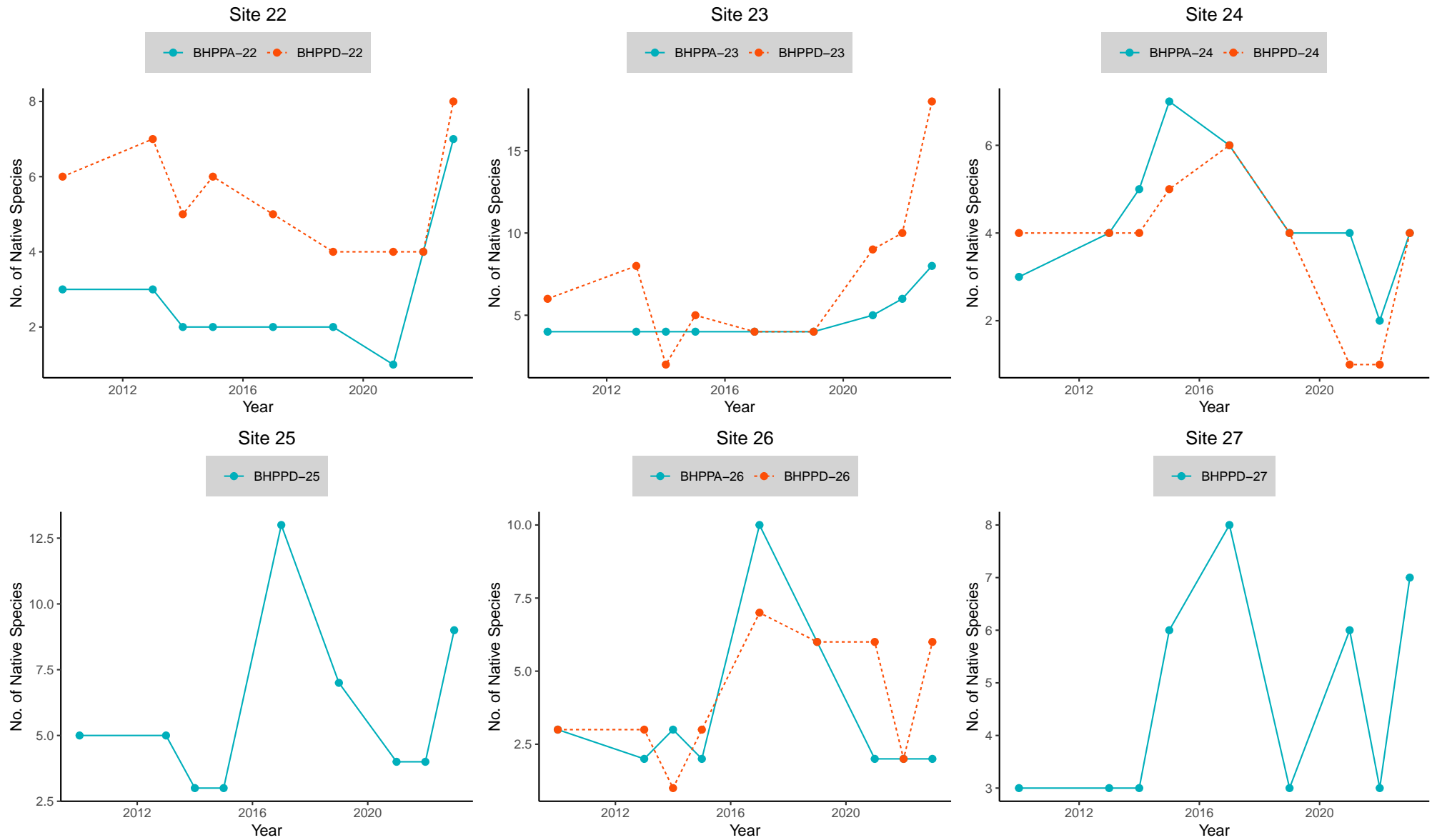
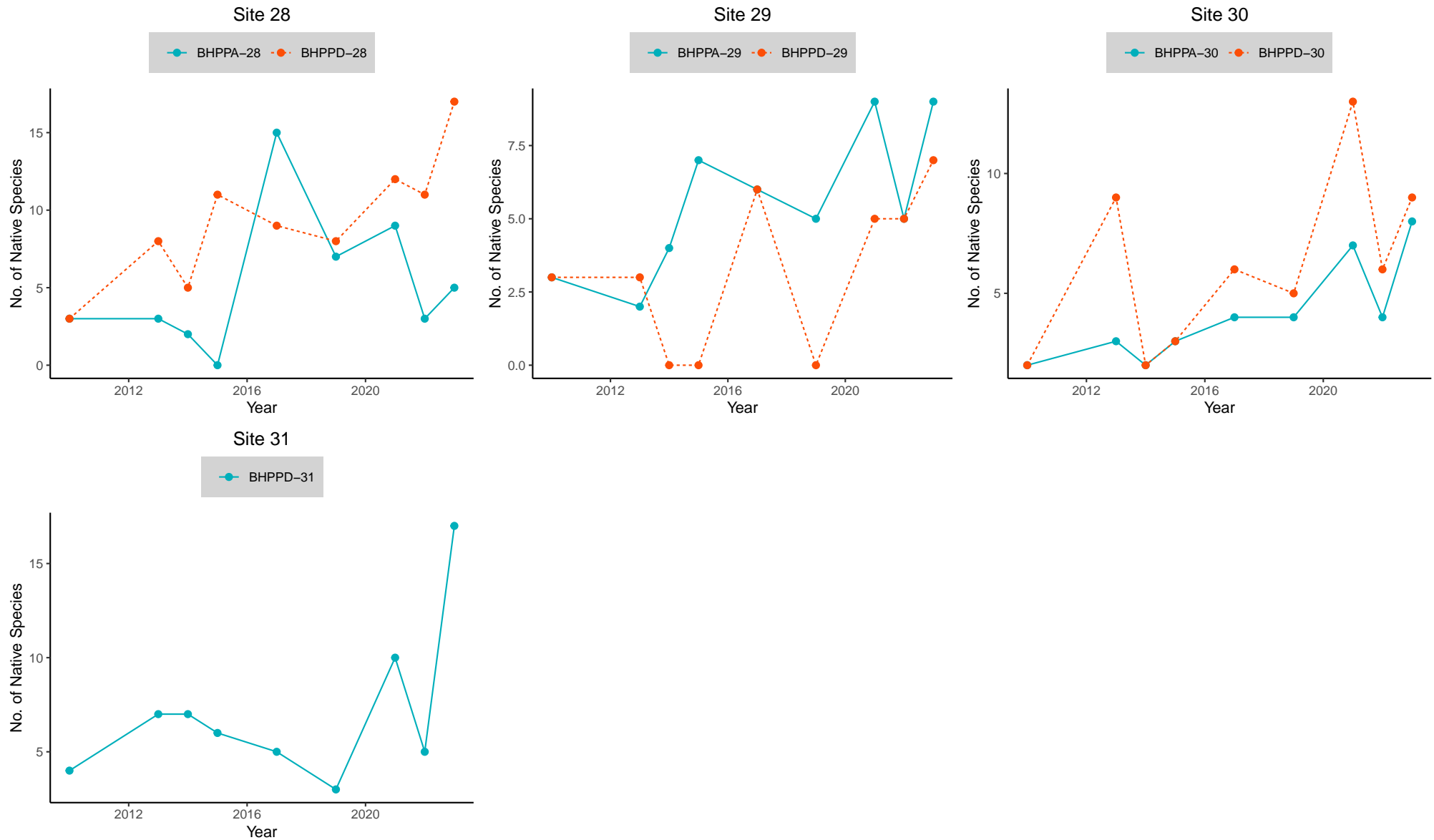


Figure 5.1: Native species richness (count data) recorded on line-transects at analogue (A) and rehabilitation (D) sites (1 of 2).



**Figure 5.2: Native species richness (count data) recorded on line-transects at analogue (A) and rehabilitation (D) sites (2 of 2).**

## 5.2.2 Similarity of Species Composition

Another measure that should be considered within the broad context of the original “diversity” is the similarity of the species present in the rehabilitation areas in relation to those present in the pre-clearing vegetation and also those in the relevant analogue site. Floristic clustering analyses were run using PRIMER to investigate this aspect. The first analysis used the presence/absence data for native species in 2010 and 2023 and was run separately for the analogue transects (Figure 5.3) and rehabilitation transects (Figure 5.4).

For the analogue transects, the major findings were as follows:

- *Triodia glabra* was the main driver of similarity within 2010 and 2023 transects (contributing to 75% and 80% of the overall cumulative similarity respectively).
- The average dissimilarity between 2010 and 2023 was 70% with differences in presence/absence of *Acacia ancistrocarpa* and *A. xiphophylla* contributing to 20% of that dissimilarity, and species only recorded in 2023 (*Triodia wiseana*, *Codonocarpus cotinifolius*, and *Maireana planifolia*) contributing to 13% dissimilarity.
- All analogue transects had a more similar floristic composition in 2023 to that recorded from the same transect in 2010, rather than to other transects in the current phase, with the exception of BHPPA-26, which was considered to be more similar to BHPPA-28 from 2010, and BHPPA-28 which was considered to be more similar to both BHPPA-23 from 2010 and 2023 equally.
- The key species leading to clustering at significant similarity within the analogue transects in Figure 5.3 are:
  - BHPPA-22: *Triodia schinzii*.
  - BHPPA-23 and BHPPA-28: *Triodia epactia*.
  - BHPPA-24 and BHPPA-26: *Corymbia hamersleyana* and *Acacia ancistrocarpa*.
  - BHPPA-29 and BHPPA-30: *Acacia xiphophylla*.

For the rehabilitation transects:

- *Triodia glabra* was again the main driver of similarity within 2010 and 2023 transects (contributing to 73% and 52% of the overall cumulative similarity respectively).
- Transects BHPPD-29, BHPPD-30, and BHPPD-31 in 2023 were considered significantly differently to all other rehabilitation transects from both years because of the presence of *Acacia synchronicia* and *Salsola australis*.
- 2023 transects BHPPD-29, BHPPD-30, and BHPPD-31 grouped together at approximately 15% similarity due to the presence of *Acacia synchronicia* and *Salsola australis* that were not recorded elsewhere. It is also these shared species that led to this group of three transects being considered significantly dissimilar to the larger cluster of 17 transects.
- The separation of mostly all transects from their year equivalent (except for BHPPD-22, BHPPD-26 and BHPPD-27) can be attributed to the number of unique species recorded within the two phases. Collectively, seven unique species contribute to 28% of the overall dissimilarity between rehabilitation transects in 2010 and 2023.
- Transect BHPPD-22 from 2010 and 2023 clustered together at a similarity level of 67%. This is not unexpected as this is the only transect located on fine red sand dunes dominated by the hummock grass *Triodia schinzii*, and one of two spatially close sites containing *Acacia stellaticeps*.
- Transects BHPPD-26 and BHPPD-27 from both 2010 and 2023 grouped together at a similarity level of 67% due to the presence of *Acacia ancistrocarpa* at BHPPD-26 and *Acacia inaequilatera* and *Triodia glabra* at BHPPD-27. Over the course of five phases of monitoring sites BHPPD-26 and BHPPD-27 have always presented as the most stable and consistent sites in terms of native species composition and structure.



- Transects BHPPD-23, BHPPD-24, BHPPD-25, and BHPPD- 28 didn't cluster closely together across years. The difference in dominant perennial species recorded at these transects in 2010 and 2023 will continue to see them not cluster together from different phases. The species recorded in either phase driving the separations are:
  - BHPPD-23: *Acacia trachycarpa*, *Chrysopogon fallax*, *Corchorus sidoides*.
  - BHPPD-24: *Acacia ancistrocarpa*, *A. bivenosa*, *Scaevola spinescens*, *Eucalyptus xerothermica*.
  - BHPPD-25: *Acacia ancistrocarpa*, *A. bivenosa*, *A. coriacea*, *Corymbia hamersleyana*, *Eucalyptus xerothermica*.
  - BHPPD-28: *Acacia ancistrocarpa*, *A. bivenosa*.

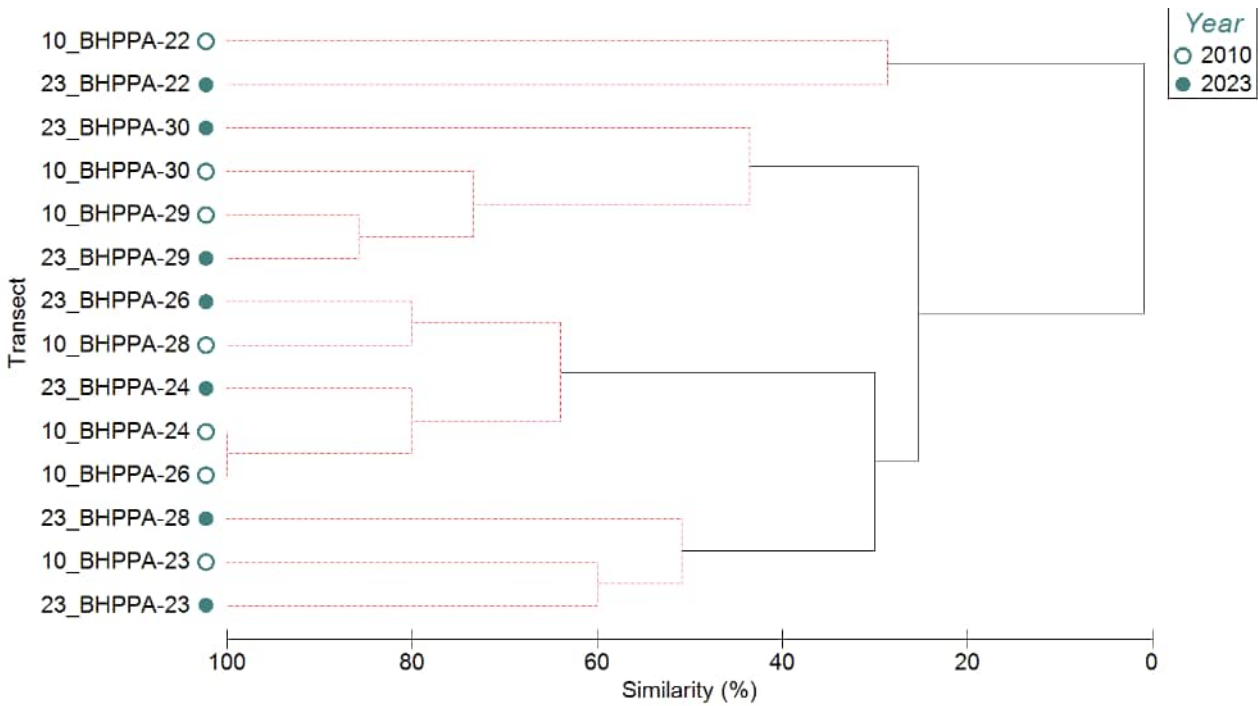


Figure 5.3: Clustering of the analogue transects based on the species recorded in 2010 and 2023<sup>4</sup>.

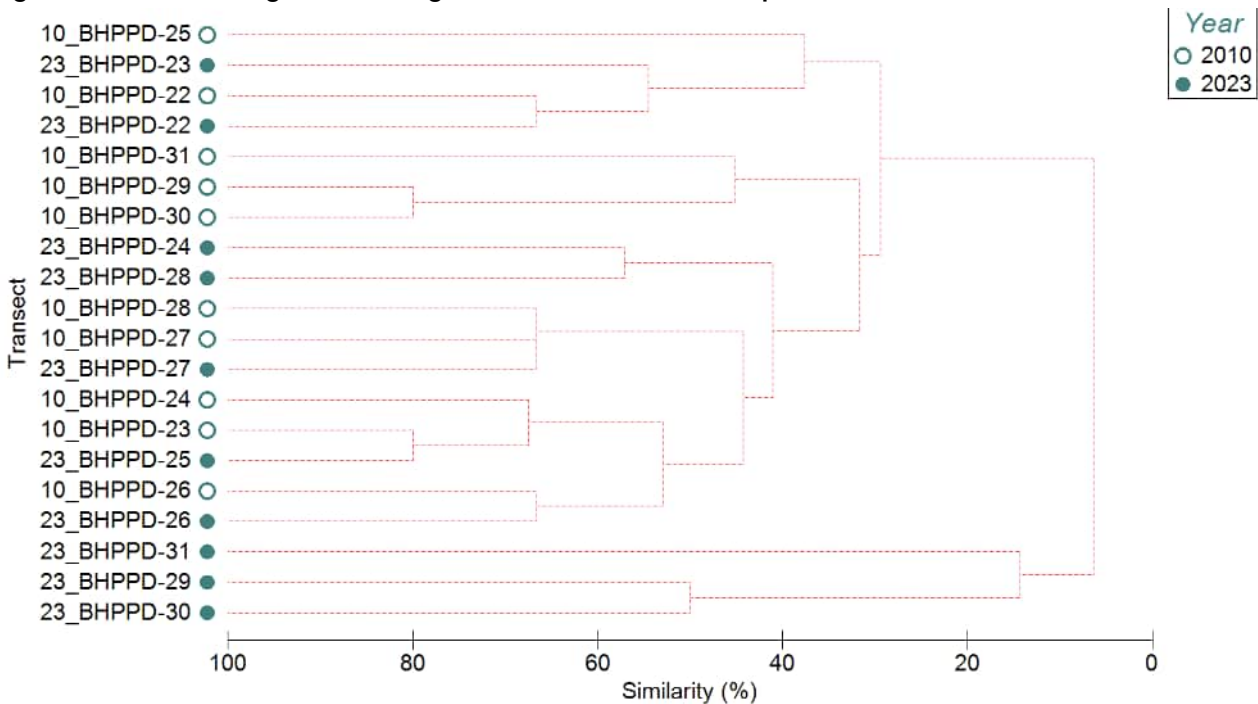


Figure 5.4: Clustering of the rehabilitation transects based on the species recorded in 2010 and 2023.

<sup>4</sup> Red lines indicate that sites are not significantly different ( $p > 0.05$ ) from each other (SIMPROF test).

The second clustering analysis used presence/absence data for native species from 2023 only, but for all transects sampled (both the rehabilitation transects and the analogues). This identified three significantly different floristic groups: all with multiple sites, and all including both analogue and rehabilitation transects within the same group (see Figure 5.5, Figure 5.6, Figure 5.7 and Table 5.3).

The site groupings can be summarised through the three broad groups shown in Figure 5.5, which are briefly described below:

1. The first group (FGp 1) comprised the transects containing the only records of *Triodia schinzii* which is indicative of red sand dunes and/or deep red sand plains. The herbs *Bonamia alatisemina*, *Cassytha capillaris*, and *Goodenia microptera* were only recorded in this group.
2. The second group (FGp 2) comprised transects with *Acacia ancistrocarpa*, *A. bivenosa*, *Triodia glabra* and other species typically associated with sandy substrates on open plains. Key findings include:
  - a. grouped at 18% similarity.
  - b. consisted of open plains with a mix of several mature *Acacia* species: *A. ancistrocarpa*, *A. bivenosa*, and *A. stellaticeps*.
  - c. These transects are likely separated from FGp 1 and 3 and loosely grouped together due to the absence of grasses (genera *Cynodon*, *Chrysopogon*, *Dactyloctenium*, *Iseilema*, *Paspalidium*) and herbs (genera *Bonamia*, *Cassytha*, *Enchylaena*, *Gomphrena*, *Maireana*, *Pluchea*, *Pterocaulon*, *Rhynchosia*, *Salsola*, *Sida*, *Stemodia*), together with the only records of *Acacia ancistrocarpa*, *Acacia bivenosa*, *Aristida contorta*, *Aristida holathera* var. *holathera*, *Codonocarpus cotinifolius*, *Corchorus sidoides*, *Corymbia hamersleyana*, *Eriachne aristidea*, *Indigofera boviparda*, *Indigofera colutea*, *Ptilotus axillaris*, *Scaevola spinescens*, and *Tephrosia* sp. B Kimberley Flora (C.A. Gardner 7300).
3. The third group (FGp 3) included transects that typically occupy the low-lying, stony open gibber plain with a fine clayey-loam substrate and scattered mixed quartz of the Stuart land system. This was also the only floristic group to record covers of *Acacia inaequilatera*, *A. xiphophylla*, *Triodia wiseana* and *Salsola australis*.

These transects are likely separated from the remainder and loosely grouped together due to the presence of the dominating *Acacia* species *Acacia xiphophylla* and *A. synchronica*.

Additionally, a shared absence/presence of the following species results in the separation from the combined broader grouping of FGp 1 and 2 (see Figure 5.5, Figure 5.6, Figure 5.7):

- a. The overall presence of annual grasses and herbs (particularly notable suggesting that the transects located in south-eastern half of the linear study area most likely received more localised rainfall preceding the survey).
- b. The specific absence of *Acacia stellaticeps*, *Scaevola spinescens*, *Indigofera boviparda* var. *boviparda*, *Indigofera colutea*, and *Corymbia hamersleyana* typically not recorded in this landform, is a major influence on the separation of this grouping from FGp 2.

The number of annual/bi-annual herbs and grasses that were recorded during this phase (and that of the previous phase in 2022) was due to the preceding amount of rainfall, and had an influence on the clustering of transects into floristic groups. In comparison, the floristic groups identified through this identical analysis in the 2019 phase (Biota 2019) were highly driven by mainly perennial shrubs and hummock grasses.

For those transects with paired analogues, all clustered within the same floristic group, indicating similar floristic composition.

Overall, these results indicate significant similarity in terms of floristic composition between the rehabilitation transects and the appropriate analogue transects in 2023, but of variable similarity with the original floristic composition recorded in the pre-clearing vegetation.

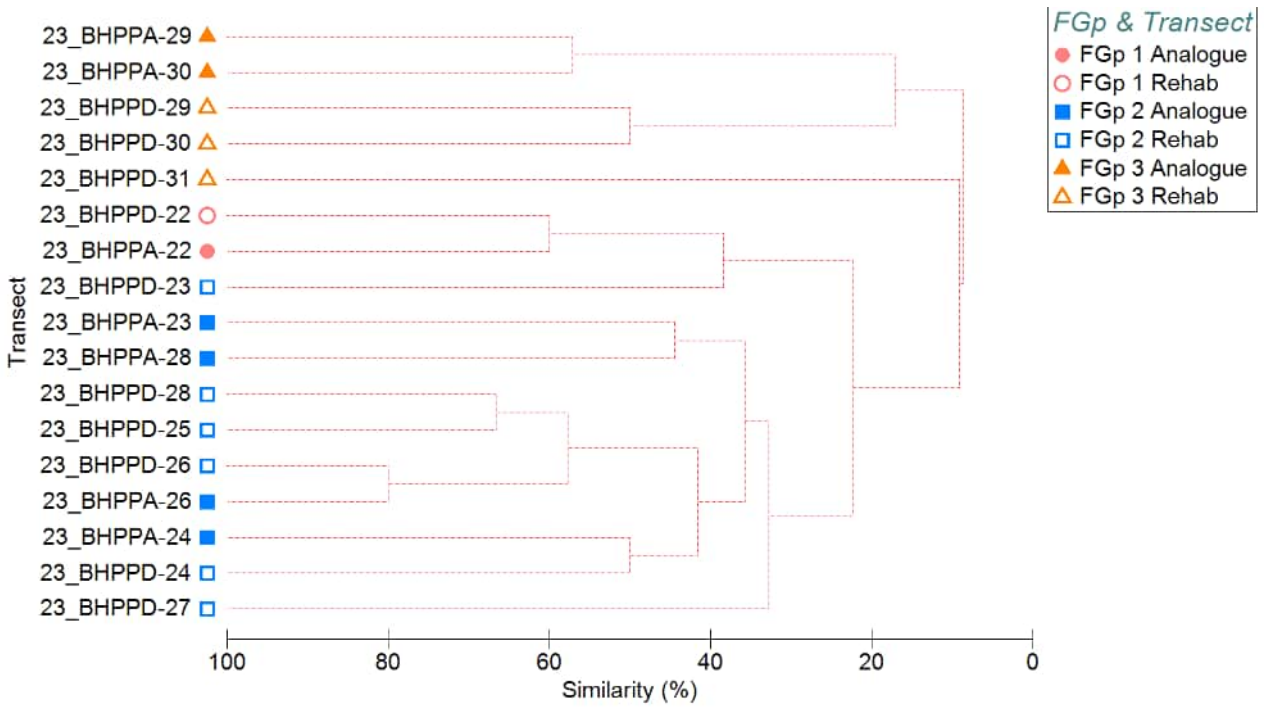


Figure 5.5: Results of the floristic clustering analysis carried out on the 2023 data for the monitoring transects (presence/absence of native species only).

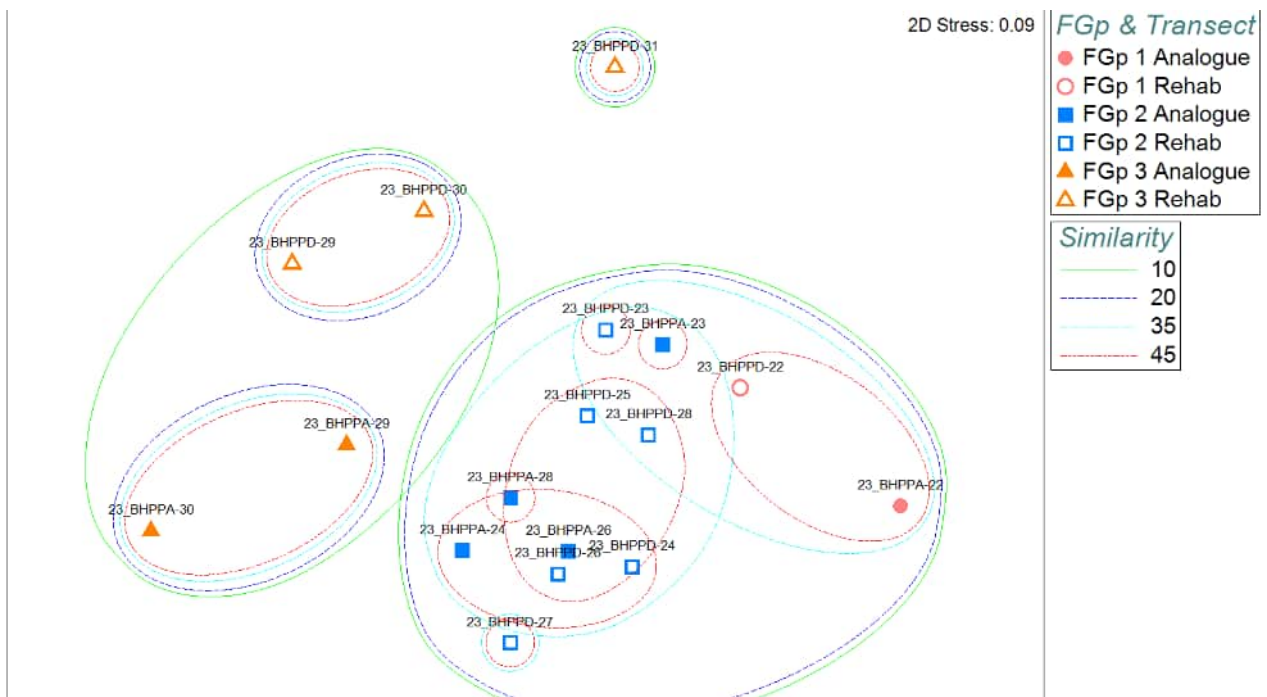


Figure 5.6: NMDS plot of 2023 data for the monitoring transects (presence-absence of native species only).

Table 5.3: Floristic groups identified by the clustering analysis of 2023 presence/absence data for native species at each site.

Floristic Group	Transect		Comments
	Analogue	Rehabilitation	
FGp 1	BHPPA-22	BHPPD-22	This floristic group contained all records of the species <i>Triodia schinzii</i> , and two of the three records of <i>Acacia stellaticeps</i> (the other being at the nearby BHPPD-23), which are indicative of red sand dunes and/or deep red sand plains: both BHPPA-22 and BHPPD-22 are the only transects situated within the sand dunes landform. The herb <i>Bonamia alatisemina</i> was only recorded at site 22 with both <i>Goodenia microptera</i> and <i>Cassytha capillaris</i> only recorded at site 22 and the nearby site 23. The rehabilitation transect in this sub-group was in Excellent condition again in 2023, with well-developed native vegetation.
FGp 2	BHPPA-23	BHPPD-23	This group contained all records of the species: <i>Acacia ancistrocarpa</i> , <i>Acacia bivenosa</i> , <i>Acacia inaequilatera</i> , <i>Aristida contorta</i> , <i>Aristida holathera</i> var. <i>holathera</i> , <i>Codonocarpus cotinifolius</i> , <i>Corchorus sidoides</i> , <i>Corymbia hamersleyana</i> , <i>Eriachne aristidea</i> , <i>Indigofera boviparda</i> , <i>Indigofera colutea</i> , <i>Ptilotus axillaris</i> , <i>Scaevola spinescens</i> , and <i>Tephrosia</i> sp. B Kimberley Flora (C.A. Gardner 7300), and was dominated by a high percentage cover of <i>Triodia glabra</i> . These species are indicative of the open sandy loam plains vegetation that dominates the locality of these transects.  The continued absence of grasses recorded in FGp 1 and 3 (genera <i>Cynodon</i> , <i>Chrysopogon</i> , <i>Dactyloctenium</i> , <i>Iseilema</i> , <i>Paspalidium</i> ) and herbs (genera <i>Bonamia</i> , <i>Cassytha</i> , <i>Enchylaena</i> , <i>Gomphrena</i> , <i>Maireana</i> , <i>Pluchea</i> , <i>Pterocaulon</i> , <i>Rhynchosia</i> , <i>Salsola</i> , <i>Sida</i> , <i>Stemodia</i> ), results in the separation from the other floristic groups (see Figure 5.5, Figure 5.6).  Four of the six rehabilitation transects in this grouping all showed Excellent development of native vegetation in 2023, with BHPPD-23 rated as Fair and BHPPD-28 rated as Good (see Table 5.5 for an overview).
	BHPPA-24	BHPPD-24	
	NA	BHPPD-25	
	BHPPA-26	BHPPD-26	
	NA	BHPPD-27	
	BHPPA-28	BHPPD-28	
FGp 3	BHPPA-29	BHPPD-29	Species that were present in the groups transects with a percentage cover and influenced clustering were: <i>Acacia xiphophylla</i> , <i>Acacia inaequilatera</i> , <i>Triodia wiseana</i> , and <i>Salsola australis</i> . The absence of the perennial shrub <i>Acacia stellaticeps</i> , grass <i>Aristida holathera</i> var. <i>holathera</i> , and herbs in the genus <i>Bonamia</i> , typically not recorded in this landform, is a major influence on the separation of this grouping from both FGp 1 and FGp 3.
	BHPPA-30	BHPPD-30	This group contained all records of the species: <i>Abutilon fraseri</i> subsp. <i>fraseri</i> , <i>Acacia xiphophylla</i> , <i>A. synchronicia</i> , <i>Cynodon prostratus</i> , <i>Dactyloctenium radulans</i> , <i>Enchylaena tomentosa</i> , <i>Gomphrena affinis</i> subsp. <i>pilbarensis</i> , <i>Gomphrena canescens</i> , <i>Iseilema dolichotrichum</i> , <i>Maireana planifolia</i> , <i>Paspalidium clementii</i> , <i>Pterocaulon sphaeranthoides</i> , <i>Ptilotus exaltatus</i> , <i>Rhynchosia minima</i> , <i>Solanum horridum</i> , <i>Solanum lasiophyllum</i> , <i>Stemodia grossa</i> , <i>Trianthema triquetrum</i> , and <i>Triodia wiseana</i> .
	NA	BHPPD-31	This was also the only floristic group to record covers of the perennial shrubs <i>Acacia synchronicia</i> , and <i>A. xiphophylla</i> . These <i>Acacia</i> species are indicative of transects in lower-lying positions in the landscape, in this instance a stony open (gibber) plain with a fine clayey-loam substrate and scattered mixed quartz. The rehabilitation transects in this group were all considered Poor in terms of their native vegetation development (see Table 5.5 for an overview).

† Paired analogue/rehabilitation transect is clustered within a separate floristic group.



## 5.3 Introduced Flora (Weeds)

Two perennial weed species were recorded from the study area in 2022, neither of which were new for the monitoring program:

- Live individuals of *\*Cenchrus ciliaris* and/or *\*C. setiger* were recorded from five of the rehabilitation transects (along five of the line transects; see Table 5.4). In contrast, *\*Cenchrus* spp. were recorded from a two analogue sites: along the line intercept transect at BHPPA-30, and within the strip-transect at BHPPA-23.

The data for *\*Cenchrus* spp. are discussed further below in relation to the relevant criterion from Condition 8-1 of MS844:

### (2) Weed coverage is equal to or less than that of pre-cleared levels.

#### 5.3.1 *\*Cenchrus* spp.

While *\*Cenchrus* spp. are not listed as either declared pests or Weeds of National Significance (WONS), they are significant environmental weeds. They are aggressive and effective competitors for resources and space, have the potential to increase the fuel load (leading to more frequent and/or hotter fires), and regenerate quickly following fire and cessation of drought. In addition, *\*Cenchrus ciliaris* is believed to have the capacity for allelopathy, or biochemical inhibition of other plant species (see Cheam 1984a, 1984b).

The DBCA *Weed Prioritisation Process for the Pilbara* (WPP; Department of Parks and Wildlife 2013) ranks these species as highly invasive and with the potential for serious environmental impact, but widespread through the region and therefore having a low feasibility for control. However, the process does identify *\*Cenchrus* spp. as being a priority for management when there is potential for impact to the conservation estate (e.g. at Barrow Island Nature Reserve).

Records of *\*Cenchrus* spp. at the monitoring sites over the course of the program are presented in Table 5.4, Figure 5.8 and Figure 5.9 and are summarised below:

**Table 5.4: Cover and presence of *\*Cenchrus* spp. at monitoring transects within the Mt Minnie conservation area from 2010 to 2023.**

Transect	2010	2013	2014	2015	2017	2019	2021	2022	2023	Change in % Cover	
										2022 to 2023	2010 to 2023
<b>Analogue</b>											
BHPPA-23	-	-	-	-	+	-	-	-	+	+	+
BHPPA-29	-	+	+	1.90	2.50	9.70	-	-	-	-	-
BHPPA-30	-	-	-	-	-	+	0.35	+	1.05	1.05	+
<b>Rehabilitation</b>											
BHPPD-22	-	-	-	-	-	-	-	+	-	-	-
BHPPD-23	-	1.00	3.00	4.00	+	-	0.45	5.00	22.60	17.60	22.60
BHPPD-28	-	-	-	-	0.40	+	+	0.20	7.50	7.30	7.50
BHPPD-29	-	7.00	15.00	3.30	70.15	21.55	24.20	8.15	48.50	40.35	48.50
BHPPD-30	-	2.50	10.00	1.05	27.95	27.00	45.05	36.30	41.80	5.50	41.80
BHPPD-31	-	5.25	19.25	12.35	27.35	1.90	31.20	73.65	35.15	-38.50	35.15

Values are the percentage of the 20 m line transect occupied by each species at each site.

+ indicates presence only in the 1 m wide strip transect, which was utilised from 2013 onwards.

## 2013

In 2013, when the additional strip transect monitoring technique was implemented, *\*Cenchrus ciliaris* was not recorded from either of the rehabilitation transects at which it was found in 2010, however it was recorded along the line transects at seven other rehabilitation sites. This species was also recorded from only the strip transect at one rehabilitation site and at two analogue sites. In addition, *\*Cenchrus setiger* was recorded from the strip transect only at rehabilitation transect BHPPD-18. It is possible that these records of *\*Cenchrus* species from the strip transects may not truly represent “new” records for these four transects, as these species may have already been present at these sites in 2010, but not recorded due to the differing methodology. The apparent increase in records between 2010 and 2013 likely reflect the better seasonal conditions in which the latter survey was conducted.

## 2014 and 2015

Over the next two monitoring phases, it appears that both the cover and distribution of *\*Cenchrus* spp. increased in the study area, particularly in the rehabilitation areas (Table 5.4 and Figure 5.8). In 2014, *\*Cenchrus ciliaris* was recorded from the same two analogue transects but from 13 rehabilitation transects, with *\*C. setiger* co-occurring at six of the latter (BHPPD-12, BHPPD-13, BHPPD-16, BHPPD-18, BHPPD-23 and BHPPD-31). The cover of *\*Cenchrus* spp. increased from 2013 to 2014 at all of the rehabilitation transects, in some cases substantially (e.g. at BHPPD-15, BHPPD-16 and BHPPD-31). In 2015, *\*Cenchrus ciliaris* was recorded from at least one of the same analogue transects (while no data were provided for BHPPA-12, it is likely that the species was again present along the strip transect at this site). *\*Cenchrus ciliaris* was also recorded from 10 of the rehabilitation sites, with *\*C. setiger* recorded only from the strip transect at BHPPD-18. The cover of *\*Cenchrus* spp. at the sites in 2015 showed no consistent pattern compared to 2014, decreasing at seven sites and increasing at seven.

## 2017

In 2017, *\*Cenchrus ciliaris* was recorded from both analogue sites at which it was previously recorded; it was also recorded in the strip transect only at a third analogue (BHPPA-23), together with *\*Cenchrus setiger*. The cover of *\*Cenchrus ciliaris* at analogue transect BHPPA-29 showed a slight increase compared to 2015. In terms of the rehabilitation transects, *\*Cenchrus* spp. were recorded from all transects from which they had previously been recorded, and a small amount was recorded from a new rehabilitation transect (BHPPD-28). Sterile *\*Cenchrus* sp. was recorded along the line transect at BHPPD-17, with *\*C. ciliaris* confirmed from the strip transect at this site. *\*Cenchrus ciliaris* was present along the line transects at all the remaining rehabilitation sites, except for BHPPD-11, BHPPD-13 and BHPPD-19, where it occurred only in the strip transects. *\*Cenchrus setiger* occurred along the line transect at BHPPD-13 and co-occurred with *\*C. ciliaris* along the line transect at BHPPD-18 and BHPPD-31; it also occurred in relatively small amounts at BHPPD-16, and was recorded from the strip transect only at BHPPD-15.

## 2019

In 2019, *\*Cenchrus ciliaris* was recorded from analogue site BHPPA-29 at which it was previously recorded; it was also recorded in the strip transect only at BHPPA-30 for the first time. The percentage cover of *\*Cenchrus ciliaris* at analogue transect BHPPA-29 showed an increase of 7.2% from 2017. In terms of the rehabilitation transects, *\*Cenchrus* spp. were recorded from all transects from which they had previously been recorded, except for BHPPD-23 where it was absent in 2019. *\*Cenchrus setiger* co-occurred with *\*C. ciliaris* along the line transect at BHPPD-31.

From 2017 to 2019, the cover of *\*Cenchrus* spp. decreased at four of the rehabilitation sites, including at BHPPD-28 where *\*Cenchrus* was no longer recorded along the line transect but only in the strip transect, and at BHPPA-23 where *\*C. ciliaris* and *\*C. setiger* were no longer recorded in the strip-transect. Substantial decreases in cover were observed at BHPPD-29 and BHPPD-31 following herbicide treatment (see Plate 5.1, Plate 5.3). There was essentially no change in *\*Cenchrus* cover at the remaining site (BHPPD-30; Plate 5.2). The cover of *\*Cenchrus* species along the line transects at four rehabilitation sites was greater than that of pre-cleared levels, with all four situated in the Mt Minnie conservation area (BHPPD-28 to BHPPD-31).



Plate 5.1: \**Cenchrus* at site BHPPD-29 in 2017 (A); 2019 (B); 2021 (C); 2022 (D); and 2023 (E).



Plate 5.2: \**Cenchrus* at site BHPPD-30 in 2017 (F); 2019 (G); 2021 (H); 2022 (I); and 2023 (J).



Plate 5.3: \**Cenchrus* at site BHPPD-31 in 2017 (K); 2019 (L); 2021 (M); 2022 (N); and 2023 (O).



## 2021

In 2021, *Cenchrus ciliaris* was not recorded from analogue site BHPPA-29 at which it was previously recorded; it was recorded along the line transect of BHPPA-30 for the first time, having only previously been recorded within the strip transect of BHPPA-30. The cover of *Cenchrus ciliaris* at analogue site BHPPA-29 decreased to 0% in 2021 from 9.7% in 2019; with a small increase of 0.35% at the analogue site BHPPA-30. In terms of the rehabilitation transects, *Cenchrus* spp. were recorded from all the transects where they had been previously recorded, including the reoccurrence of *Cenchrus* spp. within BHPPD-23 where it had been absent in 2019. *Cenchrus setiger* co-occurred with *C. ciliaris* within BHPPD-30 and BHPPD-23.

From 2019 to 2021, the cover of *Cenchrus* spp. increased at four of the rehabilitation sites (BHPPD-23, BHPPD-29, BHPPD-30 and BHPPD-31) with one site (BHPPD-28) only recording *Cenchrus* spp. within the strip transect. Substantial increases in cover were observed at BHPPD-30 (Plate 5.2) and BHPPD-31 (Plate 5.2), 18.05% and 29.30% respectively. Site BHPPD-23 saw the reoccurrence of *Cenchrus* spp., with an increase of 0.45%, when it was not recorded in the 2019 monitoring in either the strip or line transect. The cover of *Cenchrus* species within five rehabilitation sites is currently greater than that of pre-cleared levels (Table 5.4), with four situated in the Mt Minnie conservation area (BHPPD-28 to BHPPD-31).

## 2022

In 2022, *Cenchrus* was again recorded at analogue site BHPPA-30, this time as only a presence, down from 0.35% in 2021. Additionally, for the first time since monitoring began, *Cenchrus* was recorded as a presence within the strip-transect at rehabilitation site BHPPD-22 (Table 5.4).

A decrease in the cover of *Cenchrus* at rehabilitation transects BHPPD-29 (-14.05%; Plate 5.1) and BHPPD-30 (-8.75%) was observed in 2022 (Table 5.4, Figure 5.9); however, a significant increase in the cover of *Cenchrus* (42.45%) was recorded at BHPPD-31, with the highest levels of infestation recorded at this transect in the last two phases.

Importantly, three rehabilitation transects with high *Cenchrus* spp. cover (BHPPD-29, BHPPD-30 and BHPPD-31) are located in the southern end of the study area within the Mt Minnie conservation area (Table 5.4). It is clear from the data that with regards to *Cenchrus* spp., the level of weed coverage at three of the rehabilitation transects (BHPPD-29, BHPPD-30, and BHPPD-31) is not equal or less than the pre-cleared levels but is considerably higher. The rehabilitation in these areas therefore does not meet Condition 8-1 of MS844. Notwithstanding the potential that the monitoring conducted during the dry year in 2010 substantially underestimated both the number of sites at which *Cenchrus* spp. was present and the amount of cover of *Cenchrus* spp. at those sites, there is an increase at several sites over subsequent years, with decreases or plateaus following appropriate herbicide application (Table 5.4, Figure 5.8, Figure 5.9).

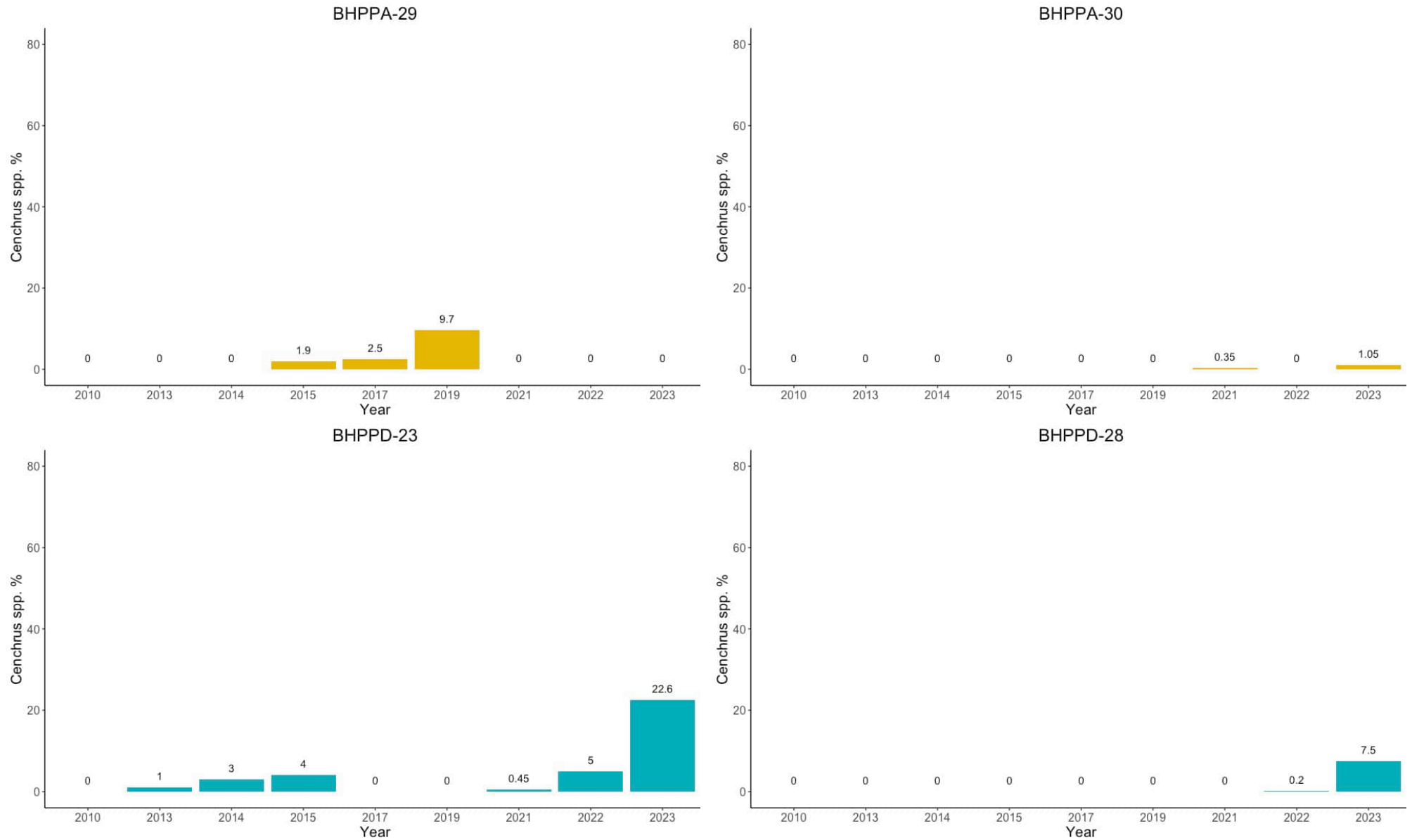
## 2023

In 2023, *Cenchrus* was again recorded at analogue site BHPPA-30, this time as a cover of 1.05%, increasing from only a presence in 2022. Additionally, for the first time since monitoring began, *Cenchrus* was recorded as a presence within the strip-transect at analogue site BHPPA-23 (Table 5.4).

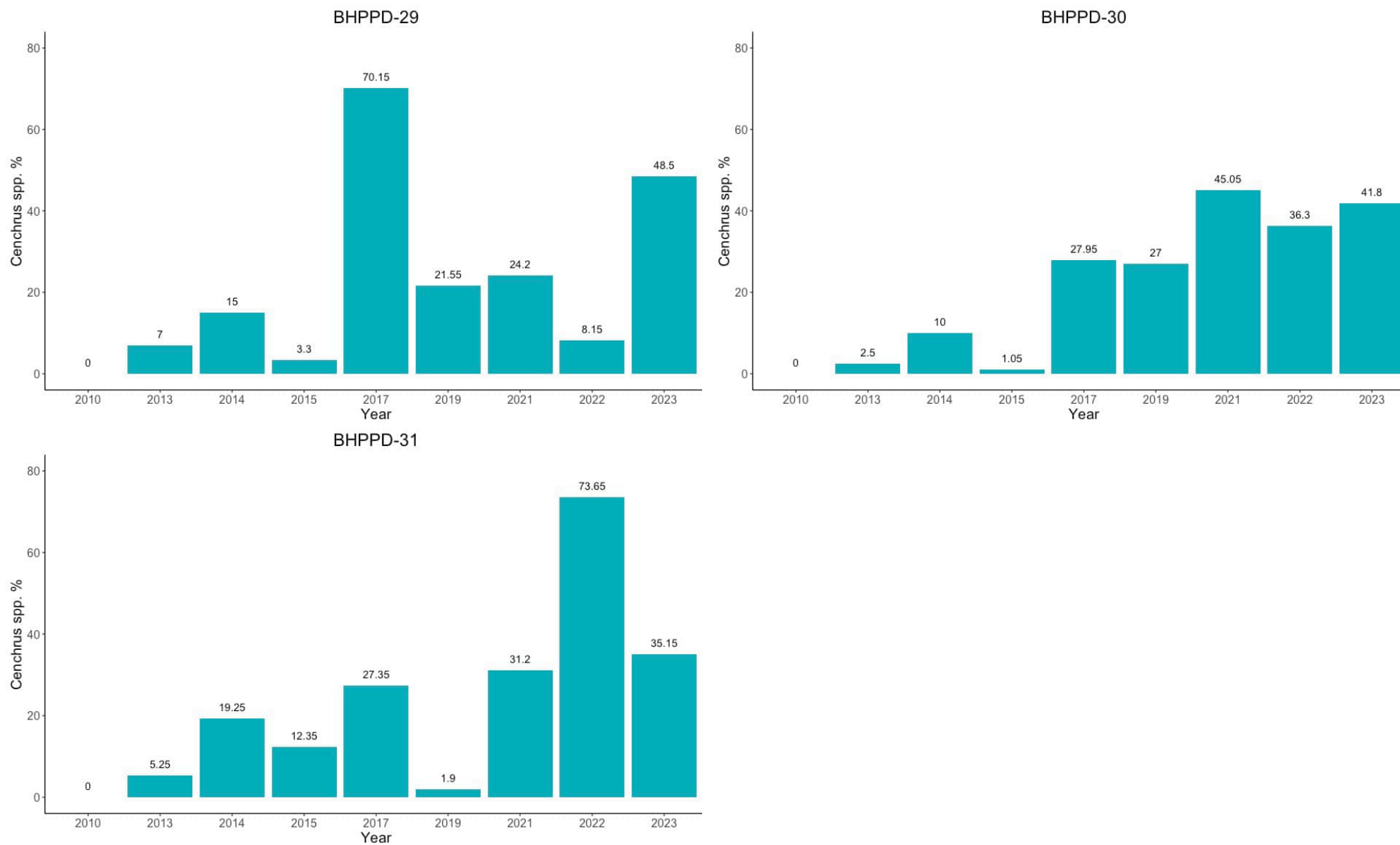
A significant decrease in the cover of *Cenchrus* at rehabilitation transect BHPPD-31 (-38.5%; Plate 5.1) and was observed in 2023 (Table 5.4, Figure 5.9); however, a significant increase in the cover of *Cenchrus* (40.35%) was recorded at BHPPD-29, with the highest levels of infestation recorded at this transect in the last four phases, and increases at BHPPD-23 (17.60%) and BHPPD-28 (7.30%) representing the highest level of infestation at both transects over the entirety of the programme.

Importantly, four rehabilitation transects with high *Cenchrus* spp. cover (BHPPD-23, BHPPD-29, BHPPD-30, and BHPPD-31) are in the southern end of the study area within the Mt Minnie conservation area (Table 5.4). It is clear from the data that with regards to *Cenchrus* spp., the level of weed coverage at four of the rehabilitation transects (BHPPD-23, BHPPD-29, BHPPD-30, and BHPPD-31) is not equal or less than the pre-cleared levels but is considerably higher. The

rehabilitation in these areas therefore does not meet Condition 8-1 of MS844. Notwithstanding the potential that the monitoring conducted during the dry year in 2010 substantially underestimated both the number of sites at which *Cenchrus* spp. was present and the amount of cover of *Cenchrus* spp. at those sites, there is an increase at several sites over subsequent years, with decreases or plateaus following appropriate herbicide application (Table 5.4, Figure 5.8, Figure 5.9).



**Figure 5.8:** Cover of \*Cenchrus spp. recorded along line-transects across all monitoring phases. 2010 represents pre-clearing monitoring.



**Figure 5.9:** Cover of *Cenchrus* spp. recorded along line-transects across all monitoring phases. 2010 represents pre-clearing monitoring.

## 5.4 Development of Vegetation Cover

In addition to species diversity and weed coverage, a third parameter warrants investigation: the degree of development of vegetation in the rehabilitation areas. The amount of cover provided by native plants at each transect was calculated for the different growth form and longevity classes (i.e. hummock grasses, perennial tussock grasses, shrubs and trees, and annual grasses and annual herbs). This is presented along with the cover of *\*Cenchrus spp.* in Appendix 2.

Some of the rehabilitation transects have clearly developed a substantially higher cover of vegetation post-clearing than others, and the proportion of the different life form classes has often changed over the six monitoring phases since the areas were cleared. This information has been incorporated into the qualitative assessment in Section 5.5.

## 5.5 Summary Overview of Transect Condition

The data recorded during the survey were summarised to provide a broad qualitative assessment of the transects monitored in 2023. Transects were assigned to one of five categories (Excellent, Good, Fair, Poor or Very Poor) depending on the degree of perennial native vegetation cover, its similarity to original vegetation composition, and the level of invasion by weeds (principally *\*Cenchrus spp.*; see Table 3.4). The effect of fire was excluded from this process as far as possible. Most of the analogue transects monitored in 2023 (five of the seven) were in Excellent condition, with the exception of BHPPA-23 and BHPPA-30 in the Mt Minnie conservation area; these transects were ranked as Very Good to take into account the presence of juvenile *\*Cenchrus ciliaris* individuals either within the strip-transect or intersecting the transect line.

Half of the rehabilitation transects were ranked as being in Excellent condition (see Table 5.5). The remaining five transects were ranked as Good (BHPPD-28), Fair (BHPPD-23), and Poor (BHPPD-29, BHPPD-30, and BHPPD-31), reflecting the lack of development of native vegetation and/or substantial development of weeds.

Rehabilitation transects BHPPD-27 and BHPPD-31 have both improved in qualitative assessment of vegetation development since 2022; whereas BHPPD-23, BHPPD-28, and BHPPD-29 have declined in overall development of native vegetation, mainly due to the increase in cover of *\*Cenchrus* recorded in 2023. The remaining transects exhibited a similar level of vegetation development in 2023 to that observed in 2022.

Table 5.5: Qualitative assessment of the development of vegetation on the rehabilitation transects in 2021.

Transect	2017	2019	2021	2022	2023 - Overall Ranking and Comments
BHPPD-22	Excellent	Excellent	Excellent	Excellent	<b>Excellent</b> Perennial <i>Acacia</i> mature and flowering, increasing in 2023 to above pre-clearing levels; spinifex is above pre-clearing levels and has been steady over the last five phases. Perennial herbs maintained level of cover since 2022.
BHPPD-23	Good	Good	Good (towards Excellent)	Good (towards Excellent)	<b>Fair</b> Spinifex cover steady from 2022, however still 30% less than pre-clearing levels; <i>Acacia ancistrocarpa</i> has decreased in cover to only a presence (0.1%). <i>Acacia bivenosa</i> , <i>A. stellaticeps</i> , and <i>A. trachycarpa</i> yet to approach pre-clearing levels.  * <i>Cenchrus</i> spp. increased from 5% to 22.6% in 2023.
BHPPD-24	Excellent	Excellent	Excellent	Excellent	<b>Excellent</b> Steady cover of mature spinifex since 2017 which is still 15% greater than the pre-clearing levels; the cover of spinifex appear to be at a level that is representative of the surrounding vegetation; <i>Acacia</i> spp. appear to be dead and absent in the 2022 monitoring again; no weeds recorded within the sites and surrounding vegetation.
BHPPD-25	Good	Good	Excellent	Excellent	<b>Excellent</b> Spinifex has regenerated to the levels prior to the 2017 fire and increased from 2022 levels by 10% - spinifex cover is now only 4% less than that observed pre-clearing. Mature <i>Acacia</i> spp. present; spinifex and <i>Acacia</i> spp. appear to be at a level that is representative of the greater area; as expected with trees post-clearing, scattered <i>Corymbia hamersleyana</i> and <i>Eucalyptus xerothermica</i> are still absent; no weeds recorded within the sites and surrounding vegetation.
BHPPD-26	Good	Good	Excellent	Excellent	<b>Excellent</b> Almost identical to analogue site (strata and species composition): spinifex and <i>Acacia</i> spp. cover has exceeded pre-clearing levels with the continued absence of <i>Corymbia hamersleyana</i> (as expected with trees post-clearing); annual grasses and herbs have mostly disappeared since 2021; no weeds have been recorded within the sites or in the surrounding vegetation; the Rehabilitation and Analogue sites are very similar in terms of strata and percentage cover.

Transect	2017	2019	2021	2022	2023 - Overall Ranking and Comments
BHPPD-27	Fair	Excellent		Good (verging on Excellent)	<b>Excellent</b> Spinifex cover has continually increased since 2013 to half of pre-clearing levels in 2022, however a natural cycle in perennial hummock grasses is most likely observed in 2023. <i>Acacia ancistrocarpa</i> and <i>A. inaequilatera</i> has remained steady since 2022; overall there is positive indication that vegetation structure is tending towards its natural state; decrease in annual grasses <i>Aristida contorta</i> and <i>Paspalidium clementii</i> ; no weeds were recorded within the sites or in the surrounding vegetation.
BHPPD-28	Excellent	Excellent	Excellent	Excellent	<b>Good (trending to Fair)</b> Spinifex cover has again decreased since slightly since 2022 and is now 10% less than pre-clearing levels; cover of <i>Acacia</i> spp. shrubs is still very low compared to pre-clearing with mature <i>Acacia ancistrocarpa</i> and <i>A. bivenosa</i> in the surrounding non-cleared vegetation; less mature <i>Acacia</i> 's appear to be present over the clearing footprint; in 2022 the cover of * <i>Cenchrus</i> was recorded as 0.2% along the line-intercept and the cover in the surrounding rehabilitated area was minimal, but * <i>Cenchrus</i> spp. has increased from 0.2% to 7.5% in 2023.
BHPPD-29	Very Poor	Poor	Poor	Fair	<b>Poor</b> No spinifex or <i>Acacia</i> 's have established along the transect (or in the surrounding cleared footprint) following clearing; cover of * <i>Cenchrus</i> has increased to its highest level since 2017.  * <i>Cenchrus</i> spp. increased by 40% in 2023.  Overall, the Rehabilitation site does not represent pre-clearing vegetation cover levels.
BHPPD-30	Poor	Poor	Very Poor	Poor	<b>Poor (verging on Very Poor)</b> Spinifex has re-established on the transect and is continuing the trend towards pre-clearing levels, remaining at a steady 33-38% since 2017 which is somewhat a promising indicator; perennial shrubs ( <i>Acacia</i> 's and <i>Senna</i> ) have remained steady since the last phase and annual grasses are absent all together; the cover of * <i>Cenchrus</i> remains high despite a decrease of 9% since 2021.  * <i>Cenchrus</i> spp. increased by 5.5% to 41.8% in 2023.
BHPPD-31	Poor	Good	Poor	Very Poor	<b>Poor</b> Spinifex cover remains steady since 2021 but is still 22% less than pre-clearing levels; the cover of <i>Acacia</i> species is non-existent with the <i>Acacias</i> in the greater area (not cleared) in healthy condition and flowering; there was a slight increase in annual grasses. * <i>Cenchrus</i> spp. decreased significantly by 38.5% to 35.15% in 2023.  Overall, the Rehabilitation site does not represent pre-clearing vegetation cover levels.

## 6.0 Conclusions

### 6.1 Satisfaction of Completion Criteria

When assessing rehabilitation progress against the completion criteria, consideration needs to be given to the existing pipeline access track, and its potential to act as a vector for weed introduction along the pipeline disturbance corridor, particularly in areas that are currently weed free or where vegetation has not become adequately established.

With regards to the criteria for the rehabilitation areas listed for Condition 8 of MS844:

**(1) Species diversity is not less than 60 per cent of the known original species diversity.**

This criterion has been met for species richness (native species count) in all the monitored transects. In the absence of threatening factors such as weed invasion, revegetation in the study area is 'Excellent' in the north-western transects but 'Poor' in the south-eastern transects. It would be expected to continue to develop towards a floristic community and composition more aligned with pre-clearing levels in the longer term.

**(2) Weed coverage is equal to or less than that of pre-cleared levels.**

The criterion for Condition 8 in MS844 has again not been met for rehabilitation transects BHPPD-29, BHPPD-30 and BHPPD-31 in 2023 with regard to the introduced tussock grasses *\*Cenchrus ciliaris* (Buffel Grass) and *\*C. setiger* (Birdwood Grass). Additionally, the criterion has also not been met for the transects BHPPD-23 and BHPPD-28 in 2023.

When comparing the 2023 result to that of 2022, *\*Cenchrus ciliaris* and *\*C. setiger* have decreased in abundance (as measured by their percent cover along the line transect) at BHPPD-31 but increased significantly at BHPPD-23, BHPPD-28, BHPPD-29, and BHPPD-30. Provided that continued spraying of these species within the rehabilitated areas is undertaken at the appropriate times and intensity of effort over the course of the next several seasons, it would be expected that the cover of *\*Cenchrus* spp. will at the very least decrease and begin to trend towards pre-clearing levels.

### 6.2 Rehabilitation within the Mt Minnie Conservation Area

While most of the rehabilitation transects sampled in the Mt Minnie conservation area show Good to Excellent vegetation development, with few or no weeds, three transects remain in relatively Poor condition, with a fourth considered to be fair:

- Transect BHPPD-23 is considered Fair, with a somewhat moderate cover of *\*Cenchrus ciliaris* tussock grasses (22.6%). Development of spinifex and perennial shrubs remains steady over the last two phases of monitoring.
- Transect BHPPD-29 is considered Poor, with a high cover of *\*Cenchrus ciliaris* tussock grasses (48.5%) and no development of spinifex or perennial shrubs over the course of monitoring. Importantly, *\*Cenchrus* cover increased by 40% since the last phase.
- Transect BHPPD-30 is considered Poor. It shows a reasonable development of both spinifex and perennial shrub cover, but the cover of *\*Cenchrus* has remained high (33-38%) since 2017 with an increase of 5.5% since the last monitoring phase.
- Transect BHPPD-31 is considered Poor in 2023: spinifex cover has increased by approximately 4% to less than pre-clearing levels, with *\*Cenchrus* cover decreasing by 38.5%.

### 6.3 Likely Progression of Rehabilitation Transect Vegetation

Prior to the 2019 survey, DBCA requested discussion of the likely progression of revegetation in the rehabilitation areas situated within the Mt Minnie conservation area in the short term (2-5 years), medium term (5-10 years) and long term (10-20 years). Based on the data recorded from



the monitoring transects in these areas to date, vegetation development is clearly variable in different areas, and would be expected to progress differently over time.

Transects ranked as 'Excellent' in Table 5.5 comprise **BHPPD-22, BHPPD-24, BHPPD-25, BHPPD-26** and **BHPPD-27**. Vegetation at these transects is relatively comparable to that which existed prior to clearing, with a similar or sometimes greater amount of vegetation cover and no weeds. This vegetation would be expected to continue to develop in the short term, with additional species recruiting from the soil seed bank and adjacent areas. In the medium and long term, vegetation at the rehabilitation transects would be expected to remain stable over time, with major changes arising only due to disturbance events such as fire, or long-term shifts in the amount of rainfall received.

Transects ranked as 'Good' in Table 5.5 comprise **BHPPD-28**. The cover of native perennial vegetation along these transects is generally approaching the percentage recorded prior to clearing in 2010, although the proportions of shrubs and spinifex are often dissimilar (typically more shrubs and less spinifex). A notable increase was recorded in *\*Cenchrus* at **BHPPD-28** in 2023 at 7.5% cover, increasing from 0.2% cover in 2022. It would be expected that the native vegetation cover would increase to reach the pre-clearing levels within 5 years and would then remain stable over time. Unless spot spraying is undertaken at **BHPPD-28**, it would be expected that *\*Cenchrus* spp. levels would continue to increase over the short term.

Transects ranked as 'Fair' in Table 5.5 comprise **BHPPD-23**. Spinifex has re-established on the transect and is continuing the trend towards pre-clearing levels, remaining at a steady 40-50% since 2015; perennial shrubs (*Acacia*'s and *Senna*) have decreased since the last phase and annual herbs are absent all together; the cover of *\*Cenchrus* increased to 22.6% in 2023, resulting in the rating of this transect being downgraded from 'Good' to 'Fair'. It would be expected that the native vegetation cover, specifically perennial woody shrubs, would only re-establish at higher levels if the population of *\*Cenchrus* spp. in the surrounding vegetation is controlled in the medium to long-term.

Transects ranked as 'Poor' in Table 5.5 comprise **BHPPD-29, BHPPD-30, BHPPD-31**.

- Although there is a lack of development of perennial vegetation at **BHPPD-29** (no hummock grassland of *Triodia glabra* and no shrubland of *Acacia synchronicia* and *A. xiphophylla* that existed prior to clearing), the current cover of *\*Cenchrus* spp. at this transect (40.35%) has increased greatly from the 8.15% recorded in 2022. It is expected that in the short term, with continued spraying, that the level of *\*Cenchrus* spp. may well decline. It would only be expected that the perennial *Acacia* shrubs and *Triodia* hummocks would become established in the long term given favourable conditions and the absence of competition from *\*Cenchrus* spp.
- At **BHPPD-30**, hummock grasses are at almost pre-clearing levels, whilst perennial woody shrubs are at 8.95% (15% less than the 23.5% recorded in 2010). The cover of *\*Cenchrus* has remained consistently steady over the last five phases (ranging between 27-45%). As at **BHPPD-29**, it would only be expected that the perennial *Acacia* shrubs would become established in the long term given favourable conditions and the absence of competition from *\*Cenchrus* spp.
- At **BHPPD-31**, it is unlikely that the cover of *Acacia xiphophylla* will return to pre-clearing levels of 72%, with colonisation of *A. bivenosa* shrubs along this transect only likely in the very long-term. Spinifex cover has remained steady since 2021 but still 22% less than pre-clearing levels, and the cover of *\*Cenchrus* has in fact decreased significantly from 73.65% in 2022 to 35.15% in 2023. The greater area surrounding **BHPPD-31** continues to support large, permanent populations of *A. xiphophylla*, and as whole presents as a stable, healthy vegetation unit.

For transects **BHPPD-29, BHPPD-30, and BHPPD-31**, the presence of relatively substantial amounts of *\*Cenchrus* spp. is likely to influence the development of native vegetation, through competition for resources and allelopathy. In the short to medium term, it is expected that the cover of native vegetation may still increase, however it is also likely that the cover of *\*Cenchrus* spp. will continue to remain steady or increase unless continued herbicide spraying is undertaken.

The presence of *\*Cenchrus* spp. is not the only factor influencing slow revegetation, however it is likely to be a significant factor over time, particularly for transects at which the cover of weeds is still moderate or high following herbicide spraying. Given the amount of *\*Cenchrus* spp. cover currently recorded at **BHPPD-29**, **BHPPD30** and **BHPPD-31**, these infestations would be expected to increase again in the short to medium term, and would likely suppress the regeneration of native perennial vegetation. It is unlikely that native vegetation would be able to re-establish to a similar state as was present prior to clearing, without continued weed control efforts.

To ameliorate the current long-term trend of a relatively stable, or increasing, *\*Cenchrus* population (specifically in the south-eastern end of the study area), it is recommended that the **herbicide treatment plan is a bi-annual occurrence for at least seven years** to eradicate the species from the soil seedbank.

## 6.4 Recommendations of DBCA Review

With regards to meeting the four recommendations outlined by the DBCA in 2018 (see Section 2.2):

### Recommendation 1

Woodside completed a weed survey of the ROW in July 2018, and appointed a contractor to complete herbicide spraying of *\*Cenchrus* spp. infestations and individuals along the section situated within the proposed Mt Minnie conservation area in Q3 of the same year, July of 2019, October 2020, November 2021, and May 2022.

Additionally, Woodside commissioned Biota to undertake additional phases of rehabilitation and weed monitoring in March/April 2019, May 2021, May 2022, and April 2023 following appropriate rainfall.

### Recommendation 2

In order to address completion criteria required by Condition 8-3 under MS844, it is again recommended that the following contingency management measures are implemented:

- a) for the pipeline disturbance corridor, especially the section within the Mt Minnie conservation area, it is recommended that as a minimum standard, ongoing herbicide spraying of *\*Cenchrus* spp. is undertaken when conditions are appropriate. Additionally, opportunistic (reactive) spraying of populations should be undertaken following appropriate rainfall events (6.5-20 mm over consecutive days) to ensure both mature individuals and germinating seedlings are targeted.
- b) that vehicles and machinery utilising the ROW within the pipeline gas corridor adhere to the current Woodside weed hygiene management practices.

### Recommendation 3

To date, Woodside has completed herbicide spraying of *\*Cenchrus* spp. populations in Q3 of 2018, July of 2019, October 2020, November 2021, and May 2022. Additionally, weed hygiene protocols have been implemented and utilised for all vehicles and machinery traversing the ROW within the Mt Minnie conservation area.

### Recommendation 4

Woodside, along with the results and conclusions of this report, recognises that the existing pipeline access track is likely to be acting as a potential vector for weed introduction along the pipeline disturbance corridor. Current weed hygiene protocols are in place to prevent the spread of weeds along the pipeline access track. Appropriate weed hygiene signage along the length of the access track, as well as appropriately timed, herbicide application to *\*Cenchrus* spp. populations, will need to be adopted as a continual, ongoing effort for a number of years in order to control and prevent the spread of weeds into the surrounding vegetation.

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# Appendix 1

## 2023 Monitoring Transect Coordinates





**ANALOGUE TRANSECTS**

Transect ID	Peg Location – 0 m (start)		Peg Location – 20 m (end)	
	Easting	Northing	Easting	Northing
BHPPA-22	308722	7581767	308707	7581757
BHPPA-23	310680	7579965	310663	7579949
BHPPA-24	324359	7572037	324352	7572018
BHPPA-26	329727	7568156	329716	7568139
BHPPA-28	338649	7561624	338638	7561607
BHPPA-29	339668	7560530	339663	7560510
BHPPA-30	340703	7559306	340696	7559287

**REHABILITATION TRANSECTS**

Transect ID	Peg Location – 0 m (start)		Peg Location – 20 m (end)	
	Easting	Northing	Easting	Northing
BHPPD-22	308753	7581829	308743	7581814
BHPPD-23	310693	7580026	310681	7580010
BHPPD-24	324437	7572060	324428	7572043
BHPPD-25	326911	7570292	326903	7570273
BHPPD-26	329764	7568214	329760	7568195
BHPPD-27	332180	7566205	332173	7566188
BHPPD-28	338709	7561652	338704	7561632
BHPPD-29	339711	7560604	339703	7560590
BHPPD-30	340706	7559391	340699	7559379
BHPPD-31	341811	7558474	341800	7558458





## Appendix 2

### Transect Photographs and Summarised Data (2010-2023)





**Photographs of transects over the course of the monitoring program, together with summarised data from the monitoring transects.**

**Cover of each lifeform category along the line transect:**





















Values in table are the percentage of the 20 m line transect occupied by each native lifeform category at each site, along with the percentage occupied by weeds. (Note that \**Cenchrus* tussock grasses were the only weeds recorded on the line transects, although other weeds were sometimes present in the broader sites.)

**Covers and presence of individual species:**

















Values in table are the percentage of the 20 m line transect occupied by each species at each site.

+ indicates additional species present in 1 m wide strip transect (note that the strip transect was only utilised from 2013 onwards).

**Site 22 (Mt Minnie conservation area)**

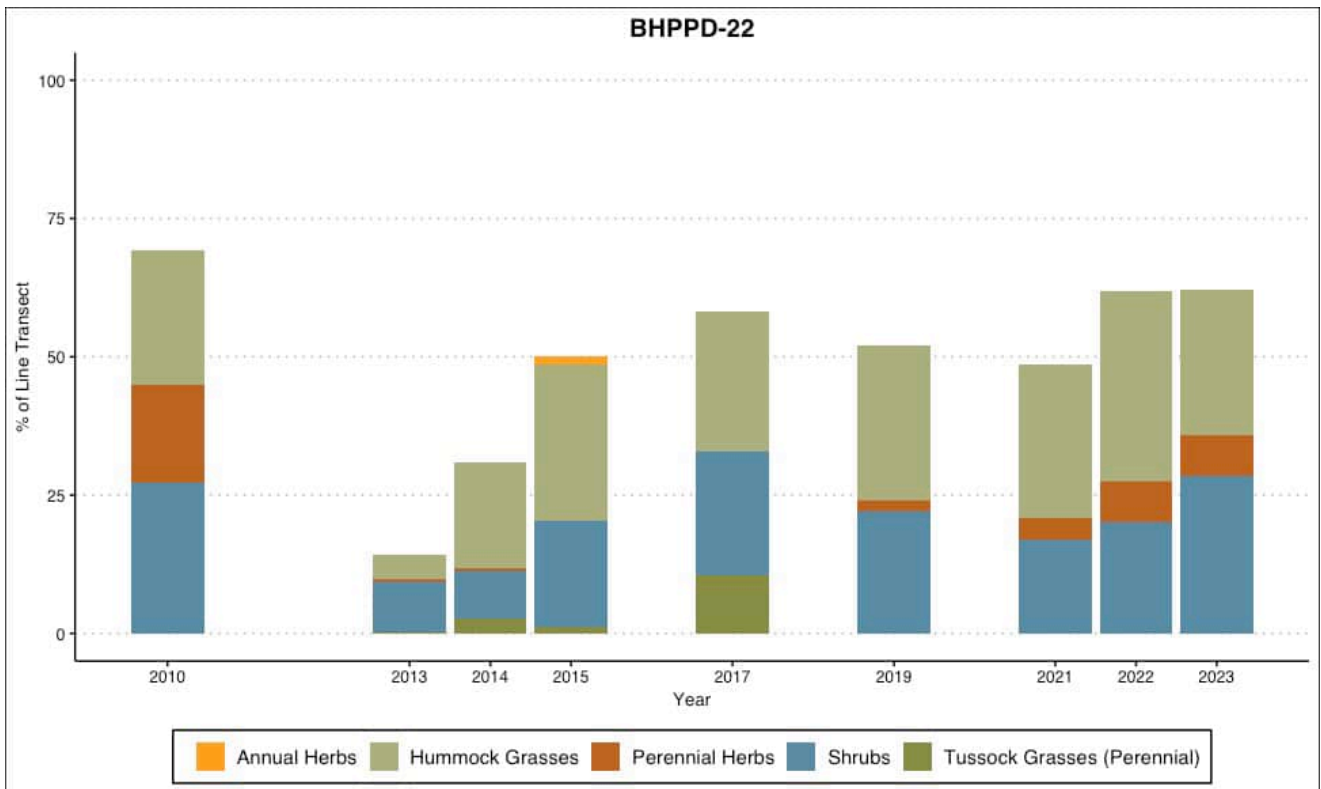
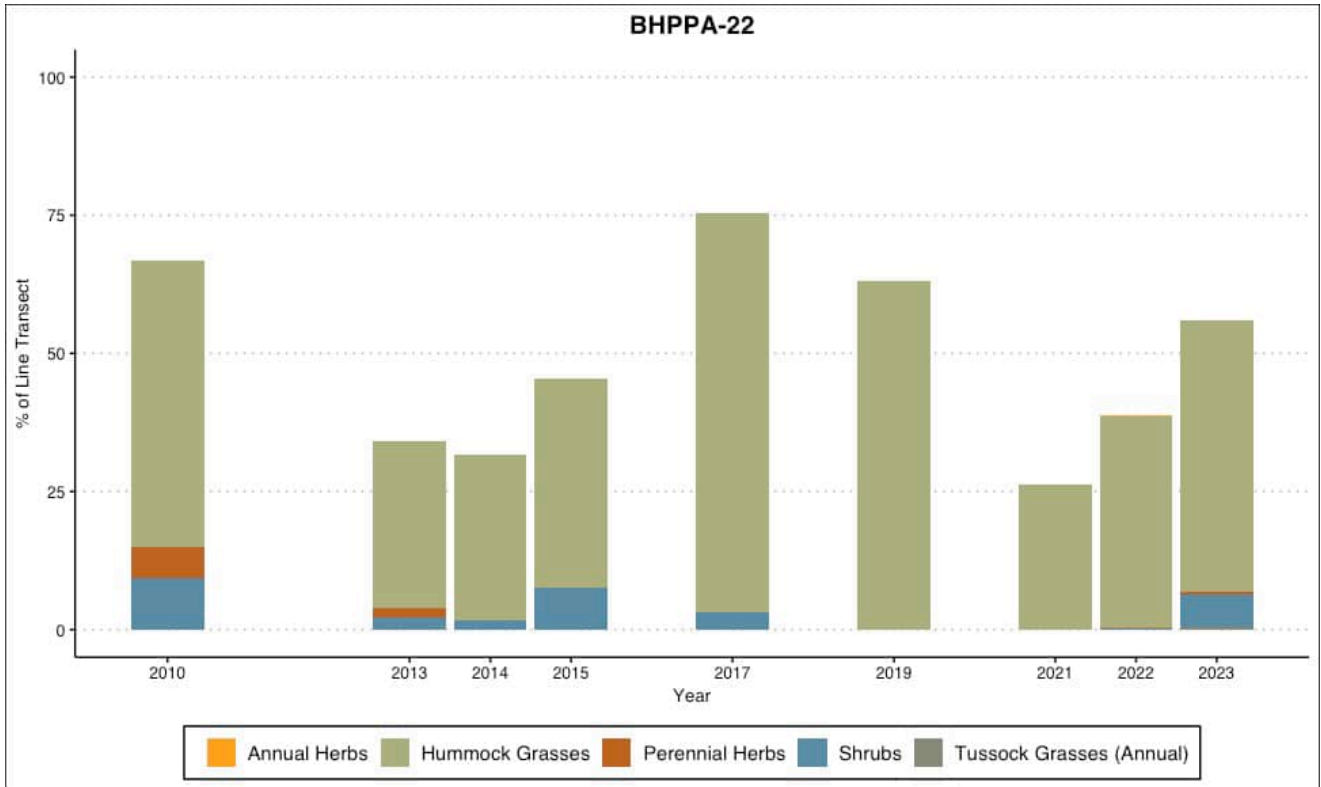
Analogue Transect BHPPA-22		Rehabilitation Transect BHPPD-22	
			
2010 - 0 m	2010 - 20 m	2010 - 0 m	2010 - 20 m
			
2013 - 0 m	2013 - 20 m	2013 - 0 m	2013 - 20 m
			
2014 - 0 m	2014 - 20 m	2014 - 0 m	2014 - 20 m
			
2015 - 0 m	2015 - 20 m	2015 - 0 m	2015 - 20 m
			
2017 - 0 m	2017 - 20 m	2017 - 0 m	2017 - 20 m

Site 22 (Mt Minnie conservation area)

Analogue Transect BHPPA-22		Rehabilitation Transect BHPPD-22	
 2019 - 0 m	 2019 - 20 m	 2019 - 0 m	 2019 - 20 m
 2021 - 0 m	 2021 - 20 m	 2021 - 0 m	 2021 - 20 m
 2022 - 0 m	 2022 - 20 m	 2022 - 0 m	 2022 - 20 m
 2023 - 0 m	 2023 - 20 m	 2023 - 0 m	 2023 - 20 m

Cover of each lifeform category along the line transect:

Transect	Year	Perennials					Annuals		Weeds (*Cenchrus)
		Hummock Grasses	Shrubs	Trees	Tussock Grasses	Perennial Herbs	Annual Grasses	Annual Herbs	
<b>Analogue BHPPA-22</b>	2010	52.05	9.30			5.55			
	2013	30.00	2.25			1.75			
	2014	30.00	1.75						
	2015	38.00	7.50						
	2017	72.25	3.05						
	2019	63.20							
	2021	26.15							
	2022	38.40	0.10			0.10		0.25	
	2023	49.20	5.90			0.40	0.55		
<b>Rehab BHPPD-22</b>	2010	24.40	27.15			17.80			
	2013	4.40	9.10		0.25	0.35			
	2014	19.20	8.70		2.60	0.40			
	2015	28.20	19.10		1.25			1.45	
	2017	25.35	22.30		10.55				
	2019	28.05	22.05			2.05			
	2021	27.60	16.90			4.05			
	2022	34.40	20.05			7.40			
	2023	26.45	28.40			7.35			





## Site 22 (Mt Minnie conservation area)
















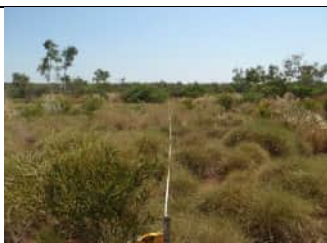




### Cover and presence of individual species:

Family / Species	BHPPA-22									BHPPD-22								
	2010	2013	2014	2015	2017	2019	2021	2022	2023	2010	2013	2014	2015	2017	2019	2021	2022	2023
<b>Amaranthaceae</b>																		
<i>Ptilotus polystachyus</i>								0.25									+	
<b>Convolvulaceae</b>																		
<i>Bonamia alatisemina</i>								0.10	0.40			0.40		+			+	1.40
<i>Bonamia erecta</i>			+	+	+		+	+	+									
<i>Polymeria lanata</i>											0.35							
<b>Fabaceae</b>																		
<i>Acacia stellaticeps</i>							+	0.10	5.90	12.30	0.10	+	6.40	12.10	22.05	16.90	20.05	28.4
<i>Petalostylis cassioides</i>											8.75	8.70	12.70	10.20			+	
<i>Swainsona ?kingii</i>													1.45					
<b>Goodeniaceae</b>																		
<i>Goodenia microptera</i>				+					+									+
<i>Scaevola parvifolia</i>												+	+	+				
<b>Lamiaceae</b>																		
<i>Dicrastylis cordifolia</i>	9.30	2.25	1.75	7.50	3.05	+				7.85	0.25	+	+	+				
<i>Quoya paniculata</i>										7.00								
<b>Lauraceae</b>																		
<i>Cassytha capillaris</i>					+				+					+	+	4.05	7.40	5.95
<i>Cassytha sp.</i>	5.55	1.75								17.8								
<b>Malvaceae</b>																		
<i>Corchorus sp.</i>								+										
<b>Poaceae</b>																		
<i>Aristida holathera</i> var. <i>holathera</i>									0.55		+		+					+
* <i>Cenchrus ciliaris</i>																		+
<i>Eragrostis eriopoda</i>											0.25	2.60	1.25	10.55				
<i>Triodia epactia</i>										22.45	4.15	18.45						1.25
<i>Triodia schinzii</i>	52.05	30.00	30.00	38.00	72.25	63.20	26.15	38.40	49.2			+	25.80	21.85	28.05	22.15	25.55	20.90
<i>Triodia glabra</i>										1.95	0.25	0.75	2.40	3.50	+	5.45	9.85	4.30
<b>Proteaceae</b>																		
<i>Grevillea stenobotrya</i>													+	+				
<b>Total no. of native species</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>4</b>	<b>4</b>	<b>2</b>	<b>3</b>	<b>6</b>	<b>7</b>	<b>6</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>10</b>	<b>4</b>	<b>4</b>	<b>7</b>	<b>8</b>
<b>Total no. of weed species</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>

### Comments regarding site:

Rehabilitation is again in excellent condition in 2023; perennial shrub *Acacia stellaticeps* mature and flowering; spinifex is above pre-clearing levels and has been steady over the last six phases of monitoring and is representative of the greater area (as mentioned in previous monitoring reports *Triodia schinzii* has replaced *T. epactia* but is now recorded again at 1.25%); spinifex cover within the Analogue site has increased by 10-12% each season since 2021; perennial herbs cover has remained steady (e.g. *Cassytha capillaris*) over the last three phases of monitoring; \**Cenchrus ciliaris* was recorded as a presence for the first time in 2022 in the rehabilitation site, but was not recorded again in 2023

**Site 23 (Mt Minnie conservation area)**

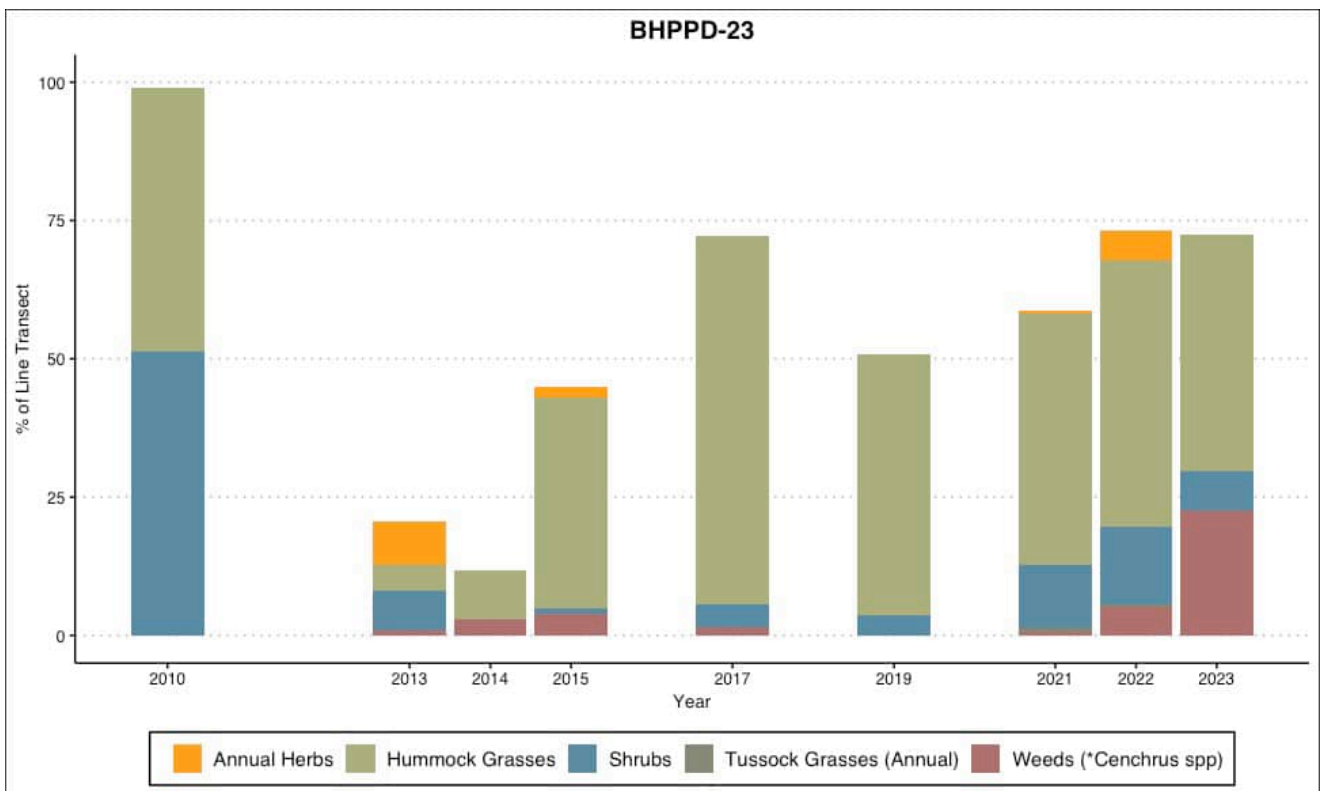
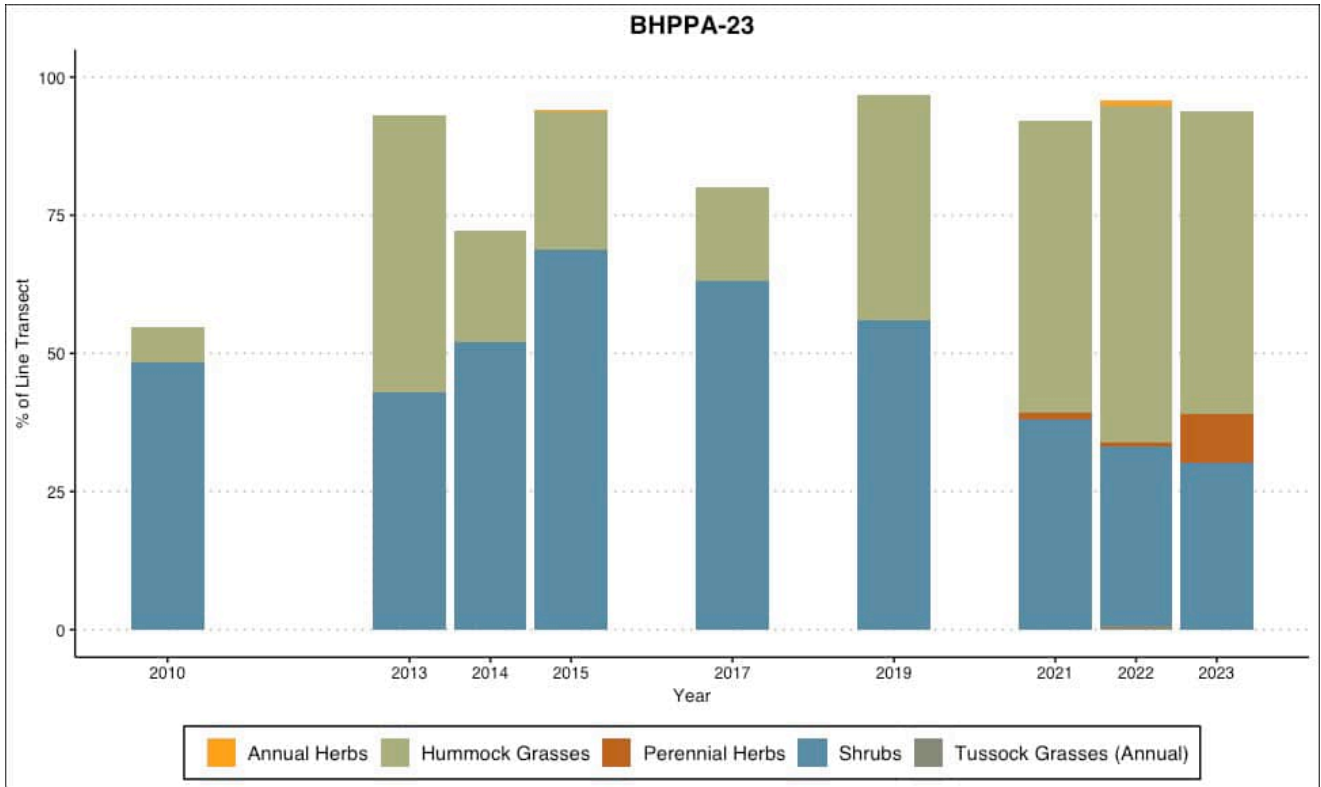
Analogue Transect BHPPA-23		Rehabilitation Transect BHPPD-23	
			
2010 - 0 m	2010 - 20 m	2010 - 0 m	2010 - 20 m
			
2013 - 0 m	2013 - 20 m	2013 - 0 m	2013 - 20 m
			
2014 - 0 m	2014 - 20 m	2014 - 0 m	2014 - 20 m
			
2015 - 0 m	2015 - 20 m	2015 - 0 m	2015 - 20 m
			
2017 - 0 m	2017 - 20 m	2017 - 0 m	2017 - 20 m

Site 23 (Mt Minnie conservation area)

Analogue Transect BHPPA-23		Rehabilitation Transect BHPPD-23	
 <p>2019 - 0 m</p>	 <p>2019 - 20 m</p>	 <p>2019 - 0 m</p>	 <p>2019 - 20 m</p>
 <p>2021 - 0 m</p>	 <p>2021 - 20 m</p>	 <p>2021 - 0 m</p>	 <p>2021 - 20 m</p>
 <p>2022 - 0 m</p>	 <p>2022 - 20 m</p>	 <p>2022 - 0 m</p>	 <p>2022 - 20 m</p>
 <p>2023 - 0 m</p>	 <p>2023 - 20 m</p>	 <p>2023 - 0 m</p>	 <p>2023 - 20 m</p>

Cover of each lifeform category along the line transect:

Transect	Year	Perennials				Annuals		Weeds (*Cenchrus)	
		Hummock Grasses	Shrubs	Trees	Tussock Grasses	Perennial Herbs	Annual Grasses		Annual Herbs
<b>Analogue BHPPA-23</b>	2010	93.70	48.25						
	2013	50.00	43.00						
	2014	20.00	52.10						
	2015	25.00	68.70					0.25	
	2017	76.55	63.15						
	2019	74.30	55.95						
	2021	53.00	38.15			1.00			
	2022	73.50	32.50			0.75	0.65	0.95	
	2023	80.40	30.15			8.80			
<b>Rehab BHPPD-23</b>	2010	72.70	51.25						
	2013	4.75	7.00					7.75	1.00
	2014	8.75							3.00
	2015	38.05	0.85					2.00	4.00
	2017	66.75	4.15						
	2019	47.20	3.65						
	2021	45.30	11.45				0.90	0.65	0.45
	2022	44.35	13.85				0.65	5.60	5.00
	2023	42.85	7.05						22.60



**Site 23 (Mt Minnie conservation area)**

**Cover and presence of individual species:**

Family / Species	BHPPA-23									BHPPD-23								
	2010	2013	2014	2015	2017	2019	2021	2022	2023	2010	2013	2014	2015	2017	2019	2021	2022	2023
<b>Amaranthaceae</b>																		
<i>Ptilotus axillaris</i>											1.00				+			
<i>Ptilotus polystachyus</i>											4.75		0.10			+	5.50	
<b>Araliaceae</b>																		
<i>Trachymene oleracea</i>								+										
<b>Asteraceae</b>																		
<i>Pluchea dentex</i>																	+	
<i>Pluchea dunlopii</i>				+														
<i>Streptoglossa decurrens</i>				+												+		+
<b>Boraginaceae</b>																		
<i>Heliotropium crispatum</i>							+	0.95			2.00					+		
<b>Chenopodiaceae</b>																		
<i>Dysphania rhadinostachya subsp. rhadinostachya</i>																+		
<b>Cleomaceae</b>																		
<i>Arivela viscosa</i>																+	0.10	
<b>Convolvulaceae</b>																		
<i>Bonamia erecta</i>											+	+	+					
<i>Evolvulus alsinoides var. villosicalyx</i>					+												+	+
<b>Cyperaceae</b>																		
<i>Bulbostylis barbata</i>												+				0.65	+	
<b>Euphorbiaceae</b>																		
<i>Euphorbia tannensis</i>																+		
<i>Euphorbia tannensis subsp. eremophila</i>								+										
<i>Euphorbia boophthona</i>																	+	+
<b>Fabaceae</b>																		
<i>Acacia ancistrocarpa</i>										8.55		+	0.85	2.75	3.65	3.50	9.9	+
<i>Acacia bivenosa</i>	40.50	37.50	43.50	56.05	55.25	55.95	37.40	32.50	28	4.05		+	+			+		+
<i>Acacia stellaticeps</i>										30.90			+	1.40	+	5.20	3.45	2.60
<i>Acacia synchronicia</i>	7.75	5.50	8.60	12.65	7.90	+	0.75	+	+									
<i>Acacia trachycarpa</i>										7.75								
<i>Indigofera boviparda subsp. boviparda</i>													+			2.30	0.30	+
<i>Indigofera colutea</i>											+		1.90			+	+	+
<i>Petalostylis cassioides</i>													+					
<i>Tephrosia sp. B Kimberley Flora (C.A. Gardner 7300)</i>					+						+	+					+	+
<b>Goodeniaceae</b>																		
<i>Goodenia microptera</i>				0.25					+		+							
<b>Lauraceae</b>																		
<i>Cassytha capillaris</i>							1.00	0.75	8.8									
<b>Malvaceae</b>																		
<i>Abutilon lepidum</i>											1.00					0.45	+	3.40
<i>Abutilon otocarpum</i>											3.00						0.20	1.05
<i>Abutilon ?sp. Onslow (F. Smith s.n. 10/9/61)</i>							+	+	0.3									
<i>Abutilon sp.</i>				+														
<i>Corchorus sidoides subsp. sidoides</i>																+		+
<i>Hibiscus sturtii</i>													+					
<i>Hibiscus sturtii var. campylochlamys</i>					+													
<i>Hibiscus sturtii var. platychlams</i>												+						+
<i>Sida arsinata</i>									1.85				+					
<i>Sida cardiophylla</i>							+											
<i>Sida fibulifera</i>								+			3.00					+	+	+
<i>Sida sp.</i>				+							+	+						
<b>Montiaceae</b>																		
<i>Calandrinia sp.</i>																	+	
<b>Phyllanthaceae</b>																		
<i>Dendrophyllanthus erwinii</i>																+	+	
<i>Nelica maderaspatensis</i>				+														
<b>Poaceae</b>																		
* <i>Cenchrus ciliaris</i>					+						1.00	2.00	2.00	+		+	1.15	+
* <i>Cenchrus setiger</i>					+				+			1.00	2.00			0.45	3.85	22.60
<i>Chrysopogon fallax</i>																		+
<i>Eriachne aristidea</i>																	0.35	+
<i>Paspalidium clementii</i>								0.65								0.90	0.30	
<i>Sporobolus australasicus</i>								+										
<i>Triodia epactia</i>	92.45	30.00	15.00	25.00	70.65	61.00	27.45	45.75	54.85	66.55	4.50	7.50	30.00	62.00	47.20	36.65	28.45	35.45
<i>Triodia glabra</i>	1.25	20.00	5.00		5.90	13.30	25.55	27.75	25.55	6.15	0.25	1.25	8.05	4.75	+	8.65	15.90	7.40
<i>Yakirra australiensis var. australiensis</i>																+		





















Family / Species	BHPPA-23									BHPPD-23								
	2010	2013	2014	2015	2017	2019	2021	2022	2023	2010	2013	2014	2015	2017	2019	2021	2022	2023
Portulacaceae																		
<i>Portulaca oleracea</i>											+							
<b>Total no. of native species</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>9</b>	<b>7</b>	<b>4</b>	<b>8</b>	<b>14</b>	<b>8</b>	<b>6</b>	<b>14</b>	<b>9</b>	<b>12</b>	<b>4</b>	<b>4</b>	<b>21</b>	<b>20</b>	<b>18</b>
<b>Total no. of weed species</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>2</b>

**Comments regarding site:**

Rehabilitation is in very good condition in 2023; spinifex is mature and cover steady from 2022 with a decrease in *Triodia glabra* but an increase in *Triodia epactia* recorded; *Acacia ancistrocarpa* has decreased in cover, with *Acacia bivenosa*, *Acacia stellaticeps*, and *Acacia trachycarpa* yet to approach pre-clearing levels, with very few having colonised within the clearing footprint; a relatively high percentage of \**Cenchrus* was recorded in the transect and in the surrounding vegetation in 2023 suggesting that since herbicide application events prior to the survey the weed looks to be naturally re-establishing in the area.

















The Analogue site is showed an increase in overall spinifex cover in 2023, but still remains 12% lower than pre-clearing levels.

**Site 24 (Mt Minnie conservation area)**

Analogue Transect BHPPA-24		Rehabilitation Transect BHPPD-24	
			
2010 - 0 m	2010 - 20 m	2010 - 0 m	2010 - 20 m
			
2013 - 0 m (burnt)	2013 - 20 m (burnt)	2013 - 0 m	2013 - 20 m
			
2014 - 0 m	2014 - 20 m	2014 - 0 m	2014 - 20 m
			
2015 - 0 m	2015 - 20 m	2015 - 0 m	2015 - 20 m
			
2017 - 0 m	2017 - 20 m	2017 - 0 m	2017 - 20 m

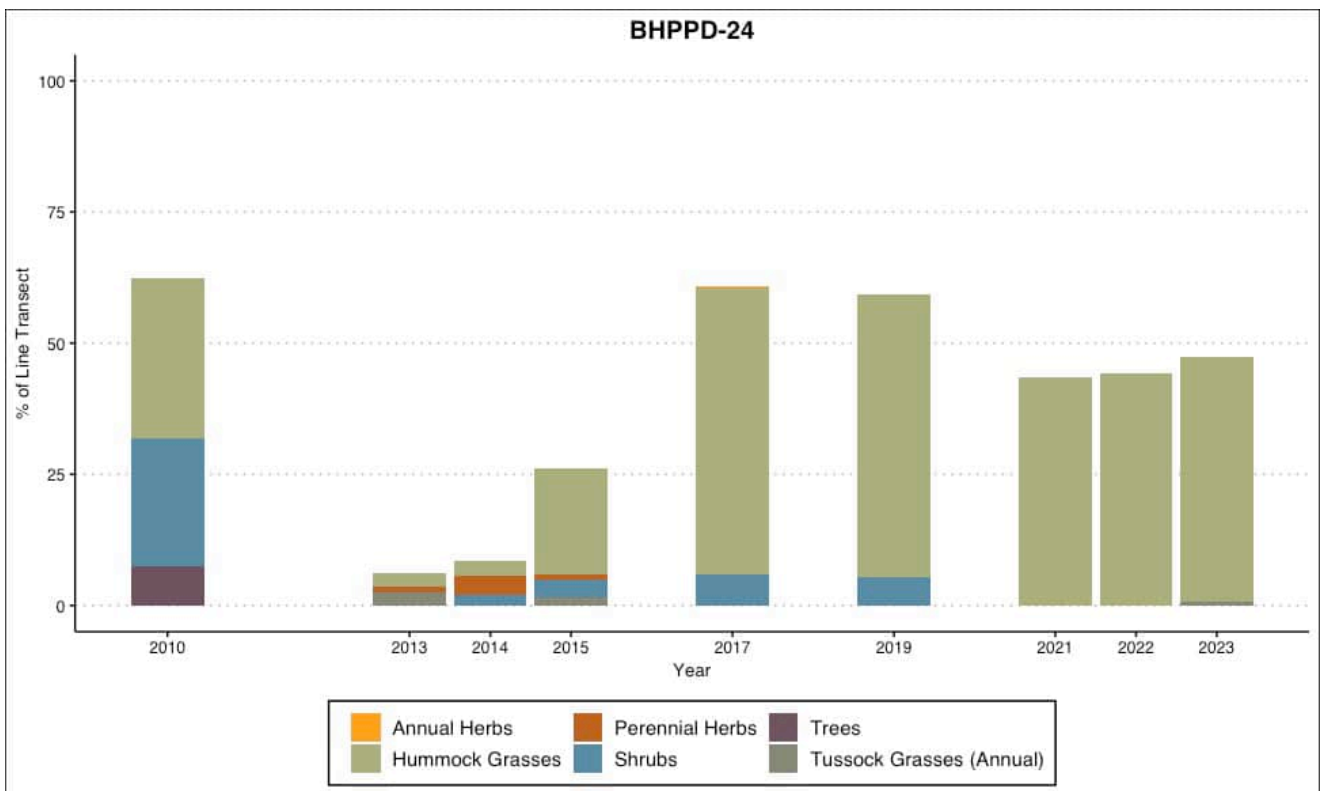
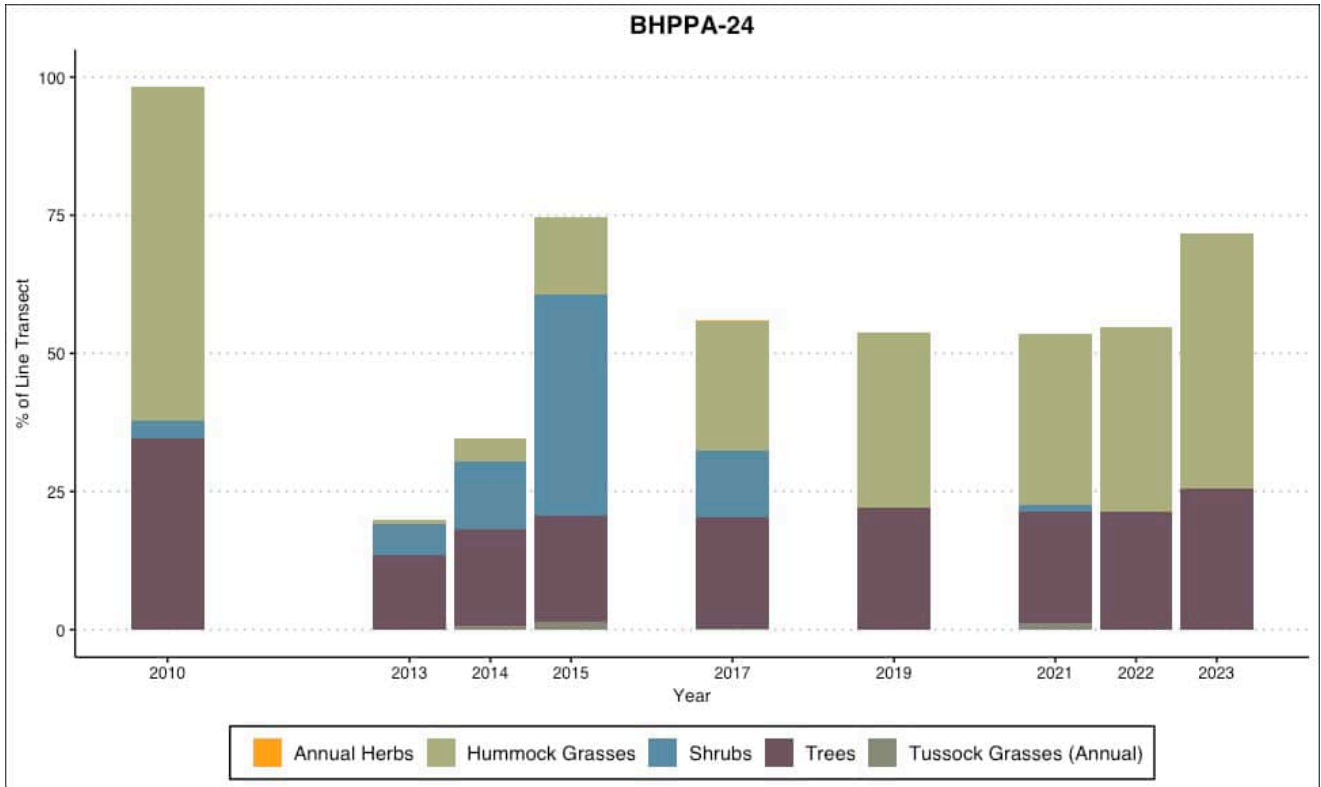


Site 24 (Mt Minnie conservation area)

Analogue Transect BHPPA-24		Rehabilitation Transect BHPPD-24	
 <p>2019 - 0 m</p>	 <p>2019 - 20 m</p>	 <p>2019 - 0 m</p>	 <p>2019 - 20 m</p>
 <p>2021 - 0 m</p>	 <p>2021 - 20 m</p>	 <p>2021 - 0 m</p>	 <p>2021 - 20 m</p>
 <p>2022 - 0 m</p>	 <p>2022 - 20 m</p>	 <p>2022 - 0 m</p>	 <p>2022 - 20 m</p>
 <p>2023 - 0 m</p>	 <p>2023 - 20 m</p>	 <p>2023 - 0 m</p>	 <p>2023 - 20 m</p>

Cover of each lifeform category along the line transect (NB. BHPPA-24 was burnt prior to the 2013 survey):

Transect	Year	Perennials					Annuals		Weeds (*Cenchrus)
		Hummock Grasses	Shrubs	Trees	Tussock Grasses	Perennial Herbs	Annual Grasses	Annual Herbs	
<b>Analogue BHPPA-24</b>	2010	60.50	3.30	34.50					
	2013	0.75	5.60	13.50					
	2014	4.15	12.20	17.40			0.75		
	2015	13.90	40.25	19.05			1.45		
	2017	23.25	12.05	20.15			0.25	0.40	
	2019	31.85		21.95					
	2021	31.05	1.20	20.00			1.25		
	2022	33.40		21.30					
2023	46.15		25.50						
<b>Rehab BHPPD-24</b>	2010	30.50	24.40	7.50					
	2013	2.50				1.00	2.65		
	2014	3.00	1.95			3.60			
	2015	20.00	3.25			1.20	1.55		
	2017	54.60	5.85					0.25	
	2019	53.80	5.90						
	2021	43.55							
	2022	44.30							
2023	46.65					0.80			



## Site 24 (Mt Minnie conservation area)

NB. Analogue transect BHPPA-24 was burnt prior to the 2013 survey.

### Cover and presence of individual species:





















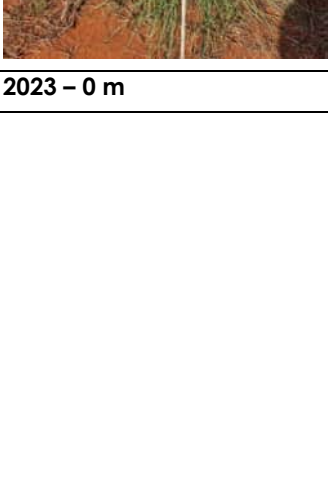
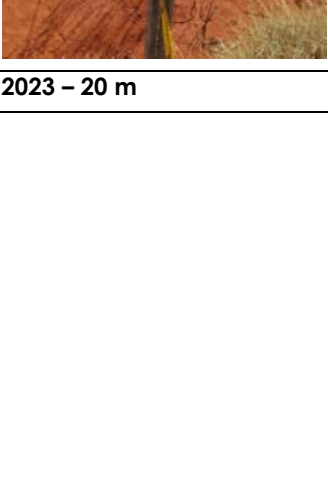
Family / Species	BHPPA-24									BHPPD-24								
	2010	2013	2014	2015	2017	2019	2021	2022	2023	2010	2013	2014	2015	2017	2019	2021	2022	2023
<b>Amaranthaceae</b>																		
<i>Ptilotus axillaris</i>												+				+		
<i>Ptilotus fusiformis</i>												+						
<b>Cleomaceae</b>																		
<i>Cleome uncifera</i>				+														
<b>Convolvulaceae</b>																		
<i>Bonamia alatisemina</i>					+							3.60						
<i>Bonamia erecta</i>		5.35	10.75	17.90	8.55		1.20	+	+		+	+	1.65	2.30		+	+	+
<i>Evolvulus alsinoides</i>													1.20					
<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>				+														
<i>Polymeria lanata</i>											1.00							
<b>Cyperaceae</b>																		
<i>Bulbostylis barbata</i>					0.40									0.25				
<b>Fabaceae</b>																		
<i>Acacia ancistrocarpa</i>	3.30			+		+				21.25		+	+	2.50	4.75			
<i>Acacia bivenosa</i>										3.15		+	+	0.75	0.65			
<i>Indigofera boviparda</i> subsp. <i>boviparda</i>			+	+							+	+						
<i>Indigofera</i> sp.				+														
<i>Isotropis atropurpurea</i>			+	18.05	3.50							+	+					
<i>Tephrosia uniovulata</i>												+						
<b>Goodeniaceae</b>																		
<i>Goodenia microptera</i>				+														
<i>Scaevola spinescens</i>											+	0.35	+	0.30	+	+	+	+
<b>Malvaceae</b>																		
<i>Corchorus sidoides</i>		0.25	1.45	4.30														
<i>Sida cardiophylla</i>												1.60	1.60					
<i>Sida</i> sp. Pilbara (A.A. Mitchell PRP 1543)		+	+								+							
<b>Myrtaceae</b>																		
<i>Corymbia hamersleyana</i>	34.50	13.50	17.40	19.05	20.15	21.95	20.00	21.30	25.5									
<i>Eucalyptus xerothermica</i>										7.50								
<b>Poaceae</b>																		
<i>Aristida contorta</i>		+																
<i>Aristida holathera</i> var. <i>holathera</i>			0.75	1.15		+	1.25		+		2.00	+	+			+		0.80
<i>Eriachne aristidea</i>		+		0.30							+		1.55					
<i>Eriachne pulchella</i> var. <i>pulchella</i>					0.25													
<i>Iseilema vaginiflorum</i>											+							
<i>Paspalidium clementii</i>				+	+													
<i>Paspalidium</i> sp.											0.65							
<i>Triodia glabra</i>	60.50	0.75	4.15	13.90	23.25	13.30	31.05	33.40	46.15	30.50	2.50	3.00	20.00	54.60	+	43.55	44.30	46.65
<b>Proteaceae</b>																		
<i>Grevillea striata</i>							+											
<b>Total no. of native species</b>	<b>3</b>	<b>7</b>	<b>8</b>	<b>14</b>	<b>8</b>	<b>4</b>	<b>5</b>	<b>3</b>	<b>4</b>	<b>4</b>	<b>10</b>	<b>13</b>	<b>10</b>	<b>6</b>	<b>4</b>	<b>5</b>	<b>3</b>	<b>4</b>
<b>Total no. of weed species</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

### Comments regarding site:

Rehabilitation is in excellent condition in 2023; there has been a relatively steady cover of mature spinifex since 2017 which is still 15% greater than the pre-clearing levels; the cover of spinifex appear to be at a level that is representative of the surrounding vegetation; *Acacia* spp. appear to be dead and absent in the 2023 monitoring again; no weeds were recorded within the sites and surrounding vegetation.

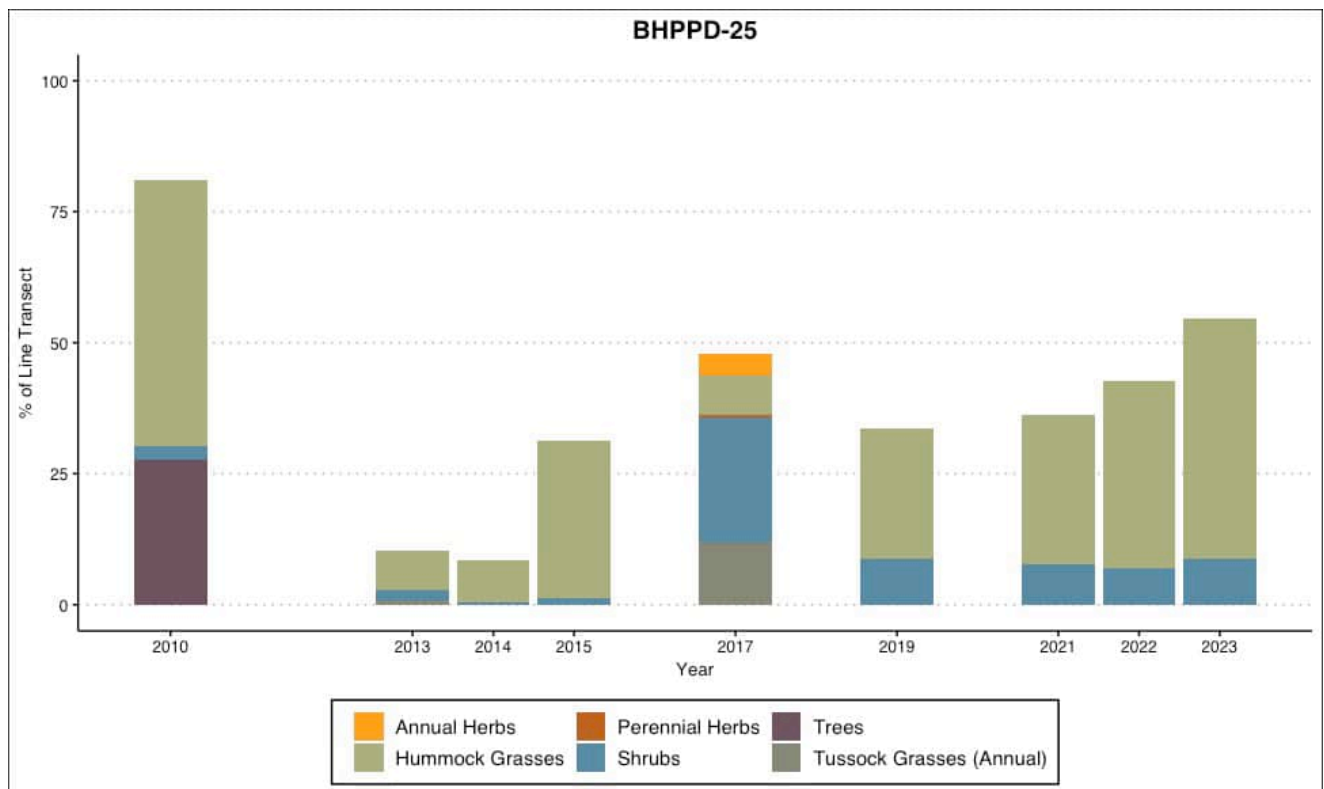
The spinifex and tree cover has remained steady within the Analogue site and still recovering from the fire prior to 2013 with the increase of annual grasses and perennial shrubs recorded.

**Site 25 (Mt Minnie conservation area)**  
 (no analogue transect)

Rehabilitation Transect BHPPD-25			
 2010 - 0 m	 2010 - 20 m	 2019 - 0 m	 2019 - 20 m
 2013 - 0 m	 2013 - 20 m	 2019 - 0 m	 2019 - 20 m
 2014 - 0 m	 2014 - 20 m	 2021 - 0 m	 2021 - 20 m
 2015 - 0 m	 2015 - 20 m	 2021 - 0 m	 2021 - 20 m
 2017 - 0 m (patchily burnt)	 2017 - 20 m (patchily burnt)	 2022 - 0 m	 2022 - 20 m
		 2023 - 0 m	 2023 - 20 m

Cover of each lifeform category along the line transect (NB. Patchily burnt prior to 2017 survey):

Transect	Year	Perennials					Annuals		Weeds (*Cenchrus)
		Hummock Grasses	Shrubs	Trees	Tussock Grasses	Perennial Herbs	Annual Grasses	Annual Herbs	
Rehab BHPPD-25	2010	50.70	2.50	27.75					
	2013	7.50	2.00				0.75		
	2014	8.00	0.55						
	2015	30.00	1.25						
	2017	7.45	24.05			0.55	11.75	4.15	
	2019	24.75	8.80						
	2021	28.45	7.65						
	2022	35.80	6.90						
	2023	46.00	8.70						



## Site 25 (Mt Minnie conservation area)

NB. Patchily burnt prior to 2017 survey.





















### Cover and presence of individual species:

Family / Species	BHPPD-25								
	2010	2013	2014	2015	2017	2019	2021	2022	2023
<b>Asteraceae</b>									
<i>Streptoglossa decurrens</i>									+
<b>Amaranthaceae</b>									
<i>Ptilotus axillaris</i>					2.75				
<i>Ptilotus fusiformis</i>					+				
<b>Boraginaceae</b>									
<i>Heliotropium crispatum</i>					+				
<i>Heliotropium inexplicitum</i>					+				
<b>Convolvulaceae</b>									
<i>Bonamia alatisemina</i>			+		0.55				
<i>Polycarpaea corymbosa</i> var. <i>corymbosa</i>					+				
<b>Cyperaceae</b>									
<i>Bulbostylis barbata</i>			+		0.35				
<b>Euphorbiaceae</b>									
<i>Euphorbia vaccaria</i> var. <i>vaccaria</i>					+				
<b>Fabaceae</b>									
<i>Acacia ancistrocarpa</i>					1.90	3.20	3.30	5.45	5.75
<i>Acacia bivenosa</i>					+	+	4.35	1.45	2.95
<i>Acacia coriacea</i>	2.50								
<i>Indigofera boviparda</i> subsp. <i>boviparda</i>					2.10	+			+
<i>Senna notabilis</i>		+			2.65				+
<i>Tephrosia uniovulata</i>					13.30	1.85	+		
<b>Goodeniaceae</b>									
<i>Goodenia microptera</i>					1.05				
<b>Malvaceae</b>									
<i>Corchorus sidoides</i> subsp. <i>vermicularis</i>					3.15				
<i>Sida</i> sp. Pilbara (A.A. Mitchell PRP 1543)						+			
<b>Molluginaceae</b>									
<i>Mollugo molluginea</i>					+				
<b>Myrtaceae</b>									
<i>Corymbia hamersleyana</i>	10.50								
<i>Eucalyptus xerothermica</i>	17.25								
<b>Poaceae</b>									
<i>Aristida contorta</i>		+							+
<i>Aristida holathera</i> var. <i>holathera</i>		+			10.85		+		
<i>Eriachne aristidea</i>		0.50			0.90				+
<i>Eriachne pulchella</i> var. <i>pulchella</i>		+			+				
<i>Paspalidium</i> sp.		0.25							
<i>Triodia epactia</i>	35.95	4.10	3.00	15.00	7.45	14.80	16.00	11.85	19.45
<i>Triodia glabra</i>	14.75	3.40	5.00	15.00	+	+	12.45	23.95	26.55
<b>Solanaceae</b>									
<i>Solanum lasiophyllum</i>		2.00	0.55	1.25	0.95				
<b>Total no. of native species</b>	<b>5</b>	<b>9</b>	<b>5</b>	<b>3</b>	<b>22</b>	<b>7</b>	<b>6</b>	<b>4</b>	<b>9</b>
<b>Total no. of weed species</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

### Comments regarding site:

















Rehabilitation has remained as Excellent condition 2023; spinifex has regenerated to the levels prior to the fire that preceded the 2017 monitoring phase, and increased from 2022 levels, further supporting the expectation that it would continue to increase towards the pre-clearing levels over the course of the next few years; mature *Acacia* spp. present; spinifex and *Acacia* spp. appear to be at a level that is representative of the greater area; as expected with trees post-clearing, scattered *Corymbia hamersleyana* and *Eucalyptus xerothermica* are still absent within the clearing footprint; no weeds have been recorded within the sites and surrounding vegetation.

**Site 26 (Mt Minnie conservation area)**

Analogue Transect BHPPA-26		Rehabilitation Transect BHPPD-26	
			
2010 - 0 m	2010 - 20 m	2010 - 0 m	2010 - 20 m
			
2013 - 0 m	2013 - 20 m	2013 - 0 m	2013 - 20 m
			
2014 - 0 m	2014 - 20 m	2014 - 0 m	2014 - 20 m
			
2015 - 0 m	2015 - 20 m	2015 - 0 m	2015 - 20 m
			
2017 - 0 m (burnt)	2017 - 20 m (burnt)	2017 - 0 m (burnt)	2017 - 20 m (burnt)

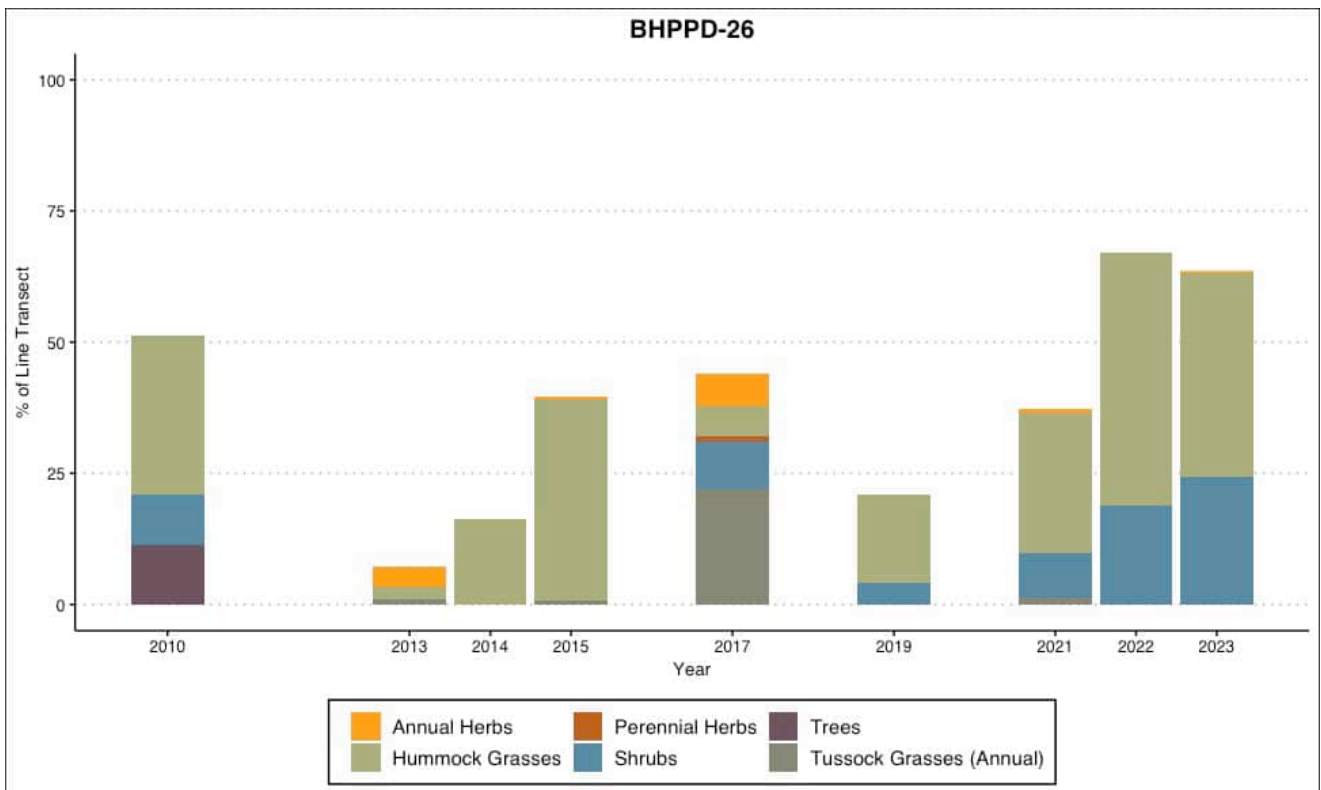
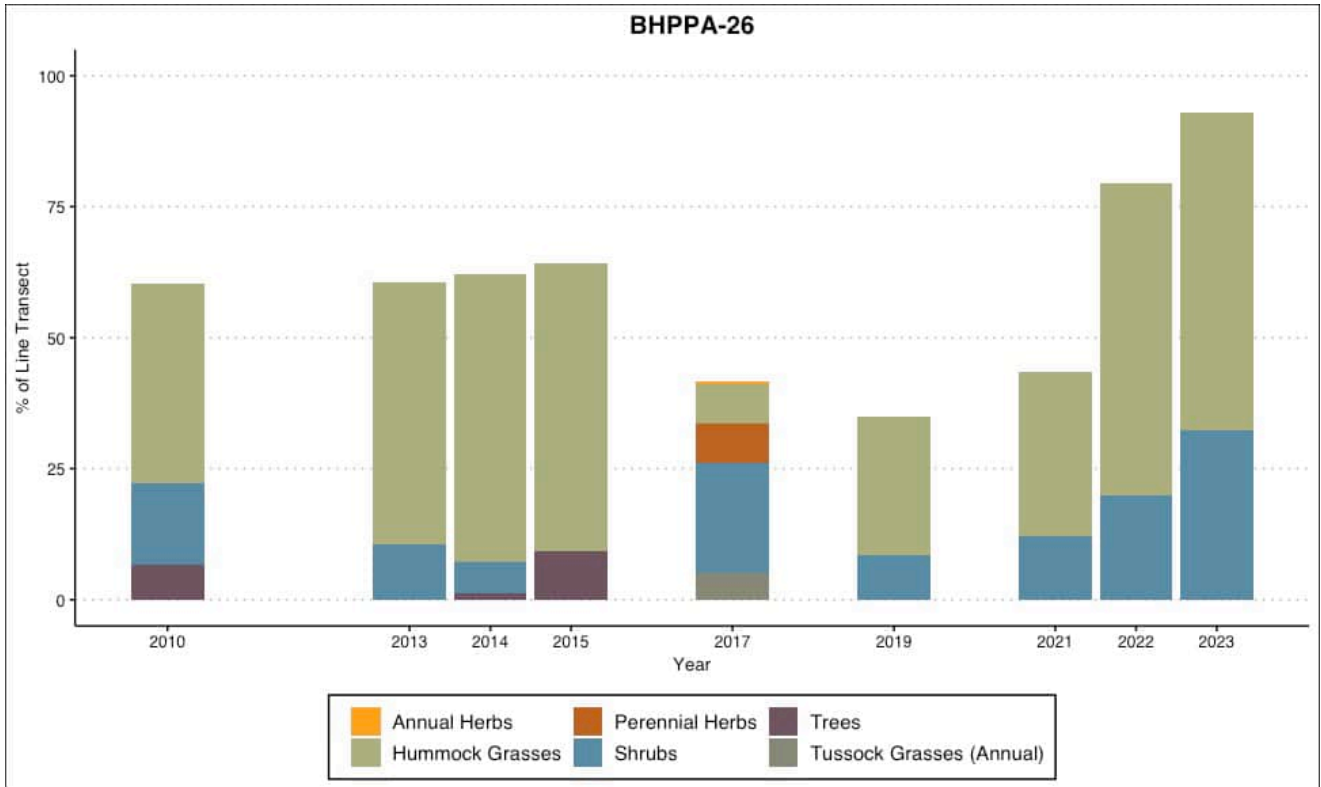


Site 26 (Mt Minnie conservation area)

Analogue Transect BHPPA-26		Rehabilitation Transect BHPPD-26	
			
2019 - 0 m	2019 - 20 m	2019 - 0 m	2019 - 20 m
			
2021 - 0 m	2021 - 20 m	2021 - 0 m	2021 - 20 m
			
2022 - 0 m	2022 - 20 m	2022 - 0 m	2022 - 20 m
			
2023 - 0 m	2023 - 20 m	2023 - 0 m	2023 - 20 m

Cover of each lifeform category along the line transect (NB: Both transects were burnt prior to the 2017 survey):

Transect	Year	Perennials					Annuals		Weeds (*Cenchrus)
		Hummock Grasses	Shrubs	Trees	Tussock Grasses	Perennial Herbs	Annual Grasses	Annual Herbs	
<b>Analogue BHPPA-26</b>	2010	37.85	15.60	6.75					
	2013	50.00	10.50						
	2014	55.00	5.95	1.25					
	2015	55.00		9.25					
	2017	7.50	20.85			7.70	5.15	0.50	
	2019	26.50	8.40						
	2021	31.35	12.05						
	2022	59.60	19.90						
	2023	60.70	32.35						
<b>Rehab BHPPD-26</b>	2010	30.30	9.65	11.25					
	2013	2.25					1.00	4.00	
	2014	16.15							
	2015	38.45					0.70	0.35	
	2017	5.80	9.05			1.00	21.90	6.20	
	2019	16.95	4.00						
	2021	26.60	8.60				1.25	0.90	
	2022	48.25	18.90						
	2023	38.95	24.30					0.20	



## Site 26 (Mt Minnie conservation area)

NB: Both the analogue and rehabilitation sites were burnt prior to the 2017 survey.












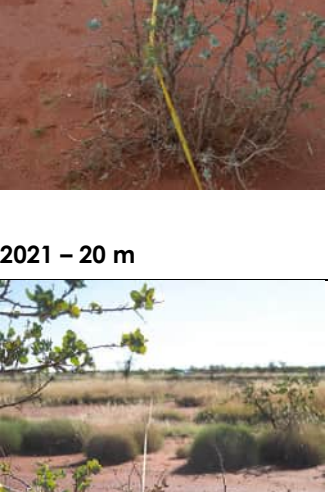








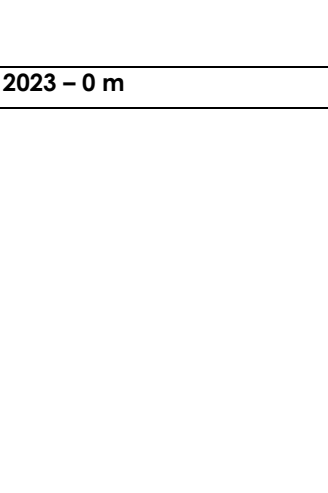
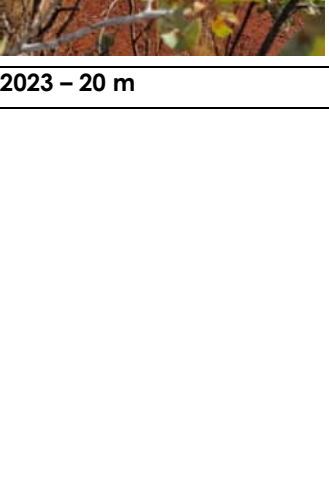
### Cover and presence of individual species:

Family / Species	BHPPA-26									BHPPD-26								
	2010	2013	2014	2015	2017	2019	2021	2022	2023	2010	2013	2014	2015	2017	2019	2021	2022	2023
<b>Amaranthaceae</b>																		
<i>Ptilotus axillaris</i>							+							+		+		
<i>Ptilotus fusiformis</i>					+						4.00	+	0.35	6.20		+		
<b>Chenopodiaceae</b>																		
<i>Dysphania</i> sp.					+									+		+		
<b>Convolvulaceae</b>																		
<i>Bonamia alatisemina</i>					7.70									1.00				
<i>Bonamia erecta</i>					+									+		+		+
<i>Bonamia pilbarensis</i>															0.50			
<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>													+					
<b>Cyperaceae</b>																		
<i>Bulbostylis barbata</i>					0.50		+					+		+		0.90	+	0.20
<b>Fabaceae</b>																		
<i>Acacia ancistrocarpa</i>	15.60	10.50	5.95		0.75	8.40	12.05	19.90	32.35	9.65	+	+	+	+	1.1	7.75	18.90	24.30
<i>Indigofera boviparda</i> subsp. <i>boviparda</i>					7.70		+	+						1.05		0.35		
<i>Indigofera colutea</i>																	+	+
<i>Isotropis atropurpurea</i>					7.95	+								8.00	+			
<i>Senna notabilis</i>					1.95									+				
<b>Malvaceae</b>																		
<i>Abutilon otocarpum</i>														+				
<i>Corchorus sidoides</i> subsp. <i>vermicularis</i>					2.50	+								+	+			
<i>Hannafordia quadrivalvis</i> subsp. <i>recurva</i>															2.90			
<i>Sida</i> sp. Pilbara (A.A. Mitchell PRP 1543)													+					
<i>Triumfetta ramosa</i>														+				
<b>Molluginaceae</b>																		
<i>Mollugo molluginea</i>					+									+				
<b>Myrtaceae</b>																		
<i>Corymbia hamersleyana</i>	6.75	+	1.25	9.25		+				11.25								
<b>Poaceae</b>																		
<i>Aristida contorta</i>							+							+				
<i>Aristida holathera</i> var. <i>holathera</i>					3.65	+							0.70	8.50	+	+		
<i>Aristida</i> sp.																1.25		
<i>Eragrostis eriopoda</i>											+	+						
<i>Eragrostis tenellula</i>					+									+				
<i>Eriachne aristidea</i>					1.50						+	+		13.40				+
<i>Eriachne pulchella</i> subsp. <i>pulchella</i>																+		
<i>Paspalidium</i> sp.											1.00	+						
<i>Sporobolus australasicus</i>																		+
<i>Triodia glabra</i>	37.85	50.00	55.00	55.00	7.50	26.50	31.35	59.60	60.70	30.30	2.25	16.15	38.45	5.80	16.95	26.60	48.25	38.95
<b>Total no. of native species</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>15</b>	<b>6</b>	<b>6</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>6</b>	<b>7</b>	<b>6</b>	<b>19</b>	<b>6</b>	<b>12</b>	<b>6</b>	<b>6</b>
<b>Total no. of weed species</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

### Comments regarding site:

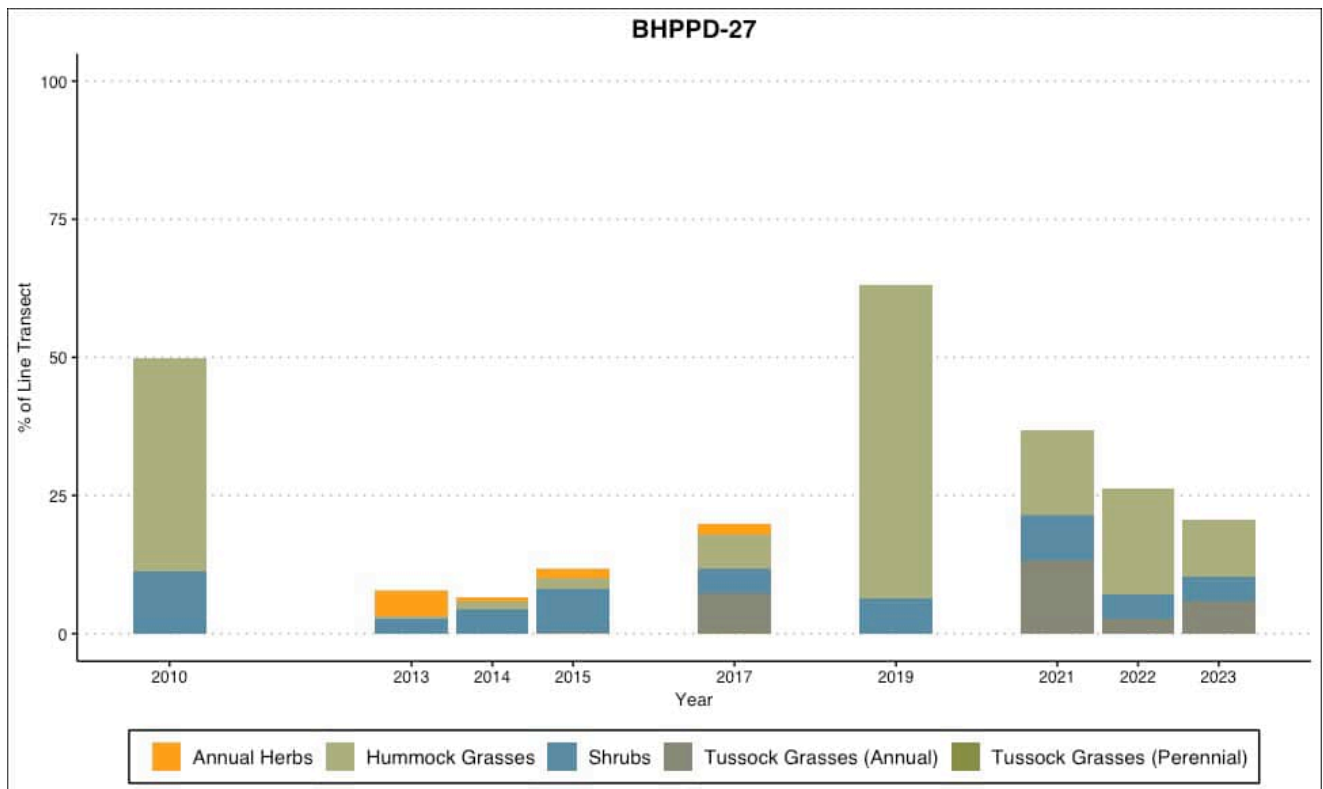
Rehabilitation has remained in excellent condition in 2023; spinifex and *Acacia* spp. cover continues to exceed pre-clearing levels with the continued absence of *Corymbia hamersleyana* (this can also be said for the Analogue site which is still recovering from the fire prior to 2017); annual grasses and herbs have largely disappeared since 2022; no weeds have been recorded within the sites or in the surrounding vegetation; the Rehabilitation and Analogue sites are very similar in terms of strata and percentage cover.

**Site 27 (Mt Minnie conservation area)**  
 (no analogue transect)

Rehabilitation Transect BHPPD-27			
			
			
			
			
			
			
		2023 - 0 m	2023 - 20 m

Cover of each lifeform category along the line transect:

Transect	Year	Perennials					Annuals		Weeds (*Cenchrus)
		Hummock Grasses	Shrubs	Trees	Tussock Grasses	Perennial Herbs	Annual Grasses	Annual Herbs	
Rehab BHPPD-27	2010	38.70	11.20						
	2013	0.50	2.75					4.50	
	2014	1.25	4.50					0.85	
	2015	2.00	7.80				0.25	1.75	
	2017	6.30	4.30		0.30		7.05	1.85	
	2019	10.00	6.40						
	2021	15.45	8.05				13.30		
	2022	19.20	4.40		2.75				
	2023	10.15	4.55		5.80				



## Site 27 (Mt Minnie conservation area)





















### Cover and presence of individual species:

Family / Species	BHPPD-27								
	2010	2013	2014	2015	2017	2019	2021	2022	2023
<b>Amaranthaceae</b>									
<i>Ptilotus astrolasius</i>							0.10		
<i>Ptilotus axillaris</i>		4.50	+	1.00	1.70			+	+
<i>Ptilotus exaltatus</i>							+	+	
<i>Ptilotus fusiformis</i>		+	0.85		+				
<i>Ptilotus polystachyus</i>							+	+	
<b>Boraginaceae</b>									
<i>Heliotropium inexplicitum</i>				0.75					
<b>Chenopodiaceae</b>									
<i>Dysphania rhadinostachya</i>			+						
<i>Dysphania sp.</i>					+				
<b>Cleomaceae</b>									
<i>Arivela uncifera</i>							+		
<b>Cyperaceae</b>									
<i>Bulbostylis barbata</i>			+		+		+		
<b>Euphorbiaceae</b>									
<i>Euphorbia australis</i>				+					
<i>Euphorbia vaccaria</i> var. <i>vaccaria</i>					+				
<b>Fabaceae</b>									
<i>Acacia ancistrocarpa</i>	2.05					+	0.55		
<i>Acacia inaequilatera</i>	9.15	2.75	4.50	6.80	2.60	6.40	7.40	4.40	4.55
<i>Acacia pyrifolia</i> var. <i>pyrifolia</i>									+
<i>Indigofera boviparda</i> subsp. <i>boviparda</i>			+	+	1.70		+		
<i>Senna notabilis</i>				1.00					
<b>Goodeniaceae</b>									
<i>Goodenia microptera</i>					+				
<b>Molluginaceae</b>									
<i>Mollugo molluginea</i>		+		+	+			+	
<b>Nyctaginaceae</b>									
<i>Boerhavia coccinea</i>					0.15				
<b>Poaceae</b>									
<i>Aristida contorta</i>			+		6.90		12.65	2.75	5.80
<i>Aristida holathera</i> var. <i>holathera</i>				0.25					
<i>Dichanthium sericeum</i> subsp. <i>humilius</i>							+		
<i>Eriachne aristidea</i>							+	+	
<i>Eriachne pulchella</i> var. <i>pulchella</i>		+	+		+		+	+	+
<i>Panicum sp.</i>					0.30				
<i>Paspalidium clementii</i>							0.65	+	
<i>Sporobolus australasicus</i>					0.15			+	
<i>Triodia glabra</i>	38.70	0.50	1.25	2.00	6.30	10.00	15.45	19.20	10.15
<i>Yakirra australiensis</i> var. <i>australiensis</i>		+		+					
<b>Portulacaceae</b>									
<i>Portulaca oleracea</i>							+		+
<i>Portulaca sp.</i>								+	
<b>Zygophyllaceae</b>									
<i>Tribulus hirsutus</i>							+		
<i>Tribulus macrocarpus</i>							+		
<b>Total no. of native species</b>	<b>3</b>	<b>7</b>	<b>9</b>	<b>10</b>	<b>15</b>	<b>3</b>	<b>17</b>	<b>12</b>	<b>7</b>
<b>Total no. of weed species</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

### Comments regarding site:

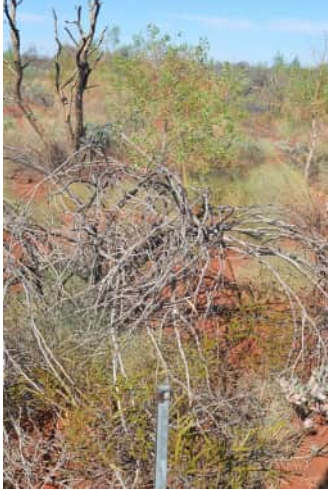









Rehabilitation has remained as good condition in 2023; spinifex cover has seen a decrease in 2023 to 10.15% which now represent only a quarter of pre-clearing levels. Overall there is positive indication that vegetation structure is tending towards its natural state, and would likely be evident in further phases of monitoring given appropriate rainfall; there has also been a decrease in annual grasses like *Aristida contorta* and *Paspalidium clementii*; no weeds were recorded within the sites or in the surrounding vegetation.

**Site 28 (Mt Minnie conservation area)**

Analogue Transect BHPPA-28		Rehabilitation Transect BHPPD-28	
			
2010 - 0 m	2010 - 20 m	2010 - 0 m	2010 - 20 m
			
2013 - 0 m	2013 - 20 m	2013 - 0 m	2013 - 20 m
			
2014 - 0 m	2014 - 20 m	2014 - 0 m	2014 - 20 m
			
2015 - 0 m (burnt)	2015 - 20 m (burnt)	2015 - 0 m	2015 - 20 m
			
2017 - 0 m	2017 - 20 m	2017 - 0 m	2017 - 20 m



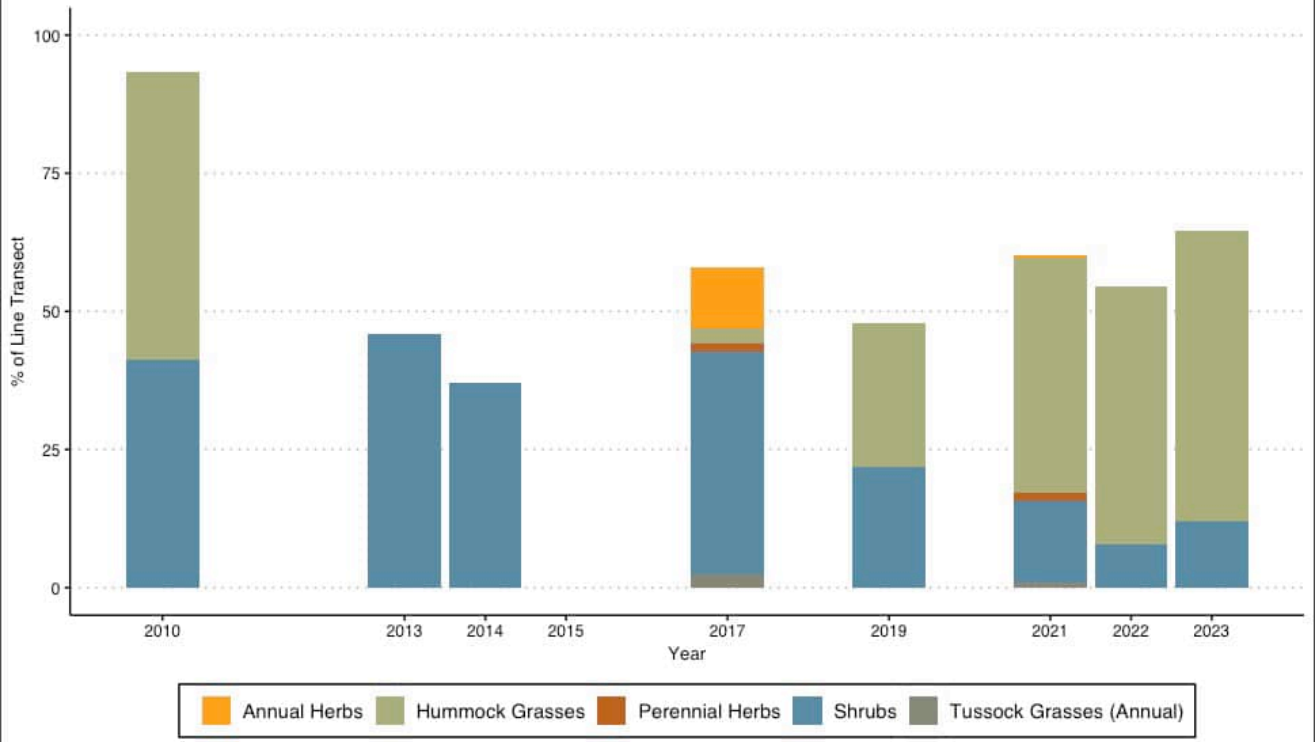
Site 28 (Mt Minnie conservation area)

Analogue Transect BHPPA-28		Rehabilitation Transect BHPPD-28	
 <p>2019 - 0 m</p>	 <p>2019 - 20 m</p>	 <p>2019 - 0 m</p>	 <p>2019 - 20 m</p>
 <p>2021 - 0 m</p>	 <p>2021 - 20 m</p>	 <p>2021 - 0 m</p>	 <p>2021 - 20 m</p>
 <p>2022 - 0 m</p>	 <p>2022 - 20 m</p>	 <p>2022 - 0 m</p>	 <p>2022 - 20 m</p>
 <p>2023 - 0 m</p>	 <p>2023 - 20 m</p>	 <p>2023 - 0 m</p>	 <p>2023 - 20 m</p>

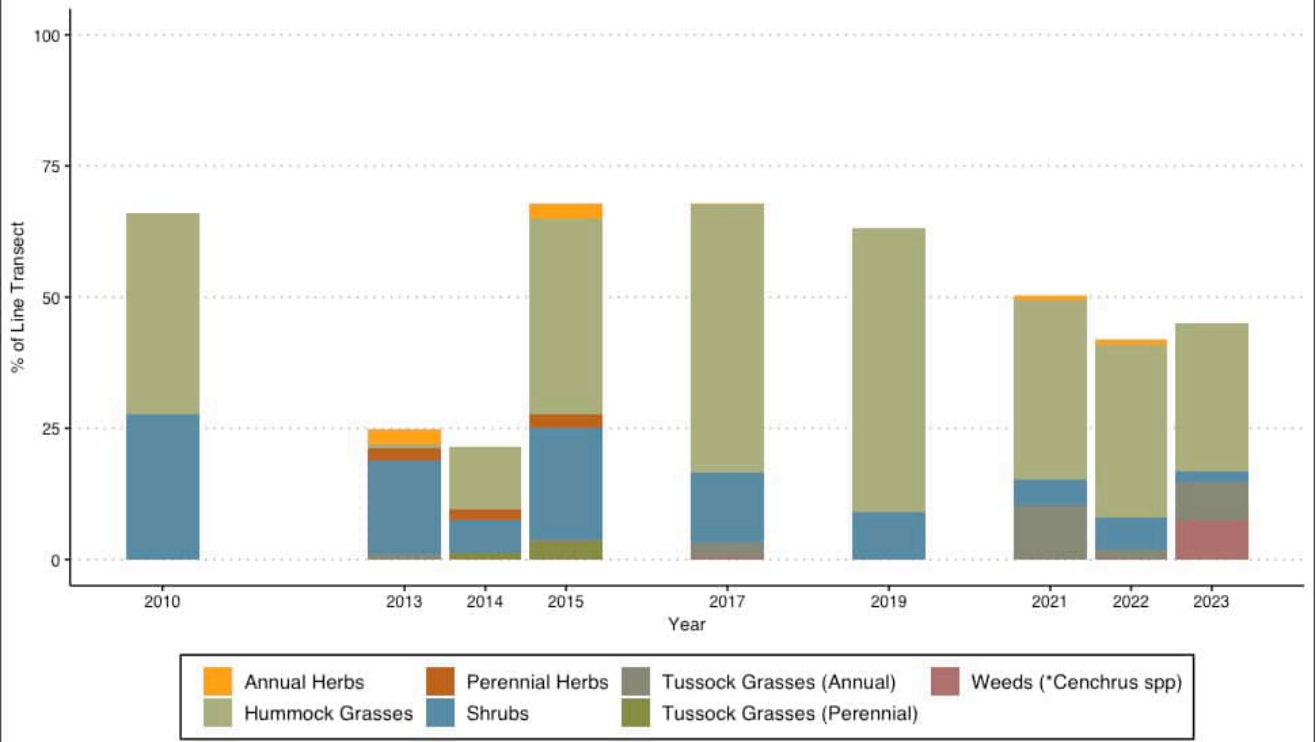
Cover of each lifeform category along the line transect (BHPPA-28 was burnt immediately prior to 2015 survey):

Transect	Year	Perennials				Annuals		Weeds (*Cenchrus)	
		Hummock Grasses	Shrubs	Trees	Tussock Grasses	Perennial Herbs	Annual Grasses		Annual Herbs
Analogue BHPPA-28	2010	52.10	41.30						
	2013	65.00	46.00						
	2014	65.00	37.00						
	2015	Burnt	Burnt						
	2017	2.70	40.25			1.45	2.45	11.20	
	2019	25.95	21.85						
	2021	42.35	14.75			1.50	1.00	0.65	
	2022	46.70	7.85						
	2023	52.40	12.10						
Rehab BHPPD-28	2010	38.35	27.70						
	2013	0.75	17.75			2.50	1.00	2.75	
	2014	11.90	6.40		1.15	1.95			
	2015	39.85	18.90		3.25	2.55	0.50	2.75	
	2017	51.20	13.30				2.75	0.15	0.40
	2019	52.35	9.05				1.75		
	2021	34.25	4.85				10.30	0.85	
	2022	33.10	6.10				1.55	0.75	0.20
	2023	28.35	1.95				7.30		7.50

BHPPA-28



BHPPD-28



**Site 28 (Mt Minnie conservation area)**

NB: Analogue transect BHPPA-28 was burnt immediately prior to the 2015 survey.

**Cover and presence of individual species:**

Family / Species	BHPPA-28									BHPPD-28								
	2010	2013	2014	2015	2017	2019	2021	2022	2023	2010	2013	2014	2015	2017	2019	2021	2022	2023
<b>Aizoaceae</b>																		
<i>Trianthema triquetrum</i>																0.10	+	
<b>Amaranthaceae</b>																		
<i>Gomphrena canescens</i>												+						+
<i>Gomphrena cunninghamii</i>																	0.10	+
<i>Ptilotus astrolasius</i>					+	3.80	2.55									0.15	3.70	
<i>Ptilotus axillaris</i>					+		+				1.50		2.75			0.75	0.10	
<i>Ptilotus exaltatus</i>																	+	
<i>Ptilotus nobilis</i>												+						
<i>Ptilotus polystachyus</i>								+								+	+	
<b>Asteraceae</b>																		
<i>Streptoglossa decurrens</i>					+		+						+					
<b>Caryophyllaceae</b>																		
<i>Polycarpha corymbosa</i> var. <i>corymbosa</i>												+				+		
<b>Chenopodiaceae</b>																		
<i>Dysphania kalpari</i>								0.30										
<i>Dysphania rhadinostachya</i>								+				+	+			+		
<i>Dysphania</i> sp.																	+	
<i>Salsola australis</i>					1.30				+	+		+	+			+	0.65	+
<b>Convolvulaceae</b>																		
<i>Bonamia alatisemina</i>					0.95							+						
<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>													0.75			+		
<i>Polymeria lanata</i>											+							
<b>Cucurbitaceae</b>																		
<i>Cucumis variabilis</i>												+						
<b>Cyperaceae</b>																		
<i>Bulbostylis barbata</i>			+				+	+						0.15		+		
<i>Cyperaceae</i> sp.											2.50							
<b>Euphorbiaceae</b>																		
<i>Euphorbia vaccaria</i> var. <i>vaccaria</i>					+		+											
<b>Fabaceae</b>																		
<i>Acacia ancistrocarpa</i>	24.55	31.25	37.00			6.35	+	0.10	+			+	3.75		+	+	0.40	1.95
<i>Acacia bivenosa</i>					0.30	+	+	+	1.75	20.75	+	+	2.50		+			
<i>Acacia inaequilatera</i>	16.75	14.75			+	+				6.95	+	+	0.75	0.15	1.60	+	0.50	+
<i>Acacia stellaticeps</i>								0.70										
<i>Acacia synchronicia</i>														11.60				
<i>Acacia trachycarpa</i>								1.65										
<i>Cullen leucanthum</i>					1.30													
<i>Cullen martinii</i>					3.75													
<i>Indigofera bovipерda</i> subsp. <i>bovipерda</i>					17.45	4.25					0.75	4.90	10.65	0.75	4.80			
<i>Senna notabilis</i>					0.90						15.25		+	+	1.95	0.90	0.25	+
<b>Goodeniaceae</b>																		
<i>Goodenia microptera</i>					4.00		0.35				1.25					+		
<b>Gyrostemonaceae</b>																		
<i>Codonocarpus cotinifolius</i>					6.75	7.45	9.85	7.75	10.35									
<b>Malvaceae</b>																		
<i>Abutilon fraseri</i> subsp. <i>fraseri</i>					3.45													
<i>Abutilon lepidum</i>							+				+	+	+	0.60	0.70	3.35	1.25	+
<i>Abutilon</i> sp. <i>Pilbara</i> (W.R.Barker 2025)																+		
<i>Corchorus laniflorus</i>													1.25					
<i>Corchorus sidoides</i>											+	+	+					
<i>Corchorus sidoides</i> subsp. <i>vermicularis</i>					+		+									+		
<i>Hannafordia quadrivalvis</i> subsp. <i>recurva</i>																0.45		
<i>Triumfetta ramosa</i>											1.75	1.50	+					
<b>Molluginaceae</b>																		
<i>Mollugo molluginea</i>					0.50		1.50				+	1.95	1.80			+		
<b>Nyctaginaceae</b>																		
<i>Boerhavia coccinea</i>					5.90													+
<b>Poaceae</b>																		
* <i>Cenchrus ciliaris</i>														0.40	+	+	0.20	7.50
<i>Aristida contorta</i>							+									2.40		+
<i>Aristida holathera</i> var. <i>holathera</i>					2.45									2.65	1.75			5.35
<i>Enneapogon caeruleus</i>																+	+	1.95
<i>Eragrostis eriopoda</i>												1.15	3.25					
<i>Eragrostis pergracilis</i>											+					2.10		





















Family / Species	BHPPA-28									BHPPD-28								
	2010	2013	2014	2015	2017	2019	2021	2022	2023	2010	2013	2014	2015	2017	2019	2021	2022	2023
<i>Eragrostis tenellula</i>																3.25	+	+
<i>Eriachne aristidea</i>							1.00				+	+	0.50			0.80		+
<i>Eriachne pulchella</i> subsp. <i>pulchella</i>																+		
<i>Iseilema dolichotrichum</i>														+				
<i>Iseilema vaginiflorum</i>											+				+	0.10		
<i>Panicum australiense</i> var. <i>australiense</i>																		+
<i>Paspalidium clementii</i>							+				1.00					1.75		
<i>Paspalidium rarum</i>																+		
<i>Sporobolus australasicus</i>												+		0.10		+	1.45	+
<i>Triodia epactia</i>																		4.00
<i>Triodia glabra</i>	52.10	65.00	65.00		2.70	25.95	42.35	46.70	52.40	38.35	0.75	11.90	39.85	51.20	52.35	34.25	33.10	24.35
Portulacaceae																		
<i>Portulaca oleracea</i>							+					+				+	+	
Solanaceae																		
<i>Solanum diversiflorum</i>					+													
Surianaceae																		
<i>Stylobasium spathulatum</i>														0.20				
Zygophyllaceae																		
<i>Tribulus hirsutus</i>																+		
<b>Total no. of native species</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>0</b>	<b>21</b>	<b>7</b>	<b>22</b>	<b>6</b>	<b>5</b>	<b>3</b>	<b>20</b>	<b>19</b>	<b>16</b>	<b>11</b>	<b>8</b>	<b>31</b>	<b>18</b>	<b>18</b>
<b>Total no. of weed species</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>

**Comments regarding site:**

Rehabilitation is again in very good condition in 2023; spinifex cover has again decreased since 2019 and is at approximately half that of pre-clearing levels in 2023; cover of *Acacia* spp. shrubs is still low compared to pre-clearing with mature *Acacia ancistrocarpa* and *A. bivenosa* reaching 200cm in height and *Senna artemisioides* subsp. *oligophylla* reaching 150cm in the surrounding non-cleared vegetation; less mature *Acacia*'s appear to be present over the clearing footprint; a sharp increase in the cover of *Cenchrus* was recorded 7.5% along the line-intercept and the cover in the surrounding rehabilitated area has increased somewhat.

Species diversity is slightly less in both the Rehabilitation and Analogue transects in 2023 which is most likely due to seasonal conditions. Spinifex cover has again increased in 2023 within the Analogue site to pre-clearing levels.

**Site 29 (Mt Minnie conservation area)**

Analogue Transect BHPPA-29		Rehabilitation Transect BHPPD-29	
			
2010 - 0 m	2010 - 20 m	2010 - 0 m	2010 - 20 m
			
2013 - 0 m	2013 - 20 m	2013 - 0 m	2013 - 20 m
			
2014 - 0 m	2014 - 20 m	2014 - 0 m	2014 - 20 m
			
2015 - 0 m	2015 - 20 m	2015 - 0 m	2015 - 20 m
			
2017 - 0 m	2017 - 20 m	2017 - 0 m	2017 - 20 m

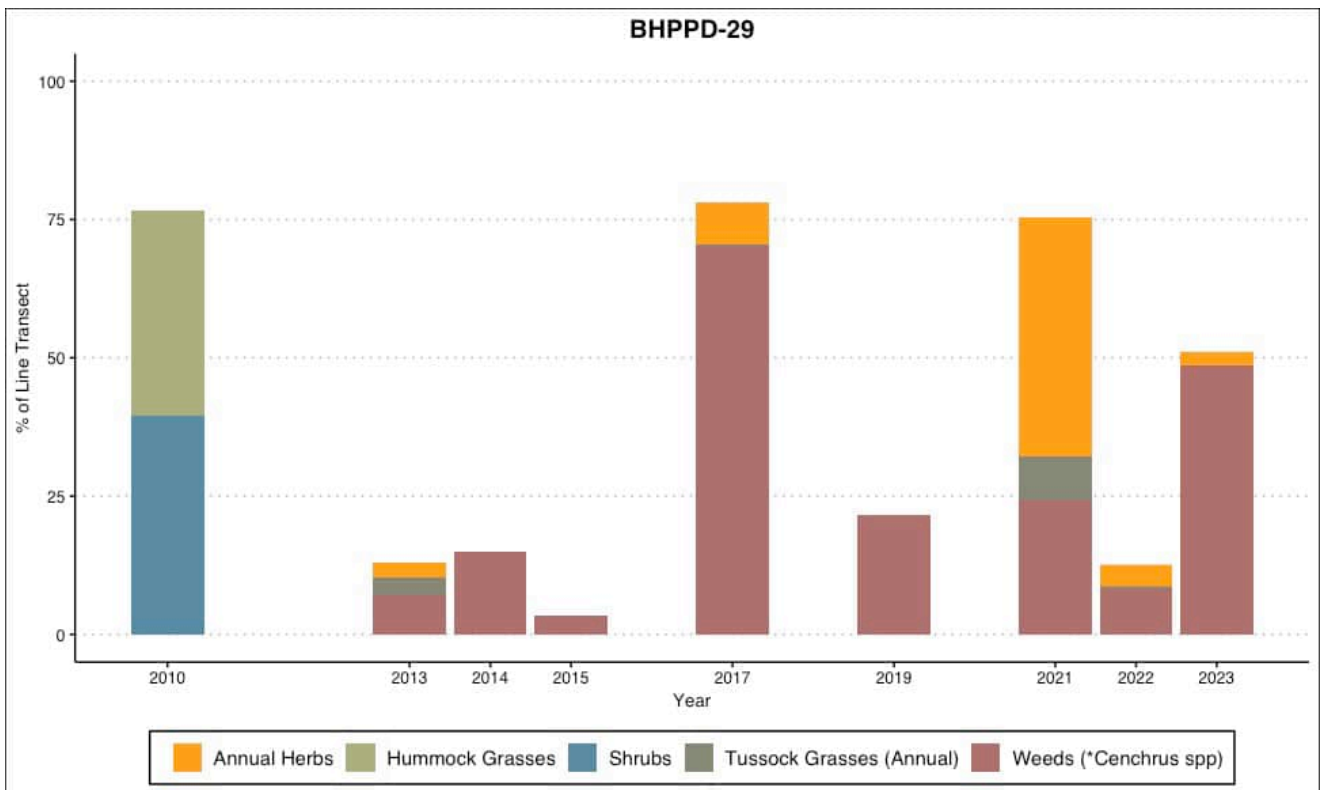
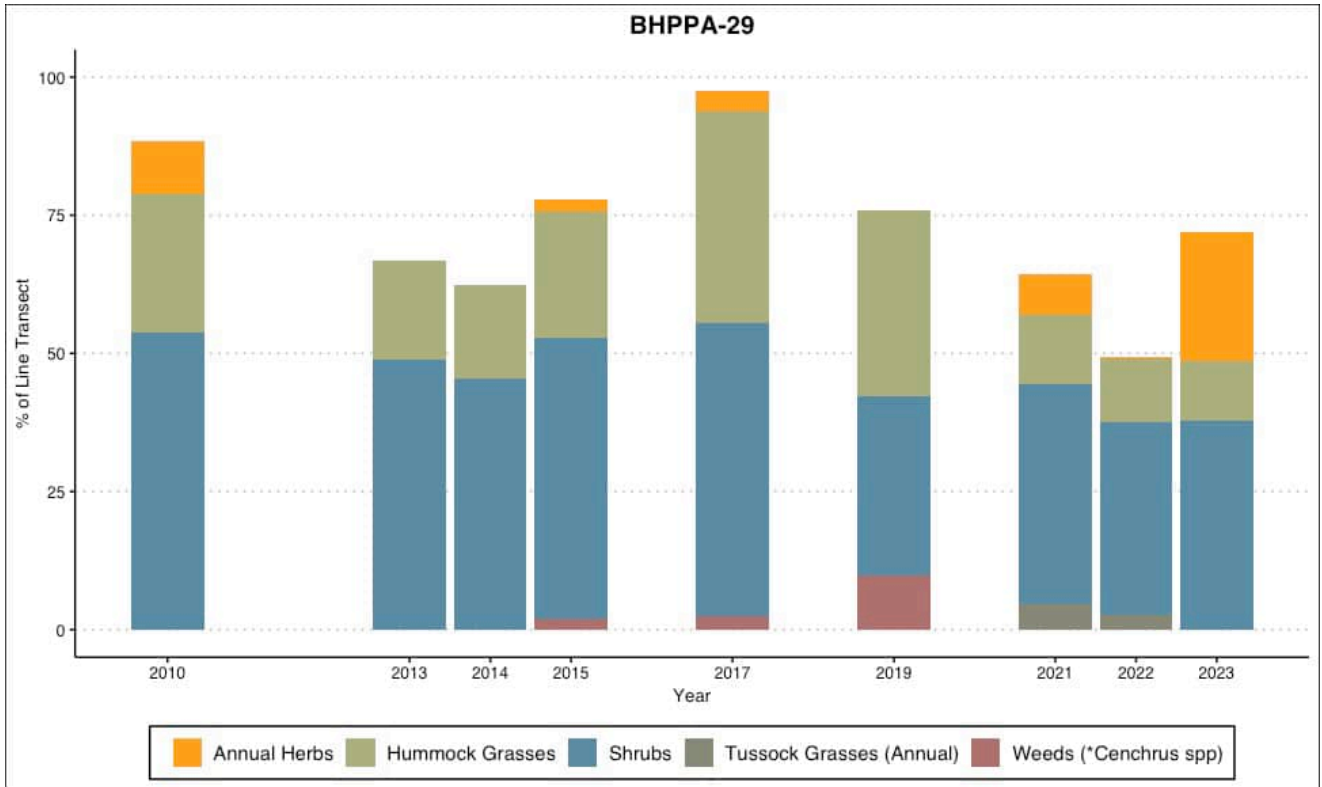
Site 29 (Mt Minnie conservation area)

Analogue Transect BHPPA-29		Rehabilitation Transect BHPPD-29	
 <p>2019 - 0 m</p>	 <p>2019 - 20 m</p>	 <p>2019 - 0 m</p>	 <p>2019 - 20 m</p>
 <p>2021 - 0 m</p>	 <p>2021 - 20 m</p>	 <p>2021 - 0 m</p>	 <p>2021 - 20 m</p>
 <p>2022 - 0 m</p>	 <p>2022 - 20 m</p>	 <p>2022 - 0 m</p>	 <p>2022 - 20 m</p>
 <p>2023 - 0 m</p>	 <p>2023 - 20 m</p>	 <p>2023 - 0 m</p>	 <p>2023 - 20 m</p>

Cover of each lifeform category along the line transect:

Transect	Year	Perennials					Annuals		Weeds (*Cenchrus)
		Hummock Grasses	Shrubs	Trees	Tussock Grasses	Perennial Herbs	Annual Grasses	Annual Herbs	
<b>Analogue BHPPA-29</b>	2010	25.15	53.70					9.60	
	2013	18.00	48.75						
	2014	16.75	45.50						
	2015	22.70	51.00					2.15	1.90
	2017	38.30	53.00					6.60	2.50
	2019	33.70	32.60						9.70
	2021	12.55	39.75				4.70	7.45	
	2022	11.65	34.90		2.40			0.25	
2023	10.80	37.70					23.35		
<b>Rehab BHPPD-29</b>	2010	37.10	39.50						
	2013						3.25	2.75	7.00
	2014								15.00
	2015								3.30
	2017						0.25	7.65	70.15
	2019								21.55
	2021						7.85	43.30	24.20
	2022						0.10	3.95	8.15
2023							2.50	48.50	





## Site 29 (Mt Minnie conservation area)

### Cover and presence of individual species:

Family / Species	BHPPA-29									BHPPD-29								
	2010	2013	2014	2015	2017	2019	2021	2022	2023	2010	2013	2014	2015	2017	2019	2021	2022	2023
<b>Aizoaceae</b>																		
<i>Trianthema triquetrum</i>		+	+				3.95	0.25				+		0.50		24.60	3.70	+
<b>Amaranthaceae</b>																		
<i>Amaranthus cuspidifolius</i>							0.25									+		
<i>Amaranthus ? interruptus</i>					+													
<i>Amaranthus sp.</i>								+										
<i>Amaranthus undulatus</i>		+		1.30							+	+						
<i>Gomphrena affinis</i> subsp. <i>pilbarensis</i>					+								6.15		+			
<i>Gomphrena canescens</i>		+		+							+	+				+	+	+
<i>Ptilotus astrolasius</i>																+		
<i>Ptilotus axillaris</i>																	0.15	
<i>Ptilotus exaltatus</i> (was <i>nobilis</i> )												+	+	0.30		+		
<b>Asteraceae</b>																		
<i>Streptoglossa decurrens</i>																+		
<b>Chenopodiaceae</b>																		
<i>Dysphania rhadinostachya</i>																+		
<i>Enchylaena tomentosa</i>																	+	+
<i>Maireana villosa</i>														+				
<i>Salsola australis</i>	9.60			0.85	6.50			+	23.35			+	+	+		+	+	2.50
<b>Fabaceae</b>																		
<i>Acacia ancistrocarpa</i>											+	+						
<i>Acacia synchronicia</i>										25.00								
<i>Acacia xiphophylla</i>	53.70	48.75	45.50	50.25	52.00	32.60	39.75	34.90	37.70	14.50								
<b>Malvaceae</b>																		
<i>Abutilon fraseri</i> subsp. <i>fraseri</i>					1.00	+		+	+									
<i>Abutilon lepidum</i>				0.75														
<i>Abutilon ?sp. Pilbara</i> (W.R.Barker 2025)							+											
<i>Corchorus laniflorus</i>																+		
<i>Hibiscus sturtii</i> var. <i>grandiflorus</i>																+		+
<i>Sida fibulifera</i>												+						
<b>Nyctaginaceae</b>																		
<i>Boerhavia coccinea</i>					+				+		1.50	+		0.50		+		
<b>Poaceae</b>																		
<i>Aristida contorta</i>							0.30		+									
<i>Aristida sp.</i>									+									
* <i>Cenchrus ciliaris</i>		+	+	1.90	2.50	9.70					7.00	15.00	3.30	70.15	21.55	24.20	8.15	48.50
* <i>Cenchrus setiger</i>																	+	
<i>Cynodon prostratus</i>		+	+		+		4.00	2.40	+									
<i>Dactyloctenium radulans</i>							+	0.15	+								0.30	+
<i>Enneapogon caeruleus</i>											+	+				+		
<i>Eragrostis tenellula</i>							+											
<i>Paspalidium clementii</i>							0.40									1.00		
<i>Sporobolus australasicus</i>		+			+						3.25	+		0.25		6.85	0.10	+
<i>Sporobolus actinocladius</i>																	+	
<i>Triodia epactia</i>			7.50	5.50	2.00	12.80												
<i>Triodia glabra</i>	25.15		1.75	9.10	+	+	4.75	11.65	3.20	37.10								
<i>Triodia wiseana</i>		18.00	7.50	8.10	36.30	20.90	7.80		7.60									
<b>Portulacaceae</b>																		
<i>Portulaca oleracea</i>		+	+		0.10		3.25				1.25			0.20		18.70		
<i>Portulaca sp. oleracea/intraterranea</i>								+									0.10	
<b>Zygophyllaceae</b>																		
<i>Tribulus astrocarpus</i>								+										
<b>Total no. of native species</b>	<b>3</b>	<b>8</b>	<b>7</b>	<b>8</b>	<b>12</b>	<b>5</b>	<b>13</b>	<b>10</b>	<b>9</b>	<b>3</b>	<b>7</b>	<b>10</b>	<b>2</b>	<b>8</b>	<b>0</b>	<b>14</b>	<b>9</b>	<b>8</b>
<b>Total no. of weed species</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>0</b>



### Comments regarding site:

Rehabilitation has gone from fair condition in 2022 to poor condition in 2023; no spinifex or *Acacia*'s have established along the transect (or in the surrounding cleared footprint heading north and south) following clearing; the cover of \**Cenchrus* has increased significantly in 2023 to 48.5%. However, following the application of herbicide in 2018, \**Cenchrus* cover was reduced from 70% to 21%, minimising competition and allowing for the establishment and increase (40%) in native annual grasses and herbs. Overall the Rehabilitation site does not represent pre-clearing vegetation cover levels.





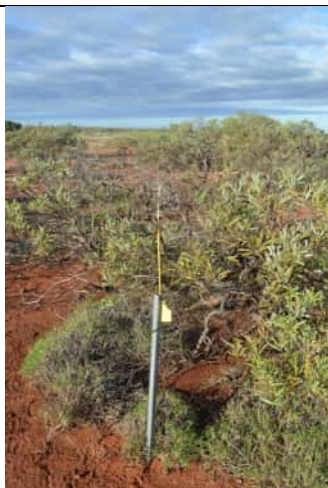









In 2017 the pipeline corridor either side of rehabilitation transect was dominated by mature \**Cenchrus* populations, with high cover of \**Cenchrus* tussocks to the southeast, and significant colonisation of bare areas by juvenile \**Cenchrus* to the northwest. These populations were targeted with herbicide in 2018 and appear to have died off in the 2019 monitoring phase but with discontinuation of herbicide treatment those large populations have again returned.

The Analogue site saw steady spinifex cover (composition of spinifex species different in 2023) and slight increase in perennial shrub cover; with no weeds recorded during the 2023 monitoring phase.

**Site 30 (Mt Minnie conservation area)**

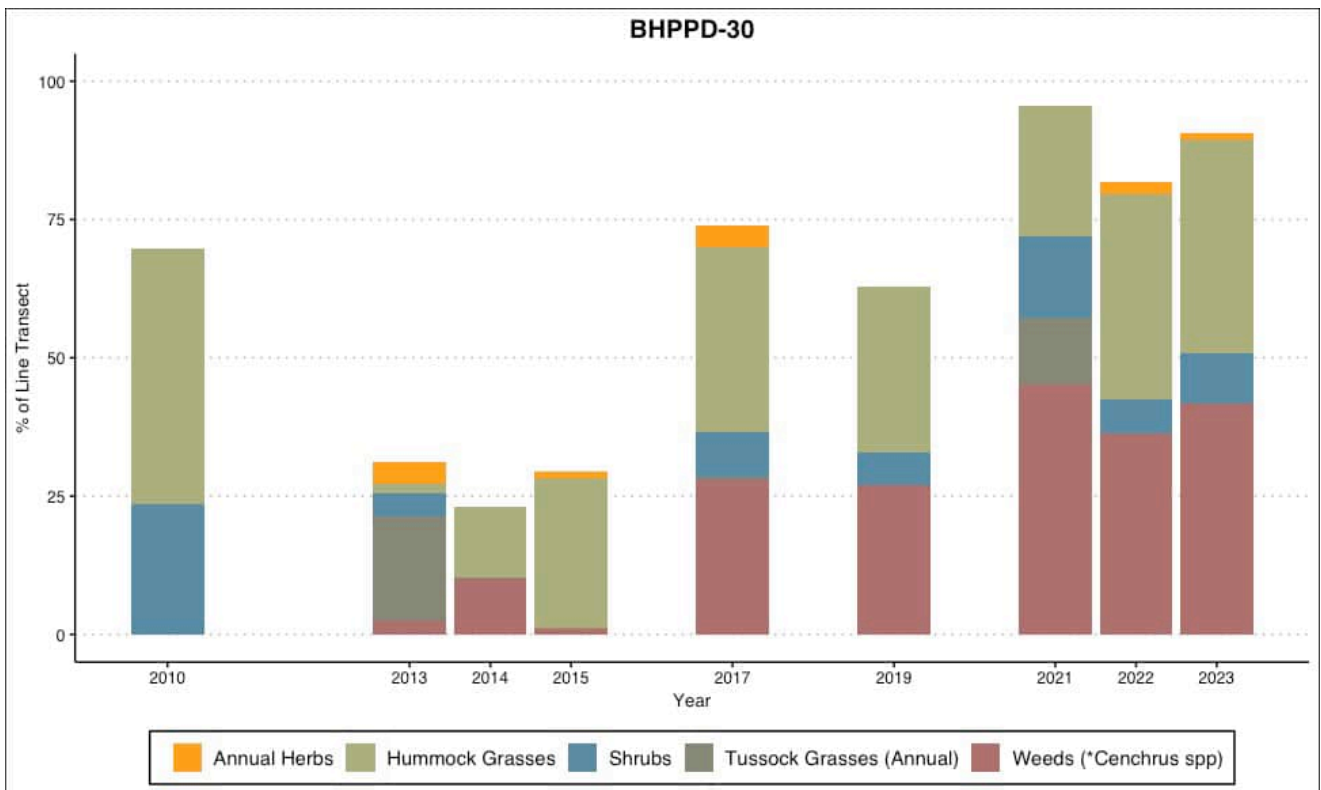
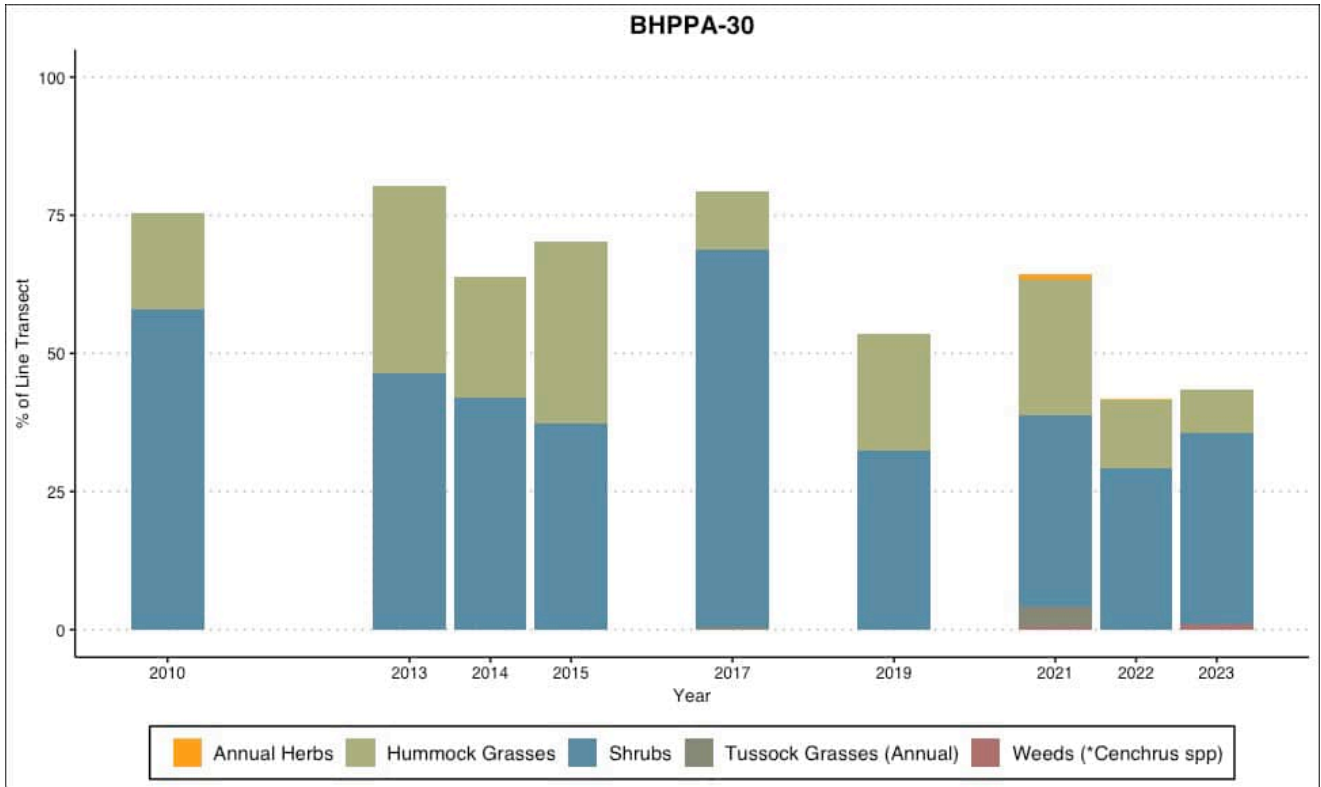
Analogue Transect BHPPA-30		Rehabilitation Transect BHPPD-30	
			
2010 - 0 m	2010 - 20 m	2010 - 0 m	2010 - 20 m
			
2013 - 0 m	2013 - 20 m	2013 - 0 m	2013 - 20 m
			
2014 - 0 m	2014 - 20 m	2014 - 0 m	2014 - 20 m
			
2015 - 0 m	2015 - 20 m	2015 - 0 m	2015 - 20 m
			
2017 - 0 m	2017 - 20 m	2017 - 0 m	2017 - 20 m

Site 30 (Mt Minnie conservation area)

Analogue Transect BHPPA-30		Rehabilitation Transect BHPPD-30	
 <p>2019 - 0 m</p>	 <p>2019 - 20 m</p>	 <p>2019 - 0 m</p>	 <p>2019 - 20 m</p>
 <p>2021 - 0 m</p>	 <p>2021 - 20 m</p>	 <p>2021 - 0 m</p>	 <p>2021 - 20 m</p>
 <p>2022 - 0 m</p>	 <p>2022 - 20 m</p>	 <p>2022 - 0 m</p>	 <p>2022 - 20 m</p>
		 <p>2023 - 0 m</p>	 <p>2023 - 20 m</p>

Cover of each lifeform category along the line transect:

Transect	Year	Perennials				Annuals		Weeds (*Cenchrus)	
		Hummock Grasses	Shrubs	Trees	Tussock Grasses	Perennial Herbs	Annual Grasses		Annual Herbs
<b>Analogue BHPPA-30</b>	2010	17.50	57.90						
	2013	33.85	46.50						
	2014	22.00	41.90						
	2015	32.95	37.40						
	2017	10.55	68.25				0.45		
	2019	21.05	32.50						
	2021	24.70	34.50				3.90	0.85	0.35
	2022	12.25	28.20			0.95		0.40	
2023	7.80	34.60						1.05	
<b>Rehab BHPPD-30</b>	2010	46.25	23.50						
	2013	1.75	4.25				18.75	3.95	2.50
	2014	12.70					0.35		10.00
	2015	27.10						1.20	1.05
	2017	33.35	8.20				0.50	3.80	27.95
	2019	29.95	5.95						27.00
	2021	35.55	14.65				12.20	3.70	45.05
	2022	37.05	6.10					2.30	36.30
2023	38.75	8.95					1.10	41.80	



## Site 30 (Mt Minnie conservation area)



















### Cover and presence of individual species:

Family / Species	BHPPA-30									BHPPD-30								
	2010	2013	2014	2015	2017	2019	2021	2022	2023	2010	2013	2014	2015	2017	2019	2021	2022	2023
<b>Aizoaceae</b>																		
<i>Trianthema triquetrum</i>							+									1.05		
<b>Amaranthaceae</b>																		
<i>Amaranthus cuspidifolius</i>							+									+		
<i>Gomphrena affinis subsp. pilbarensis</i>													0.45			+		
<i>Gomphrena canescens</i>												+					0.25	+
<i>Ptilotus astrolasius</i>											+	+					+	
<i>Ptilotus axillaris</i>								+								+		
<i>Ptilotus exaltatus (was nobilis)</i>					+		0.85	+								+	+	+
<b>Asteraceae</b>																		
<i>Pterocaulon sphaeranthoides</i>												+						
<i>Streptoglossa bubakii</i>											+	+				+		
<b>Brassicaceae</b>																		
<i>Lepidium phlebopetalum</i>																+		
<b>Chenopodiaceae</b>																		
<i>Dysphania rhadinostachya</i>							+											
<i>Maireana planifolia</i>			+	0.40	1.20	1.25	0.80	0.95	5.30									
<i>Salsola australis</i>					+		+	0.40	+		2.25	+	1.20	3.35		2.65	2.05	1.10
<b>Cyperaceae</b>																		
<i>Bulbostylis barbata</i>											0.20					+		
<b>Fabaceae</b>																		
<i>Acacia synchronicia</i>										23.50		+		6.15	2.35	4.55	1.50	+
<i>Acacia xiphophylla</i>	57.90	46.50	41.90	37.00	67.05	31.25	33.70	28.20	29.30									
<i>Senna notabilis</i>							+				4.25	+		+		1.45		+
<b>Goodeniaceae</b>																		
<i>Goodenia microptera</i>																+		
<b>Nyctaginaceae</b>																		
<i>Boerhavia coccinea</i>											1.50	+				+	+	
<b>Malvaceae</b>																		
<i>Corchorus laniflorus</i>								+										
<i>Corchorus sidoides var. vermicularis</i>							+									+		
<i>Sida sp. Spiciform panicles (E. Leyland s.n. 14/08/90)</i>									+									
<b>Poaceae</b>																		
* <i>Cenchrus ciliaris</i>						+	0.35	+	1.05		2.50	10.00	1.05	27.95	27.00	45.05	36.30	41.80
<i>Cynodon prostratus</i>											4.00	+				+		
<i>Dactyloctenium radulans</i>												+	0.50			3.05	+	
<i>Dichanthium sericeum</i>											1.75	0.35				+		
<i>Enneapogon caerulescens</i>								+										
<i>Eragrostis pergracilis</i>											1.00							
<i>Eragrostis tenellula</i>								+								+		
<i>Eriachne pulchella subsp. pulchella</i>							0.25		+									
<i>Iseilema dolichotrichum</i>							+											
<i>Iseilema vaginiflorum</i>											+					0.95		
<i>Paspalidium clementii</i>					0.45		3.65	+	+							2.35		
<i>Paspalidium sp.</i>											+							
<i>Sporobolus australasicus</i>											12.00					5.85	+	+
<i>Triodia epactia</i>													4.70		8.95	9.50	37.05	38.75
<i>Triodia glabra</i>	17.50	15.25						12.25	+	46.25							+	
<i>Triodia wiseana</i>		18.60	22.00	32.95	10.55	21.05	24.70		7.80		1.75	12.70	22.40	33.35	21.00	26.05		
<b>Portulacaceae</b>																		
<i>Portulaca oleracea</i>								+								+		
<i>Portulaca sp. oleraceae/intraterranea</i>									+									
<b>Solanaceae</b>																		
<i>Solanum horridum</i>												+			+	4.10	+	+
<i>Solanum lasiophyllum</i>													2.05		3.60	4.55	4.60	8.95
<b>Total no. of native species</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>6</b>	<b>4</b>	<b>17</b>	<b>7</b>	<b>8</b>	<b>2</b>	<b>13</b>	<b>13</b>	<b>3</b>	<b>7</b>	<b>6</b>	<b>25</b>	<b>13</b>	<b>9</b>
<b>Total no. of weed species</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>

### Comments regarding site:

The Rehabilitation has remained in a poor condition in 2023; spinifex has re-established on the transect and is continuing the trend towards pre-clearing levels, remaining at a steady 30-38% since 2019; perennial shrubs (*Acacia*'s and *Senna*) have decreased since the last phase and annual grasses are absent all together; the cover of \**Cenchrus* remains high despite a decrease of 9% in the last monitoring phase. The application of herbicide in 2018 is evident in some patches of \**Cenchrus*, but it appears to have had minimal impact upon the substantial populations, with the establishment of \**Cenchrus* still found within the Analogue site (recorded over the last three phases).

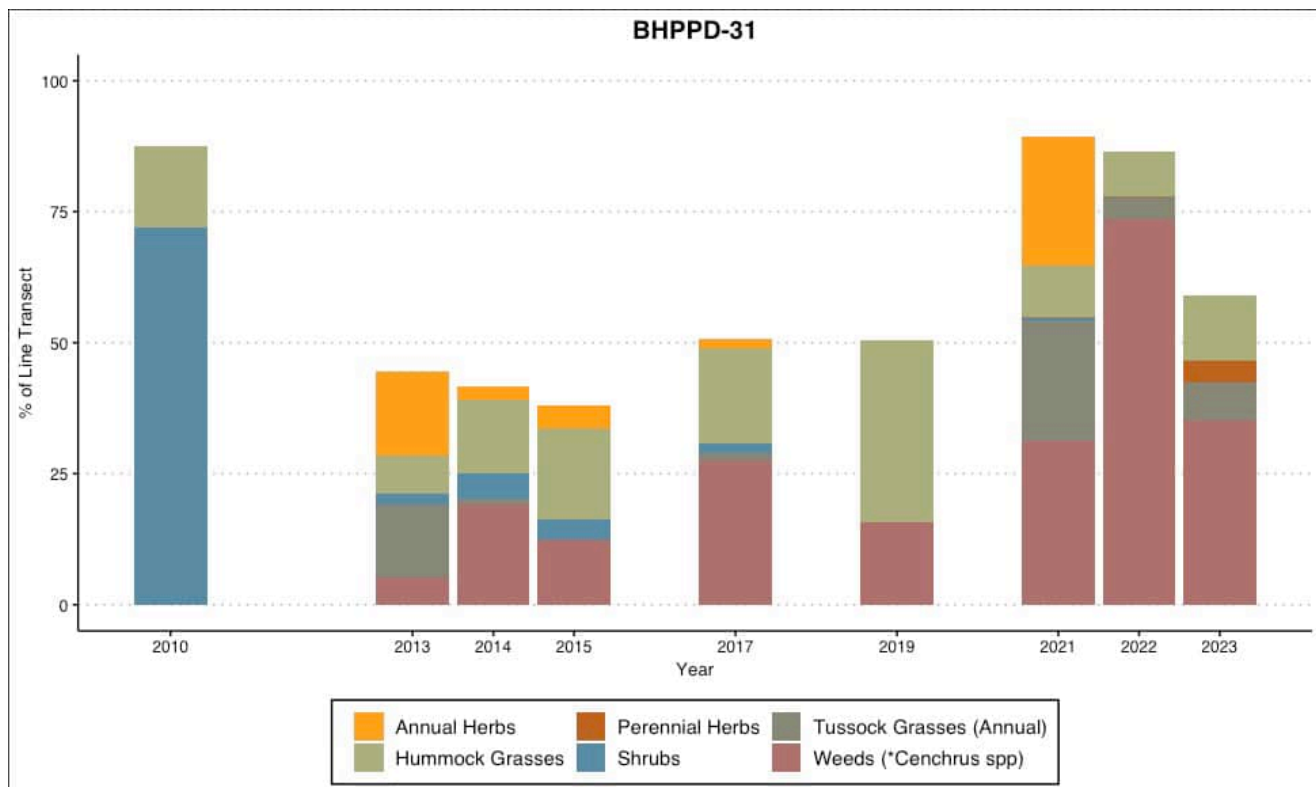
**Site 31 (Mt Minnie conservation area)**  
 (no analogue transect)

Rehabilitation Transect BHPPD-31			
 2010 - 0 m	 2010 - 20 m	 2019 - 0 m	 2019 - 20 m
 2013 - 0 m	 2013 - 20 m	 2019 - 0 m	 2019 - 20 m
 2014 - 0 m	 2014 - 20 m	 2021 - 0 m	 2021 - 20 m
 2015 - 0 m	 2015 - 20 m	 2022 - 0 m	 2022 - 20 m
 2017 - 0 m	 2017 - 20 m	 2023 - 0 m	 2023 - 20 m



Cover of each lifeform category along the line transect:

Transect	Year	Perennials				Annuals		Weeds (*Cenchrus)	
		Hummock Grasses	Shrubs	Trees	Tussock Grasses	Perennial Herbs	Annual Grasses		Annual Herbs
Rehab BHPPD-31	2010	34.05	72.05						
	2013	7.25	2.25				13.75	16.00	5.25
	2014	14.00	4.95				1.00	2.35	19.25
	2015	17.50	3.90					4.20	12.35
	2017	18.20	1.80				1.55	1.75	27.35
	2019	34.65							1.90
	2021	9.75	0.40			0.40	23.00	24.50	31.20
	2022	8.60					4.10		73.65
	2023	12.50				4.10	7.25		35.15



## Site 31 (Mt Minnie conservation area)

### Cover and presence of individual species:

Family / Species	BHPPD-31								
	2010	2013	2014	2015	2017	2019	2021	2022	2023
<b>Aizoaceae</b>									
<i>Trianthema triquetrum</i>		15.00					23.15	+	
<b>Amaranthaceae</b>									
<i>Gomphrena affinis</i> subsp. <i>pilbarensis</i>									+
<i>Ptilotus axillaris</i>								+	
<i>Ptilotus exaltatus</i>							0.75		
<b>Asteraceae</b>									
<i>Pluchea dentex</i>									+
<i>Pterocaulon sphacelatum</i>									2.15
<i>Stemodia grossa</i>									1.95
<i>Streptoglossa decurrens</i>							+		+
<b>Chenopodiaceae</b>									
<i>Cleome viscosa</i>								+	
<b>Cleomaceae</b>									
<i>Dysphania rhadinostachya</i>							+		
<i>Dysphania</i> sp.		+							
<i>Maireana</i> sp.		2.25	2.50						+
<i>Salsola australis</i>		+	2.35	4.20	1.75			+	+
<b>Cyperaceae</b>									
<i>Bulbostylis barbata</i>							0.35		
<b>Euphorbiaceae</b>									
<i>Euphorbia boophthona</i>							+		
<b>Fabaceae</b>									
<i>Acacia bivenosa</i>		+	0.25	2.50	1.80	+		+	+
<i>Acacia synchronicia</i>							+	+	+
<i>Acacia xiphophylla</i>	68.15								
<i>Crotalaria medicaginea</i> var. <i>neglecta</i>							+		
<i>Rhynchosia minima</i>							+	+	+
<i>Senna artemisioides</i> subsp. <i>oligophylla</i> 'thinly sericeous'	3.90								
<i>Senna notabilis</i>							0.30		
<b>Malvaceae</b>									
<i>Hibiscus sturtii</i>			+	0.15					
<i>Iseilema eremaeum</i>								+	
<i>Sida echinocarpa</i>							0.10		
<i>Sida fibulifera</i>			2.20	1.25	+			+	+
<i>Sida</i> sp.		+							
<b>Plantaginaceae</b>									
<i>Stemodia grossa</i>		+	+					+	
<b>Poaceae</b>									
* <i>Cenchrus ciliaris</i>		5.25	7.55	4.75	13.15	1.00	31.20	+	33.80
* <i>Cenchrus setiger</i>			11.70	7.60	14.20	0.90	+	73.65	1.35
<i>Dactyloctenium radulans</i>		1.00	1.00		1.55		6.95	+	7.25
<i>Eragrostis cumingii</i>					+				
<i>Eragrostis dielsii</i>		0.75							
<i>Eragrostis tenellula</i>							+		
<i>Iseilema dolichotrichum</i>							+	3.45	+
<i>Iseilema vaginiflorum</i>								0.35	
<i>Sporobolus australasicus</i>		12.00	+	+			16.05	0.30	+
<i>Triodia epactia</i>			8.50	12.50	17.20	16.10	+		12.50
<i>Triodia glabra</i>	28.10	7.25	5.50	5.00	1.00	18.55	9.75	8.60	+
<i>Triodia</i> ? <i>schinzii</i>	5.95								
<b>Portulacaceae</b>									
<i>Portulaca oleracea</i>		1.00	+		+		0.25		+
<b>Solanaceae</b>									
<i>Solanum diversiflorum</i>							+		
<b>Total no. of native species</b>	<b>4</b>	<b>12</b>	<b>11</b>	<b>7</b>	<b>8</b>	<b>3</b>	<b>19</b>	<b>17</b>	<b>17</b>
<b>Total no. of weed species</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>

### Comments regarding site:

The Rehabilitation increased to a poor condition in 2023; spinifex cover increased slightly in 2023 but is still 22% less than pre-clearing levels; the cover of *Acacia* species is non-existent with the *Acacias* in the greater area (not cleared) in healthy condition and flowering; there was a large decrease in annual grasses and herbs, but this is due to seasonal conditions; \**Cenchrus* cover decreased significantly by approximately one third.



## Appendix 3

### Vascular Flora Species List (2010 -2023)



**N.B.** The relatively low number of species recorded in 2019, 2021, 2022, and 2023 is due to the fact that only the section of sales gas pipeline situated within the Mt Minnie conservation area was surveyed during this phase (17 transects in total, compared to 56 in previous phases).

Family	Species	Astron				Biota				
		2010	2013	2014	2015	2017	2019	2021	2022	2023
<b>Aizoaceae</b>	<i>Trianthema pilosum</i>		+	+	+					
	<i>Trianthema triquetrum</i>		+	+		+		+	+	+
	<i>Trianthema turgidifolium</i>	+	+	+	+	+				
<b>Amaranthaceae</b>	<i>Amaranthus cuspidifolius</i>							+		
	<i>Amaranthus ? interruptus</i>					+				
	<i>Amaranthus undulatus</i>		+	+	+					
	<i>Gomphrena affinis</i> subsp. <i>pilbarensis</i>					+		+		+
	<i>Gomphrena canescens</i>		+	+	+				+	+
	<i>Gomphrena cunninghamii</i>								+	+
	<i>Ptilotus appendiculatus</i>				+					
	<i>Ptilotus arthrolasius</i>					+				
	<i>Ptilotus astrolasius</i>		+	+		+	+	+	+	
	<i>Ptilotus axillaris</i>		+	+	+	+		+	+	+
	<i>Ptilotus exaltatus</i> (formerly <i>Ptilotus nobilis</i> subsp. <i>nobilis</i> )		+	+	+	+		+	+	+
	<i>Ptilotus fusiformis</i>		+	+	+	+		+		
	<i>Ptilotus gomphrenoides</i>		+							
	<i>Ptilotus latifolius</i>		+	+	+					
	<i>Ptilotus murrayi</i>			+						
	<i>Ptilotus polystachyus</i>		+	+	+			+	+	
	<i>Ptilotus villosiflorus</i>				+					
<i>Ptilotus xerophilus</i>			+	+						
<b>Araliaceae</b>	<i>Trachymene pilbarensis</i>			+						
<b>Asteraceae</b>	<i>Calotis porphyroglossa</i>				+					
	<i>Pluchea dentex</i>								+	+
	<i>Pluchea dunlopii</i>				+					
	<i>Pluchea rubelliflora</i>				+					

Family	Species	Astron				Biota				
		2010	2013	2014	2015	2017	2019	2021	2022	2023
<b>Asteraceae (cont.)</b>	<i>Pterocaulon sphaeranthoides</i>			+						
	<i>Streptoglossa bubakii</i>		+	+	+	+		+		
	<i>Streptoglossa decurrens</i>			+	+	+		+		+
	<i>Streptoglossa odora</i>				+					
<b>Boraginaceae</b>	<i>Heliotropium crispatum</i>		+	+	+	+		+		
	<i>Heliotropium curassavicum</i>				+					
	<i>Heliotropium glanduliferum</i>		+	+	+					
	<i>Heliotropium inexplicitum</i>				+	+				
	<i>Trichodesma zeylanicum</i>			+	+					
	<i>Trichodesma zeylanicum</i> var. <i>grandiflorum</i>					+				
<b>Brassicaceae</b>	<i>Lepidium phlebopetalum</i>							+		
<b>Caryophyllaceae</b>	<i>Polycarpha corymbosa</i> var. <i>corymbosa</i>			+		+		+		
<b>Chenopodiaceae</b>	<i>Atriplex codonocarpa</i>				+					
	<i>Atriplex semilunaris</i>					+				
	<i>Atriplex</i> sp. (inadequate material)			+						
	<i>Dysphania kalpari</i>			+				+		
	<i>Dysphania rhadinostachya</i>		+	+				+		
	<i>Dysphania</i> sp. (inadequate material)		+			+		+	+	
	<i>Enchylaena tomentosa</i>								+	+
	<i>Maireana planifolia</i>			+	+	+	+	+		+
	<i>Maireana villosa</i>					+				
	<i>Maireana</i> sp. (inadequate material)		+	+						+
	<i>Neobassia astrocarpa</i>			+	+					
	<i>Salsola australis</i>	+	+	+	+	+		+	+	+
	<i>Sclerolaena burbidgeae</i>				+					
	<i>Sclerolaena costata</i>				+					
	<i>Sclerolaena recurvicuspis</i>					+				
<i>Tecticornia auriculata</i>				+						

Family	Species	Astron				Biota				
		2010	2013	2014	2015	2017	2019	2021	2022	2023
<b>Chenopodiaceae</b> (cont.)	<i>Tecticornia halocnemoides</i> (subsp. not determined)	+	+	+						
	<i>Tecticornia halocnemoides</i> subsp. <i>tenuis</i>				+					
	<i>Tecticornia indica</i>	+	+	+	+					
<b>Cleomaceae</b>	<i>Arivela uncifera</i>				+			+		
	<i>Arivela viscosa</i>							+	+	
<b>Convolvulaceae</b>	<i>Bonamia alatisemina</i>			+	+	+			+	+
	<i>Bonamia erecta</i>		+	+	+	+		+	+	+
	<i>Bonamia pilbarensis</i>							+		
	<i>Cressa australis</i>			+	+					
	<i>Evolvulus alsinoides</i> (sterile; var. not determined)				+			+		
	<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>		+	+	+	+		+	+	+
	<i>Ipomoea coptica</i>				+	+				
	<i>Ipomoea muelleri</i>		+	+	+	+				
	<i>Ipomoea polymorpha</i>				+	+				
	<i>Ipomoea</i> sp. (inadequate material)			+						
	<i>Operculina aequisepala</i>				+					
	<i>Polymeria ambigua</i>		+	+						
	<i>Polymeria lanata</i>		+							
<b>Cucurbitaceae</b>	<i>Cucumis variabilis</i>		+							
<b>Cyperaceae</b>	<i>Bulbostylis barbata</i>		+	+	+	+		+	+	+
	<i>Cyperus bulbosus</i>			+	+					
	Cyperaceae sp. (inadequate material)		+							
<b>Euphorbiaceae</b>	<i>Adriana tomentosa</i> var. <i>tomentosa</i>	+	+	+	+					
	<i>Euphorbia australis</i> (var. not determined)				+					
	<i>Euphorbia boophthona</i>			+				+	+	+
	<i>Euphorbia coghlanii</i>		+	+						
	<i>Euphorbia myrtoides</i>			+	+	+				
	<i>Euphorbia tannensis</i> subsp. <i>eremophila</i>			+				+		

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		2010	2013	2014	2015	2017	2019	2021	2022	2023
Euphorbiaceae	<i>Euphorbia vaccaria</i> var. <i>vaccaria</i>					+		+		
	<i>Euphorbia</i> sp. (inadequate material)		+	+						
Fabaceae	<i>Acacia ancistrocarpa</i>	+	+	+	+	+	+	+	+	+
	<i>Acacia bivenosa</i>	+	+	+	+	+	+	+	+	+
	<i>Acacia coriacea</i>	+	+	+	+					
	<i>Acacia gregorii</i>	+								
	<i>Acacia inaequilatera</i>	+	+	+	+	+	+	+	+	+
	<i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i>				+					
	<i>Acacia stellaticeps</i>	+	+	+	+	+	+	+	+	+
	<i>Acacia synchronicia</i>	+	+	+	+	+	+	+		+
	<i>Acacia tetragonophylla</i>	+	+	+	+			+		
	<i>Acacia trachycarpa</i>	+						+		
	<i>Acacia xiphophylla</i>	+	+	+	+	+	+	+	+	+
	<i>Aenictophyton reconditum</i>		+	+						
	<i>Crotalaria cunninghamii</i> subsp. <i>sturtii</i>		+	+	+	+				
	<i>Crotalaria medicaginea</i> var. <i>neglecta</i>		+	+	+	+		+		
	<i>Crotalaria ramosissima</i>			+	+	+				
	<i>Cullen cinereum</i>		+	+	+					
	<i>Cullen leucanthum</i>		+		+	+				
	<i>Cullen martinii</i>		+	+	+	+		+		
	<i>Desmodium filiforme</i>			+		+		+		
	<i>Indigofera boviparda</i> subsp. <i>boviparda</i>		+	+	+	+	+	+	+	+
	<i>Indigofera colutea</i>		+	+	+	+		+	+	+
	<i>Indigofera linifolia</i>		+	+	+	+		+		
	<i>Indigofera linnaei</i>				+					
<i>Indigofera</i> sp. (inadequate material)				+						
<i>Isotropis atropurpurea</i>			+	+	+	+				
<i>Rhynchosia minima</i>									+	



Family	Species	Astron				Biota				
		2010	2013	2014	2015	2017	2019	2021	2022	2023
<b>Fabaceae (cont.)</b>	<i>Lotus cruentus</i>			+						
	<i>Petalostylis cassioides</i>		+	+	+	+			+	
	* <i>Prosopis</i> sp. (inadequate material)				+	+				
	<i>Rhynchosia minima</i>		+	+	+			+	+	
	<i>Senna artemisioides</i> subsp. <i>oligophylla</i> '(thinly sericeous form)'	+								
	<i>Senna notabilis</i>		+	+	+	+	+	+	+	+
	<i>Sesbania cannabina</i>				+	+				
	<i>Swainsona kingii</i>			+	+			+		
	<i>Swainsona pterostylis</i>		+	+	+					
	<i>Tephrosia clementii</i>							+		
	<i>Tephrosia uniovulata</i>		+	+		+	+	+		
	<i>Tephrosia</i> sp. B Kimberley Flora (C.A. Gardner 7300)		+	+	+	+		+	+	+
	<i>Tephrosia</i> sp. (inadequate material)				+					
	* <i>Vachellia farnesiana</i>	+	+	+	+	+				
<b>Frankeniaceae</b>	<i>Frankenia pauciflora</i>	+	+	+	+					
<b>Gentianaceae</b>	<i>Schenkia clementii</i>				+					
<b>Geraniaceae</b>	<i>Erodium cygnorum</i>			+						
<b>Goodeniaceae</b>	<i>Goodenia forrestii</i>		+	+	+	+				
	<i>Goodenia microptera</i>		+	+	+	+		+		+
	<i>Goodenia tenuiloba</i>		+	+	+					
	<i>Scaevola parvifolia</i>			+	+	+				
	<i>Scaevola sericophylla</i>	+	+	+	+	+				
	<i>Scaevola spinescens</i>		+	+	+	+	+	+	+	+
<b>Gyrostemonaceae</b>	<i>Codonocarpus cotinifolius</i>					+	+	+		+
<b>Haloragaceae</b>	<i>Haloragis gossei</i>		+	+						
<b>Lamiaceae</b>	<i>Dicrastylis cordifolia</i>	+	+	+	+	+	+			
	<i>Quoya loxocarpa</i>					+				
	<i>Quoya paniculata</i>	+	+	+	+					

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		2010	2013	2014	2015	2017	2019	2021	2022	2023
Lauraceae	<i>Cassytha capillaris</i>	+			+	+	+	+	+	+
	<i>Cassytha</i> sp. (inadequate material)	+	+	+	+					
Malvaceae	<i>Abutilon fraseri</i> subsp. <i>fraseri</i>					+	+			+
	<i>Abutilon lepidum</i>		+	+	+	+	+	+	+	+
	<i>Abutilon otocarpum</i>		+			+			+	+
	<i>Abutilon</i> sp. Pilbara (W.R.Barker 2025)							+		
	<i>Abutilon</i> sp. Onslow (F. Smith s.n. 10/9/61) – <b>Priority 1</b>							+		+
	<i>Abutilon</i> sp. (inadequate material)		+	+	+					
	<i>Alyogyne pinoniana</i> var. <i>pinoniana</i>	+			+	+				
	<i>Corchorus laniflorus</i>				+			+		
	<i>Corchorus sidoides</i> (inadequate material)		+	+	+					
	<i>Corchorus sidoides</i> subsp. <i>sidoides</i>							+		+
	<i>Corchorus sidoides</i> subsp. <i>vermicularis</i>					+	+	+		
	<i>Hannafordia quadrivalvis</i> subsp. <i>recurva</i>			+	+		+	+		
	<i>Hibiscus brachychlaenus</i>				+	+				
	<i>Hibiscus sturtii</i> (inadequate material)		+	+	+					
	<i>Hibiscus sturtii</i> var. <i>campylochlamys</i>					+				
	<i>Hibiscus sturtii</i> var. <i>grandiflorus</i>							+		+
	<i>Hibiscus sturtii</i> var. <i>platychlamys</i>			+	+					+
	<i>Hibiscus</i> sp. (inadequate material)		+	+						
	<i>Lawrenzia viridigrisea</i>			+	+					
	<i>Melhania oblongifolia</i>			+		+				
	<i>Sida arsiniata</i>				+			+		+
<i>Sida cardiophylla</i>			+	+			+			
<i>Sida fibulifera</i>		+	+	+	+		+	+	+	
<i>Sida</i> ? <i>intricata</i>		+								
<i>Sida rohlenae</i> subsp. <i>rohlenae</i>		+	+	+						
<i>Sida</i> sp. Pilbara (A.A. Mitchell PRP 1543)		+	+	+		+				

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		2010	2013	2014	2015	2017	2019	2021	2022	2023
<b>Malvaceae (cont.)</b>	<i>Sida</i> sp. (inadequate material)		+	+	+	+				+
	<i>Triumfetta ramosa</i>		+	+	+	+				
	? <i>Triumfetta</i> sp. (inadequate material)		+							
<b>Marsileaceae</b>	<i>Marsilea hirsuta</i>				+	+				
<b>Molluginaceae</b>	<i>Trigastrotheca molluginea</i>		+	+	+	+		+		
<b>Myrtaceae</b>	<i>Corymbia hamersleyana</i>	+	+	+	+	+	+	+		+
	<i>Eucalyptus victrix</i>	+	+	+	+					
	<i>Eucalyptus</i> ? <i>victrix</i> (inadequate material)	+								
	<i>Eucalyptus xerothermica</i>	+								
<b>Nyctaginaceae</b>	<i>Boerhavia coccinea</i>		+	+		+		+	+	+
	<i>Boerhavia</i> sp. (inadequate material)			+						
<b>Phyllanthaceae</b>	<i>Dendrophyllanthus erwinii</i> (formerly <i>Phyllanthus erwinii</i> )							+	+	
	<i>Nellica maderaspatensis</i> (formerly <i>Phyllanthus maderaspatensis</i> )			+	+					
<b>Plantaginaceae</b>	<i>Stemodia grossa</i>		+	+					+	+
<b>Poaceae</b>	<i>Aristida contorta</i>		+	+		+		+	+	+
	<i>Aristida holathera</i> var. <i>holathera</i>		+	+	+	+	+	+		+
	* <i>Cenchrus ciliaris</i>	+	+	+	+	+	+	+	+	+
	* <i>Cenchrus setiger</i>		+	+	+	+	+	+	+	+
	* <i>Cenchrus</i> sp. (inadequate material)					+			+	
	<i>Chloris pumilio</i>		+	+	+	+				
	<i>Chrysopogon fallax</i>			+						+
	<i>Cynodon prostratus</i>		+	+		+		+		+
	<i>Dactyloctenium radulans</i>		+	+		+		+	+	+
	<i>Dichanthium sericeum</i> subsp. <i>humilius</i>		+	+				+		
	<i>Enneapogon caeruleascens</i>		+	+				+	+	+
	<i>Eragrostis cumingii</i>					+				
	<i>Eragrostis dielsii</i>		+							
<i>Eragrostis eriopoda</i>		+	+	+	+					

Family	Species	Astron				Biota				
		2010	2013	2014	2015	2017	2019	2021	2022	2023
Poaceae (cont.)	<i>Eragrostis pergracilis</i>		+	+	+	+		+		
	<i>Eragrostis tenellula</i>					+		+	+	
	<i>Eragrostis</i> sp. (inadequate material)	+								
	<i>Eriachne aristidea</i>		+	+	+	+		+	+	+
	<i>Eriachne benthamii</i>	+	+	+	+					
	<i>Eriachne obtusa</i>			+	+					
	<i>Eriachne pulchella</i> var. <i>pulchella</i>		+	+		+		+	+	+
	<i>Eriachne</i> sp. (inadequate material)	+								
	<i>Eulalia aurea</i>	+	+	+	+	+				
	<i>Iseilema dolichotrichum</i>					+		+	+	+
	<i>Iseilema eremaeum</i>									
	<i>Iseilema vaginiflorum</i>		+	+	+			+	+	
	<i>Panicum decompositum</i>				+					
	<i>Panicum</i> sp. (inadequate material)					+				
	<i>Paractaenum refractum</i>		+	+						+
	<i>Paspalidium clementii</i>		+		+	+		+	+	
	<i>Paspalidium rarum</i>							+		
	<i>Paspalidium</i> sp. (inadequate material)		+	+						
	<i>Setaria dielsii</i>				+					
	<i>Sorghum plumosum</i>		+	+	+					
	<i>Sporobolus actinocladus</i>								+	
	<i>Sporobolus australasicus</i>		+	+	+	+		+	+	+
	<i>Sporobolus mitchellii</i>		+	+	+	+				
	<i>Triodia epactia</i>	+	+	+	+	+	+	+	+	+
	<i>Triodia glabra</i>	+	+	+	+	+	+	+	+	+
	<i>Triodia schinzii</i>	+	+	+	+	+	+	+	+	+
<i>Triodia</i> ? <i>schinzii</i> (inadequate material)	+									
	<i>Triodia wiseana</i>		+	+	+	+	+	+	+	

Family	Species	Astron				Biota				
		2010	2013	2014	2015	2017	2019	2021	2022	2023
<b>Poaceae (cont.)</b>	<i>Urochloa holosericea</i> subsp. <i>velutina</i>					+				
	<i>Yakirra australiensis</i> var. <i>australiensis</i>		+		+	+		+		+
	Poaceae sp. (inadequate material)	+								
<b>Polygalaceae</b>	<i>Polygala isingii</i>			+						
<b>Portulacaceae</b>	<i>Calandrinia</i> sp. (inadequate material)			+					+	
	<i>Portulaca oleracea</i>		+	+		+		+	+	+
<b>Proteaceae</b>	<i>Grevillea eriostachya</i>	+	+	+	+					
	<i>Grevillea stenobotrya</i>	+	+	+	+	+		+		
<b>Sapindaceae</b>	<i>Diplopeltis eriocarpa</i>	+	+	+	+					
<b>Solanaceae</b>	<i>Nicotiana occidentalis</i>			+						
	<i>Nicotiana rosulata</i>			+	+					
	<i>Solanum diversiflorum</i>					+		+		
	<i>Solanum horridum</i>			+			+	+	+	+
	<i>Solanum lasiophyllum</i>		+	+	+	+	+	+	+	+
<b>Surianaceae</b>	<i>Stylobasium spathulatum</i>					+				
<b>Zygophyllaceae</b>	<i>Tribulus astrocarpus</i>							+		
	<i>Tribulus hirsutus</i>		+	+				+		
	<i>Tribulus occidentalis</i>					+				
	<i>Tribulus macrocarpus</i>							+		
	<i>Tribulus</i> sp. (inadequate material)		+	+						
	<i>Zygophyllum retivalve</i>			+						

# Macedon Gas Development MS844 2023 Compliance Assessment Report

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