BHP

Macedon Gas Project Compliance Assessment Report

25 January 2022

Disclaimer

BHP Disclaimer

Cover

Photograph on cover of report shows the Macedon Gas Plant.

Contents

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).

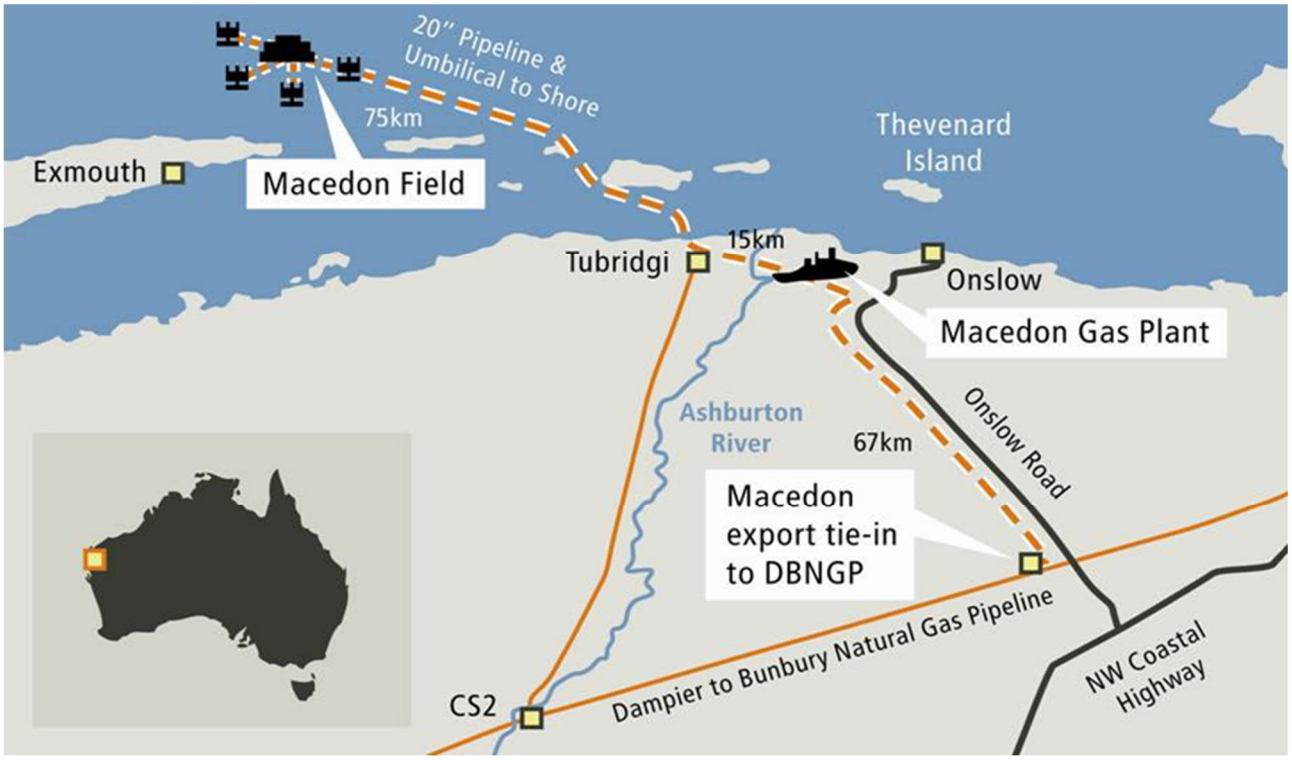


Figure 1: Macedon Gas Project Location

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.

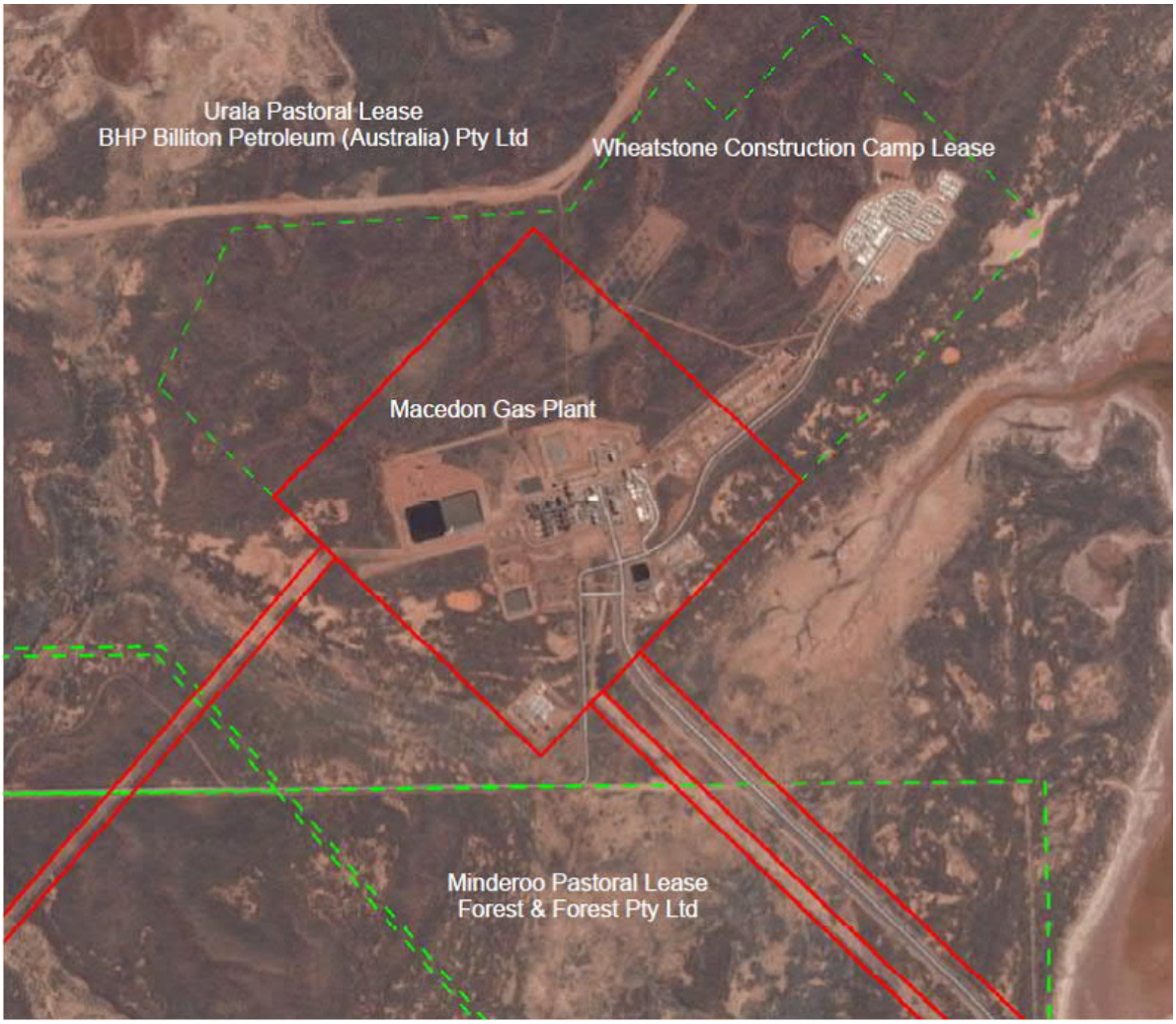


Figure 2: Macedon Gas Plant Lease (red line) and Layout

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, approved on 18 March 2011.

The CAR 2021 covers activities undertaken during the period 1 January 2021 to 31 December 2021.

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).

Endorsement of CAR

This Compliance Assessment Report has been endorsed by Shiva McMahon, General Manager Australia, BHP Petroleum.

Project Status

Current Status of Project

The project is currently in the operational phase.

Project Activities covered by CAR

This CAR covers the following project activities undertaken in the period 1 January 2021 to 31 December 2021:

1) Operations, 1 January 2021 to 31 December 2021.

Compliance with Ministerial Statement 844

Compliance with Conditions

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

Rehabilitation Monitoring

In March 2012, BHP Petroleum 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 at least 60 per cent of pre-clearing species diversity and weed coverage of no more 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 and 2021. There was no vegetation rehabilitation survey completed in 2020 due to Covid restrictions impacting on personnel movements and availability, and later, affecting the optimal timing of the survey (i.e. after adequate rainfall).

For the 2021 reporting year, the field survey was completed between 5-7 May 2021. 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. 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 2021 Rehabilitation Monitoring Survey is provided below and the full report is provided in Appendix 1.

A total of 98 native vascular flora species from 55 genera and 25 families were recorded from the 17 transects in 2021. Two weed species were recorded: **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 in the monitored transects, with the exception of rehabilitation transect BHPPD-24. However, it is likely that some of the transects situated towards the north-western end of the Mt Minnie conservation area, including BHPPD-24, did not receive adequate rainfall compared to transects situated closer to the Great Northern Highway end of the study area. In the absence of threatening factors such as weed invasion, revegetation in this area is again considered to be 'Excellent' and would be expected to continue to develop towards pre-clearing floristic community 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 not been met for rehabilitation transects BHPPD-29, BHPPD-30 and BHPPD-31 in 2021 with regards to the introduced tussock grasses **Cenchrus ciliaris* (Buffel Grass) and **C. setiger* (Birdwood Grass).

When comparing the 2021 survey results to those of 2019, **Cenchrus ciliaris* and **C. setiger* have increased in both distribution and abundance (as measured by their percent cover along the line transect) across the monitored rehabilitation transects within the Mt Minnie conservation area. Provided that continued spraying of these species within the rehabilitated areas is undertaken over the course of the next few years, it would be expected that the cover of **Cenchrus* spp. will tend towards pre-clearing levels.

In the reporting period, rehabilitation transects BHPPD-29, BHPPD-30 and BHPPD-31 were sprayed using targeted application of herbicide to the introduced tussock grasses during November 2021.

Greenhouse Gas

Greenhouse Gas (GHG) Emissions and Intensity

Macedon Gas Project GHG emissions for the period 1 January 2021 to 31 December 2021 are illustrated in Figure 3 and detailed in Table 1.

Annual GHG emissions for the period 1 January 2021 to 31 December 2021 were 83,955 tonne equivalent of carbon dioxide (t CO2-e); carbon emissions intensity for the period was 7.01 t CO2-e per 1,000 barrels of oil equivalent production. Recorded emissions were slightly higher than those recorded previously and lower than those provided in the Final Environmental Performance Standard (EPS) (85,000 t CO2-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.

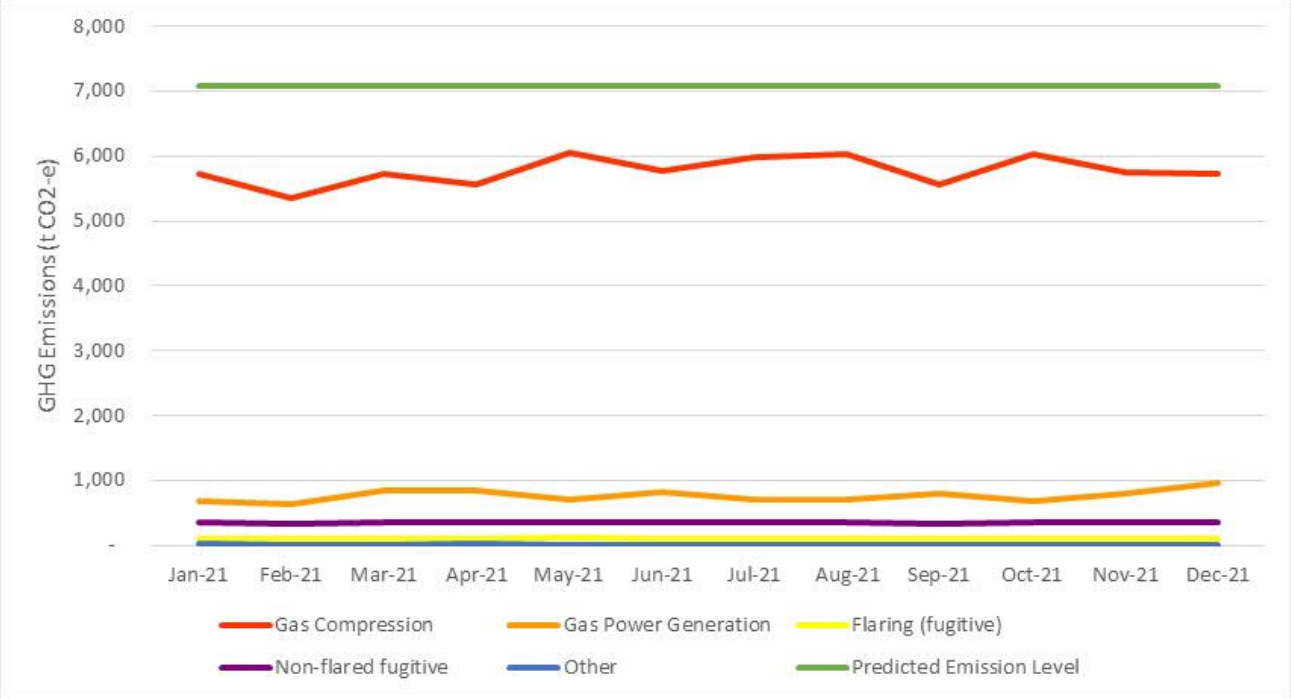


Figure 3: Macedon Gas Project GHG Emissions (1 January 2021 - 31 December 2021)

Table 1: Macedon Gas Project GHG Emissions (1 January 2021 - 31 December 2021)

	Greenhouse Gas Emissions (t CO2-e)												
Emission Source	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Gas Compression	5,719	5,349	5,735	5,568	6,047	5,766	5,976	6,034	5,557	6,040	5,737	5,726	**69,253**
Gas Power Generation	691	629	849	844	692	819	712	713	786	687	793	957	**9,173**
Flaring (fugitive)	99	90	100	98	109	102	105	104	105	102	103	103	**1,221**
Non-flared fugitive	350	333	351	344	353	348	354	352	339	348	347	351	**4,171**
Other	15	13	11	14	11	12	10	9	12	12	9	8	**137**
Total	**6,875**	**6,413**	**7,046**	**6,868**	**7,212**	**7,047**	**7,157**	**7,213**	**6,800**	**7,190**	**6,990**	**7,145**	**83,955**

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.

BHP Petroleum continues to identify and evaluate GHG reduction opportunities through internal processes designed to implement greenhouse gas abatement opportunities.

GHG Reduction Measures Implemented

Several improvements in equipment, technology and procedures identified in the Macedon Gas Project energy optimisation study were implemented in design including:

- Low resistance internal pipeline coating;
- Waste heat recovery; and
- Equipment selection designed to minimise facility pressure drop.

Audit Table

Table 2: 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	2021 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 remains BHP Petroleum 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	Updated January 2013 (letter dated 14.01.2013) No change since last notification
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 following annual review, dated 25.01.2022)
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: • the frequency of compliance reporting; • the approach and timing of compliance assessments; • the retention of compliance assessments; • the method of reporting of potential non-compliances and corrective actions taken;	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

Audit Code	Subject	Action (from Ministerial Statement 844)	How	Evidence	Satisfy	Advice	Phase	When	Status	Further Information
		• the table of contents of compliance assessment reports; and • public availability of compliance assessment reports.								
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 (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 (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 Statement and then annually from the date of submission of the first CAR. The CAR shall: • be endorsed by the proponent's Managing Director or a person delegated to sign on the Managing Director's behalf; • include a statement as to whether the proponent has complied with the conditions; • identify all potential non-compliances and describe corrective and preventative actions taken; • be made publicly available in accordance with the approved CAP; and • indicate any proposed changes to the CAP required by condition 4-1.	CAR will be issued Make CAR publicly available in accordance with 'Proposal Implementation Monitoring Branch – Draft Fact Sheet 1 – Making Documents Publicly Available – April 2010'	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 CAR, 2019 CAR; 2020 CAR, 2021 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	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	CLD	Letter of Approval from CEO of EPA received 28.11.2011

Audit Code	Subject	Action (from Ministerial Statement 844)	How	Evidence	Satisfy	Advice	Phase	When	Status	Further Information
		satisfaction of the CEO on advice from the Department of Fisheries.						pipeline and umbilical		
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	DBCA	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:M6.1 A	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	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
		separation distances during construction of the marine pipeline and umbilical : (1) pipeline to primary feature – 700 metres; (2) pipeline to secondary feature – 600 metres; (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	DBCA	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 May 2021 indicated the criterion for Condition 8 in MS844 has not been met during the FY21 period but is expected to be met longer term. One transect out of the 17 monitored transects did not meet the criterion for species diversity and three transects did not meet

Audit Code	Subject	Action (from Ministerial Statement 844)	How	Evidence	Satisfy	Advice	Phase	When	Status	Further Information
										the criterion for weed coverage. Refer to Rehabilitation Monitoring section in this report.
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	DBCA	Overall	Appropriately timed after rain on an annual basis unless otherwise agreed by the CEO until the completion criteria are met	C	Rehabilitation Survey undertaken in 2021 (Appendix 1 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	Rehabilitation monitoring report attached as Appendix 1 of the 2021 CAR (this document)
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

Audit Code	Subject	Action (from Ministerial Statement 844)	How	Evidence	Satisfy	Advice	Phase	When	Status	Further Information
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;	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 (this document, see Section above on GHG)

Audit Code	Subject	Action (from Ministerial Statement 844)	How	Evidence	Satisfy	Advice	Phase	When	Status	Further Information
		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.								
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 2. remediation or rehabilitation of all disturbed areas to a standard suitable for the agreed new land use(s).	Submit Final Decommissioning Plan	Approval of Final Decommissioning Plan	CEO		Operation	At least six months prior to the anticipated date of closure	NR	
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	Decommission-ing	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 = Minster for the Environment; CEO = Chief Executive Officer of OEPA; OEPA = Office of the Environmental Protection Authority; EPA = Environmental Protection Authority; DBCA = Department of Biodiversity, Conservation and Attractions (formerly Department of Environment and Conservation DEC)); DMIRS = Department of Mines, Industry Regulation and Safety (formerly Department on Mines and Petroleum (DMP); DoH = Department of Health; DPIRD = Department of Primary Industries and Regional Development (formerly Department of Fisheries (DoF)
- Status: C – Compliant (implementation of the proposal has been carried out in accordance with the requirements of the audit element); NC – Non-compliant; CLD – Completed (A requirement with a finite period of application has been satisfactorily completed); NR – Not required at this stage.
- Abbreviations: MTI MP - Marine Turtle Impact Management Plan; IMP MP - Introduced Marine Pest Management Plan; AEBPR - Air Emissions Best Practice Report; GHG - Greenhouse Gas.

Non-compliance and Corrective/Preventative Actions

Non-Compliance

During the period covered by this CAR (1 January 2021 to 31 December 2021), there was a non-compliance with condition 8.1 with regard to meeting species diversity and weed coverage criteria for the re-establishment of terrestrial vegetation.

As presented in above Section '*Rehabilitation Monitoring'*, one transect out of the 17 monitored transects did not meet the criterion for species diversity, however it is likely the area did not receive adequate rainfall compared to the other sites. In the absence of threatening factors, it is anticipated that this transect will once again be considered "excellent" and expected to continue to develop towards pre-clearing floristic diversity in the longer term. Three transects did not meet the criterion regarding weed coverage. Introduced tussock grasses *Cenchrus ciliaris* and *C. setiger* have increased in both distribution and abundance. With continued spraying, it is expected the coverage of *Cenchrus spp*. will tend towards pre-clearing levels.

Corrective/Preventative Actions

The monitoring of rehabilitation is ongoing on a yearly basis, with no additional actions required to improve species diversity. An additional weed spraying event is planned for FY22, dependent on suitable conditions for weed growth, and the frequency of these events will be re-evaluated for future years.

Changes to the Compliance Assessment Plan

The following changes have been incorporated into the Compliance Assessment Plan (Revision 12, January 2022):

1. Change key contacts in Section 2:

   Ben Brydson – APU Operations Manager – Email ben.brydson@bhp.com; and

   Dr Samantha Vize – Principal Environment & Regulatory (only change being position title).
2. Change to person authorised to sign in Section 3.1:

   General Manager Australia updated as being Shiva McMahon.

References

BHP Billiton Petroleum 2010, Macedon Gas Project Environmental Protection Statement, July 2010 – Final. BHP Billiton Petroleum, Perth.

BHP Petroleum Macedon Gas Project – Compliance Assessment Plan, (PMA-BHP-EN-EIA-0002).

Department of Parks and Wildlife 2013, *Weed Prioritisation Process for DPaW (formerly DEC) – "An Integrated Approach to Weed Management on DPaW-Managed Lands in WA"*, Government of Western Australia, Perth.

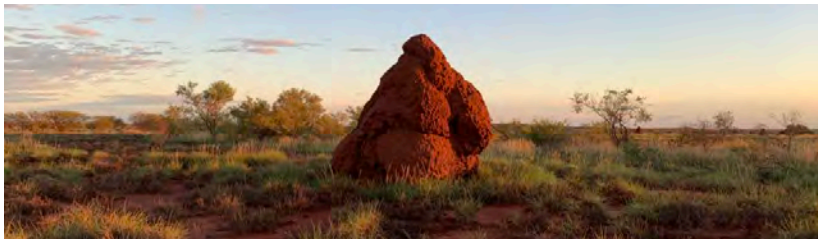
Australian Weeds Committee 2012, *Weeds of National Significance 2012*, Department of Agriculture, Fisheries and Forestry, Canberra.

Appendix 1

Macedon Rehabilitation Monitoring Report

Biota Environmental Sciences

Macedon Gas Pipeline Rehabilitation Survey 2021



Prepared for BHP

August 2021

Biota Environmental Sciences

ABN 49 092 687 119
Level 1, 228 Carr Place
Leederville Western Australia 6007
Ph: (08) 9328 1900 Fax: (08) 9328 6138

Project No.: 1593

Prepared by: A. Braxton-Smith
S. Werner

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This report has been designed for double-sided printing. Hard copies supplied by Biota are printed on recycled paper.

Macedon Pipeline Rehabilitation Survey 2021

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1.0 Summary

1.1 Background

In 2012, BHP 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 and 2019 (Biota 2017, and 2019 respectively).

In 2021, Biota was commissioned to undertake an additional monitoring survey of the Macedon Gas Pipeline situated within the proposed Mt Minnie conservation area.

1.2 Methodology

The field survey was completed between 5-7 May 2021. 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 98 native vascular flora species from 55 genera and 25 families were recorded from the 17 transects in 2021. Two weed species were recorded: **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 in the monitored transects, with the exception of rehabilitation transect BHPPD-24. However, it is likely that some of the transects situated towards the north-western end of the Mt Minnie conservation area, including BHPPD-24, did not receive adequate rainfall compared to transects situated closer to the Great Northern Highway end of the study area. In the absence of threatening factors such as weed invasion, revegetation in this area is again considered to be 'Excellent' and would be expected to continue to develop towards pre-clearing floristic community 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 not been met for rehabilitation transects BHPPD-29, BHPPD-30 and BHPPD-31 in 2021 with regards to the introduced tussock grasses **Cenchrus ciliaris* (Buffel Grass) and **C. setiger* (Birdwood Grass).

When comparing the 2021 result to that of 2019, **Cenchrus ciliaris* and **C. setiger* have increased in both distribution and abundance (as measured by their percent cover along the line transect) across the monitored rehabilitation transects within the Mt Minnie conservation

area. Provided that continued spraying of these species within the rehabilitated areas is undertaken over the course of the next few years, it would be expected that the cover of *Cenchrus spp. will tend 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, two transects at the southern end of the study area remain in relatively Poor condition, with a third considered to be Good but tending towards Poor:

- Transect BHPPD-29 is considered Poor, with a relatively high cover of *Cenchrus ciliaris tussock grasses and no development of spinifex or perennial shrubs over the course of monitoring.
- Transect BHPPD-31 is particularly Poor in 2021: spinifex cover has decreased by approximately 25% to less than pre-clearing levels, with *Cenchrus cover increasing by 30%.
- Transect BHPPD-30 is considered Good (verging on Poor). It shows a reasonable development of both spinifex and perennial shrub cover trending towards to that of pre-clearing levels, but the cover of *Cenchrus has remained high and increased by 18% since the last monitoring phase.

1.3.3 Likely Progression of Vegetation along Rehabilitation Transects

For the 2017 report, 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).

- Transects ranked as 'Excellent' in 2021 comprise BHPPD-22, BHPPD-24, BHPPD-25, BHPPD-26, and BHPPD-28. 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, other than a presence within the strip transect at BHPPD-28. 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 these 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.
- Transects ranked as 'Good' in 2021 comprise BHPPD-23, BHPPD-27, and BHPPD-30. 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). Weeds are generally absent or provide negligible cover, with the exception of a small number of seedlings re-establishing at BHPPD-23, and an increase of 18% *Cenchrus spp. cover recorded at BHPPD-30. It would be expected that the native vegetation cover would increase to reach the pre-clearing levels within 5 years, and similar to the transects currently ranked as Excellent, would then remain stable over time. The only exception to this may be at transect BHPPD-30, where the cover of *Cenchrus has increased since the last monitoring phase.
- Transects ranked as 'Poor' in 2021 comprise BHPPD-29 and BHPPD-31. Although there is a lack of development of perennial vegetation at BHPPD-29 (i.e. no hummock grassland of soft spinifex *Triodia glabra* and no shrubland of *Acacia synchronicia* and *A. xiphophylla* that existed prior to clearing), the cover of *Cenchrus spp. at this transect (24%) has greatly reduced from the 70% recorded in 2017, but has increased by 3% since the previous monitoring phase. 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 likely in the very long-term. Spinifex cover has decreased by 25% since the last monitoring phase, to less than pre-clearing levels, and the cover of *Cenchrus has increased from 2% in 2017 to 31% in 2021. The greater area surrounding BHPPD-31 continues to support large, permanent populations of *A. xiphophylla*, and as whole presents as a quite stable, healthy vegetation unit.

  For both of these transects, 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.

Given the cover of *Cenchrus spp. currently recorded at BHPPD-29, BHPPD30, and BHPPD-31, these infestations would be expected to increase again in the short 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. The increase in rainfall has caused the *Cenchrus populations to return to pre-treatment levels.

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 partially met by continual activities (herbicide application, last weed treatment occurring in October 2020), 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

BHP constructed and now 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, BHP 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 and 2019 (Biota 2017, and 2019 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, BHP 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. BHP 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 2021 (Figure 2.1). The principal aims of the study, as identified by BHP, were to:

1. conduct an additional phase of rehabilitation monitoring in 2021 (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, 2010, 2013, 2014, 2016, Biota 2017, 2019), together with information available for the locality (see Section 4.0). This was followed by a field survey in May 2021 to repeat the monitoring following appropriate rainfall conditions (Section 3.0).

The approach and methodology used for the current rehabilitation monitoring phase 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).

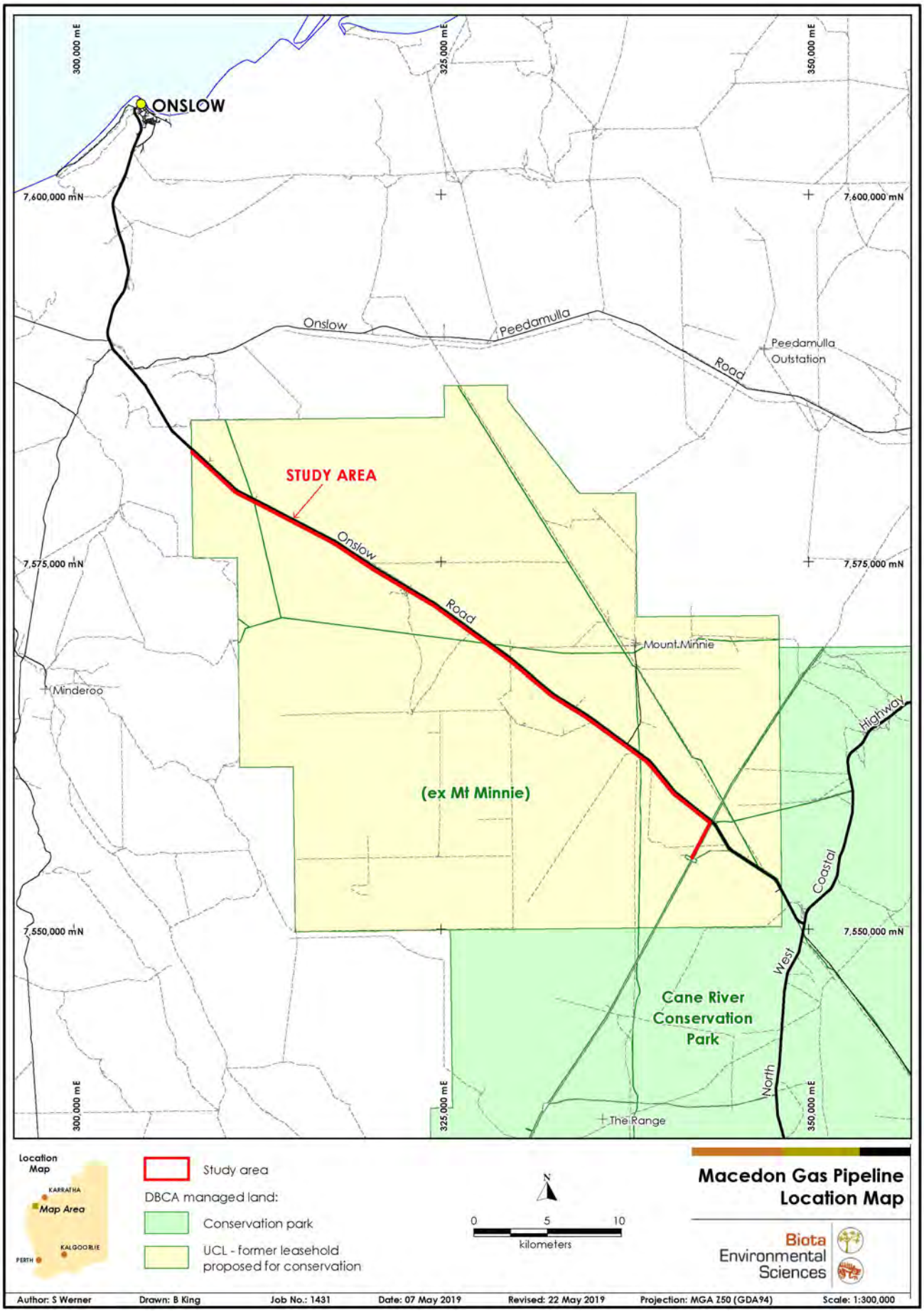

Figure 2.1: Location of the Macedon Gas Pipeline study area in which the current rehabilitation monitoring survey was completed.

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3.0 Methodology

3.1 Survey Team and Timing

The field survey was conducted by Scott Werner (Senior Biologist) and Aster Braxton-Smith (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 5 – 7 May 2021 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 2021 Macedon Gas Pipeline rehabilitation monitoring.

Name	Position	Qualification	Years of Experience	Flora Licence No.†
Scott Werner	Senior Biologist	BSc. Hons.	10	FB62000038
Aster Braxton-Smith	Botanist	BSc.	3	FB62000269

† 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)[1] show that rainfall in the six months prior to the current monitoring survey (November 2020 to April 2021) totalled 251.6 mm, which is 193.6 mm more than the total of the long-term monthly medians[2] for the locality during those months (50.2 mm). Much of this rain was due to a combination of both tropical lows and systems resulting from ex-tropical cyclones Seroja and Odette throughout March and April, with 133 mm (53% of the rainfall of the six months preceding the survey) recorded in March/April 2020. The last substantial rainfall event prior to the current phase of monitoring was recorded on the morning of May 5 (immediately preceding the survey), when 28.6 mm was received.

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 second 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 current survey in 2021 commenced approximately 12 weeks following the first significant rainfall event received in the Onslow locality in 2021, with additional significant rainfall received at both eight weeks and 3-4 weeks prior to the survey. The survey was therefore undertaken during a period that would be considered adequate for general collection of flora and ideal for the determination of **Cenchrus* spp. in the field.

1 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.

2 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.

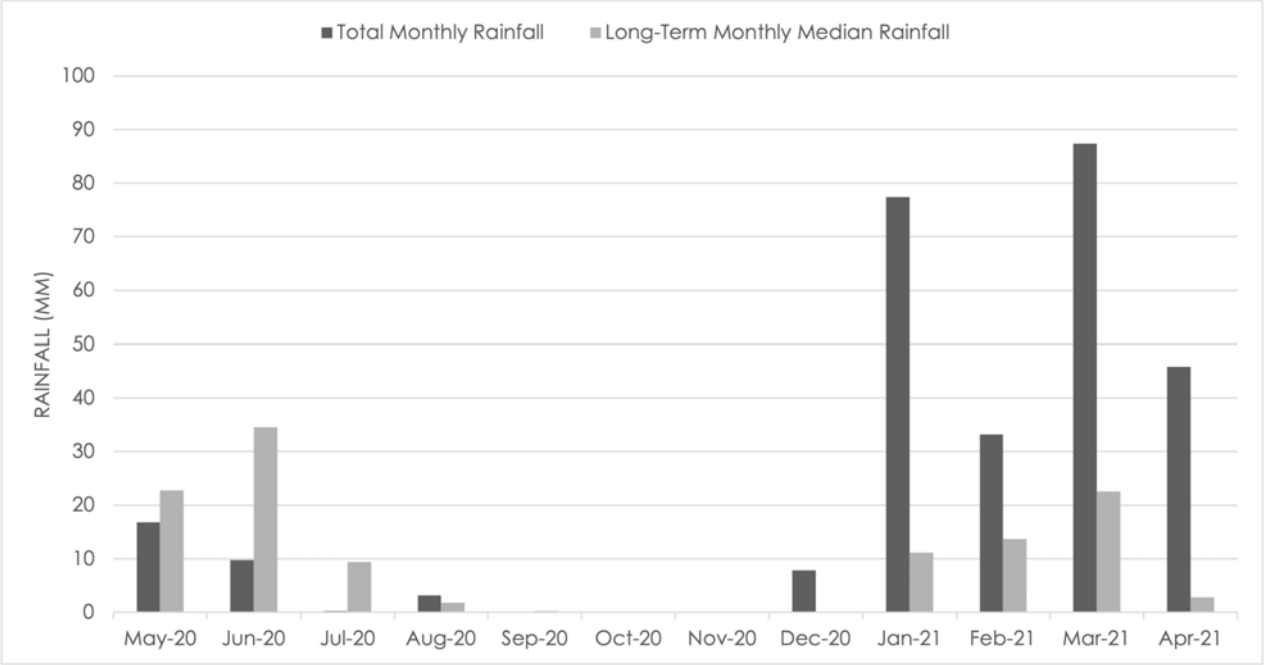

Figure 3.1: Total monthly rainfall at Onslow Airport recording station (#5017) for the 12 months preceding the survey, compared to the long-term monthly median (1998-2020).
Data supplied by the Bureau of Meteorology (http://www.bom.gov.au).

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
Baseline Survey		
14 – 19 October 2010	28.0 mm (Apr – Sep 2010)	14.8 mm (Jul – Sep 2010)
Post–Rehabilitation Surveys		
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 (Nov 2018 – Apr 2019)	40.8 mm (Feb 2018 – Apr 2019)
5 – 7 May 2021	251.6 mm (Nov 2020 – Apr 2021)	50.2 mm (Feb 2021 – Apr 2021)

3.2 Monitoring Methodology

The survey methodology for the current phase of monitoring was consistent with that outlined in the current monitoring procedure (Astron 2012) and the most recent survey completed (Biota 2019).

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 2021 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 2021.

Monitoring Sites§	Line-Intercept Transects Reassessed in 2021 (Total Number of Transects)	
	Rehabilitation	Analogue
22, 23, 24, 26, 28, 29, 30	Yes (7)	Yes (7)
25, 27, 31	Yes (3)	No
Total	**10**	**7**

§ 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[3] 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).

[3] http://florabase.dpaw.wa.gov.au

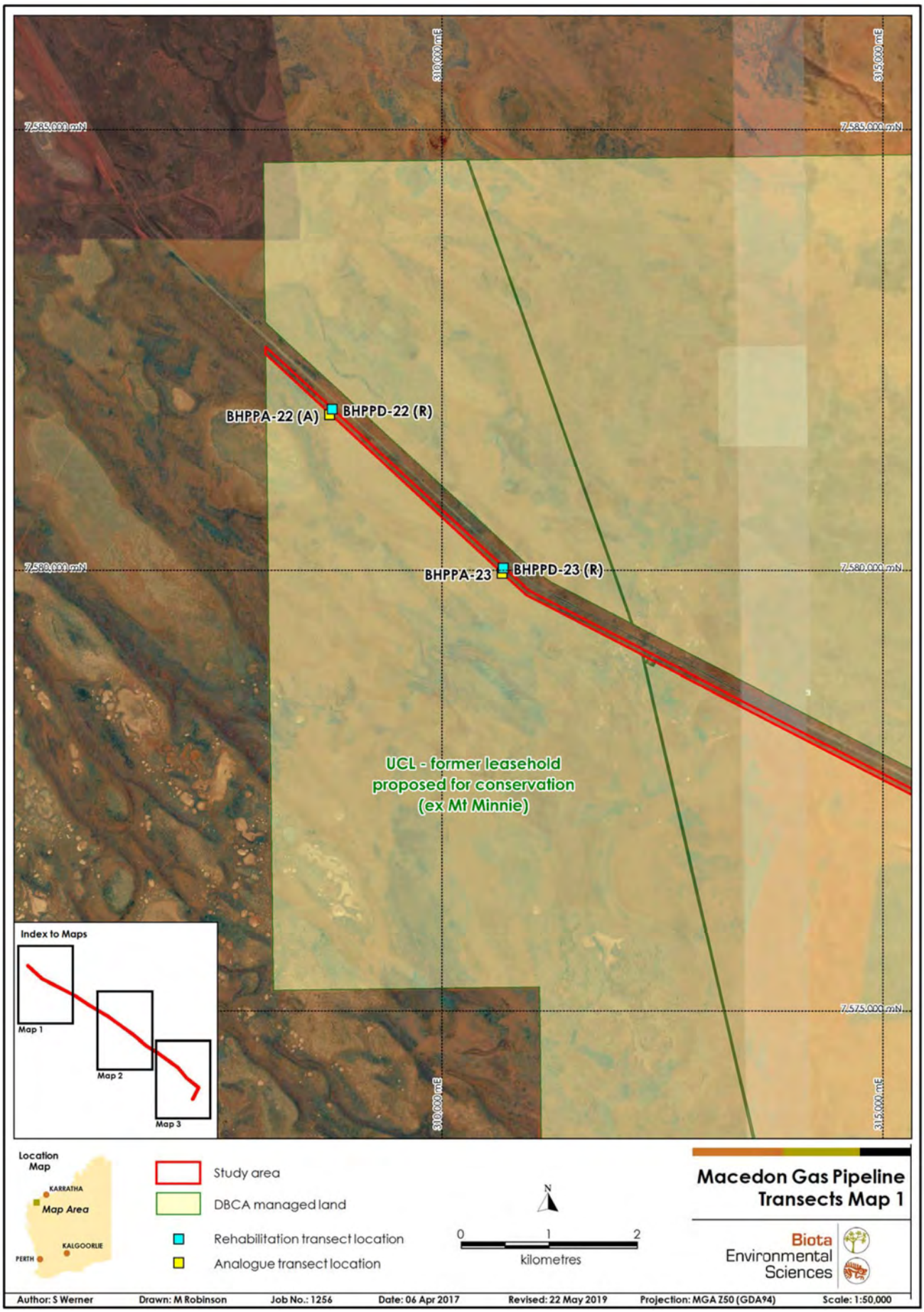

Figure 3.2: Monitoring transect locations (Map 1).

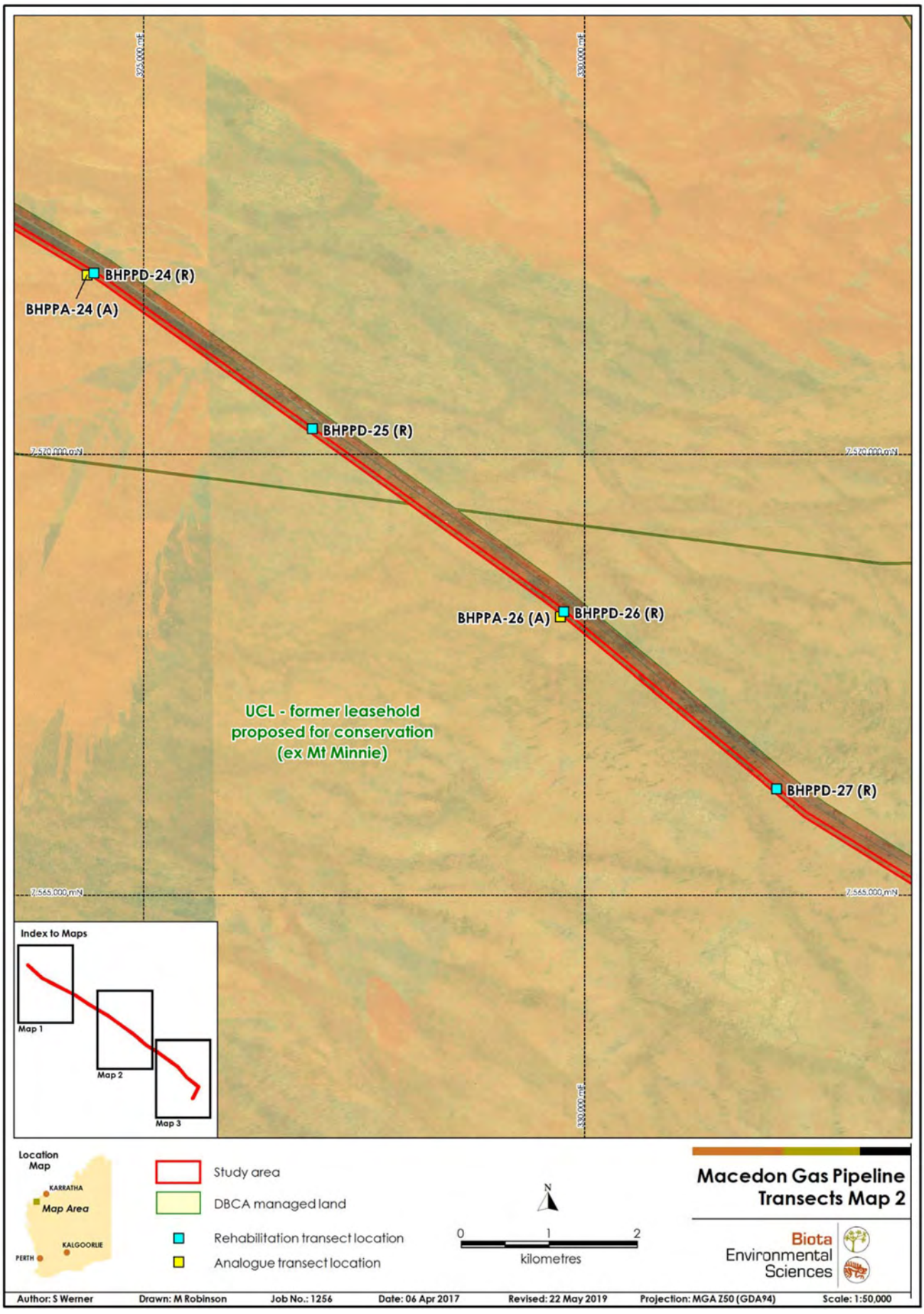

Figure 3.3: Monitoring transect locations (Map 2).

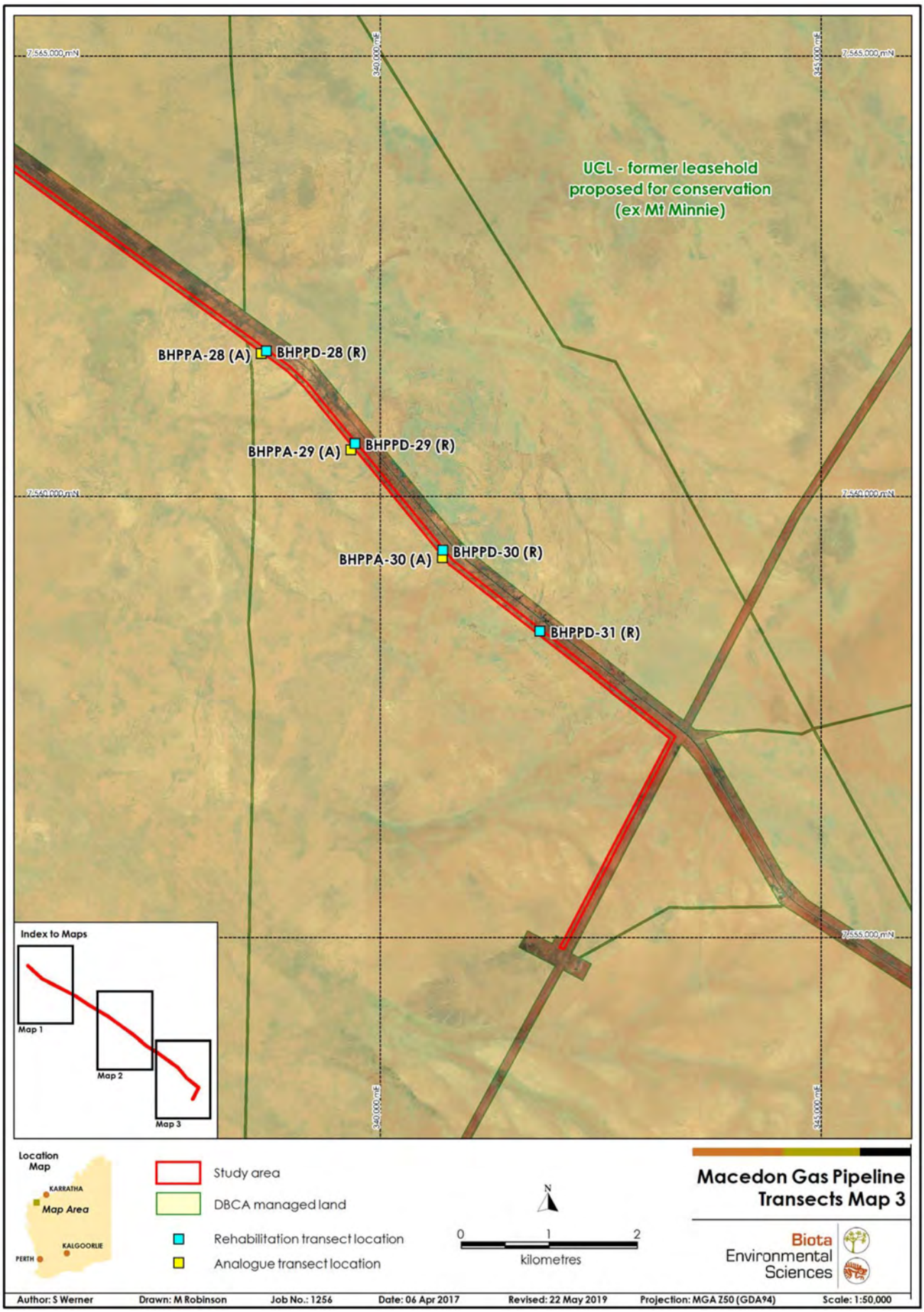

Figure 3.4: Monitoring transect locations (Map 3).

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. 2021, 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 2021; this was based on the combined data from the line transect (for 2010 and 2021) and the strip transect (2021 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 *Cenchrus* 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 *Cenchrus* is negligible to low (<10%).
Fair	There is limited re-establishment of perennial vegetation along the transect (<20% cover) AND the cover of *Cenchrus* 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 *Cenchrus* 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 *Cenchrus* 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 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 2021 do not have a paired analogue.
4. Significant amounts of rainfall preceding the survey appear to have reached the southeast section of the study area, more so than the northwest. Considering the sporadic and localised nature of rainfall in the Pilbara bioregion, it is expected that the study area would receive varying amounts of rainfall across its length, given its size and linear shape.

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 unchanneled, 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 unchanneled 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 *Grevillea eriostachya* or *Hakea stenophylla* shrubs, *Acacia* sp., *Crotalaria cunninghamii* over mixed low shrubs over *Triodia epactia* 'sens. lat.' or *T. glabra* hummock grasslands.	2 (13%)	1 (14%)	1 (10%)
Sandy/loamy plains supporting *Eucalyptus* and *Corymbia* low trees in patches over mixed shrubs over *Triodia glabra* hummock grasslands; some vegetation types characterised by an upper storey of *Hakea chordophylla* or *Grevillea wickhamii*.	9 (60%)	2 (29%)	3 (30%)
Lower, often stony plains supporting *A. xiphophylla* and other *Acacia* species shrublands over *Triodia* hummock grasslands, occasionally with a *Corymbia* isolated low trees overstorey.	3 (20%)	3 (43%)	5 (50%)
Internal, undirected drainages supporting **Prosopis*, *Acacia* or *Eucalyptus victrix* shrubland/low woodland over mixed shrubs and mixed tussock grassland, occasionally *Triodia* hummock grassland.	1 (7%)	1 (14%)	1 (10%)
Total	**15**	**7**	**10**

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 – 2021) 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 2021

A total of 98 native vascular flora species from 55 genera and 25 families were recorded from the 17 transects resampled in 2021. 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 2021, 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
Number of Native Species	39	117	144	136	104	29	98
Number of Weed Species	3	3	3	4	4	2	2
Number of Transects	56	56	56	56	56	17	17
Mean Species per Transect	0.70	2.09	2.57	2.43	1.86	1.70	5.76

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 BHPPA23.

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 2021 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 but one rehabilitation transect and one analogue transect meet the criterion of "*not less than 60% of the known original species diversity*", with most transects equalling or exceeding the original species richness. The transects that did not meet the criterion comprised:

- BHPPD-24: only one native species (*Triodia glabra*) was recorded along this line transect in 2021, compared to four species recorded from the same transect in 2010 (*Acacia ancistrocarpa*, *A. bivenosa*, *Eucalyptus xerothermica*, and *Triodia glabra*) and three species recorded from the paired analogue, BHPPA-24, in 2010 (*Acacia ancistrocarpa*, *Corymbia hamersleyana*, and *Triodia glabra*).

  In 2019, *Acacia bivenosa* and *A. ancistrocarpa* occupied 13 cm and 95 cm of the BHPPD-24 line-transect respectively, whilst in 2017 *A. bivenosa* occupied 15 cm and *A. ancistrocarpa* 60 cm. In contrast, in 2014 and 2015 both these perennial shrubs were not recorded as intercepting the BHPPD-24 line-transect, and were entirely absent from the rehabilitation site in 2013. It is possible that the shrubs have senesced after re-establishing in 2014, or that the line-intercept was misaligned due to missing transect pegs.

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^2 area; e.g. some wetlands, spinifex plains, and samphire vegetation).

Table 5.2: Native species richness of rehabilitation line transects in 2021 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 Compared to Itself		Rehabilitation Transect Compared to Paired (or Equivalent †) Analogue		
Rehabilitation Transect	**2021 Species Richness**	**2010 Species Richness**	**Criterion Met? (2021 Species Richness as % of Original)**	**Analogue Transect**	**2010 Species Richness**	**Criterion Met? (2021 Species Richness as % of 2010 Analogue)**
BHPPD-22	4	6	Yes (67%)	BHPPA-22	3	Yes (133%)
BHPPD-23	9	6	Yes (150%)	BHPPA-23	4	Yes (225%)
BHPPD-24	1	4	No (25%)	BHPPA-24 ß	3	No (33%)
BHPPD-25 ß	4	5	Yes (80%)	BHPPA-26 †, ß	3	Yes (133%)
BHPPD-26 ß	6	3	Yes (200%)	BHPPA-26 ß	3	Yes (200%)
BHPPD-27	6	3	Yes (200%)	BHPPA-26 †, ß	3	Yes (200%)
BHPPD-28	12	3	Yes (400%)	BHPPA-28 ß	3	Yes (400%)
BHPPD-29	5	3	Yes (167%)	BHPPA-29	3	Yes (167%)
BHPPD-30	13	2	Yes (650%)	BHPPA-30	2	Yes (650%)
BHPPD-31	10	4	Yes (250%)	BHPPA-30 †	3	Yes (333%)

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

ß Transect has been burnt in relatively recent years (approximately <9 years prior to 2021 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 (Figure 5.1).

The fact that all but one rehabilitation transect (BHPPD-24) and its paired analogue transect (BHPPA-24) exceeded 60% of the original species richness is expected given the age of the rehabilitation areas.

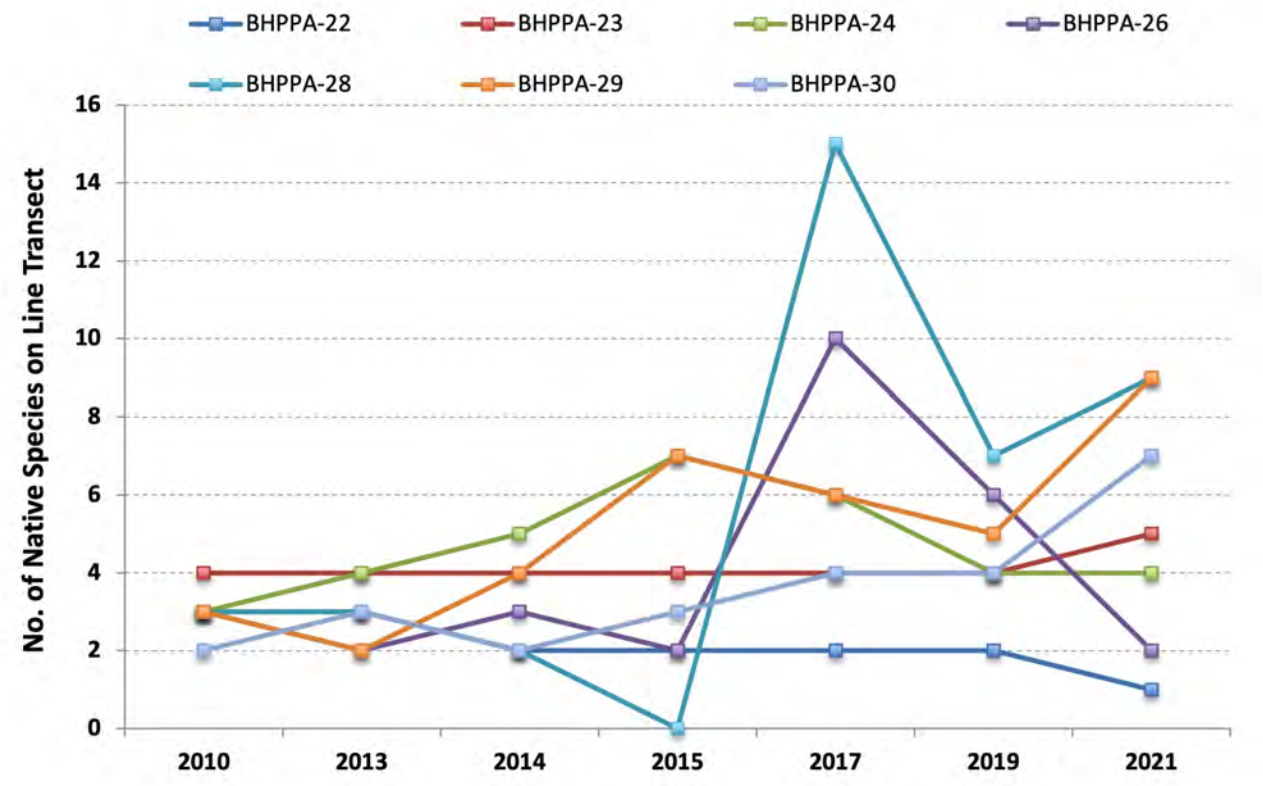

Figure 5.1: **Native species richness recorded on line transects at analogue sites.**
Note the dramatic increase in richness following fires prior to the 2015 monitoring phase at transect BHPPA-28 and prior to the 2017 monitoring phase at BHPPA-26, with a return to pre-fire numbers beginning to show in 2019/2021.

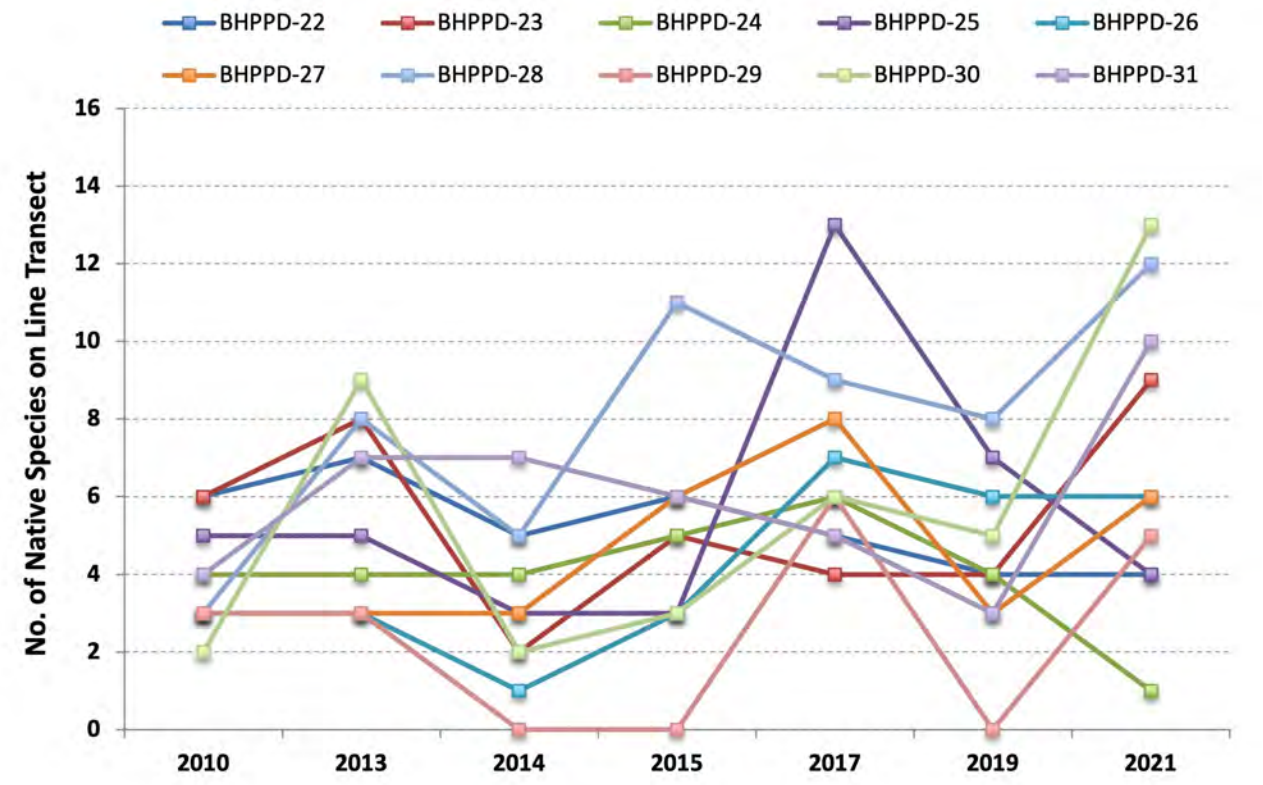

Figure 5.2: **Native species richness recorded on line transects at rehabilitation sites.**
2010 represents the pre-clearing monitoring phase; at least 60% of the 2010 species richness was recorded at all transects in 2021 except BHPPD-24.

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 2021 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 2021 transects (contributing to 75% and 38% of the overall cumulative similarity respectively).
- Highlighting the impact annual grasses and herbs had during 2021:
  - in 2010, a total of **12** species contributed to an overall cumulative similarity level of 75%.
  - in 2021, a total of **26** species contributed to an overall cumulative similarity level of 75%.
- Two of the transects had a more similar floristic composition in 2021 to that recorded from the same transect in 2010, rather than to other transects in the current phase (BHPPA-22, BHPPA-23).
- Three transects in 2021 (BHPPA-28, BHPPA-29, and BHPPA-30) grouped together at a similarity of approximately 21%, but were considered to not be significantly similar to the same transects from 2010, showing seasonal differences. This is highly likely due to the number of annual grasses and herbs recorded from these transects in 2021 (due to the preceding rainfall received over the south-eastern half of the study area), that were not recorded in 2010.
- Two transects (BHPPA-24 and BHPPA-26) were statistically similar across the two phases (2010 versus 2021), whilst also clustering with the three additional 2010 transects mentioned above (BHPPA-28, BHPPA-29, and BHPPA-30), most likely due to the suite of annual grasses and herbs not being recorded in transects BHPPA-24 and BHPP-26 in 2021 (see floristic group 3 (FG3) in Table 5.3).

For the rehabilitation transects:

- *Triodia glabra* was again the main driver of similarity in within 2010 and 2021 transects (contributing to 73% and 25% of the overall cumulative similarity respectively).
- Highlighting the impact annual grasses and herbs had during 2021 (and thus why the majority of 2021 transects clustered together, and were not considered statistically similar to the 2010 transects):
  - in 2010, a total of **12** species contributed to an overall cumulative similarity level of 75%.
  - in 2021, a total of **38** species contributed to an overall cumulative similarity level of 75%.
- Four transects clustered in the same grouping, at a statistically significant level, on the basis of their data from 2010 and 2021 (BHPPD-22, BHPPD-24, BHPPD-25, and BHPPD-26). These are all transects at which very few annuals were recorded relative to other rehabilitation transects in 2021 (see FG3 in Table 5.3).
- Transect BHPPD-22 from 2010 and 2021 clustered together at a similarity level of 60%. This is not unexpected as this is the only transect located on fine red sand dunes dominated by the hummock grass *Triodia schinzii.*
- The difference in dominant perennial species recorded at BHPPD-25 in 2010 and 2021 will continue to see this transect not cluster together from different phases: *Corymbia hamersleyana* and *Eucalyptus xerothermica* were recorded in 2010 but not in 2021[4]. Additionally, *Acacia ancistrocarpa* and *A. bivenosa* were not recorded in 2010, but were recorded in 2021.

[4] It is unlikely these individuals will recolonise following removal during vegetation clearing. Unless these taxa are excluded from the baseline 2010 data in recognition of this, similar clustering will likely remain the case in future analyses.

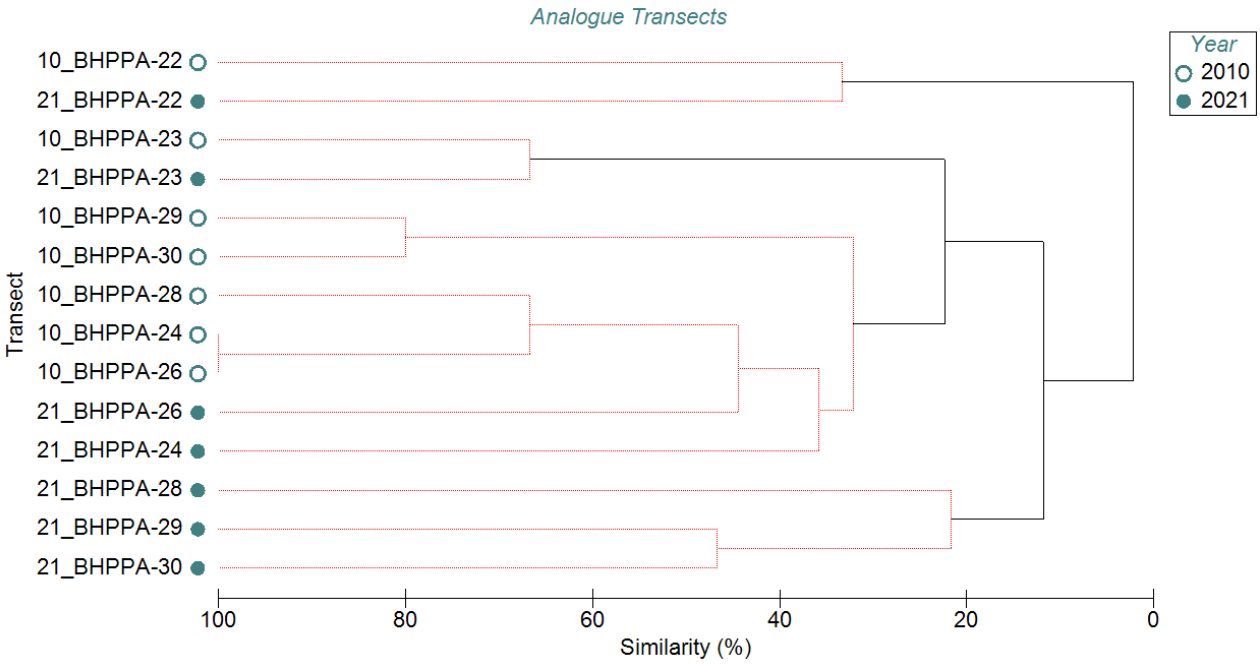

Figure 5.3: **Dendrogram showing clustering of the analogue transects based on the species recorded in 2010 and 2021.**
Red lines indicate that sites are not significantly different (p>0.05) from each other (SIMPROF test).

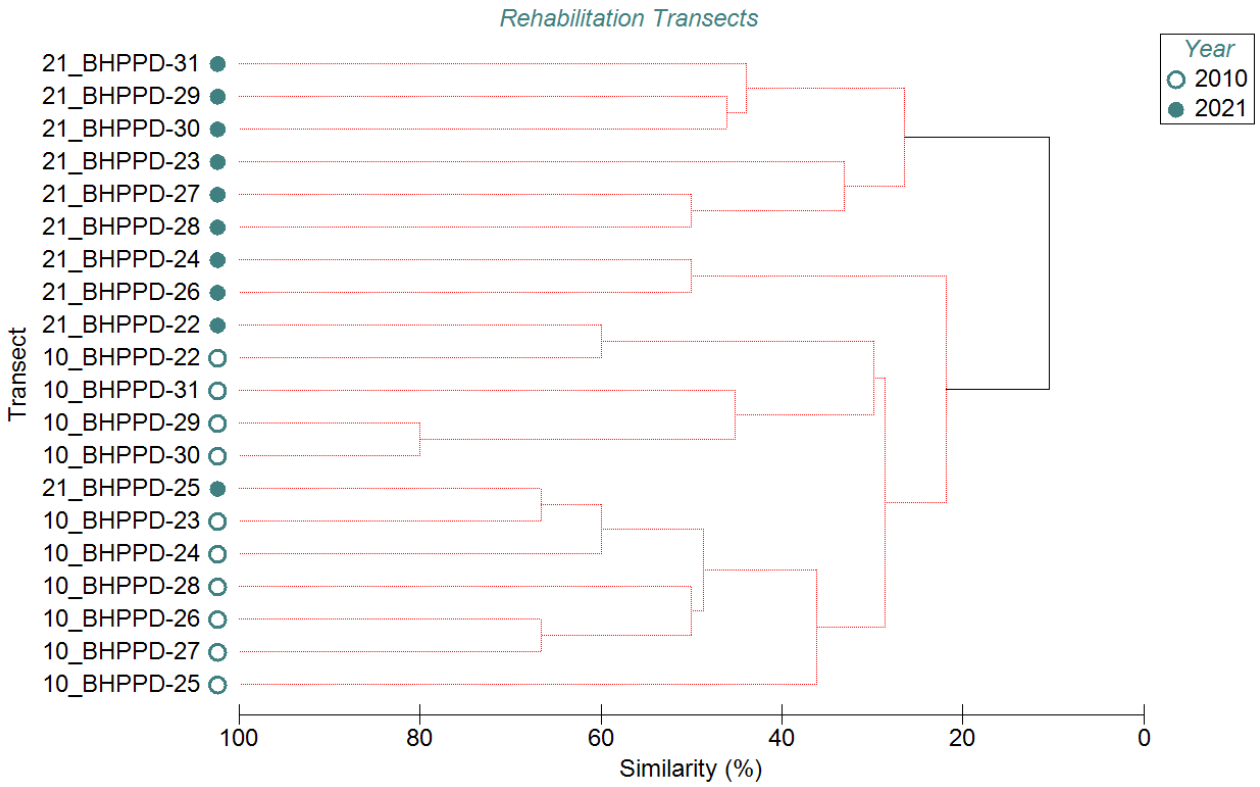

Figure 5.4: **Dendrogram showing clustering of the rehabilitation transects based on the species recorded in 2010 and 2021.**
Red lines indicate that sites are not significantly different (p>0.05) from each other (SIMPROF test).

The second clustering analysis used presence/absence data for native species from 2021 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 groups (see Figure 5.5, Figure 5.6 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 (FG1) comprised transects with *Acacia* spp., *Triodia glabra* and other species typically associated with sandy substrates on open plains. Key findings include:
    a. grouped at 40% similarity.
    b. consisted of open plains with a mix of several mature *Acacia* species: *A. ancistrocarpa, A. bivenosa, A. inaequilatera, A. stellaticeps, A. synchronicia,* and *A. trachycarpa.*
    c. high number of associated species after significant rain in the preceding months: *Abutilon lepidum*, *Aristida contorta*, *Bulbostylis barbata*, *Eriachne aristidea*, *Goodenia microptera*, *Paspalidium clementii*, *Ptilotus astrolasius*, *P. polystachyus*, *Tribulus* spp., *Triodia glabra.*
2. The second group (FG2) comprised the transects dominated by *Acacia xiphophylla* and *Triodia wiseana* that typically occupy the low-lying, stony open gibber plains of the Stuart land system in the locality.
3. The third group (FG3) included transects situated on open plains with a sandy-loam substrate and those from red fine sand dunes. These transects are likely separated from the remainder and loosely grouped together due to the presence of the dominating hummock grass species *Triodia glabra* and *T. schinzii*, along with the only records of *Corymbia hamersleyana, Grevillea stenobotrya, Scaevola spinescens* and *Sida cardiophylla.*

    Additionally, a shared absence of many annual herbs and grasses results in the separation from the combined broader grouping of FG1 and FG2 (see Figure 5.5 and 5.6):
    a. The overall absence of annual grasses and herbs recorded in FG1 and FG2 (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. Specific absence of *Iseilema* and *Paspalidium* annual grasses, *Ptilotus astrolasius* and *Ptilotus exaltatus*, *Senna notabilis, Streptoglossa* spp., *Trianthema triquetrum* and *Tribulus* spp.

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

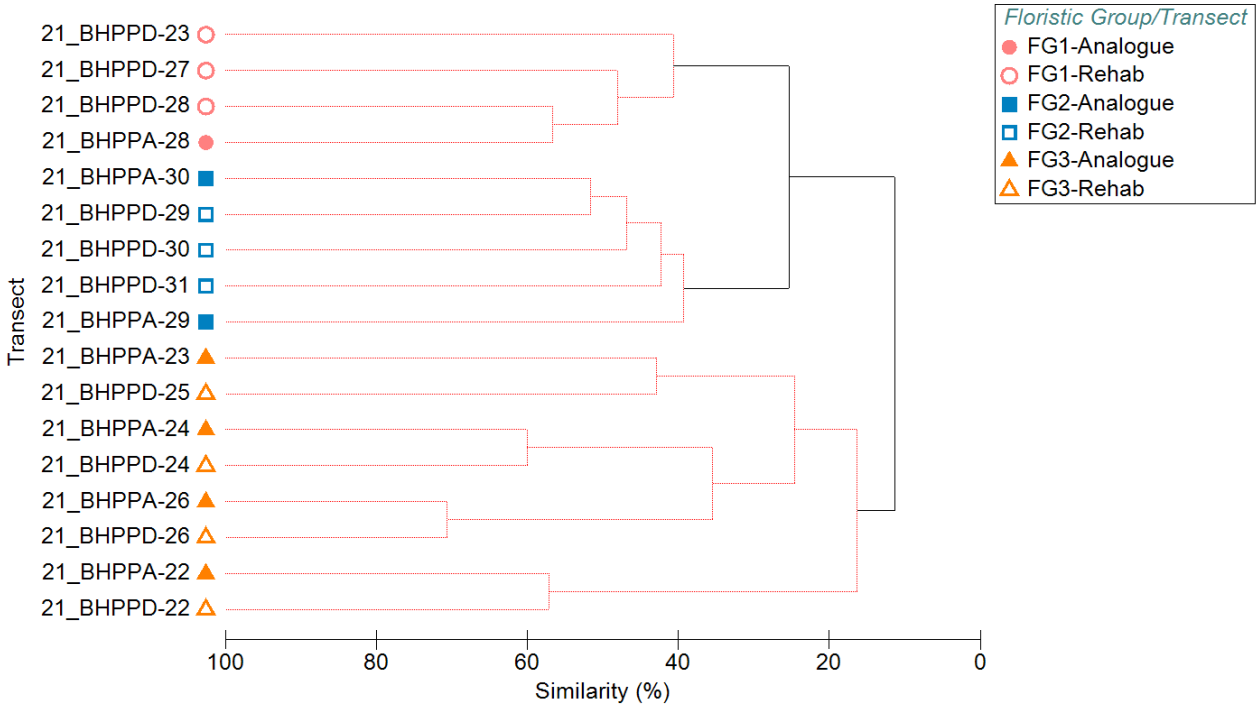

Figure 5.5: **Results of the floristic clustering analysis carried out on the 2021 data for the monitoring transects (presence/absence of native species only).**
Red lines indicate that sites are not significantly different from each other (SIMPROF test).

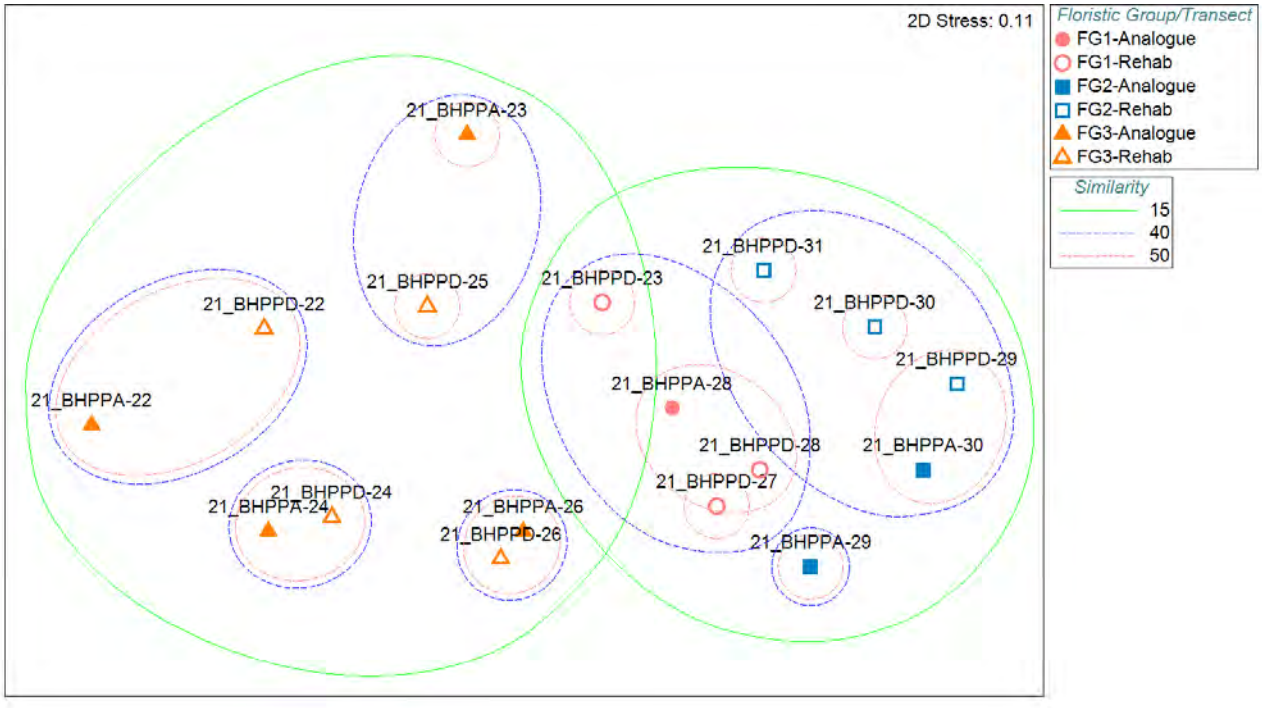

Figure 5.6: **NMDS plot of 2021 data for the monitoring transects (presence-absence of native species only).**

Table 5.3: Floristic groups identified by the clustering analysis of 2021 presence/absence data for native species at each site.

Floristic Group	Transect		Comments
	Analogue	Rehabilitation	
FG1	(group 3)†	BHPPD-23	Species that were present in all four of the groups transects and influenced clustering were: *Acacia ancistrocarpa, Bulbostylis barbata, Paspalidium clementii, Ptilotus polystachyus,* and *Triodia glabra.* This group also contained all the records of *Abutilon lepidum*, *Acacia inaequilatera*, *A. trachycarpa, Arivela* spp., *Codonocarpus cotinifolius*, *Corchorus sidoides*, *Eragrostis pergracilis, Euphorbia alsinoides* var. *villosicalyx, Hannafordia quadrivalvis* subsp. *recurva, Indigofera colutea, Trigastrotheca molluginea, Ptilotus polystachyus*, and *Sida fibulifera*, The presence of five *Acacia* taxa and a high number of annual grasses and herbs (compared to very few annual grasses and herbs in FG3) are likely to be the main contributors to the split from FG2 and FG3. The rehabilitation transects were in Good (verging on Excellent) to Excellent condition in terms of development of native vegetation.
	NA	BHPPD-27	
	BHPPA-28	BHPPD-28	
FG2	BHPPA-29	BHPPD-29	Species that were present in at least four of the five groups transects and influenced clustering of these transects were: *Amaranthus cuspidifolius, Eragrostis tenellula, Paspalidium clementii, Portulaca oleracea, Ptilotus exaltatus,* and *Trianthema triquetrum.* The presence, and only records, of *Triodia wiseana* and *Acacia xiphophylla*, together with only relatively low percentage cover of *Triodia glabra* in comparison to FG1 and FG3, are likely to be the main contributors to the distinct clustering of this group. The absence of the perennial shrubs *Acacia ancistrocarpa* and *A. bivenosa*, typically not recorded in this landform, is also a major influence on the separation of this grouping from FG1 and FG3. This group also contained all records of the species *Acacia xiphophylla, A. synchronicia, Amaranthus cuspidifolius, Boerhavia coccinea, Corchorus laniflorus, Crotalaria medicaginea* var. *neglecta*, *Cynodon prostratus, Dactyloctenium radulans, Gomphrena affinis* subsp. *pilbarensis, Hibiscus sturtii, Sida arsiniata,* and *Solanum* spp. *(S. diversiflorum, S. horridum, S. lasiophyllum*), as well as the only recorded covers of *A. synchronicia, Portulaca oleracea*, *Sporobolus australasicus,* and *Trianthema triquetrum* intersecting the line-transect. These 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 considered to show Good (verging on Poor) to Poor vegetation development, consistent with the overall rankings of previous phases (see Table 5.5 for an overview).
	BHPPA-30	BHPPD-30	
	NA	BHPPD-31	
FG3	BHPPA-22	BHPPD-22	This sub-group contained all records of the species *Triodia schinzii*, which is 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 rehabilitation transect in this sub-group was in Excellent condition again in 2021, with well-developed native vegetation.
	BHPPA-23	(group 1)†	Species that were present in at least half of the eight transects and influenced clustering were: *Aristida holathera* var. *holathera, Bonamia erecta,* and *Triodia glabra.* This group also contained all the records of *Aristida holathera* var. *holathera, Bonamia erecta, Cassytha capillaris, Corymbia hamersleyana, Grevillea stenobotrya, Scaevola spinescens,* and *Sida cardiophylla* in the data set. The species are indicative of the open sandy loam plains vegetation that dominates the locality. The absence of the following taxa results in the separation from the combined broader grouping of FG1 and FG2 (see Figure 5.5 and 5.6): • The overall absence of annual grasses and herbs recorded in FG1 and FG2 (particularly notable suggesting that the transects located in the south-eastern half of the linear study area most likely received more localised rainfall preceding the survey). • Specific absence of *Iseilema* and *Paspalidium* annual grasses, *Ptilotus astrolasius* and *P. exaltatus*, *Senna notabilis, Streptoglossa* spp., *Trianthema triquetrum*, and *Tribulus* spp. Rehabilitation transects in this grouping all showed Excellent development of native vegetation, with an improvement in rating for both BHPPD-25 and BHPPD-26 from 2019.
	BHPPA-24	BHPPD-24	
	NA	BHPPD-25	
	BHPPA-26	BHPPD-26	

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

For those transects with paired analogues, all but one clustered within the same floristic group, indicating similar floristic composition. The transect that clustered separately from its analogue comprised BHPPD-23:

- The inclusion of BHPPD-23 into FG1 (and separation from BHPPA-23) is due to both the presence of numerous annual grasses and herbs, and only 0.1% cover of *Acacia bivenosa* compared to 37% cover recorded in BHPPA-23.

Overall, these results indicate relative similarity in terms of floristic composition between the rehabilitation transects and the appropriate analogue transects in 2021, but of variable similarity with the original floristic composition recorded in the pre-clearing vegetation.

5.3 Introduced Flora (Weeds)

Two weed species were recorded from the study area in 2021, 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 four of the line transects, and in a single strip-transect; see Table 5.4). In contrast, **Cenchrus* spp. were recorded from only one analogue site (along the line transect at BHPPA-30).

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 and Figure 5.7, and are briefly summarised below:

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 analogues 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.

Table 5.4: Cover and presence of *C*enchrus spp. at monitoring transects within the Mt Minnie conservation area from 2010 to 2019.

Transect	Year							Change in % Cover from 2019 to 2021	Change in % Cover from 2010 to 2021
	2010	2013	2014	2015	2017	2019	2021		
Analogue									
BHPPA-23	-	-	-	-	✓	-	-	-	-
BHPPA-29	-	✓	✓	1.90	2.50	9.70	-	- 9.70	-
BHPPA-30	-	-	-	-	-	✓	0.35	0.35	0.35
Rehabilitation									
BHPPD-23	-	1.00	3.00	4.00	✓	-	0.45	0.45	0.45
BHPPD-28	-	-	-	-	0.40	✓	✓	-	✓
BHPPD-29	-	7.00	15.00	3.30	70.15	21.55	24.20	2.65	24.20
BHPPD-30	-	2.50	10.00	1.05	27.95	27.00	45.05	18.05	45.05
BHPPD-31	-	5.25	19.25	12.35	27.35	1.90	31.20	29.30	29.30

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.

2014 and 2015

Over the next two monitoring phases, it appears that both the cover and distribution of *C*enchrus spp. increased in the study area, particularly in the rehabilitation areas (Table 5.4 and Figure 5.7). In 2014, *C*enchrus 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 *C*enchrus* 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, *C*enchrus 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). *C*enchrus 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 *C*enchrus* spp. at the sites in 2015 showed no consistent pattern compared to 2014, decreasing at seven sites and increasing at seven.

2017

In 2017, *C*enchrus 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 *C*enchrus setiger*. The cover of *C*enchrus ciliaris* at analogue transect BHPPA-29 showed a slight increase compared to 2015. In terms of the rehabilitation transects, *C*enchrus* 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 *C*enchrus* sp. was recorded along the line transect at BHPPD-17, with *C. ciliaris* confirmed from the strip transect at this site. *C*enchrus 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. *C*enchrus 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, *C*enchrus 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 *C*enchrus ciliaris* at analogue transect BHPPA-29 showed an increase of 7.2% from 2017. In terms of the rehabilitation transects, *C*enchrus* spp. were recorded from all transects from which they had previously been recorded, except for BHPPD-23 where it was absent in 2019. *C*enchrus 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 and Plate 5.2). There was essentially no change in *Cenchrus cover at the remaining site (BHPPD-30). 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 (left); 2019 (middle); and 2021 (right).

Plate 5.2: *Cenchrus at site BHPPD-31 in 2017 (left); 2019 (middle); and 2021 (right).

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 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).

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). Analogue transect BHPPA-29 is located in the vicinity of one of the most dense of these infestations (BHPPD-29) and has shown a small but gradual increase in *Cenchrus spp. cover over the duration of monitoring (see Table 5.4); but an absence of any *Cenchrus in 2021. It is possible that this represents a pre-existing population of *Cenchrus spp., unrelated to the proximity of the disturbed pipeline corridor, however it is also possible that this population has spread as a result of the clearing activities within the pipeline corridor.

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 herbicide application (Table 5.4, Figure 5.7).

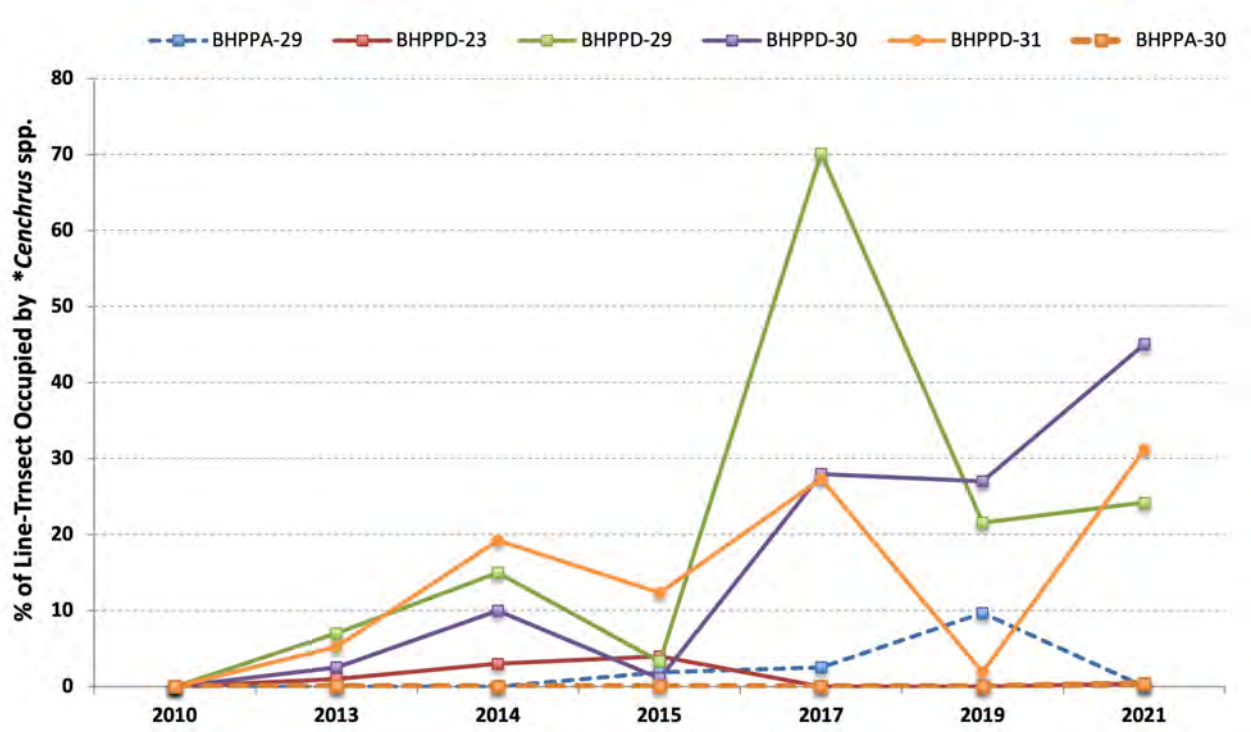

Figure 5.7: **Cover of *Cenchrus* spp. recorded along line transects across all monitoring phases.** 2010 represents pre-clearing monitoring.

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 2021. 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 2021 (86%; six of the seven) were in Excellent condition, with the exception of BHPPA-30 in the Mt Minnie conservation area; this transect was

ranked as Very Good to take into account the presence of *Cenchrus ciliaris* tussock grass seedlings within the strip-transect (0.1% cover).

The majority (8 of 10) of the rehabilitation transects were ranked as being in Excellent or Good condition, with five transects ranked as Excellent and three ranked as Good (see Table 5.5). The remaining two transects were ranked as Poor, reflecting poor development of native vegetation and/or substantial development of weeds.

Rehabilitation transects BHPPD-25, BHPPD-26 and BHPPD-30 have all improved in qualitative assessment of vegetation development since 2019; whereas BHPPD-27 and BHPPD-31 have declined in overall development of native vegetation. The remaining transects exhibited a similar level of vegetation development in 2021 to that observed in 2019.

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

Transect	2017	2019	2021 - Overall Ranking and Comments
BHPPD-22	**Excellent**	**Excellent**	**Excellent** Perennial *Acacia* mature and flowering; spinifex is above pre-clearing levels and has been steady over the last four phases; no weeds recorded.
BHPPD-23	**Good**	**Good**	**Good (verging on Excellent)** Mature spinifex close to pre-clearing levels; *Acacia* spp. have increased in cover, trending towards pre-clearing. Small number of re-established seedling/juvenile **Cenchrus* recorded in 2021.
BHPPD-24	**Excellent**	**Excellent**	**Excellent** Spinifex reduced by 10% but has maintained its level of cover from 2017 and is still greater than pre-clearing levels. *Acacia* spp. appear to be dead and absent in 2021. No weeds were recorded.
BHPPD-25	**Good**	**Good**	**Excellent** Spinifex regenerated to pre-fire levels (pre-2017), and increased slightly from 2019, further supporting the expectation that it would continue towards pre-clearing levels; mature *Acacia* spp. present; *Triodia* spp. and *Acacia* spp. appear to be at a level that is representative of the greater area. No weeds recorded.
BHPPD-26	**Good**	**Good**	**Excellent** Almost identical to analogue site (strata and species composition): spinifex and *Acacia* spp. cover is continuing towards pre-clearing levels; annual grasses and herbs have increased since 2019 due to rainfall preceding survey; no weeds recorded within the sites or in the surrounding vegetation.
BHPPD-27	**Fair**	**Excellent**	**Good (verging on Excellent)** Spinifex cover has continually increased since 2013 to just below half of pre-clearing levels in 2021 .The increase in both *Acacia ancistrocarpa* and *A. inaequilatera* to near pre-clearing levels is a positive indication that vegetation structure is tending towards its natural state; there has been an increase in annual grasses due to the high rainfall preceding the survey; no weeds were recorded.
BHPPD-28	**Excellent**	**Excellent**	**Excellent** Spinifex cover has decreased since 2019 but is still maintaining pre-clearing levels (with 2017 and 2019 cover exceeding the pre-clearing levels); cover of *Acacia* spp. shrubs is still low compared to pre-clearing with mature *Acacia ancistrocarpa* and *A. bivenosa* in the surrounding non-cleared vegetation; less mature *Acacia* spp. present over the clearing footprint. Cover of *Cenchrus negligible; only recorded as a presence from the strip-transect.

Transect	2017	2019	2021 - Overall Ranking and Comments
BHPPD-29	**Very Poor**	**Poor**	**Poor** No spinifex or *Acacia* spp. have established along the transect (or in the surrounding cleared footprint heading north and south); the cover of **Cenchrus* is still high in 2021 (24%). However, following the application of herbicide in 2018, **Cenchrus* cover was reduced from 70% to 21% in 2019, minimising competition and allowing for the establishment of native species. Overall, the rehabilitation site does not represent pre-clearing vegetation cover levels.
BHPPD-30	**Poor**	**Poor**	**Good (verging on Poor)** Spinifex has re-established on the transect and is continuing the trend towards pre-clearing levels; perennial shrubs (*Acacia* spp. and *Senna*) have also increased and show a trend towards pre-clearing levels; however, the cover of **Cenchrus* has remained high and increased by 18% since the last monitoring phase and the presence of **Aerva javanica* was also noted near the site. Establishment of **Cenchrus* now found within the analogue site.
BHPPD-31	**Poor**	**Good**	**Poor** Spinifex cover decreased by approximately 25%, to less than pre-clearing levels; the cover of *Acacia* species is non-existent with the *Acacia* spp. in the greater area in healthy condition and flowering; **Cenchrus* cover increased by 30%.

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 in the monitored transects, with the exception of rehabilitation transect BHPPD-24. However, it is likely that some of the transects situated towards the north-western end of the Mt Minnie conservation area, including BHPPD-24, did not receive adequate rainfall compared to transects situated closer to the Great Northern Highway end of the study area. In the absence of threatening factors such as weed invasion, revegetation in this area is considered to be 'Excellent' and 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 not been met for rehabilitation transects BHPPD-29, BHPPD-30 and BHPPD-31 in 2021 with regard to the introduced tussock grasses **Cenchrus ciliaris* (Buffel Grass) and **C. setiger* (Birdwood Grass).

When comparing the 2021 result to that of 2019, **Cenchrus ciliaris* and **C. setiger* have increased in both distribution and abundance (as measured by their percent cover along the line transect) across the monitored rehabilitation transects within the Mt Minnie conservation area. Provided that continued spraying of these species within the rehabilitated areas is undertaken over the course of the next few years, it would be expected that the cover of **Cenchrus* spp. will tend 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, two transects at the southern end of the study area remain in relatively Poor condition, with a third considered to be Good tending towards Poor:

- Transect BHPPD-29 is considered Poor, with a relatively high cover of **Cenchrus ciliaris* tussock grasses and no development of spinifex or perennial shrubs over the course of monitoring.
- Transect BHPPD-30 is considered Good (verging on Poor). It shows a reasonable development of both spinifex and perennial shrub cover trending towards to that of pre-clearing levels, but the cover of **Cenchrus* has remained high and increased by 18% since the last monitoring phase.
- Transect BHPPD-31 is particularly Poor in 2021: spinifex cover has decreased by approximately 25% to less than pre-clearing levels, with **Cenchrus* cover increasing by 30%.

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-28**. 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, other than a presence within the strip transect at BHPPD-28. 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-23, BHPPD-27** and **BHPPD-30**. 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). Weeds are generally absent or provide negligible cover, except for a small number of seedlings re-establishing at **BHPPD-23**, and an increase of 18% **Cenchrus* spp. cover recorded at **BHPPD-30**. 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. The only deviation to this may be at transect **BHPPD-30**, where the cover of **Cenchrus* has increased since the last monitoring phase, with notable observation of the weed **Aerva javanica* (Kapok Bush) in the surrounding area.

Transects ranked as 'Poor' in Table 5.5 comprise **BHPPD-29** and **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 cover of **Cenchrus* spp. at this transect (24%) has been reduced greatly from the 70% recorded in 2017, but has increased by 3% since the previous monitoring phase. 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 likely in the very long-term. Spinifex cover has decreased by 25% since the last monitoring phase, to less than pre-clearing levels, and the cover of **Cenchrus* has increased from 2% in 2017 to 31% in 2021. 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 both of these transects (**BHPPD-29** 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 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.

High rainfall in the six months preceding the 2021 monitoring phase resulted in an increase in native annuals (grasses and herbs) and a subsequent increase in overall species diversity within

most sites. Unfortunately, this increase in rainfall has also caused the *Cenchrus populations to return to pre-treatment levels and even spread.

To ameliorate the current trend of an 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

BHP 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 and October 2020.

Additionally, BHP commissioned Biota to undertake an additional phase of rehabilitation and weed monitoring in both March/April 2019 and May 2021 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 BHP weed hygiene management practices.

Recommendation 3

To date, BHP has completed herbicide spraying of *Cenchrus spp. populations in Q3 of 2018, July of 2019 and October 2020. 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

BHP, 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

2021 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 (2010-2021)

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:

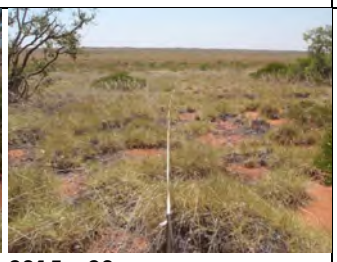
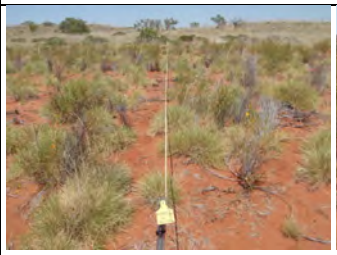
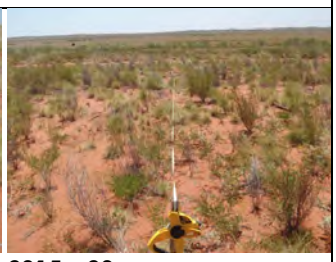
Values in table are the percentage of the 20 m line transect occupied by each native lifeform category at each site, along with the percentage occupied by weeds. (Note that *C*enchrus* tussock grasses were the only weeds recorded on the line transects, although other weeds were sometimes present in the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

Covers and presence of individual species:

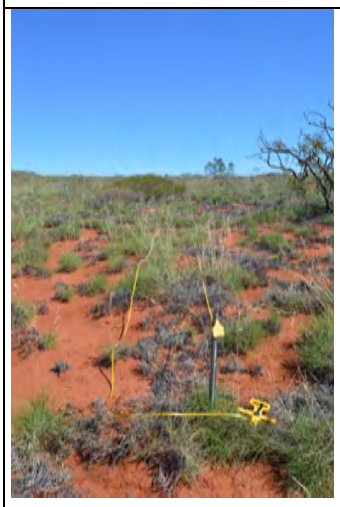
Values in table are the percentage of the 20 m line transect occupied by each species at each site.

✓ 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)

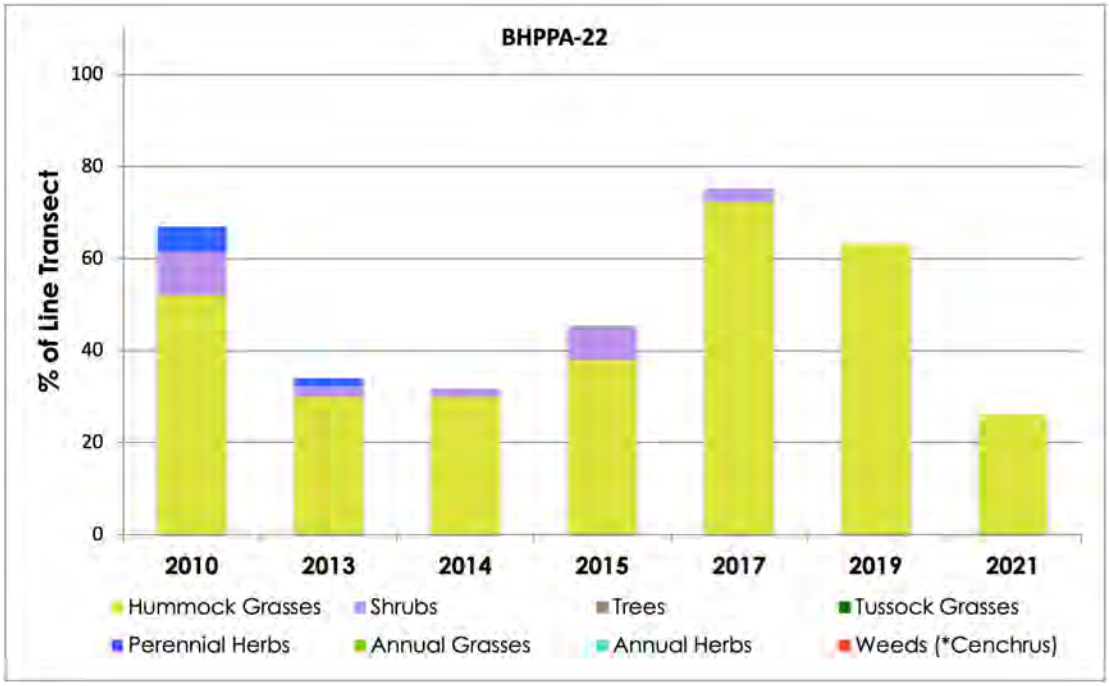
Analogue Transect BHPPA-22		Rehabilitation Transect BHPPD-22	
			
2010 – 0 m	2010 – 20 m	2010 – 0 m	2010 – 20 m
			
2013 – 0 m	2013 – 20 m	2013 – 0 m	2013 – 20 m
			
2014 – 0 m	2014 – 20 m	2014 – 0 m	2014 – 20 m
			
2015 – 0 m	2015 – 20 m	2015 – 0 m	2015 – 20 m

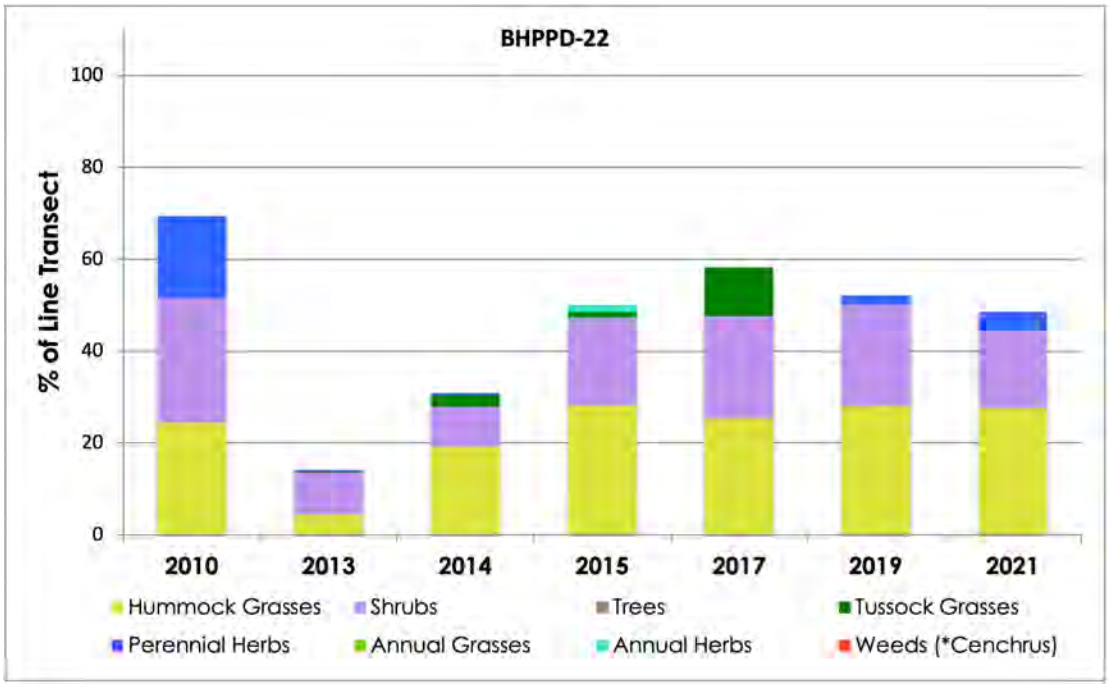
Site 22 (Mt Minnie conservation area)

Analogue Transect BHPPA-22		Rehabilitation Transect BHPPD-22	
			
2017 – 0 m	2017 – 20 m	2017 – 0 m	2017 – 20 m
			
2019 – 0 m	2019 – 20 m	2019 – 0 m	2019 – 20 m
			
2021 – 0 m	2021 – 20 m	2021 – 0 m	2021 – 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	
Analogue BHPPA-22	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							
Rehab BHPPD-22	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			





Site 22 (Mt Minnie conservation area)

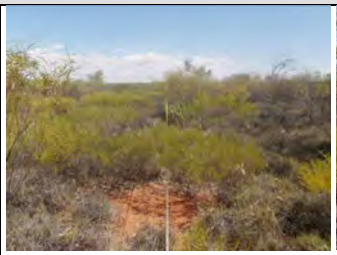
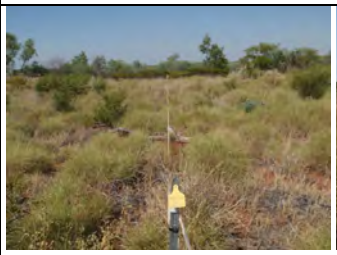
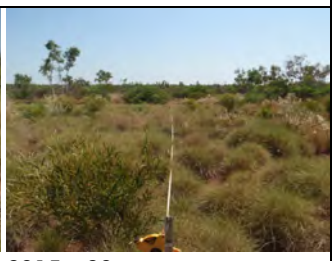
Cover and presence of individual species:

	BHPPA-22							BHPPD-22						
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**
Convolvulaceae														
Bonamia alatisemina										0.40		✓		
Bonamia erecta			✓	✓	✓		✓							
Polymeria lanata									0.35					
Fabaceae														
Acacia stellaticeps							✓	12.30	0.10	✓	6.40	12.10	22.05	16.90
Petalostylis cassioides									8.75	8.70	12.70	10.20		
Swainsona ?kingii											1.45			
Goodeniaceae														
?Goodenia microptera				✓										
Scaevola parvifolia										✓	✓	✓		
Lamiaceae														
Dicrastylis cordifolia	9.30	2.25	1.75	7.50	3.05	✓		7.85	0.25	✓	✓	✓		
Quoya paniculata								7.00						
Lauraceae														
Cassytha capillaris					✓							✓	□□□□	4.05
Cassytha sp.	5.55	1.75						17.8						
Poaceae														
Aristida holathera var. *holathera*									✓		✓			
Eragrostis eriopoda									0.25	2.60	1.25	10.55		
Triodia epactia								22.45	4.15	18.45				
Triodia schinzii	52.05	30.00	30.00	38.00	72.25	63.20	26.15			✓	25.80	21.85	28.05	22.15
Triodia glabra								1.95	0.25	0.75	2.40	3.50	✓	5.45
Proteaceae														
Grevillea stenobotrya											✓	✓		
Total no. of native species	**3**	**3**	**3**	**4**	**4**	**2**	**1**	**6**	**8**	**9**	**10**	**10**	**4**	**4**
Total no. of weed species	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Comments regarding site:

Rehabilitation is again in excellent condition in 2021; perennial shrub *Acacia stellaticeps* mature and flowering; spinifex is above pre-clearing levels and has been steady over the last four phases of monitoring and is representative of the greater area (as mentioned in the last monitoring report *Triodia schinzii* has either replaced *T. epactia*, or the soft spinifex was misidentified in the early phases); in comparison there has been a 37% reduction in spinifex cover within the Analogue site; perennial herbs have increased (e.g. *Cassytha capillaris*) showing a trend towards pre-clearing levels; and no weeds were recorded.

Site 23 (Mt Minnie conservation area)

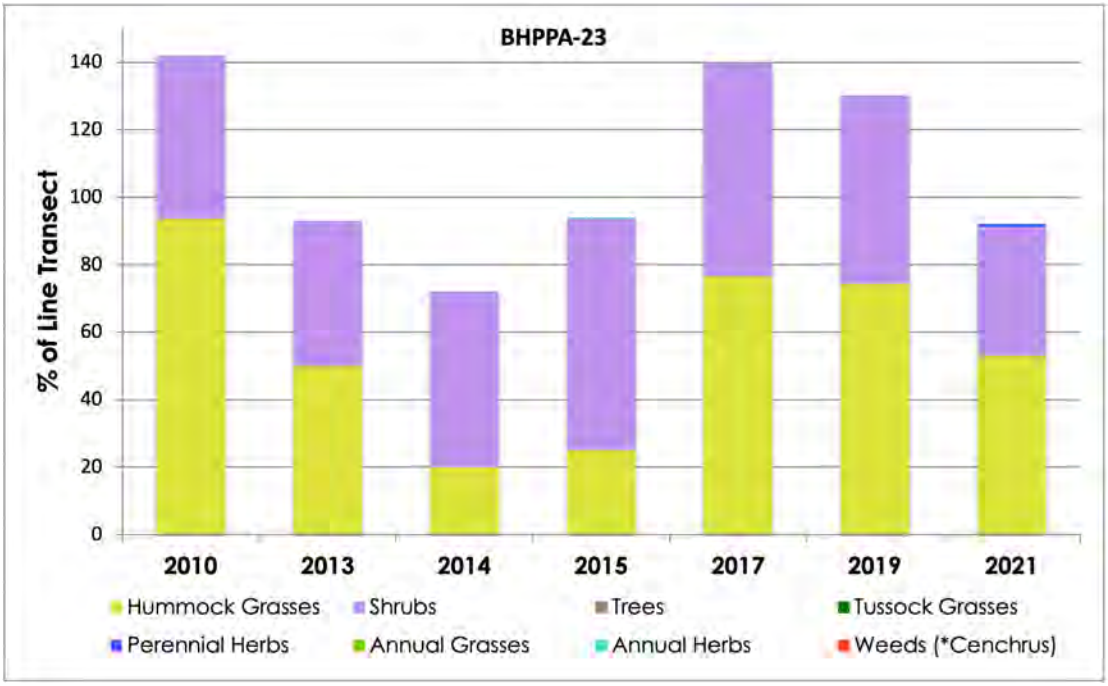
Analogue Transect BHPPA-23		Rehabilitation Transect BHPPD-23	
			
2010 – 0 m	2010 – 20 m	2010 – 0 m	2010 – 20 m
			
2013 – 0 m	2013 – 20 m	2013 – 0 m	2013 – 20 m
			
2014 – 0 m	2014 – 20 m	2014 – 0 m	2014 – 20 m
			
2015 – 0 m	2015 – 20 m	2015 – 0 m	2015 – 20 m

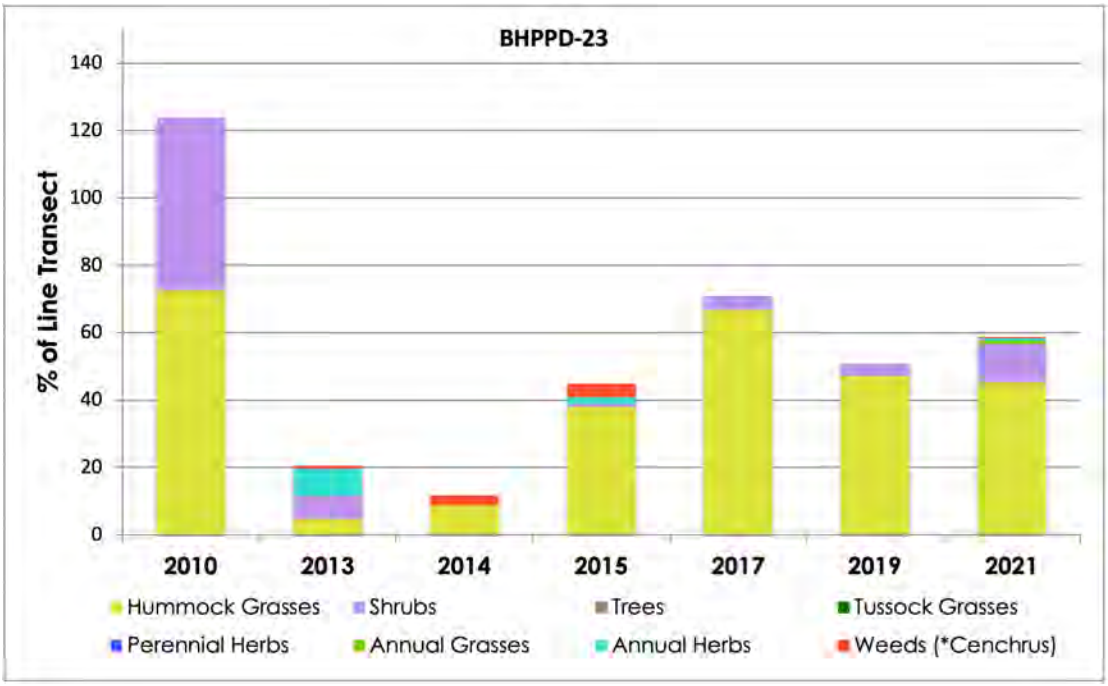
Site 23 (Mt Minnie conservation area)

Analogue Transect BHPPA-23		Rehabilitation Transect BHPPD-23	
			
2017 – 0 m	2017 – 20 m	2017 – 0 m	2017 – 20 m
			
2019 – 0 m	2019 – 20 m	2019 – 0 m	2019 – 20 m
			
2021 – 0 m	2021 – 20 m	2021 – 0 m	2021 – 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	
Analogue BHPPA-23	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			
Rehab BHPPD-23	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





Site 23 (Mt Minnie conservation area)

Cover and presence of individual species:

	BHPPA-23							BHPPD-23						
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**
Amaranthaceae														
Ptilotus axillaris									1.00					✓
Ptilotus polystachyus									4.75		0.10			✓
Asteraceae														
Pluchea dunlopii				✓										
Streptoglossa decurrens				✓										✓
Boraginaceae														
Heliotropium crispatum							✓		2.00					✓
Chenopodiaceae														
Dysphania rhadinostachya subsp. rhadinostachya														✓
Cleomaceae														
Arivela viscosa														✓
Convolvulaceae														
Bonamia erecta									✓	✓	✓			
Evolvulus alsinoides var. *villosicalyx*					✓									
Cyperaceae														
Bulbostylis barbata										✓				0.65
Euphorbiaceae														
Euphorbia tannensis														✓
Fabaceae														
Acacia ancistrocarpa								8.55		✓	0.85	2.75	3.65	3.50
Acacia bivenosa	40.50	37.50	43.50	56.05	55.25	55.95	37.40	4.05		✓	✓			✓
Acacia stellaticeps								30.90			✓	1.40	✓	5.20
Acacia synchronicia	7.75	5.50	8.60	12.65	7.90	✓	0.75							
Acacia trachycarpa								7.75						
Indigofera boviperda subsp. *boviperda*											✓			2.30
Indigofera colutea									✓		1.90			✓
Petalostylis cassioides											✓			
Tephrosia sp. B Kimberley Flora (C.A. Gardner 7300)					✓				✓	✓				
Goodeniaceae														
Goodenia microptera				0.25					✓					
Lauraceae														
Cassytha capillaris							1.00							
Malvaceae														
Abutilon lepidum									1.00					0.45
Abutilon otocarpum									3.00					

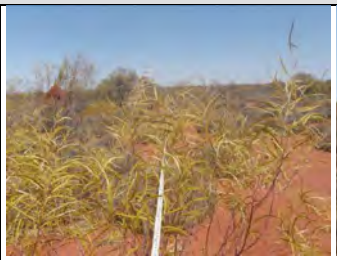
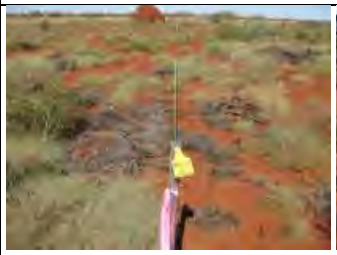
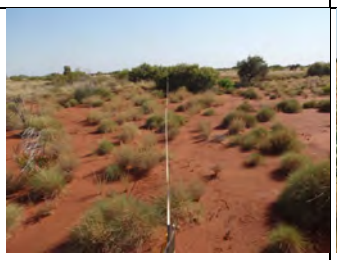
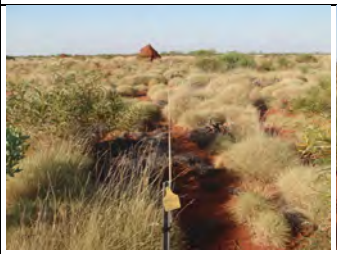
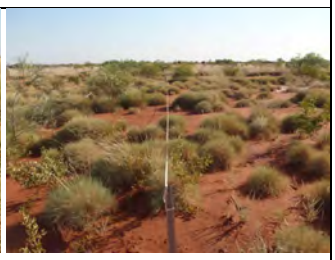
	BHPPA-23							BHPPD-23						
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**
Abutilon ?sp. Onslow (F. Smith s.n. 10/9/61)							✓							
Abutilon sp.				✓										
Corchorus sidoides subsp. *sidoides*														✓
Hibiscus sturtii											✓			
Hibiscus sturtii var. *campylochlamys*					✓									
Hibiscus sturtii var. *platychlamys*										✓				
Sida arsiniata											✓			
Sida cardiophylla							✓							
Sida fibulifera									3.00					✓
Sida sp.				✓					✓	✓				
Phyllanthaceae														
Phyllanthus erwinii														✓
Phyllanthus maderaspatensis				✓										
Poaceae														
**Cenchrus ciliaris*					✓				1.00	2.00	2.00	✓		✓
**Cenchrus setiger*					✓					1.00	2.00			0.45
Paspalidium clementii														0.90
Triodia epactia	92.45	30.00	15.00	25.00	70.65	61.00	27.45	66.55	4.50	7.50	30.00	62.00	47.20	36.65
Triodia glabra	1.25	20.00	5.00		5.90	13.30	25.55	6.15	0.25	1.25	8.05	4.75	✓	8.65
Yakirra australiensis var. australiensis														✓
Portulacaceae														
Portulaca oleracea									✓					
Total no. of native species	**4**	**4**	**4**	**9**	**7**	**4**	**8**	**6**	**14**	**9**	**12**	**4**	**4**	**21**
Total no. of weed species	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**1**	**2**	**2**	**1**	**0**	**2**

Comments regarding site:

Rehabilitation is in very good condition in 2021; spinifex is mature and cover steady from 2019 with an increase in *Triodia glabra* recorded, it is relatively close to pre-clearing levels; *Acacia* spp. have increased in cover, trending towards pre-clearing levels but noticeable very few have colonised within the clearing footprint; a small percentage of **Cenchrus* was recorded in the transect and in the surrounding vegetation in 2021 suggesting that since the herbicide application event in 2018 there has been no further weed control activities in the subsequent years allowing the weed to naturally re-establish in the area.

The Analogue site is showing a decrease in spinifex cover and perennial shrubs, but overall steady over the year's; the 2021 monitoring picked up the recruitment of perennial herb *Cassytha capillaris*.

Site 24 (Mt Minnie conservation area)

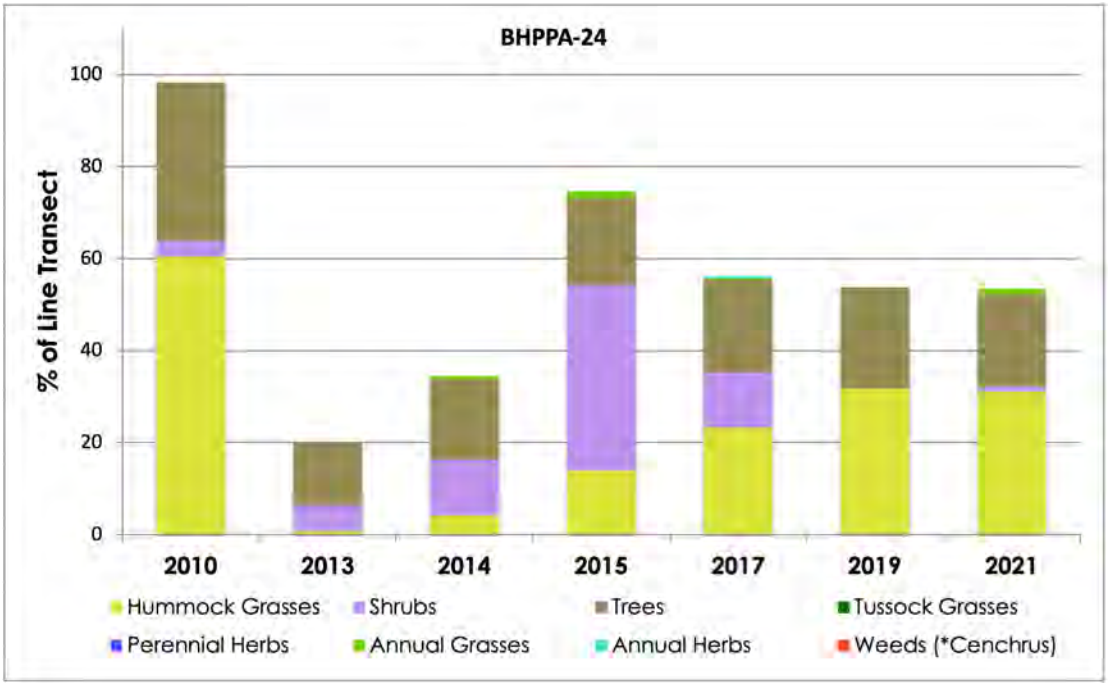
Analogue Transect BHPPA-24		Rehabilitation Transect BHPPD-24	
			
2010 – 0 m	2010 – 20 m	2010 – 0 m	2010 – 20 m
			
2013 – 0 m (burnt)	2013 – 20 m (burnt)	2013 – 0 m	2013 – 20 m
			
2014 – 0 m	2014 – 20 m	2014 – 0 m	2014 – 20 m
			
2015 – 0 m	2015 – 20 m	2015 – 0 m	2015 – 20 m

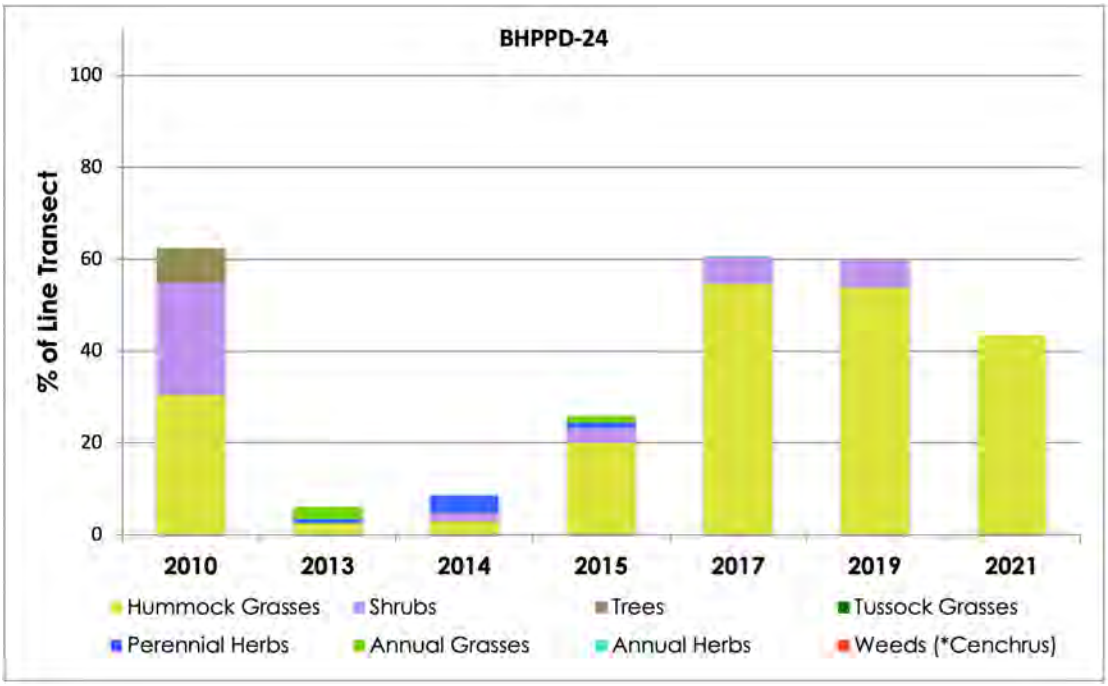
Site 24 (Mt Minnie conservation area)

Analogue Transect BHPPA-24		Rehabilitation Transect BHPPD-24	
			
2017 – 0 m	2017 – 20 m	2017 – 0 m	2017 – 20 m
			
2019 – 0 m	2019 – 20 m	2019 – 0 m	2019 – 20 m
			
2021 – 0 m	2021 – 20 m	2021 – 0 m	2021 – 20 m

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	
Analogue BHPPA-24	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		
Rehab BHPPD-24	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							





Site 24 (Mt Minnie conservation area)

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

Cover and presence of individual species:

	BHPPA-24							BHPPD-24						
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**
Amaranthaceae														
Ptilotus axillaris										✓				✓
Ptilotus fusiformis										✓				
Cleomaceae														
Cleome uncifera				✓										
Convolvulaceae														
Bonamia alatisemina					✓					3.60				
Bonamia erecta		5.35	10.75	17.90	8.55		1.20		✓	✓	1.65	2.30		✓
Evolvulus alsinoides											1.20			
Evolvulus alsinoides var. *villosicalyx*				✓										
Polymeria lanata									1.00					
Cyperaceae														
Bulbostylis barbata					0.40							0.25		
Fabaceae														
Acacia ancistrocarpa	3.30			✓		✓		21.25		✓	✓	2.50	4.75	
Acacia bivenosa								3.15		✓	✓	0.75	0.65	
Indigofera boviperda subsp. *boviperda*			✓	✓					✓	✓				
Indigofera sp.				✓										
Isotropis atropurpurea			✓	18.05	3.50					✓	✓			
Tephrosia uniovulata										✓				
Goodeniaceae														
Goodenia microptera				✓										
Scaevola spinescens									✓	0.35	✓	0.30	✓	✓
Malvaceae														
Corchorus sidoides		0.25	1.45	4.30										
Sida cardiophylla										1.60	1.60			
Sida sp. Pilbara (A.A. Mitchell PRP 1543)		✓	✓						✓					
Myrtaceae														
Corymbia hamersleyana	34.50	13.50	17.40	19.05	20.15	21.95	20.00							
Eucalyptus xerothermica								7.50						
Poaceae														
Aristida contorta		✓												
Aristida holathera var. *holathera*			0.75	1.15		✓	1.25		2.00	✓	✓			✓
Eriachne aristidea		✓		0.30					✓		1.55			
Eriachne pulchella var. *pulchella*					0.25									
Iseilema vaginiflorum									✓					

	BHPPA-24							BHPPD-24						
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**
Paspalidium clementii				✓	✓									
Paspalidium sp.									0.65					
Triodia glabra	60.50	0.75	4.15	13.90	23.25	13.30	31.05	30.50	2.50	3.00	20.00	54.60	✓	43.55
Proteaceae														
Grevillea striata							✓							
Total no. of native species	**3**	**7**	**8**	**14**	**8**	**4**	**5**	**4**	**10**	**13**	**10**	**6**	**4**	**5**
Total no. of weed species	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Comments regarding site:

Rehabilitation is in excellent condition in 2021; there has been a 10% decrease in cover of mature spinifex but remained at a steady level of cover since 2017 which is 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 2021 monitoring; no weeds were recorded within the sites and surrounding vegetation.

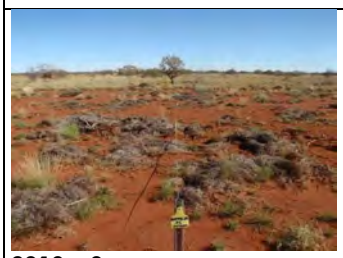
The spinifex and tree cover has remained steady within the Analogue site and still recovering from the fire prior to 2013 with the increase of annual grasses and perennial shrubs recorded.

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

Rehabilitation Transect BHPPD-25

2010 – 0 m

2010 – 20 m

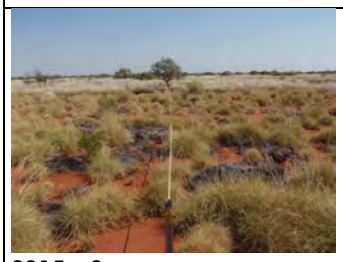


2013 – 0 m

2013 – 20 m

2014 – 0 m

2014 – 20 m



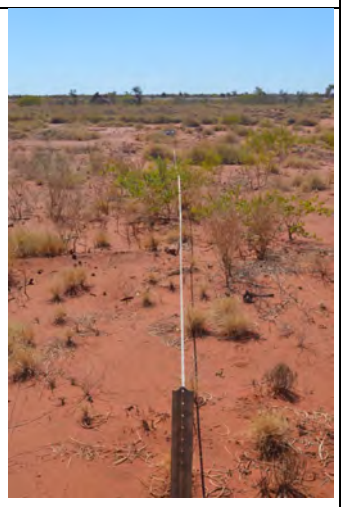
2015 – 0 m

2015 – 20 m

2017 – 0 m (patchily burnt)

2017 – 20 m (patchily burnt)

2019 – 0 m



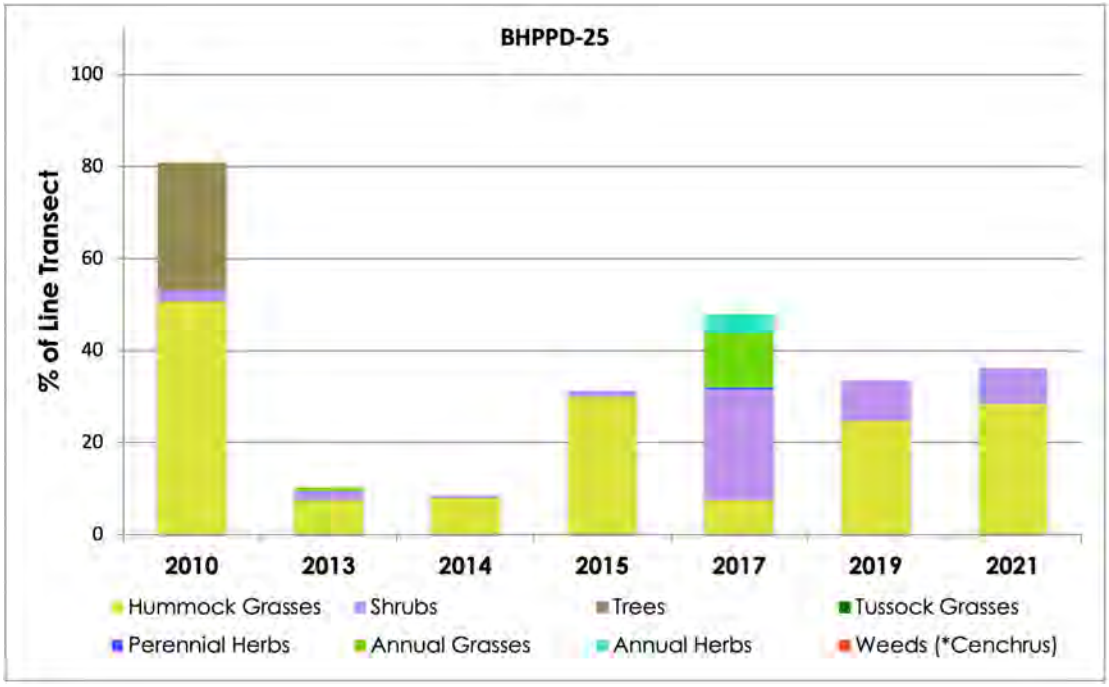
2019 – 20 m

2021 – 0 m

2021 – 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						



Site 25 (Mt Minnie conservation area)

NB. Patchily burnt prior to 2017 survey.

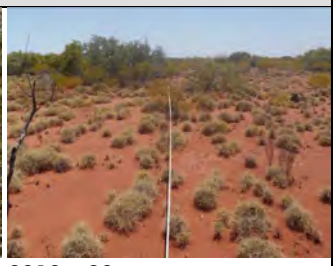
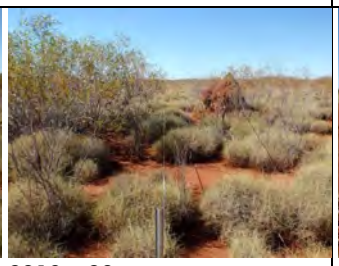
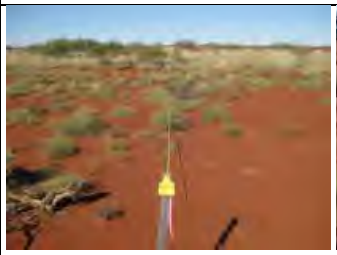
Cover and presence of individual species:

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

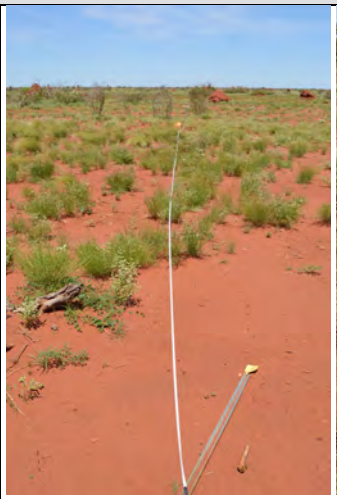
Comments regarding site:

Rehabilitation has gone from good condition in 2019 to excellent condition in 2021; spinifex has regenerated to the levels prior to the fire that preceded the 2017 monitoring phase, and increased slightly from 2019 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; notably scattered *Corymbia hamersleyana* and *Eucalyptus xerothermica* are absent within the clearing footprint; no weeds have been recorded within the sites and surrounding vegetation.

Site 26 (Mt Minnie conservation area)

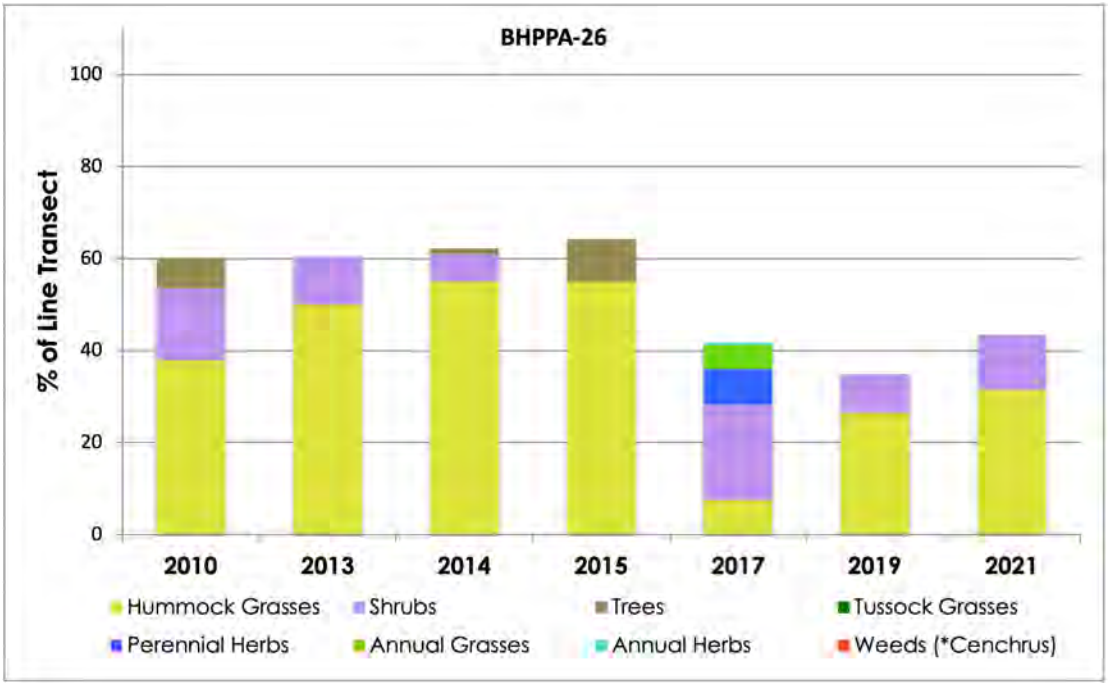
Analogue Transect BHPPA-26		Rehabilitation Transect BHPPD-26	
			
2010 – 0 m	2010 – 20 m	2010 – 0 m	2010 – 20 m
			
2013 – 0 m	2013 – 20 m	2013 – 0 m	2013 – 20 m
			
2014 – 0 m	2014 – 20 m	2014 – 0 m	2014 – 20 m
			
2015 – 0 m	2015 – 20 m	2015 – 0 m	2015 – 20 m

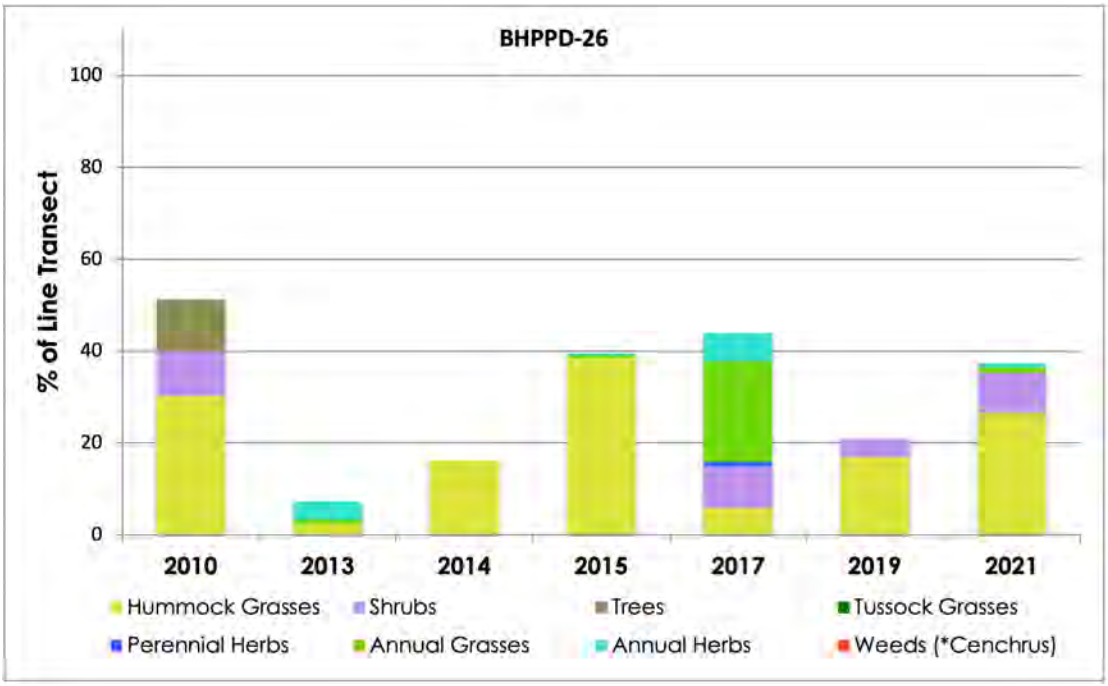
Site 26 (Mt Minnie conservation area)

Analogue Transect BHPPA-26		Rehabilitation Transect BHPPD-26	
			
2017 – 0 m (burnt)	2017 – 20 m (burnt)	2017 – 0 m (burnt)	2017 – 20 m (burnt)
			
2019 – 0 m	2019 – 20 m	2019 – 0 m	2019 – 20 m
			
2021 – 0 m	2021 – 20 m	2021 – 0 m	2021 – 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	
Analogue BHPPA-26	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						
Rehab BHPPD-26	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	





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:

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

Comments regarding site:

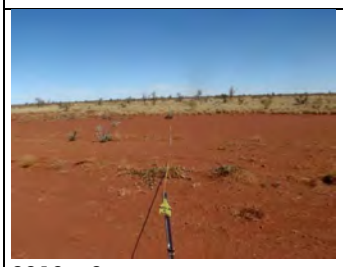
Rehabilitation has gone from good condition in 2019 to excellent condition in 2021; spinifex and *Acacia* spp. cover is continuing towards pre-clearing levels with the continued absence of *Corymbia hamersleyana* (this can also be said for the Analogue site which is still recovering from the fire prior to 2017); annual grasses and herbs have increased since 2019 due to increased rainfall over the last 6 months; 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

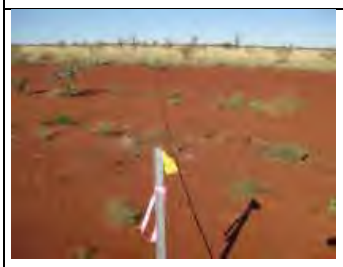
2010 – 0 m

2010 – 20 m



2013 – 0 m

2013 – 20 m



2014 – 0 m

2014 – 20 m

2015 – 0 m

2015 – 20 m

2017 – 0 m

2017 – 20 m

2019 – 0 m

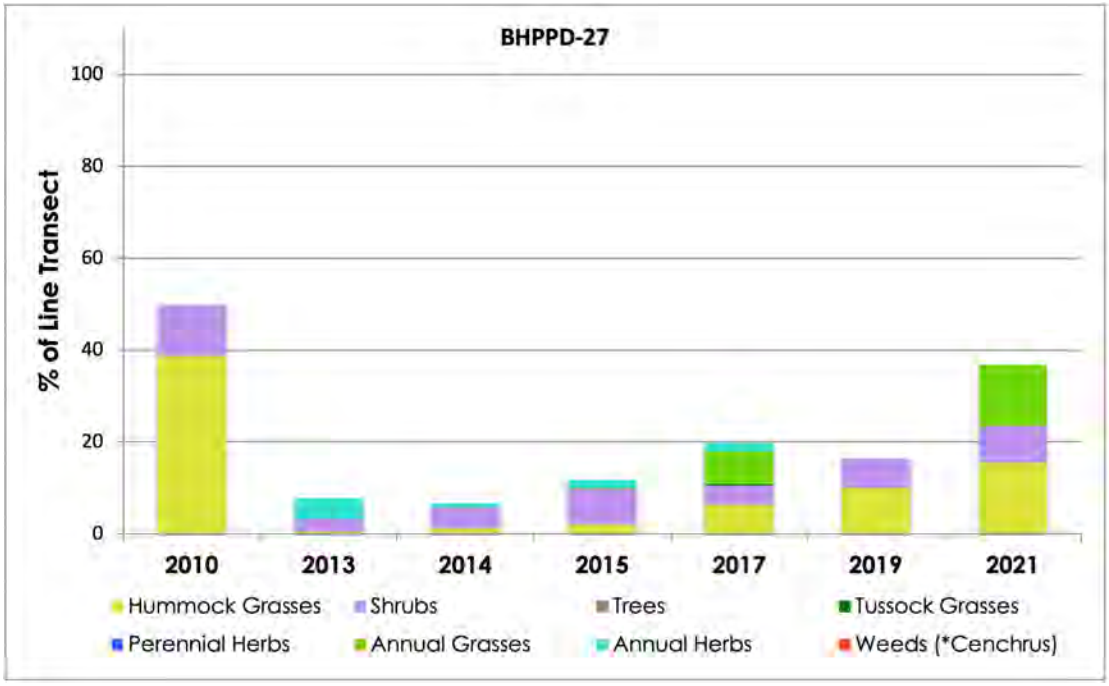
2019 – 20 m

2021 – 0 m

2021 – 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		



Site 27 (Mt Minnie conservation area)

Cover and presence of individual species:

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

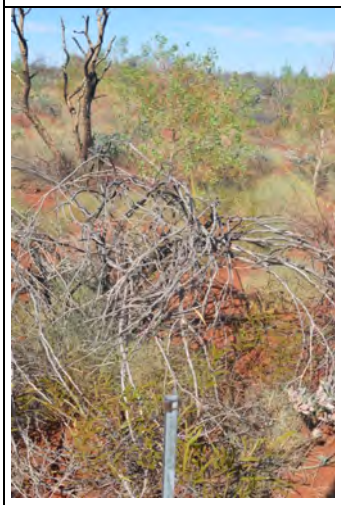
Comments regarding site:

Rehabilitation has gone from excellent condition in 2019 to very good condition in 2021; spinifex cover has continually increased since 2013 to just below half of pre-clearing levels in 2021 .The increase in both *Acacia ancistrocarpa*, and *A. inaequilatera* to near pre-clearing levels, is a positive indication that vegetation structure is tending towards its natural state; there has been an increase in annual grasses like *Aristida contorta* which is likely due to the high rainfall in the 6 months preceding the 2021 monitoring; no weeds were recorded within the sites or in the surrounding vegetation.

Site 28 (Mt Minnie conservation area)

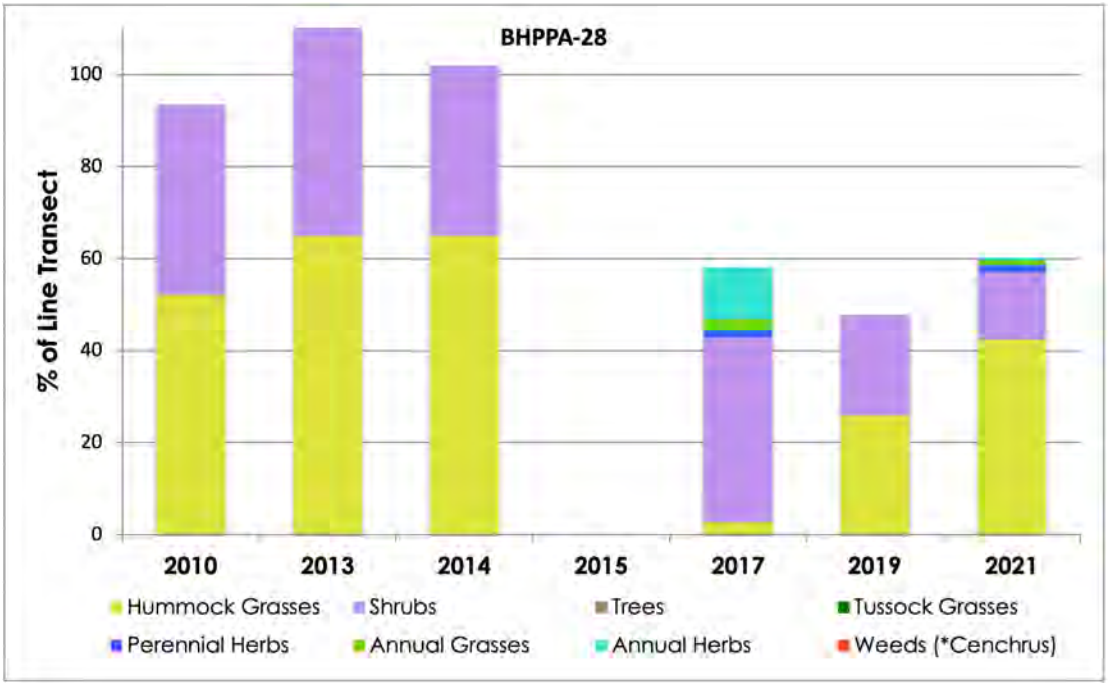
Analogue Transect BHPPA-28		Rehabilitation Transect BHPPD-28	
			
2010 – 0 m	2010 – 20 m	2010 – 0 m	2010 – 20 m
			
2013 – 0 m	2013 – 20 m	2013 – 0 m	2013 – 20 m
			
2014 – 0 m	2014 – 20 m	2014 – 0 m	2014 – 20 m
			
2015 – 0 m (burnt)	2015 – 20 m (burnt)	2015 – 0 m	2015 – 20 m

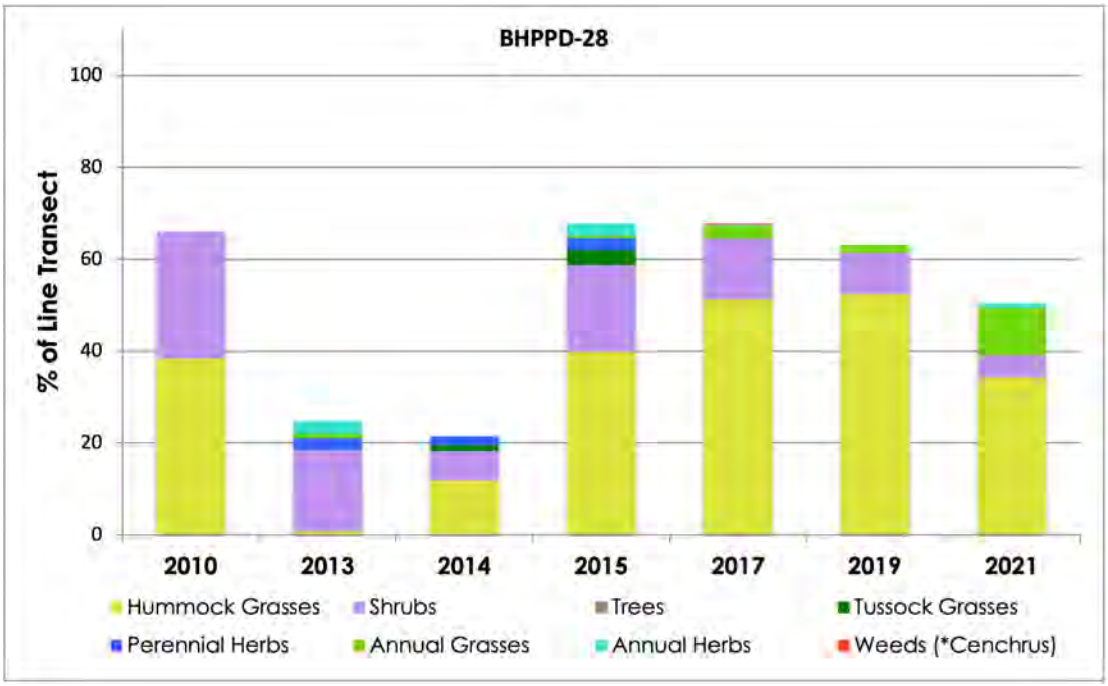
Site 28 (Mt Minnie conservation area)

Analogue Transect BHPPA-28		Rehabilitation Transect BHPPD-28	
			
2017 – 0 m	2017 – 20 m	2017 – 0 m	2017 – 20 m
			
2019 – 0 m	2019 – 20 m	2019 – 0 m	2019 – 20 m
			
2021 – 0 m	2021 – 20 m	2021 – 0 m	2021 – 20 m

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	
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	





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:

	BHPPA-28							BHPPD-28						
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**
Aizoaceae														
Trianthema triquetrum														0.10
Amaranthaceae														
Gomphrena canescens										✓				
Ptilotus astrolasius					✓	3.80	2.55							0.15
Ptilotus axillaris					✓		✓		1.50		2.75			0.75
Ptilotus nobilis										✓				
Ptilotus polystachyus							✓							✓
Asteraceae														
Streptoglossa decurrens					✓		✓				✓			
Caryophyllaceae														
Polycarpaea corymbosa var. *corymbosa*										✓				✓
Chenopodiaceae														
Dysphania kalpari							0.30							
Dysphania rhadinostachya							✓		✓	✓				✓
Salsola australis					1.30				✓	✓				✓
Convolvulaceae														
Bonamia alatisemina					0.95					✓				
Evolvulus alsinoides var. *villosicalyx*											0.75			✓
Polymeria lanata									✓					
Cucurbitaceae														
Cucumis variabilis									✓					
Cyperaceae														
Bulbostylis barbata			✓				✓					0.15		✓
Cyperaceae sp.									2.50					
Euphorbiaceae														
Euphorbia vaccaria var. *vaccaria*					✓		✓							
Fabaceae														
Acacia ancistrocarpa	24.55	31.25	37.00			6.35	✓			✓	3.75		✓	✓
Acacia bivenosa					0.30	✓	✓	20.75	✓	✓	2.50		✓	
Acacia inaequilatera	16.75	14.75			✓	✓		6.95	✓	✓	0.75	0.15	1.60	✓
Acacia stellaticeps							0.70							
Acacia synchronicia												11.60		
Acacia trachycarpa							1.65							
Cullen leucanthum					1.30									

	BHPPA-28							BHPPD-28						
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**
Cullen martinii					3.75									
Indigofera boviperda subsp. *boviperda*					17.45	4.25			0.75	4.90	10.65	0.75	4.80	
Senna notabilis					0.90				15.25		✓	✓	1.95	0.90
Goodeniaceae														
Goodenia microptera					4.00		0.35		1.25					✓
Gyrostemonaceae														
Codonocarpus cotinifolius					6.75	7.45	9.85							
Malvaceae														
Abutilon fraseri subsp. *fraseri*					3.45									
Abutilon lepidum							✓		✓	✓	✓	0.60	0.70	3.35
Abutilon sp. Pilbara (W.R.Barker 2025)														✓
Corchorus laniflorus											1.25			
Corchorus sidoides									✓	✓	✓			
Corchorus sidoides subsp. *vermicularis*					✓		✓							✓
Hannafordia quadrivalvis subsp. *recurva*														0.45
Triumfetta ramosa									1.75	1.50	✓			
Molluginaceae														
Mollugo molluginea					0.50		1.50		✓	1.95	1.80			✓
Nyctaginaceae														
Boerhavia coccinea					5.90									
Poaceae														
**Cenchrus ciliaris*												0.40	✓	✓
Aristida contorta							✓							2.40
Aristida holathera var. *holathera*					2.45							2.65	1.75	
Enneapogon caerulescens														✓
Eragrostis eriopoda										1.15	3.25			
Eragrostis pergracilis									✓					2.10
Eragrostis tenellula														3.25
Eriachne aristidea							1.00		✓	✓	0.50			0.80
Eriachne pulchella subsp. *pulchella*														✓
Iseilema dolichotrichum												✓		
Iseilema vaginiflorum									✓					✓
Paspalidium clementii							✓		1.00					1.75
Paspalidium rarum														✓
Sporobolus australasicus										✓		0.10		✓
Triodia glabra	52.10	65.00	65.00		2.70	25.95	42.35	38.35	0.75	11.90	39.85	51.20	52.35	34.25
Portulacaceae														
Portulaca oleracea							✓			✓				✓
Solanaceae														

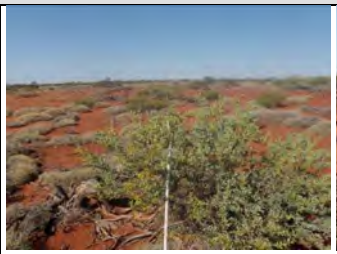
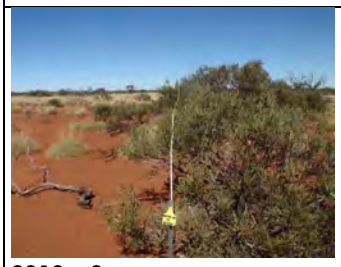
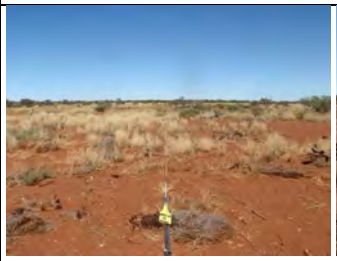
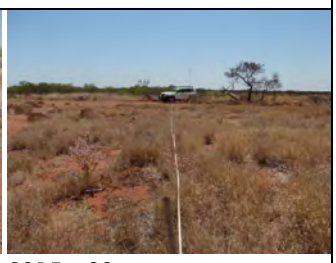
	BHPPA-28							BHPPD-28						
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**
Solanum diversiflorum					✓									
Surianaceae														
Stylobasium spathulatum												0.20		
Zygophyllaceae														
Tribulus hirsutus														✓
Total no. of native species	**3**	**3**	**3**	**0**	**21**	**7**	**22**	**3**	**20**	**19**	**16**	**11**	**8**	**31**
Total no. of weed species	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**

Comments regarding site:

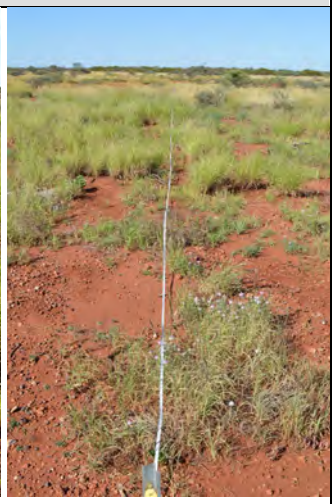
Rehabilitation is again in excellent condition in 2021; spinifex cover has decreased since 2019 but is more or less at pre-clearing levels (with 2017 and 2019 cover exceeding the pre-clearing levels); Cover of *Acacia* spp. shrubs is still low compared to pre-clearing with mature *Acacia ancistrocarpa* 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; the cover of **Cenchrus* was only recorded as a presence from the strip-transect in 2021 and the cover in the surrounding rehabilitated area is minimal.

Species diversity is much higher in both the Rehabilitation and Analogue transects in 2021 which is caused from the high rainfall in the 6 months preceding the monitoring allowing an increase of annual grasses and herbs to establish. Spinifex cover has also increased within the Analogue site to pre-fire levels.

Site 29 (Mt Minnie conservation area)

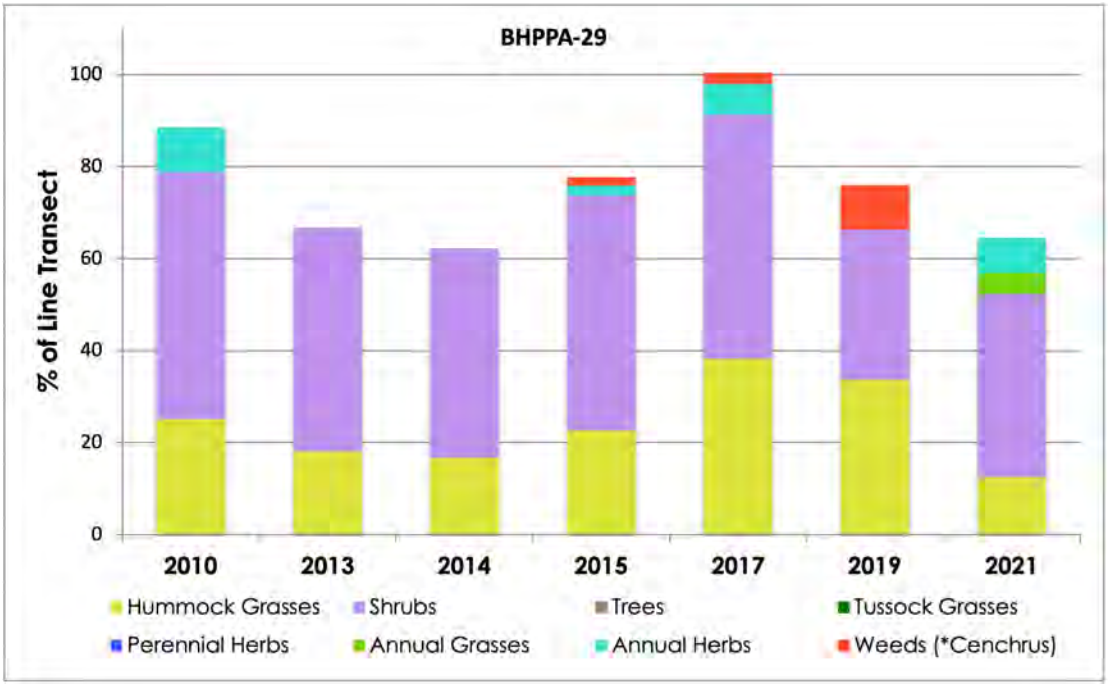
Analogue Transect BHPPA-29		Rehabilitation Transect BHPPD-29	
			
2010 – 0 m	2010 – 20 m	2010 – 0 m	2010 – 20 m
			
2013 – 0 m	2013 – 20 m	2013 – 0 m	2013 – 20 m
			
2014 – 0 m	2014 – 20 m	2014 – 0 m	2014 – 20 m
			
2015 – 0 m	2015 – 20 m	2015 – 0 m	2015 – 20 m

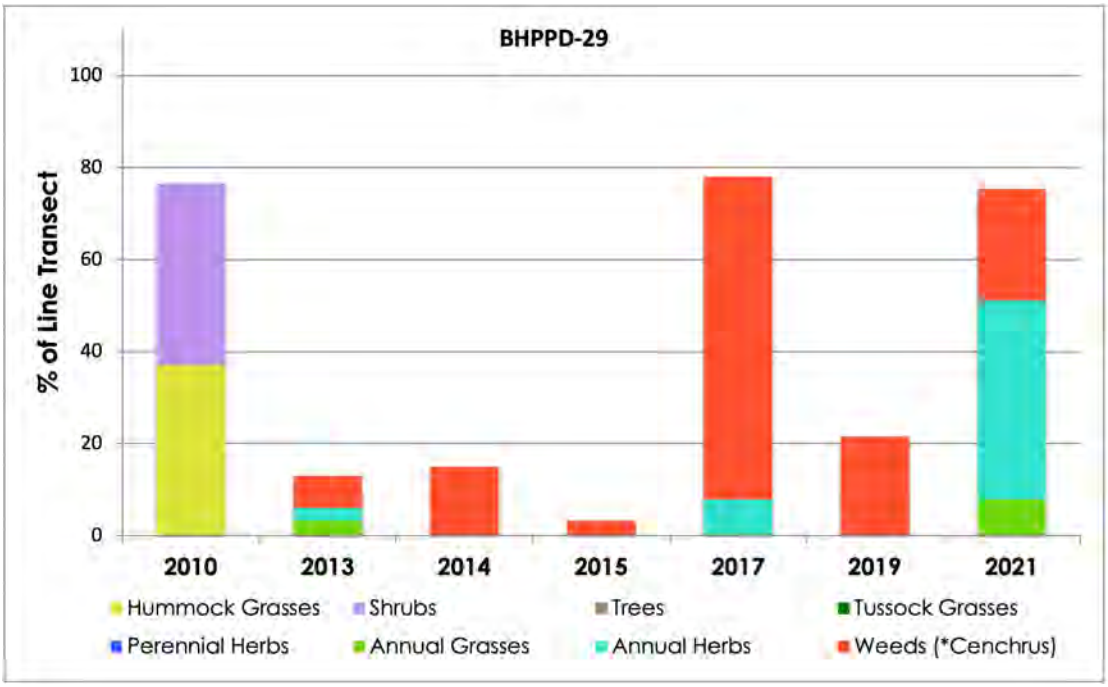
Site 29 (Mt Minnie conservation area)

Analogue Transect BHPPA-29		Rehabilitation Transect BHPPD-29	
			
2017 – 0 m	2017 – 20 m	2017 – 0 m	2017 – 20 m
			
2019 – 0 m	2019 – 20 m	2019 – 0 m	2019 – 20 m
			
2021 – 0 m	2021 – 20 m	2021 – 0 m	2021 – 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	
Analogue BHPPA-29	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	
Rehab BHPPD-29	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





Site 29 (Mt Minnie conservation area)

Cover and presence of individual species:

	BHPPA-29							BHPPD-29						
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**
Aizoaceae														
Trianthema triquetrum		✓	✓				3.95			✓		0.50		24.60
Amaranthaceae														
Amaranthus cuspidifolius							0.25							✓
Amaranthus ? interruptus					✓									
Amaranthus undulatus		✓		1.30					✓	✓				
Gomphrena affinis subsp. *pilbarensis*					✓							6.15		✓
Gomphrena canescens		✓		✓					✓	✓				
Ptilotus astrolasius														✓
Ptilotus exaltatus (was *nobilis*)										✓	✓	0.30		✓
Asteraceae														
Streptoglossa decurrens														✓
Chenopodiaceae														
Dysphania rhadinostachya														✓
Maireana villosa												✓		
Salsola australis	9.60			0.85	6.50					✓	✓	✓		
Fabaceae														
Acacia ancistrocarpa									✓	✓				
Acacia synchronicia								25.00						
Acacia xiphophylla	53.70	48.75	45.50	50.25	52.00	32.60	39.75	14.50						
Malvaceae														
Abutilon fraseri subsp. *fraseri*					1.00	✓								
Abutilon lepidum				0.75										
*Abutilon ?*sp. Pilbara (W.R.Barker 2025)							✓							
Corchorus laniflorus														✓
Hibiscus sturtii var. *grandiflorus*														✓
Sida fibulifera										✓				
Nyctaginaceae														
Boerhavia coccinea					✓				1.50	✓		0.50		✓
Poaceae														
Aristida contorta							0.30							
**Cenchrus ciliaris*		✓	✓	1.90	2.50	9.70			7.00	15.00	3.30	70.15	21.55	24.20
Cynodon prostratus		✓	✓		✓		4.00							
Dactyloctenium radulans							✓							
Enneapogon caerulescens									✓	✓				✓
Eragrostis tenellula							✓							
Paspalidium clementii							0.40							1.00

	BHPPA-29							BHPPD-29						
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**
Sporobolus australasicus		✓			✓				3.25	✓		0.25		6.85
Triodia epactia			7.50	5.50	2.00	12.80								
Triodia glabra	25.15		1.75	9.10	✓	✓	4.75	37.10						
Triodia wiseana		18.00	7.50	8.10	36.30	20.90	7.80							
Portulacaceae														
Portulaca oleracea		✓	✓		0.10		3.25		1.25			0.20		18.70
Zygophyllaceae														
Tribulus astrocarpus							✓							
Total no. of native species	**3**	**8**	**7**	**8**	**12**	**5**	**13**	**3**	**7**	**10**	**2**	**8**	**0**	**14**
Total no. of weed species	**0**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**1**

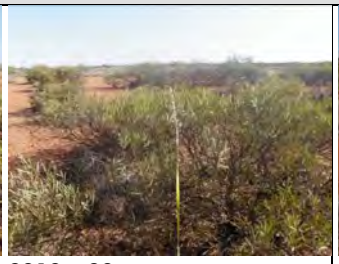
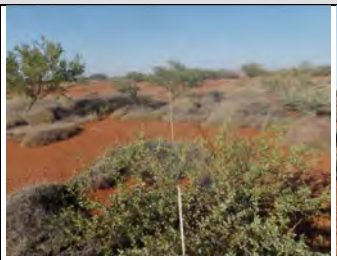
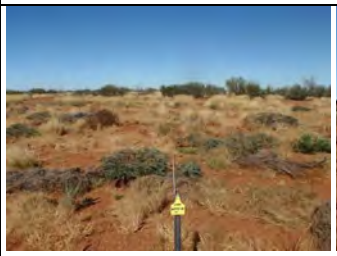
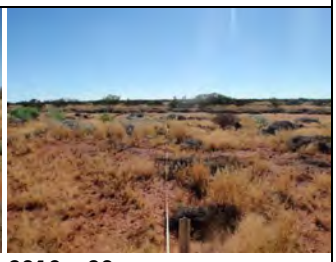
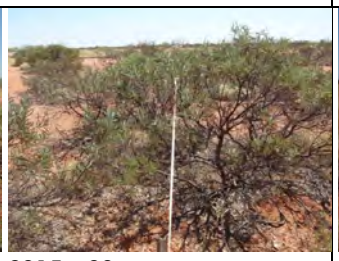
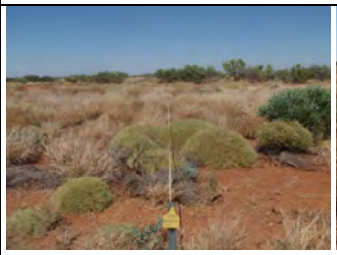
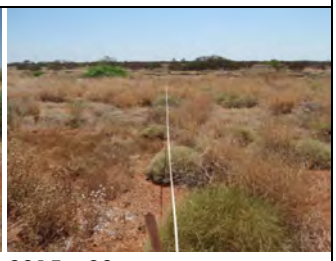
Comments regarding site:

Rehabilitation has gone from very poor in 2019 to poor condition in 2021; no spinifex or *Acacia's* have established along the transect (or in the surrounding cleared footprint heading north and south) following clearing and the cover of **Cenchrus* is still high and similar to the previous phase of monitoring. 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.

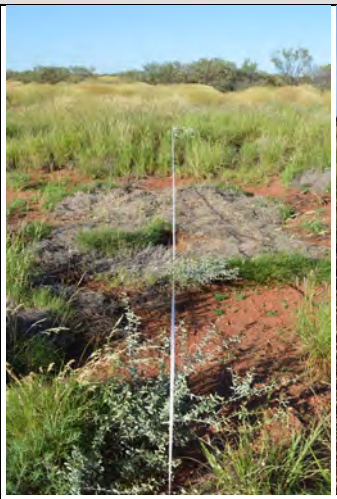
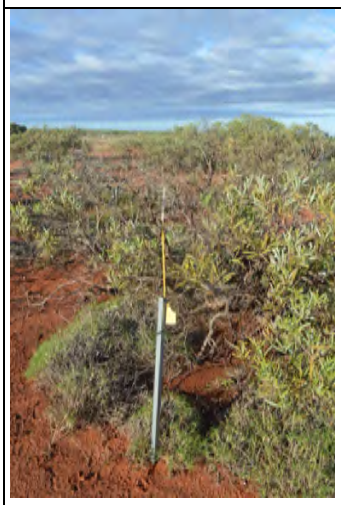
In 2017 the pipeline corridor either side of rehabilitation transect was dominated by mature **Cenchrus* populations, with high cover of **Cenchrus* tussocks to the southeast, and significant colonisation of bare areas by juvenile **Cenchrus* to the northwest. These populations were targeted with herbicide 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 a decrease in spinifex and perennial shrub covers and an increase in native annuals; with no weeds recorded during the 2021 monitoring phase.

Site 30 (Mt Minnie conservation area)

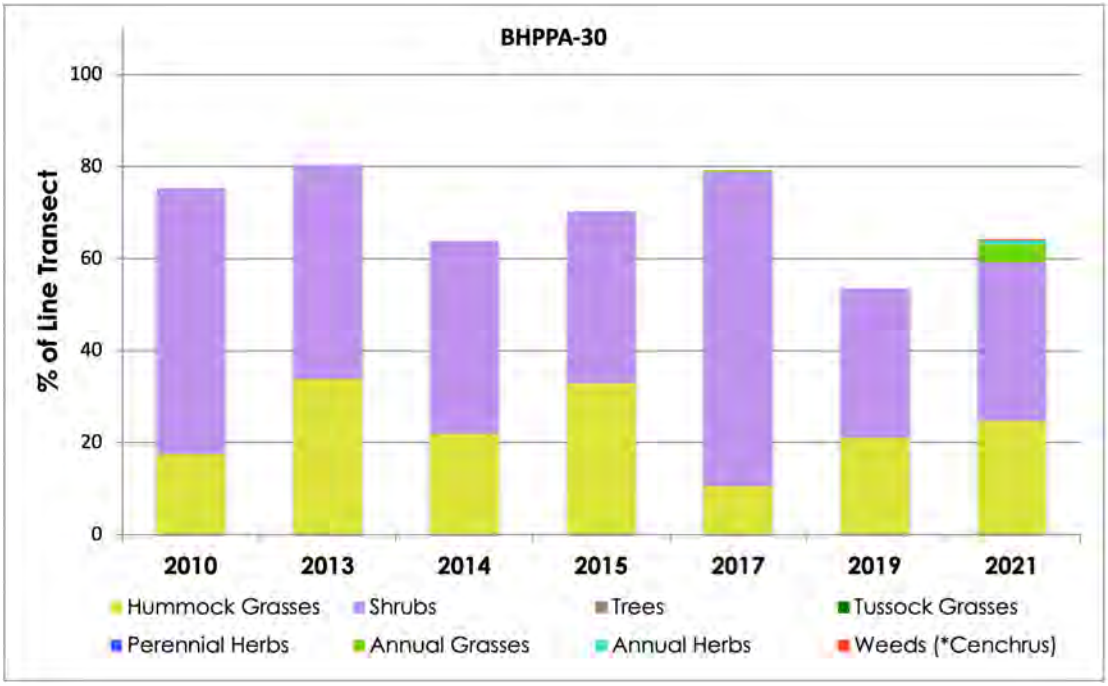
Analogue Transect BHPPA-30		Rehabilitation Transect BHPPD-30	
			
2010 – 0 m	2010 – 20 m	2010 – 0 m	2010 – 20 m
			
2013 – 0 m	2013 – 20 m	2013 – 0 m	2013 – 20 m
			
2014 – 0 m	2014 – 20 m	2014 – 0 m	2014 – 20 m
			
2015 – 0 m	2015 – 20 m	2015 – 0 m	2015 – 20 m

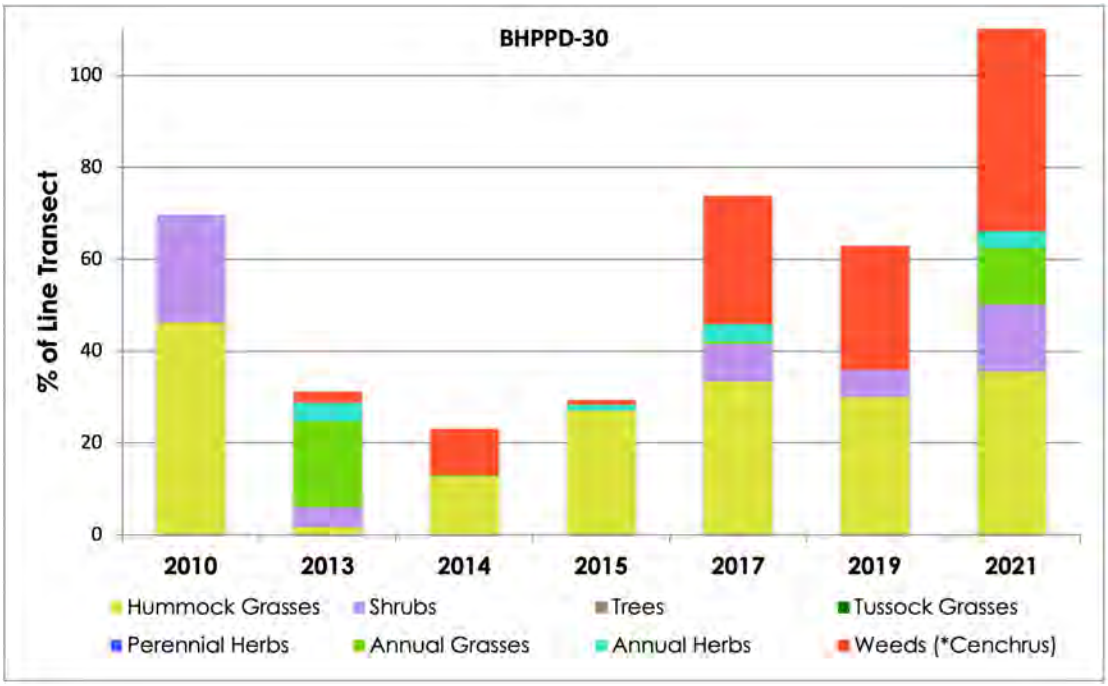
Site 30 (Mt Minnie conservation area)

Analogue Transect BHPPA-30		Rehabilitation Transect BHPPD-30	
			
2017 – 0 m	2017 – 20 m	2017 – 0 m	2017 – 20 m
			
2019 – 0 m	2019 – 20 m	2019 – 0 m	2019 – 20 m
			
2021 – 0 m	2021 – 20 m	2021 – 0 m	2021 – 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	
Analogue BHPPA-30	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
Rehab BHPPD-30	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





Site 30 (Mt Minnie conservation area)

Cover and presence of individual species:

	BHPPA-30							BHPPD-30						
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**
Aizoaceae														
Trianthema triquetrum							✓							1.05
Amaranthaceae														
Amaranthus cuspidifolius							✓							✓
Gomphrena affinis *subsp. pilbarensis*												0.45		✓
Gomphrena canescens										✓				
Ptilotus astrolasius									✓	✓				
Ptilotus axillaris							✓							✓
Ptilotus exaltatus (was *nobilis*)					✓		0.85							✓
Asteraceae														
Pterocaulon sphaeranthoides										✓				
Streptoglossa bubakii									✓	✓				✓
Brassicaceae														
Lepidium phlebopetalum														✓
Chenopodiaceae														
Dysphania rhadinostachya							✓							
Maireana planifolia			✓	0.40	1.20	1.25	0.80							
Salsola australis					✓		✓		2.25	✓	1.20	3.35		2.65
Cyperaceae														
Bulbostylis barbata									0.20					✓
Fabaceae														
Acacia synchronicia								23.50		✓		6.15	2.35	4.55
Acacia xiphophylla	57.90	46.50	41.90	37.00	67.05	31.25	33.70							
Senna notabilis							✓		4.25	✓		✓		1.45
Goodeniaceae														
Goodenia microptera														✓
Nyctaginaceae														
Boerhavia coccinea									1.50	✓				✓
Malvaceae														
Corchorus laniflorus							✓							
Corchorus sidoides var. *vermicularis*						✓							✓	
Poaceae														
**Cenchrus ciliaris*						✓	0.35		2.50	10.00	1.05	27.95	27.00	45.05
Cynodon prostratus									4.00	✓				✓
Dactyloctenium radulans										✓		0.50		3.05
Dichanthium sericeum									1.75	0.35				✓
Enneapogon caerulescens							✓							

	BHPPA-30							BHPPD-30						
Family / Species	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**
Eragrostis pergracilis									1.00					
Eragrostis tenellula							✓							✓
Eriachne pulchella subsp. *pulchella*							0.25							
Iseilema dolichotrichum							✓							
Iseilema vaginiflorum									✓					0.95
Paspalidium clementii					0.45		3.65							2.35
Paspalidium sp.									✓					
Sporobolus australasicus									12.00					5.85
Triodia epactia											4.70		8.95	9.50
Triodia glabra	17.50	15.25						46.25						
Triodia wiseana		18.60	22.00	32.95	10.55	21.05	24.70		1.75	12.70	22.40	33.35	21.00	26.05
Portulacaceae														
Portulaca oleracea							✓							✓
Solanaceae														
Solanum horridum										✓			✓	4.10
Solanum lasiophyllum												2.05	3.60	4.55
Total no. of native species	**2**	**3**	**3**	**3**	**6**	**4**	**17**	**2**	**13**	**13**	**3**	**7**	**6**	**25**
Total no. of weed species	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**1**	**1**	**1**	**1**	**1**	**1**

Comments regarding site:

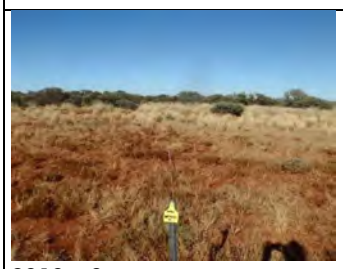
The Rehabilitation has gone from poor condition in 2019 to good condition in 2021; spinifex has re-established on the transect and is continuing the trend towards pre-clearing levels; perennial shrubs (*Acacia*'s and *Senna*) has also increased and show a trend towards pre-clearing levels; however, the cover of **Cenchrus* has remained high and increased by 18% since the last monitoring phase and the presence of **Aerva javanica* was also noted near the site. 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 now found within the Analogue site.

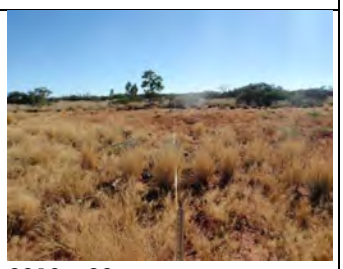
Site 31 (Mt Minnie conservation area)
(no analogue transect)

Rehabilitation Transect BHPPD-31


2010 – 0 m


2010 – 20 m


2013 – 0 m


2013 – 20 m


2014 – 0 m


2014 – 20 m


2015 – 0 m


2015 – 20 m

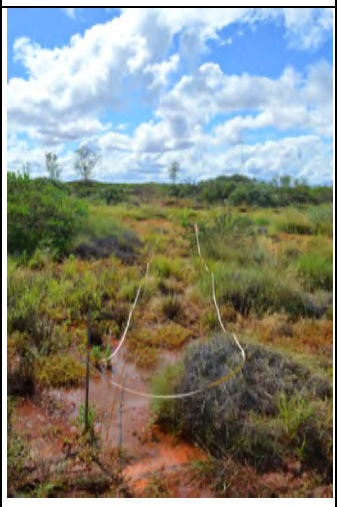

2017 – 0 m


2017 – 20 m


2019 – 0 m

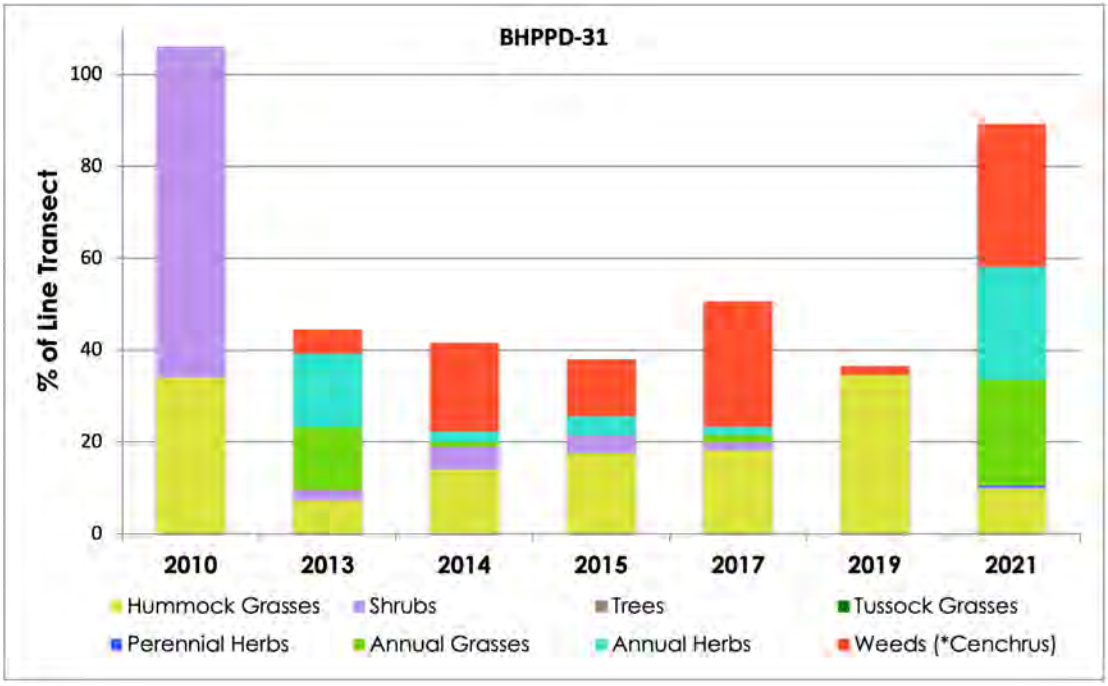

2019 – 20 m


2021 – 0 m


2021 – 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



Site 31 (Mt Minnie conservation area)

Cover and presence of individual species:

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

Comments regarding site:

The Rehabilitation was in poor condition in 2021; spinifex cover decreased by approximately 25%, to 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 increase in annual grasses and herbs; **Cenchrus* cover increased by 30% which is most likely due to the high rainfall in the preceding months and the discontinuation of herbicide application since the initial treatment in 2018.

Appendix 3

Vascular Flora Species List (2010 -2021)

N.B. The relatively low number of species recorded in 2019 and 2021 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).

		Astron				Biota		
Family	**Species**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**
Aizoaceae	*Trianthema pilosum*		✓	✓	✓			
	Trianthema triquetrum		✓	✓		✓		✓
	Trianthema turgidifolium	✓	✓	✓	✓	✓		
Amaranthaceae	*Amaranthus cuspidifolius*							✓
	Amaranthus ? interruptus					✓		
	Amaranthus undulatus		✓	✓	✓			
	Gomphrena affinis subsp. *pilbarensis*					✓		✓
	Gomphrena canescens		✓	✓	✓			
	Ptilotus appendiculatus				✓			
	Ptilotus arthrolasius					✓		
	Ptilotus astrolasius		✓	✓		✓	✓	✓
	Ptilotus axillaris		✓	✓	✓	✓		✓
	Ptilotus exaltatus (formerly *Ptilotus nobilis* subsp. *nobilis*)		✓	✓	✓	✓		✓
	Ptilotus fusiformis		✓	✓	✓	✓		✓
	Ptilotus gomphrenoides		✓					
	Ptilotus latifolius		✓	✓	✓			
	Ptilotus murrayi			✓				
	Ptilotus polystachyus		✓	✓	✓			✓
	Ptilotus villosiflorus				✓			
	Ptilotus xerophilus			✓	✓			
Araliaceae	*Trachymene pilbarensis*			✓				
Asteraceae	*Calotis porphyroglossa*				✓			
	Pluchea dunlopii				✓			
	Pluchea rubelliflora				✓			
	Pterocaulon sphaeranthoides			✓				
	Streptoglossa bubakii		✓	✓	✓	✓		✓

		Astron				Biota		
Family	**Species**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**
Asteraceae (cont.)	*Streptoglossa decurrens*			✓	✓	✓		✓
	Streptoglossa odora				✓			
Boraginaceae	*Heliotropium crispatum*		✓	✓	✓	✓		✓
	Heliotropium curassavicum				✓			
	Heliotropium glanduliferum		✓	✓	✓			
	Heliotropium inexplicitum				✓	✓		
	Trichodesma zeylanicum			✓	✓			
	Trichodesma zeylanicum var. *grandiflorum*					✓		
Brassicaceae	*Lepidium phlebopetalum*							✓
Caryophyllaceae	*Polycarpaea corymbosa* var. *corymbosa*			✓		✓		✓
Chenopodiaceae	*Atriplex codonocarpa*				✓			
	Atriplex semilunaris					✓		
	Atriplex sp. (inadequate material)			✓				
	Dysphania kalpari			✓				✓
	Dysphania rhadinostachya		✓	✓				✓
	Dysphania sp. (inadequate material)		✓			✓		✓
	Maireana planifolia			✓	✓	✓	✓	✓
	Maireana villosa					✓		
	Maireana sp. (inadequate material)		✓	✓				
	Neobassia astrocarpa			✓	✓			
	Salsola australis	✓	✓	✓	✓	✓		✓
	Sclerolaena burbidgeae				✓			
	Sclerolaena costata				✓			
	Sclerolaena recurvicuspis					✓		
	Tecticornia auriculata				✓			
	Tecticornia halocnemoides (subsp. not determined)	✓	✓	✓				
	Tecticornia halocnemoides subsp. *tenuis*				✓			
	Tecticornia indica	✓	✓	✓	✓			

		Astron				Biota		
Family	**Species**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**
Cleomaceae	*Arivela uncifera*				✓			✓
	Arivela viscosa							✓
Convolvulaceae	*Bonamia alatisemina*			✓	✓	✓		
	Bonamia erecta		✓	✓	✓	✓		✓
	Bonamia pilbarensis							✓
	Cressa australis			✓	✓			
	Evolvulus alsinoides (sterile; var. not determined)				✓			✓
	Evolvulus alsinoides var. *villosicalyx*		✓	✓	✓	✓		✓
	Ipomoea coptica				✓	✓		
	Ipomoea muelleri		✓	✓	✓	✓		
	Ipomoea polymorpha				✓	✓		
	Ipomoea sp. (inadequate material)			✓				
	Operculina aequisepala				✓			
	Polymeria ambigua		✓	✓				
	Polymeria lanata		✓					
Cucurbitaceae	*Cucumis variabilis*		✓					
Cyperaceae	*Bulbostylis barbata*		✓	✓	✓	✓		✓
	Cyperus bulbosus			✓	✓			
	Cyperaceae sp. (inadequate material)		✓					
Euphorbiaceae	*Adriana tomentosa* var. *tomentosa*	✓	✓	✓	✓			
	Euphorbia australis (var. not determined)				✓			
	Euphorbia boophthona			✓				✓
	Euphorbia coghlanii		✓	✓				
	Euphorbia myrtoides			✓	✓	✓		
	Euphorbia tannensis subsp. *eremophila*			✓				✓
	Euphorbia vaccaria var. *vaccaria*					✓		✓
	Euphorbia sp. (inadequate material)		✓	✓				
Fabaceae	*Acacia ancistrocarpa*	✓	✓	✓	✓	✓	✓	✓

		Astron				Biota		
Family	**Species**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**
Fabaceae (cont.)	*Acacia bivenosa*	✓	✓	✓	✓	✓	✓	✓
	Acacia coriacea	✓	✓	✓	✓			
	Acacia gregorii	✓						
	Acacia inaequilatera	✓	✓	✓	✓	✓	✓	✓
	Acacia sclerosperma subsp. *sclerosperma*				✓			
	Acacia stellaticeps	✓	✓	✓	✓	✓	✓	✓
	Acacia synchronicia	✓	✓	✓	✓	✓	✓	✓
	Acacia tetragonophylla	✓	✓	✓	✓			✓
	Acacia trachycarpa	✓						✓
	Acacia xiphophylla	✓	✓	✓	✓	✓	✓	✓
	Aenictophyton reconditum		✓	✓				
	Crotalaria cunninghamii subsp. *sturtii*		✓	✓	✓	✓		
	Crotalaria medicaginea var. *neglecta*		✓	✓	✓	✓		✓
	Crotalaria ramosissima			✓	✓	✓		
	Cullen cinereum		✓	✓	✓			
	Cullen leucanthum		✓		✓	✓		
	Cullen martinii		✓	✓	✓	✓		✓
	Desmodium filiforme			✓		✓		✓
	Indigofera boviperda subsp. *boviperda*		✓	✓	✓	✓	✓	✓
	Indigofera colutea		✓	✓	✓	✓		✓
	Indigofera linifolia		✓	✓	✓	✓		✓
	Indigofera linnaei				✓			
	Indigofera sp. (inadequate material)				✓			
	Isotropis atropurpurea			✓	✓	✓	✓	
	Lotus cruentus			✓				
	Petalostylis cassioides		✓	✓	✓	✓		
	**Prosopis* sp. (inadequate material)				✓	✓		
Fabaceae (cont.)	*Rhynchosia minima*		✓	✓	✓			✓

		Astron				Biota		
Family	**Species**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**
	Senna artemisioides subsp. *oligophylla* '(thinly sericeous form)'	✓						
	Senna notabilis		✓	✓	✓	✓	✓	✓
	Sesbania cannabina				✓	✓		
	Swainsona kingii			✓	✓			✓
	Swainsona pterostylis		✓	✓	✓			
	Tephrosia clementii							✓
	Tephrosia uniovulata		✓	✓		✓	✓	✓
	Tephrosia sp. B Kimberley Flora (C.A. Gardner 7300)		✓	✓	✓	✓		✓
	Tephrosia sp. (inadequate material)				✓			
	**Vachellia farnesiana*	✓	✓	✓	✓	✓		
Frankeniaceae	*Frankenia pauciflora*	✓	✓	✓	✓			
Gentianaceae	*Schenkia clementii*				✓			
Geraniaceae	*Erodium cygnorum*			✓				
Goodeniaceae	*Goodenia forrestii*		✓	✓	✓	✓		
	Goodenia microptera		✓	✓	✓	✓		✓
	Goodenia tenuiloba		✓	✓	✓			
	Scaevola parvifolia			✓	✓	✓		
	Scaevola sericophylla	✓	✓	✓	✓	✓		
	Scaevola spinescens		✓	✓	✓	✓	✓	✓
Gyrostemonaceae	*Codonocarpus cotinifolius*					✓	✓	✓
Haloragaceae	*Haloragis gossei*		✓	✓				
Lamiaceae	*Dicrastylis cordifolia*	✓	✓	✓	✓	✓	✓	
	Quoya loxocarpa					✓		
	Quoya paniculata	✓	✓	✓	✓			
Lauraceae	*Cassytha capillaris*	✓			✓	✓	✓	✓
	Cassytha sp. (inadequate material)	✓	✓	✓	✓			
Malvaceae	*Abutilon fraseri* subsp. *fraseri*					✓	✓	
Malvaceae (cont.)	*Abutilon lepidum*		✓	✓	✓	✓	✓	✓

		Astron				Biota		
Family	**Species**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**
	Abutilon otocarpum		✓			✓		
	Abutilon sp. Pilbara (W.R.Barker 2025)							✓
	Abutilon sp. Onslow (F. Smith s.n. 10/9/61) – **Priority 1**							✓
	Abutilon sp. (inadequate material)		✓	✓	✓			
	Alyogyne pinoniana var. *pinoniana*	✓			✓	✓		
	Corchorus laniflorus				✓			✓
	Corchorus sidoides (inadequate material)		✓	✓	✓			
	Corchorus sidoides subsp. *sidoides*							✓
	Corchorus sidoides subsp. *vermicularis*					✓	✓	✓
	Hannafordia quadrivalvis subsp. *recurva*			✓	✓		✓	✓
	Hibiscus brachychlaenus				✓	✓		
	Hibiscus sturtii (inadequate material)		✓	✓	✓			
	Hibiscus sturtii var. *campylochlamys*					✓		
	Hibiscus sturtii var. *grandiflorus*							✓
	Hibiscus sturtii var. *platychlamys*			✓	✓			
	Hibiscus sp. (inadequate material)		✓	✓				
	Lawrencia viridigrisea			✓	✓			
	Melhania oblongifolia			✓		✓		
	Sida arsiniata				✓			✓
	Sida cardiophylla			✓	✓			✓
	Sida fibulifera		✓	✓	✓	✓		✓
	Sida ? intricata		✓					
	Sida rohlenae subsp. *rohlenae*		✓	✓	✓			
	Sida sp. Pilbara (A.A. Mitchell PRP 1543)		✓	✓	✓		✓	
	Sida sp. (inadequate material)		✓	✓	✓	✓		
	Triumfetta ramosa		✓	✓	✓	✓		
	? Triumfetta sp. (inadequate material)		✓					
Marsileaceae	*Marsilea hirsuta*				✓	✓		

		Astron				Biota		
Family	**Species**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**
Molluginaceae	*Trigastrotheca molluginea*		✓	✓	✓	✓		✓
Myrtaceae	*Corymbia hamersleyana*	✓	✓	✓	✓	✓	✓	✓
	Eucalyptus victrix	✓	✓	✓	✓			
	Eucalyptus ? victrix (inadequate material)	✓						
	Eucalyptus xerothermica	✓						
Nyctaginaceae	*Boerhavia coccinea*		✓	✓		✓		✓
	Boerhavia sp. (inadequate material)			✓				
Phyllanthaceae	*Phyllanthus erwinii*							✓
	Phyllanthus maderaspatensis			✓	✓			
Plantaginaceae	*Stemodia grossa*		✓	✓				
Poaceae	*Aristida contorta*		✓	✓		✓		✓
	Aristida holathera var. *holathera*		✓	✓	✓	✓	✓	✓
	**Cenchrus ciliaris*	✓	✓	✓	✓	✓	✓	✓
	**Cenchrus setiger*		✓	✓	✓	✓	✓	✓
	**Cenchrus* sp. (inadequate material)					✓		
	Chloris pumilio		✓	✓	✓	✓		
	Chrysopogon fallax			✓				
	Cynodon prostratus		✓	✓		✓		✓
	Dactyloctenium radulans		✓	✓		✓		✓
	Dichanthium sericeum subsp. *humilius*		✓	✓				✓
	Enneapogon caerulescens		✓	✓				✓
	Eragrostis cumingii					✓		
	Eragrostis dielsii		✓					
	Eragrostis eriopoda		✓	✓	✓	✓		
	Eragrostis pergracilis		✓	✓	✓	✓		✓
	Eragrostis tenellula					✓		✓
	Eragrostis sp. (inadequate material)	✓						
Poaceae (cont.)	*Eriachne aristidea*		✓	✓	✓	✓		✓

		Astron				Biota		
Family	**Species**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**
	Eriachne benthamii	✓	✓	✓	✓			
	Eriachne obtusa			✓	✓			
	Eriachne pulchella var. *pulchella*		✓	✓		✓		✓
	Eriachne sp. (inadequate material)	✓						
	Eulalia aurea	✓	✓	✓	✓	✓		
	Iseilema dolichotrichum					✓		✓
	Iseilema vaginiflorum		✓	✓	✓			✓
	Panicum decompositum				✓			
	Panicum sp. (inadequate material)					✓		
	Paractaenum refractum		✓	✓				
	Paspalidium clementii		✓		✓	✓		✓
	Paspalidium rarum							✓
	Paspalidium sp. (inadequate material)		✓	✓				
	Setaria dielsii				✓			
	Sorghum plumosum		✓	✓	✓			
	Sporobolus australasicus		✓	✓	✓	✓		✓
	Sporobolus mitchellii		✓	✓	✓	✓		
	Triodia epactia	✓	✓	✓	✓	✓	✓	✓
	Triodia glabra	✓	✓	✓	✓	✓	✓	✓
	Triodia schinzii	✓	✓	✓	✓	✓	✓	✓
	Triodia ? schinzii (inadequate material)	✓						
	Triodia wiseana		✓	✓	✓	✓	✓	✓
	Urochloa holosericea subsp. *velutina*					✓		
	Yakirra australiensis var. *australiensis*		✓		✓	✓		✓
	Poaceae sp. (inadequate material)	✓						
Polygalaceae	*Polygala isingii*			✓				
Portulacaceae	*Calandrinia* sp. (inadequate material)			✓				
Portulacaceae (cont.)	*Portulaca oleracea*		✓	✓		✓		✓

		Astron				Biota		
Family	**Species**	**2010**	**2013**	**2014**	**2015**	**2017**	**2019**	**2021**
Proteaceae	*Grevillea eriostachya*	✓	✓	✓	✓			
	Grevillea stenobotrya	✓	✓	✓	✓	✓		✓
Sapindaceae	*Diplopeltis eriocarpa*	✓	✓	✓	✓			
Solanaceae	*Nicotiana occidentalis*			✓				
	Nicotiana rosulata			✓	✓			
	Solanum diversiflorum					✓		✓
	Solanum horridum			✓			✓	✓
	Solanum lasiophyllum		✓	✓	✓	✓	✓	✓
Surianaceae	*Stylobasium spathulatum*					✓		
Zygophyllaceae	*Tribulus astrocarpus*							✓
	Tribulus hirsutus		✓	✓				✓
	Tribulus occidentalis					✓		
	Tribulus macrocarpus							✓
	Tribulus sp. (inadequate material)		✓	✓				
	Zygophyllum retivalve			✓				