4-2024

Procedures for rangeland condition assessment in the Pilbara and southern rangelands 2022

Department of Primary Industries and Regional Development

Department of
Primary Industries and
Regional Development

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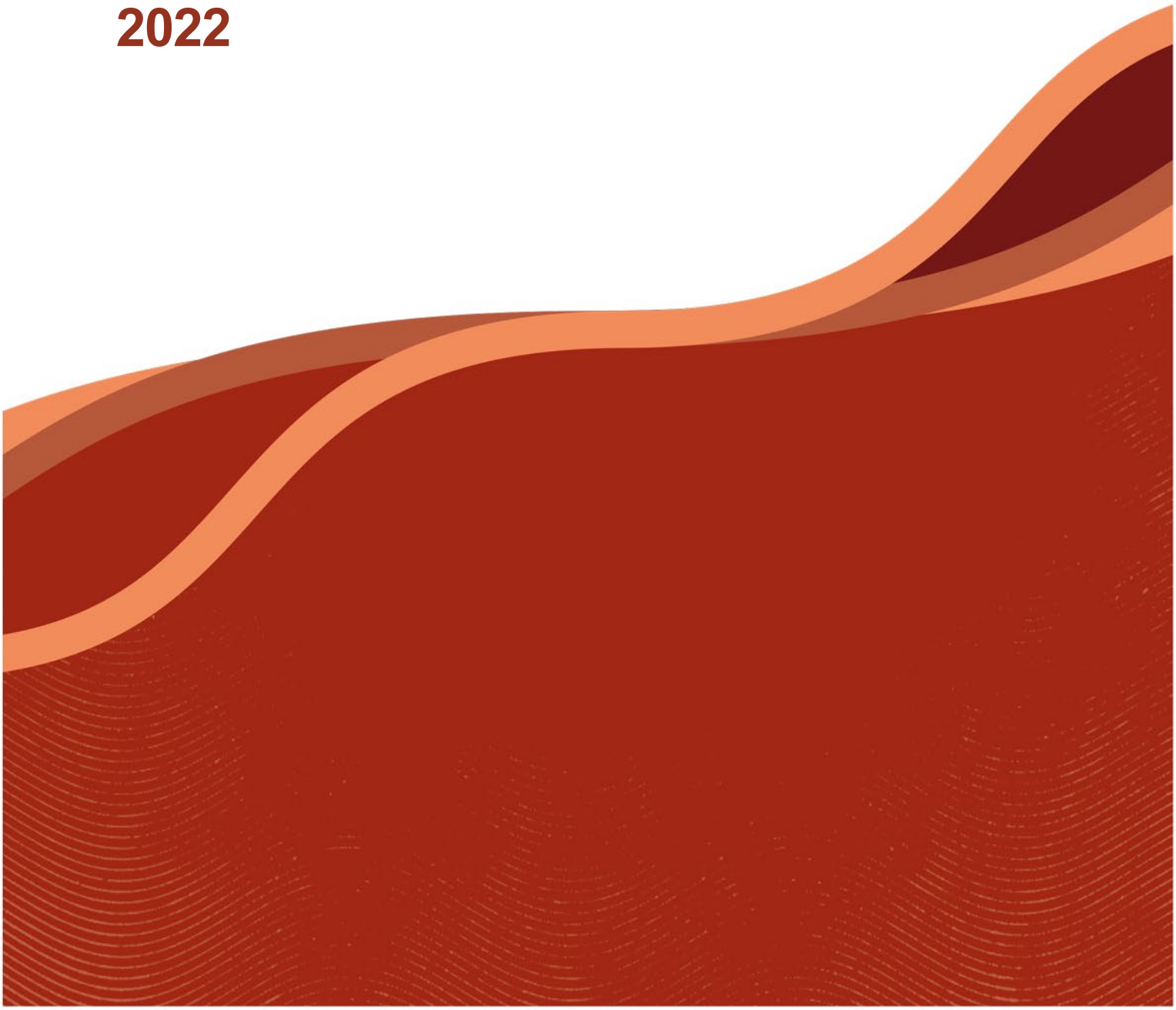
Procedures for rangeland condition assessment in the Pilbara and southern rangelands

2022



Acknowledgement of Country

The Department of Primary Industries and Regional Development (DPIRD) acknowledges the Traditional Custodians of Country, the Aboriginal peoples of the many lands that we work on and their language groups throughout Western Australia and recognises their continuing connection to the land and waters. DPIRD respects the continuing culture of Aboriginal peoples and the contribution they make to the life of our regions, and we pay our respects to Elders past, present and emerging.

Procedures for rangeland condition assessment in the Pilbara and southern rangelands 2022

Department of Primary Industries and Regional Development

Recommended reference

Department of Primary Industries and Regional Development (2024) *Procedures for rangeland condition assessment in the Pilbara and southern rangelands 2022*, DPIRD, Western Australian Government.

Acknowledgements

This procedures document is an initiative of the Rangelands Science Team of the Department of Primary Industries and Regional Development.

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Disclaimer

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Contents

1 Purpose

To define the procedures used in 2022 by the Department of Primary Industries and Regional Development (DPIRD) to complete rangeland condition assessment (RCA) in the Pilbara and southern rangelands region which has predominantly shrub-based pastures (Figure 1). For the rest of the pastoral estate, DPIRD uses the *Procedures for RCA in the Kimberley* which has grass pastures.

RCA is the process DPIRD uses to make systematic, lease level assessment of rangeland. Rangeland condition considers both the condition of pastures (as defined in the Pasture condition and management guide for the Pilbara rangelands or Southern rangelands pasture condition and management guides) and soils (as determined by erosion, using the erosion assessment method [Appendix A]) on pastoral lands in Western Australia (WA). The methods have evolved over several decades of practice and are unique to WA.

RCAs generally report on the basis of pastoral stations, which may contain one or more pastoral leases and, on occasion, include land with other tenure types that is used for pastoral purposes.

The data collected during an RCA are used to report on rangeland condition at the lease and regional scales. The RCA aims to quantify the condition of rangeland landscapes and pastures and to use this and other information to assess the effectiveness of pastoral management. The RCA process is part of the *Regulatory compliance approach* (DPIRD 2022).

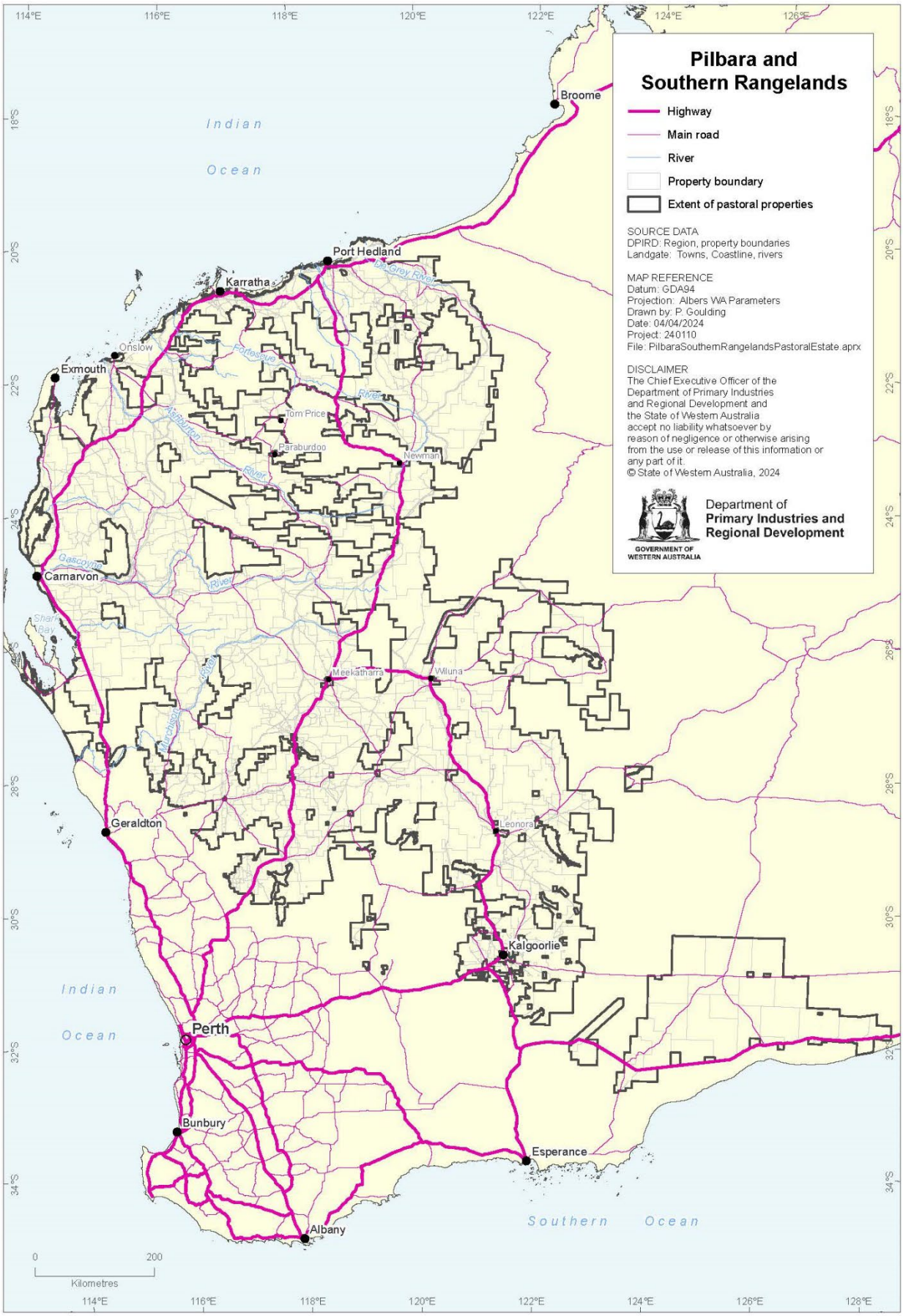

Figure 1: Pastoral stations within the Pilbara and southern rangelands covered by these procedures

2 Legislation

RCA meets requirements of the *Soil and Land Conservation Act 1945* (SLC Act) and the *Land Administration Act 1997* (LA Act).

2.1 Soil and Land Conservation Act

The intention of the SLC Act is to conserve the soil, water and vegetation resources of WA. The SLC Act establishes and is administered by the Office of the Commissioner of Soil and Land Conservation (s 7(1)).

The functions of the Commissioner of Soil and Land Conservation (the Commissioner) include preventing and mitigating land degradation (s 13). Land degradation includes soil erosion, salinity, eutrophication, flooding and the removal or deterioration of natural or introduced vegetation that may be detrimental to the present or future use of the land (s 4).

To achieve these statutory obligations, the Commissioner may:

- carry out surveys, investigations, research and monitoring for problem detection and definition and suggest solutions
- extend research and monitoring findings to industry
- monitor and ensure compliance and carry out enforcement where breaches of standard are detected and it is in the public interest to do so.

DPIRD and the Commissioner also provide advice and information to the Department of Planning, Lands and Heritage (DPLH) and the Pastoral Lands Board (PLB) about matters relating to Part 7 of the LA Act.

Power of entry

The Commissioner can authorise a DPIRD officer with the power to enter any lands, including a lease (s 7(4)). To use this power, the Commissioner must provide at least 7 days notice in writing to the holder of a pastoral lease (lessee) and ensure minimal interference to the lessee's lawful activities (s 21(1)). However, if it is reasonable to do so because of circumstances, notice may be given verbally with less than 7 days notice (s 21(1a)).

The authorised officer may be provided with an authority card (s 21(2)) upon completion of the form set out by the Soil and Land Conservation Regulations 1992, Schedule 1. An authority card is evidence of the authority of the officer to enter any land to which such authority card relates, and to make surveys, place marks and carry out investigations (s 21(4)). It is an offence (penalty $1,000) to obstruct or hinder an authorised officer from entering land, carrying out any investigation, placing marks or interfering with any such marks (s 21(5)).

The PLB also has powers to investigate compliance with the conditions of the lease and with the LA Act. To determine compliance, the PLB authorises both DPLH officers and DPIRD officers to enter the land subject to the lease and inspect it (LA Act s 139). The PLB authorises each officer for a period of one calendar year and then reviews the authorisation.

2.2 Land Administration Act

Part 7 of the LA Act establishes pastoral leases and the PLB, a statutory authority which has joint responsibility with the Minister for Lands for administering pastoral leases.

A lessee must use methods of best pastoral and environmental management practice, appropriate to the area where the land is situated, to manage livestock and to manage, conserve and regenerate pasture for grazing (s 108(2)).

The lessee must maintain the indigenous pasture and other vegetation on the land under the lease to the satisfaction of the PLB (s 108(4)). For satisfaction under section 108(4), the PLB must seek and have regard to the advice and recommendations of the Commissioner on the matter (s 108(5)).

3 Objective of an RCA

The objective of an RCA is to assess rangeland condition on a lease, and to check lessee compliance with:

- the SLC Act
- the LA Act (s 108(2), (4))
- the PLB's rangeland management compliance policy.

4 Responsibilities of personnel

The Executive Director of Fisheries and Agriculture Resource Management will ensure that:

- all personnel meet their obligations under the *Work Health and Safety Act 2020* (WHS Act) and implement the DPIRD remote field work policy.

The rangeland science team leader will ensure that:

- the procedures described in this document are kept up to date
- rangeland science officers (hereon referred to as a rangeland officer) are trained to follow these procedures
- any updates to these procedures are provided to rangeland officers in a timely manner
- rangeland officers meet their obligations under the WHS Act.

A rangeland officer will ensure that:

- they follow these procedures when inspecting pastoral lands
- they meet their obligations under the WHS Act and implement the DPIRD remote field work policy.

Rangeland officers shall carry out work activities to minimise risks of injury to themselves or any other person by applying the following policies and procedures:

- Communication safety policy
- Communications procedure for field operations requiring scheduled calls
- Land based trip itinerary and communication details form
- SAR procedure for missed call or failure to check-in

- Work in remote areas policy
- Working in the sun policy.

Rangeland officers will assess safety risks in any work activity and carry out practicable actions within their control to minimise risk. Hazards that are identified as requiring further action should be brought to the relevant manager's attention for action. If serious and imminent risks are present, a rangeland officer has the right to cease work. Any safety incidents are to be reported immediately to the rangeland science team leader.

5 RCA process

An RCA involves several steps described below and summarised in Figure 2.

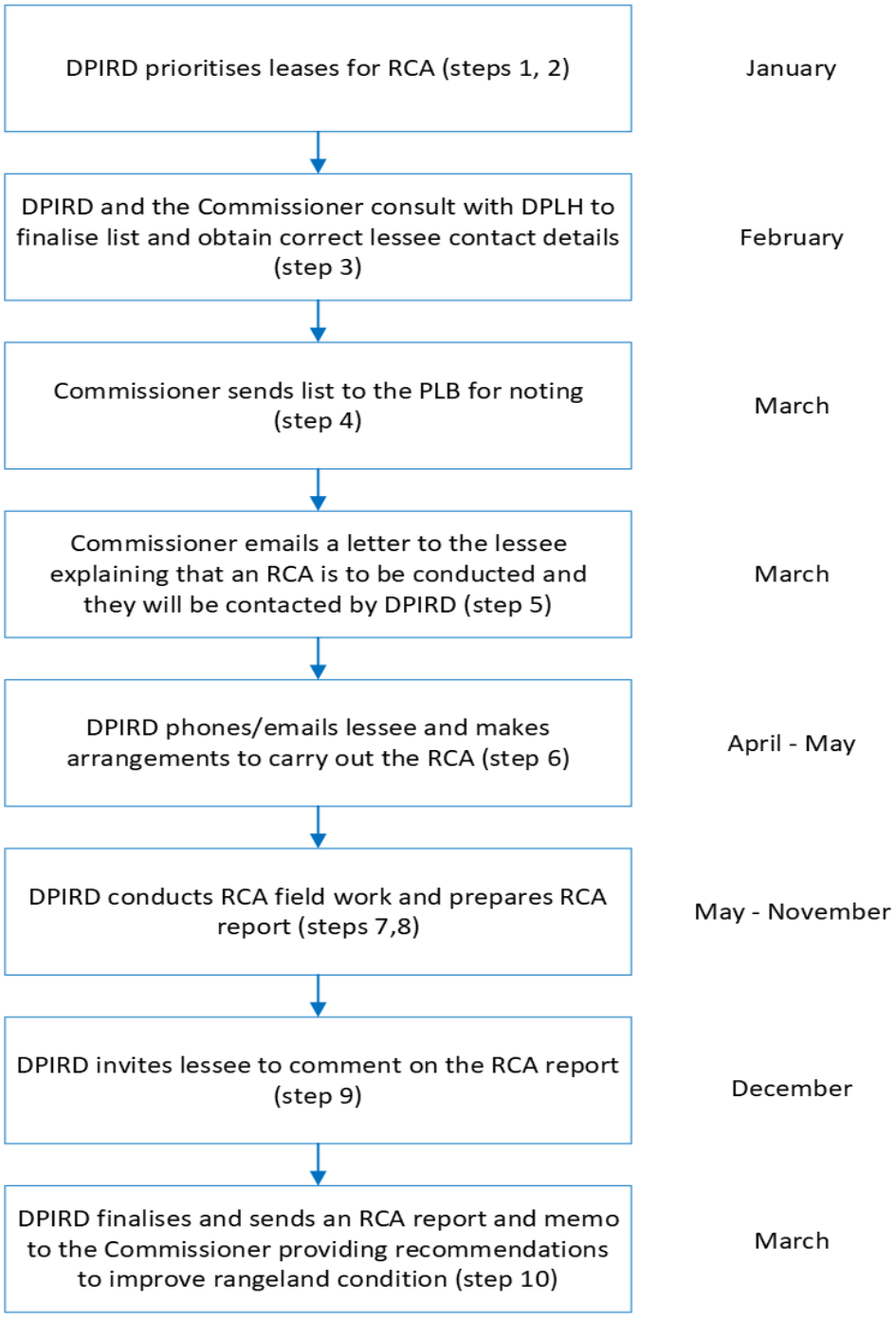

Figure 2: Steps to complete a rangeland condition assessment (RCA)

Identify leases for RCA

It is the intention that all pastoral leasehold land is regularly subject to RCA as part of DPIRD's broader pastoral rangelands monitoring effort. To prioritise the timing and frequency that leases will be assessed, DPIRD uses the risk management approach described in the *Framework for sustainable pastoral management – Land condition version* (Fletcher 2022).

This approach prioritises the assessment of leases where the risk of land degradation is considered to be high and where a greater period of time has elapsed since the last RCA (i.e. an up-to-date assessment of rangeland condition is required). Where resources permit, lower priority leases are also assessed.

Prepare an annual list of leases scheduled for an RCA or follow-up inspection

Step 1 The pastoral lease data manager compiles an initial shortlist of leases based on the following information which is given various weightings to estimate priority.

- previous RCAs – these are used to give an overall condition score for each lease. They are weighted according to the time since the assessment was made. The more recent the last inspection, the more certainty the condition of the lease has not changed significantly.
- reported stocking rates, current carrying capacity and rainfall – these are jointly considered. When the stocking rate exceeds the current carrying capacity and seasonal rainfall conditions are unfavourable for pasture growth, the risk of degradation increases. A lessee's record – reported in the Annual Returns to DPLH – of reducing stock numbers in response to a decline in seasonal conditions (dry season planning) is considered in assessing risk.
- remotely sensed data – these are used to estimate changes in vegetation cover over time. Changes on each lease are expressed relative to mean regional changes. A relative decrease in vegetation cover suggests an increased risk of degradation.

Step 2 Rangeland officers provide expertise and local knowledge of the leases to refine the shortlist. Other DPIRD business units that may have direct knowledge of pastoral leases are asked to provide any relevant information.

Step 3 Rangeland officers and the Commissioner consult with DPLH to finalise the list. DPLH provides local on-ground advice, advises which leases have PLB rangeland management compliance actions in place and confirms lessee contact details. If a lease has been scheduled for a follow-up inspection (FUP) as a consequence of a previous RCA or regulatory action, that lease is added to the list.

During the prioritisation process, leases may be identified as requiring contact from the PLB or DPIRD to clarify stocking rate or other management matters.

Step 4 The Commissioner sends the list of leases scheduled for an RCA or FUP to the PLB for noting.

The number of RCAs and FUPs varies from year to year depending on the outcome of the shortlisting process and DPIRD's ongoing commitments to the Commissioner and the PLB.

Once the list of leases scheduled for an RCA or FUP is approved, by the Commissioner, rangeland officers prepare for the RCA's field work (section 6.1).

Contact lessees

Step 5 The Commissioner emails a letter to the registered lessee(s) providing at least 2 weeks notice of the inspection. If a lease has several registered lessees at multiple addresses, a letter is emailed to each lessee and address. The lessee and their delegate(s) – typically the station manager – are invited to attend during the inspection so they can observe and understand the RCA process.

Step 6 After the Commissioner has notified the lessees, rangeland officers contact the lessee's delegate by phone and email to arrange an inspection time, preferably at least 2 weeks prior to the inspection. The phone call is an opportunity for the rangeland officers to gather relevant information about the lease; the email provides written confirmation and evidence that contact has been sought prior to field work.

Conduct RCA field work and write report

Step 7 Rangeland officers carry out the RCA field work (section 6.2).

Step 8 Rangeland officers write a draft RCA report (section 6.3).

Step 9 DPIRD invites lessee to comment on the RCA report (section 6.3).

Step 10 Rangeland officers finalise the RCA report, then write a memo summarising the report and, if required, include recommendations for improving rangeland condition. These are then emailed to the Commissioner (section 6.3).

6 RCA method

6.1 Prepare field work data

To ensure the most efficient use of time and resources, rangeland officers consider various data and information before carrying out the RCA field work: cadastral map, high resolution imagery, previous traverse route, station map, past rangeland condition, land systems, key pastures, vegetation cover trend, fire history, livestock and rainfall.

ESRI ArcGIS Field Maps is the digital platform used to collect store and analyse data collected during an RCA. Rangeland officers and the GIS team load Field Maps with these data for use during field work.

Traverse route

During the RCA, rangeland officers use available tracks to travel (traverse) across the lease and assess pasture condition and erosion at assessment sites located at 1 km intervals along the traverse route. While the traverse route is identified prior to field work, it may be amended on the advice of the lessee or their delegate.

Pasture and erosion assessment is focused on the most productive pastures (key pastures) on a lease. Key pastures are assessed under the assumption that these pastures are most important pastorally and most indicative of the combined effects of seasonal conditions and grazing management (*Framework for sustainable pastoral management – Land condition version* [Fletcher 2022]).

The traverse route is designed to assess pastures that provide at least 80% of the potential carrying capacity (PCC) of the lease. Generally, this capacity is provided by key pastures, but where key pastures represent less than 80% of PCC, non-key pastures are also assessed.

Where possible, previous traverse routes are followed to minimise variability among RCAs. Rangeland officers review the previous traverse route and may add or remove assessment sites. An assessment site may be added if it better represents the geographical distribution of a particular land system or pasture type, or if areas with land management or environmental issues identified by remote sensing data or previous RCAs or survey warrant inspection. An assessment site may be removed if it is no longer accessible or it is no longer a good indicator of pastoral management and pasture condition – for example, it is less than 500 m from a constructed stock water point, or another track or other infrastructure is constructed within 50 m.

If time allows, traverse routes may also include Western Australian Rangeland Monitoring System (WARMS) sites.

Station map of pastoral infrastructure

Following the Commissioner's letter notifying the lessee of the planned RCA, a DPIRD GIS officer invites the lessee to update the station map of pastoral infrastructure. The GIS officer provides the lessee with a return envelope and two A2 maps to update the location of the roads, fences and water points.

The lessee can then send an updated map back to the GIS officer and keep a map for their own records. If the lessee responds, the GIS officer provides the updated map to the rangeland officers and the lessee.

Past rangeland condition

Rangeland officers download past rangeland condition data (where available) from previous RCA reports – stored in DPIRD's record management system, Objective – or from the rangeland surveys. Rangeland condition data includes the assessment site location, pasture type and condition score, erosion score and up to 3 dominant pasture species recorded for each assessment site along the traverse route.

Land systems and key pastures

A land system is a recurring pattern of topography, soils and vegetation in the landscape. Land systems, key pastures, composition, indicator species and condition states are described in the relevant rangeland surveys (note: the Wiluna area is yet to be surveyed). Detailed information regarding the condition states of some of the more common and regionally extensive pasture types is also provided in the Pasture condition and management guide for the Pilbara rangelands and Southern rangelands pasture condition and management guides.

Vegetation and fire remote sensing mapping

The DPIRD remote sensing officer provides:

- vegetation cover trend mapping (Landsat)
- pasture type mapping (where available).

The DPIRD GIS officer provides:

- a map of pastoral lease boundaries and infrastructure, land systems and the previous RCA assessment locations and condition ratings (if available).
- vegetation greenness mapping derived from the Normalised Differential Vegetation Index (NDVI), which is satellite remotely sensed data.

Rangeland officers source fire history mapping from the Northern Australia & Rangelands Fire Information (NAFI) website or Landgate. They may also source NDVI and fractional vegetation cover information from the Pastoral remote sensing and VegMachine websites.

Livestock data

Lessees are required to submit information about the number and classes of livestock on the lease, in an Annual Return to the DPLH for consideration by the PLB. The PLB share this data with DPIRD for regulatory purposes. The DPIRD pastoral lease data manager merges this data into the Livestock Database. The pastoral lease data manager then provides a copy of the Livestock Database to rangeland officers so the lease's livestock data can be included in the RCA report.

Rainfall data

Rainfall information provided in the RCA is based on the Silo Patched Point dataset, unless explicitly stated otherwise. Rangeland officers source rainfall data from the Silo Patched Point dataset (data.qld.gov.au/dataset/silo-patched-point-data).

6.2 Conduct field work

On arrival at the lease, 2 rangeland officers will attempt to meet with the lessee or their delegate to discuss the proposed RCA field work, track conditions, route, logistics, station protocols and to address any other concerns the lessee or delegate may have.

Rangeland officers will ask the lessee or delegate for the latest rainfall figures, details of stock numbers, information on declared plants and animals and what is being done to control them, and other land management issues.

The lessee or delegate is invited to attend the inspection so they can observe and understand the RCA process. The inspection is a valuable opportunity for the lessee or delegate to gain skills and knowledge of the lease's pasture species, their productivity, condition, landscape function and management. It is also a valuable opportunity for the rangeland officers to gain an understanding of the lessee's perspective and management. The lessee's feedback is incorporated into the RCA.

If the lessee or delegate is unavailable for a face-to-face meeting at the start of the RCA, it may be necessary to meet later during the field work.

At the completion of the RCA, rangeland officers will inform the lessee or delegate that they are leaving the lease. If the rangeland officers see any issues which require the immediate attention of station management, they inform the lessee or delegate at the earliest practical opportunity.

Rangeland officers will apply field work practices that ensure field work is conducted safely, appropriately and with minimal disruption to the pastoral operations of the lease. This includes following station protocols for visitors including safety, communications and biosecurity.

Rangeland officers will maintain appropriate farm biosecurity and hygiene for their vehicle and equipment to ensure that weed seeds, pests or diseases are not carried from one area to another.

Field assessment

Rangeland officers follow the designated traverse route (guided using a GPS) across the lease and make pasture condition and erosion assessments at 1 km intervals. The GPS is used to locate the assessment sites generally within 10 m of the predefined locations, or as near as practical. If the rangeland officers observe a land condition issue off the traverse route, they may alter the route to investigate and record the land condition issue.

Prior to the 2021 field work season, rangeland officers assessed condition on both sides of the vehicle at each assessment site. This practice was reviewed and modified to assess only one side of the vehicle to increase efficiency for the 2021 season and onwards.

The assessment site is located on one side of the vehicle and at each stop alternates to the opposite side of the vehicle from the previous site. The assessment site encompasses a semicircular area with a 50 m radius extending away from the vehicle (Figure 3). If there is a fence on the passenger's side, the driver's side is used (Figure 4).

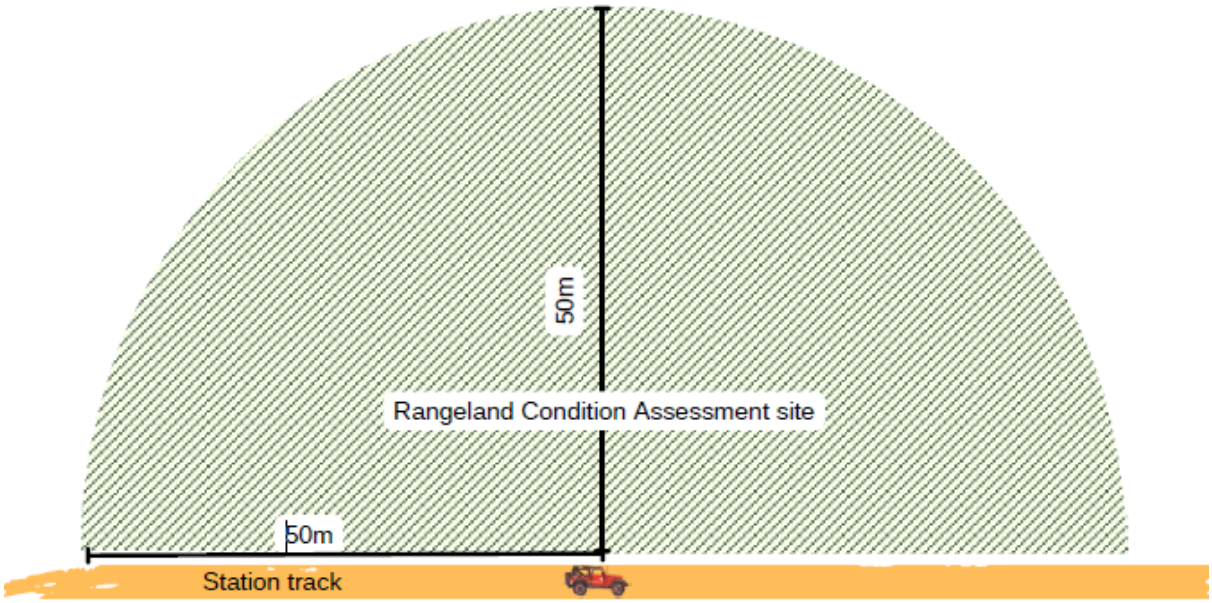

Figure 3: Layout of the assessment site on the passenger's side of the vehicle

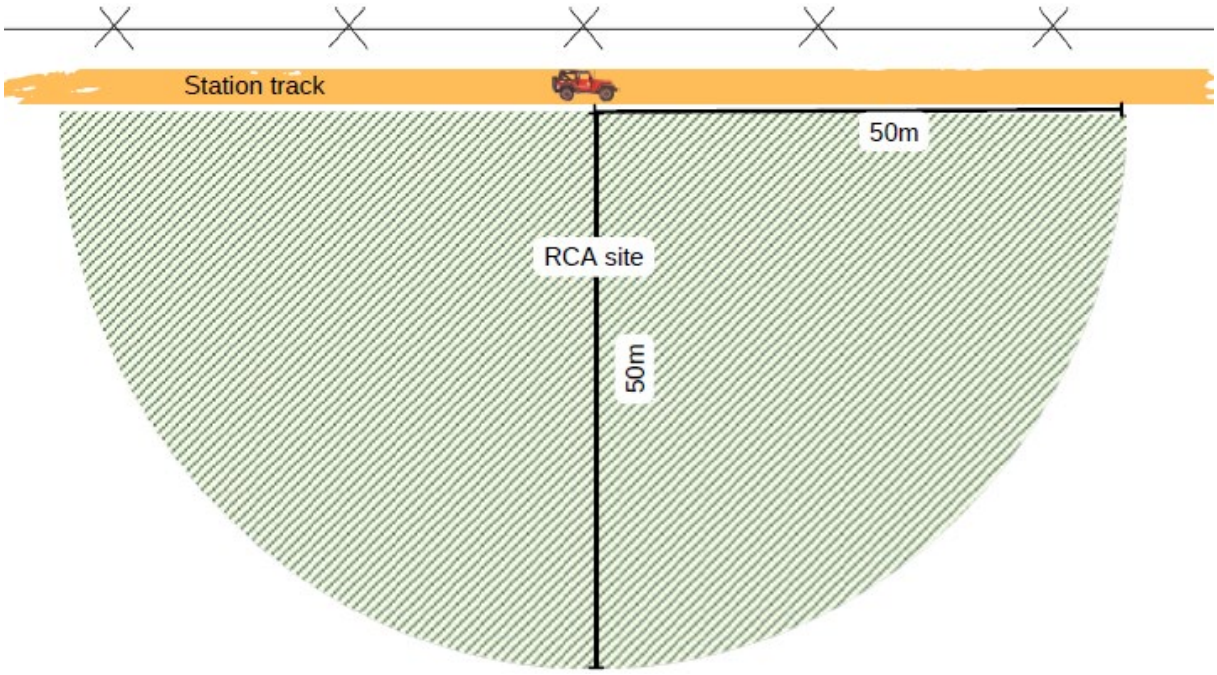

Figure 4: Layout of the assessment site on the driver's side of the vehicle if there is a fence on the passenger's side

The assessment site is located to avoid significant localised disturbances, such as track maintenance (e.g. table drains, grader turn-arounds), the presence of another track (current or disused), track erosion, a run-off shadow due to altered surface flows (i.e. pasture which no longer receives run-off), cattle pads parallel to the track, or if the site is more than 50% burned. If the disturbance extends for less than 50 m from the vehicle, the assessment site is shifted to avoid the disturbed area (Figure 5). If the disturbance extends for more than 50 m from the vehicle and the pasture on the driver's side is free of disturbance, the driver's side is assessed instead. If the track has an area of disturbance for more than 50 m from both sides of the vehicle, the assessment site remains on the side of the vehicle due to be assessed and is located to avoid the most severe disturbance, which is typically closest to the track.

At each assessment site, if rangeland officers can form a consensus rating of overall pasture condition, and erosion presence and severity without leaving the vehicle, they do so. If consensus cannot be determined from within the vehicle, both rangeland officers walk in an arc across the site (Figure 6).

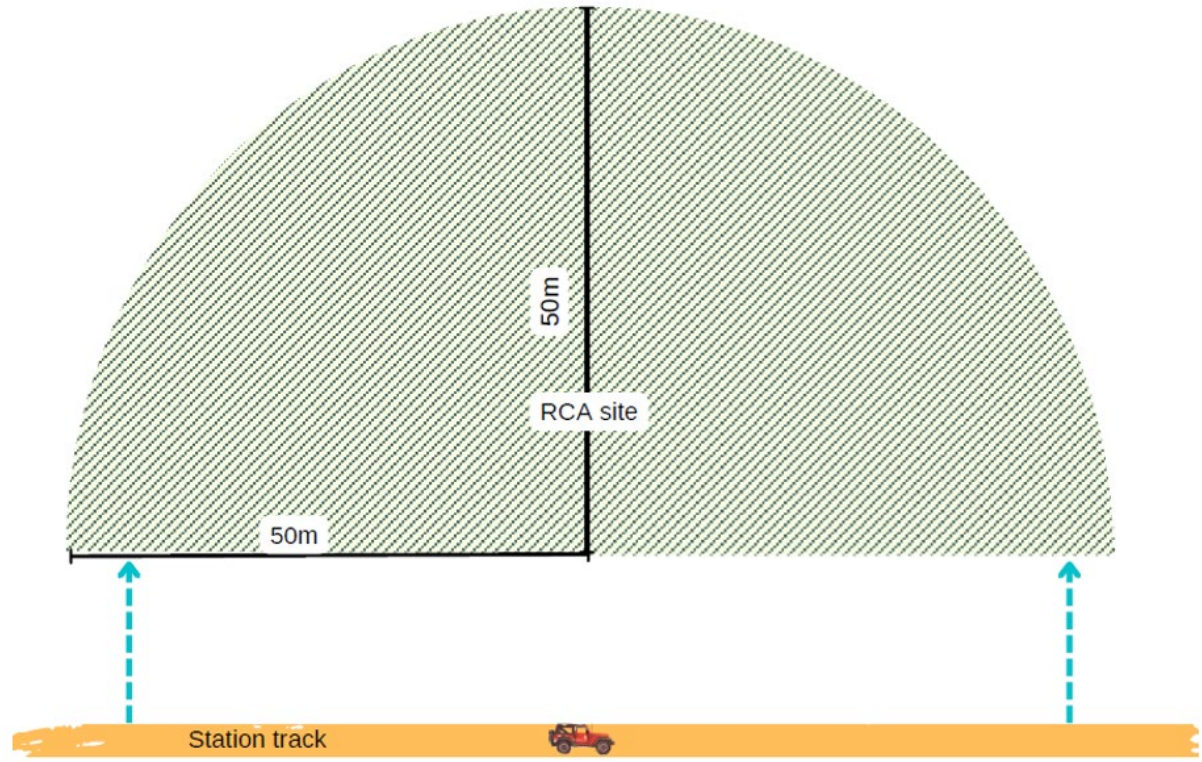

Figure 5: Layout of the assessment site away from the track to avoid localised disturbance, such as erosion or water starvation

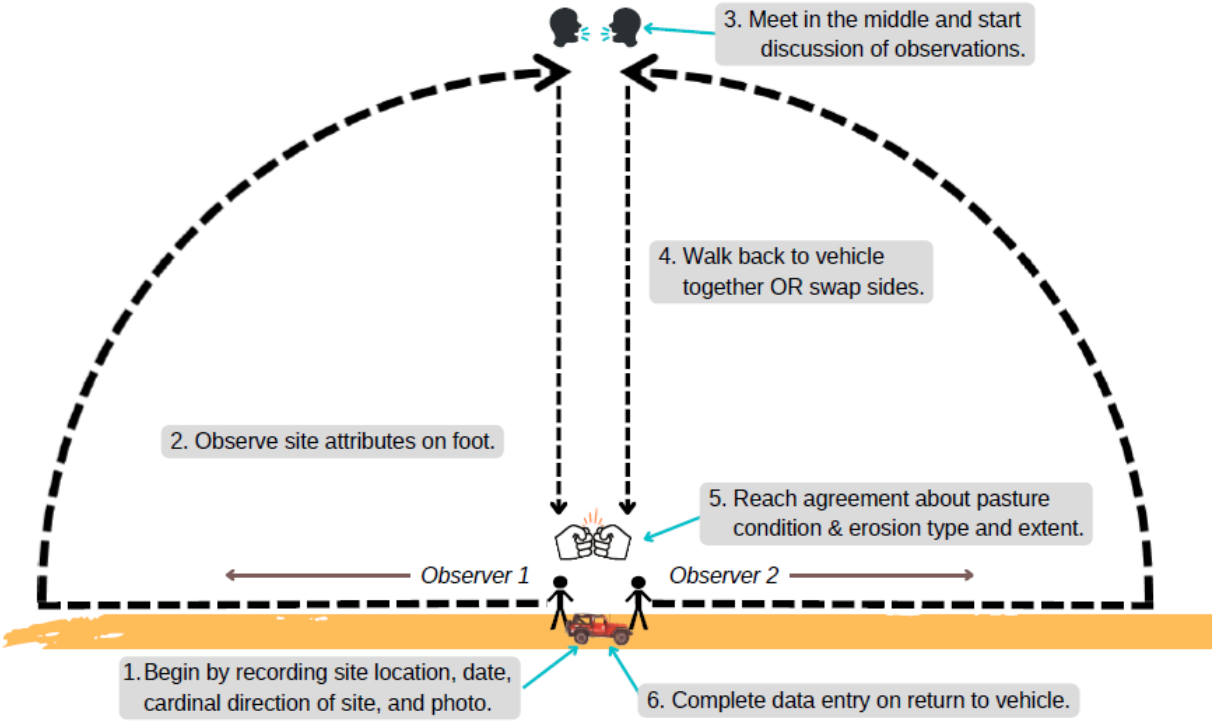

Figure 6: Steps for rangeland officers to assess an assessment site when a consensus rating cannot be determined from within the vehicle

The following data are recorded directly into Field Maps: date and time, GPS coordinates, cardinal direction of site, station name, paddock name (where present), land system (where present), pasture type, 3 dominant pasture species present (in order of biomass), other pasture species (optional), pasture condition, erosion (extent and type), grazing level and other comments (e.g. presence of weeds, observed numbers of cattle and other grazing animals [feral or native], track erosion, infrastructure). A GPS-located digital image of each assessment site is captured and recorded with the field data.

When there is internet connectivity, these data automatically upload and are stored in DPIRD's ArcGIS online environment (cloud based).

Pasture condition assessment

Pasture type and condition is assessed using the criteria set out in Pasture condition and management guide for the Pilbara rangelands and Southern rangelands pasture condition and management guides.

Pasture condition describes the current state of the perennial pasture relative to the species composition and vigour that a particular site is capable of producing. Pasture condition is reported as good, fair or poor, based on the degree of departure from optimal condition.

Erosion assessment

Erosion at each assessment site is described and rated using the erosion assessment method (Appendix A). Where erosion has originated from a track and extends for more than 50 m from both sides of the track, it is included in the erosion assessment. However, track erosion that is confined near the track is not included. Any significant track erosion or other erosion observed on the lease that is not part of an assessment site may be investigated and noted.

6.3 Prepare report

Store and analyse data

Folders for each station are created in Objective (DPIRD's record management system) to store the correspondence, data analysis files, mapping, reports, and other files and information associated with each RCA.

The raw field data are downloaded from the DPIRD ArcGIS online environment via the Portal – RCA into Excel worksheets. Then the assessment sites are sorted by land system and pasture type.

Pasture condition is calculated as the percentage of assessment sites – all sites assessed on the traverse across either the station, land systems or pasture types – with pasture in good, fair or poor condition. Erosion score is similarly reported as the percentage of assessment sites with nil, minor, moderate or severe erosion.

Where pastoral lease boundaries have changed, assessment sites from the previous RCA may no longer be within the lease. If this is the case, only the field data within the current lease boundaries are used to calculate the pasture condition and erosion scores that are used to compare between current and previous RCA ratings. This ensures a direct comparison of the same areas of land.

The lease's current carrying capacity is calculated using the potential carrying capacity as reported by Landgate and DPIRD's discount factors for fair and poor condition. Where a pasture type has not been assessed during the RCA (usually a non-key pasture), it is assumed it is in good condition for the purposes of calculating lease current carrying capacity.

To understand how total stock numbers have been managed in response to seasonal rainfall, rainfall and stocking rate data are charted using a spreadsheet template.

DPIRD GIS officers prepare maps, such as station and vegetation cover trend, for the RCA report. The stations maps show the traverse route, pasture condition and erosion scores at each assessment site and are prepared as high resolution A3 and A4 images. The maps are stored in the station's Objective folder.

Determine degradation risk

The degradation risk is determined according to the *Framework for sustainable pastoral management – Land condition version* (Fletcher 2022) and pastoral land condition standards for that region (report in preparation). The risk is derived by considering the pasture condition and erosion and land management impact.

To assign a land condition category (see the *Framework for sustainable pastoral management – Land condition version* and land condition standards) to an individual pasture type, there needs to be data from at least 6 assessments sites for that pasture type. A land condition category cannot be assigned to a pasture type that has less than 6 assessment sites.

Draft RCA report

The RCA report is prepared using the Pilbara and southern rangelands RCA report template. To speed the delivery of RCA reports, rangeland officers should complete as much of the RCA report as possible before going out to the station. This could include station and contact details, previous assessments of pasture condition and erosion, fire mapping if appropriate, rainfall and stock data, and previous compliance information (where available). If required, rangeland officers may contact the lessee to clarify details when completing the report. A record of the RCA report progress and outcomes is kept in DPIRD's RCA tracker.

Review draft report

Draft RCA reports are reviewed by the rangeland science leader and/or the rangeland science team leader before they are emailed to the lessee for comment. This review ensures the report contents prepared by various rangeland officers are consistent.

Invite lessee comment

The draft RCA report is emailed to the lessee or delegate who is invited to and allowed at least 3 weeks to provide written comment. If the lessee identifies any errors of fact, these errors will be corrected in the report. If the lessee provides written information on pastoral operations, seasonality or condition, this information is included in the lessee's comments in the report.

Prepare final RCA report and Commissioner's memo

The finalised RCA report containing any corrections and the lessee's comments is prepared along with the Commissioner's memo. The Commissioner's memo template is used to summarise the findings of the RCA and provide the Commissioner with recommendations around dealing with any degradation risks identified.

The finalised RCA report and memo are again reviewed by the rangeland science leader and/or the rangeland science team leader before being emailed to the director of Agriculture Resource Management and Assessment and the Office of the Commissioner.

7 Role of the Office of the Commissioner

The Commissioner or their delegate will consider the RCA report and may seek further information and clarification from the rangeland officers who prepared the report. The Commissioner may consult with DPLH Board support officers in deciding what actions to take.

Once satisfied, the Commissioner will email the lessee the RCA report, a letter to notify them of the outcomes of the RCA, any rangeland condition concerns and if any actions need to be taken under the SLC Act or if there are recommendations for the PLB to implement under the LA Act.

The Commissioner will also email the PLB the RCA report, a letter to notify them of the outcomes of the RCA, any rangeland condition concerns and if any actions need to be taken under the SLC Act or if there are recommendations for the PLB to implement under the LA Act. A record of these actions and recommendations are entered in the RCA tracker.

Appendix A RCA erosion assessment method

Reliable and repeatable assessment of soil erosion at an RCA assessment site and consistent interpretation among individual assessors is essential. The following method was developed to meet these needs.

Field data is recorded using ESRI ArcGIS Field Maps. When doing assessments, the erosion recorded during the previous RCA is displayed and can be modified or accepted into the current assessment if no change is recognised. This data provides a reference on which to base the current assessment and ensure consistency.

For RCAs done up to 2019, the criteria for assessing accelerated erosion was based on methods described by Pringle et al. (1994) and Payne et al. (1998). One of the shortcomings of their methods was only the most severe erosion type was recorded for each assessment site. The current method was introduced in February 2020 and allows for multiple erosion types and their extent to be recorded at each assessment site. The overall erosion severity rating is then based on all of the erosion types and their extent. This method allows better tracking of changes in erosion over time and is less prone to assessor error in assigning a severity rating.

Method

1. Use the erosion assessment form to record observations and determine the extent and overall severity rating (Table A1).
2. Rate each assessment site on the traverse route – where practical, these sites should be at the same locations as previous RCA assessments.
3. Assessments are made on one side of the access track. The assessment site is an approximate semicircular area within a 50 m radius, radiating out from the vehicle. The actual placement of the site is dependent on several factors. For a complete explanation of how the assessment site is located refer to section 6.2.
4. Note the absence or presence and type of erosion (see Types of erosion).
5. For each erosion type, note the percentage of the site affected.
6. Make sure the total area of erosion at the site does not exceed 100% – an area within a site can be assessed as having more than one type of erosion. For example, an area may have a small rill (considered moderate in extent) eroding through a plain that has widespread sheet erosion (considered severe in extent).
7. For each erosion type, note if the erosion is active or not – this information is used to compare assessments and evaluate trends in severity.
8. The severity of each type of erosion is set by the percentage of the site affected and can range from nil to severe (Table A1).
9. Determine the overall severity of erosion at the site – this is a function of the cumulative severity of each erosion type present (see Overall erosion severity rating).

Types of erosion

There are 6 erosion types (defined in *Australian soil and land survey field handbook* [NCST 2009]):

- sheet – subdivided into 3 levels of water sheeting based on depth of erosion
- rill – small channel up to 30 cm deep
- gully – channel more than 30 cm deep
- water borne soil deposition (aggradation) – sediment deposited by water
- wind – subdivided into 4 subtypes based on sorting, soil loss or accumulation
- scald – based on habitat type being saline or non-saline.

Terracettes and pedestalling are treated as symptoms of other erosion types, like sheeting or rilling, and are not rated individually.

Overall site erosion severity rating

The overall erosion severity rating at an assessment site is based on the cumulative severity across the 6 erosion types listed in Table A1 and ranges from nil to severe. The rating starts with the most severe erosion score recorded at the site and the other lesser erosion scores are added to it (Table A2).

Cumulative severity scoring is rated as follows:

- no erosion is rated as nil
- 2 or less ‘minor’ ratings keeps an overall rating of ‘minor’
- 3 or more ‘minor’ ratings increases the overall rating to ‘moderate’
- a ‘moderate’ rating with one ‘minor’ rating keeps an overall rating of ‘moderate’
- a ‘moderate’ rating with 2 or more ‘minor’ ratings increases the overall rating to ‘severe’
- 2 or more ‘moderate’ ratings increases the overall rating to ‘severe’
- if any severe erosion is present, the overall rating remains ‘severe’.

Table A1: Erosion assessment form

Erosion type		Description	Extent (percentage of area within assessment site)						Erosion active? Y / N
			1	2	3	4	5	6	
			0%	<5%	5–9%	10–19%	20–49%	50–100%	
A	Water sheet	Litter movement; terracing <2 cm; pedestals <2 cm; exposed roots	nil	minor	minor	minor	moderate	severe	
	Water sheet	Terracing 2–5 cm; pedestals 2–5 cm; exposed roots	nil	minor	minor	moderate	moderate	severe	
	Water sheet	Terracing >5 cm; pedestals >5 cm; exposed roots	nil	minor	moderate	moderate	severe	severe	
B	Rill	Channels up to 30 cm deep	nil	moderate	moderate	severe	severe	severe	
C	Gully	Channels more than 30 cm deep	nil	moderate	severe	severe	severe	severe	
D	Water borne soil deposition	Unconsolidated soil deposits on level areas or associated with intercepts	nil	minor	moderate	moderate	severe	severe	
E	Wind	Slight litter movement; accumulation of soil around plants	nil	minor	minor	minor	minor	minor	
	Wind	Shallow (<1 cm) deflation hollows; mounding around plants	nil	minor	minor	moderate	moderate	severe	
	Wind	Localised sorting and soil loss; deflation hollows (>1 cm); loss of fine material leaving coarse sand lenses; unconsolidated hummocks around plants	nil	moderate	moderate	severe	severe	severe	
	Wind	Extensive movement of surface soil leading to: deflation (absence of fine material, bare surfaces) or accumulation (mobile dunes, buried plants)	nil	severe	severe	severe	severe	severe	
F	Scald (non-saline habitat)	Exposure of impervious A2 or B horizon due to water or wind erosion leaving inhospitable surface	nil	moderate	severe	severe	severe	severe	
	Scald (saline habitat)	Exposure of impervious A2 or B horizon due to water or wind erosion leaving inhospitable surface	nil	moderate	moderate	severe	severe	severe	

Table A2: Overall erosion severity rating

Other erosion scores recorded	Most severe erosion recorded: Nil	Most severe erosion recorded: Minor	Most severe erosion recorded: Moderate	Most severe erosion recorded: Severe
Nil	nil	minor	moderate	severe
+1 minor		minor	moderate	severe
+2 or more minor		moderate	severe	severe
+1 or more moderate			severe	severe
Severe				severe

Shortened forms

Shortened form	Meaning
Commissioner	Commissioner of Soil and Land Conservation
DPIRD	Department of Primary Industries and Regional Development
DPLH	Department of Planning, Lands and Heritage
GIS	geographic information system
GPS	global positioning system
m; km	metre; kilometre
LA Act	*Land Administration Act (1997)*
NAFI	North Australia & Rangelands Fire Information
NDVI	Normalised Differential Vegetation Index
PLB	Pastoral Lands Board
RCA	rangeland condition assessment
SLC Act	*Soil and Land Conservation Act (1945)*
WA	Western Australia

Glossary

Animal equivalent (AE): One AE is the equivalent of a 450 kg steer or dry cow at maintenance.

Cattle unit (CU): One CU is the equivalent of a 400 kg steer or dry cow at maintenance.

Current carrying capacity (CCC): Estimated average number of cattle (animal equivalent or cattle unit) that can be sustainably carried on the lease over a number of years experiencing the historical range of climate conditions. This estimate assumes there is sufficient fencing and water infrastructure for the entire lease area to be sustainably grazed, but accounts for actual pasture condition by reducing the carrying capacity where pastures are not in good condition. This lower carrying capacity is designed to allow pasture condition to improve.

Erosion: Refers to accelerated erosion which is the more rapid erosion that follows the destruction or loss of protective cover often resulting from people's influence on the soil, vegetation or landform (NCST 2009). Reported as the percentage of assessment sites recording nil, minor, moderate and severe erosion.

Key pasture: The most pastorally important pasture types within a particular region. Generally, there are at least 2 key pastures present on every lease in a region and they make a significant contribution to the carrying capacity of the lease. These pastures are monitored to ensure pasture management is maintained or improved across the lease.

Landsat: Moderate spatial-resolution (30 m) imagery that provides large areas of repeated data coverage. Landsat satellites have the optimal ground resolution and spectral bands to efficiently track land use and to document land change due to climate change, urbanisation, drought, wildfire, biomass changes (carbon assessments), and a host of other natural and human-caused changes (see US Geological Survey).

MODIS (Moderate Resolution Imaging Spectroradiometer): A key instrument aboard the Terra and Aqua satellites. Terra's orbit around the Earth is timed so that it passes from north to south across the equator in the morning, while Aqua passes south to north over the equator in the afternoon. Terra MODIS and Aqua MODIS are viewing the entire Earth's surface every 1 to 2 days, acquiring data in 36 spectral bands, or groups of wavelengths (NASA MODIS)

NAFI (North Australia & Rangelands Fire Information): The NAFI website provides regularly updated maps of active fires and burnt areas in the open landscapes of the Australian rangelands. Burnt area maps show what has already burned and are updated every week or so throughout the year. Fire scars for northern WA are sourced from the Darwin Centre for Bushfires Research at Charles Darwin University (see NAFI).

NDVI (Normalised Difference Vegetation Index): An index which measures the difference between near infrared light (which live vegetation strongly reflects) and red light (which live vegetation absorbs) to provide a measure of the greenness of the vegetation. This greenness provides a measure of vegetation density and condition. It is derived from satellite data. Also known as a greenness index.

Pasture condition: Pasture condition describes the state of a given pasture relative to the optimal condition in a well-managed pastoral system on that site (region, landscape position, soil, climate, vegetation). Calculated as the percentage of assessment sites with pasture in good, fair or poor condition (percentage of all sites assessed on the traverse across the station or across land system):

- good condition – perennial plants present include all or most of the palatable species expected; some less palatable or unpalatable species may have increased, but the total perennial cover is not very different from optimal
- fair condition – moderate loss of palatable perennials and/or increased in unpalatable shrubs or grasses, but most palatable species and stability desirables are still present; foliar cover is less than on comparable sites rated in good condition unless unpalatable species have increased[1]
- poor condition – conspicuous loss of palatable perennials; foliar cover has either decreased through general loss of perennials or has increased by the invasion of unpalatable species.

See also *Pastoral land condition standards: Conceptual basis and West Kimberley region case study* (Fletcher et al. 2022).

Pasture type: A distinctive mix of plant species, soil type and landscape position, defined by the Pasture condition and management guide for the Pilbara rangelands and Southern rangelands pasture condition and management guides.

Potential carrying capacity (PCC): Estimated average number of cattle (expressed as cattle units) that can be sustainably carried on the lease over a number of years experiencing the historical range of climate conditions. This estimate assumes all the pastures on the lease are in good condition and there is sufficient fencing and water infrastructure for the entire lease area to be sustainably grazed. The PCCs were reviewed by Landgate and updated by the Valuer General in 2018 for a number of leases (Spektrum Consulting 2018). For leases not covered by the Landgate review in the southern rangelands, and unless specifically updated on a lease-by-lease basis, the PCC is available in the region-specific rangelands inventory and condition survey.

Vegetation cover trend: Remotely sensed data are used to estimate vegetation cover since 2010. Trend lines are fitted to data for all years for each vegetation cover data pixel. Some years were omitted because of the extent of fire or atypical seasonal conditions (e.g. 2011 in the southern rangelands). Where the slope of the trendline is more than one standard deviation greater or less than the mean slope, vegetation cover is considered to have significantly increased or decreased, respectively.

Vegetation greenness: A measure of how much vegetation grew or 'greened up' (seasonal greenness) during each growing season for the period 2017–21. This provides an indication of seasonal effectiveness – in terms of the timeliness and amount

[1] Stability desirables refers to perennial plant species that are not primarily related to grazing history. They usually only decrease in number after natural disturbance events, such as fire or hail damage. These species are usually not palatable or only slightly palatable. They are recognised for their role in maintaining soil stability and ecosystem function.

of rainfall – and the ability of the pasture to use the rainfall. Vegetation greenness is measured using data from MODIS NDVI.

Western Australian Rangeland Monitoring System (WARMS): A set of permanent rangeland monitoring sites in pastoral Western Australia; established by the then Department of Agriculture Western Australia in the early 1990s. WARMS site assessments provide a visual record of pasture and soil surface changes and repeated measures of the composition and density of plant species within the assessment area.

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