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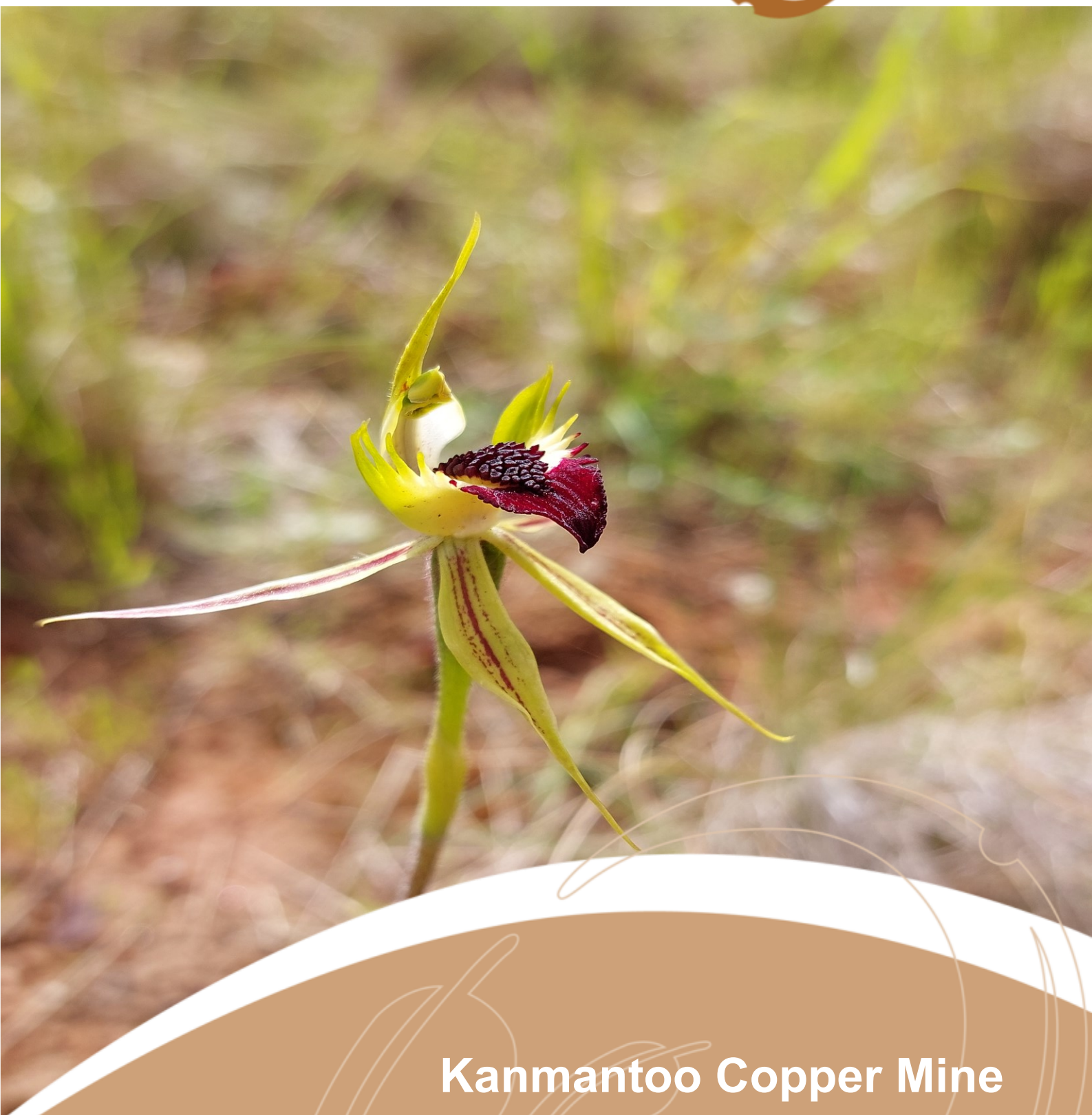

Kanmantoo Copper Mine

Landscape Function Analysis 2022

Kanmantoo Copper Mine Landscape Function Analysis 2022

30 January 2023

Version 2

Prepared by EBS Ecology for Hillgrove Resources Limited

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GLOSSARY AND ABBREVIATION OF TERMS

ACA	Derived *Acacia pycnantha* (Golden Wattle) low woodlands
BOM	Bureau of Meteorology
EBS	Environment and Biodiversity Services Pty Ltd – trading as EBS Ecology
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GRA	Modified hillslope grasslands
ha	Hectares
Hillgrove	Hillgrove Resources Limited
IWL	Integrated Waste Landform
Kanmantoo	Kanmantoo Copper Mine
km	Kilometre(s)
LFA	Landscape Function Analysis: an environmental monitoring technique which is internationally recognized as a method of measuring and monitoring ecosystem function and rehabilitation progress.
LOM	*Lomandra effusa* (Scented Mat-rush) +/- *Lomandra multiflora* subsp. *dura* (Stiff Mat-rush) Open Tussock Grassland
ML	Mining Lease
m²	square metres
mm	millimetres
ODO	*Eucalyptus odorata* (Peppermint Box) Woodland
PEPR	Program for Environmental Protection and Rehabilitation
Project Area	Kanmantoo Mining Lease (ML) and Significant Environmental Benefit areas
RT	Rehabilitation Transect
SA	South Australia/South Australian
SEB	Significant Environmental Benefit
ssp.	sub-species
spp.	species (plural)
SSA	Soil Surface Assessment
STI	*Austrostipa scabra* ssp. (Spear Grass) Grassland sites
TSF	Tailings Storage Facility
WRL	Waste Rock Landform

EXECUTIVE SUMMARY

A long-term Landscape Function Analysis (LFA) monitoring program is in place to measure the ongoing environmental management, restoration and Significant Environmental Benefit (SEB) offset program components of the Kanmantoo Copper Mine (Kanmantoo) operations in South Australia. Permanent LFA monitoring sites have been established across the Kanmantoo (Mining Lease) ML and SEB areas (together referred to as the 'Project Area').

The vegetation monitoring program commenced in 2011 and is now in its eleventh year (which excludes 2016 as the site was not monitored). Two Nationally Threatened Ecological Communities occur within the Project Area: *Eucalyptus odorata* (Peppermint Box) Open Woodland and *Lomandra effusa* (Scented Mat-rush) +/- *Lomandra multiflora* subsp. *dura* (Stiff Mat-rush) Open Tussock Grassland, which are both listed as Critically Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Permanent LFA monitoring sites, established in these communities at the beginning of the monitoring program (2011-2013) are used as baselines to guide restoration targets for rehabilitation and SEB areas.

This report provides LFA monitoring results for the 2022 monitoring program and compares these results with those from previous years and with the reference (analogue) sites. The 2022 monitoring included an assessment of 27 existing sites, of which four are analogue sites and 23 are sites to monitor rehabilitation success.

Across the Project Area the restoration sites are in various states of rehabilitation. However, many rehabilitation sites are indicating successful germination and flora survival with positive trends toward analogue landscape function indices and restoration goals.

In general, the LFA indicators have shown positive rehabilitation trends over the life of the Kanmantoo monitoring program (2011-2022). Rehabilitation plots have typically reached a level of 'self-sustaining communities', that is a development of native vegetation cover and soil stability relative to analogue sites, after a period of only 3-4 years. Revegetation sites that have managed to establish vegetation cover have generally maintained or increased cover type complexity, shifting from predominantly grass cover to additional shrub and tree cover. Based on the initial success rates of restoration activities across the Kanmantoo area, it is likely that ongoing restoration works will result in functional trends similar to those observed using LFA to date. Trends include initial low values, followed by a rebound period whereby plant cover produces high stability, infiltration and nutrient cycling values before stabilising towards analogue values. However, these indices can still be variable due to yearly fluctuations from stochastic factors such as weather.

Ecological vegetation attributes such as plant species richness (and whether species are native or exotic) are currently not recorded as part of the LFA monitoring method, limiting the ability of the current program to determine species abundance and diversity or the success of species of interest used in revegetation and seeding mixes. Species composition and germination success should be considered as part of ongoing monitoring to provide information on how specific species respond to restoration methods, thus informing future rehabilitation activities.

The ongoing monitoring design should continue to adapt to maximise the efficiency and effectiveness of detecting changes in LFA monitoring sites to inform and improve restoration outcomes. Ongoing annual review and adaptation of the monitoring program is recommended, taking into account factors such as frequency of assessment, indicators measured and sampling locations.

Table of Contents

List of Tables

List of Figures

1 INTRODUCTION

A long-term monitoring program using Landscape Function Analysis (LFA) has been implemented by Hillgrove Resources Limited (Hillgrove) to measure the ongoing environmental management, restoration and Significant Environmental Benefit (SEB) offset program components of the Kanmantoo Copper Mine (Kanmantoo from hereon) in South Australia.

Hillgrove has an obligation to meet its rehabilitation objectives associated with the Program for Environmental Protection and Rehabilitation (PEPR) for Kanmantoo. Part of the PEPR requires monitoring of nominated areas commissioned to offset clearance of native vegetation associated with mine operations and infrastructure. The monitoring is specifically undertaken to measure the progress of a restoration program over time using the LFA methodology of Tongway and Hindley (2004).

LFA is a tool that brings together a number of different components that, when measured together over time, provide an accurate indication of how a distinct rehabilitation area is performing, and advancing toward a functioning system. The intention of the Kanmantoo LFA monitoring program is to achieve a time series trajectory of land condition across the mine site, enabling critical indicators to be identified, their values analysed and utilised for revision of future management activities (i.e., adaptive management) if required. A comparison with data collected from reference (analogue) sites with similar characteristics, but under ambient conditions, will account for seasonal and external effects beyond the control of the manager and enables a direct comparison of performance. For a system to be developing towards sustainability, it must be accumulating resources faster than they are lost. A functional landscape is one where vital resources such as water, plant litter and topsoil are retained and efficiently used (cycled) within the boundaries of the landscape and released very slowly (Tongway and Ludwig 2006). LFA provides a rapid assessment of this functionality. When applied over time, results can be analysed to identify trends in the progress of the rehabilitation or remediation.

Since 2011, EBS Ecology has worked with Hillgrove Resources to undertake the ongoing LFA monitoring program across the Kanmantoo Project Area. Details of the monitoring program and associated methodologies and design are detailed in *Kanmantoo Mine Vegetation Monitoring – Landscape Function Analysis* (EBS Ecology 2011).

1.1 Objectives

The primary objectives of the 2022 LFA monitoring program are to:

- Repeat LFA at a selection of pre-existing sites established since 2011 at Kanmantoo;
- Provide results of ongoing LFA monitoring data assessed in 2022 across the Kanmantoo Project Area and compare with analogue sites and data from previous years;
- Discuss the LFA program results to this point and comment on trends observed.

1.2 Project Area

The Project Area is located approximately 45 kilometres (km) south-east of Adelaide in the eastern Mount Lofty Ranges of South Australia (SA) and 1.5 km south-west of the Kanmantoo township (Figure 1). The

area is representative of a transitional zone on the eastern face of the Mount Lofty Ranges, between the Adelaide Hills woodland regions and the Murray River Plains mallee. It has a long-term average rainfall of 469 millimetre (mm) (BOM 2022a) and encompasses a variety of soil types and geological structures, conducive to an assortment of vegetation types and habitat niches.

Within the Kanmantoo Project Area, the target landscape functionality of natural areas (as characterised by reference sites established within native vegetation communities) is compared with rehabilitated opencast mines and rehabilitated slopes of tailings dams. Soil surface quality indicators and landscape indices at Kanmantoo are similar to those observed by Van der Walt *et al*. (2012) in platinum mining operations in South Africa. In particular, patches vegetated with grasses and shrubs showed higher functionality than sparsely vegetated interpatch areas.

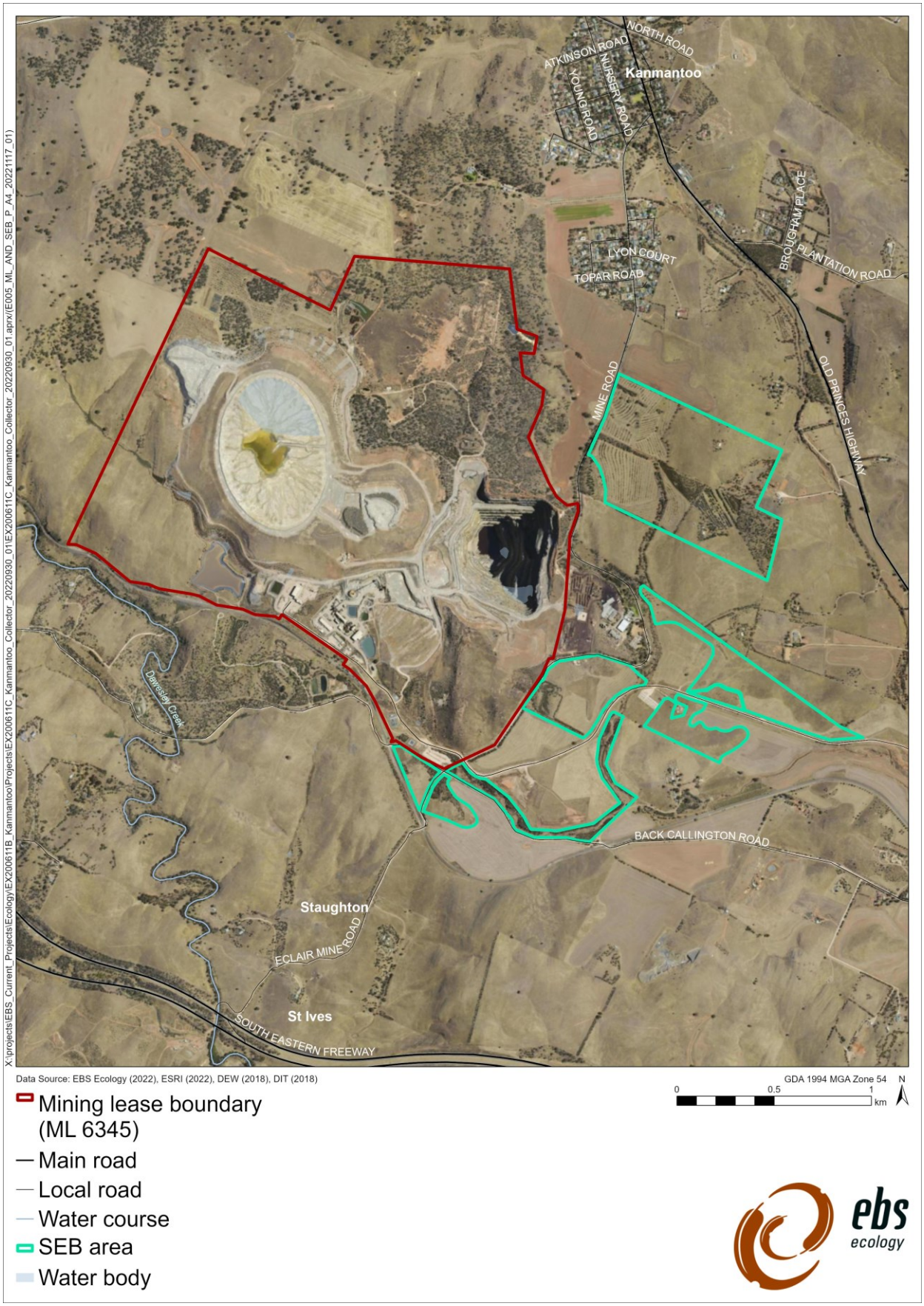

Figure 1. Location of the Kanmantoo Mining Lease (ML) and SEB areas over the Project Area.

2 BACKGROUND

A land condition and restoration monitoring program has been undertaken at Kanmantoo over a number of years, with the initial baseline surveys commencing in 2011. To date, fifty-one (51) permanent LFA monitoring sites have been established across the Kanmantoo Mining Lease (ML) and SEB areas. The LFA sites comprise a mix of baseline (analogue) and restoration/rehabilitation sites and each site has been monitored at different times and frequencies since 2011, based on changing restoration activities and monitoring priorities over time (Figure 2). Analogue sites were assessed (using the LFA method) in order to provide baseline data against which to compare future rehabilitation trajectories. These included three *Lomandra effusa* (Scented Mat Rush) Grassland sites, six *Eucalyptus odorata* (Peppermint Box) Woodland sites and three *Austrostipa scabra* ssp. (Spear Grass) Grassland sites.

Initially, the areas set aside for vegetation restoration were highly degraded areas of pastoral land historically utilised for sheep and / or cattle grazing. The soil cover comprised mostly exotic pasture species such as *Avena barbata* (Wild Oat), *Phalaris aquatica* (Phalaris), *Festuca* sp. (Fescue) and *Lolium* spp. (Perennial Rye grass). Remnant woodlands consisted of mature *Eucalyptus odorata* (Peppermint Box) trees devoid of understorey native vegetation. In 2013, a vegetation rehabilitation program commenced with a variety of proven restoration techniques employed, including inter row stripping, tubestock planting and hydroseeding. These methods aim to replicate the compositional, structural and functional characteristics observed in local vegetation communities present in the Pre-European period as closely as possible.

In the *Kanmantoo Mine Native Vegetation Management Plan* (Coffey Environments 2010), a series of measures associated with achieving a SEB under the *Native Vegetation Act 1991* were developed to offset native vegetation clearance for Kanmantoo. These measures included protection of quality remnant native vegetation and improving the condition of more degraded remnant native vegetation within the Project Area; and revegetation of pasture and disturbed areas aiming to reduce biomass of exotic species and restore native vegetation communities. Under the existing restoration program, four primary methods are being utilised:

- Direct seeding with native seed (following ripping / soil removal);
- Planting native flora seedlings (tube stock);
- Hydroseeding and hand broadcasting of seed on Tailings Storage Facility (TSF) walls;
- Weed control and bush care; and
- Translocation of significant flora such as *Diuris behrii* (Cowslip Orchid).

Using these methods, approximately 97 hectares (ha) have been managed for rehabilitation / restoration since the program commenced (Figure 2). LFA monitoring has been progressively established to assess these restored areas. Monitoring results are compared with analogue sites that were assessed in the initial stages of the monitoring program (i.e., 2011-2013) to measure progress towards a ‘functional’ state (Tongway and Hindley 2004).

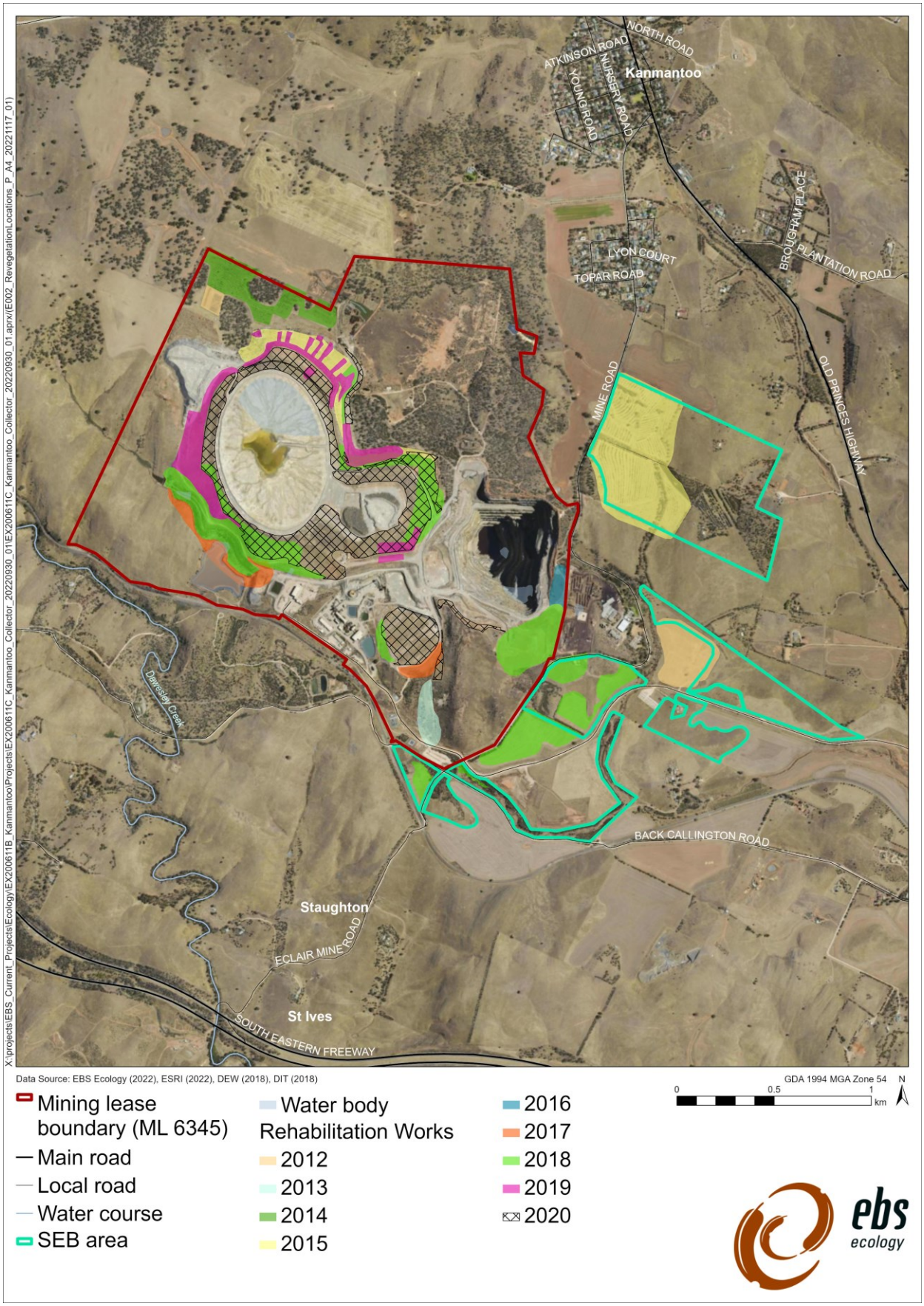

Figure 2. Rehabilitation and restoration activities at Kanmantoo 2012-2020. No rehabilitation works have been conducted since 2020.

3 METHODOLOGY MONITORING PROGRAM

3.1 Survey timing

The 2022 field survey was conducted in early October (7th and 11th to 13th inclusive), a similar period to previous surveys. t

3.2 Vegetation rehabilitation monitoring – Landscape Function Analysis

LFA monitoring sites are established in areas that enable Hillgrove to report on its required lease conditions under the current PEPR. LFA sites have been strategically positioned to enable evaluation of the LFA monitoring program, the following attributes of rehabilitation areas have been considered:

- Location of monitoring sites;
- Representation of vegetation communities; and
- Effectiveness of analogue versus rehabilitation sites as comparable data.

3.2.1 LFA rehabilitation sites

The 2022 LFA Monitoring program included assessment of 27 sites, comprised of nine analogue transects and eighteen rehabilitation transects (Table 1, Figure 3).

Analogue sites were initially established in three different vegetation community types:

1. *Eucalyptus odorata* (Peppermint Box) Woodland (ODO);
2. *Lomandra effusa* (Scented Mat-rush) +/- *Lomandra multiflora* subsp. *dura* (Stiff Mat-rush) Open Tussock Grassland (LOM); and
3. *Austrostipa scabra* ssp. (Spear Grass) Grassland sites (STI).

3.2.2 LFA Analogue sites

Additional analogue sites have since been established to match restoration priorities in the following two communities:

1. **Derived *Acacia pycnantha* (Golden Wattle) low woodlands (ACA) – established in 2014**

Examples of this community are located at the north-eastern end of the pit along the degraded edge of the *Eucalyptus odorata* open woodland (Figure 2). The current community is more accurately described as a *Eucalyptus odorata* open woodland with the overstorey removed, where *Acacia pycnantha* is now dominating as an interim climax community. The sites were therefore considered suitable as analogue sites to obtain LFA target reference figures for *Acacia pycnantha* low woodland rehabilitation sites.

2. **Modified hillslope grasslands (GRA) – established in 2019**

Two of these sites were established within the ML on ‘Carmens’ paddock, west of the dam and two sites were located outside of the ML on the southern side of Back Callington Road near the weather / dust monitoring station (Figure 3).

Data collection and analysis were undertaken in accordance with the LFA procedures manual developed by Tongway & Hindley (2004). Details of the rehabilitation monitoring program and associated methodologies are detailed in Kanmantoo Mine Vegetation Monitoring – Landscape Function Analysis (EBS Ecology 2011). A summary of all sites monitored since 2011 is provided in Appendix 1.

3.3 Other monitoring related to rehabilitation

The 2022 fauna monitoring program included monitoring of avifauna (birds) and possums (primarily Common Brushtail – *Trichosurus vulpecula*). Twenty-three avian transects are located over the Project Area; 14 within the Mining Lease (ML) and nine within the SEB area. Results from the Spring 2022 fauna survey are detailed elsewhere in EBS Ecology (2023b).

3.4 Limitations

As this is a long-term project different surveyors have undertaken the monitoring at Kanmantoo over the years. Observer bias may result in a systematic difference between a true value and the value actually observed due to observer variation. Observer bias has been reduced as much as possible by having the same observer conduct the survey in successive years where possible, and by training new observers on how to conduct the survey works.

Table 1. Selection of existing LFA rehabilitation (RH) sites and analogue (AN) sites assessed in 2022, including assessment history from 2011-2022.

Site type	Site name	2011	2012	2013	2014	2015	2017	2018	2019	2020	2021	2022
RH	KANODO 4	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
RH	KANODO 5	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
RH	KANODO 6	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
RH	KANODO 8				✔	✔	✔	✔	✔	✔	✔	✔
RH	KANODO 9				✔	✔	✔	✔	✔	✔	✔	✔
RH	KANODO RT 07					✔	✔	✔	✔	✔	✔	✔
RH	KANODO RT 10					✔	✔	✔	✔	✔	✔	✔
RH	KANODO RT 12					✔	✔	✔	✔	✔	✔	✔
RH	KANODO RT 13					✔	✔	✔	✔		✔	✔
RH	KANODO RT 14					✔	✔	✔	✔	✔	✔	✔
RH	KANODO RT 15					✔	✔	✔	✔	✔	✔	✔
RH	KANODO RT 16					✔	✔	✔	✔		✔	✔
RH	KANODO RT 17					✔	✔	✔	✔	✔	✔	✔
RH	KANODO RT 18						✔	✔	✔	✔	✔	✔
RH	KANODO RT 19						✔	✔	✔	✔	✔	✔
RH	KANODO RT 20						✔	✔	✔	✔	✔	✔
RH	KANODO RT 21							✔	✔	✔	✔	✔
RH	KANLOM RT 01						✔	✔	✔	✔	✔	✔
RH	KANLOM RT 02							✔	✔	✔	✔	✔
RH	KANACA RT 01						✔	✔	✔	✔	✔	✔
RH	KANACA RT 02						✔	✔	✔	✔	✔	✔
RH	KANACA RT 03							✔	✔	✔	✔	✔
RH	KANGRA RT 01			✔	✔	✔	✔	✔	✔	✔	✔	✔
AN	KANGRA 10								✔	✔	✔	✔
AN	KANGRA 11								✔	✔	✔	✔
AN	KANGRA 12								✔	✔	✔	✔
AN	KANGRA 13								✔	✔	✔	✔

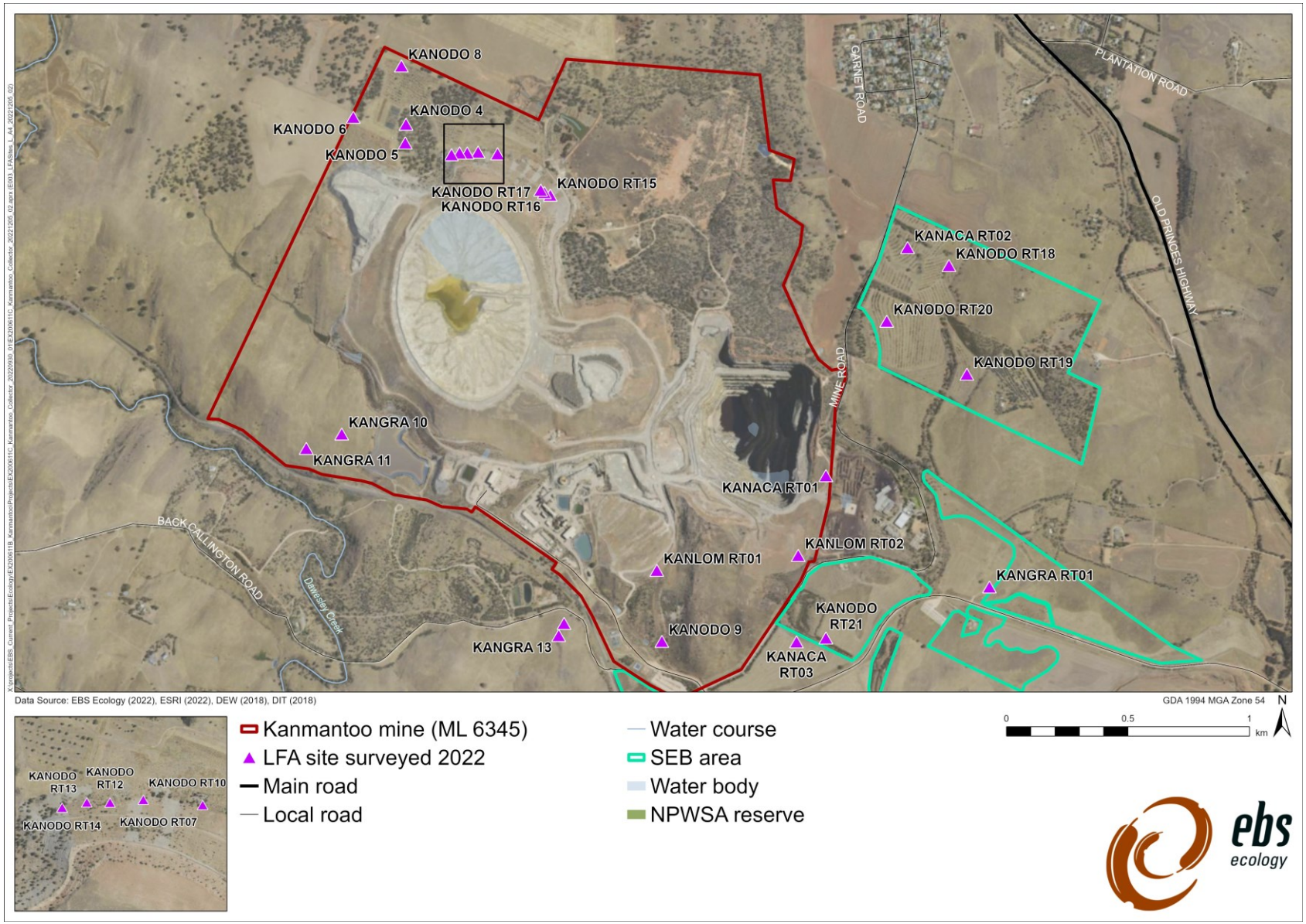

Figure 3. LFA monitoring sites assessed at Kanmantoo in October 2022.

4 LFA RESULTS 2022

4.1 Climate

Weather conditions over the 2022 LFA survey period were characterised by cool to mild mornings and afternoon temperatures (BOM 2022b) with both winds and rainfall varying from light to strong/heavy. Long term rainfall data (1874-2022) was primarily sourced from the Kanmantoo weather station (BOM 2022a) with consideration and reference to the Murray Bridge (Pallamana Aerodrome) weather station (BOM 2022b). Both weather stations were utilised to better reflect long term averages and recent high rainfall events. Annual rainfall data was analysed from the Kanmantoo weather station across the 12 months from October to September so that data from the end of the previous year and into the current survey year was incorporated (i.e. for 2022 rainfall data was analysed from October 2021 to September 2022 inclusive). This better reflects the survey period and ensures that as much data is as possible is analysed.

Rainfall at Kanmantoo shows annual variability, particularly over the 2011 to 2022 timeframe, as annual rainfall ranged from the lowest in 2018 (345.4 mm) to the highest in 2016 (578.8 mm) (BOM 2022a). Overall, 2010-2012, 2014, 2016-2017, 2021 had above average rainfall (> 466 mm), while 2013, 2015, 2018-2020 had below average rainfall (Figure 4) (BOM 2022a). Rainfall in 2022 from the Kanmantoo weather station data is less than the long-term average, however rainfall data for 2022 is limited to the months Oct-Aug, as at the time of the current report rainfall records for September were not yet available. Therefore, rainfall totals for 2022 are likely to be greater than the values presented in Figure 4, particularly with recent rainfall events in November of 2022. For example, on the 8th of September 14.6mm of rainfall was recorded at the Murray Bridge weather station (BOM 2022b). Additionally, it must be noted that there is missing rainfall data for the years 2012, 2017 and 2019 and therefore rainfall totals in these years may be greater than the values presented in Figure 4.

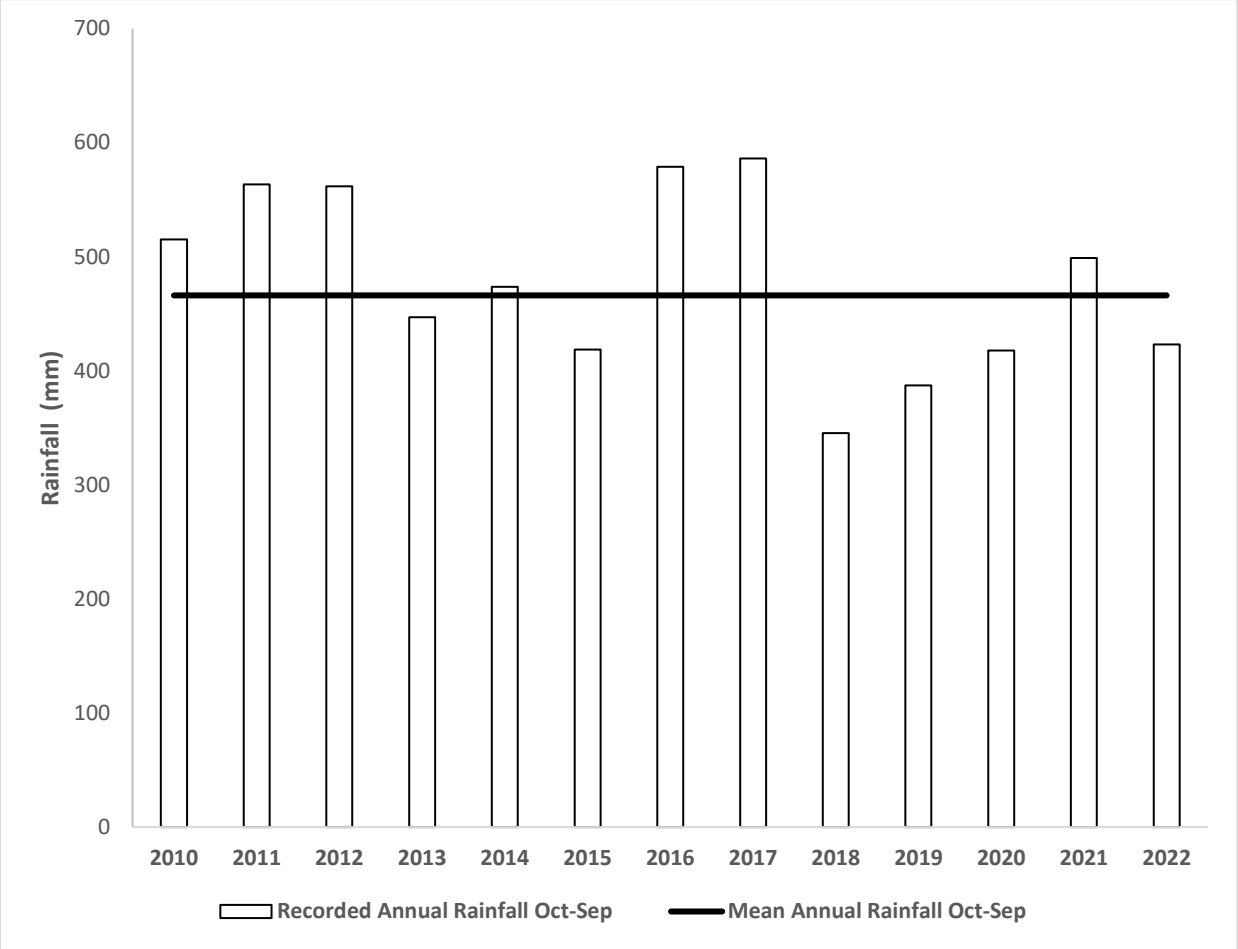

Figure 4. Mean annual rainfall from October to September inclusive at Kanmantoo weather station (23724) from 2011 to 2022.

Note: There is missing data for Oct 2012, Oct 2017 and Dec 2019 and therefore, the total rainfall for these years may be lower than the true value (BOM 2022). Rainfall data for 2022 is limited to the months Oct-Aug, as at the time of the reporting rainfall records for September 2022 were unavailable. Therefore, the total rainfall for 2022 may be higher than the true value (BOM 2022a).

4.2 LFA Soil Surface Assessment results

Results for Soil Surface Assessments (SSA) for individual zones and their contribution to whole of site values are provided in Appendix 2. Baseline data obtained from multiple analogue sites of the same vegetation association were combined to obtain average values (e.g., KANODO 01, 02 and 03) that are used as target values for rehabilitation sites (see chart columns with error bars below).

4.3 *Eucalyptus odorata* (Peppermint Box) Woodland rehabilitation transects

4.3.1 KANODO 4

Site KANODO 4 had soil surface indices approaching analogue values (Figure 5) for stability and nutrients but a lower level of infiltration than previous years. Apart from small fluctuations in proportions of Shrub, Tree and Branch Complex patches, the general patch proportions are similar to the previous 3 years of monitoring (Figure 6). Landscape organisation is approaching or exceeding analogue values, with larger average interpatch length compared to the analogue (Table 2). Visually, this site appears to show little change from previous years, including the shrub layer of which individuals have remained small after the removal of corflute tree guards (Appendix 3).

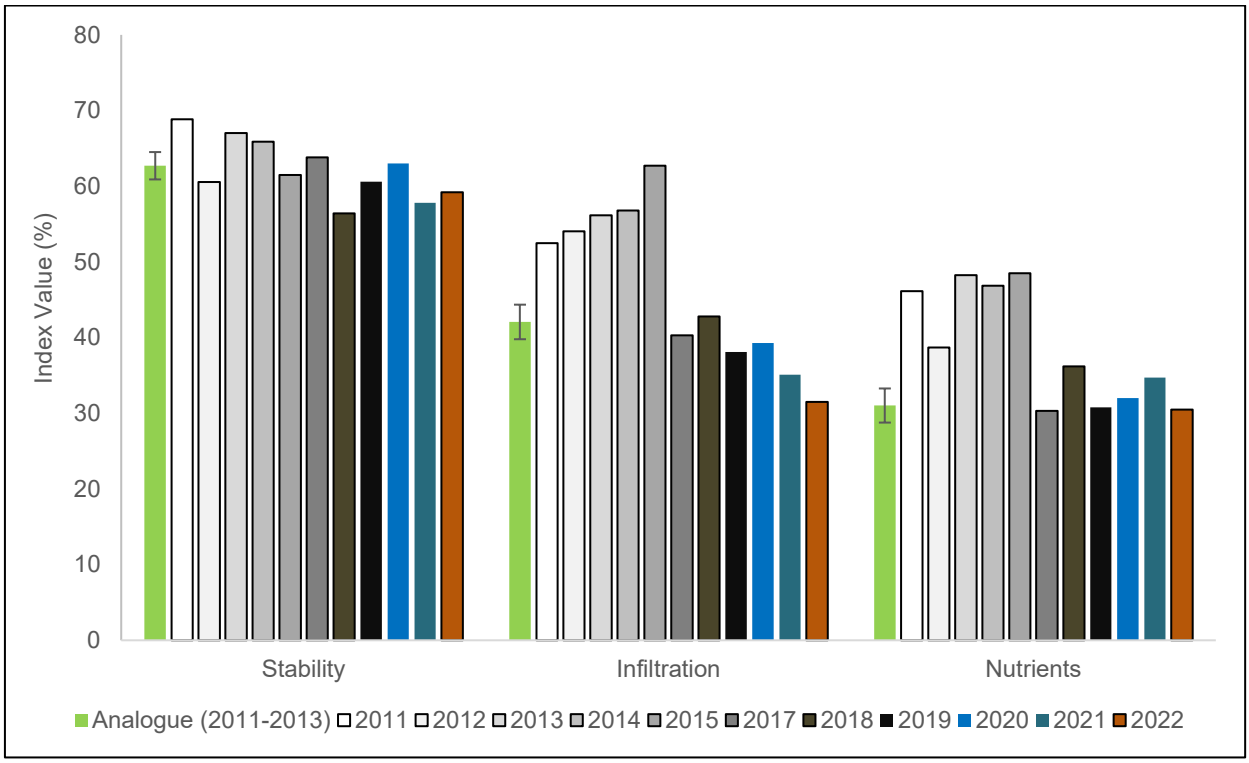

Figure 5. Landscape function indices change (2011-2022) for KANODO 4 with respect to mean analogue site values (2011-2013).

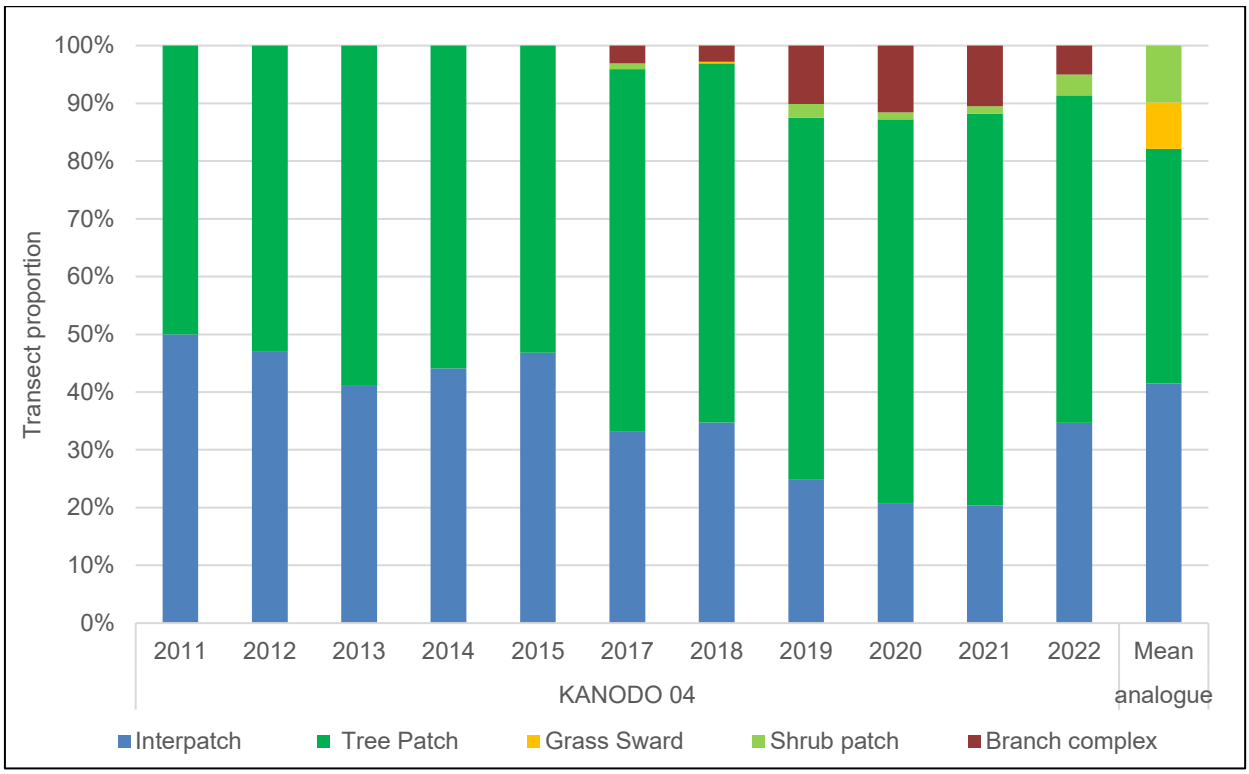

Figure 6. Percentage cover of each of the Surface Soil Assessment zones recorded at site KANODO 4 2011-2022.

Table 2. Summary of the landscape organisation data for KANODO analogue and KANODO 4 rehabilitation site 2011-2022.

Site Type	No. of patch zones per 10m	Total patch area (m²)	Average inter-patch length (m)	Landscape Organisational Index
Analogue 2011 -13	**2.8**	**308.4**	**1.8**	**0.6**
KANODO 4 Rehabilitation 2011	0.6	269.1	9.0	0.5
KANODO 4 Rehabilitation 2012	0.6	291.3	6.3	0.5
KANODO 4 Rehabilitation 2013	0.7	309.6	5.5	0.6
KANODO 4 Rehabilitation 2014	0.6	300.2	7.9	0.6
KANODO 4 Rehabilitation 2015	0.6	275.5	5.9	0.5
KANODO 4 Rehabilitation 2017	1.3	270.8	2.6	0.7
KANODO 4 Rehabilitation 2018	1.3	268.7	2.7	0.7
KANODO 4 Rehabilitation 2019	1.5	306.4	1.9	0.8
KANODO 4 Rehabilitation 2020	1.3	336.3	1.6	0.8
KANODO 4 Rehabilitation 2021	1.5	337.1	1.4	0.8
KANODO 4 Rehabilitation 2022	1.9	258.2	1.9	0.7

4.3.2 KANODO 5

At KANODO 5, stability, infiltration and nutrient indices had similar values to the analogue values after a decreasing trend up until 2019 (Figure 7). Transect proportions indicated a similar complexity to previous years (2018-2021), with a mix of tree patches, shrubs, and branch complexes (Figure 8). These are components that were initially absent in the degraded, unrestored community, however the site remains visually similar to previous years which includes some plants (i.e., *Acacia pycnantha*) remaining small (Appendix 3). The landscape organisation summary data for this site is highly variable over years, with no obvious trends able to be deciphered (Table 3). This may be a result of observer bias.

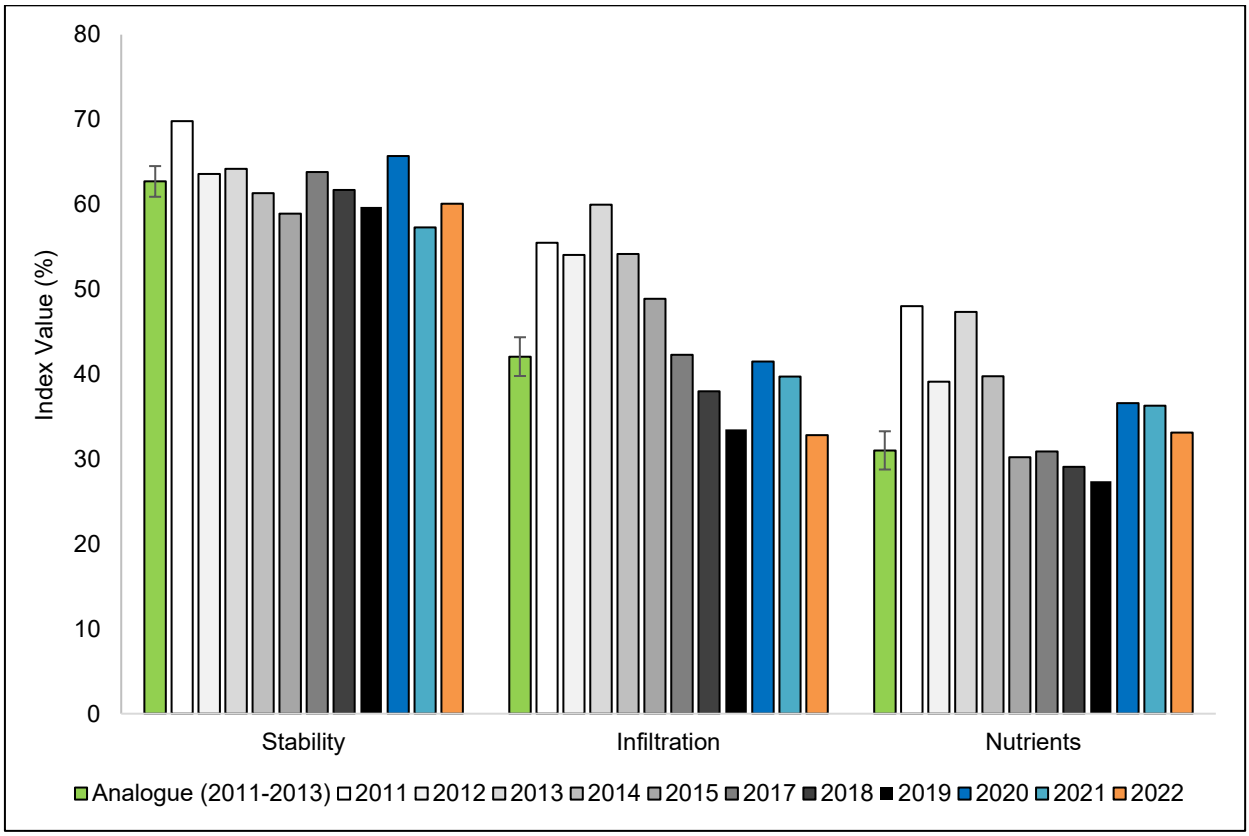

Figure 7. Landscape function indices change (2011-2022) for KANODO 5 with respect to mean analogue site values (2011-2013).

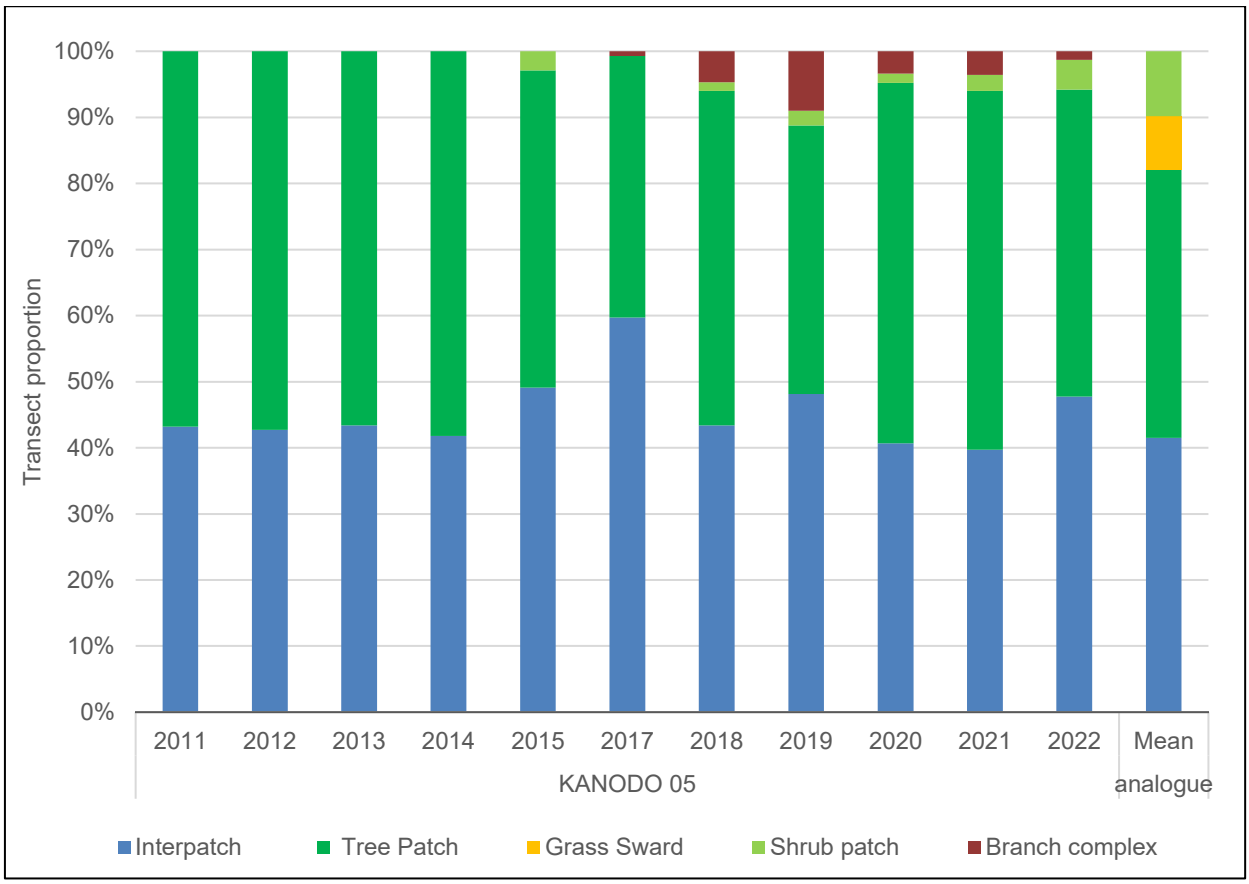

Figure 8. Percentage cover of each of the Surface Soil Assessment zones recorded at site KANODO 5.

Table 3. Summary of the landscape organisation data for KANODO analogue and KANODO 5 rehabilitation site 2011-2022.

Site Type	No. of patch zones per 10m	Total patch area (m^2)	Average inter-patch length (m)	Landscape Organisational Index
Analogue 2011 -13	**2.8**	**308.4**	**1.8**	**0.6**
KANODO 5 Rehabilitation 2011	0.4	324.6	8.2	0.6
KANODO 5 Rehabilitation 2012	0.7	252.0	4.7	0.6
KANODO 5 Rehabilitation 2013	0.5	249.5	6.4	0.6
KANODO 5 Rehabilitation 2014	0.5	256.6	4.6	0.6
KANODO 5 Rehabilitation 2015	1.1	196.0	2.0	0.5
KANODO 5 Rehabilitation 2017	0.9	226.0	5.3	0.4
KANODO 5 Rehabilitation 2018	1.6	178.9	2.7	0.6
KANODO 5 Rehabilitation 2019	2.5	146.0	1.9	0.5
KANODO 5 Rehabilitation 2020	1.1	203.2	3.0	0.6
KANODO 5 Rehabilitation 2021	1.4	203.1	2.5	0.6
KANODO 5 Rehabilitation 2022	2.9	155.2	1.5	0.5

4.3.3 KANODO 6

Landscape function values for 2022 at KANODO 6 showed small variability from previous years except for infiltration. Recorded values are similar to analogue values, which demonstrate low rates of change within the remnant communities (Figure 9). Transect proportions show similar complexities to previous years (2017-2022), particularly 2021 with similar shrub and tree patch areas (Figure 10). It is possible that the very high numbers of kangaroos do not allow very rapid recolonisation and establishment of herbaceous species. The Landscape organisational data summary does demonstrate the site is changing towards the analogue values, albeit slowly (Table 4).

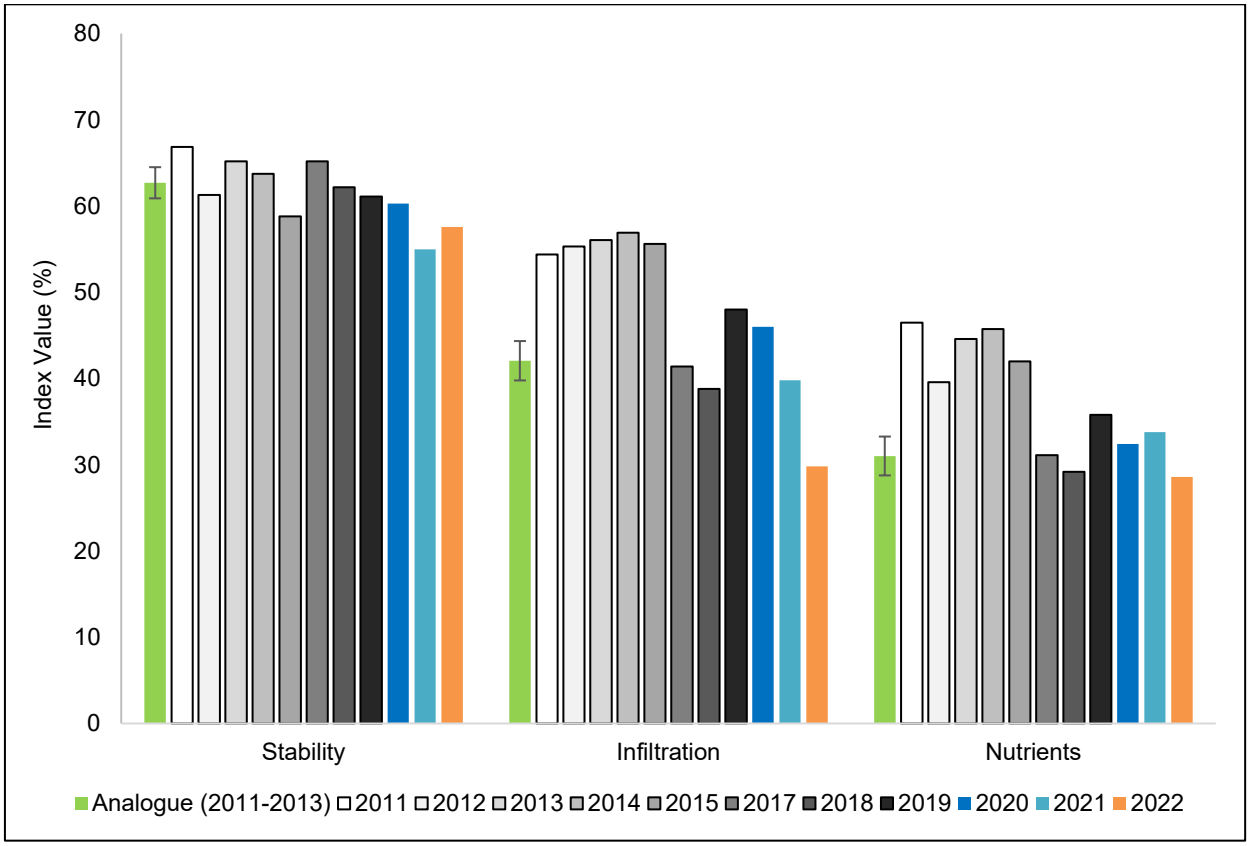

Figure 9. Landscape function indices change (2011-2022) for KANODO 6 with respect to mean analogue site values (2011-2013).

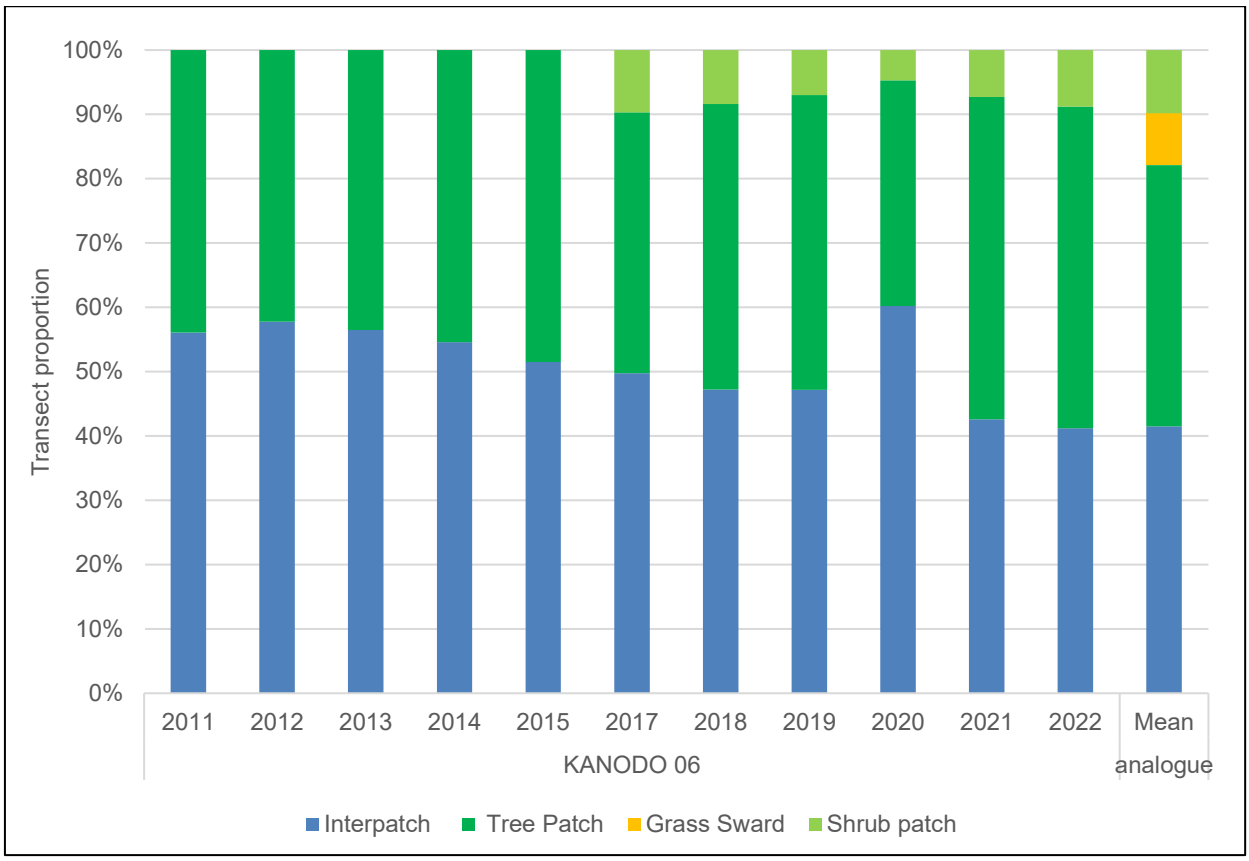

Figure 10. Percentage cover of each of the Surface Soil Assessment zones recorded at site KANODO 6.

Table 4. Summary of the landscape organisation data for KANODO analogue and KANODO 6 rehabilitation site 2011-2022.

Site Type	No. of patch zones per 10m	Total patch area (m²)	Average inter-patch length (m)	Landscape Organisational Index
Analogue 2011 -13	**2.8**	**308.4**	**1.8**	**0.6**
KANODO 6 Rehabilitation 2011	0.4	194.7	12.9	0.4
KANODO 6 Rehabilitation 2012	0.2	194.0	5.9	0.4
KANODO 6 Rehabilitation 2013	0.4	196.0	13.0	0.4
KANODO 6 Rehabilitation 2014	0.4	208.9	12.6	0.5
KANODO 6 Rehabilitation 2015	0.4	215.0	6.1	0.5
KANODO 6 Rehabilitation 2017	1.3	171.0	4.6	0.5
KANODO 6 Rehabilitation 2018	1.3	168.3	3.1	0.5
KANODO 6 Rehabilitation 2019	1.3	174.0	3.6	0.5
KANODO 6 Rehabilitation 2020	1.1	134.5	4.6	0.4
KANODO 6 Rehabilitation 2021	1.5	191.9	3.3	0.6
KANODO 6 Rehabilitation 2022	1.7	188.5	2.7	0.6

4.3.4 KANODO 8

This site has performed well with a transition from an exotic grassland into a moderately complex restored area. The stability, infiltration and nutrient indices are similar to previous years, with stability and nutrients increasing towards the analogue values, but infiltration remains low (Figure 11). The site is maintaining complexity with the presence of shrub patches, grass swards and tree patches (Figure 12). The number of patch zones per 10 m has increased away from the analogue values while the total patch area and interpatch length have decreased from analogue values (Table 5). Visually, the vegetation (predominantly *Acacia pycnantha*) is growing and increasing in size at this site (Appendix 3).

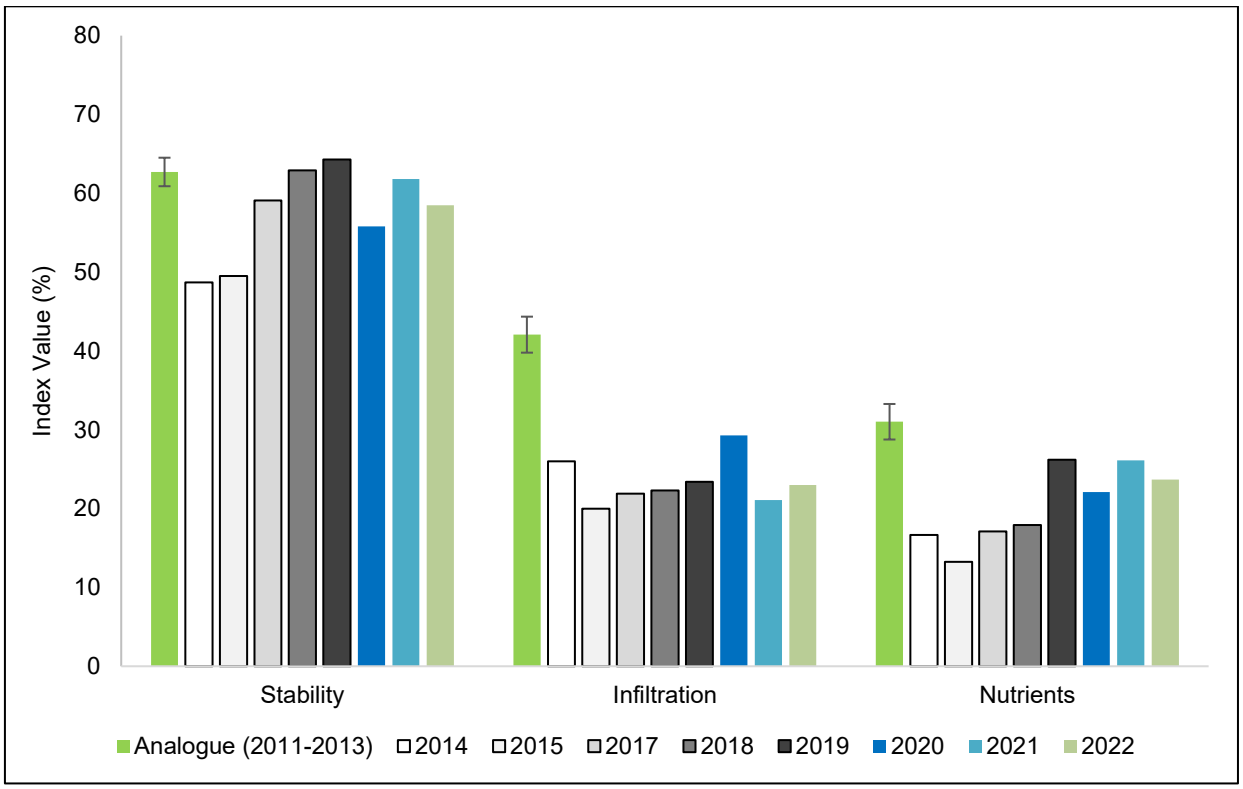

Figure 11. Landscape function indices change (2014-2022) for KANODO 8 with respect to mean analogue site values (2011-2013).

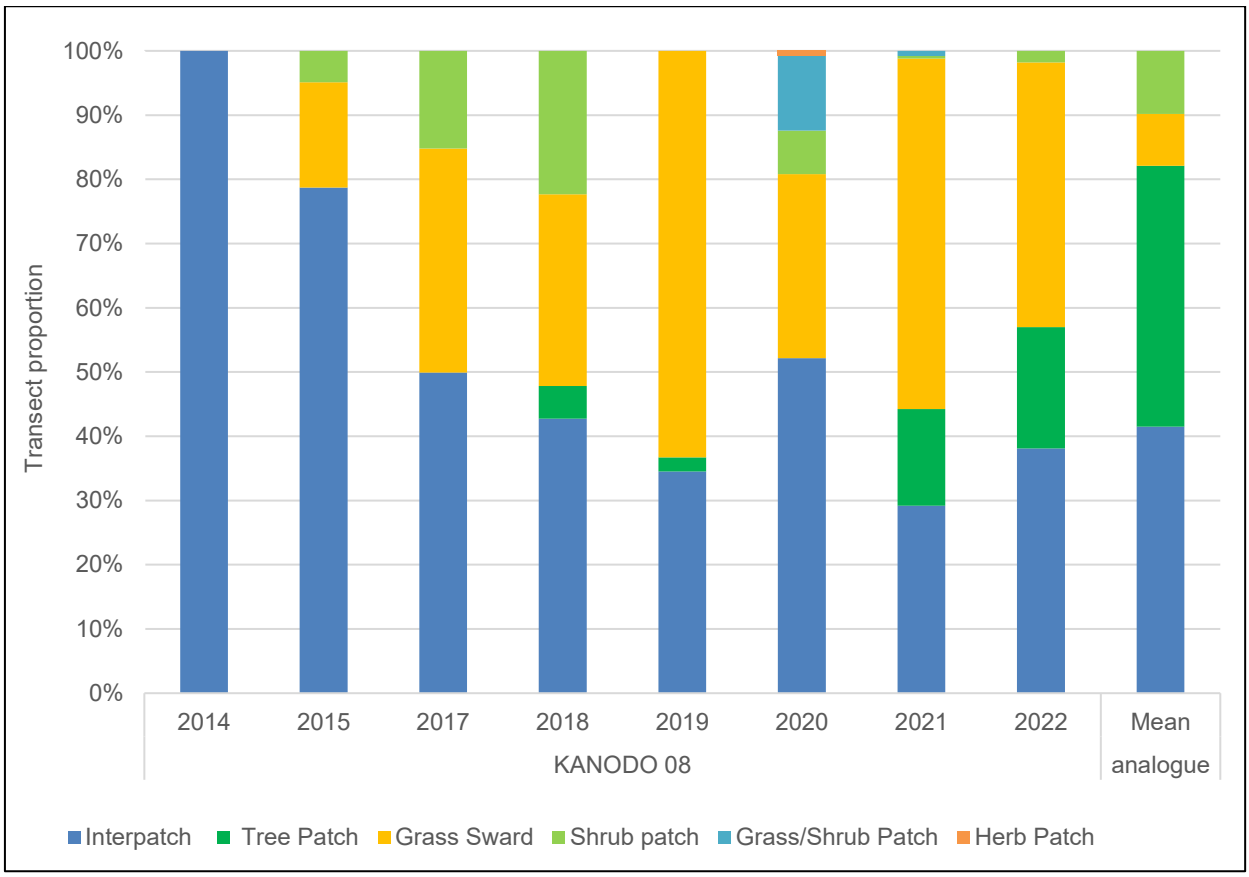

Figure 12. Percentage cover of each of the Surface Soil Assessment zones recorded at site KANODO 8.

Table 5. Summary of the landscape organisation data for KANODO analogue and KANODO 8 rehabilitation site 2014-2022.

Site Type	No. of patch zones per 10m	Total patch area (m^2)	Average inter-patch length (m)	Landscape Organisational Index
Analogue 2011 -13	**2.8**	**308.4**	**1.80**	**0.6**
KANODO 8 Rehabilitation 2014	0.0	0.0	20.0	0.0
KANODO 8 Rehabilitation 2015	4.5	20.0	1.5	0.2
KANODO 8 Rehabilitation 2017	1.3	17.1	4.6	0.4
KANODO 8 Rehabilitation 2018	10.9	5.3	0.4	0.6
KANODO 8 Rehabilitation 2019	11.8	12.4	0.3	0.7
KANODO 8 Rehabilitation 2020	14.0	15.1	0.5	0.5
KANODO 8 Rehabilitation 2021	17.5	13.9	0.2	0.7
KANODO 8 Rehabilitation 2022	14.9	15.3	0.3	0.6

4.3.5 KANODO 9

At KANODO 9, the soil stability index has remained similar to analogue values while infiltration and nutrient indices remain lower than analogue values (Figure 13). Proportions of grass swards have continued to decrease compared to all previous years (Figure 14), which is the likely cause for a lower landscape organisational index in the past three surveys years (Table 6). Number of patch zones per 10 m is increasing away from the analogue, while all other landscape organisation data is decreasing below analogue values.

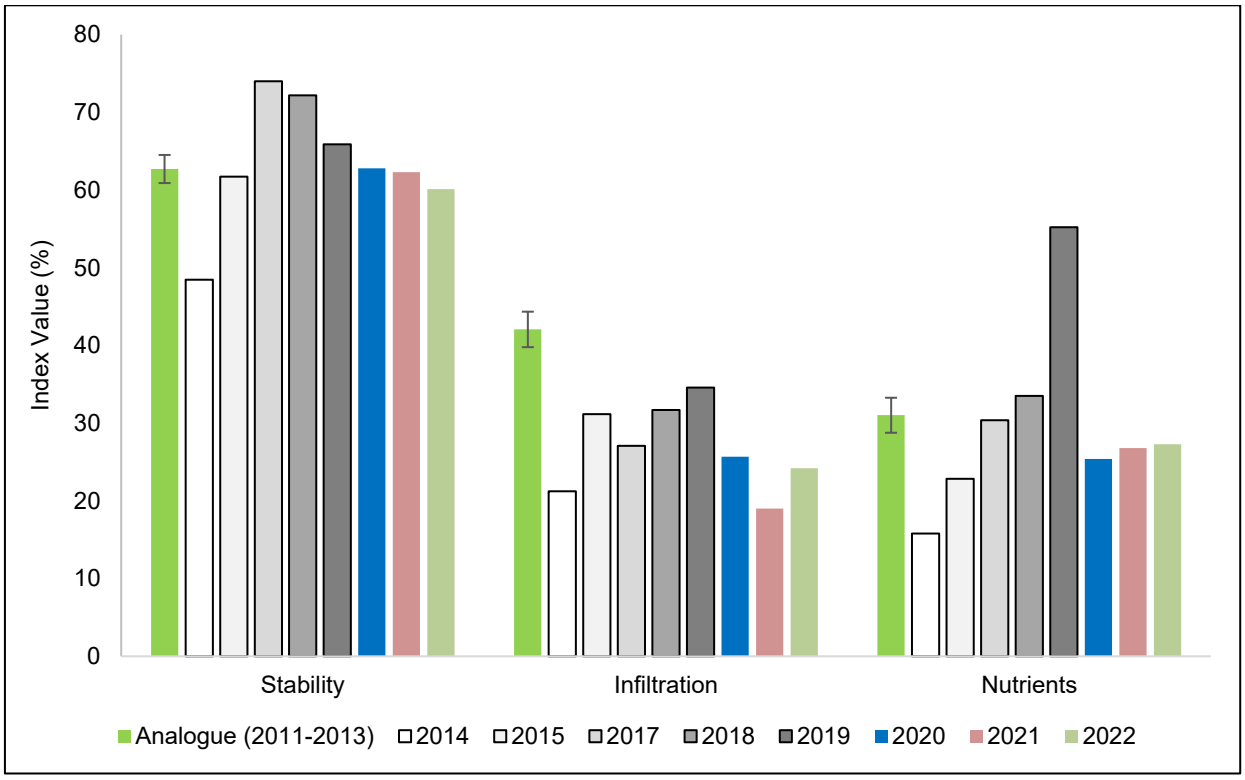

Figure 13. Landscape function indices change (2014-2022) for KANODO 9 with respect to mean analogue site values (2011-2013).

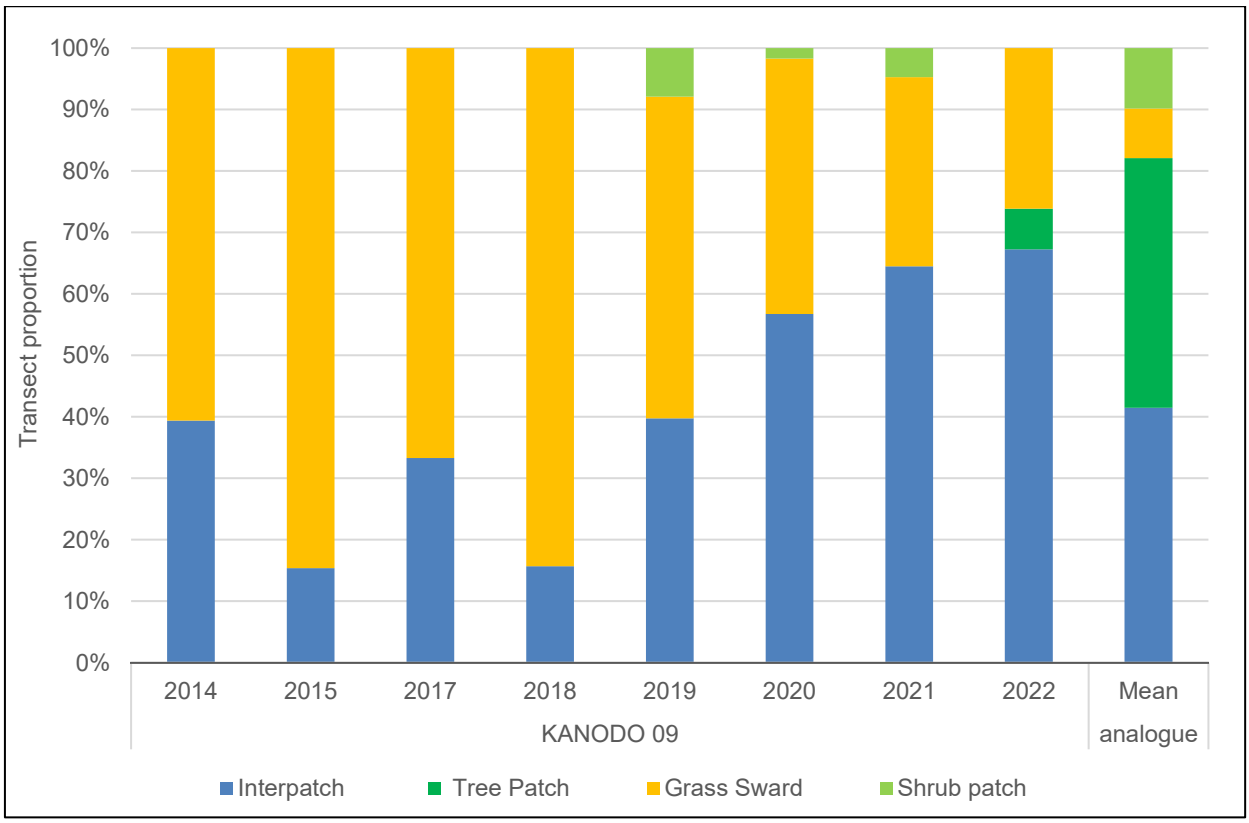

Figure 14. Percentage cover of each of the Surface Soil Assessment zones recorded at site KANODO 9.

Table 6. Summary of the landscape organisation data for KANODO analogue and KANODO 9 rehabilitation site 2014-2022.

Site Type	No. of patch zones per 10m	Total patch area (m^2)	Average inter-patch length (m)	Landscape Organisational Index
Analogue 2011 -13	**2.8**	**308.40**	**1.80**	**0.6**
KANODO 9 Rehabilitation 2014	3.6	95.50	1.09	0.61
KANODO 9 Rehabilitation 2015	1.9	136.20	0.80	0.90
KANODO 9 Rehabilitation 2017	4.8	111.30	0.76	0.70
KANODO 9 Rehabilitation 2018	2.0	166.90	0.67	0.84
KANODO 9 Rehabilitation 2019	6.0	83	0.71	0.60
KANODO 9 Rehabilitation 2020	9.3	28.9	0.61	0.43
KANODO 9 Rehabilitation 2021	12.7	4.9	0.51	0.35
KANODO 9 Rehabilitation 2022	11.2	4.6	0.60	0.33

4.3.6 KANODO RT 07

At KANODO RT 07 the soil stability index is similar to analogue values while nutrients and infiltration remain lower than the analogue after a high in 2018 and 2019 (Figure 15). The percentage cover of each of the Surface Soil Assessment zones remain similar in 2022, compared to the proportions in 2019-2021, although overall this site has more interpatches and less shrub cover than early assessments of the site. Notably however, a tree patch was present for the first time at this site (Figure 16). Patch sizes have decreased, and inter-patch lengths have increased compared to previous years, leading to a reduction in Landscape Organisational Index away from analogue values (Table 7).

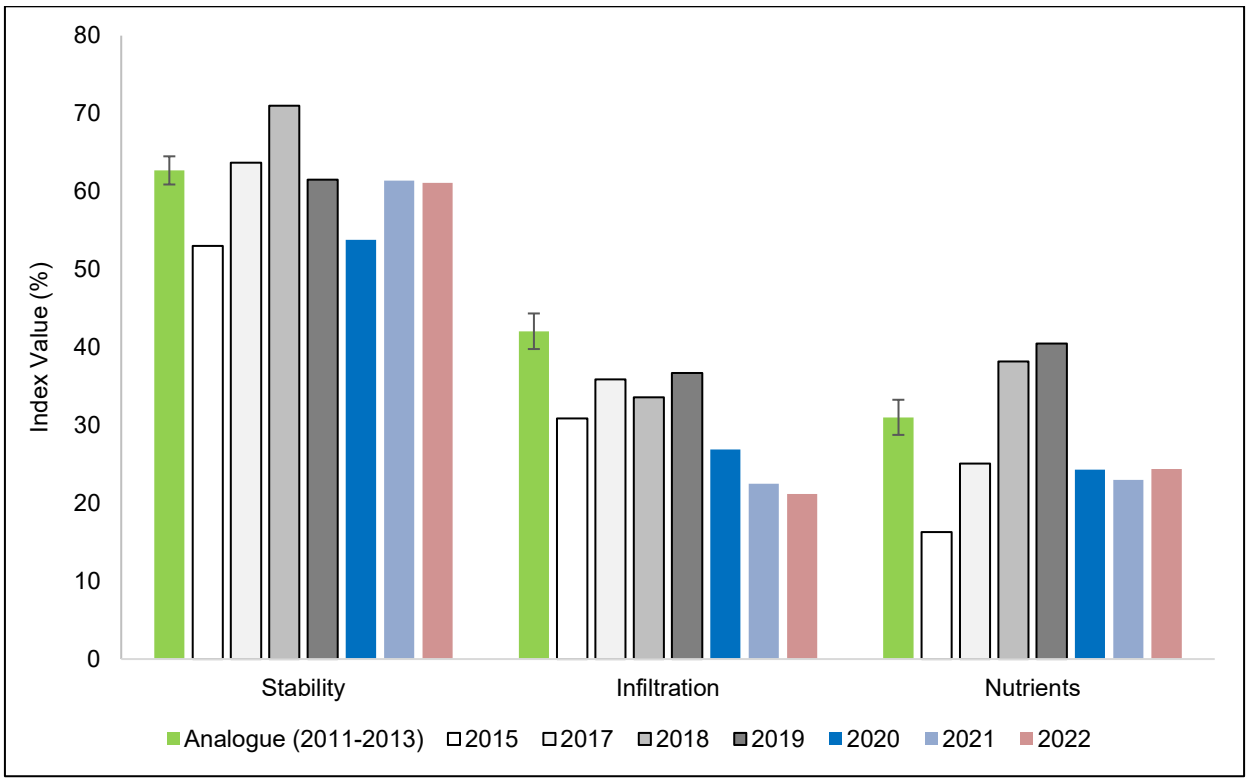

Figure 15. Landscape function indices change (2015-2022) for KANODO RT 07 with respect to mean analogue site values (2011-2013).

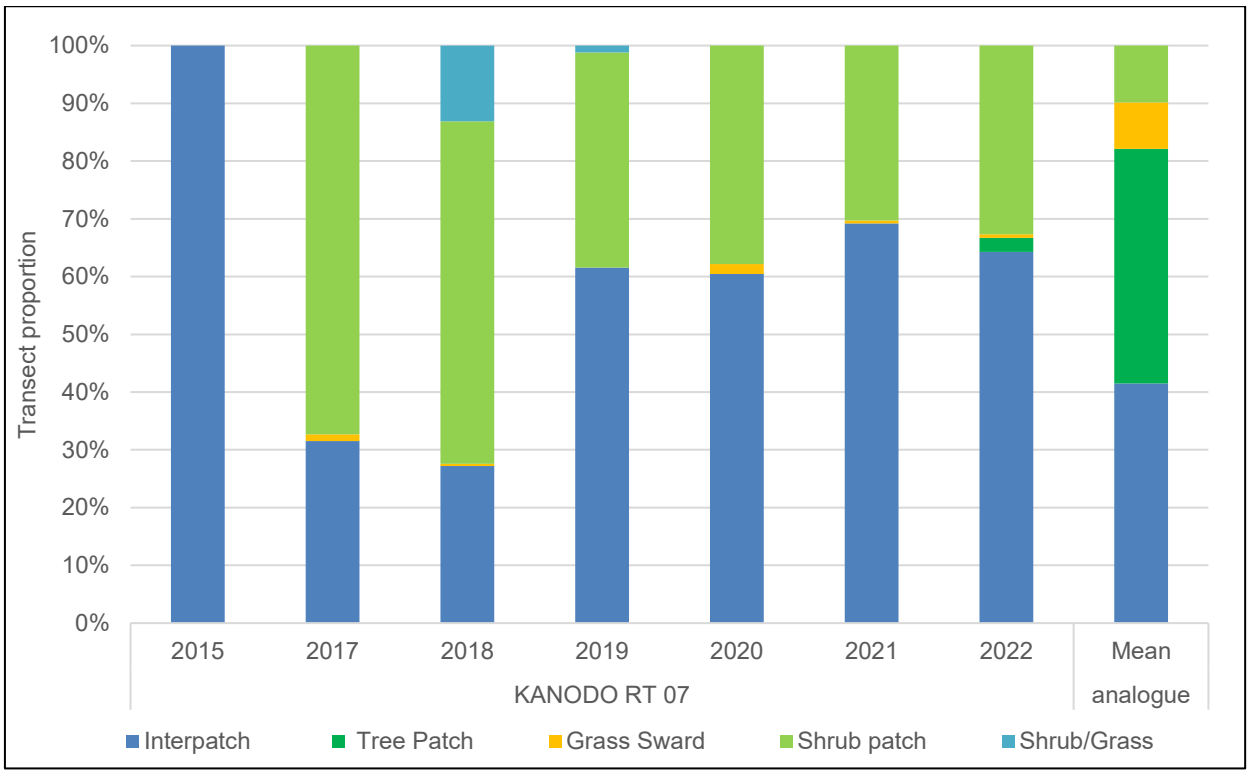

Figure 16. Percentage cover of each of the Surface Soil Assessment zones recorded at site KANODO RT 07.

Table 7. Summary of the landscape organisation data for KANODO analogue and KANODO RT 07 rehabilitation site 2015-2022.

Site Type	No. of patch zones per 10m	Total patch area (m²)	Average inter-patch length (m)	Landscape Organisational Index
Analogue 2011 -13	**2.8**	**308.4**	**1.8**	**0.6**
KANODO RT 07 Rehabilitation 2015	0.0	0.0	1.5	0.0
KANODO RT 07 Rehabilitation 2017	3.1	79.9	1.3	0.7
KANODO RT 07 Rehabilitation 2018	3.1	83.1	1.1	0.7
KANODO RT 07 Rehabilitation 2019	5.6	8.7	1.1	0.4
KANODO RT 07 Rehabilitation 2020	4.2	26.8	1.4	0.4
KANODO RT 07 Rehabilitation 2021	3.2	11.7	2.2	0.3
KANODO RT 07 Rehabilitation 2022	2.9	14.8	2.2	0.4

4.3.7 KANODO RT 10

KANODO RT 10 remains below mean analogue values for all landscape function indices (Figure 17). Complexity of cover is increasing at the site, with the addition of more tree cover and a reduction in interpatches (Figure 18). Landscape organisational data continues to trend towards analogue values (Table 8).

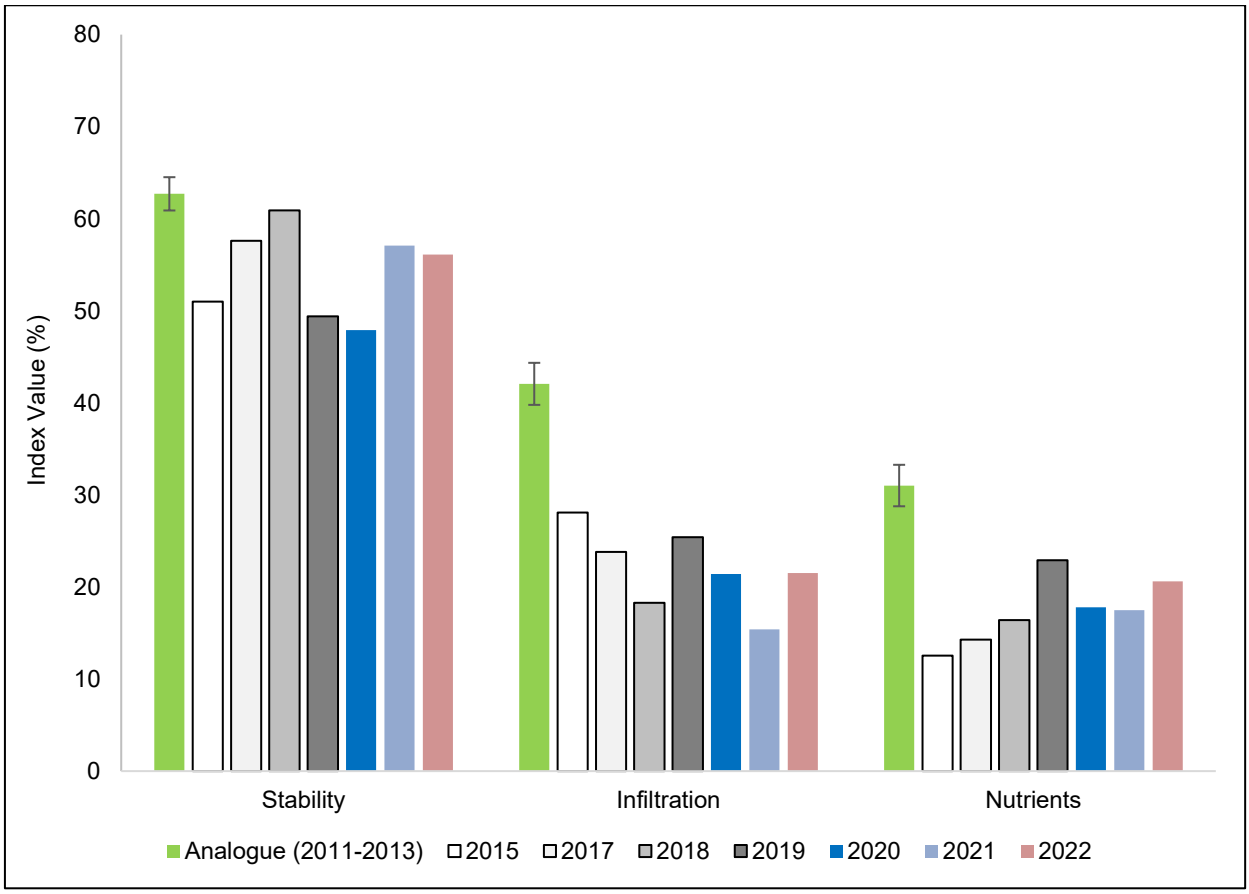

Figure 17. Landscape function indices change (2015-2022) for KANODO RT 10 with respect to mean analogue site values (2011-2013).

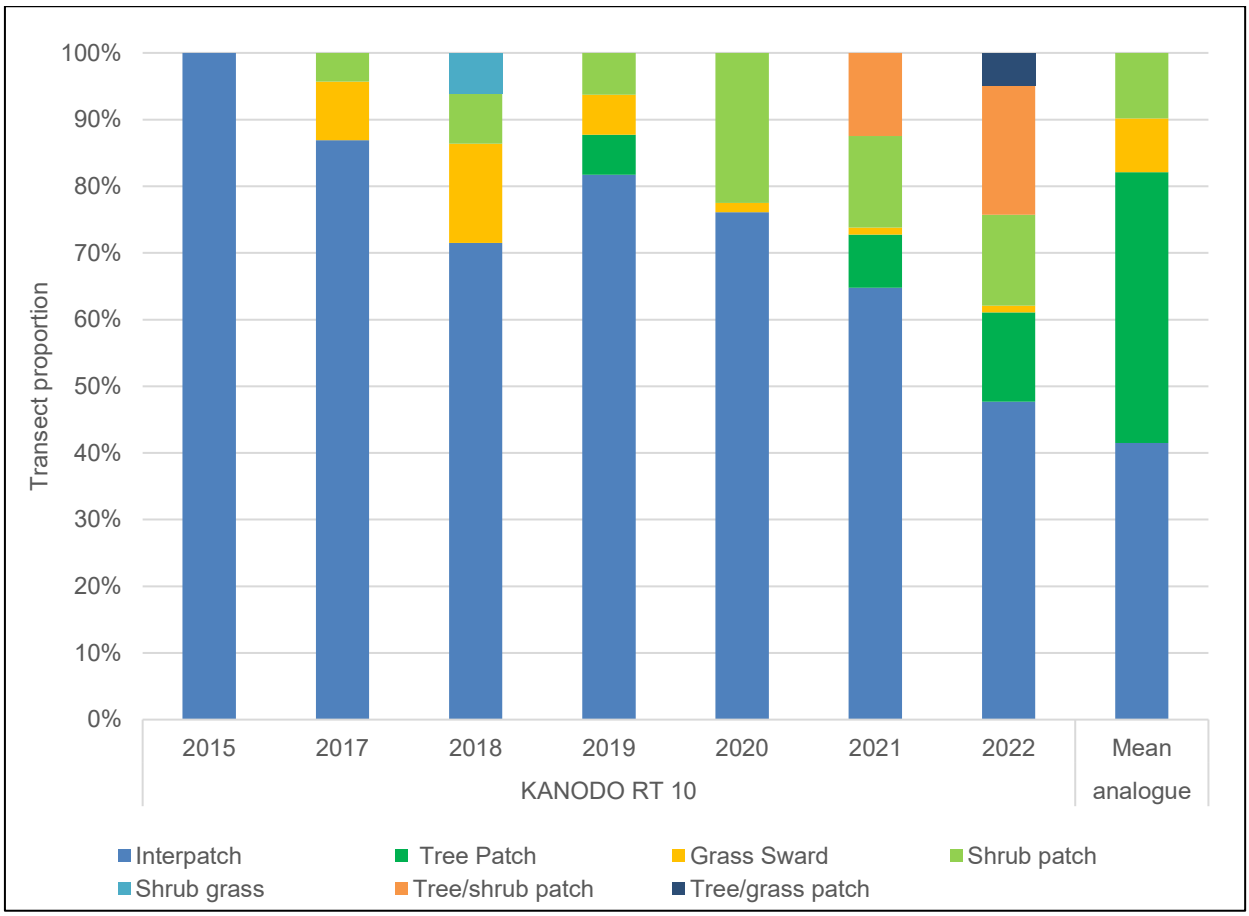

Figure 18. Percentage cover of each of the Surface Soil Assessment zones recorded at site KANODO RT 10.

Table 8. Summary of the landscape organisation data for KANODO analogue and KANODO RT 10 rehabilitation site 2015-2022.

Site Type	No. of patch zones per 10m	Total patch area (m²)	Average inter-patch length (m)	Landscape Organisational Index
Analogue 2011 -13	**2.8**	**308.4**	**1.8**	**0.6**
KANODO RT 10 Rehabilitation 2015	0.0	0.0	20.0	0.0
KANODO RT 10 Rehabilitation 2017	5.3	1.7	1.64	0.13
KANODO RT 10 Rehabilitation 2018	5.3	2.3	1.36	0.29
KANODO RT 10 Rehabilitation 2019	6.4	3.3	1.28	0.18
KANODO RT 10 Rehabilitation 2020	3.7	7.0	2.07	0.24
KANODO RT 10 Rehabilitation 2021	5.7	21.6	0.98	0.34
KANODO RT 10 Rehabilitation 2022	4.3	42.1	1.00	0.52

4.3.8 KANODO RT 12

The stability landscape function index for KANODO RT 12 is similar to the analogue value, while the infiltration and nutrient indices have increased since last year but are still lower than the analogue values (Figure 19). This could be in part due to a reduction in shrub cover compared previous years (Figure 20) which is also reflected in the low total patch area and landscape organisation index values compared to other years. Landscape organisation values are consistent with observations from 2019 and last year, where low shrub cover was observed, and patches predominantly consisted of interpatches (Table 9).

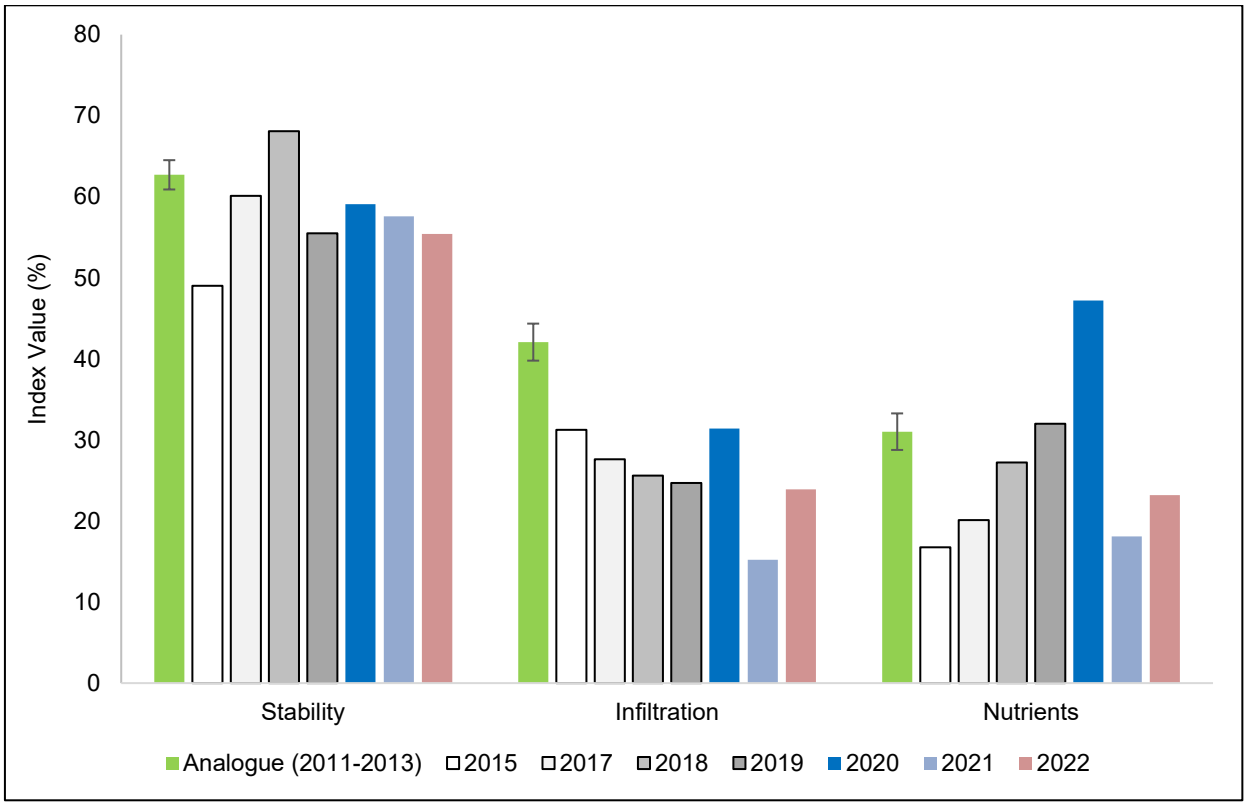

Figure 19 Landscape function indices change (2015-2022) for KANODO RT 12 with respect to mean analogue site values (2011-2013).

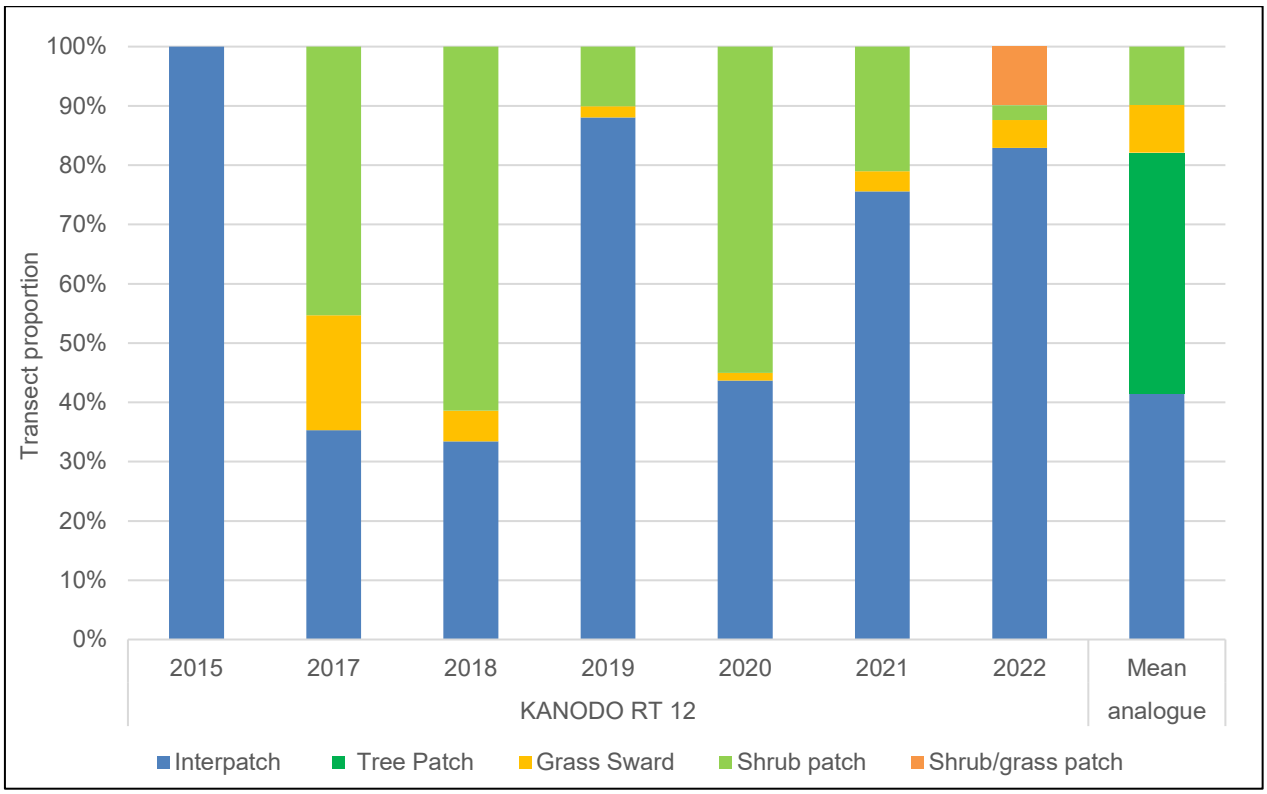

Figure 20. Percentage cover of each of the Surface Soil Assessment zones recorded at site KANODO RT 12.

Table 9. Summary of the landscape organisation data for KANODO analogue and KANODO RT 12 rehabilitation site 2015-2022.

Site Type	No. of patch zones per 10m	Total patch area (m²)	Average inter-patch length (m)	Landscape Organisational Index
Analogue 2011 -13	**2.8**	**308.4**	**1.8**	**0.6**
KANODO RT 12 Rehabilitation 2015	0	0	20	0
KANODO RT 12 Rehabilitation 2017	4.1	45.9	0.9	0.7
KANODO RT 12 Rehabilitation 2018	4.7	32.2	0.8	0.7
KANODO RT 12 Rehabilitation 2019	4.8	4.6	1.2	0.2
KANODO RT 12 Rehabilitation 2020	4.1	12.6	1.1	0.6
KANODO RT 12 Rehabilitation 2021	4.4	8.0	1.7	0.2
KANODO RT 12 Rehabilitation 2022	5.2	8.6	1.6	0.2

4.3.9 KANODO RT 13

Landscape function indices recorded at KANODO RT 13 has been similar for the past three survey years but remains lower compared to the analogue values (Figure 21). Interpatch cover remains high, and shrub or shrub grass cover has remained relatively consistent since 2019 (Figure 22). The number of patch zones per 10 m was higher while all other landscape organisation data remains lower than analogue values (Table 10). Visually, the size of shrubs remains similar to previous years (Appendix 3).

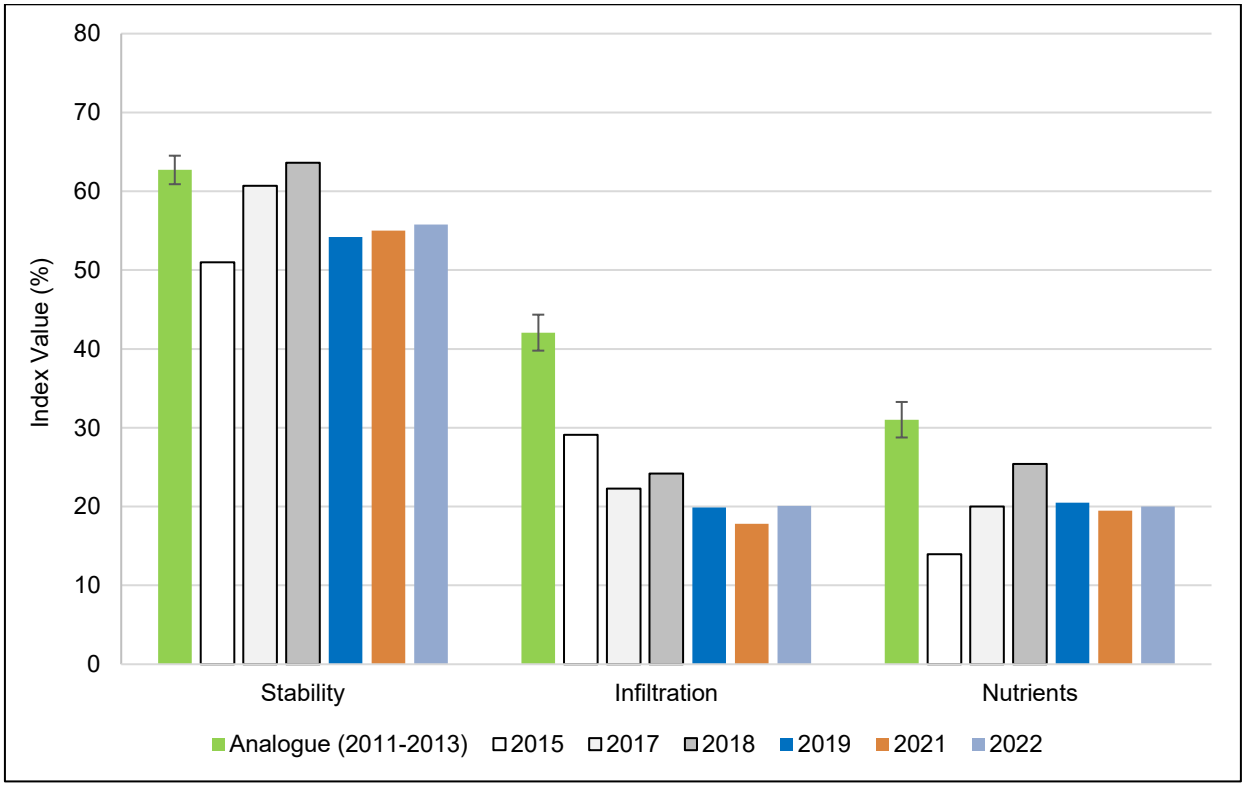

Figure 21. Landscape function indices change (2015-2019 & 2021-2022) for KANODO RT 13 with respect to mean analogue site values (2011-2013).

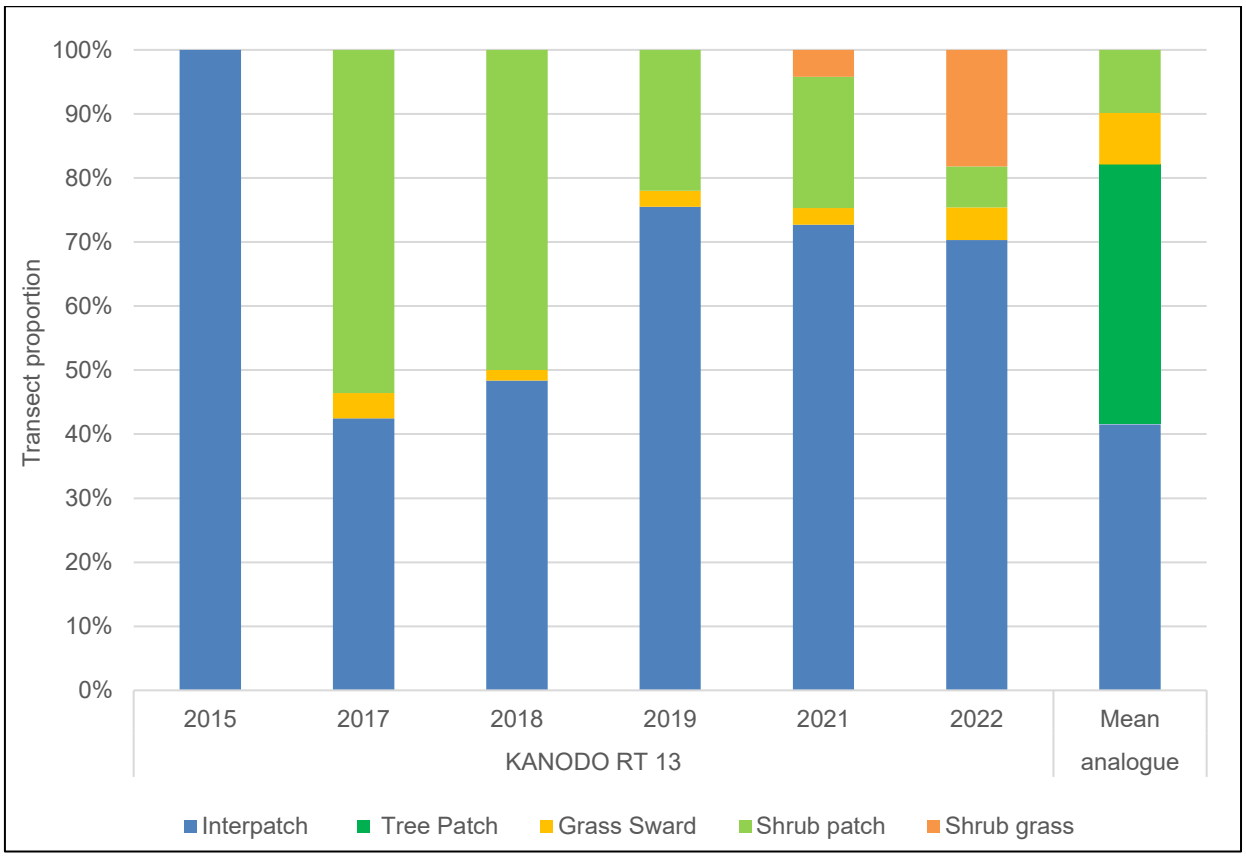

Figure 22. Percentage cover of each of the Surface Soil Assessment zones recorded at site KANODO RT 13.

Table 10. Summary of the landscape organisation data for KANODO analogue and KANODO RT 13 rehabilitation site 2015-2019 & 2021-2022.

Site Type	No. of patch zones per 10m	Total patch area (m²)	Average inter-patch length (m)	Landscape Organisational Index
Analogue 2011 -13	**2.8**	**308.4**	**1.8**	**0.6**
KANODO RT 13 Rehabilitation 2015	0	0	15	0
KANODO RT 13 Rehabilitation 2017	4.6	45.1	0.9	0.59
KANODO RT 13 Rehabilitation 2018	4.2	57.8	1.15	0.52
KANODO RT 13 Rehabilitation 2019	4.6	5.6	1.64	0.24
KANODO RT 13 Rehabilitation 2021	6.7	7.1	1.09	0.27
KANODO RT 13 Rehabilitation 2022	6.3	15.4	1.12	0.30

4.3.10 KANODO RT 14

KANODO RT 14 showed very similar stability, infiltration and nutrient index values to previous years (2017-2021), of which infiltration and nutrients remain lower than the analogue values (Figure 23). The consistency in indices suggests that this site is stabilising below analogue values. The proportion of shrub and grass cover is very similar to last year's results but has increased compared to 2019 and 2020. An increase in cover complexity is also apparent with the addition of tree cover in the last two survey years (Figure 24). The Landscape Organisational Index for KANODO RT 14 is similar to previous years (Table 11), suggesting the site may not improve towards analogue values under current regimes and may require more intervention to meet target outcomes.

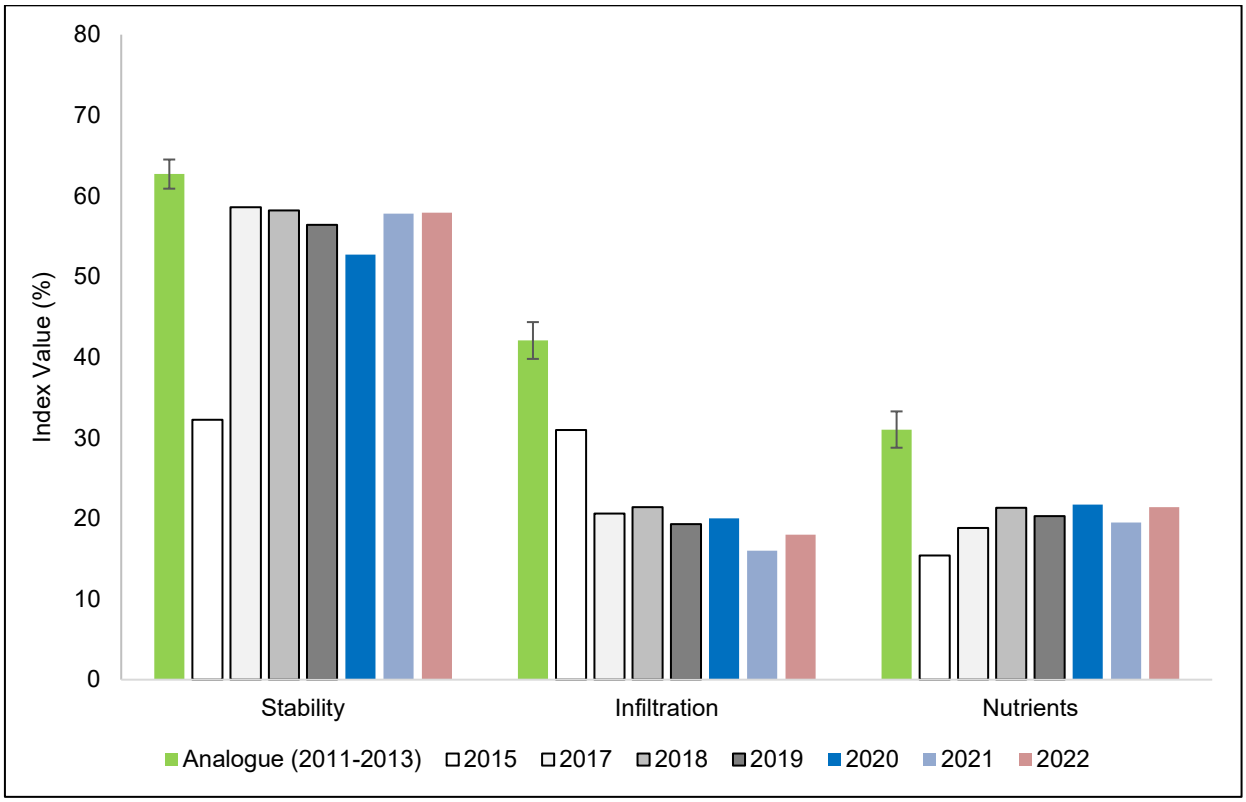

Figure 23. Landscape function indices change (2015-2022) for KANODO RT 14 with respect to mean analogue site values (2011-2013).

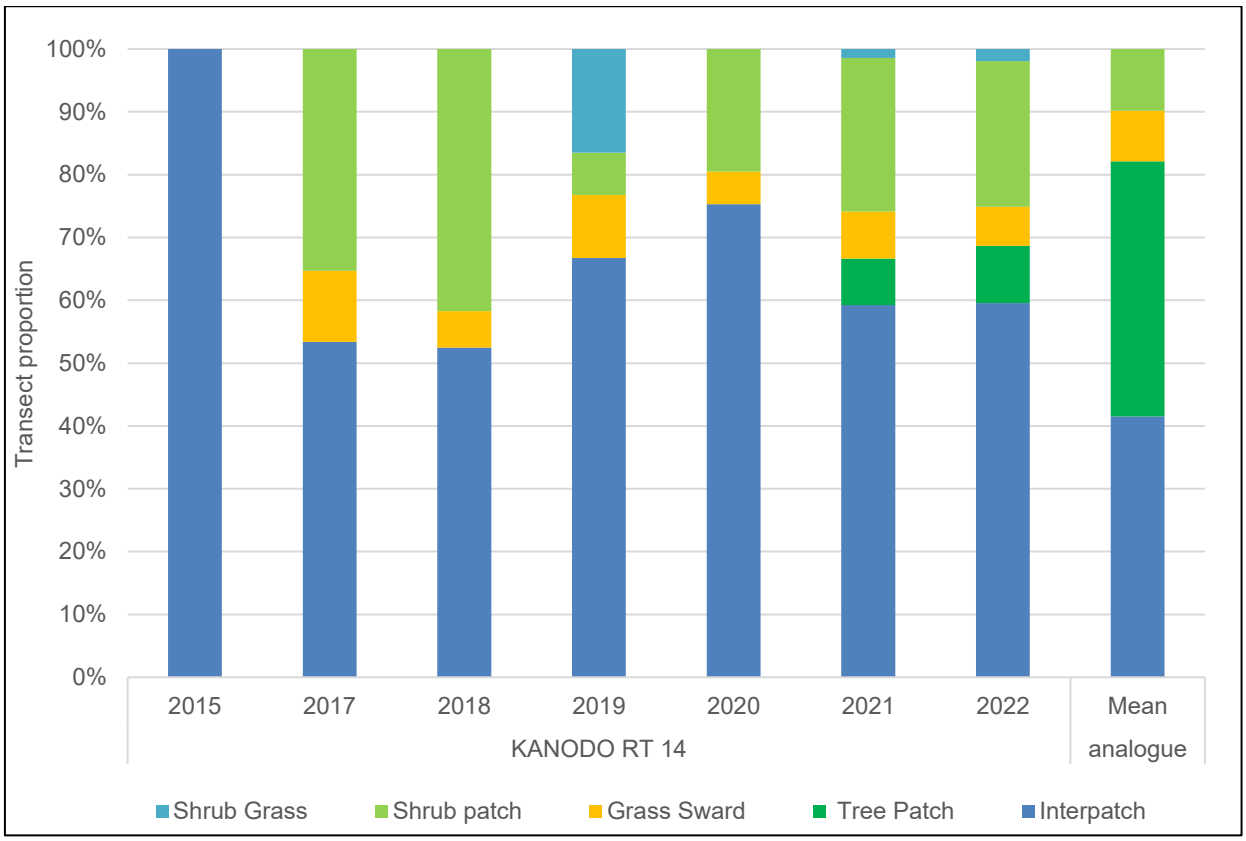

Figure 24. Percentage cover of each of the Surface Soil Assessment zones recorded at site KANODO RT 14.

Table 11. Summary of the landscape organisation data for KANODO analogue and KANODO RT 14 rehabilitation site 2015-2022.

Site Type	No. of patch zones per 10m	Total patch area (m²)	Average inter-patch length (m)	Landscape Organisational Index
Analogue 2011 -13	**2.8**	**308.4**	**1.8**	**0.6**
KANODO RT 14 Rehabilitation 2015	0	0	15	0
KANODO RT 14 Rehabilitation 2017	5	22.6	1.3	0.5
KANODO RT 14 Rehabilitation 2018	4.5	24.4	1.2	0.5
KANODO RT 14 Rehabilitation 2019	8.1	12.3	0.8	0.3
KANODO RT 14 Rehabilitation 2020	5.4	13.6	1.4	0.3
KANODO RT 14 Rehabilitation 2021	8.6	15.3	0.7	0.4
KANODO RT 14 Rehabilitation 2022	8.6	19.4	0.7	0.4

4.3.11 KANODO RT 15

Landscape function indices at KANODO RT 15 remain low across all three soil surface indicators at this site (Figure 25). Trough cover has decreased since 2022, while small grass swards have persisted, indicating reduced weathering of the surface is occurring (Figure 26). Additionally, patchiness has decreased to below analogue values suggesting a reduction in the severity of troughs at this site (Table 12). Visually, the site is still predominantly bare ground (Appendix 3).

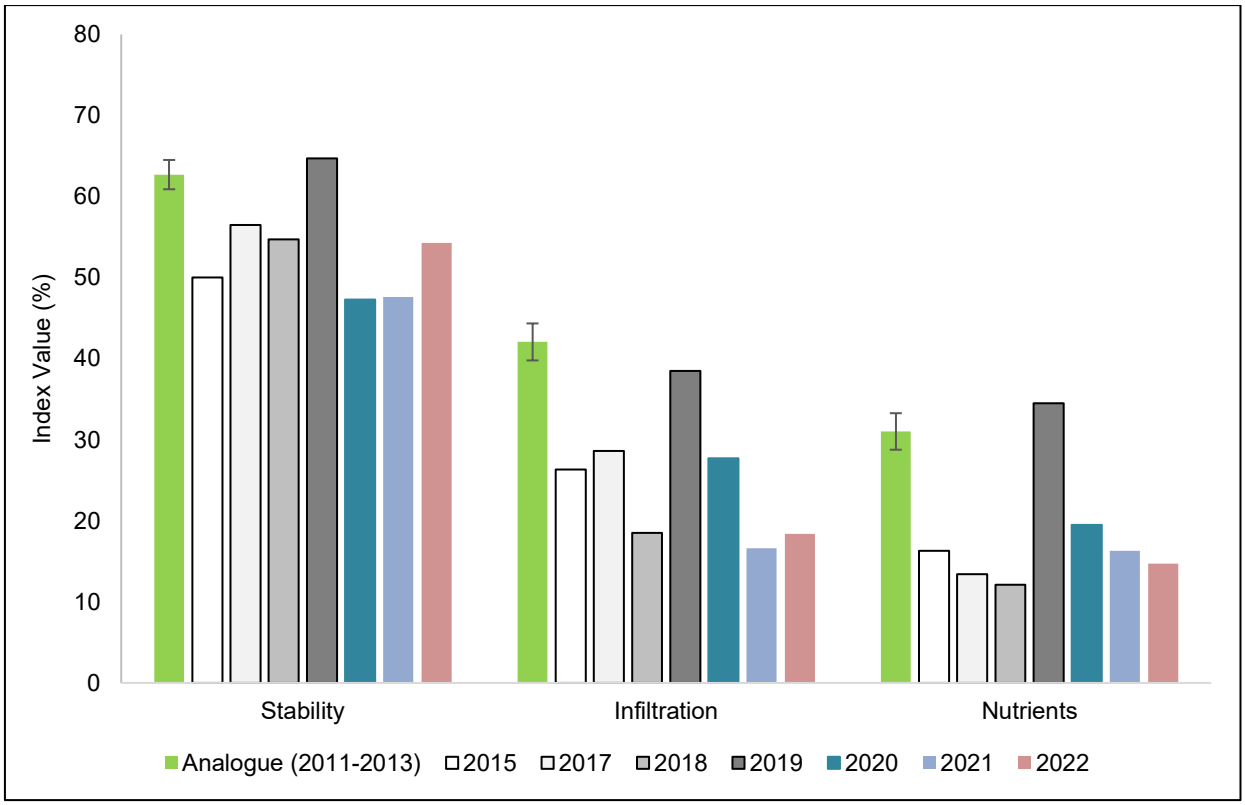

Figure 25. Landscape function indices change (2015-2022) for KANODO RT 15 with respect to mean analogue site values (2011-2013).

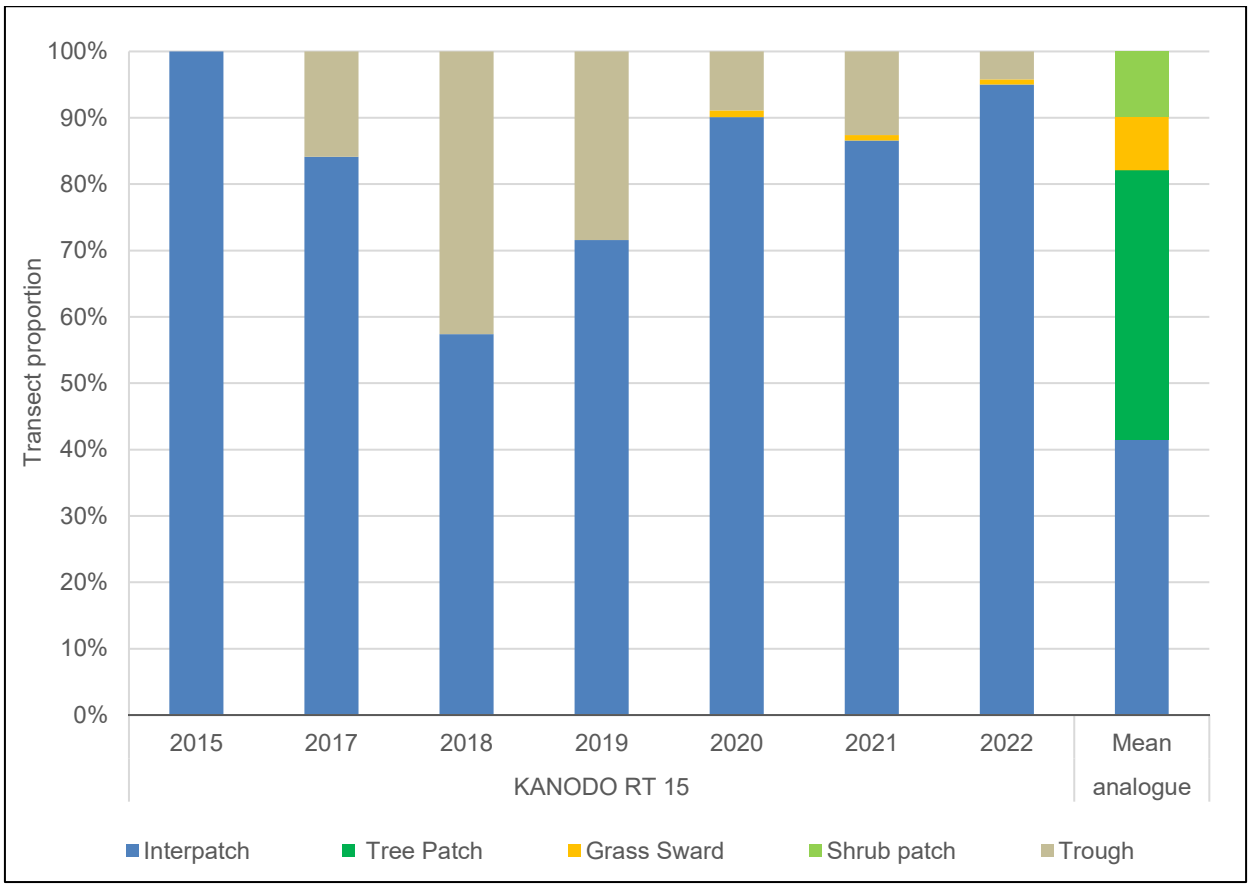

Figure 26. Percentage cover of each of the Surface Soil Assessment zones recorded at site KANODO RT 15.

Table 12. Summary of the landscape organisation data for KANODO analogue and KANODO RT 15 rehabilitation site 2015-2022.

Site Type	No. of patch zones per 10m	Total patch area (m²)	Average inter-patch length (m)	Landscape Organisational Index
Analogue 2011 -13	**2.8**	**308.4**	**1.8**	**0.6**
KANODO RT 15 Rehabilitation 2015	0.0	0.0	20.0	0.0
KANODO RT 15 Rehabilitation 2017	10.1	15.1	0.83	0.16
KANODO RT 15 Rehabilitation 2018	12.3	41.6	0.47	0.43
KANODO RT 15 Rehabilitation 2019	9.0	27.8	0.79	0.28
KANODO RT 15 Rehabilitation 2020	2.1	33.8	4.33	0.10
KANODO RT 15 Rehabilitation 2021	1.7	48.5	4.62	0.13
KANODO RT 15 Rehabilitation 2022	1.0	14.1	7.60	0.05

4.3.12 KANODO RT 16

Landscape function indices at KANODO RT 16 were very similar to last year. Stability remained consistent with previous years, but substantial decreases occurred in infiltration and nutrient cycling indices in 2021 compared to 2019, away from analogue values (Figure 27). The interpatch transect proportion was similar to last year and higher than previous years. The site has increased in complexity with the addition of shrubs and shrub grass complexes (Figure 28). Number of patch zones per 10 m has remained higher than analogue values (Table 13) which is likely caused by a reduction in native grass cover (increasing interpatches) after rehabilitation efforts. This change is also reflected visually (Appendix 3).

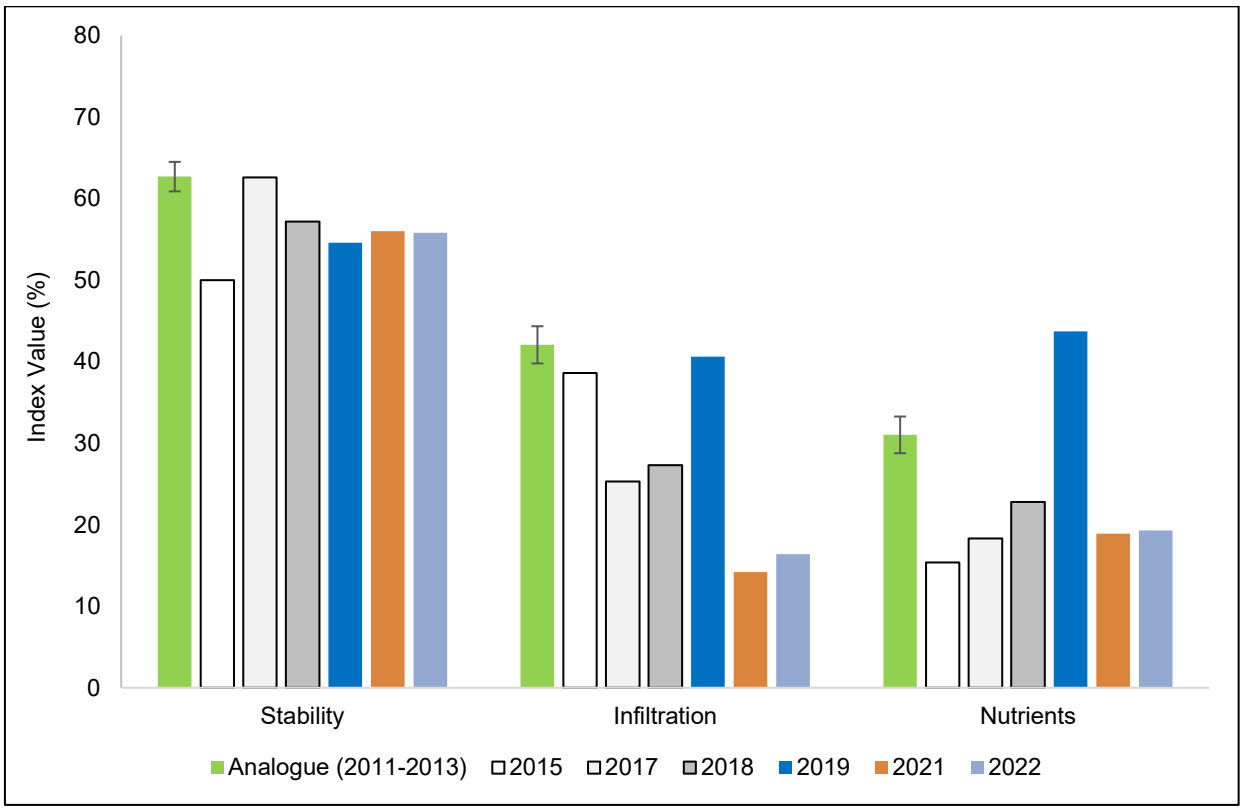

Figure 27. Landscape function indices change (2015-2019, 2021-2022) for KANODO RT 16 with respect to mean analogue site values (2011-2013).

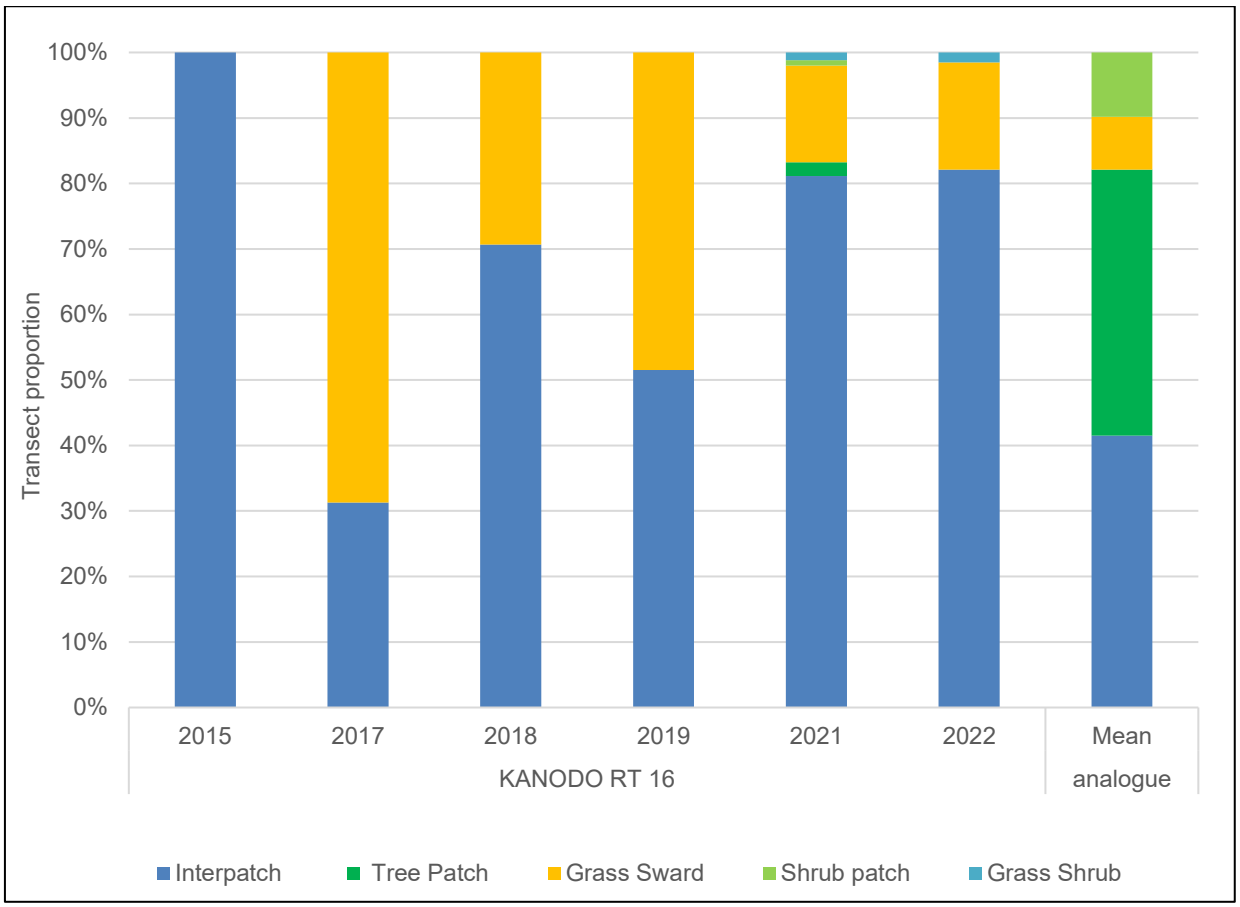

Figure 28. Percentage cover of each of the Surface Soil Assessment zones recorded at site KANODO RT 16.

Table 13. Summary of the landscape organisation data for KANODO analogue and KANODO RT 16 rehabilitation site 2015-2019, 2021-2022.

Site Type	No. of patch zones per 10m	Total patch area (m²)	Average inter-patch length (m)	Landscape Organisational Index
Analogue 2011 -13	**2.8**	**308.4**	**1.8**	**0.6**
KANODO RT 16 Rehabilitation 2015	0	0	20	0
KANODO RT 16 Rehabilitation 2017	0.8	194.1	3.70	0.69
KANODO RT 16 Rehabilitation 2018	9.5	75.8	0.74	0.29
KANODO RT 16 Rehabilitation 2019	10.8	33.5	0.45	0.49
KANODO RT 16 Rehabilitation 2021	12.5	2.5	0.65	0.19
KANODO RT 16 Rehabilitation 2022	10.0	4.2	0.81	0.18

4.3.13 KANODO RT 17

Stability and nutrient indices were similar to most previous survey years at this site, while infiltration was lower than all previous years (Figure 29). Infiltration and nutrients remain lower than the analogue values while stability is similar to analogue values. The interpatch cover is high at this site, particularly compared to 2017 and 2018, but the site has increased in complexity with the addition of shrubs to the site (Figure 30). Landscape organisation indices are variable over the survey period, reflecting the decrease in grass cover and fluctuation in shrub cover (Table 14).

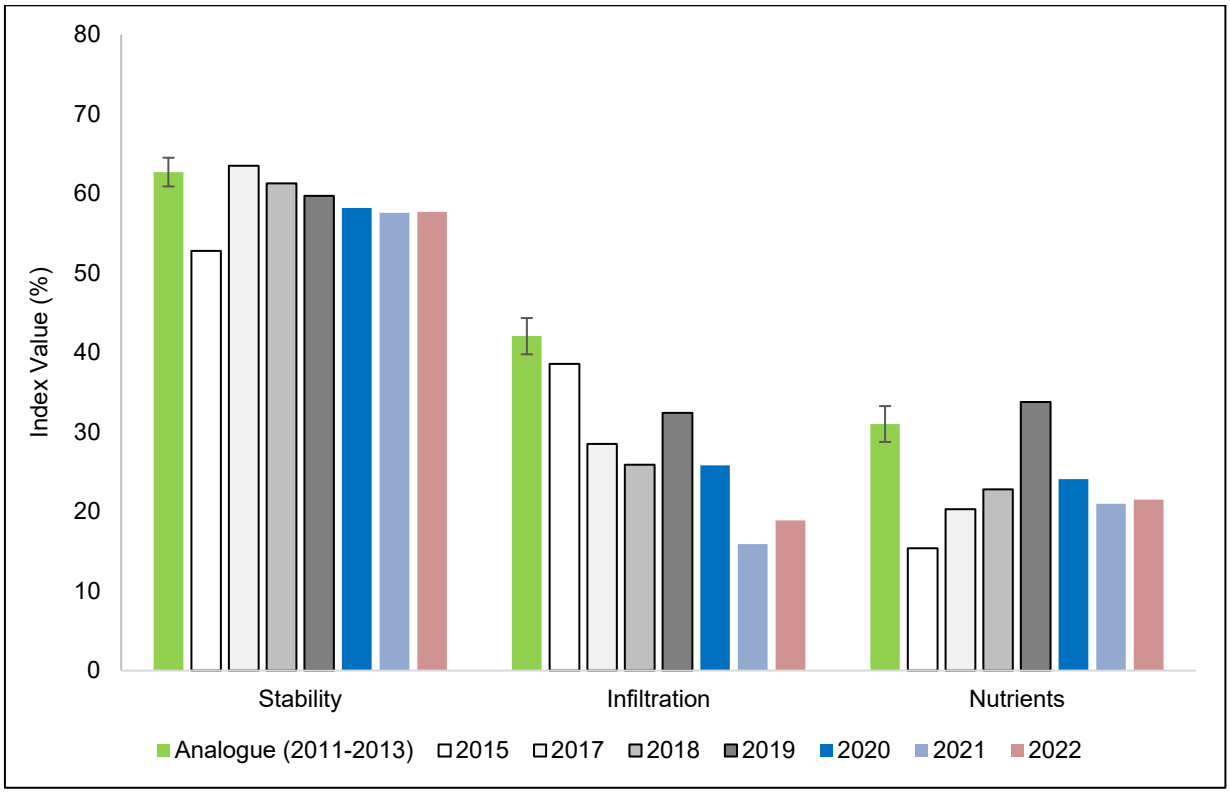

Figure 29. Landscape function indices change (2015-2022) for KANODO RT 17 with respect to mean analogue site values (2011-2013).

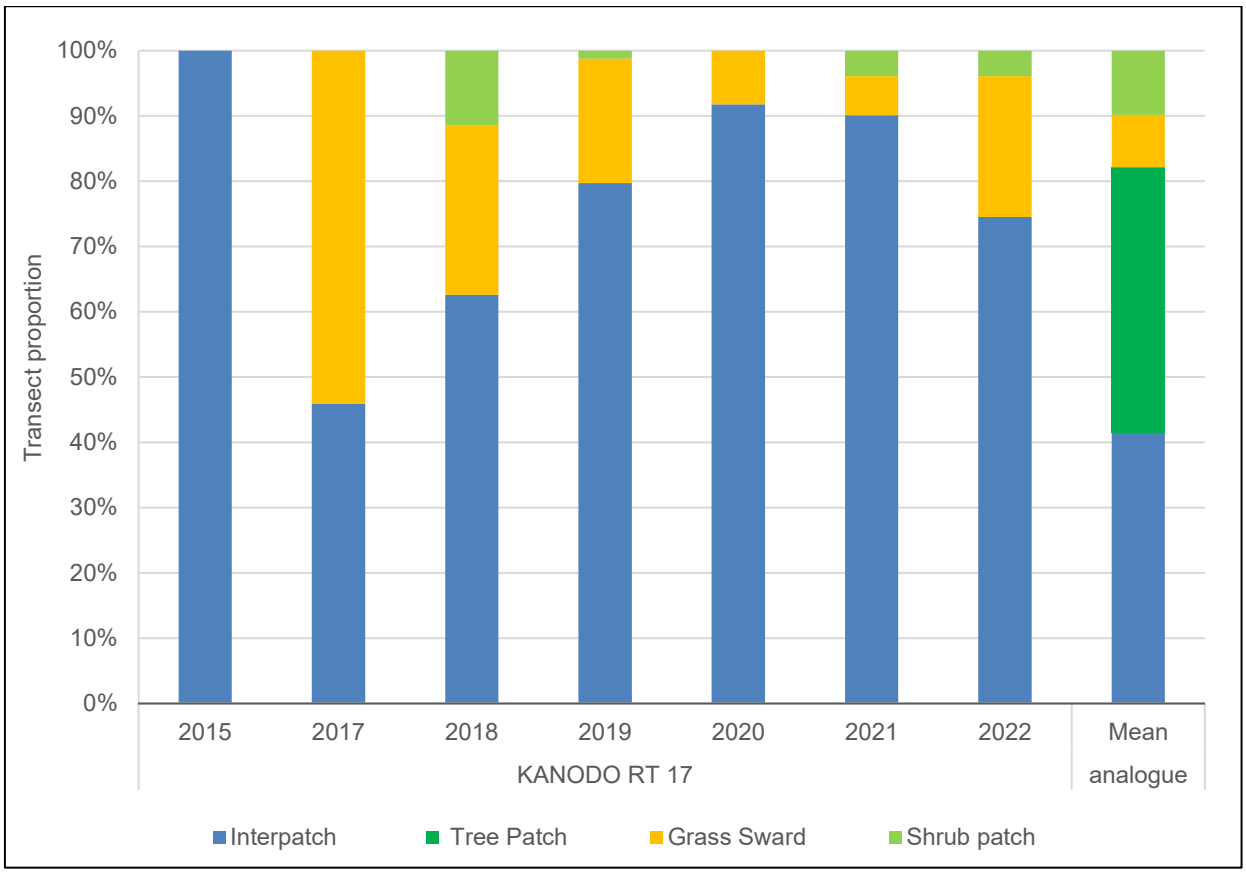

Figure 30. Percentage cover of each of the Surface Soil Assessment zones recorded at site KANODO RT 17.

Table 14. Summary of the landscape organisation data for KANODO analogue and KANODO RT 17 rehabilitation site 2015-2022.

Site Type	No. of patch zones per 10m	Total patch area (m²)	Average inter-patch length (m)	Landscape Organisational Index
Analogue 2011 -13	**2.8**	**308.4**	**1.8**	**0.6**
KANODO RT 17 Rehabilitation 2015	0	0	20	0
KANODO RT 17 Rehabilitation 2017	4.7	102.9	1.1	0.5
KANODO RT 17 Rehabilitation 2018	6.6	5.2	1.1	0.4
KANODO RT 17 Rehabilitation 2019	9.3	1.1	0.9	0.2
KANODO RT 17 Rehabilitation 2020	6.3	15.3	1.3	0.1
KANODO RT 17 Rehabilitation 2021	6.2	2.8	1.4	0.1
KANODO RT 17 Rehabilitation 2022	5.6	4.1	1.2	0.3

4.3.14 KANODO RT 18, 19, 20 and 21

These sites are all similar in terms of their location and restoration histories and as such display similar trajectories towards analogue values for soil surface values. There is variation in infiltration values between years at all sites with most remaining below analogue values (Figure 31, Figure 33, Figure 35, and Figure 37). Dense tussock grass swards and trees are developing at all sites as reflected in patches observed in the past two survey years at most sites (Figure 32, Figure 34, Figure 36 and Figure 38).

The transect proportions for these sites shows a majority covering of grass swards for all sites, with KANODO RT 18, 19 and 20 developing shrub and tree patches mainly represented by *Acacia pycnantha* (Golden Wattle). All sites also have very low patch length and high patch area values (Table 15, Table 16, Table 17, and Table 18).

From a visual perspective, there is an obvious increase in grass tussock size, spread of chenopod groundcovers and *Acacia* / shrub emergence. A gradual transition is expected within these communities as more overstorey components begin to develop (see photo points at Appendix 3).

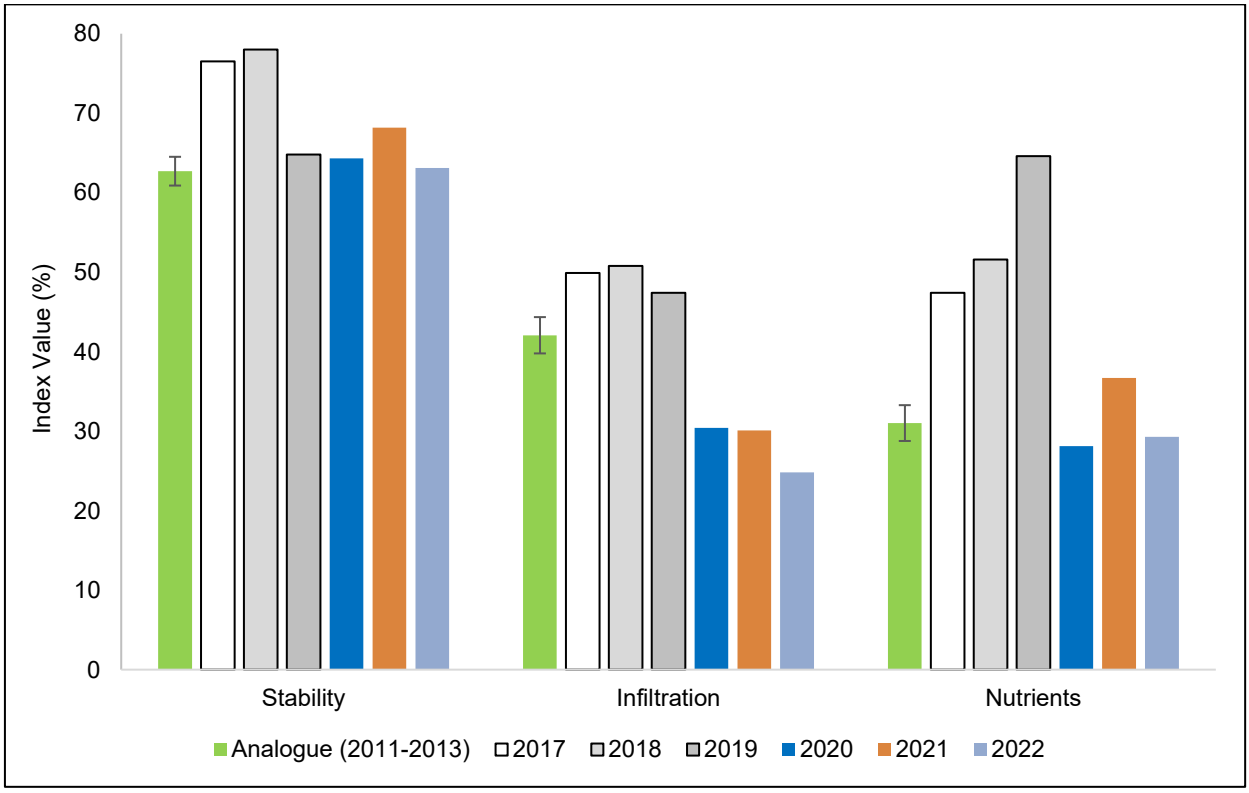

Figure 31. Landscape function indices change (2017-2022) for KANODO RT 18 with respect to mean analogue site values (2011-2013).

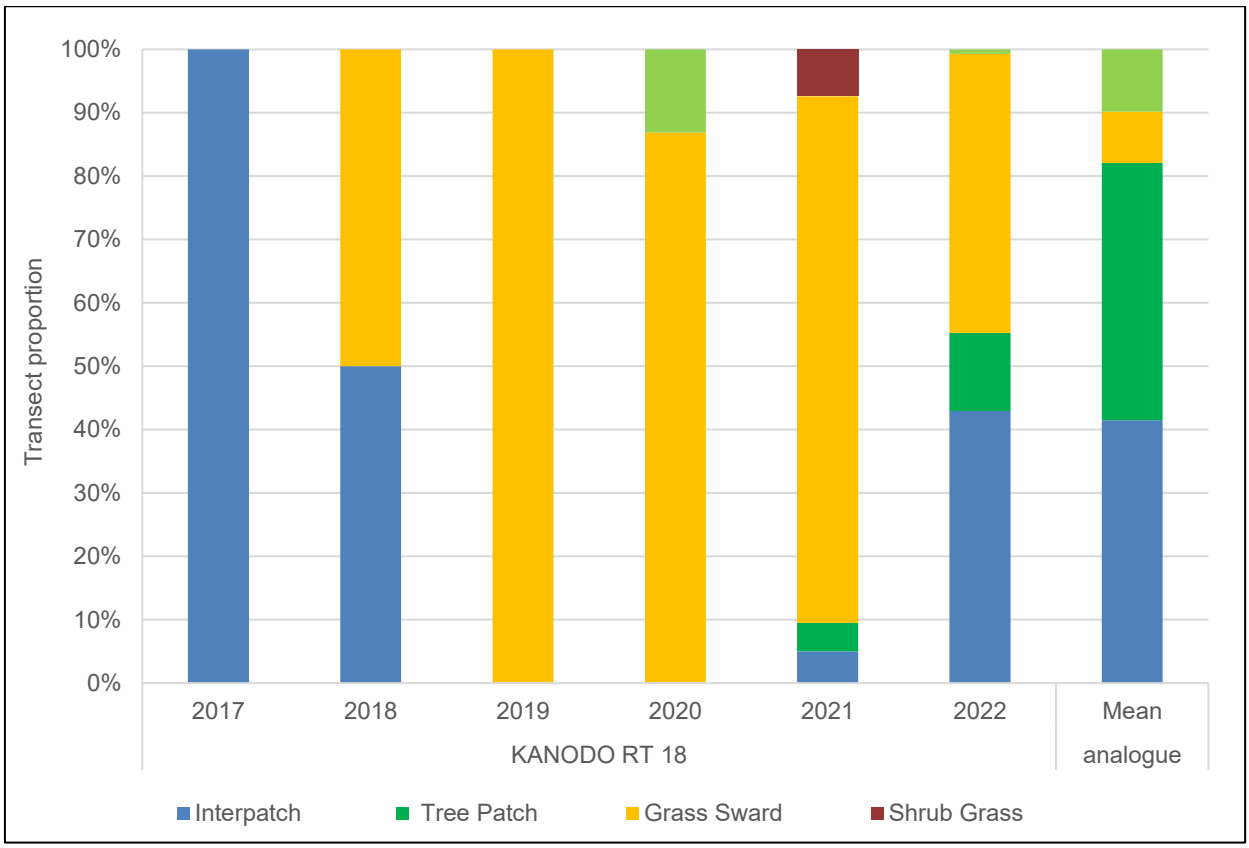

Figure 32. Percentage cover of each of the Surface Soil Assessment zones recorded at site KANODO RT 18.

Table 15. Summary of the landscape organisation data for KANODO analogue and KANODO RT 18 rehabilitation site 2017-2022.

Site Type	No. of patch zones per 10 m	Total patch area (m²)	Average inter-patch length (m)	Landscape Organisational Index
Analogue 2011 -13	**2.8**	**308.4**	**1.8**	**0.6**
KANODO RT 18 Rehabilitation 2017	0.3	125	0	1.0
KANODO RT 18 Rehabilitation 2018	0.4	125	0	1.0
KANODO RT 18 Rehabilitation 2019	0.5	95	0	1.0
KANODO RT 18 Rehabilitation 2020	2.4	116.6	0	1.0
KANODO RT 18 Rehabilitation 2021	4.8	169.6	0.3	1.0
KANODO RT 18 Rehabilitation 2022	8.4	19.3	0.6	0.6

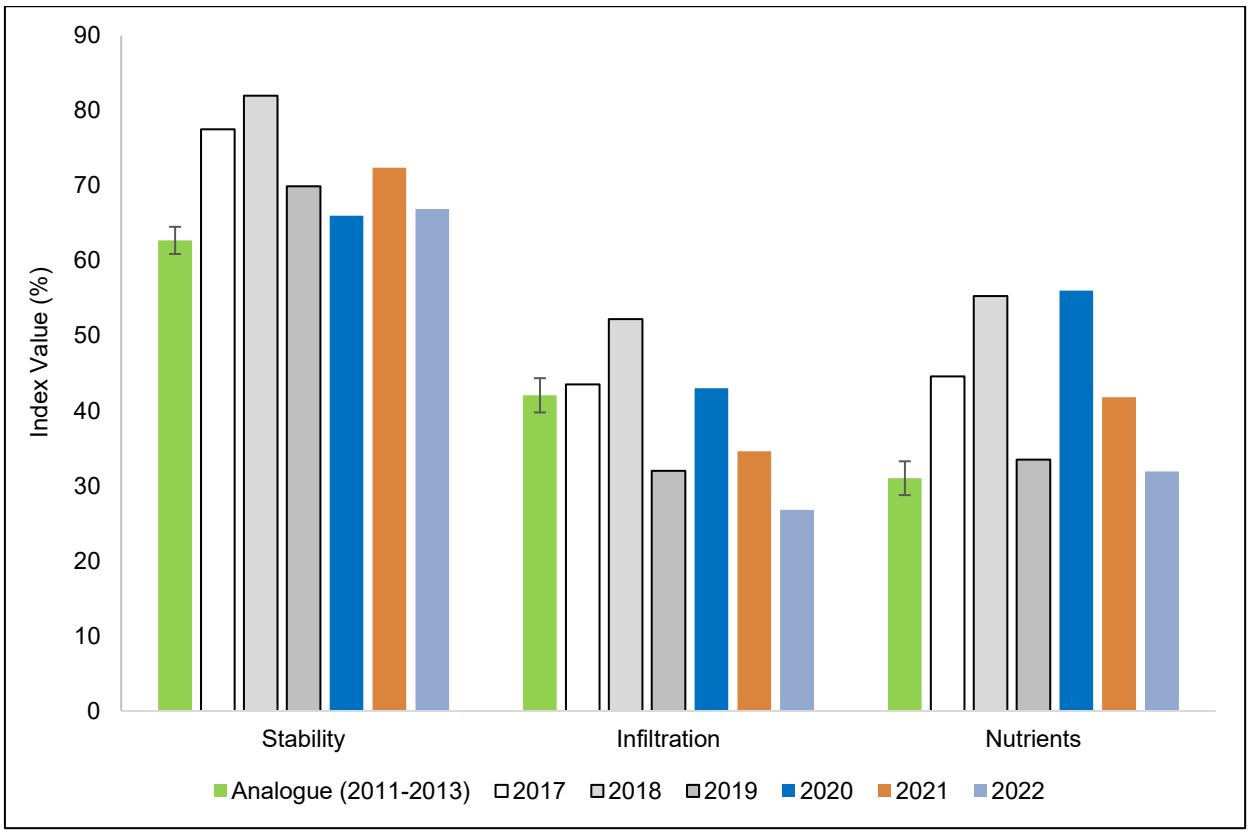

Figure 33. Landscape function indices change (2017-2022) for KANODO RT 19 with respect to mean analogue site values (2011-2013).

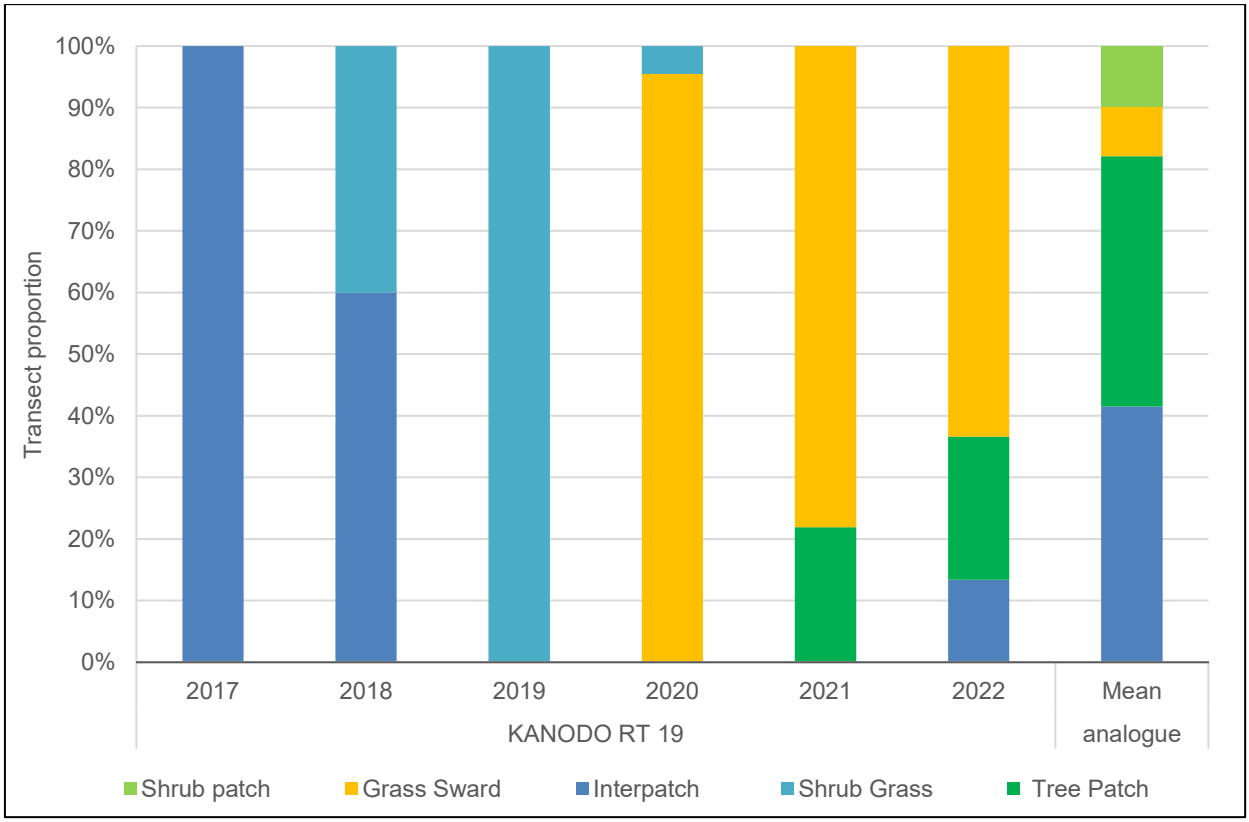

Figure 34. Percentage cover of each of the Surface Soil Assessment zones recorded at site KANODO RT 19.

Table 16. Summary of the landscape organisation data for KANODO analogue and KANODO RT 19 rehabilitation site 2017-2022.

Site Type	No. of patch zones per 10m	Total patch area (m²)	Average inter-patch length (m)	Landscape Organisational Index
Analogue 2011 -13	**2.8**	**308.4**	**1.8**	**0.6**
KANODO RT 19 Rehabilitation 2017	0.4	125.0	0	1.0
KANODO RT 19 Rehabilitation 2018	0.4	125.0	0	1.0
KANODO RT 19 Rehabilitation 2019	0.4	125.0	0	1.0
KANODO RT 19 Rehabilitation 2020	2.8	120.1	0	1.0
KANODO RT 19 Rehabilitation 2021	2.8	170.2	0	1.0
KANODO RT 19 Rehabilitation 2022	3.2	94.5	0.6	0.9

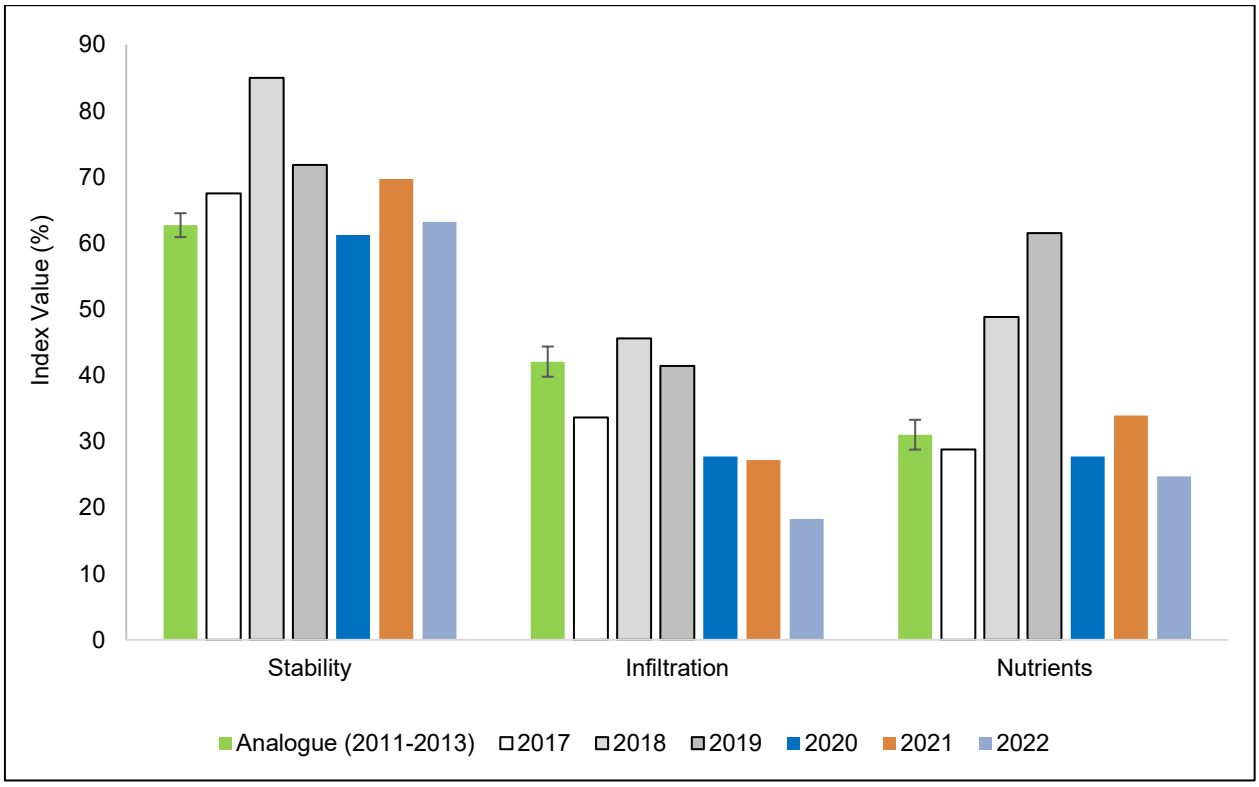

Figure 35. Landscape function indices change (2017-2022) for KANODO RT 20 with respect to mean analogue site values (2011-2013).

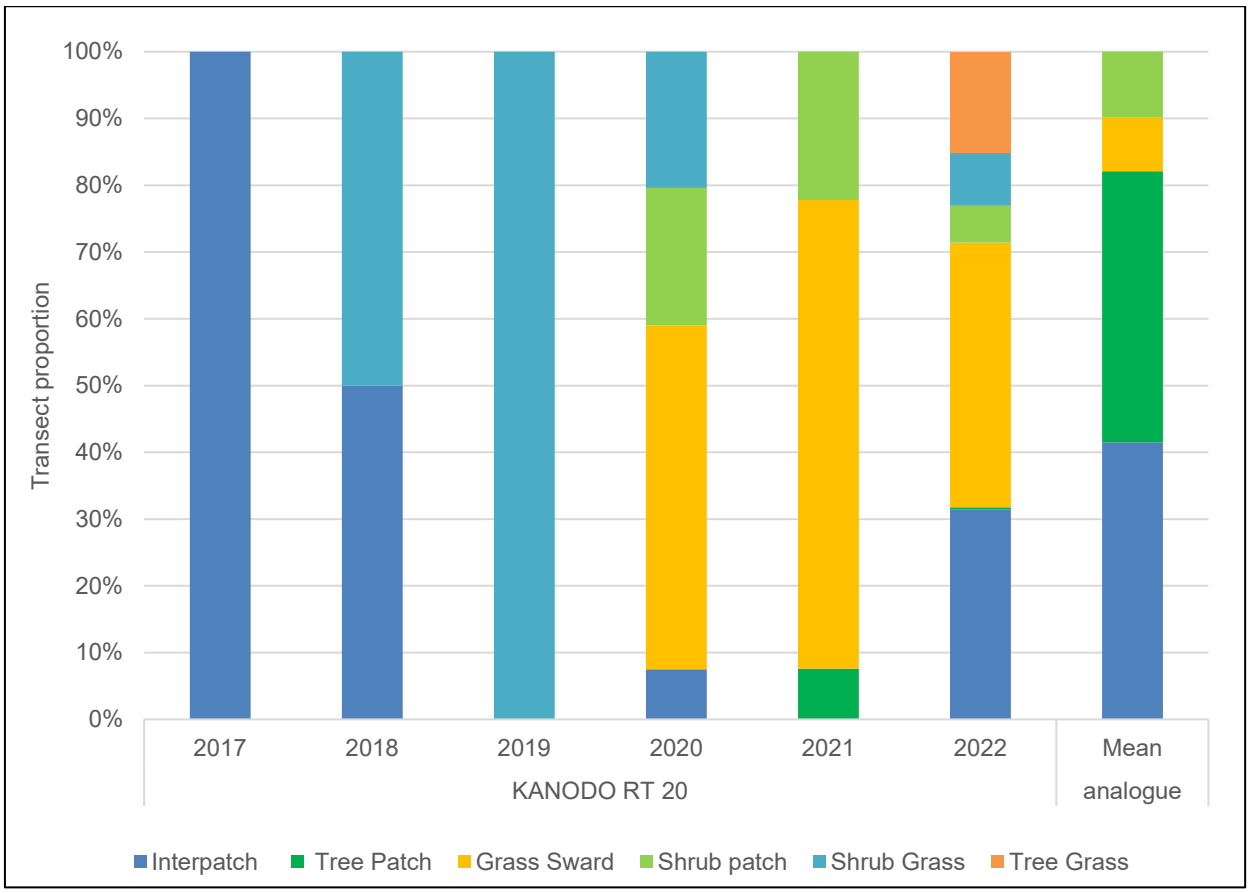

Figure 36. Percentage cover of each of the Surface Soil Assessment zones recorded at site KANODO RT 20.

Table 17. Summary of the landscape organisation data for KANODO analogue and KANODO RT 20 rehabilitation site 2017-2022.

Site Type	No. of patch zones per 10m	Total patch area (m²)	Average inter-patch length (m)	Landscape Organisational Index
Analogue 2011 -13	**2.8**	**308.4**	**1.8**	**0.6**
KANODO RT 20 Rehabilitation 2017	0.4	125.0	0	1.0
KANODO RT 20 Rehabilitation 2018	0.4	125.0	0	1.0
KANODO RT 20 Rehabilitation 2019	0.4	125.0	0	1.0
KANODO RT 20 Rehabilitation 2020	4.7	106.5	2.3	0.9
KANODO RT 20 Rehabilitation 2021	5.0	173.1	0	1.0
KANODO RT 20 Rehabilitation 2022	8.7	32.1	0.4	0.7

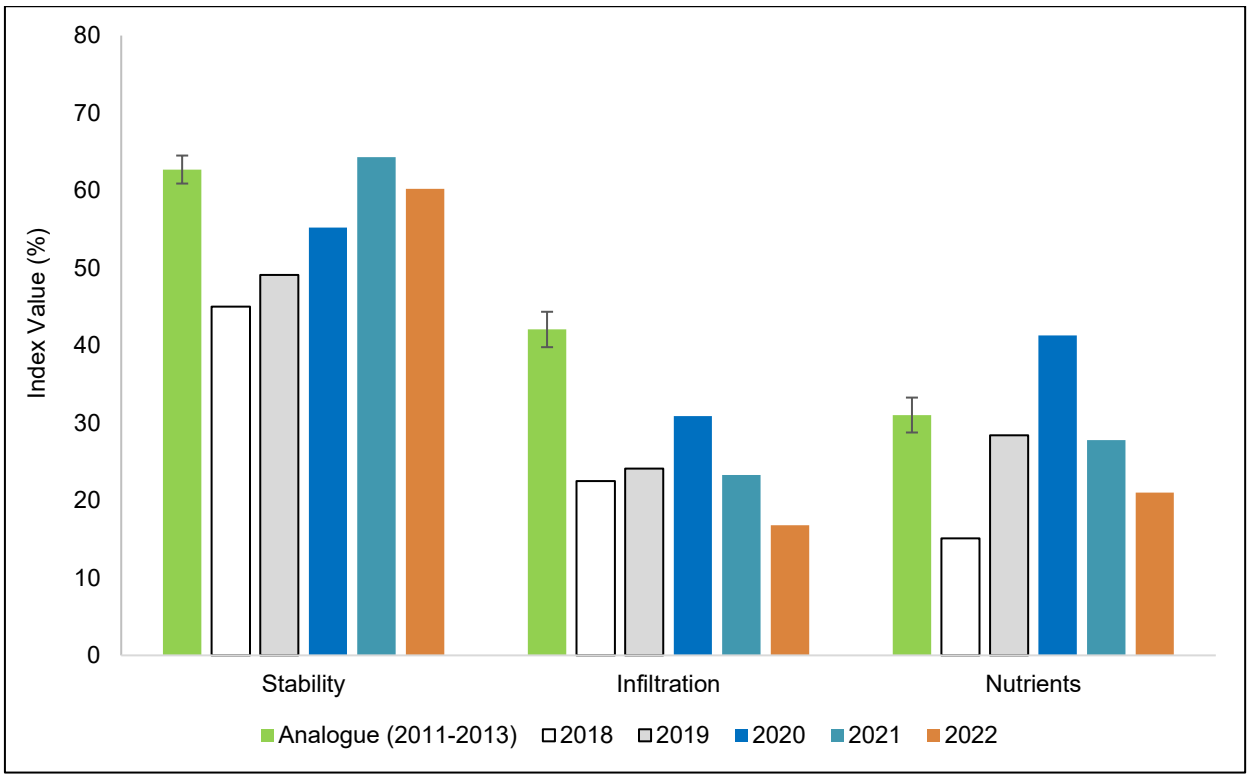

Figure 37. Landscape function indices change (2018-2022) for KANODO RT 21 with respect to mean analogue site values (2011-2013).

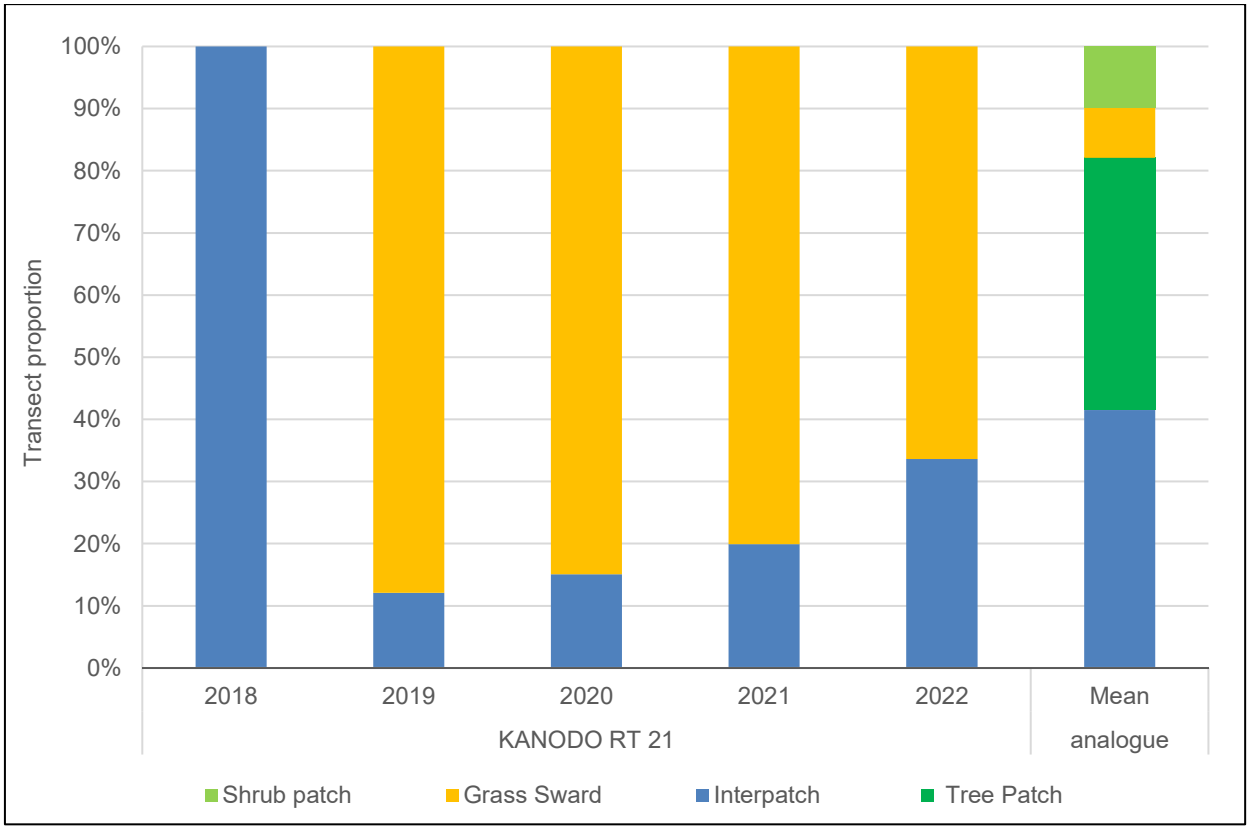

Figure 38. Percentage cover of each of the Surface Soil Assessment zones recorded at site KANODO RT 21.

Table 18. Summary of the landscape organisation data for KANODO analogue and KANODO RT 21 rehabilitation site 2018-2022.

Site Type	No. of patch zones per 10m	Total patch area (m²)	Average inter-patch length (m)	Landscape Organisational Index
Analogue 2011 -13	**2.8**	**308.4**	**1.8**	**0.6**
KANODO RT 21 Rehabilitation 2018	0.4	125.0	1.0	1.0
KANODO RT 21 Rehabilitation 2019	2.0	124.5	0.0	1.0
KANODO RT 21 Rehabilitation 2020	6.1	119.1	0.0	1.0
KANODO RT 21 Rehabilitation 2021	3.0	163.3	0.7	0.8
KANODO RT 21 Rehabilitation 2022	10.0	21.5	0.4	0.7

4.4 *Lomandra effusa* (Scented Mat Rush) Grassland rehabilitation transects

4.4.1 KANLOM RT 01

Whilst the stability value of KANLOM RT 01 has slightly increased from previous years, all index values remain lower than analogue values (Figure 39). The percent cover of troughs has been variable across surveys, likely a result of surveyor interpretation, and there are now discrete shrub patches (Figure 40). The Landscape Organisational data is variable over the years, as this site is still within early stages of rehabilitation. The number of patch zones per 10 m is higher than analogue values, reflective of the complexity of cover (Table 19).

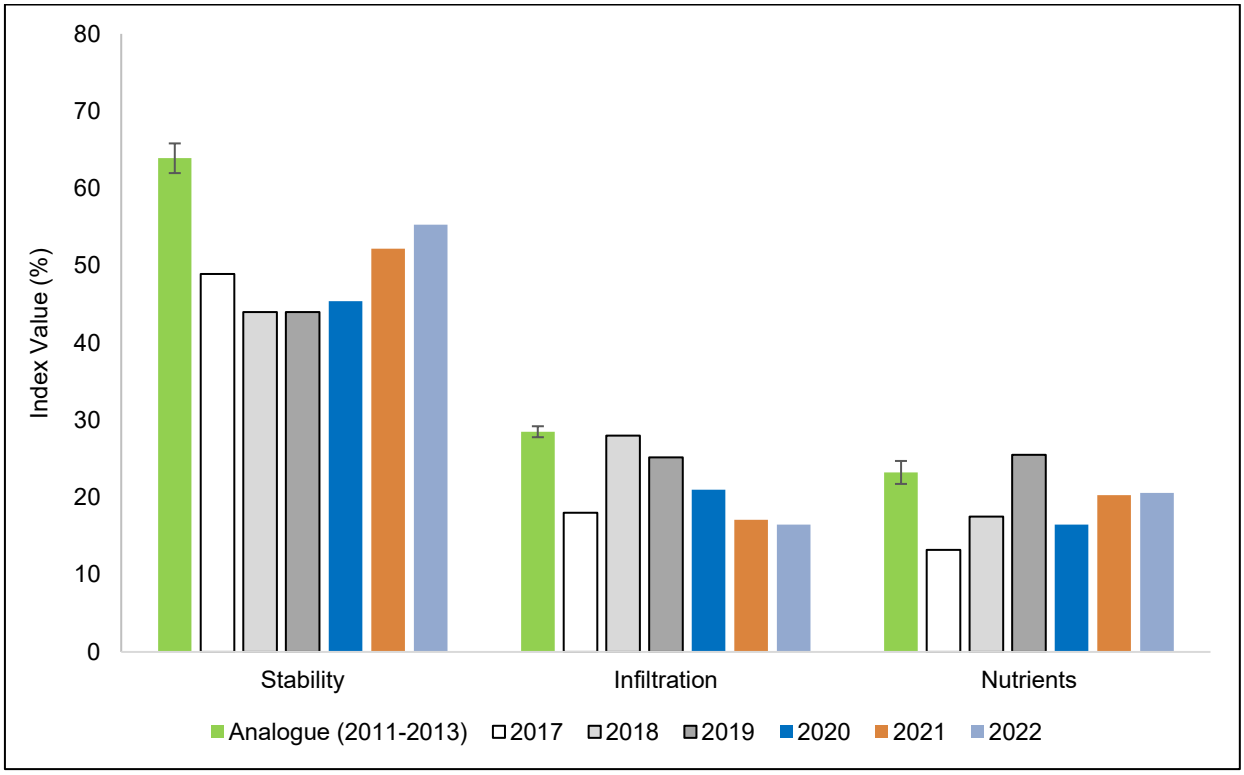

Figure 39. Landscape function indices change (2017-2022) for KANLOM RT 01 with respect to mean analogue site values (2011-2013).

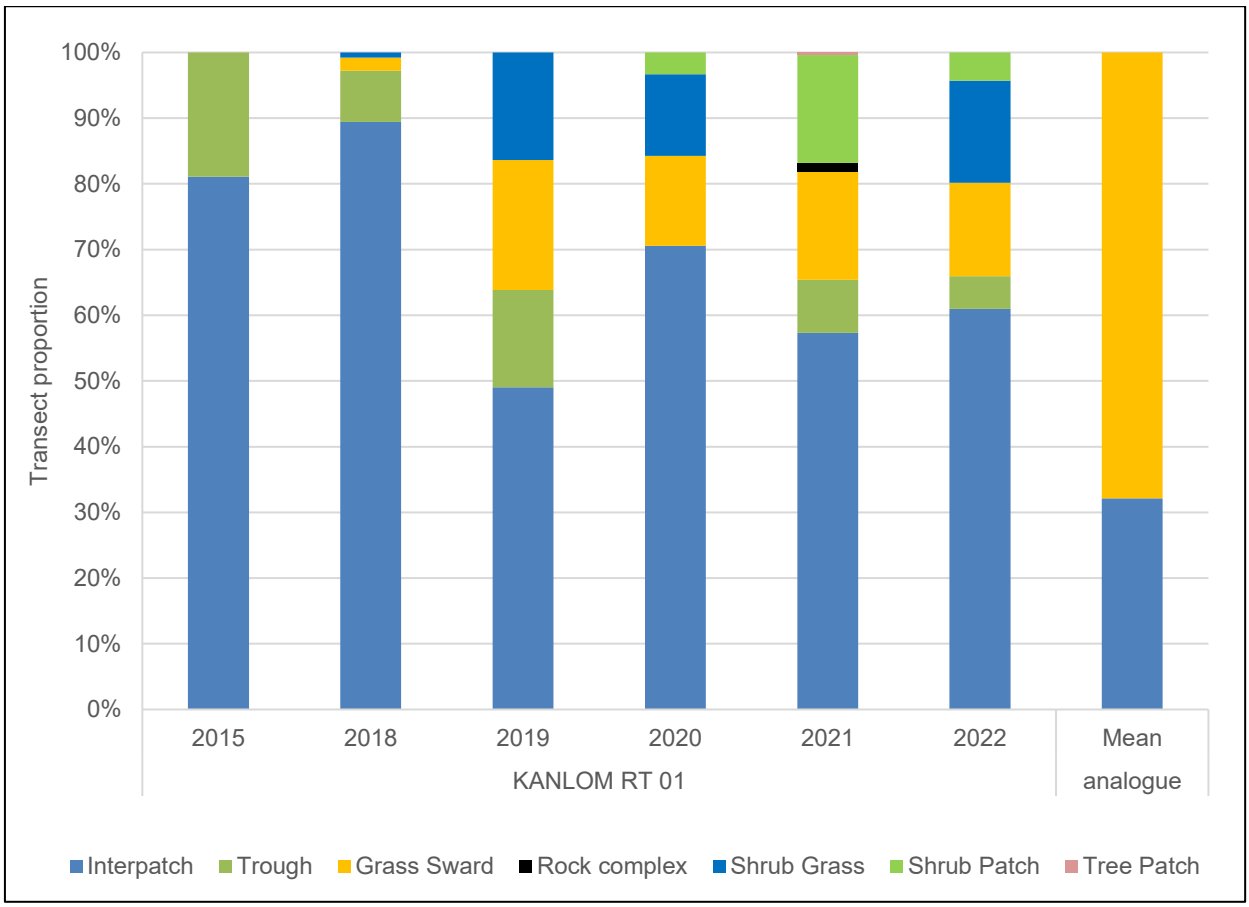

Figure 40. Percentage cover of each of the Surface Soil Assessment zones recorded at site KANLOM RT 01.

Table 19. Summary of the landscape organisation data for KANLOM analogue and KANLOM RT 01 rehabilitation site 2017-2022.

Site Type	No. of patch zones per 10m	Total patch area (m^2)	Average inter-patch length (m)	Landscape Organisational Index*
Analogue 2011 -13	**4.8**	**95.5**	**0.6**	**0.7**
KANLOM RT 01 Rehabilitation 2017	4.3	45.5	1.7	0.2
KANLOM RT 01 Rehabilitation 2018	2.8	19.3	0.8	0.1
KANLOM RT 01 Rehabilitation 2019	7.1	76.8	0.9	0.5
KANLOM RT 01 Rehabilitation 2020	12.4	31.7	0.6	0.3
KANLOM RT 01 Rehabilitation 2021	13.0	65.1	0.6	0.4
KANLOM RT 01 Rehabilitation 2022	11.7	37.6	0.5	0.4

4.4.2 KANLOM RT 02

The current landscape function indices for KANLOM RT 02 remain below the analogue, likely due to the physical properties of the soil within this area. The infiltration value has increased since last year but is lower than all other previous years and the analogue values, suggesting soil roughness and soil surface resistance to disturbance had decreased (Figure 41). Grass swards have established within the troughs, leading to the reduction in proportion of trough compared to grass from the past three survey years (Figure 42). The reduction in shrubs and shrub grasses has resulted in the percentage cover approaching analogue values. Most Landscape Organisational Indices are approaching analogue values, except the number of patches per 10 m which is an indicator of increasing complexity and more grasses growing in troughs (Table 20).

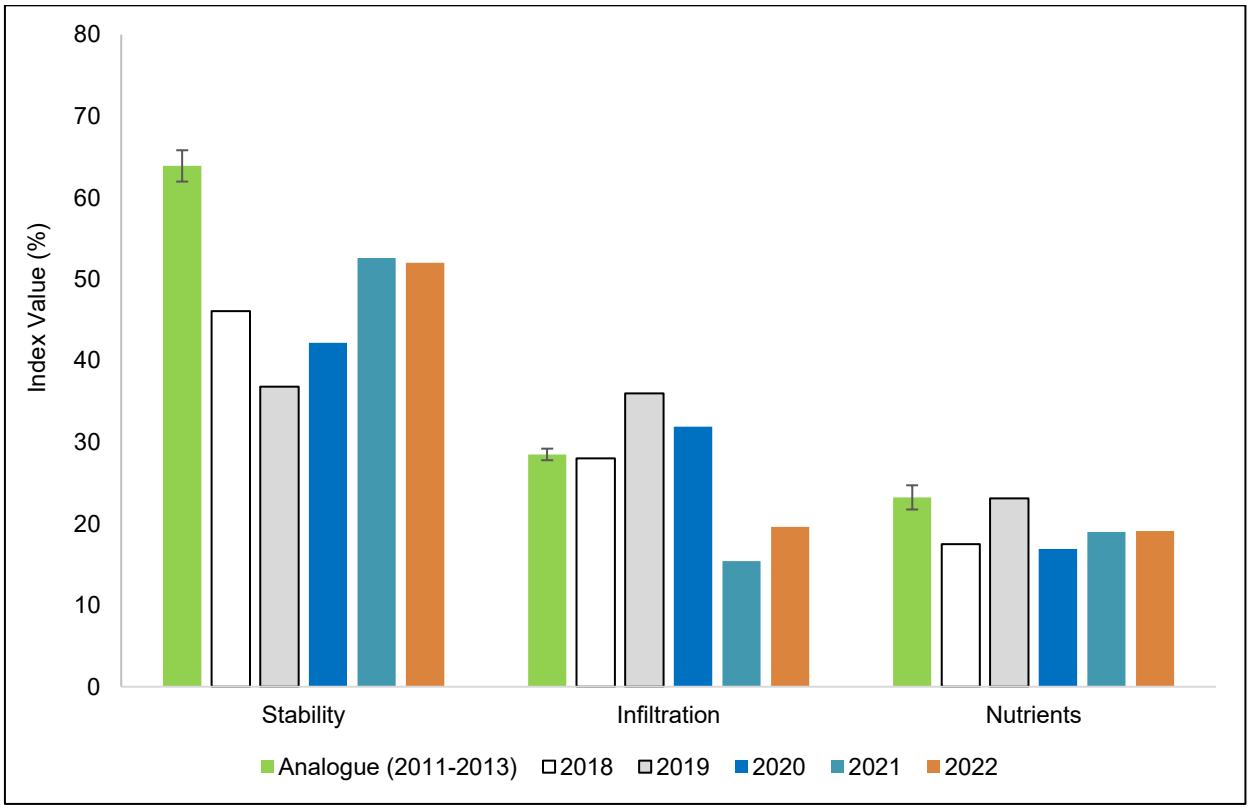

Figure 41. Landscape function indices change (2018-2022) for KANLOM RT 02 with respect to mean analogue site values (2011-2013).

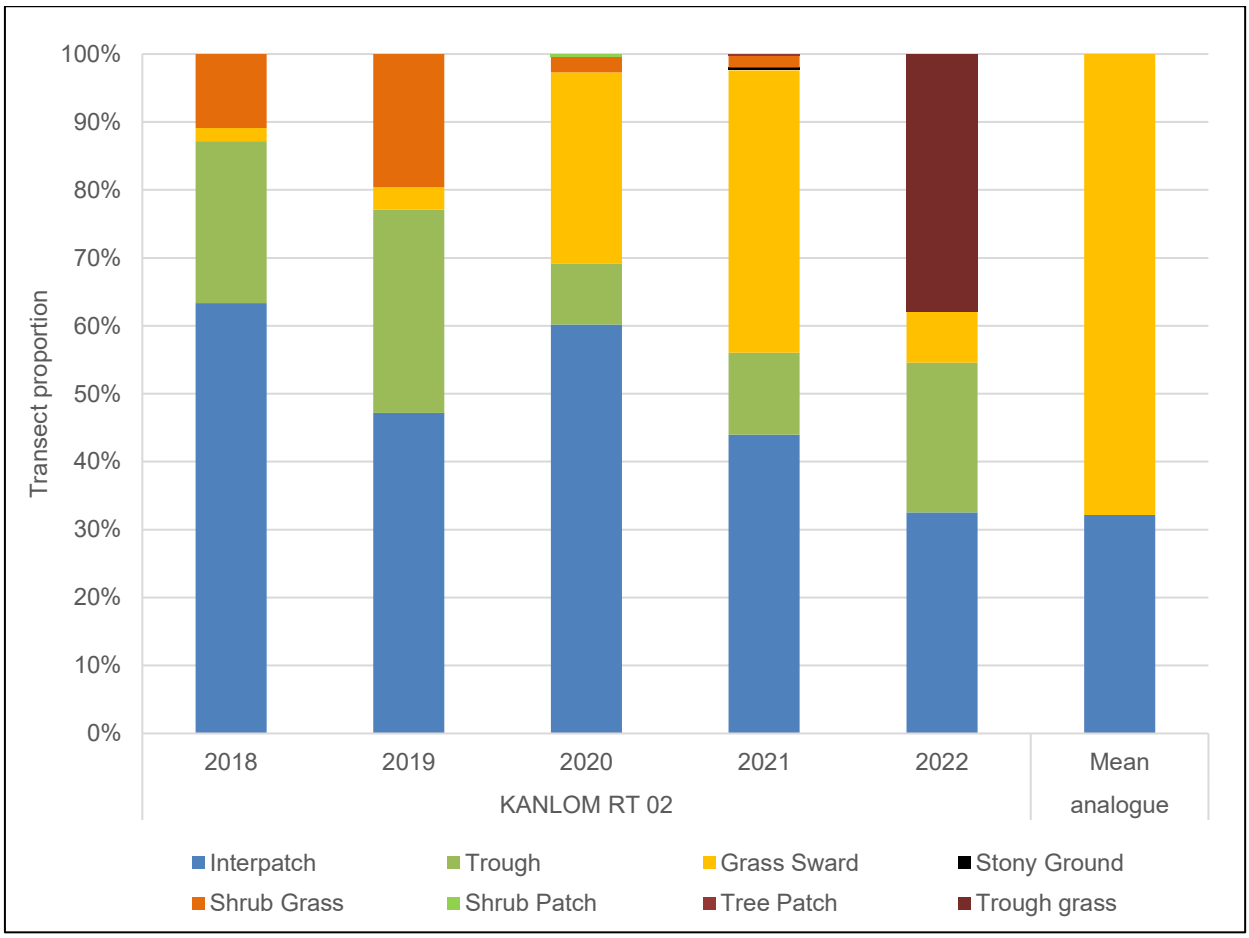

Figure 42. Percentage cover of each of the Surface Soil Assessment zones recorded at site KANLOM RT 02.

Table 20. Summary of the landscape organisation data for KANLOM analogue and KANLOM RT 02 rehabilitation site 2018-2022.

Site Type	No. of patch zones per 10m	Total patch area (m²)	Average inter-patch length (m)	Landscape Organisational Index*
Analogue 2011 -13	**4.8**	**95.5**	**0.6**	**0.7**
KANLOM RT 02 Rehabilitation 2018	5.5	49.3	1.2	0.4
KANLOM RT 02 Rehabilitation 2019	6.0	85.9	1.0	0.5
KANLOM RT 02 Rehabilitation 2020	9.2	43.9	0.8	0.4
KANLOM RT 02 Rehabilitation 2021	11.1	90.0	0.6	0.6
KANLOM RT 02 Rehabilitation 2022	6.9	57.5	0.7	0.7

4.5 Acacia pycnantha (Golden Wattle) Low Woodland rehabilitation transects

4.5.1 KANACA RT 01

The soil stability and nutrient values at KANACA RT 01 are similar to previous years, slightly below analogue values, whilst infiltration values have increased compared to the previous survey year (Figure 43). Both grass sward cover and shrub cover have decreased from previous years and away from analogue values, while tree and tree grass patches were observed for the first time (Figure 44). Patch zones are yet to stabilize as the vegetation continues to develop and transform through early successional stages. The number of patch zones per 10 m is high, reflective of the complexity of cover (Table 21). Additionally, one *Caladenia verrucosa* (Yellow-club Spider-orchid) was observed on this rehabilitation transect (Figure 45). Presumably seed from this species was in the soil and has successfully germinated this monitoring year.

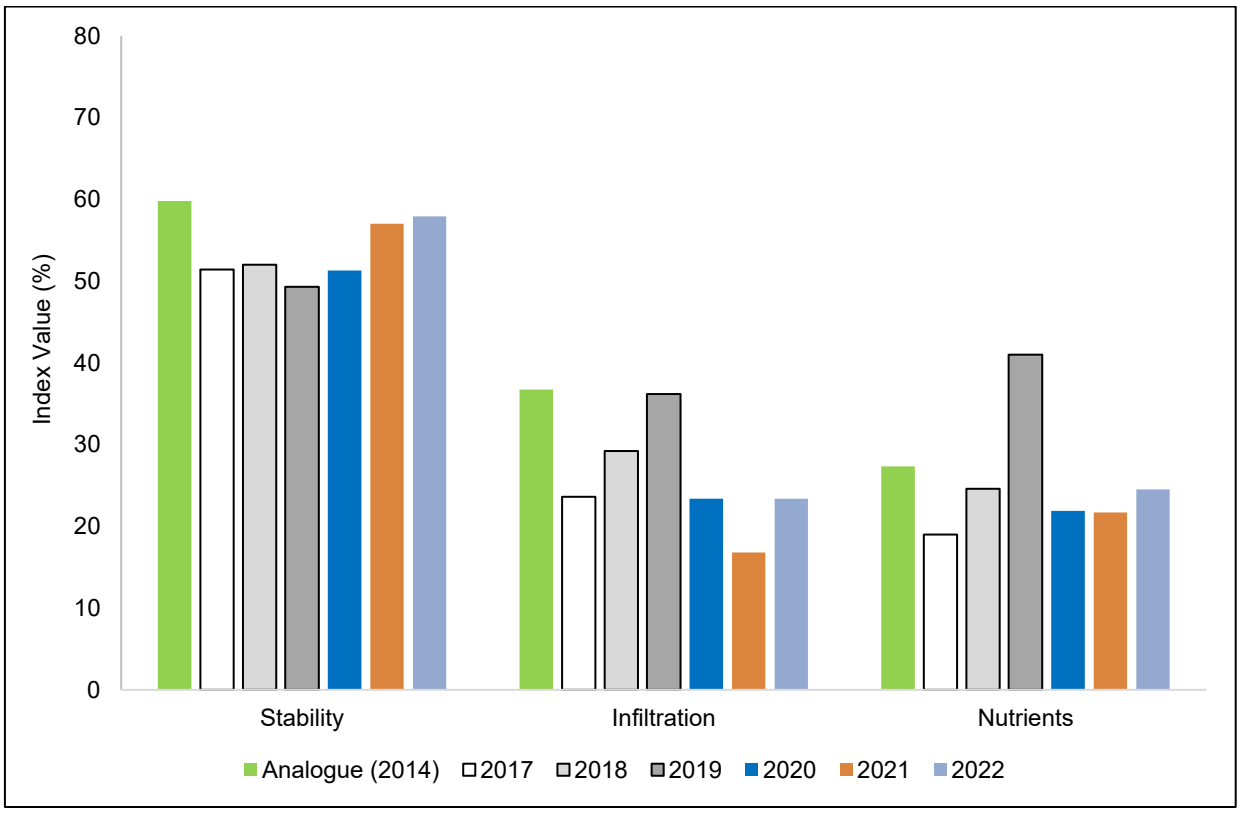

Figure 43. Landscape function indices change (2017-2022) for KANACA RT 01 with respect to mean analogue site values (2014).

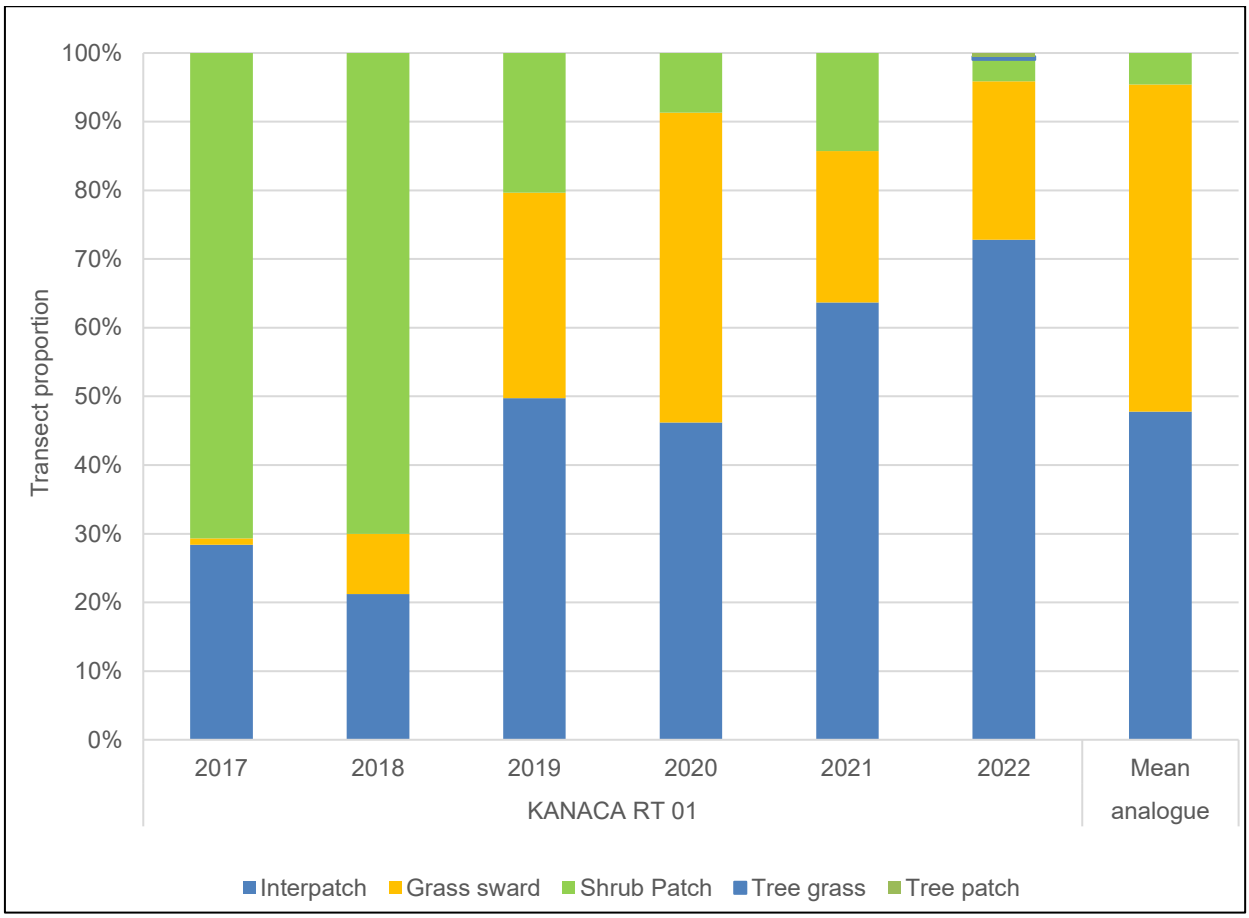

Figure 44. Percentage cover of each of the Surface Soil Assessment zones recorded at site KANACA RT 01.

Table 21. Summary of the landscape organisation data for KANACA analogue and KANACA RT 01 rehabilitation site 2017-2022.

Site Type	No. of patch zones per 10m	Total patch area (m^2)	Average inter-patch length (m)	Landscape Organisational Index*
Analogue 2014	**4.7**	**141.6**	**1**	**0.7**
KANACA RT 01 Rehabilitation 2017	7.7	158.3	2.3	0.3
KANACA RT 01 Rehabilitation 2018	4.3	150.3	0.5	0.8
KANACA RT 01 Rehabilitation 2019	8.7	46.7	0.7	0.5
KANACA RT 01 Rehabilitation 2020	9.9	61.0	0.5	0.5
KANACA RT 01 Rehabilitation 2021	9.6	9.3	0.7	0.4
KANACA RT 01 Rehabilitation 2022	11.5	4.7	0.6	0.3

Figure 45. *Caladenia verrucosa* (Yellow-club Spider-orchid) observed at rehabilitation site KANACA RT 01.

4.5.2 KANACA RT 02

The sixth year of monitoring KANACA RT 02 has seen a decrease in infiltration and nutrient values compared to previous years, although nutrient values are still above analogue values (Figure 46). After initial uniform grass sward cover over the first three years (2017, 2018 & 2019), interpatches have increased and trees have established at the site (Figure 47). Increasing patchiness in grass cover at the site has resulted in the number of patches per 10 m being greater than analogue results. Total patch area has increased while average interpatch length and landscape organisational index remain similar compared to last year (Table 22).

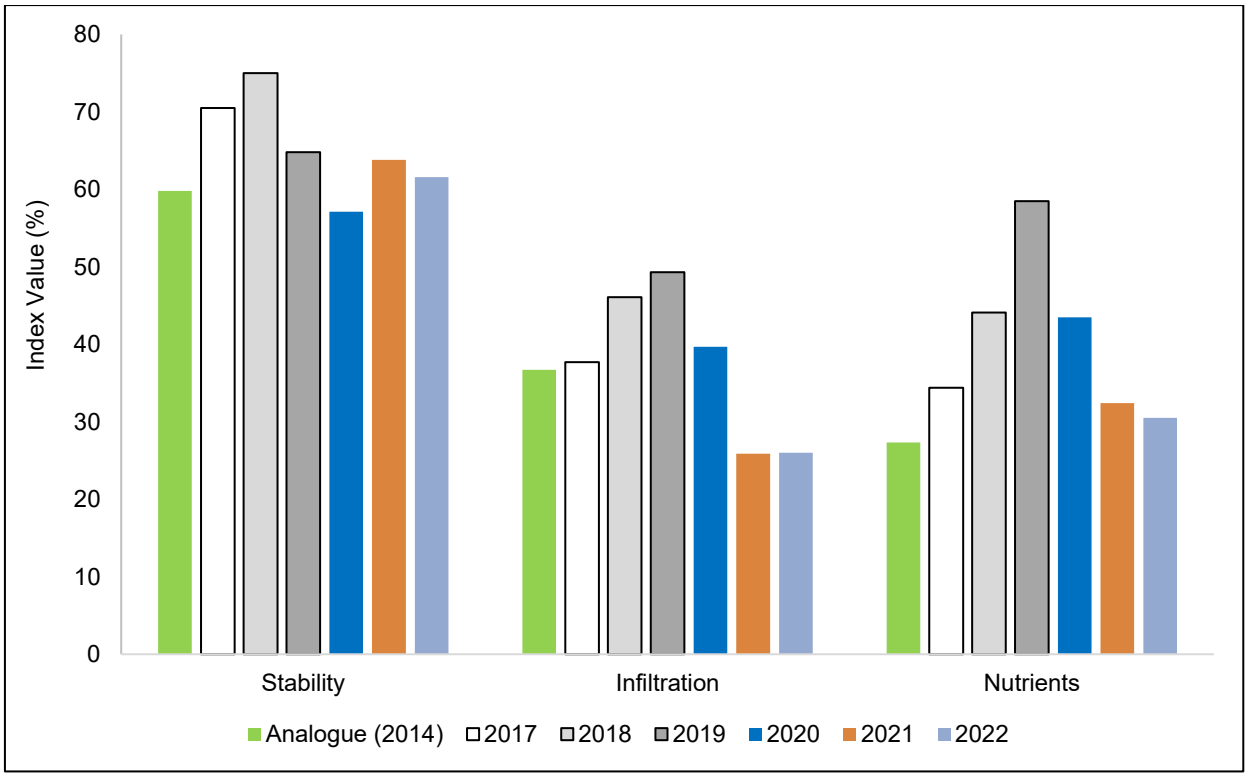

Figure 46. Landscape function indices change (2017-2022) for KANACA RT 02 with respect to mean analogue site values (2014).

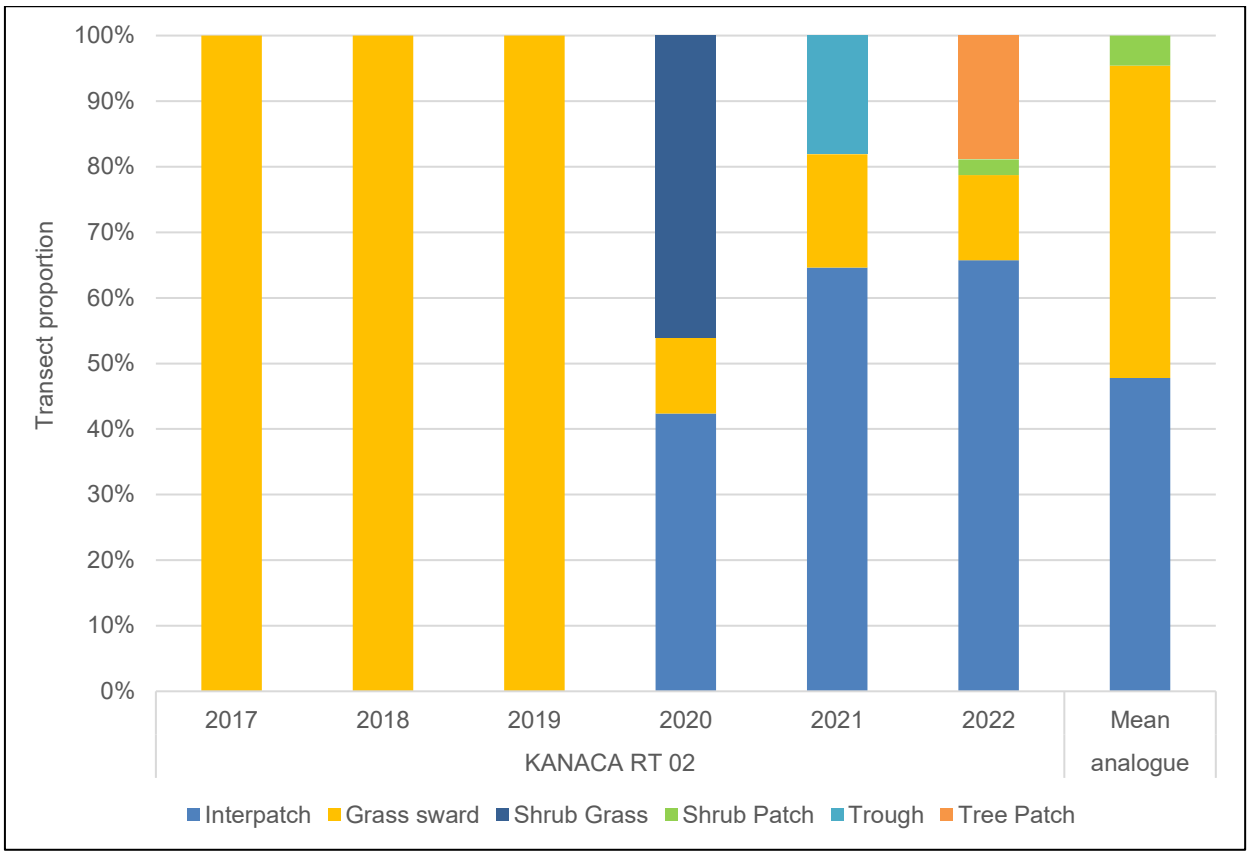

Figure 47. Percentage cover of each of the Surface Soil Assessment zones recorded at site KANACA RT 02.

Table 22. Summary of the landscape organisation data for KANACA analogue and KANACA RT 02 rehabilitation site 2017-2022.

Site Type	No. of patch zones per 10m	Total patch area (m²)	Average inter-patch length (m)	Landscape Organisational Index
Analogue 2014	**4.7**	**141.6**	**1.0**	**0.7**
KANACA RT 02 Rehabilitation 2017	1	125.0	0.0	1.0
KANACA RT 02 Rehabilitation 2018	0.4	125.0	0.0	1.0
KANACA RT 02 Rehabilitation 2019	0.4	125.0	0.0	1.0
KANACA RT 02 Rehabilitation 2020	4.4	35.2	1.0	0.6
KANACA RT 02 Rehabilitation 2021	8.0	16.3	0.9	0.4
KANACA RT 02 Rehabilitation 2022	7.6	25.1	0.9	0.3

4.5.3 KANACA RT 03

In the fifth monitoring year for KANACA RT 03, stability and nutrient values are very similar to analogue values, while infiltration remained similar to previous years (and below analogue values) (Figure 48). The site was showing some increase in complexity with the addition of shrub cover in 2021 but this cover was absent in the 2022 monitoring year (Figure 49). The landscape organisational indices across the six years are variable as the vegetation continues to develop and transform through early successional stages (Table 23).

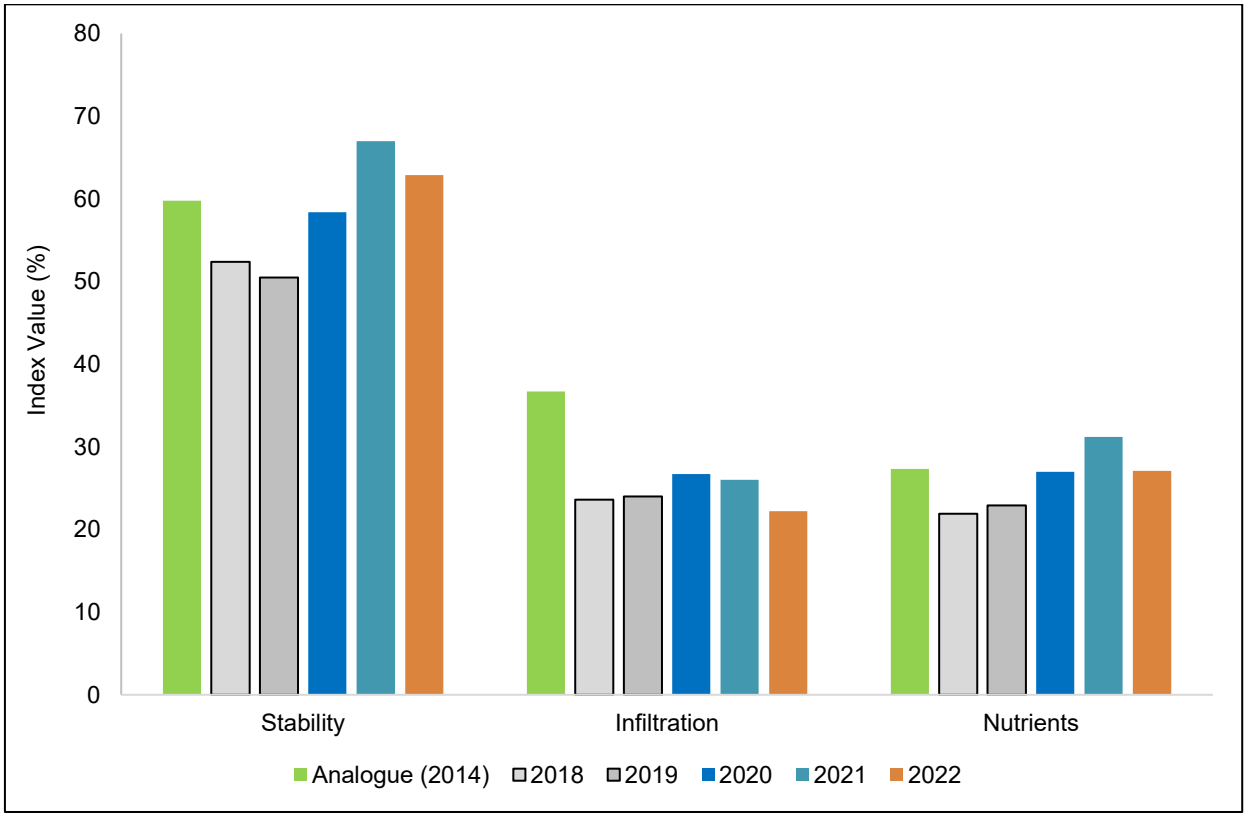

Figure 48. Landscape function indices change (2017-2022) for KANACA RT 03 with respect to mean analogue site values (2014).

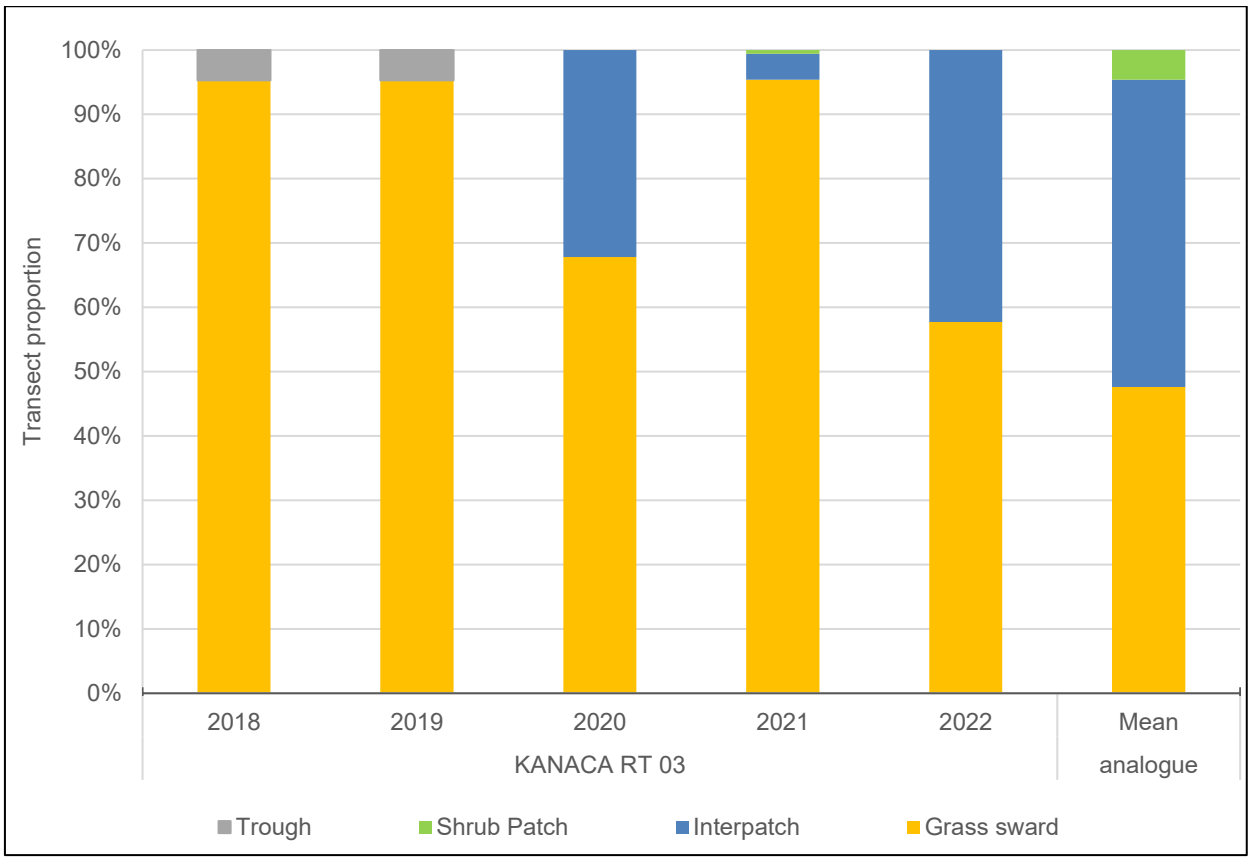

Figure 49. Percentage cover of each of the Surface Soil Assessment zones recorded at site KANACA RT 03.

Table 23. Summary of the landscape organisation data for KANACA analogue and KANACART03 rehabilitation site 2018-2022.

Site Type	No. of patch zones per 10m	Total patch area (m²)	Average inter-patch length (m)	Landscape Organisational Index
Analogue 2014	**4.7**	**141.6**	**1**	**0.7**
KANACA RT 03 Rehabilitation 2018	0.3	0.5	14.3	0.1
KANACA RT 03 Rehabilitation 2019	1.0	173.0	0	1
KANACA RT 03 Rehabilitation 2020	1.4	232.7	2.6	0.7
KANACA RT 03 Rehabilitation 2021	1.1	486.8	0.7	1.0
KANACA RT 03 Rehabilitation 2022	3.9	71.8	1.2	0.6

4.6 Grass Laydown area rehabilitation transect

4.6.1 KANGRA RT 01

The permanent grass laydown area established in 2012 now has a good cover of *Chloris truncata* (Windmill Grass) which was the original species planted. Infiltration and nutrient function indices have decreased over the past two monitoring years while stability has decreased since last year with all indices lower than analogue values (Figure 50).

The proportion of grass sward has decreased while the proportion of interpatches has increased at this site. Shrub patches have been observed for the first time at this site (Figure 51). Landscape organisation indices remain variable due to the dynamic nature of early revegetated areas (Table 24).

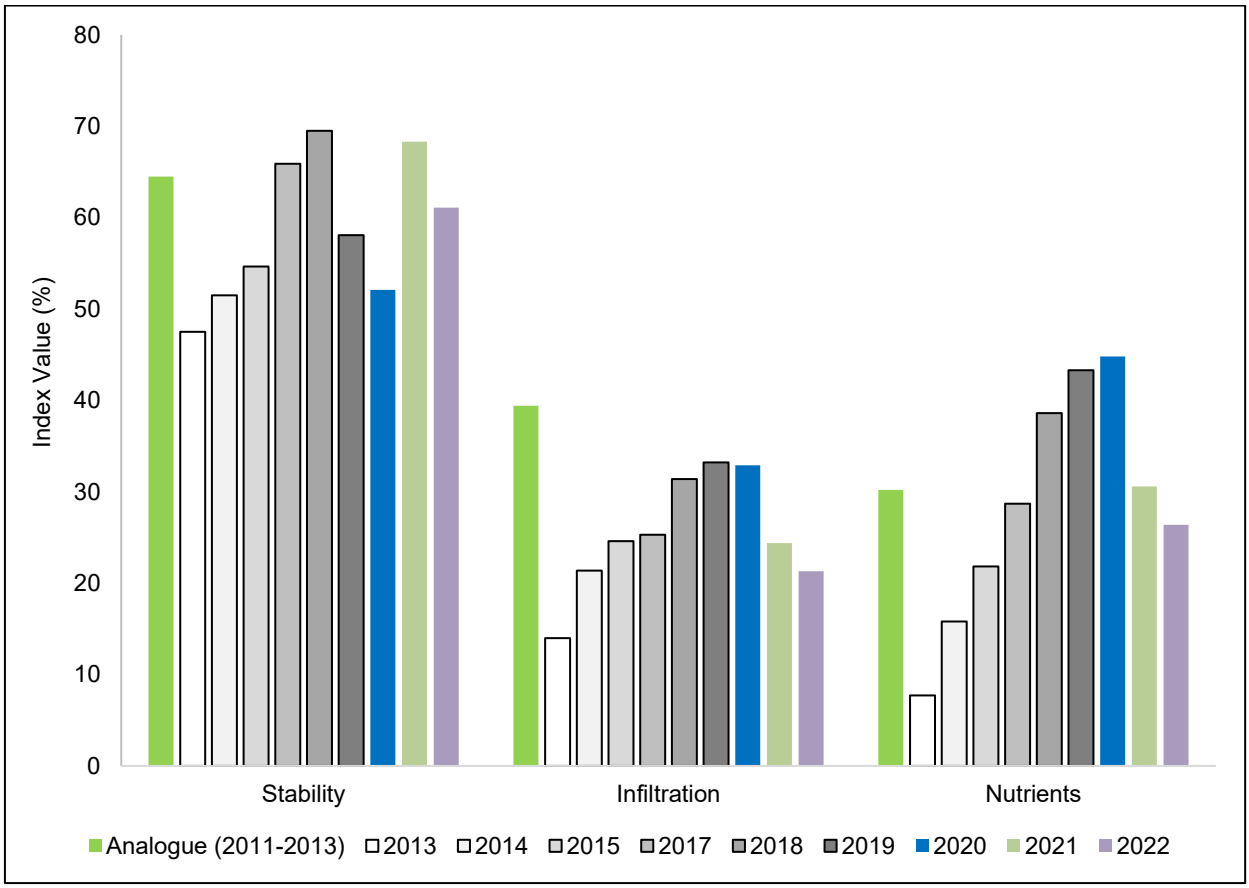

Figure 50. Landscape function indices change (2013-2022) for KANGRA RT 01 with respect to mean analogue site values (2011-2013).

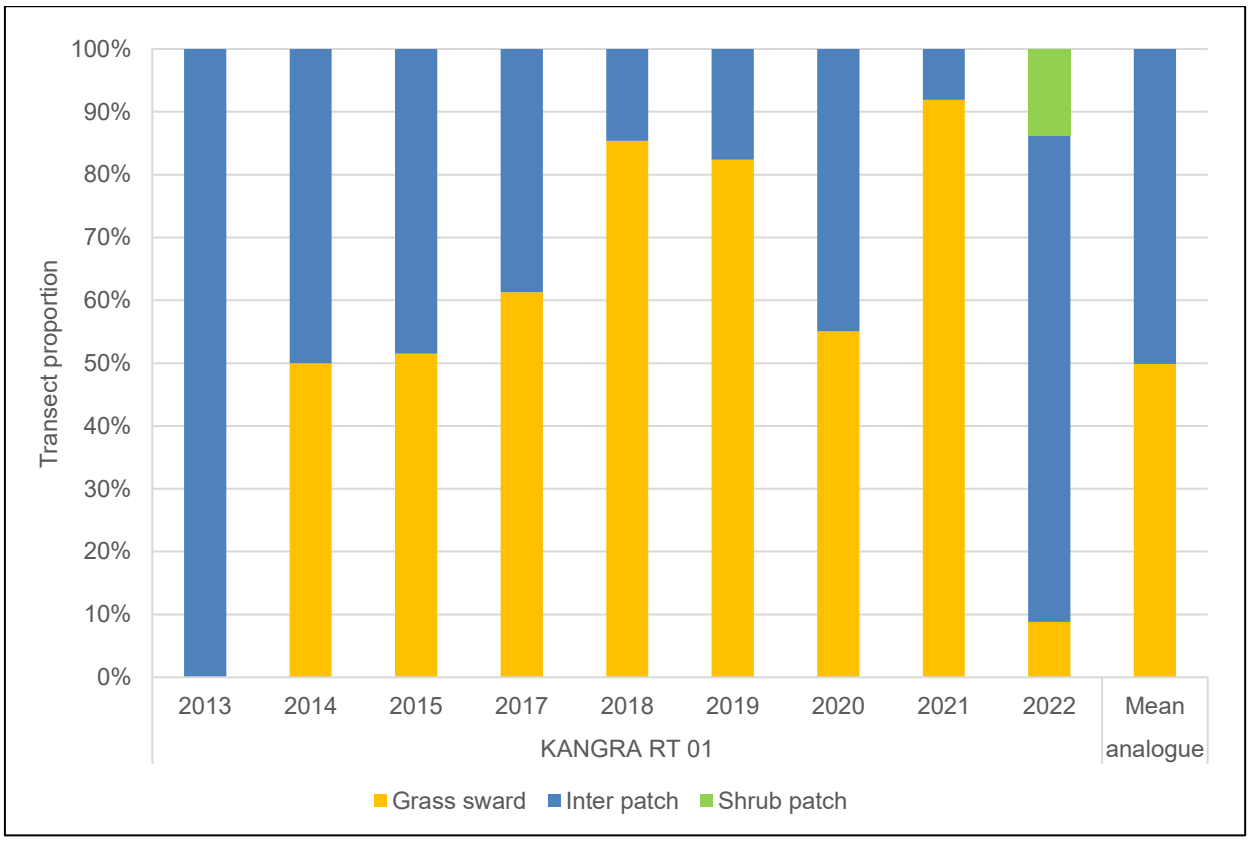

Figure 51. Percentage cover of each of the Surface Soil Assessment zones recorded at site KANGRA RT 01.

Table 24. Summary of the landscape organisation data for KANGRA analogue and KANGRA RT 01 rehabilitation site 2013-2022.

Site Type	No. of patch zones per 10m	Total patch area (m²)	Average inter-patch length (m)	Landscape Organisational Index
Analogue 2011 -13	**4.7**	**179.1**	**0.5**	**0.7**
KANGRA RT 01 Rehabilitation 2013	0.0	100.0	10.0	0.0
KANGRA RT 01 Rehabilitation 2014	5.0	64.6	1.1	0.5
KANGRA RT 01 Rehabilitation 2015	3.0	278.4	1.6	0.5
KANGRA RT 01 Rehabilitation 2017	3.3	142.5	1.3	0.6
KANGRA RT 01 Rehabilitation 2018	1.3	211.8	1.5	0.9
KANGRA RT 01 Rehabilitation 2019	2.6	204.3	0.8	0.8
KANGRA RT 01 Rehabilitation 2020	4.7	127.1	1.0	0.6
KANGRA RT 01 Rehabilitation 2021	3.0	219.0	0.3	0.9
KANGRA RT 01 Rehabilitation 2022	4.3	7.7	1.7	0.2

4.7 Grassy hillslope analogue sites

This section presents results for the four LFA grassland monitoring sites established in 2019. These sites (KANGRA 10-13) were established as analogue sites on hill slopes with different aspects (see photo points at Appendix 3), representative of hills in the surrounding landscape against which to measure future rehabilitation activities.

4.7.1 KANGRA 10-13

The average soil surface indicators were generally similar across all four sites with lower stability and nutrients for KANGRA 13 compared with the other three sites (Figure 52). Average vegetation cover proportions were also similar across sites, with sedge patch and rock grass complex a feature in only KANGRA 11 (Figure 53). Landscape organisational indexes for all four sites differ substantially from 2021 values (Table 25; Table 26; Table 27 and Table 28). Compared to the largely uniform native grasslands of 2019, it appears that annual exotic grasses had benefitted greatly with above average rainfall in the last three years, leading to much greater inter-patches compared to grass swards. This is why it is important to have multiple years of data for analogue sites, in order to lessen the effects of yearly fluctuations on data from stochastic factors such as weather.

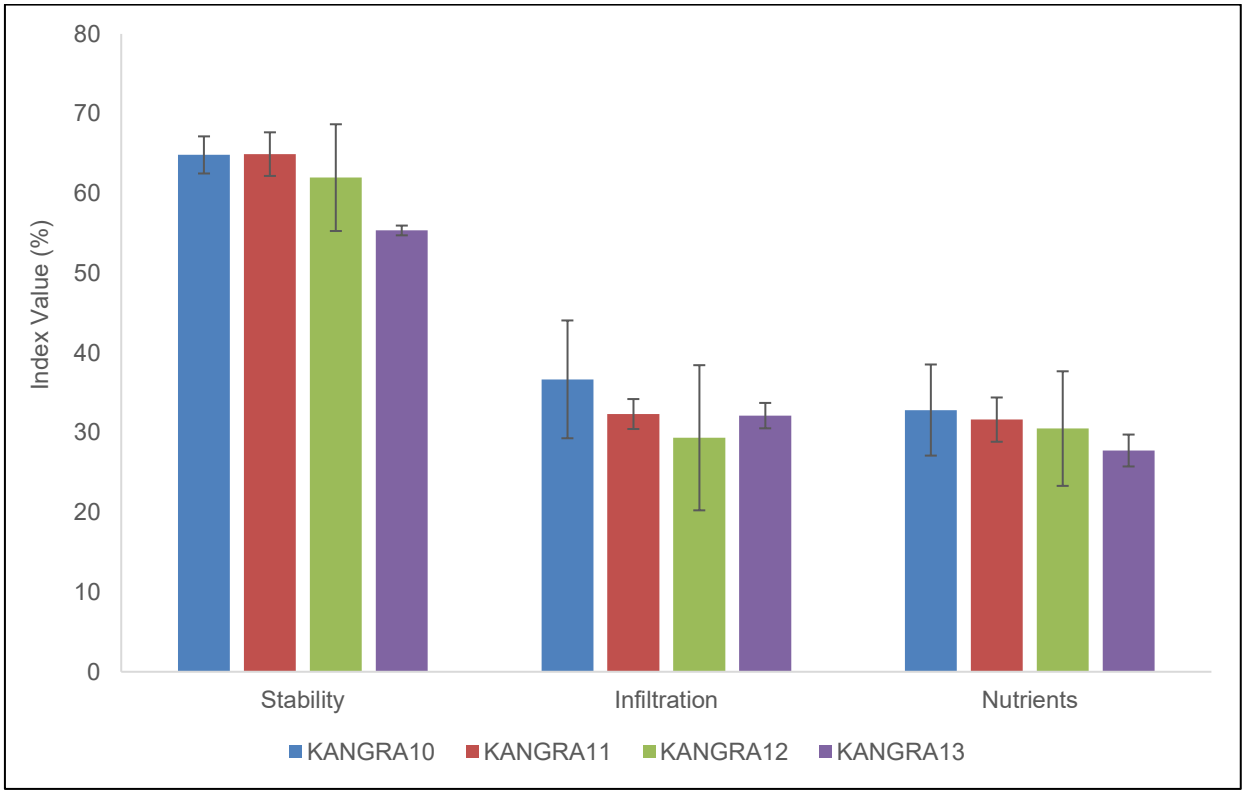

Figure 52. Average Landscape function indices from 2019 to 2022 for the four analogue grassland sites KANGRA 10-13.

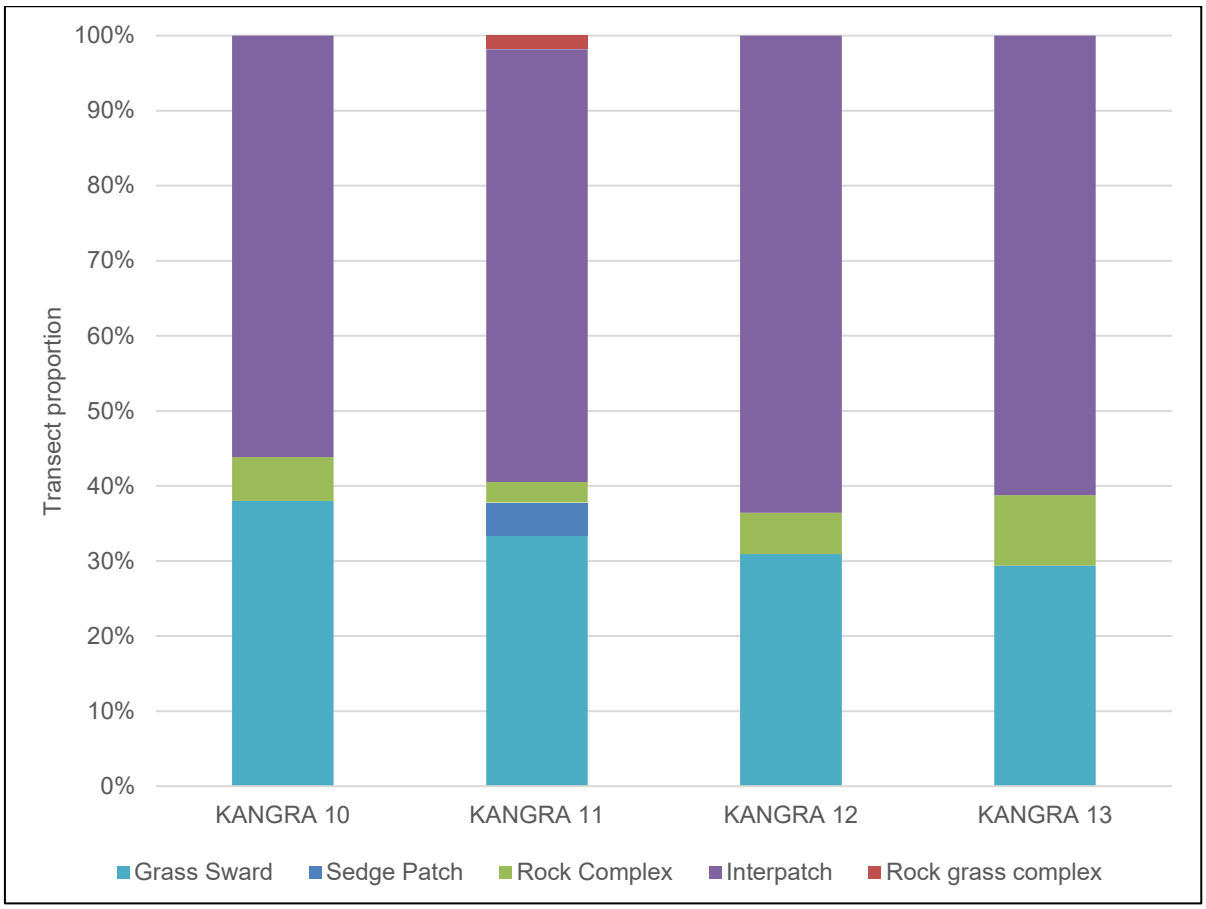

Figure 53. Average percentage cover of each of the Surface Soil Assessment zones recorded at sites KANGRA 10-13 from 2019-2022.

Table 25. Summary of the landscape organisation data for the KANGRA 10 analogue site 2019-2022.

Site Type	No. of patch zones per 10m	Total patch area (m²)	Average inter-patch length (m)	Landscape Organisational Index
KANGRA 10 2019	2.8	190.6	0.0	1.0
KANGRA 10 2020	8	7.2	0.9	0.3
KANGRA 10 2021	9.6	3.9	0.7	0.2
KANGRA 10 2022	4.0	1.9	1.8	0.2
Average	**6.1**	**50.9**	**0.9**	**0.4**

Table 26. Summary of the landscape organisation data for the KANGRA 11 analogue site 2019-2022.

Site Type	No. of patch zones per 10m	Total patch area (m²)	Average inter-patch length (m)	Landscape Organisational Index*
KANGRA 11 2019	5.2	183.4	0.0	1.0
KANGRA 11 2020	3.0	5.9	2.7	0.1
KANGRA 11 2021	5.5	6.6	1.5	0.2
KANGRA 11 2022	5.0	6.7	1.4	0.3
Average	**4.7**	**50.7**	**1.4**	**0.4**

Table 27. Summary of the landscape organisation data for the KANGRA 12 analogue site 2019-2022.

Site Type	No. of patch zones per 10m	Total patch area (m^2)	Average inter-patch length (m)	Landscape Organisational Index*
KANGRA 12 2019	3.0	232.8	0.0	1.0
KANGRA 12 2020	4.7	15.4	1.7	0.2
KANGRA 12 2021	10.1	2.4	0.9	0.2
KANGRA 12 2022	3.0	1.6	2.8	0.1
Average	**5.2**	**63.1**	**1.4**	**0.4**

Table 28. Summary of the landscape organisation data for the KANGRA 13 analogue site 2019-2022.

Site Type	No. of patch zones per 10m	Total patch area (m^2)	Average inter-patch length (m)	Landscape Organisational Index*
KANGRA 13 2019	3.0	240.0	0.0	1.0
KANGRA 13 2020	1.3	15.1	5.7	0.1
KANGRA 13 2021	1.9	24.7	3.9	0.2
KANGRA 13 2022	0.9	13.4	7.3	0.1
Average	**1.8**	**73.3**	**4.2**	**0.4**

5 DISCUSSION

In general, the LFA indicators have shown positive rehabilitation trends over the life of the Kanmantoo monitoring program (2011-2022). Rehabilitation plots have typically reached a level of 'self-sustaining communities', that is a development of native vegetation cover and soil stability relative to analogue sites, after a period of only 3-4 years. Revegetation sites that have managed to establish vegetation cover have generally maintained or increased cover type complexity, shifting from predominantly grass cover to additional shrub and tree cover. Based on the initial success rates of restoration activities across Kanmantoo, it is likely that ongoing works will result in functional trends similar to those observed using LFA to date. This includes initial low values, followed by a rebound period whereby plant cover produces high stability, infiltration and nutrient cycling values before stabilising towards analogue values. However, these indices can still be variable due to yearly fluctuations from stochastic factors such as weather.

For areas with the topsoil removed and works undertaken on the Waste Rock Landform (WRL) which is subjected to bank and trough contour ripping, all indicators show that since inception of rehabilitation works, LFA function indices all achieve or exceed analogue values in the first few years. Sites where no treatment has occurred had values lower than analogue values and downward trends in functional indices.

Based on the initial success rates of restoration activities across Kanmantoo, it is likely that ongoing works will result in similar functional trends as those observed using LFA to date. This includes initial low values, followed by a rebound period whereby plant cover produces high stability, infiltration and nutrient cycling values before stabilising back to analogue values.

The LFA sites monitored at Kanmantoo allow for sufficient data from which to detect trends in functional landscape-based attributes. Qualitative observations of rehabilitation success (i.e., field observations and photo points) are supported by long-term quantitative LFA results.

5.1 Recommendations

Non-functional ecological vegetation attributes such as plant species richness (and whether species are native or exotic) are currently not reported as part of the LFA monitoring program, limiting the ability of the program to determine the success of species of interest used in revegetation and seeding mixes. Species composition and germination success should be considered as part of ongoing monitoring to provide information on how species respond to specific restoration methods, thus informing future rehabilitation activities. Such information would also be useful for assessing:

- Overall trends in plant species abundance and diversity; and
- Impacts on vegetation from threats such as total grazing pressure.

Given the gaps in weather data (see Section 4.1), it is recommended that annual rainfall data is graphed from October to September inclusive in order to capture as much data as possible.

Ongoing monitoring should continue to adapt in order to maximise the efficiency and effectiveness of detecting changes in LFA monitoring sites. Ongoing annual review and adaptation of the monitoring program is recommended, taking into account factors such as frequency of assessment, indicators measured and sampling locations.

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7 APPENDICES

7.1 Appendix 1. Summary of LFA sites monitored and monitoring frequency 2011-2022.

Site name	Site type*	2011	2012	2013	2014	2015	2017	2018	2019	2020	2021	2022	Easting	Northing
KANSTI 4	RH				P	P							319376	6115483
KANODO RT20	RH						P	P	P	P	P	P	318732	6115394
KANODO RT21	RH							P	P	P	P	P	318482	6114090
KANODO RT19	RH						P	P	P	P	P	P	319062	6115176
KANODO RT18	RH						P	P	P	P	P	P	318988	6115623
KANODO RT17	RH					P	P	P	P	P	P	P	317308	6115933
KANODO RT16	RH					P	P	P	P		P	P	317324	6115923
KANODO RT15	RH					P	P	P	P	P	P	P	317348	6115912
KANODO RT14	RH					P	P	P	P	P	P	P	316941	6116079
KANODO RT13	RH					P	P	P	P		P	P	316974	6116086
KANODO RT12	RH					P	P	P	P	P	P	P	317006	6116086
KANODO RT11	RH					P	P	P	P				317021	6116090
KANODO RT10	RH					P	P	P	P	P	P	P	317051	6116090
KANODO RT07	RH					P	P	P	P	P	P	P	317131	6116083
KANODO 9	RH				P	P	P	P	P	P	P	P	317807	6114076
KANODO 8	RH				P	P	P	P	P	P	P	P	316735	6116444
KANODO 7	RH				P	P	P	P					319201	6115552
KANODO 6	RH	P	P	P	P	P	P	P	P	P	P	P	316537	6116233
KANODO 4	RH	P	P	P	P	P	P	P	P	P	P	P	316754	6116204
KANODO 5	RH	P	P	P	P	P	P	P	P	P	P	P	316751	6116127
KANLOM RT02	RH							P	P	P	P	P	318368	6114430
KANLOM RT01	RH						P	P	P	P	P	P	317786	6114369
KANLOM 8	RH				P	P							319346	6114276
KANLOM 7	RH				P	P							319071	6114078

Site name	Site type*	2011	2012	2013	2014	2015	2017	2018	2019	2020	2021	2022	Easting	Northing
KANLOM 6	RH				P	P							318438	6114177
KANLOM 5	RH				P	P							318697	6114345
KANLOM 4	RH				P	P							319429	6115476
KANGRA RT01	RH			P	P	P	P	P	P	P	P	P	319155	6114300
KANACA RT03	RH							P	P	P	P	P	318361	6114074
KANACA RT02	RH						P	P	P	P	P	P	318818	6115697
KANACA RT01	RH						P	P	P	P	P	P	318482	6114758
KANACA 4	AN				P								318536	6114302
KANACA 3	AN				P	P							319538	6115467
KANLOM 1	AN	P	P	P									317961	6114064
KANLOM 2	AN	P	P	P									317963	6114040
KANLOM 3	AN	P	P	P									317931	6114051
KANODO 1	AN	P	P	P									317515	6115604
KANODO 2	AN	P	P	P									317528	6115551
KANODO 3	AN	P	P	P									318229	6115760
KANSTI 1	AN	P	P	P									318063	6114321
KANSTI 2	AN	P	P	P									318008	6114283
KANSTI 3	AN	P	P	P									318130	6115752
KANGRA 2	RH			P									319163	6114317
KANGRA 3	RH			P									319180	6114339
KANACA 1	AN				P								318326	6115281
KANACA 2	AN				P								318347	6115328
KANGRA 10	AN								P	P	P	P	316490	6114929
KANGRA 11	AN								P	P	P	P	316343	6114870
KANGRA 12	AN								P	P	P	P	317408	6114149
KANGRA 13	AN								P	P	P	P	317382	6114100

P = surveyed.
Red indicates Analogue site values

7.2 Appendix 2. Landscape Function Analysis (LFA) results summary for 2011 – 2022.

Zones	Stability (%)										
	2011	2012	2013	2014	2015	2017	2018	2019	2020	2021	2022
KANODO	61.2	60.5	66.3	-	-	-	-	-	-	-	-
KANODO 4	68.9	60.5	67	65.9	61.5	63.8	56.4	60.6	63	57.8	59.2
KANODO 5	69.8	63.6	64.2	61.3	58.9	63.8	65.1	59.7	65.7	57.3	60.1
KANODO 6	66.9	61.3	65.2	63.8	58.8	65.2	61.7	61.1	60.3	55	57.6
KANODO 8	-	-	-	48.7	49.5	49.1	62.9	64.3	55.8	61.8	58.5
KANODO 9	-	-	-	48.5	61.7	74	72.2	65.9	62.8	62.3	60.1
KANODO RT 07	-	-	-	-	53	63.7	71	61.5	53.8	61.4	61.1
KANODO RT 10	-	-	-	-	51	57.6	60.9	49.4	47.9	57.1	56.1
KANODO RT 11	-	-	-	-	48.3	59.9	6.9	53.7	-	-	-
KANODO RT 12	-	-	-	-	49	60.1	68.1	55.5	59.1	57.6	55.4
KANODO RT 13	-	-	-	-	51	6037	63.6	54.2	-	55	55.8
KANODO RT 14	-	-	-	-	32.2	58.6	58.2	56.4	52.7	57.8	57.9
KANODO RT 15	-	-	-	-	50	56.5	54.7	64.7	47.3	47.6	54.3
KANODO RT 16	-	-	-	-	50	62.6	57.2	54.6	-	56	55.8
KANODO RT 17	-	-	-	-	52.8	63.5	61.3	59.7	58.2	57.6	57.7
KANODO RT 18	-	-	-	-	-	76.5	78	64.8	64.3	68.2	63.1
KANODO RT 19	-	-	-	-	-	77.5	82	49.9	66	72.4	66.9
KANODO RT 20	-	-	-	-	-	67.5	85	7.8	61.2	69.7	63.2
KANODO RT 21	-	-	-	-	-	-	45	49.1	55.2	64.3	60.2
KANLOM	62.5	61.5	67.7	-	-	-	-	-	-	-	-
KANLOM RT 01	-	-	-	-	-	48.9	42.9	44	45.4	52.2	55.3
KANLOM RT 02	-	-	-	-	-	-	46.1	36.8	42.2	52.6	52
KANACA RT 01	-	-	-	-	-	51.4	52	49.3	51.3	57	57.9
KANACA RT 02	-	-	-	-	-	70.5	75	64.8	57.1	63.8	61.6
KANACA RT 03	-	-	-	-	-	-	52.4	50.5	58.4	67	62.9
KANGRA RT 01	-	-	47.5	51.5	54.7	65.9	69.5	58.1	52.1	68.3	61.1
KANGRA 10	-	-	-	-	-	-	-	68.7	63.5	65.9	61.2
KANGRA 11	-	-	-	-	-	-	-	70.3	63.6	66.2	59.6
KANGRA 12	-	-	-	-	-	-	-	68.8	52.4	61.8	64.9
KANGRA 13	-	-	-	-	-	-	-	53.6	52.1	52.9	62.8

Red indicates Analogue site values

Zones	Infiltration (%)										
	2011	2012	2013	2014	2015	2017	2018	2019	2020	2021	2022
KANODO	37.5	44.3	44.4	-	-	-	-	-	-	-	-
KANODO 4	52.5	54.1	56.1	56.8	62.7	40.3	42.8	38.1	39.3	35.1	31.5
KANODO 5	55.5	54	60	54.2	48.9	42.3	37.9	33.5	41.5	39.7	32.8
KANODO 6	54.4	55.3	56.1	56.9	55.6	41.4	38	48	46	39.8	29.8
KANODO 8	-	-	-	26	20	21.9	22.3	23.4	29.3	21.1	23
KANODO 9	-	-	-	21.2	31.2	27.1	31.7	34.6	25.7	19	24.2
KANODO RT 07	-	-	-	-	30.9	35.9	33.6	36.7	26.9	22.5	21.2
KANODO RT 10	-	-	-	-	28.1	23.8	18.3	25.4	21.4	15.4	21.5
KANODO RT 11	-	-	-	-	32.3	29.1	24.7	35.4	-	-	-
KANODO RT 12	-	-	-	-	31.2	27.6	25.6	24.7	31.4	15.2	23.9
KANODO RT 13	-	-	-	-	31.2	22.3	24.4	19.9	-	17.8	20.1
KANODO RT 14	-	-	-	-	29.1	20.6	21.4	19.3	20	16	18
KANODO RT 15	-	-	-	-	30.9	28.6	18.5	38.5	27.7	16.6	18.4
KANODO RT 16	-	-	-	-	26.3	25.3	27.3	40.6	-	14.2	16.4
KANODO RT 17	-	-	-	-	38.6	28.5	25.9	32.4	25.8	15.9	18.9
KANODO RT 18	-	-	-	-	38.6	49.9	50.8	47.4	30.4	30.1	24.8
KANODO RT 19	-	-	-	-	-	43.5	52.2	32	43	34.6	26.8
KANODO RT 20	-	-	-	-	-	33.6	45.6	41.1	27.7	27.2	18.3
KANODO RT 21	-	-	-	-	-	-	22.5	24.1	30.9	23.3	16.8
KANLOM	27.1	29.4	29	-	-	-	-	-	-	-	-
KANLOM RT 01	-	-	-	-	-	18	30.4	25.2	21	17.1	16.5
KANLOM RT 02	-	-	-	-	-	-	28	36	31.9	15.4	19.6
KANACA RT 01	-	-	-	-	-	23.6	29.2	36.2	23.4	16.8	23.4
KANACA RT 02	-	-	-	-	-	37.7	46.1	49.3	39.7	25.9	26
KANACA RT 03	-	-	-	-	-	-	23.6	24	26.7	26	22.2
KANGRA RT 01	-	-	14	21.4	24.6	25.3	31.4	33.2	32.9	24.4	21.3
KANGRA 10	-	-	-	-	-	-	-	46.3	36.4	32.4	31.6
KANGRA 11	-	-	-	-	-	-	-	38.2	33.6	32.5	25
KANGRA 12	-	-	-	-	-	-	-	42.4	20.1	28.2	26.7
KANGRA 13	-	-	-	-	-	-	-	36.7	32.8	31.1	27.9

Red indicates Analogue site values

Zones	Nutrients (%)										
	2011	2012	2013	2014	2015	2017	2018	2019	2020	2021	2022
KANODO	26.8	31.7	34.5	-	-	-	-	-	-	-	-
KANODO 4	46.2	38.7	48.2	46.9	48.5	30.3	36.2	30.8	32	34.7	30.5
KANODO 5	48	39.1	47.3	39.7	30.2	30.9	30.7	27.4	36.6	36.3	33.1
KANODO 6	46.5	39.6	44.6	45.8	42	31.1	29.1	35.8	32.4	33.8	28.6
KANODO 8	-	-	-	16.7	13.26	17.1	17.9	26.2	22.1	26.1	23.7
KANODO 9	-	-	-	15.8	22.8	30.4	33.5	55.2	25.4	26.8	27.3
KANODO RT 07	-	-	-	-	16.3	25.1	38.2	40.5	24.3	23	24.4
KANODO RT 10	-	-	-	-	12.6	14.3	16.4	22.9	17.8	17.5	20.6
KANODO RT 11	-	-	-	-	16.3	22.5	25.8	37.3	-	-	-
KANODO RT 12	-	-	-	-	16.7	20.1	27.2	32	47.2	18.1	23.2
KANODO RT 13	-	-	-	-	14	20	25.4	20.5	-	19.5	20
KANODO RT 14	-	-	-	-	15.4	18.8	21.3	20.3	21.7	19.5	21.4
KANODO RT 15	-	-	-	-	16.3	13.4	12.1	34.5	19.5	16.3	14.7
KANODO RT 16	-	-	-	-	15.4	18.3	22.8	43.7	-	18.9	19.3
KANODO RT 17	-	-	-	-	15.4	20.3	22.8	33.8	24.1	21	21.5
KANODO RT 18	-	-	-	-	-	47.4	51.6	64.6	28.1	36.7	29.3
KANODO RT 19	-	-	-	-	-	44.6	55.3	33.5	56	41.8	31.9
KANODO RT 20	-	-	-	-	-	28.8	48.8	61.5	27.7	33.9	24.7
KANODO RT 21	-	-	-	-	-	-	15.1	28.4	41.3	27.8	21
KANLOM	21.6	21.9	26.2	-	-	-	-	-	-	-	-
KANLOM RT 01	-	-	-	-	-	13.2	16.7	25.5	16.5	20.3	20.6
KANLOM RT 02	-	-	-	-	-	-	17.5	23.1	16.9	19	19.1
KANACA RT 01	-	-	-	-	-	19	24.6	41	21.9	21.7	24.5
KANACA RT 02	-	-	-	-	-	34.4	44.1	58.5	43.5	32.4	30.5
KANACA RT 03	-	-	-	-	-	-	21.9	22.9	27	31.2	27.1
KANGRA RT 01	-	-	7.7	15.8	21.8	28.7	38.6	43.3	44.8	30.6	26.4
KANGRA 10	-	-	-	-	-	-	-	39.1	25.1	35.2	31.9
KANGRA 11	-	-	-	-	-	-	-	36.2	29.4	35.3	25.6
KANGRA 12	-	-	-	-	-	-	-	37.1	19.5	31.9	33.5
KANGRA 13	-	-	-	-	-	-	-	28.4	23.5	26.4	32.7

Red indicates Analogue site values

7.3 Appendix 3. Annual LFA monitoring site photographs

Site: KANODO 4

2011

2012

2013

2014

2015

2017

2018

2019

2020

2021

2022

Site: KANODO 5

2011

2012

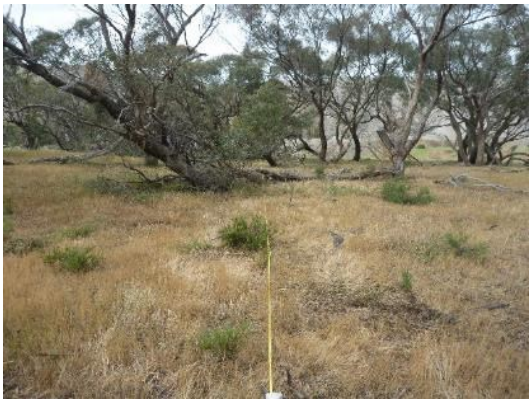
2013

2014

2015

2017

2018



2019

Not surveyed in 2020

2021

2022

Site: KANODO 6

2011

2012

2013

2014

2015

2017

2018

2019

2020

2021

2022

Site: KANODO 8

2014

2015

2017

2018

2019

2020

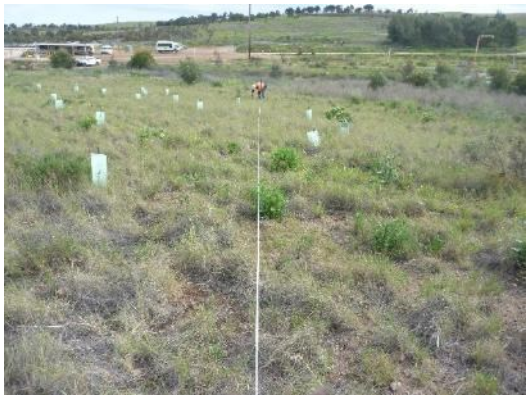
2021

2022

Site: KANODO 9

2014

2015



2017

2018

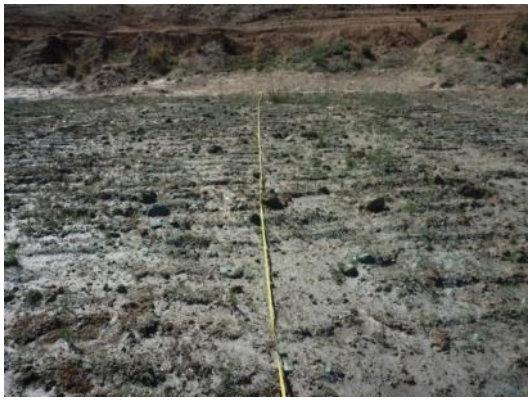
2019

2020

2021

2022

Site: KANODO RT 07



2015

2017

2018

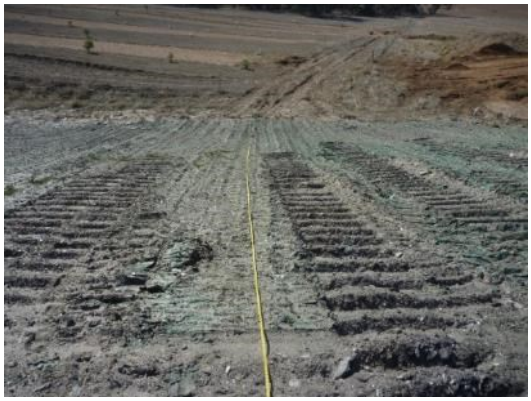
2019

2020

2021

2022

Site: KANODO RT 10



2015

2017

2018

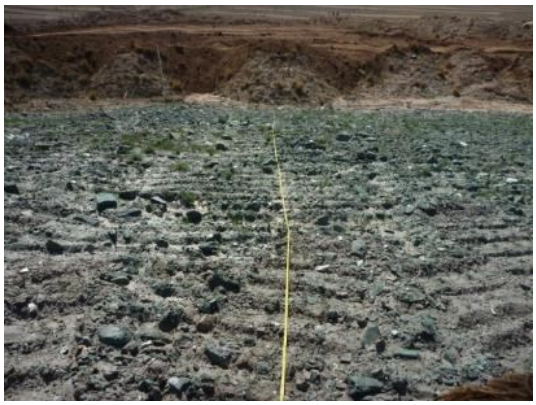
2019

2021

Photopoint not available in 2020

2022

Site: KANODO RT 11



2015

2017

2018

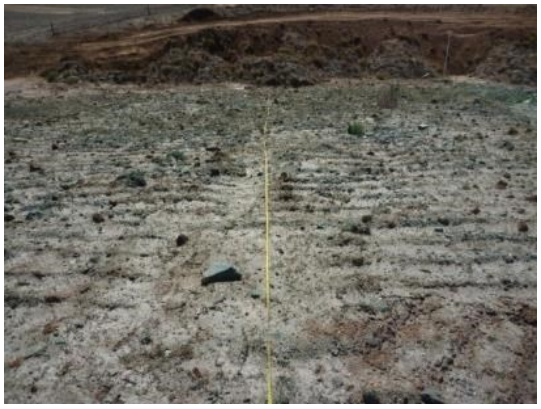
2019

Not surveyed in 2020

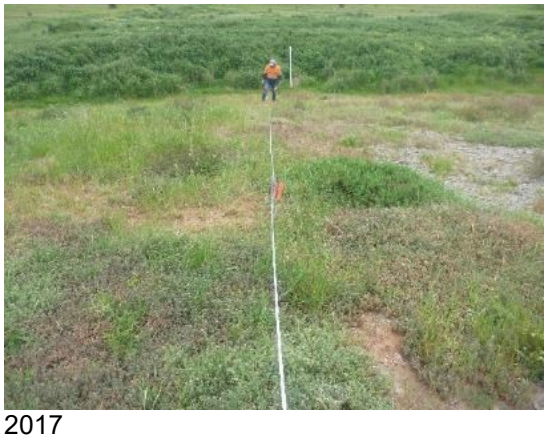
Not surveyed in 2021

Not surveyed in 2022

Site: KANODO RT 12



2015



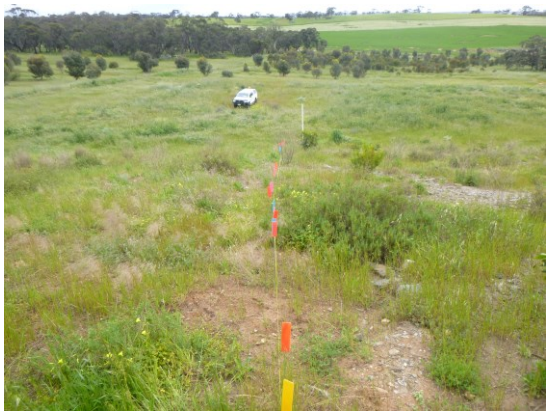
2017

2018

2019

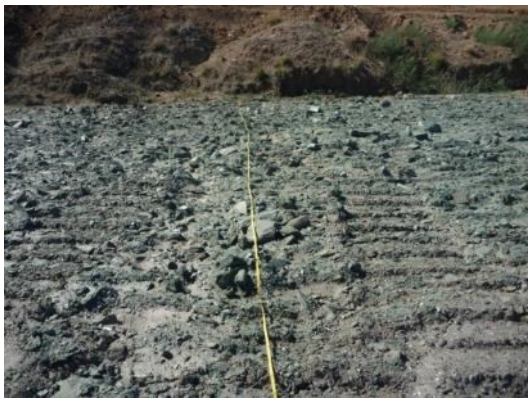
2020

2021



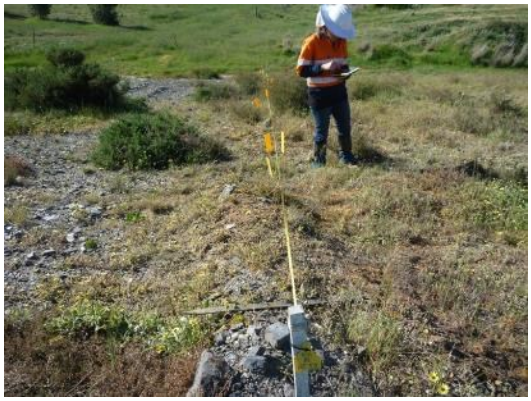
2022

Site: KANODO RT 13



2015

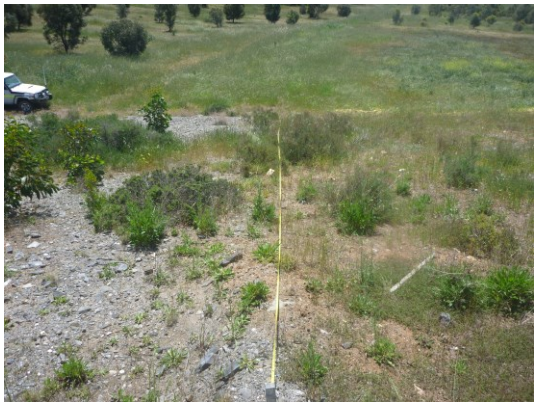
2017



2018

2019

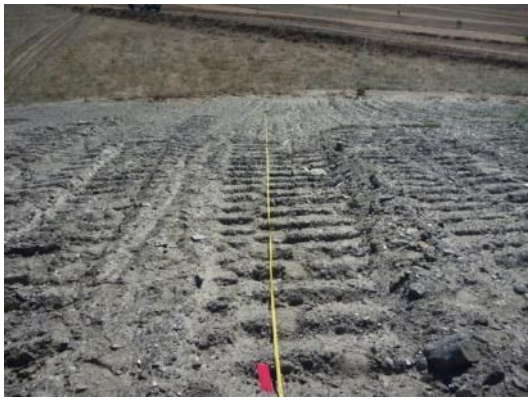
Not surveyed in 2020



2021

2022

Site: KANODO RT 14



2015

2017

2018

2019

2020

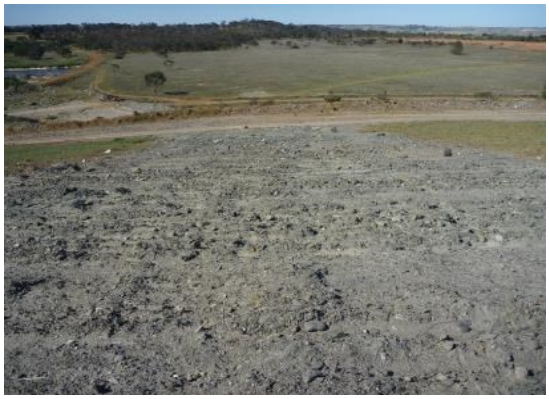
2021

2022

Site: KANODO RT 15

2015

2017



2018

2019

2020

2021

2022

Site: KANODO RT 16

2015

2017

2018

2019

2021

2020 photo unavailable

2022

Site: KANODO RT 17

2015

2017

2018

2019

2020

2021

2022

Site: KANODO RT 18

2017

2018

2019

2020

2021

2022

Site: KANODO RT 19

2017

2018

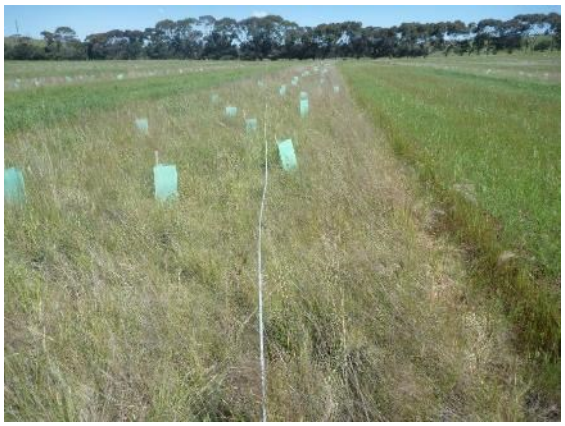
2019

2020

2021

2022

Site: KANODO RT 20



2017

2018

2019

2020 photo unavailable

2021

2022

Site: KANODO RT 21

2018

2019

2020

2021

2022

Site: KANLOM RT 01

2017

2018

2019

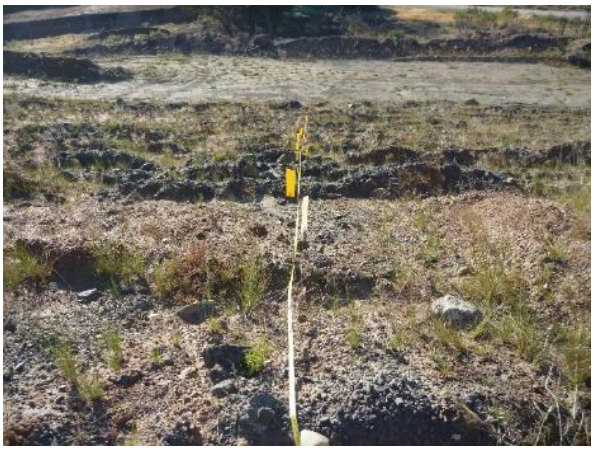
2020

2021

2022

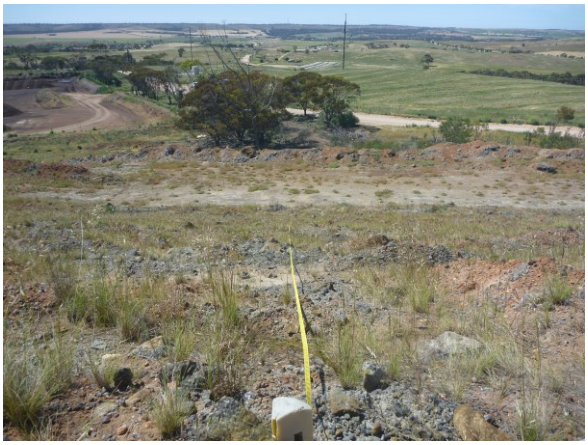
Site: KANLOM RT 02

2018



2019

2020



2021

2022

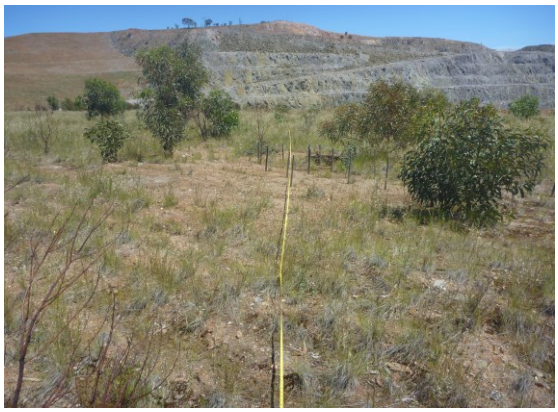
Site: KANACA RT 01

2017

2018

2019

2020



2021

2022

Site: KANACA RT 02

2017

2018

2019

2020

2021

2022

Site: KANACA RT 03

2018

2019

2020

2021

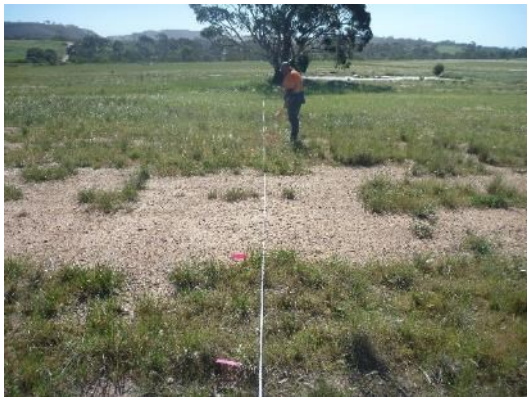
2022

Site: KANGRA RT 01

2013

2014

2015



2017

2018

2019

2020

2021

2022

Site: KANGRA 10 (new analogue)

2019

2020

2021

2022

Site: KANGRA 11 (new analogue)

2019

2020

2021

2022

Site: KANGRA 12

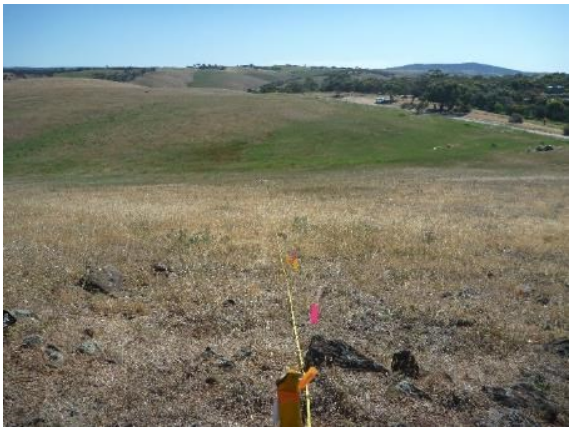
2019

2020

2021

2022

Site: KANGRA 13



2019

2020

2021

2022

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