



PASTORAL
LAND BOARD
NORTHERN TERRITORY
ANNUAL REPORT
2015-16



LETTER OF TRANSMITTAL



Chairman
Mr Paul Zlotkowski
Ph: (08) 8999 4667

Executive Officer
Tammy Smart
Ph: (08) 8999 4667

PO Box 496
PALMERSTON NT 0831
Fax: (08) 8999 4403

Email: pastorallandboard@nt.gov.au

Web: www.denr.nt.gov.au

Hon Lauren Moss MLA
Minister for Environment and Natural Resources
Parliament House
GPO Box 3146
DARWIN NT 0801

Dear Minister,

In accordance with section 29(a) of the *Pastoral Land Act*, I hereby submit for your information and presentation to Parliament, the Annual Report of the Pastoral Land Board for the reporting period ended 30 September 2016.

Yours sincerely

A handwritten signature in black ink, appearing to read "P. Zlotkowski".

Paul Zlotkowski
Chairman

EXECUTIVE SUMMARY

Good land condition is not only essential for a profitable and sustainable pastoral industry but is also essential to underpin future growth and development of agribusiness.

The Pastoral Land Board is chartered with monitoring the condition and use of pastoral land to facilitate its sustainable use and economic viability. The Board is committed to the maintenance, and where possible, the improvement of the condition of the Northern Territory's pastoral land.

The Board is a statutory authority made up of five members, including a Chairman, appointed by the Minister for Environment and Natural Resources and is tasked with reporting to the Minister on the general condition of pastoral land under the *Pastoral Land Act*. This report provides the Minister with a comprehensive analysis of current land condition across the NT Pastoral Estate. Encompassing an area of approximately 596 542 km² the NT Pastoral Estate comprises 45% of the Northern Territory's land mass held under 223 pastoral leases.

The Board's annual reporting period spans from 1 October to 30 September to align with the growing season. Using a comprehensive integrated monitoring system, Rangeland Monitoring Officers from the Department of Environment and Natural Resources (DENR) combine measured field data collected on-ground with remote sensing satellite monitoring products and the knowledge and experience of the land managers to enable reporting of land condition at property, landscape and regional scales.

The report includes specific land condition issues faced by pastoralists including erosion, feral animals, weeds and bushfires and the impact of seasonal conditions. Supplementary information includes the operations of the Board and the state of the NT cattle industry as supplied by the Department of Primary Industry and Resources.

During this 2015-16 reporting season, monitoring was undertaken at 337 sites on 53 properties across 10 of the 11 pastoral districts. Of the 337 sites assessed, 139 were assessed in 'Good' condition, 119 were assessed in 'Fair' condition and 79 were assessed in 'Poor' condition. Seasonal quality varied across the Territory. The Southern Alice Springs, and Plenty Districts and parts of the Northern Alice Springs, Tennant Creek, Barkly and Sturt Plateau Districts experienced substantially above average rainfall. The Gulf, Roper and northern Darwin Districts received average to below average rainfall.

The Board held seven meetings during this reporting period, including one each in Darwin, Katherine and Alice Springs. The Board visited Ban Ban Springs Station in the Darwin Pastoral District, and Scott Creek and Florina Stations in the Katherine Pastoral District. The Board also attended the Annual Northern Territory Cattlemen's Association Conference held in Alice Springs.

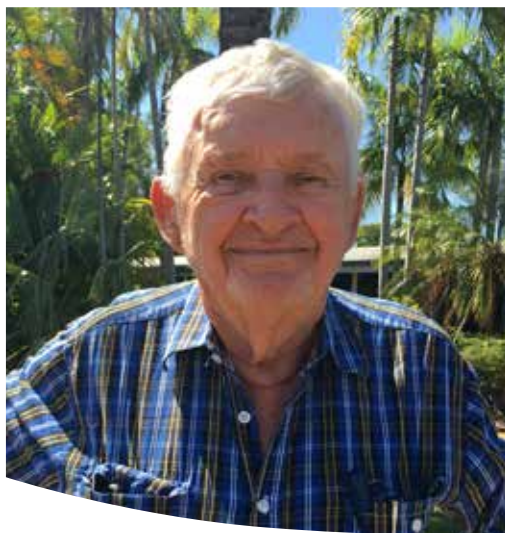
The Board approved 12 land clearing permits and five non-pastoral use permits for purposes such as agriculture, horticulture and a station store.

*"It's our vision to support a viable
pastoral industry in the NT"*

CONTENTS

Chairman's Foreword	2
Membership of the Board	3
Functions of the Board	4
Land Condition	5
Implementation of Management Plans to address Land Condition Issues	5
Erosion on Roads, Fences and other Infrastructure	5
Highlights from the 2015-16 Monitoring Season	6
2015-16 Monitoring Season	8
Pastoral District Reports 2015-16	21
Darwin Pastoral District report	21
Katherine Pastoral District report	29
VRD Pastoral District report	34
Sturt Plateau Pastoral District report	43
Roper Pastoral District report	50
Gulf Pastoral District report	56
Barkly Pastoral District report	63
Tennant Creek Pastoral District report	71
Plenty Pastoral District report	77
Northern Alice Springs Pastoral District report	83
Southern Alice Springs Pastoral District report	91
Pastoral Land Monitoring Program	98
Criteria Used to Assess Pasture Condition	101
Bushfire Activity	102
Weed Activity	104
Weed Threats	104
Darwin Region	105
Katherin Region	107
Tennant Creek Region	108
Alice Springs Region	109
Feral Animals	110
Meetings of the Board	114
Applications Considered by the Board	115
Appendices	117

CHAIRMAN'S FOREWORD



As Chairman of the NT Pastoral Land Board, I have the pleasure in presenting the Annual Report of the Board for 2015-16.

This reporting period saw the Board farewell Chairman, Mr Richard Galton and Member, Mrs Colleen Costello and I thank them both for their contribution to the Board and its achievements during their terms. Of note this includes supporting the diversification of pastoral enterprises and driving the significant improvements made to this Report to ensure the

general condition of the pastoral estate is reported in a clear and informative manner. After nearly 50 years on pastoral leases in the Gulf country I feel honoured to be appointed Chairman of the Pastoral Land Board. Also commencing as a member, Mrs Anne Kilgariff, who brings a wealth of knowledge and experience of the NT pastoral industry.

The Pastoral Land Board has the important function of monitoring the condition and changes in rangeland conditions and facilitating the sustainable use of pastoral land. The Department of Environment and Natural Resources has an integrated monitoring program of measured ground-based sites, photo points and satellite data to provide information of changes in land cover and other indicators of land condition for the entire NT pastoral estate.

The Integrated Rangeland Monitoring Program is nationally recognised and enables the Northern Territory to report on land condition using national standards. The Northern Territory further provides information and advice comparable to other rangeland dominated states and contributes measured data to national reporting.

The monitoring program continues to achieve new milestones since the reinvigoration of the program in 2012 with additional funding which can be seen below

Year	2012	2013	2014	2015	2016
Number of Properties	7	36	44	50	53
Number of Districts	4	6	9	9	10

On a final note, my thanks to all Board members past and present for their dedicated and continued input into Board matters. I would like to acknowledge the role of the staff within the Department of Environment and Natural Resources, particularly the Rangeland Monitoring Branch which is responsible for the continued operation and implementation of the pastoral monitoring program.

Paul Zlotkowski

MEMBERSHIP OF THE BOARD



Mr Paul Zlotkowski - Chairman

Commenced with the Board on 25 June 2016 for a 3 year term.



Mr Steven Craig - Member

Commenced with the Board in 2002 and was reappointed on 1 May 2016 for a 3 year term.



Mr David James - Member

Commenced with the Board on 28 September 2015 for a 3 year term.



Dr Leigh Hunt - Member

Commenced with the Board on 28 September 2015 for a 3 year term.



Mrs Anne Kilgariff Stanes - Member

Commenced with the Board on 20 June 2016 for a 3 year term.

Former Chairman Richard Galton's term expired 25 June 2016.

Former member Colleen Costello's term expired 30 April 2016.

Executive Officers

Mrs Karlie Weinert and Ms Cassandra Arnott

FUNCTIONS OF THE BOARD

Section 29 of the *Pastoral Land Act* outlines the function of the Board:

- a. to report regularly to, and as directed by, the Minister, but in any case not less than once a year, on the general condition of pastoral land and the operations of the Board;
- b. to consider applications for the subdivision or consolidation of pastoral land and make recommendations to the Minister in relation to them;
- c. to plan, establish, operate and maintain systems for monitoring the condition and use of pastoral land on a District or other basis;
- d. to assess the suitability of proposed new pastoral leases over vacant Crown land;
- e. to direct the preparation, and monitor the implementation of, remedial plans;
- f. to monitor, supervise or cause to be carried out work in relation to the rectification of degradation or other damage to pastoral land;
- g. to monitor the numbers and effect of stock and feral and other animals on pastoral land;
- h. to monitor and administer the conditions to which pastoral leases are subject;
- ha. to consider and determine applications for permission to use pastoral land for a non-pastoral purpose in accordance with Part 7;
- j. to make recommendations to the Minister on any matter relating to the administration of the Act;
- k. to hear and determine all questions, and consider and make recommendations on all matters, referred to it by the Minister; and
- m. such other functions as are imposed on it by or under the *Pastoral Land Act* or any other Act or as directed by the Minister.

Other functions outlined in the Act include:

- 1. to determine applications for clearing pastoral land [section 38(1)(h)]
- 2. to consider breaches of conditions referred by the Minister [section 41]
- 3. to consider and make recommendations to the Minister on application for conversion of term pastoral leases to perpetual tenure [section 62]
- 4. to administer the access provision of the Act, including nomination of access routes under Part 6
- 5. to determine applications for non-pastoral use of pastoral land under Part 7.
- 6. to consider and make recommendations to the Minister on application for subdivision [section 61]; and
- 7. to consider and make recommendations to the Minister on application for consent to transfer a pastoral lease or sub-lease should the advice of the Board be sought [section 68(2)].

LAND CONDITION

Land condition should be an assessment of vegetation and soil health as indicated by ground cover species composition, tree and shrub density, abundance of invading plants (native and exotic), soil surface condition and soil erosion. These attributes are assessed relative to land in near-pristine condition.

The main influences on land condition are grazing by domestic, native and feral grazers, fire and combinations of the two. Grazing is managed by manipulating stocking rate, stock water distribution, feral grazing control and fire. Fire on its own can change land condition by being too frequent or too infrequent over a long period of time, but its main effect on land condition is through changing the distribution of grazing as grazers prefer younger grass.

Implementation of Management Plans to address Land Condition Issues

In cases where land condition issues are identified on a pastoral property, the Board may request the lessee to prepare a management plan detailing the action to be taken to address the land management issues which have been identified. It is a basic tenet of the *Pastoral Land Act* that pastoral lessees acknowledge their duty to adopt sound management practices and their responsibility to address any land condition issues that may arise. In line with this philosophy, the Board seeks voluntary collaboration with pastoral lessees to address land condition issues and implementation of rehabilitation programs.

While voluntary management plans are preferred in the first instance, if the Board is of the opinion that pastoral land has been degraded or otherwise damaged it may require a remedial plan detailing the proposed management of the pastoral land over a specified period of time. Remedial plans need to be endorsed by the Board and are registered on the title.

The Board has a voluntary management plan currently in place on a pastoral lease in the Katherine Pastoral District addressing land degradation caused by heavy grazing, poorly located linear infrastructure and weed infestations. There are currently no remedial plans in place.

Erosion on Roads, Fences and other Infrastructure

Erosion on roads, tracks and fence lines continues to be a significant soil management issue on pastoral leases throughout the NT. Officers of DENR's Rangelands Division adopt a co-operative approach to assist station managers with appropriate soil conservation earthwork design and construction. Voluntary management plans have been prepared by pastoral lessees and successfully implemented on a number of properties to address issues arising from the poor siting of infrastructure, and/or inappropriate maintenance techniques.

HIGHLIGHTS FROM THE 2015-16 MONITORING SEASON

Fifty three pastoral leases in ten pastoral districts were visited by Rangeland Monitoring Officers during 2015–16.

The primary purpose of visits by Rangeland Monitoring Officers was to monitor and report on land condition. Officers also mapped new, or replaced, infrastructure (water points, fences and tracks) and updated the monitoring folder ('blue book') for each lease.

This section of the Report summarises the highlights and areas for improvement, relating to land condition and broader rangeland management from the property visits.

Land Condition

Good News

There were three notable examples in the Northern Alice Springs Pastoral District where formerly degraded parts of leases have slowly improved in land condition under the dedicated and careful stewardship of the families involved (example shown in Figure 1). Conservative stocking and periodic spelling of paddocks are common land management practices of all lessees. Extensive rehabilitation works have also been undertaken on those parts of two leases that formerly suffered extensive erosion as part of the degradation process.



Figure 1: Tier 1 monitoring site photographed in June 1995 (left) and June 2016 (right). Buffel grass is now the dominant pasture species. While it has reduced species diversity and dietary choice for cattle, it provides prolific forage in most seasons, good ground cover to protect the soil surface against erosion and rapid growth following episodic rainfall in the warmer months. Another encouraging sign for sustained livestock production is the open nature of the site; vigorous perennial grasses provide competition for establishing trees and shrubs that might otherwise dominate the landscape under continuous heavy grazing.

Degraded areas getting better

Some leases, particularly in the southern NT, have been of concern in past years because of near-continuous heavy grazing pressure on their more productive, and often fragile, land types. The 2015-16 monitoring program included some leases that had recently sold and where the new owners recognise land management problems of the past and are working to redress poor land condition (Figure 2). Given the highly variable rainfall of arid central Australia and known lags in the recovery process, the time required to restore pastoral productivity is often uncertain. Current owners are commended for their commitment to improving land condition and thereby returning degraded country to its former productive state.



Figure 2: Tier 1 monitoring site in the Southern Alice Springs Pastoral District photographed in August 1994 (left) and August 2016 (right). While there is obviously more ground cover and herbage in the latter photo, much of it is ephemeral and a result of recent winter rain. An encouraging sign for the gradual recovery of this poor-condition site is recruitment of Crimson Foxtail (*Ptilotus atriplicifolius*), the semi-palatable perennial forb in the foreground and scattered through the background of the site (2016 photo). This plant provides a degree of ground cover and more persistent forage for cattle in drier years.

Not so good news

Measured sites on a small number of leases visited in the Northern Alice Springs Pastoral District had high levels of bare soil, sparse pasture with consequent limited forage available, evidence of erosion and, in some cases, thickening of the woody layer over time. These sites were assessed in poor condition (example shown for a Tier 1 site in Figure 3). Similar expression of some or all indicators extended beyond sites to the broader landscape. The Tier 1 monitoring database and other records indicate that such issues have existed for varying periods of time.



Figure 3: Tier 1 monitoring site in the Northern Alice Springs Pastoral District photographed in June 2008 (left) and August 2016 (right). Visually, shrubs and bare soil are the most striking features. While the amount of bare soil is related to preceding amounts and effectiveness of rainfall, there is considerable research literature to document the competitive effect of woody thickening on pasture growth. This site has been assessed in poor condition since being established in 1994.

2015-16 MONITORING SEASON

Land condition assessed by the Rangeland Monitoring Branch for each of the ten Pastoral Districts is summarised in this section. This overview is drawn from the analysis of vegetation-cover dynamics based on Landsat imagery, data collected at 337 monitoring sites and more general assessment of land condition between monitoring sites during lease visits.



The criteria and methods used to monitor land condition are explained on pages 98 to 101.

Seasonal Conditions

Seasonal conditions for 2015-16, based on rainfall amount compared with the long term record, were

- Substantially above average for much of the Southern Alice Springs and Plenty Districts and parts of the Northern Alice Springs, Tennant Creek, Barkly and Sturt Plateau Districts (Figure 4).
- Above average across remaining parts of the southern NT (south of Tennant Creek) and in the Sturt Plateau and Katherine Districts. Parts of the Barkly District also received above average rainfall for the 12 months.
- Average to above average across most of the VRD Pastoral District, the western half of the Tennant Creek Pastoral District and most of the Darwin Pastoral District.
- Average to below average in the Gulf, Roper and northern Darwin Districts.

Significant features of the 12-month rainfall included extended hot dry spells through the 2015-16 wet season for much of the monsoonal north, out-of-season mid-year rainfall in parts of the north and good winter rains across most of the southern NT.

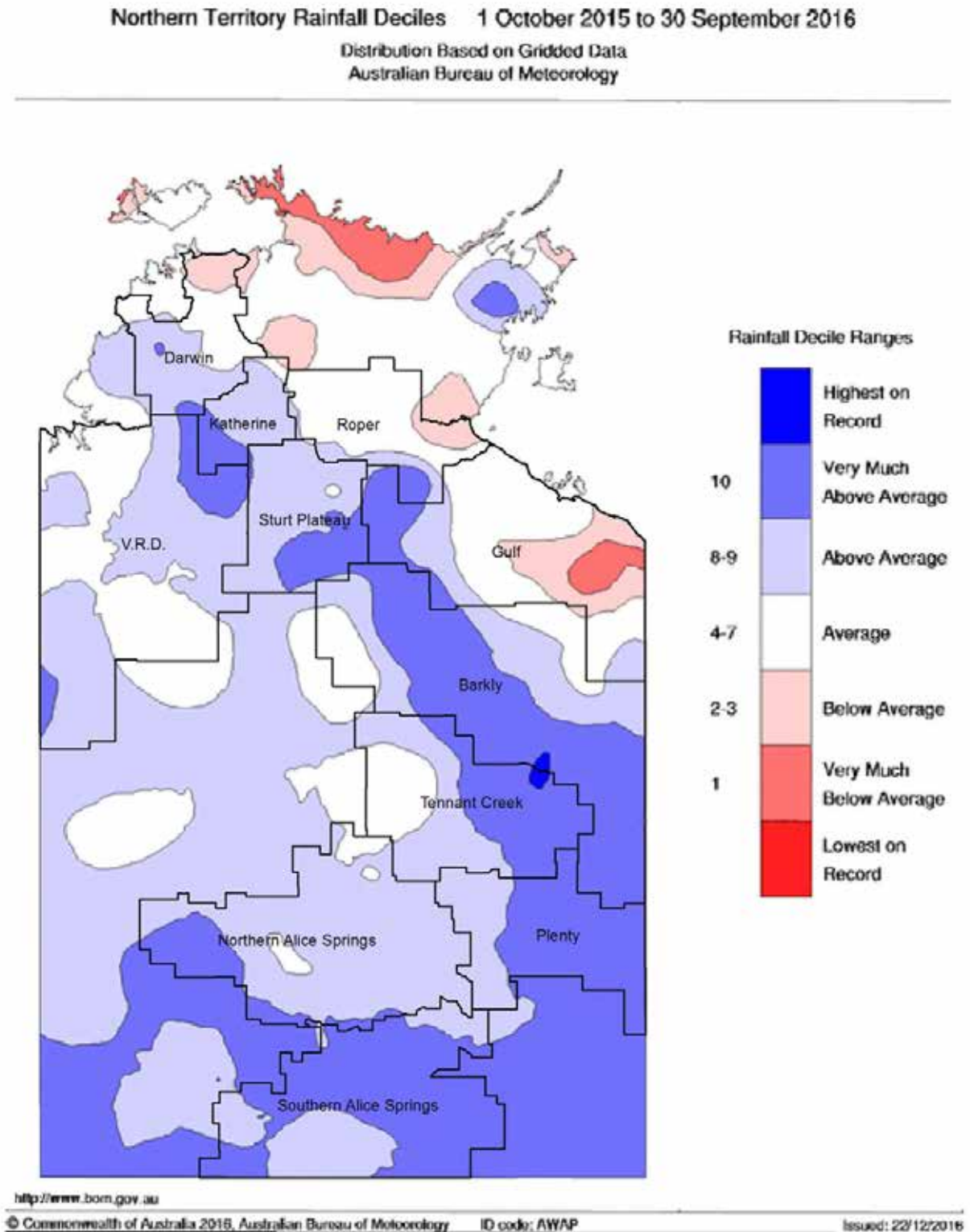


Figure 4: Decile-ranked rainfall for the October 2015 to September 2016 period.

Black polygons show the Pastoral Districts as gazetted under the Pastoral Land Act namely Darwin, Katherine, Roper, VRD, Sturt Plateau, Gulf, Barkly, Tennant Creek, Plenty, Northern Alice Springs and Southern Alice Springs.

Map obtained from the Bureau of Meteorology website (<http://www.bom.gov.au/jsp/lawap/rain/index.jsp>).

Assessing Land Condition

Land condition was assessed using a combination of remotely sensed (satellite) and field (site) data, and lease inspection. Landsat data are processed to indicate the proportions of vegetation cover (photosynthetic and non-photosynthetic) and bare soil in each pixel, an area of 0.09 ha. Change in each component can be examined since 1988, providing important information on cover dynamics over the last 28 years.

It is important that pastoral land managers maintain adequate ground cover in the latter months of each year to minimise soil loss from wind erosion and intense summer storms. It is also important to carry dry feed, and associated ground cover, into this period in case there is a late start to the wet season and/or monsoonal rains fail more generally. Figure 5 illustrates relative change in remotely-sensed vegetation cover between the latter part of 2015 and 2016. The pair of images together indicates:

- Increased amounts of bare soil (less vegetation cover) in the southern NT compared with savannah landscapes in the north. This pattern is shown by the predominantly red and brown colouring in both images.
- Higher vegetation cover (less bare soil) in the woodland-dominant savannah landscapes of the central and northern NT. Most of this area also has a substantial component of perennial grasses in the pasture meaning that there is considerable vegetation cover in the late dry season (illustrated by the brown colouring in Figure 5), where not recently burnt.

Fires remove most of the pasture layer and may cause leaf fall from trees where scorching occurs. Areas burnt in 2015 and 2016 show as brighter shades of green in Figure 5, because they had less vegetation cover compared to most previous years since 1988. Areas recovering from earlier fires (i.e. prior to 2015, left hand image and less apparent in 2016, right hand image) show as shades of orange through to yellow.

Comparing the images shows a general increase in vegetation cover (i.e. less bare soil) from late 2015 to the same period in 2016. In particular:

- The darker green and brown colouring across the Southern and Northern Alice Springs Pastoral Districts and the Plenty Pastoral District in 2016 indicates less bare soil than 12 months previously and a higher (decile) rank of vegetation cover relative to that present since 1988.
- There was similar change in the eastern Tennant Creek Pastoral District but less so in the western part, probably largely because this area has experienced consecutive years of above average seasonal conditions.
- The amount of bare soil decreased in much of the eastern and southern parts of the Barkly Pastoral District between 2015 and 2016. The corresponding rank of vegetation cover improved from 'below average' to 'average'.

The degree of change in northern pastoral districts was less marked, mainly because of generally higher cover of perennial grasses that persist from year to year in the landscape and higher woody cover which partly conceals (from the satellite sensor) bare ground that may be present.

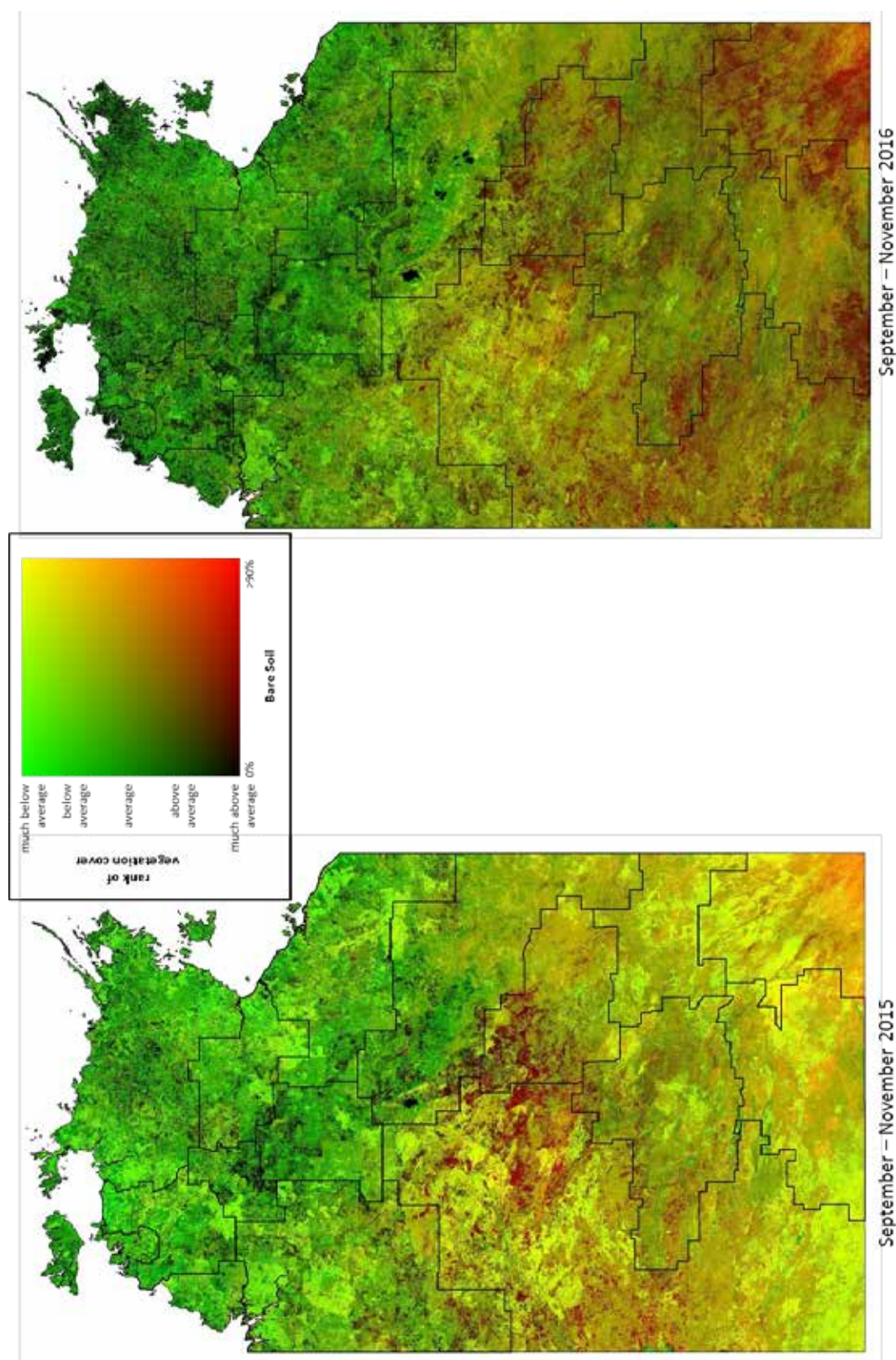


Figure 5: Change in the amount of bare soil and rank of vegetation cover between late 2015 (left) and 2016 (right). Individually, the maps show the percentage of bare soil present in 0.09-ha Landsat pixels in the latter part of 2015 (or 2016) compared with the pixel-level rank of vegetation cover over time. The latter compares vegetation cover in late 2015 (or 2016) against that present at the same time each year since 1988. The amount of bare soil is shown in shades of red (see legend; high bare soil = bright red, little bare soil = dark red). The rank of vegetation cover is depicted in green; relatively less cover in late 2015 (or 2016) = bright green, relatively more cover = dark green. Mixing of green and red indicates other possible responses (see legend); dark brown represents less bare soil in the Landsat pixel and more vegetation cover in 2015 (or 2016) compared with the recent past; yellow means high levels of bare soil and less vegetation cover relative to the recent history (since 1988). Black polygons show pastoral districts (see Figure 4 for their names).

Notwithstanding more subtle change in central and northern regions, the amount of vegetation cover and its associated rank since 1988 appears to have increased from late 2015 to 2016 in much of the Gulf, Roper, VRD and Darwin Pastoral Districts. Vegetation dynamics, based on cover, appeared quite stable across most of the Sturt Plateau and Katherine Districts.

In summary, Figure 5 shows the contrast and relative change in levels of vegetation cover (conversely, bare soil) across the NT over one year, the extent and significance of fire on the dynamics of vegetation cover and, within individual pastoral districts, the influence of rainfall on the amount of cover present. Grazing effects, where present, are more subtly embedded within these gross changes.

Understanding seasonal effects on land condition

The amount of forage available for grazing or level of ground cover present to protect the soil surface against erosion is influenced by the quantity and effectiveness of rainfall throughout the year (or wet season in the north), and subsequent grazing and fire. The effects of rainfall variability and fire, whether episodic or recurrent, must be accounted for when assessing grazing impacts in the rangelands.

A simple framework for better understanding seasonal (mainly rainfall) effects on vegetation change is the 'seasonal quality' matrix (Figure 6). Here, some measure of recent seasonal quality is intersected with the direction of change for those attributes of the vegetation being monitored. In the case of remotely sensed bare soil, we would expect bare soil to decrease following more rainfall (better seasons) and increase in droughts (i.e. poorer seasonal quality). Seasonally expected change is shown with the '~' symbol in Figure 6. When it is known what is expected, it is then possible for monitoring and management to focus on unexpected change (the ✓✓ and **XX** cells in Figure 6).

For example, at landscape and regional scales, the amount of bare soil will increase after extensive wildfire that can follow improved seasonal conditions. This is one obvious plausible explanation for unexpected change. At more local scales (water points and paddocks), an unexpected increase in bare soil may be associated with heavy stocking. A decrease in the amount of bare soil following poorer seasonal quality probably requires further investigation. It could be that areas are being temporarily spelled (protected from grazing) or the composition and/or structure of the vegetation are changing. These changes could mean recruitment of perennial species, a desirable change for the pastoral industry where such species are palatable, or longer-term thickening of woody vegetation – less desirable for grazing where competition results in reduced pasture availability.

Seasonal Quality	Change in remotely-sensed bare soil		
	Increase	No change	Decline
Above average	XX	X	~
Average	X	~	✓
Below average	~	✓	✓✓

Figure 6: Seasonal quality matrix used to interpret change in bare soil with respect to preceding seasonal conditions. 'Seasonal quality' describes the relative value of recent rainfall in producing forage for livestock.

The white cells with the ~ symbol represent expected change and coloured cells show unexpected change, akin to traffic lights; that is, less desirable change in the case of orange and red cells and more desirable for green cells.

Regional interpretation of change in bare soil: 2015 to 2016

Change in vegetation cover (conversely, bare soil) in the NT between late 2015 and 2016 is illustrated in Figure 5 and broadly described above. This change, for bare soil, is further summarised for the extent of pastoral leases in pastoral districts in Table 1. In producing this statistical summary:

- Seasonal quality is described in terms of expected pasture growth based on rainfall received, simulated using AussieGRASS (www.longpaddock.qld.gov.au). Modelled growth between October 2015 and September 2016 was ranked as a percentile of the growth for all previous 12-month periods (back to 1957).

Areas (5 km by 5 km grid cells) having less than 30% of their long term modelled pasture growth were assigned 'below average' seasonal quality. Growth percentiles above 70 were allocated to 'above average' seasonal quality. Remaining grid cells were considered to have experienced average seasonal quality.

- Change in bare soil was arbitrarily split between 'increase', 'no change' and 'decline' according to pastoral district.

In the southern NT (Southern and Northern Alice Springs Pastoral Districts, Plenty, Tennant Creek and Barkly Pastoral Districts), 'no change' was interpreted as bare soil (for each Landsat pixel) in 2016 being within ± 15 percentage points of that present in 2015. An increase in bare soil of >15 percentage points was considered an 'increase' and a decrease of more than 15 points a 'decline'.

For remaining (central and northern) pastoral districts, change in bare soil of more than ± 5 percentage points was considered an 'increase' or 'decline' (depending on its direction).

- The percentage area of the pastoral estate in each of the nine cells (Figure 6) was then calculated for each pastoral district. The percentage areas showing unexpected change (decline in bare soil with below average seasonal quality or increase in bare soil with above average seasonal quality) is summarised in Table 1. Percentage areas for increased bare soil following average seasonal quality are also included. This could serve as a possible warning to where areas of future concern may lie.

If a reasonable upper limit for unexpected change is less than 5% of the pastoral area within the pastoral district, then the magnitude and direction of change in bare soil from 2015 to 2016 accorded with seasonal expectations in most pastoral districts (Table 1). The Darwin, Roper and Gulf Districts had substantial areas with decreased bare soil despite below average seasonal quality. This appeared related to a significant rainfall event in September 2016 (Figure 7) that likely promoted a flush in ground cover (decline in bare soil) prior to capture of the Landsat imagery used in this analysis. It is probable that this growth event was short-lived, produced limited pasture growth and minimally influenced the 12 month classification of seasonal quality as being 'below average', based on modelled pasture growth.

The threshold used for assigning 'no change' in bare soil obviously influences the percentage area calculated as exhibiting unexpected change. For example, adjusting the 'no change' threshold for the Barkly district to ± 5 percentage points (of bare soil) increased the "increase in bare soil following above average seasonal quality" category to 10.4% of the grazed area. Areas mapping into this category were clearly associated with water points and paddocks on some pastoral leases and could reasonably be assumed to be related to grazing. This demonstrates that regional stakeholder engagement, including best-management grazing practice, may be required to gain consensus as to acceptable levels of change (in bare soil) for seasonal conditions experienced.

Table 1: The percentage area of pastoral leases within pastoral districts showing unexpected change in bare soil with respect to seasonal quality between the latter parts of 2015 and 2016.

Larger percentage values in the first column (e.g. >10%) serve as a possible warning of future concern. Higher values (e.g. >5%) in the second column are of greater concern; recent effects of fire apart, bare soil should not increase following above average seasonal quality.

The third (final) column is a more favourable outcome and it is useful to try and understand where and why the amount of bare soil has decreased following unfavourable seasonal conditions.

Pastoral District	Percentage area showing unexpected change		
	Increase in bare soil following average seasonal quality	Increase in bare soil following above average seasonal quality	Decline in bare soil following below average seasonal quality
Darwin	7.1	0.5	24.0
Katherine	13.0	4.4	4.0
VRD	24.0	1.7	4.8
Sturt Plateau	10.0	1.9	3.1
Roper	4.0	4.0	25.0
Gulf	3.1	0.2	28.2
Barkly	6.5	2.3	1.1
Tennant Creek	1.9	1.7	No pastoral lease country within the district experienced below average seasonal quality
Plenty	0	0.1	
Northern Alice Springs	0.2	0.1	
Southern Alice Springs	0	0	

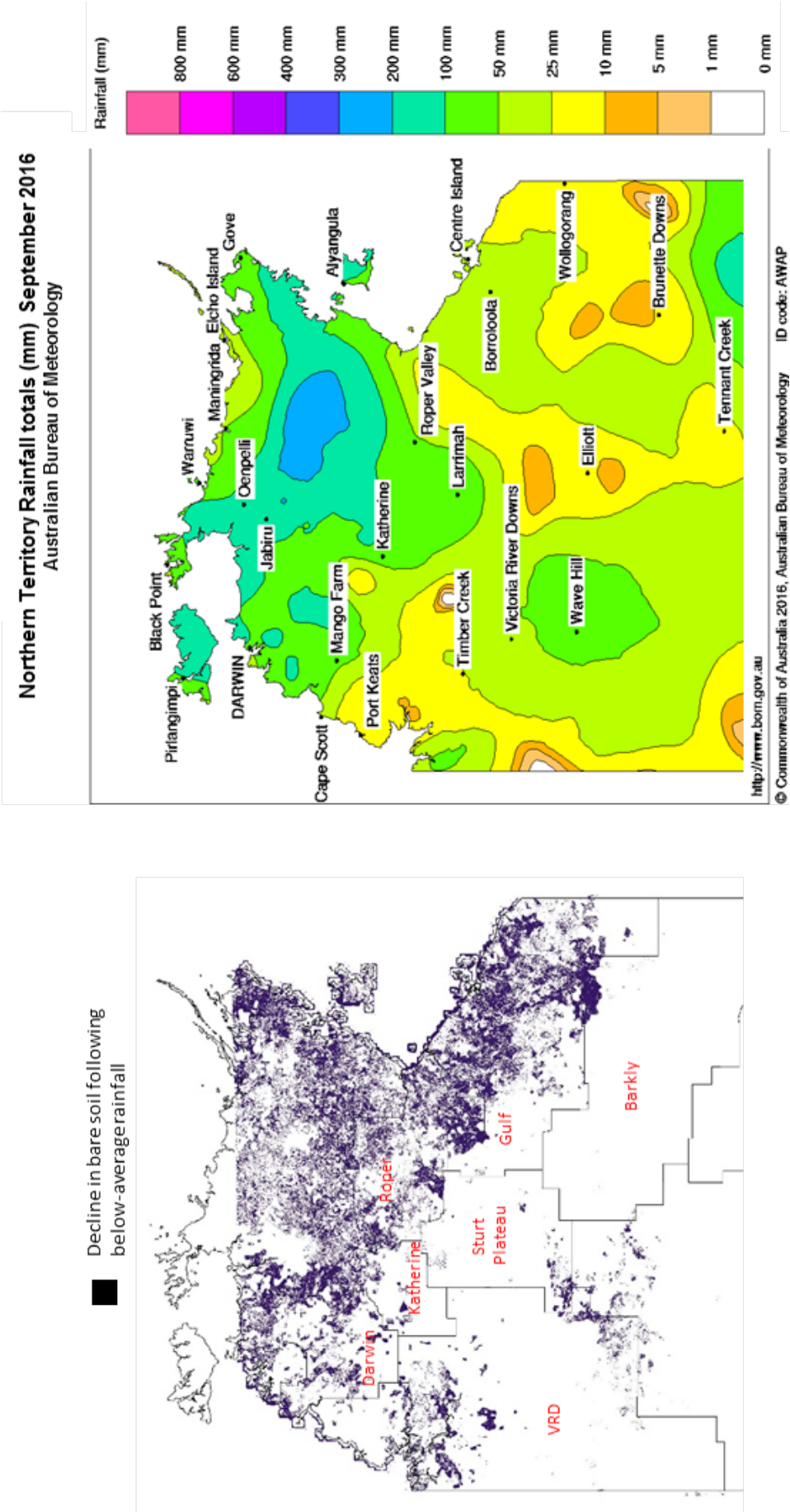


Figure 7: Spatial relationship between unexpected change in bare soil and late dry season rainfall in the northern part of the NT.

Left: areas of northern pastoral districts where the amount of bare soil declined between 2015 and 2016 despite below average seasonal quality.

Right: September 2016 rainfall as the suggested main cause of this unexpected change

(source: Bureau of Meteorology)

Other indicators of land condition

The following sections provide a detailed account of other components of land condition for each pastoral district. Information is compiled on:

- Seasonal quality – the spatially averaged growth percentile (from AussieGRASS) for each district as a summarising statistic of the amount and effectiveness of rainfall in growing forage for livestock,
- Extent and timing of wildfire,
- Further information on bare-soil dynamics including mapped areas exceeding specified thresholds of bare soil, and
- Data collected at monitoring sites and observations made during lease inspections relevant to pasture condition, presence of weed species, tree-grass balance (e.g. woody thickening) and soil erosion.

Information from the pastoral district reports is summarised in Table 2. This table effectively provides a brief snapshot of each pastoral district.

Table 2: Summary of land condition by Pastoral District.

Pastoral District	AG'sGrowth Percentile	% PD ² Burnt	% PD with category of Bare Soil ³				# ⁴ stations	Site Data condition class	# ⁵ sites	Summary of Pastoral District
			minor	moderate	high	very high				
Darwin	60	48	77	22	2	0	9	Good	18	Spatially variable seasonal quality. Fire less extensive than in preceding 12 months. Vegetation cover suppressed by recent fire. Minor amounts of bare soil. Majority of ground sites in good condition. Based on visual inspection, majority of area on most stations in good or fair condition. Weeds, where present, include Hyptis (<i>Hyptis suaveolens</i>) and Sida (<i>Sida acuta</i>).
								Fair	7	
								Poor	1	
Katherine	57	37	76	23	1	0	0	N/A		Based on modelled pasture growth, seasonal quality improved from much below average in the north-east to much above average in the south-west. Extensive wild fire in November 2015. Minor occurrence of bare soil in the latter part of the 2016 dry season. No on-ground monitoring.
VRD	54	23	21	50	27	2	4	Good	12	Variable seasonal quality based on expected pasture growth through the wet season: above average in the far south and north-east, and below average in the south-east. Moderately extensive fire in late 2015, probably mostly wildfire. Moderate amounts of bare soil, mainly in the south and south-east. Majority of sites in good condition. Similarly, much of the pastorally more productive country on most leases judged to be in good condition with lesser areas in fair condition. Parkinsonia (<i>Parkinsonia aculeate</i>) and Rubber Bush (<i>Calotropis procera</i>) were recorded around some yards and waterpoints with sections of some tracks eroded through gullying.
								Fair	9	
								Poor	1	

Pastoral District	AG's Growth Percentile	% PD ² Burnt	% PD with category of Bare Soil ³				# ⁴ stations	Site Data condition class	# ⁵ sites	Summary of Pastoral District
			minor	moderate	high	very high				
Sturt Plateau	55	22	72	26	2	0	3	Good	12	Mostly above average seasonal quality in the north-west and much below average in the south-west and far north-east. Burnt area twice as extensive as in the preceding year. Minor occurrence of elevated amounts of bare soil and its presence influenced by recent fire and poorer seasonal quality. Monitoring sites and majority of area on three stations in mostly good condition.
								Fair	6	
								Poor	1	
Roper	16	17	66	31	3	0	1	Fair	2	The majority of the district experienced poor seasonal quality based on expected wet season pasture growth. Fire much less prevalent than the previous year when three quarters of the region burnt. The two sites on one lease are an insufficient sample to adequately indicate land condition of pastoral country elsewhere in the district.
Gulf	29	15	58	37	5	0	4	Good	3	As in 2014-15, the Gulf coast and hinterland extending up to 150 km inland experienced poor seasonal quality, based on modelled pasture growth. Seasonal conditions were better in the south-west and south-east of the region. There were areas of relatively lower vegetation cover scattered throughout the district, compared with the Landsat-based record since 1988. This lower cover was not always associated with recent fire. Separate to assessments at monitoring sites, sections of tracks and fence lines showed evidence of erosion and various weed species were present. One additional lease was assessed based on existing Tier 1 sites and property inspection.
								Fair	6	

Pastoral District	AG's Growth Percentile	% PD ² Burnt	% PD with category of Bare Soil ³				# ⁴ stations	Site Data condition class	# ⁵ sites	Summary of Pastoral District
			minor	moderate	high	very high				
Barkly	64	9	22	40	35	3	6	Good	32	Simulated pasture growth, as an indicator of seasonal quality, was average to above average apart from a small area in the far north-east which experienced poorer seasonal conditions. Analysis of Landsat imagery indicated moderate to high levels of bare soil, the latter mostly in the east, south-east and south-west of the district. The majority of most leases in good or fair condition. Prickly Acacia (<i>Vachellia nilotica</i>), Parkinsonia and Rubber Bush present in areas, mostly around waterpoints and yards. Assessment of sections of two leases was restricted, either because of less development for grazing or existing infrastructure was poorly maintained.
								Fair	14	
Tennant Creek	71	8	1	42	56	1	3	Good	6	Seasonal quality much above average across most of the district based on rainfall and modelled pasture growth. Aligned with this, most areas had above average to highest levels of vegetation cover recorded since 1988 (based on Landsat imagery). Despite good seasonal conditions, a little more than half the region had a relatively high level of bare soil (41% - 60% of Landsat pixel). This, to some extent, was a continuing legacy effect of extensive wildfire in 2011 and 2012. Separate to monitoring sites, parts of the pastorally more productive country on leases was in fair or poor condition. Spinifex sandplains and other less productive land types were in good condition. Areas of Parkinsonia and Rubber Bush occur.
								Fair	9	
								Poor	5	
Plenty	78	0	2	50	47	1	2	Good	7	Mainly above average seasonal quality based on modelled pasture growth for the 12 months, October 2015 to September 2016. Reduced levels of bare soil compared with the previous year, although still relatively large amounts in the eastern half and parts of the western region. Current bare soil to some extent related to extensive wildfire in 2011 and 2012 and following dry years (to 2016). Productive grazing country in fair or good condition with smaller areas in poor condition. One lease had serious gully erosion of tracks.
								Fair	14	
								Poor	1	

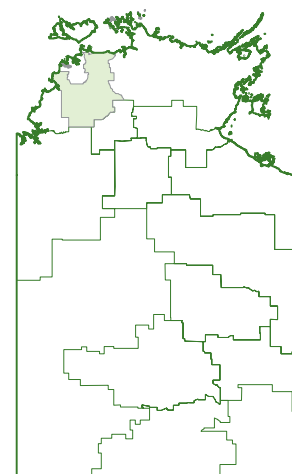
Pastoral District	AG's Growth Percentile	% PD ² Burnt	% PD with category of Bare Soil ³				# ⁴ stations	Site Data condition class	# ⁵ sites	Summary of Pastoral District
			minor	moderate	high	very high				
Northern Alice Springs	69	2	1	48	49	2	12	Good	37	Much of the district received good winter rainfall leading to above average seasonal quality based on modelled pasture growth. Reduced bare soil compared with 2014-15 but half the region still had a relatively high level, partly due to the lingering effect of extensive wildfire in 2011 and 2012. Slightly less than half the monitoring sites showed evidence of wind or water erosion and 35 sites (31% of total) were heavily grazed at the time of assessment. Land condition elsewhere on most leases varied between good and poor.
								Fair	30	
								Poor	46	
Southern Alice Springs	80	0	0	26	66	8	7	Good	12	Winter rains produced good herbage growth with grasses also responding in some areas. Accordingly, seasonal quality was above average across the whole district. Less bare soil than in 2014-15 but two-thirds of the region had a relatively high amount (and almost one tenth, a very high amount). Considerable areas of increased bare soil in the central and eastern parts appeared to be a continuing legacy effect of extensive wildfire in 2011. Past wind sheeting was recorded at almost half of the monitoring sites with scalding and/or water sheeting evident at one fifth of sites. As in the northern part of the Alice Springs region, the condition of valuable grazing country beyond monitoring sites ranged from good to poor.
								Fair	22	
								Poor	24	

1. AussieGRASS modelled pasture growth for the period November 2015 to April 2016 or October 2015 to September 2016 as a percentile of the modelled growth for all previous similar periods. The 12-month growth percentile used for the Northern and Southern Alice Springs Pastoral Districts and the Plenty District. The summer growth percentile reported elsewhere. Percentile values are available for Australia on a 5 km² grid. Reported value is the spatial average of all grid-cell values in the pastoral district.
2. Percentage area of pastoral district burnt between October 2015 and September 2016. Fire scars sourced from the North Australian Fire Information website (www.firenorth.org.au/nafi3). Repeat fires in the Darwin Pastoral District means that cumulative burnt area is greater than the area of the pastoral district.
3. The area of bare soil present between September and November 2016, as a percentage of the area of the pastoral district. Bare soil is derived from Landsat satellite imagery where the fractions of photosynthetic (green) vegetation, non-photosynthetic vegetation (dry vegetation and litter) and bare soil are estimated in each 30m square pixel (900 m² or 0.09 ha). Categories of bare soil are: minor, ≤20% of pixel is bare soil; moderate, 21% - 40% bare soil in pixel; high, 41% - 60% bare soil in pixel; and very high, >60% of pixel is bare soil. The number of pixels in each category are counted, multiplied by pixel area (0.09 ha) and converted to the percentage of pastoral district area.
4. Number of stations visited in the pastoral district.
5. Number of sites in each condition class monitored in the pastoral district.

DARWIN PASTORAL DISTRICT

Seasonal quality across the region, based on AussieGRASS modelled pasture growth, varied from much below to much above average.

The region experiences extensive and frequent fire but the total area burnt between October 2015 and September 2016 was considerably less than in the preceding reporting period (2014-15, 45 187 km²; 2015-16, 17 533 km²). Based on the Landsat record for the last 28 years, most areas of reduced vegetation cover were related to recent fire. Minor amounts of bare soil were present in the late dry season of 2016. Perennial grasses dominated at the majority of 26 sites measured on nine pastoral leases with bare soil, on average, comprising approximately 10% of total ground cover. Eighteen sites were rated in good condition and a further seven in fair condition. Based on visual inspection, the majority of country on most stations was judged to be in good or fair condition. Weeds, where present, included *Hyptis* (*Hyptis suaveolens*) and *Sida* (*Sida acuta*).



Map 1: Location of Darwin Pastoral District

Seasonal quality

“Seasonal quality” describes the relative value of recent rainfall in producing forage for livestock. It is judged with reference to the historical record. Two indicators are used: rainfall amount compared with the long term median and expected pasture growth based on rainfall received, simulated using AussieGRASS (www.longpaddock.qld.gov.au).

Descriptors of seasonal quality provide useful context for interpreting various measures of land condition. However, to the extent possible, land condition is assessed independently of seasonal conditions.

Rainfall statistics (Table 3) are based on gridded rainfall produced by the Bureau of Meteorology (www.bom.gov.au/jsp/awap/rain/index.jsp). Pixel (grid cell) values are calculated from rainfall amounts at recognised recording stations. Rainfall is from October of one year to September the following year thus incorporating an entire growing season. Modelled pasture growth is for the period November 2015 to April 2016. This growth is ranked as a percentile of the growth for all previous summers.

Table 3: Indicators of seasonal quality. Data spatially averaged for the Darwin Pastoral District.

Rainfall (mm)		AussieGRASS	
2015 - 2016	1266	Growth (kg/ha)	1987
Long term median	1262	Percentile	60

DARWIN PASTORAL DISTRICT

Spatially averaged rainfall for the Darwin Pastoral District was close to the long term median (Table 3) but displayed considerable spatial variation (Figure 8, left hand panel). Rainfall decreased from west to east across the region with much of the eastern half having twelve month rainfall of less than 1200 mm.

Modelled pasture growth over the last summer was a little above the long term average based on the spatial mean (Table 3). An area centred on Ban Ban Springs and in the far south of the pastoral district had much above average modelled growth (Figure 8, right hand panel). A small area east of Marrakai station and small dispersed areas elsewhere in the central and northern parts of the district had poor seasonal conditions based on simulated pasture growth.

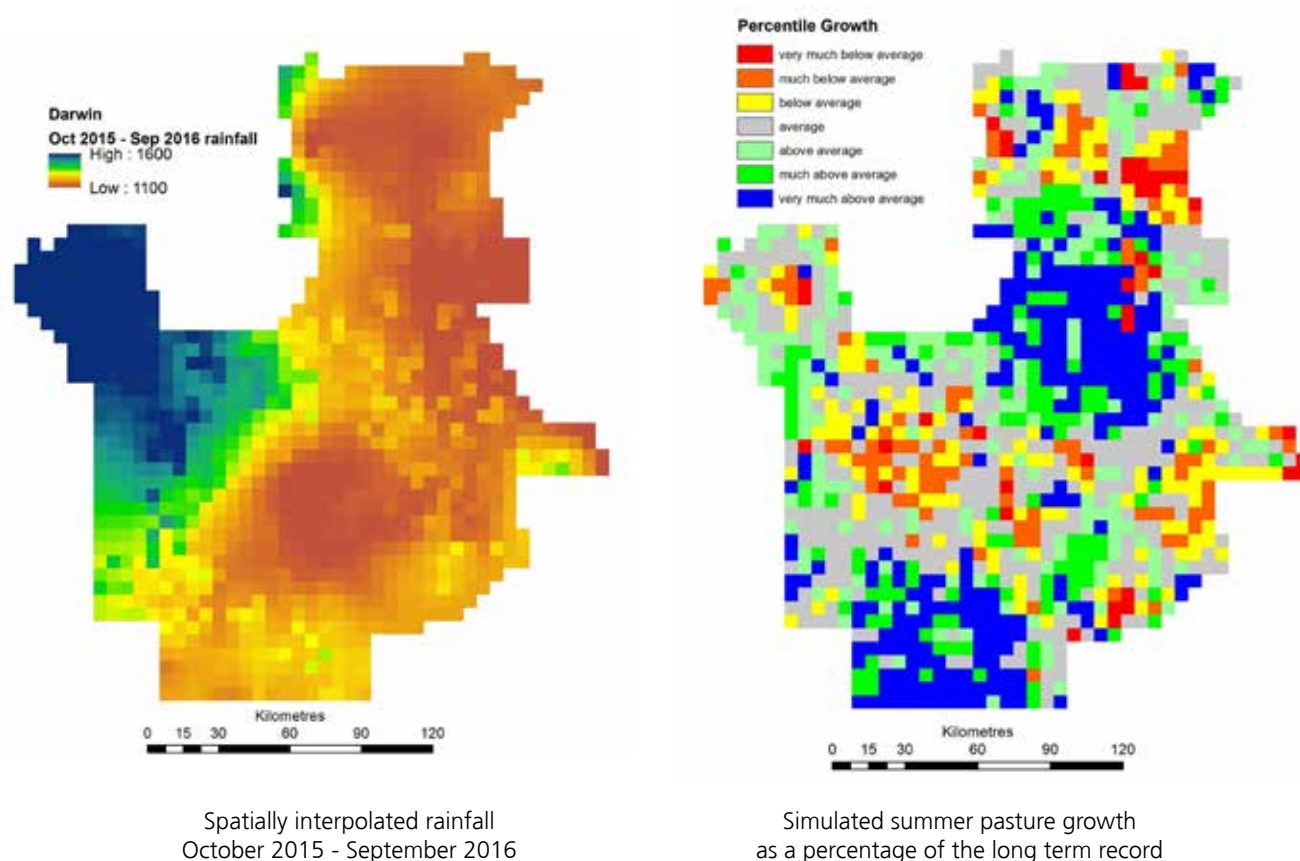


Figure 8: Maps of seasonal quality. Left, gridded rainfall, October 2015 to September 2016; right, AussieGRASS modelled pasture growth for the 2015-16 summer period as a percentage of previous summers.

DARWIN PASTORAL DISTRICT

Fire

The North Australian Fire Information website (www.firenorth.org.au/nafi3) reports that 17 533 km² burnt between October 2015 and September 2016. This was considerably less than the 45 187 km² that burnt in the previous reporting period (October 2014 to September 2015). Reduced fire occurrence in the late dry season of 2014 was the main contributor to the smaller total area burnt.

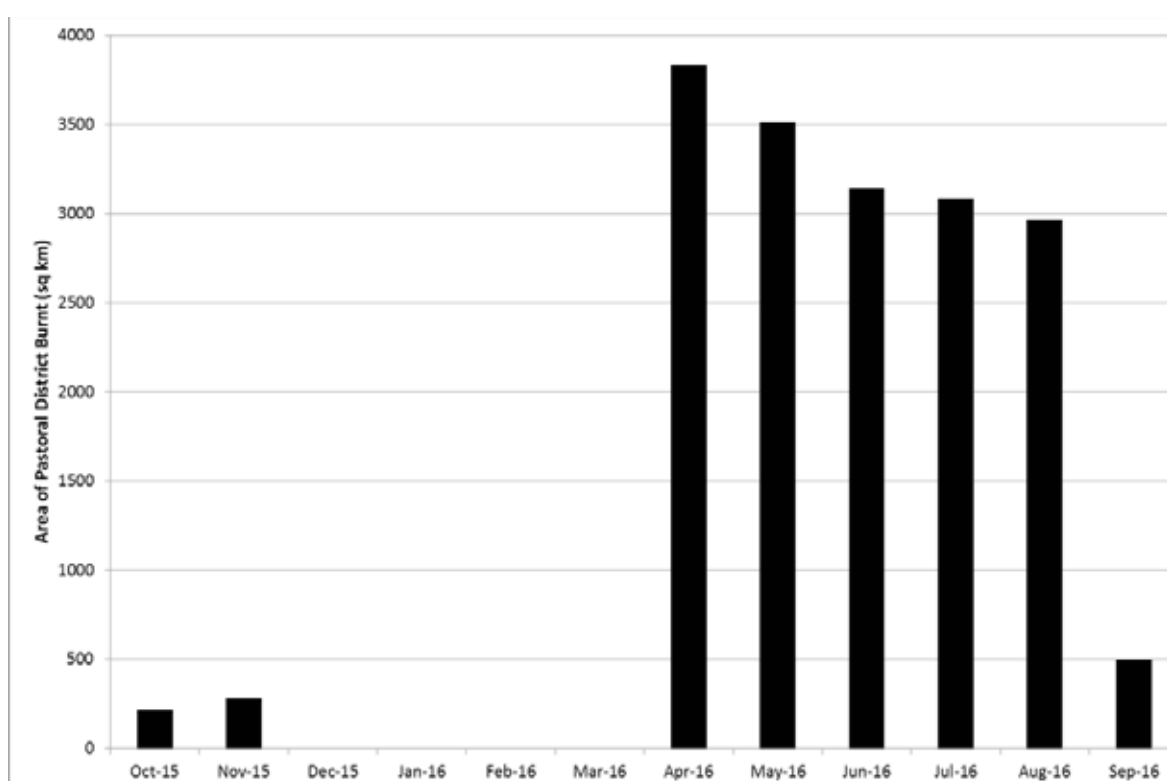


Figure 9: Monthly area burnt (km²) in the Darwin Pastoral District between October 2015 and September 2016.

Bare soil dynamics

It is important to maintain adequate ground cover in the latter months of each year to minimise soil loss from wind erosion and intense wet season storms. It is also important to carry dry feed, and associated ground cover, into the latter months of each calendar year in case there is a late start to the usual wet season and/or monsoonal rains fail more generally.

The amount of bare soil present at any location changes from year to year depending on rainfall and its effectiveness, fire history and amount of grazing. The percentage of bare soil in each 30m square Landsat pixel (900 m² or 0.09 ha) was used to report the amount of bare soil across all pixels in the Darwin Pastoral District.

DARWIN PASTORAL DISTRICT

Most areas of reduced vegetation cover, compared with the last 28 years, across much of the Darwin Pastoral District were associated with recent fire (Figure 10, burnt areas shown with diagonal hatching). However, recent fire did not always suppress vegetation cover, relative to past levels, probably because fire is a recurrent (almost annual) event in the Darwin region. Ignoring fire effects on the dynamics of vegetation cover, parts of the northern section of the pastoral district had relatively less cover in late 2016 compared with the same period back to 1988. Contrasting with this suppressed cover, much of the southern area had above average vegetation cover with reasonably extensive areas having their highest late dry season cover since 1988.

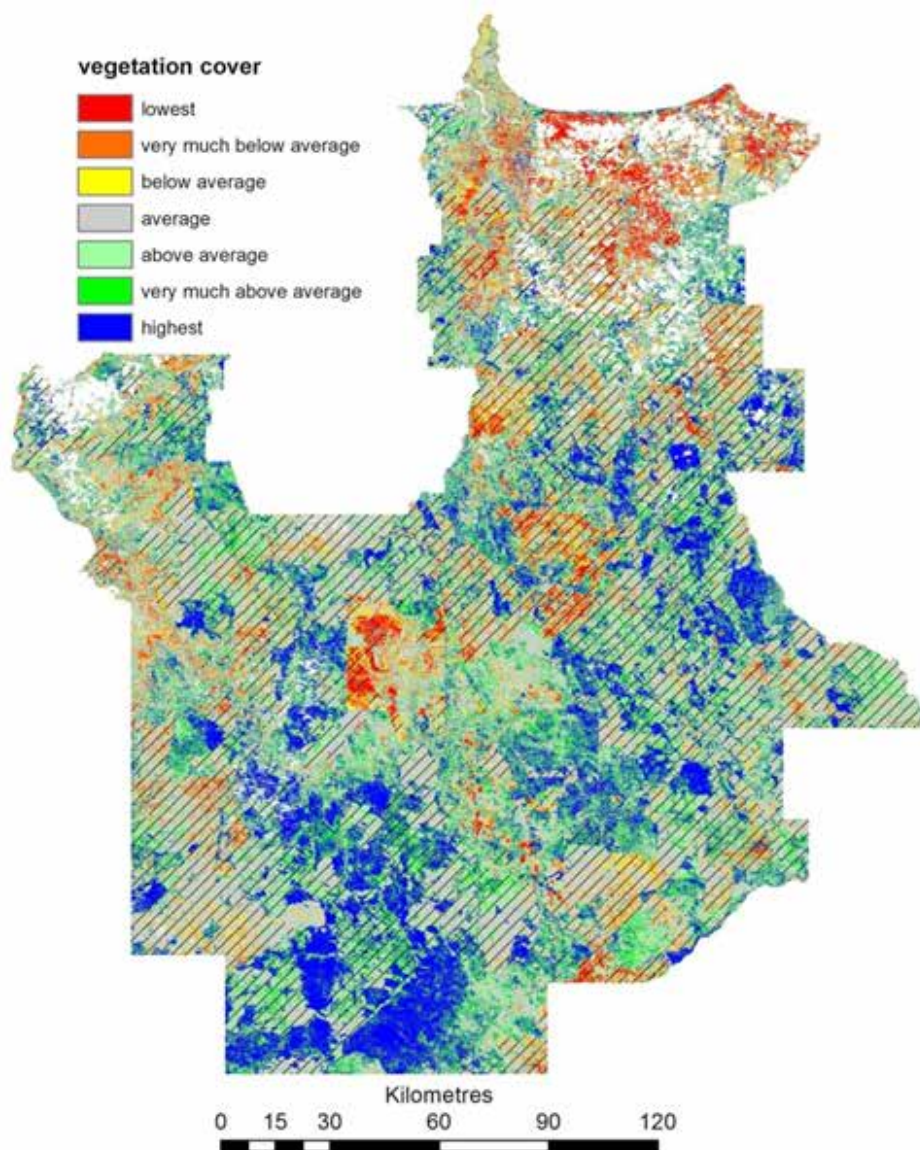


Figure 10: Rank of the amount of remotely-sensed vegetation cover present from September to November 2016 against that for previous years back to 1988.

Diagonal lines show those areas burnt between January and November 2016.

DARWIN PASTORAL DISTRICT

Half of the pastoral district had minor amounts of bare soil (<10% of the 30m Landsat pixel) towards the end of 2016 (Figure 11). One quarter of the pastoral district had >20% bare soil in each Landsat pixel with this latter area mapped in Figure 12. It includes areas burnt earlier in 2016.

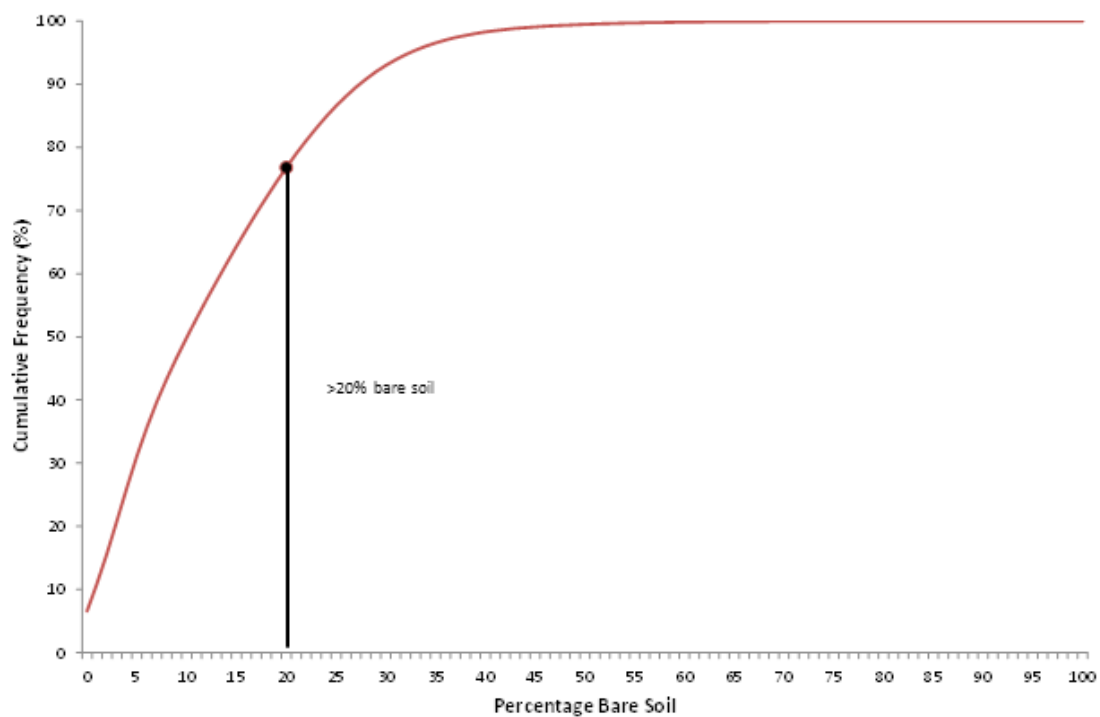


Figure 11: Percentage cumulative frequency of varying levels of bare soil in 30m square Landsat pixels in the Darwin Pastoral District between September and November 2016. Areas with greater than 20% bare soil are mapped in Figure 12.

DARWIN PASTORAL DISTRICT

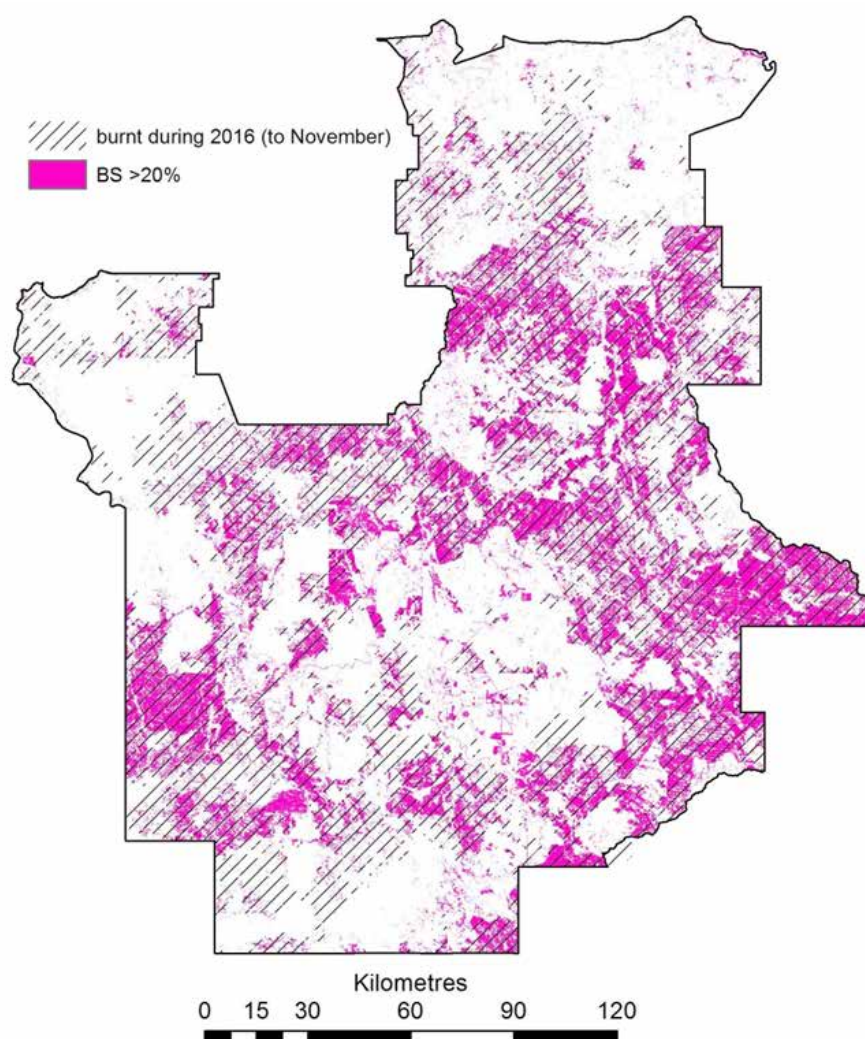


Figure 12: Parts of the Darwin Pastoral District having more than 20% bare soil per Landsat pixel in late 2016. Areas burnt between January and November 2016 are shown with diagonal lines.

Note that the threshold level of bare soil used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.

Site based monitoring

Nine pastoral leases in the Darwin Pastoral District, comprising 32% of the pastoral lease area, were visited in the latter part of 2015 and during 2016.

Vegetation cover of the ground layer was measured using the point intercept method at 26 sites across the nine leases. Perennial grasses were the dominant component, by cover, at most sites (Figure 13). Annual grasses and forbs (both perennial and annual) were a minor component. Moderate amounts of litter were generally present and bare soil, on average, comprised ~10% of total ground cover. However, one site was burnt prior to being monitored and had 70% bare soil and another site had 26% bare soil.

DARWIN PASTORAL DISTRICT

Perennial grasses are important because they protect the soil surface against wind and water erosion and, where palatable, provide persistent forage to carry livestock through dry times. Litter cover also protects the soil surface, assists infiltration of rain water and helps retain plant seeds in situ.

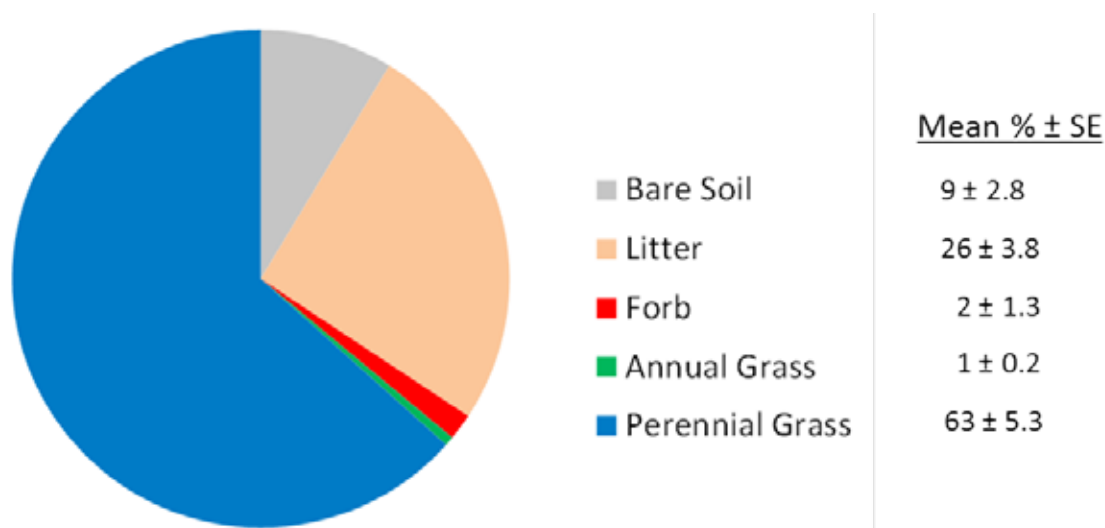


Figure 13: Mean percentage and standard error of measured components of vegetation cover in the ground layer from 26 sites on nine pastoral leases in the Darwin Pastoral District.

The majority of sites (63%) had moderate to heavy levels of grazing (Table 4), although this assessment was partly mitigated by some stations being visited later in the dry season when increased pasture utilisation is expected.

There was no evidence of erosion recorded at any of the 26 sites in the region.

Table 4: Levels of pasture utilisation recorded at 26 sites on nine pastoral leases in the Darwin Pastoral District.

Pasture Utilisation	
Rank	% of sites
No grazing	4
Minimal	34
Moderate	26
Moderate to heavy	10
Heavy	26

Land condition ratings assigned at monitoring sites and the more generalised assessment of land condition across those parts of pastoral leases traversed are summarised in Table 5. To the extent possible, these assessments are independent of the variable seasonal quality across the Darwin Pastoral District during 2015-16 (described above).

DARWIN PASTORAL DISTRICT

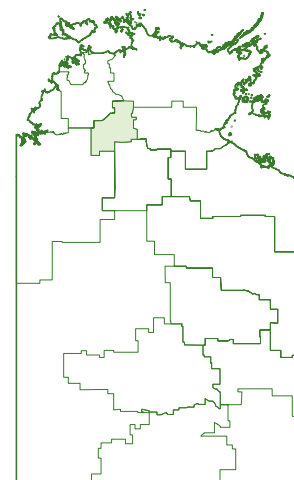
Table 5: Assessed land condition at monitoring sites and traversed parts of nine pastoral leases in the Darwin Pastoral District.

Station	Condition Rating	Comments with regard to pastoral lease
1	Good: 1 site Fair: 1 site	The property, in general, was assessed to be in good condition with a range of expected palatable perennial and annual grass species present. There were few signs of active erosion and weeds did not dominate in any part of the property.
2	Good: 1 site Fair: 2 sites	Lease in fair to good condition with most areas having some palatable perennial grasses present in the pasture. There were signs of active erosion on older tracks and along fence lines. Hyptis (<i>Hyptis suaveolens</i>) present but not dominant in any parts of the property.
3	Good: 2 sites Fair: 2 sites	Most of the lease area in good condition with a range of palatable perennial and annual grass species present and few signs of active erosion. Hyptis and Sida present around yards and bores and, occasionally, elsewhere. Management is aware of these weeds and has plans to control them.
4	Good: 4 sites Fair: 1 site	Lease in generally good to fair condition, with smaller areas in poor condition. Most pastures dominated by moderate to high grazing-value, perennial grasses. Good work is continuing to control Mimosa (<i>Mimosa pigra</i>) enabling formerly unusable land to be returned to pastoral production.
5	Poor: 1 site	Although the one measured site was rated in poor condition, other parts of the property assessed were considered to be in mainly fair condition.
6	Good: 3 sites	Station in generally fair condition. Weeds and erosion, although present, did not dominate in any area of the property.
7	Good: 1 site	Most of the property considered to be generally in fair condition. Past erosion was evident in some areas but now appears to have stabilised.
8	Good: 1 site Fair: 1 site	Station, as a whole, assessed in fair to good condition. Southern paddocks minimally grazed and had good ground cover and minimal weeds. Northern paddocks showed evidence of continued moderate to heavy grazing and reduced ground cover. Weeds, where present, are sprayed from the air and on-ground.
9	Good: 5 sites	Property rated in mainly good condition. Pastures were dominated by perennial grasses of moderate to high grazing value. Weeds and erosion, where present, did not dominate in any area of the property.

KATHERINE PASTORAL DISTRICT

Seasonal quality, as indicated by AussieGRASS modelled pasture growth, improved from much below average in the north-east of the district to much above average in the south-west.

The region experienced extensive fire in November 2015 with 37% of the district affected between October 2015 and September 2016. Most (~75%) of the region had minor occurrence of bare ground late in the 2016 dry season. No on-ground monitoring was conducted in the Katherine Pastoral District.



Map 2: Location of Katherine Pastoral District

Seasonal quality

“Seasonal quality” describes the relative value of recent rainfall in producing forage for livestock. It is judged with reference to the historical record. Two indicators are used: rainfall amount compared with the long term median and expected pasture growth based on rainfall received, simulated using AussieGRASS (www.longpaddock.qld.gov.au).

Descriptors of seasonal quality provide useful context for interpreting various measures of land condition at particular times. However, to the extent possible, land condition is assessed independently of seasonal conditions.

Rainfall statistics (Table 6) are based on gridded rainfall produced by the Bureau of Meteorology (www.bom.gov.au/jsp/awap/rain/index.jsp). Pixel (grid cell) values are calculated from rainfall amounts at recognised recording stations. Rainfall is from October of one year to September the following year thus incorporating an entire growing season. Modelled pasture growth is for the period November 2015 to April 2016. This growth is ranked as a percentile of the growth for all previous summers.

Table 6: Indicators of seasonal quality. Data spatially averaged for the Katherine Pastoral District.

Rainfall (mm)		AussieGRASS	
2015 - 2016	1145	Growth (kg/ha)	2158
Long term median	902	Percentile	57

Spatially averaged rainfall for the Katherine Pastoral District was above the long term median (Table 6) with most of the region receiving more than 1100 mm between October 2015 and September 2016. The exception was the far north-east where 12 month rainfall was less than 975 mm.

KATHERINE PASTORAL DISTRICT

Modelled pasture growth over the last summer was slightly above average based on the spatial mean (Table 6), however there was considerable variation across the region. Seasonal quality improved from much below average in the north-east of the district to much above average in the south-west (Figure 14, right hand panel).

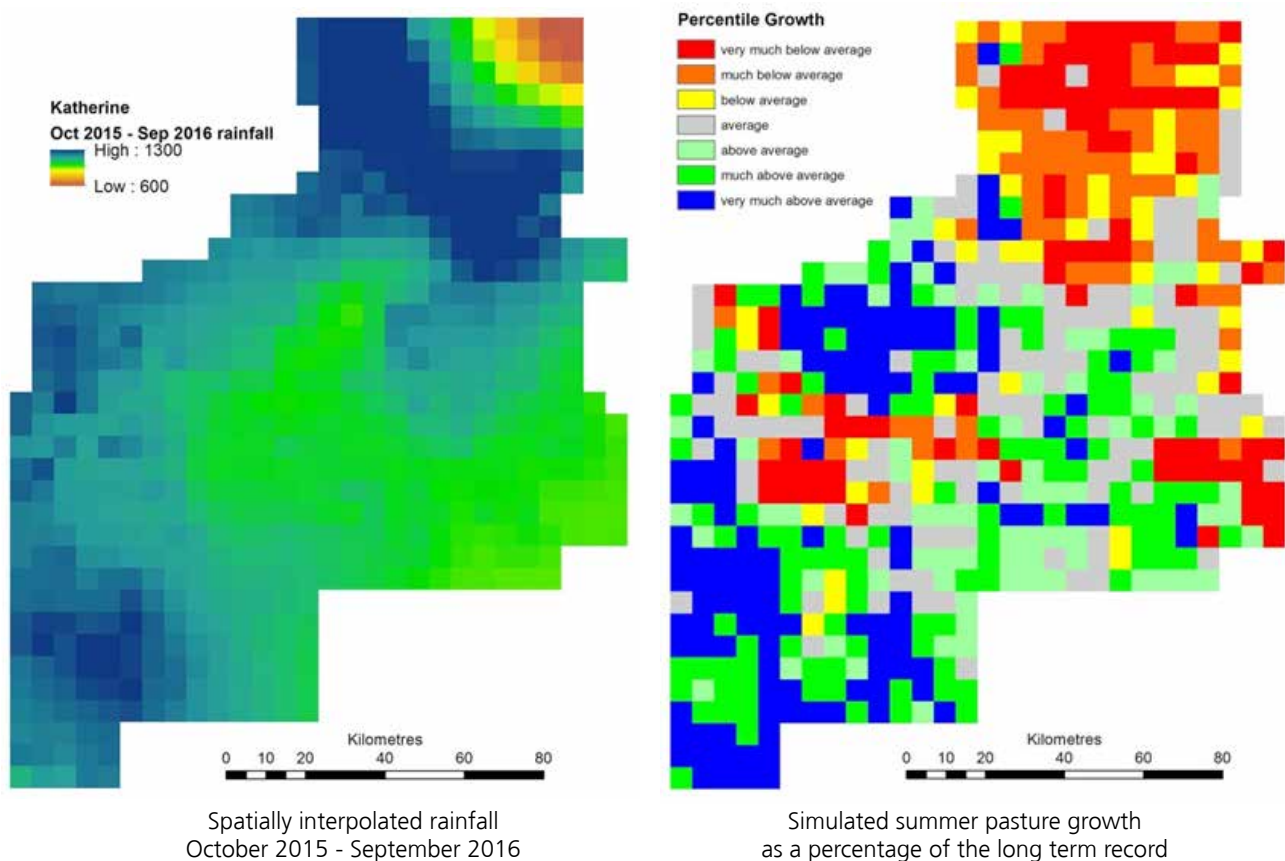


Figure 14: Maps of seasonal quality. Left, gridded rainfall, October 2015 to September 2016; right, AussieGRASS modelled pasture growth for the 2015-16 summer period as a percentage of previous summers.

Fire

The North Australian Fire Information website (www.firenorth.org.au/nafi3) reports that 7 067 km² (37% of the district) burnt between October 2015 and September 2016. Fire was most extensive in November 2015 (Figure 15) suggesting wildfire was the main reason (as this is typically when wildfires started by lightning occur). The next peak in fire activity was April – May 2016 probably being due to managed, early dry season burning.

KATHERINE PASTORAL DISTRICT

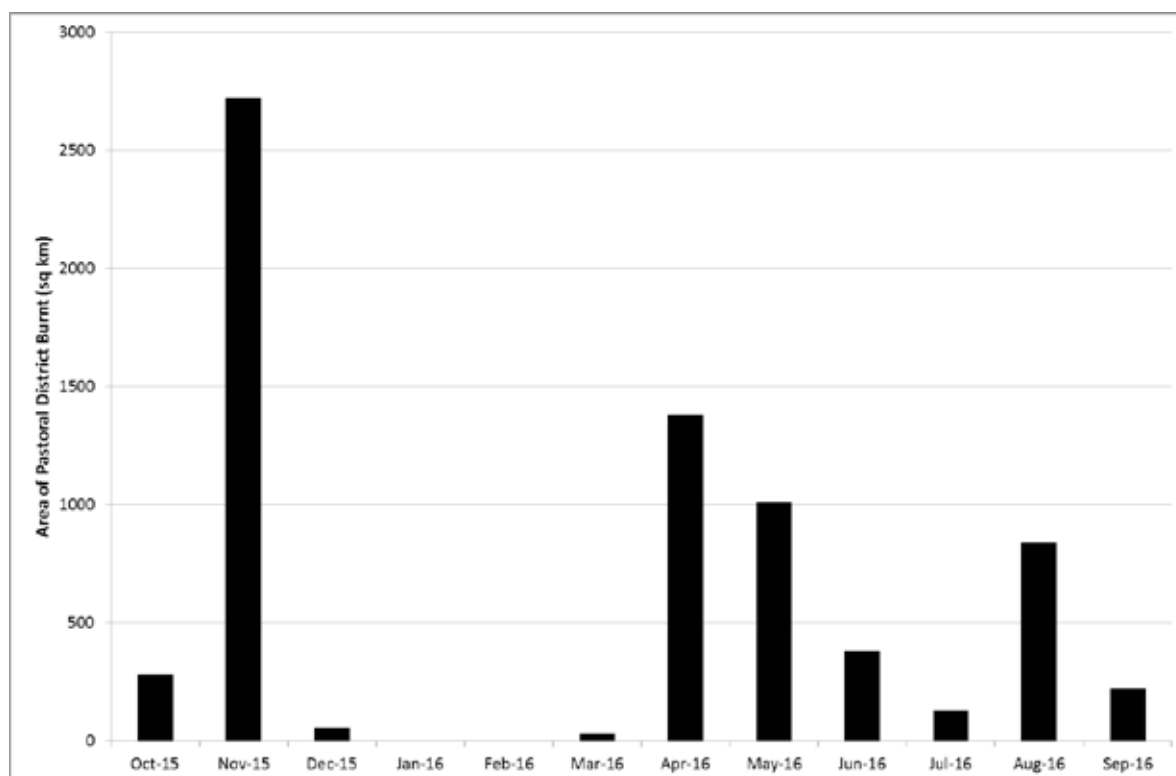


Figure 15: Monthly area burnt (km²) in the Katherine Pastoral District between October 2015 and September 2016.

Bare soil dynamics

It is important to maintain adequate ground cover in the latter months of each year to minimise soil loss from wind erosion and intense wet season storms. It is also important to carry dry feed, and associated ground cover, into the latter months of each calendar year in case there is a late start to the usual wet season and/or monsoonal rains fail more generally.

The amount of bare soil present at any location changes from year to year depending on rainfall and its effectiveness, fire history and amount of grazing. The percentage of bare soil in each 30m square Landsat pixel (900 m² or 0.09 ha) was used to report the amount of bare soil across all pixels in the Katherine Pastoral District.

Recent fire contributed to reduced vegetation cover, compared with the last 28 years, across much of the Katherine Pastoral District (Figure 16, burnt areas shown with diagonal hatching). Nearby areas in the north (Florina station) and further south had some of their highest levels of vegetation cover (for the late dry season) since 1988.

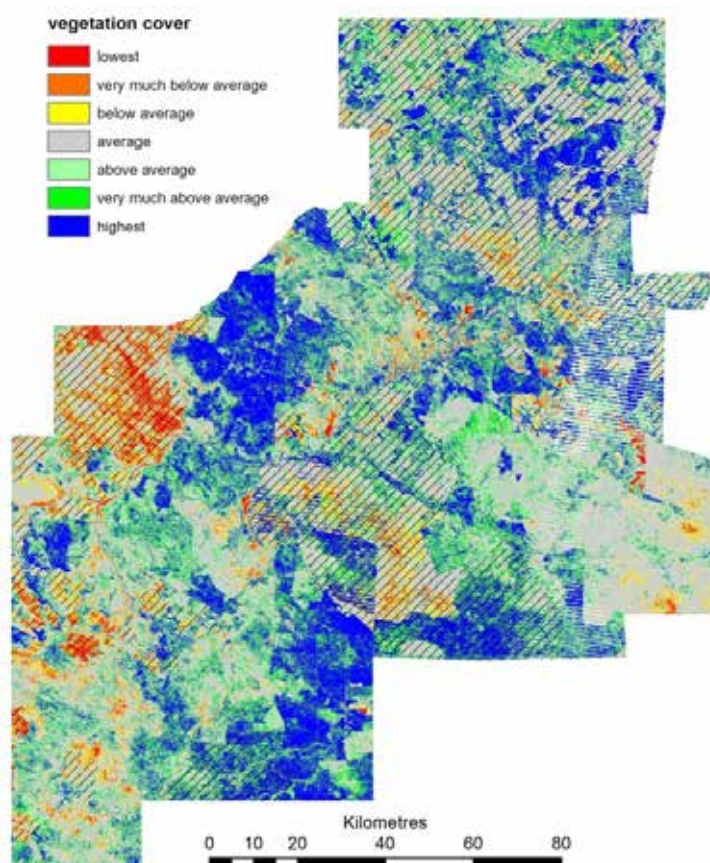


Figure 16: Rank of the amount of remotely-sensed vegetation cover present in late 2016 against that for previous years back to 1988.

Diagonal lines show those areas burnt between January and November 2016.

Forty five percent of the pastoral district had minor amounts of bare soil (<10% of the 30m Landsat pixel) towards the end of 2016 (Figure 17) and a further 30% of the region had <20% bare soil per pixel. Those parts of the region with >20% bare soil in each Landsat pixel are mapped in Figure 18 and include areas burnt earlier in 2016.

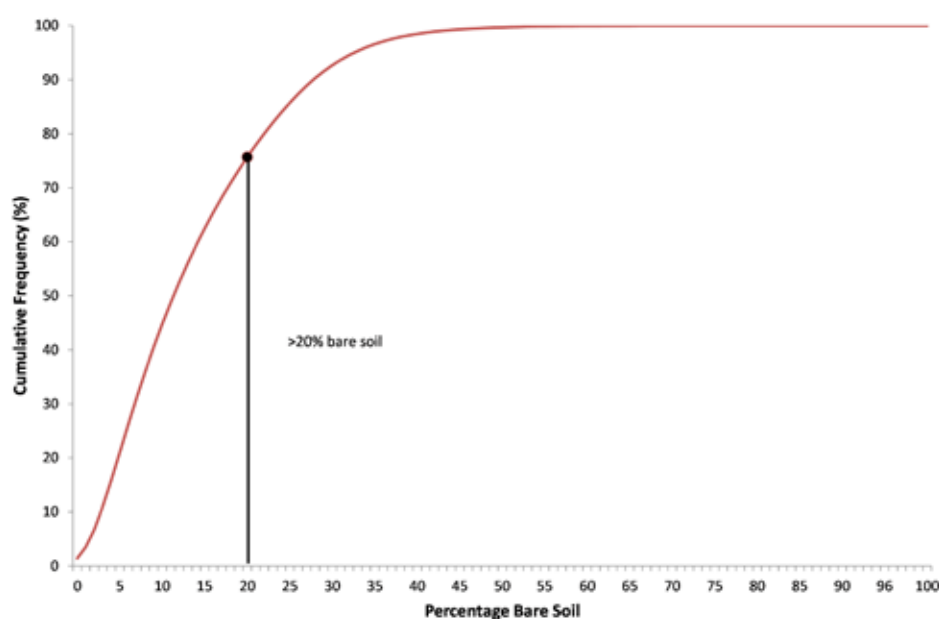


Figure 17: Percentage cumulative frequency of varying levels of bare soil in 30m square Landsat pixels in the Katherine Pastoral District between September and November 2016. Areas with greater than 20% bare soil are mapped in Figure 18.

KATHERINE PASTORAL DISTRICT

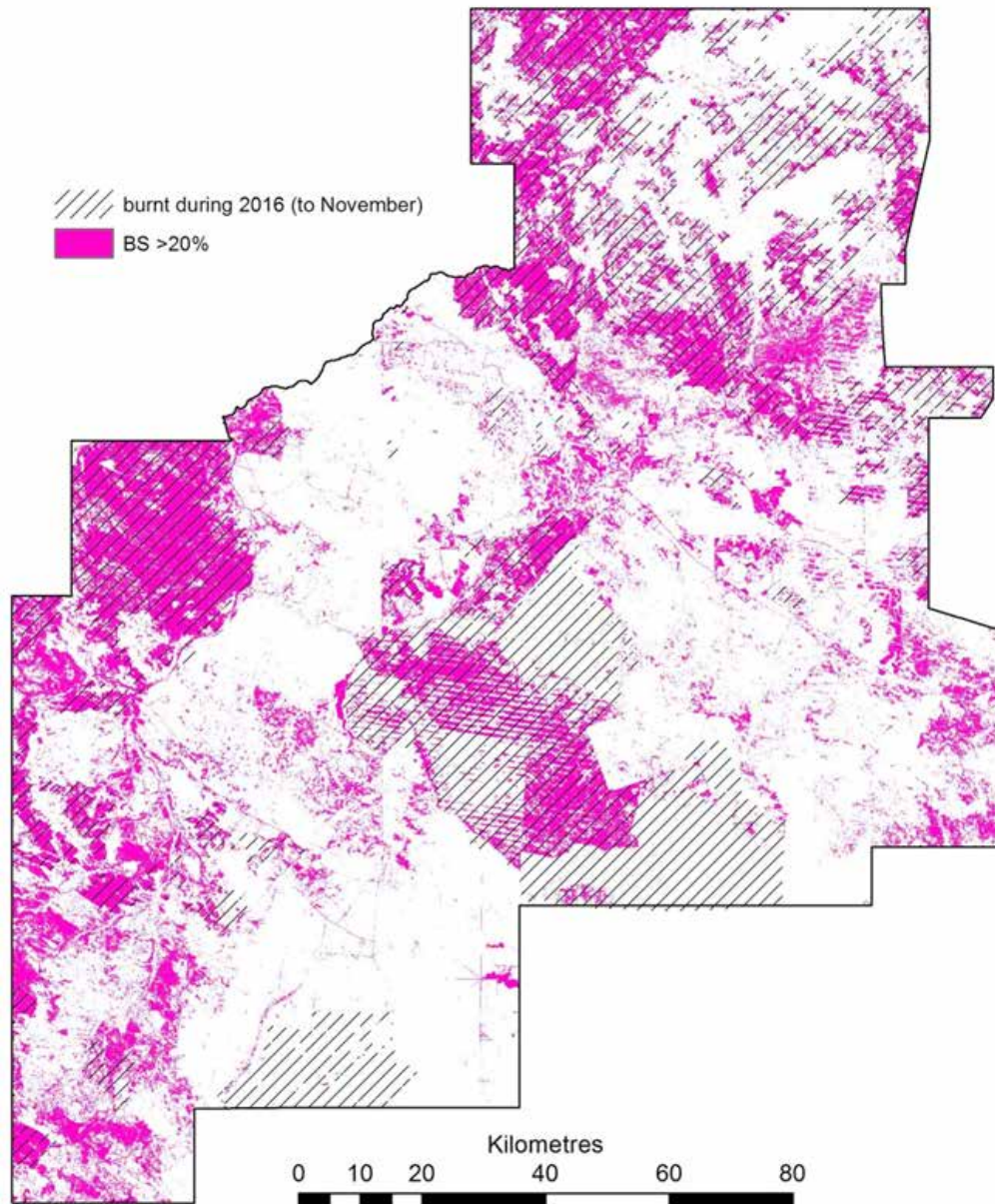


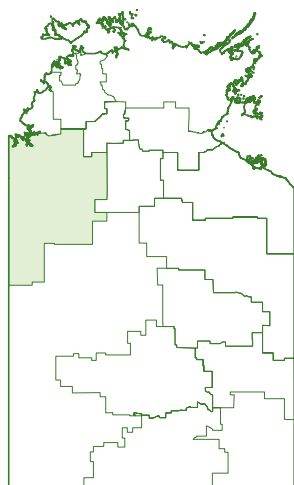
Figure 18: Parts of the Katherine Pastoral District having more than 20% bare soil per Landsat pixel in late 2016. Areas burnt between January and November 2016 are shown with diagonal lines.

Note that the threshold level of bare soil used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.

Site based monitoring

No pastoral leases were monitored in the Katherine Pastoral District in the 2015-16 reporting year.

VRD PASTORAL DISTRICT



Map 3: Location of VRD Pastoral District

The VRD Pastoral District experienced mostly above average seasonal quality in the far south and north-east, based on expected pasture growth through the 2015-16 wet season.

There were much poorer seasonal conditions in the south-east. Elsewhere, seasonal quality was mostly average, although still spatially variable. Almost one quarter of the region burnt between October 2015 and September 2016. Thirty per cent of the region had >40% bare soil per Landsat pixel, mainly in the south-east and south. This area includes 'desert-like' country of low pastoral value that is periodically burnt. On ground monitoring was conducted at 22 sites on four pastoral leases. Sites, on average, had a moderate cover of perennial grasses and lesser amounts of bare soil and litter. Forbs

and annual grasses were minor components of total ground cover. Twelve sites (55% of total) were in good condition and nine sites in fair condition. *Parkinsonia* (*Parkinsonia aculeate*) and Rubber Bush (*Calotropis procera*) were recorded around some yards and waterpoints with sections of some tracks eroded through gullying.

Seasonal quality

"Seasonal quality" describes the relative value of recent rainfall in producing forage for livestock. It is judged with reference to the historical record. Two indicators are used: rainfall amount compared with the long term median and expected pasture growth based on the rainfall received, simulated using AussieGRASS (www.longpaddock.qld.gov.au).

Descriptors of seasonal quality provide useful context for interpreting various measures of land condition at particular times. However, to the extent possible, land condition is assessed independently of seasonal conditions.

Rainfall statistics (Table 7) are based on gridded rainfall data produced by the Bureau of Meteorology (www.bom.gov.au/jsp/awap/rain/index.jsp). Pixel (grid cell) values are calculated from rainfall amounts at recognised recording stations. Rainfall is from October of one year to September the following year thus incorporating one entire growing season. Due to the considerable north-south transition in long term median rainfall for this large pastoral district, rainfall statistics are reported based on an arbitrary split of the region into two sub-districts (Figure 19).

Table 7: Recent seasonal quality for the VRD Pastoral District as indicated by spatially averaged rainfall relative to the long term median.

Rainfall (mm)	VRD North	VRD South
2015 - 2016	862	537
Long term median	759	464

VRD PASTORAL DISTRICT

Spatially averaged rainfall for the northern and southern sections of the VRD Pastoral District was above the long term median (Table 7). In the northern part of the region, there was a considerable north-to-south decrease in the spatial distribution of rainfall (Figure 19). Rainfall in the southern part of the pastoral district was more uniformly distributed, as indicated by the colour shading in Figure 19. Pastoral leases and Aboriginal land fringing the Tanami Desert in the south-east of the region had lower rainfall (<550 mm) for the 12 months, October 2015 to September 2016.

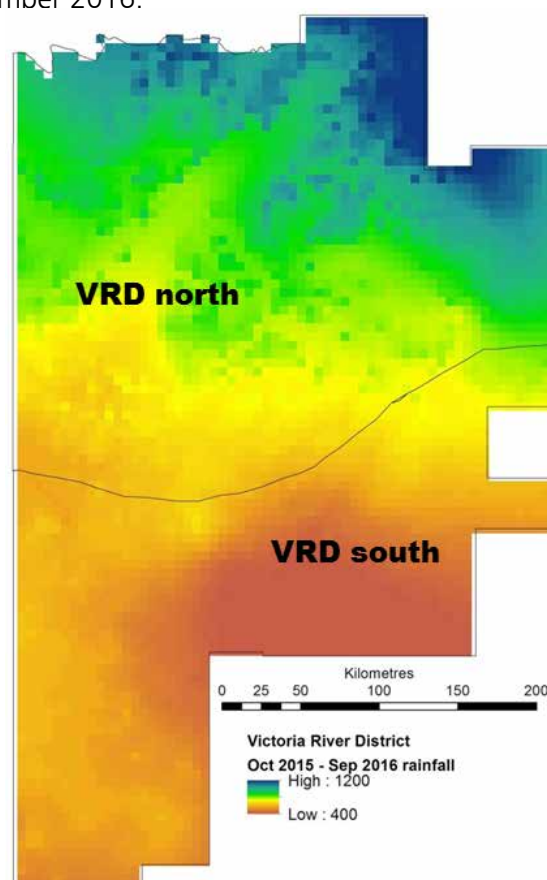


Figure 19: Spatially interpolated, gridded rainfall for the VRD Pastoral District. Reporting period is October 2015 to September 2016.

AussieGRASS modelled pasture growth, as a second indicator of seasonal quality for the entire VRD Pastoral District, is for the period November 2015 to April 2016. This growth is ranked as a percentile of the growth for all previous summers back to 1957. In this case, spatially averaged growth through the 2015-16 wet season was ~1730 kg/ha which was close to the long term median (Table 8).

Table 8: Recent seasonal quality averaged across the entire VRD Pastoral District, as indicated by modelled pasture growth.

Index of seasonal quality	VRD Pastoral District
Growth (kg/ha)	1733
Percentile	54

VRD PASTORAL DISTRICT

Modelled pasture growth over the last summer, as a percentage of the long term record, was mostly above average in the far south and north-eastern parts of the pastoral district (Figure 20). South-eastern parts, including Wave Hill and Cattle Creek stations, experienced much poorer seasonal conditions (based on simulated pasture growth), as did much of the Bradshaw military lease in the north. Elsewhere, seasonal quality was mostly average, although quite variable – with small areas having much below average expected growth situated close to areas with above average modelled growth.

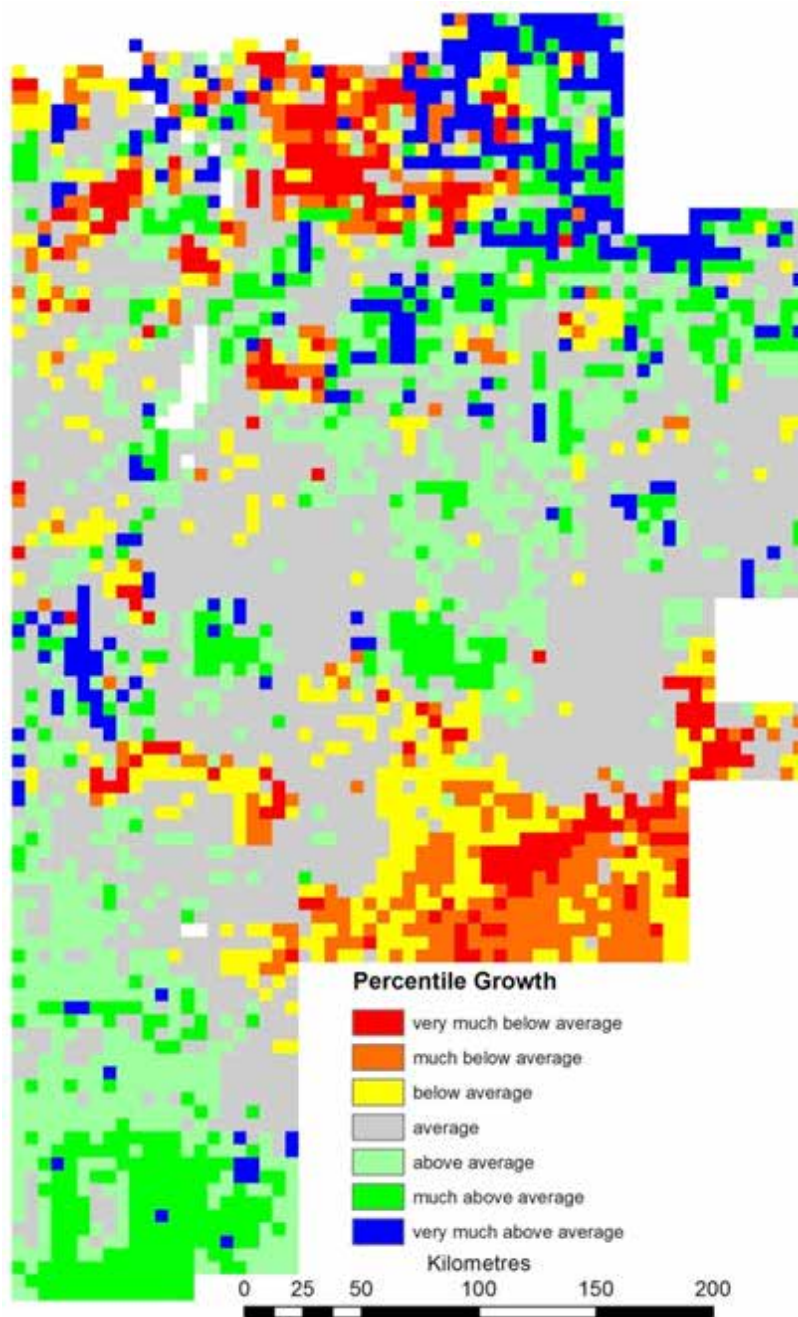


Figure 20: Simulated pasture growth for the 2015-16 wet season as a percentage of the long term record.

VRD PASTORAL DISTRICT

Fire

The North Australian Fire Information website (www.firenorth.org.au/nafi3) reports that 30 856 km² (23% of the VRD Pastoral District) burnt between October 2015 and September 2016. This was a similar area to that burnt in the preceding 12 month period. Fire was most extensive in October 2015 and less prevalent in November and following months (Figure 21). Much of the area burnt in October and November 2015 was probably due to wildfire as this is typically when wildfires started by lightning occur. Country burnt between March and June 2016 may have been due to controlled burning.

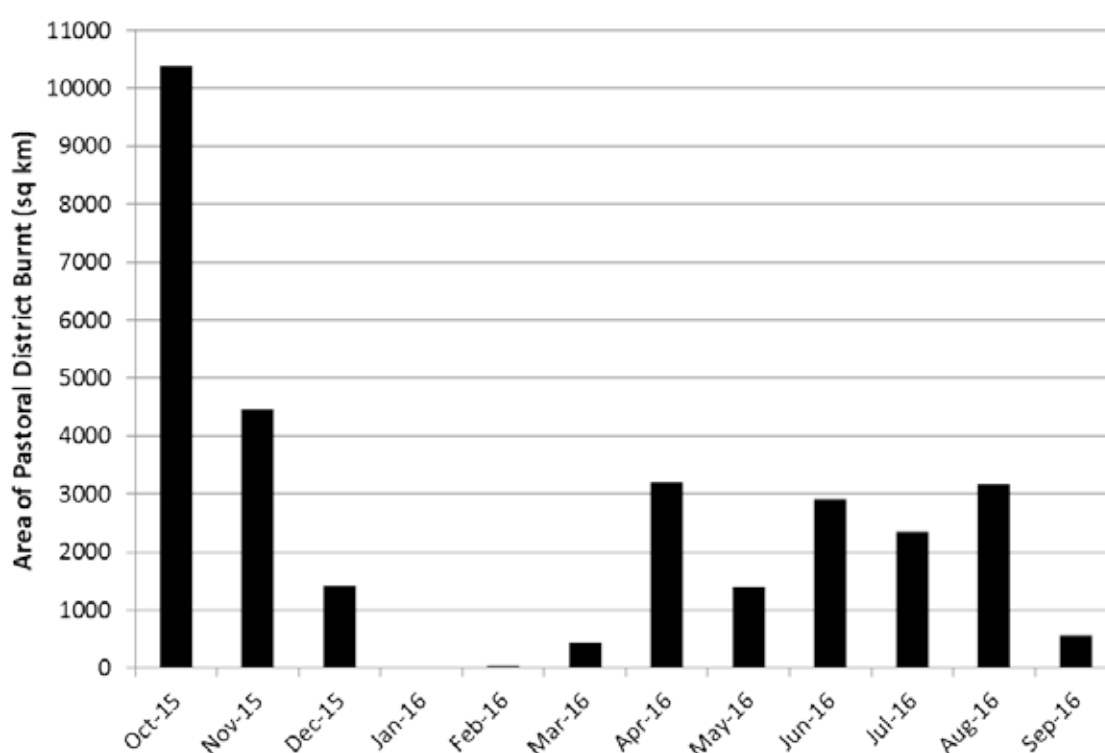


Figure 21: Monthly area burnt (km²) in the VRD Pastoral District between October 2015 and September 2016.

Bare soil dynamics

It is important to maintain adequate ground cover in the latter months of each year to minimise soil loss from wind erosion and intense summer storms. It is also important to carry dry feed, and associated ground cover, into the latter months of each calendar year in case there is a late start to the usual wet season and/or monsoonal rains fail more generally.

The amount of bare soil present at any location changes from year to year depending on rainfall and its effectiveness, fire history and amount of grazing. Remote sensing was used to assess the amount of bare soil. The percentage of bare soil in each 30m square Landsat pixel (900 m² or 0.09 ha) was used to report the amount of bare soil across all pixels in the VRD Pastoral District.

VRD PASTORAL DISTRICT

Recent fire contributed to reduced vegetation cover, compared with the last 28 years, across parts of the northern section of the pastoral district (Figure 22). Fire was also a contributing factor to much below average vegetation cover elsewhere, although this did not always appear to be the case. Parts of Suplejack pastoral lease and the Central Desert Aboriginal Land Trust in the far south had much above average vegetation cover in late 2016 despite appearing to have been recently burnt. The North Australian Fire Information website reports that these areas were burnt in November 2016 which is after Landsat imagery was acquired for this analysis of vegetation dynamics.

Much of the south-eastern VRD Pastoral District showing below average vegetation cover conforms with that area having lower rainfall and modelled pasture growth in Figure 19 and Figure 20.

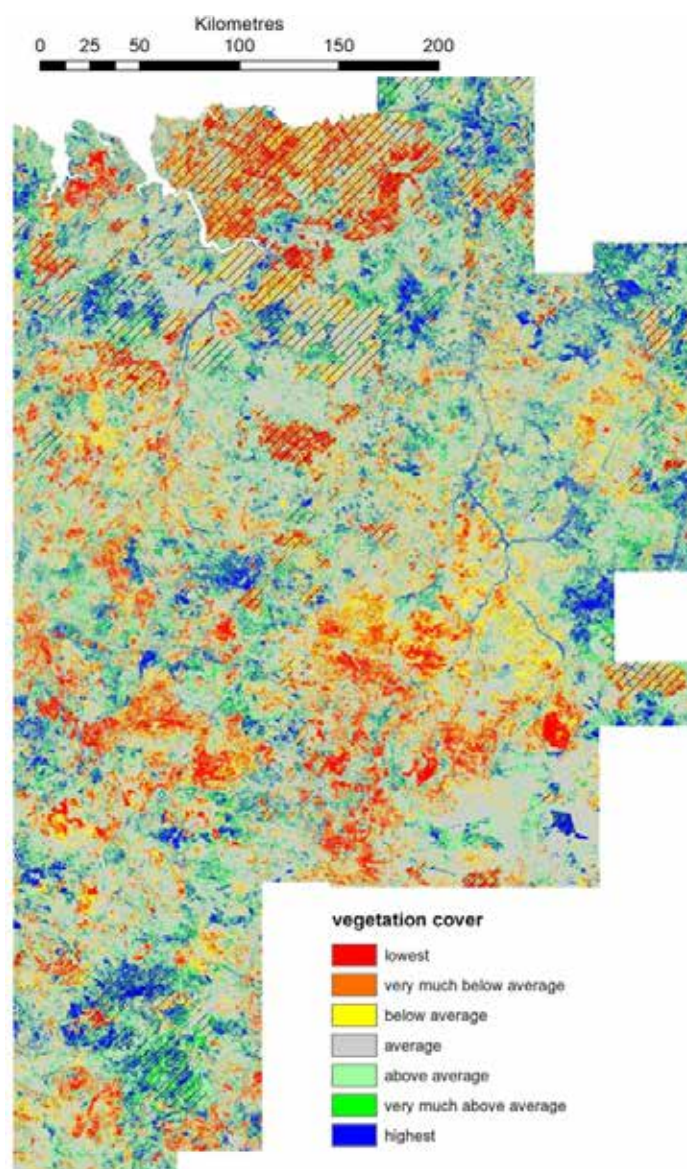


Figure 22: Rank of the amount of remotely sensed vegetation cover present from September to November 2016 against that for previous years back to 1988.

Diagonal lines show those areas burnt between January and November 2016.

VRD PASTORAL DISTRICT

Approximately 20% of the pastoral district had minor bare soil (<20% of the 30m Landsat pixel) towards the end of 2016 (Figure 23). Twice this area had less than 30% bare soil. Thirty per cent of the district had more than 40% bare soil. This latter area is mapped in Figure 24 and includes some of the country burnt in 2016 (until November).

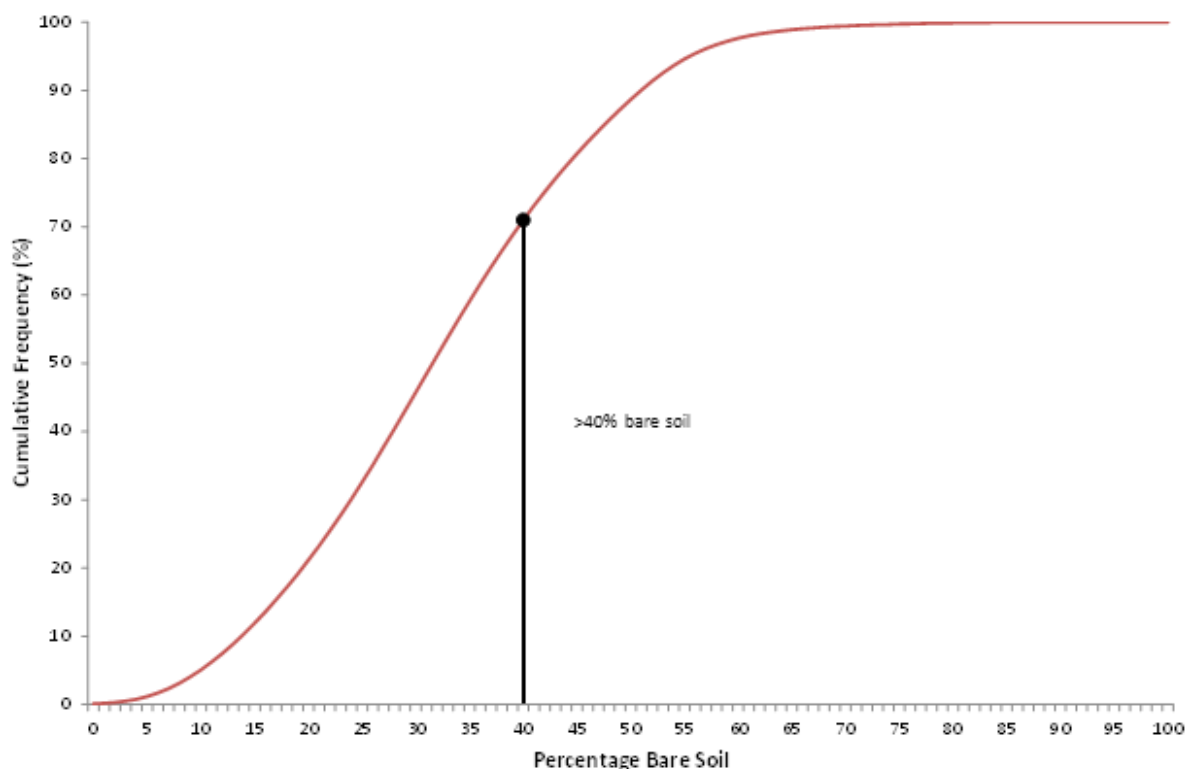


Figure 23: Percentage cumulative frequency of varying levels of bare soil in 30m square Landsat pixels in the VRD Pastoral District between September and November 2016. Areas with greater than 40% bare soil are mapped in Figure 24.

Concentrated areas exceeding the 40% bare soil threshold in the far south and south-east include desert country of low pastoral value. Extensive wildfire is a regular feature here and probably contributed to elevated levels of bare soil (the last major fire episode was in 2011 and 2012). The south-eastern area also experienced poor seasonal quality, based on modelled pasture growth (Figure 20).

VRD PASTORAL DISTRICT

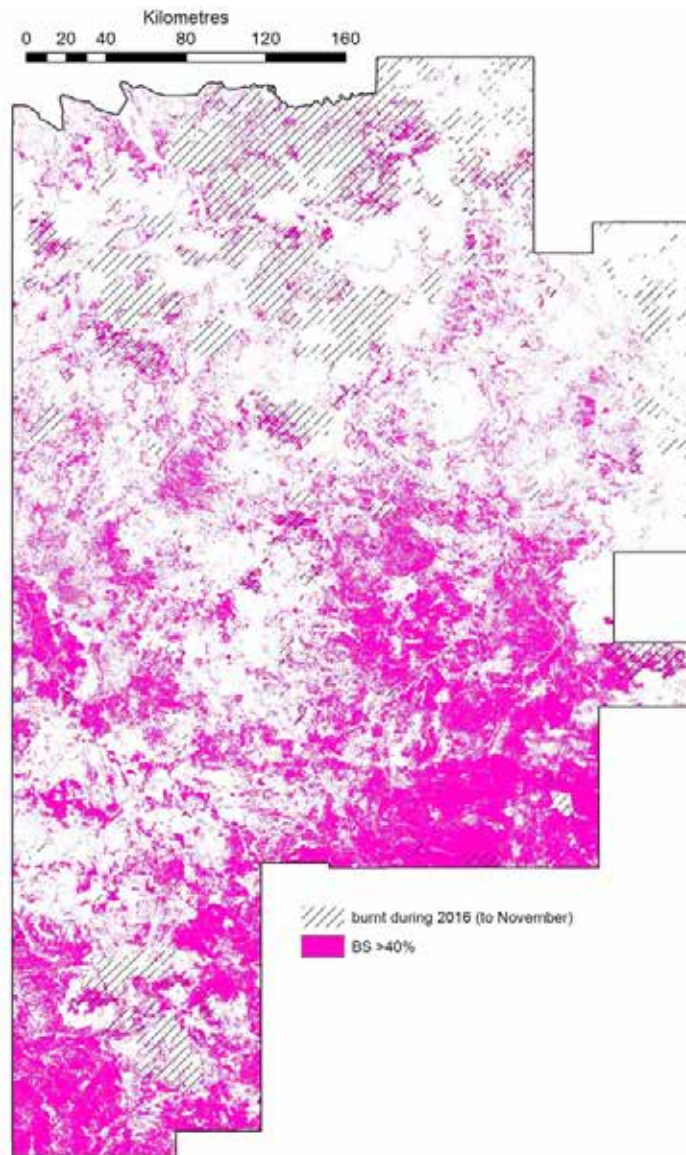


Figure 24: Parts of the VRD Pastoral District having more than 40% bare soil per Landsat pixel in late 2016. Country burnt between January and November 2016 is shown with diagonal lines.

Note that the threshold level of bare soil used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.

Site based monitoring

Four pastoral leases in the western part of the VRD Pastoral District, comprising 15% of the pastoral lease area, were visited by monitoring officers in 2016.

Vegetation cover of the ground layer was measured using the point intercept method at 22 sites of 1 ha area across the four leases. Sites, on average, had a moderate cover of perennial grasses for the region and lesser amounts of bare soil and litter (Figure 25). Annual grasses and forbs (both perennial and annual) were minor components of total ground cover.

VRD PASTORAL DISTRICT

As indicated by the standard errors for bare soil and perennial grass (Figure 25), there was considerable variation in measured cover components amongst sites. Four sites had 40% or more bare soil and perennial grasses comprised less than 20% (of total ground cover) at four sites. Two of the sites with minor perennial grasses also had large amounts of bare soil.

Perennial grasses are important because they protect the soil surface against wind and water erosion and, where palatable, provide persistent forage to carry livestock through dry times. Litter cover also protects the soil surface, assists infiltration of rain water and helps retain plant seeds in situ.

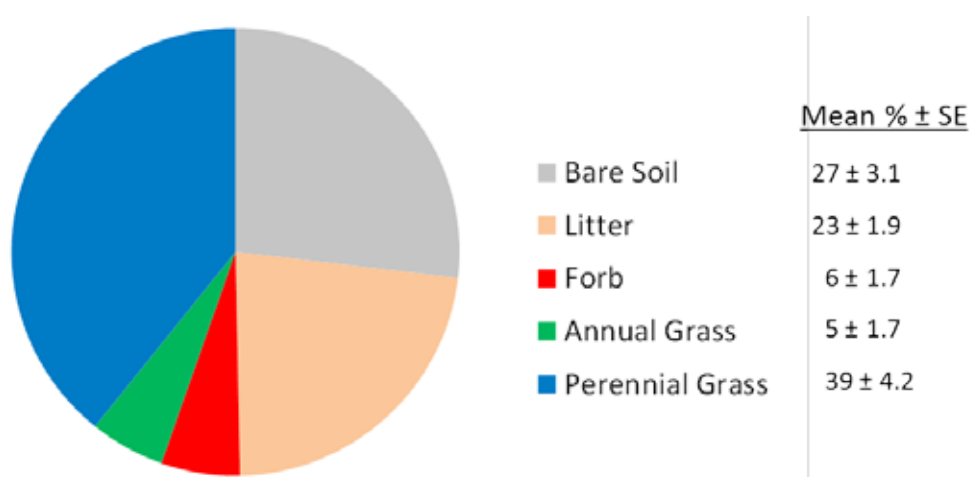


Figure 25: Mean percentage and standard error of measured components of vegetation cover in the ground layer from 22 sites on four pastoral leases in the VRD Pastoral District.

Most sites were minimally grazed at the time of assessment (Table 9). Leases assessed later in the dry season were likely to have had a higher level of pasture utilisation due to the time elapsed since the end of the previous wet season growth event. Evidence of erosion by water was documented at three sites with scalding observed at one site.

Table 9: Levels of pasture utilisation and evidence of erosion assessed at 22 sites on four pastoral leases in the VRD Pastoral District.

Pasture Utilisation		Evidence of Erosion	
Rank	% of sites	Type	% of sites
Not recorded	5	Not apparent	81
No grazing	9	Scalding	5
Minimal	40	Water sheeting	14
Moderate	23		
Moderate to heavy	23		

VRD PASTORAL DISTRICT

Land condition ratings assigned at monitoring sites and the more generalised assessment of land condition across those parts of pastoral leases traversed are summarised in Table 10. To the extent possible, these assessments are independent of the variable seasonal quality experienced across the region in the current reporting cycle (described above).

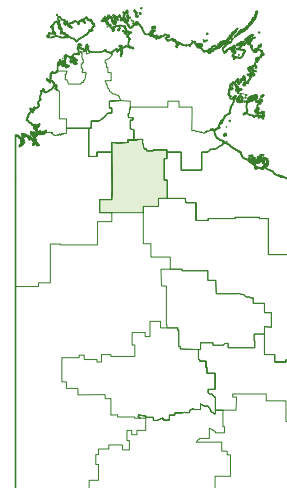
Table 10: Assessed land condition at monitoring sites and traversed parts of four pastoral leases in the VRD Pastoral District.

Station	Condition Rating	Comments with regard to pastoral lease
1	Good: 7 sites Fair: 4 sites Poor: 1 site	The property, in general, was assessed in fair condition. Some sections were in good condition having higher cover and showing minimal grazing effects. A diversity of palatable perennial and annual grasses was present across much of the property and there were few signs of active erosion. Rubber Bush (<i>Calotropis procera</i>) and Parkinsonia (<i>Parkinsonia aculeata</i>) occur in areas but appear to be effectively controlled.
2	Good: 1 site	The majority of the property traversed was rated in fair condition with some paddocks in the northern part of the property being in good condition. Areas of Parkinsonia and other weeds occur across the property with Parkinsonia appearing to be controlled in a timely manner. There were only a few signs of active erosion, mainly along creek edges and drainage lines.
3	Fair: 3 sites	Most parts inspected were assessed to be in fair condition with a moderate response by pastures to wet season rainfall. Weeds including Rubber Bush were observed in different areas across the property. Small areas of active erosion were associated with drainage lines.
4	Good: 4 sites Fair: 2 sites	Parts of the southern section of the lease were rated in good condition with most of the remainder being in fair condition. Areas in good condition had higher cover and showed minimal effects of grazing. For the most part, there was little evidence of active erosion. Rubber Bush was observed near many yards and Parkinsonia, where present, is being controlled by management.

STURT PLATEAU PASTORAL DISTRICT

Modelled pasture growth reflected rainfall distribution across the Sturt Plateau, being mostly above average in the north-west and much below average in the south-west and far north-east.

Small areas in the centre and north-west had very much above average seasonal quality. A little more than a fifth of the region burnt between October 2015 and September 2016, slightly more than twice the area burnt in the previous 12 months. Slightly more than one quarter of the pastoral district had some bare ground exposed (>20% bare soil in each Landsat pixel). Monitoring was conducted at 19 sites on three leases. Sites, on average, had a good cover of perennial grasses, a moderate amount of litter and a small amount of bare soil. Twelve sites were rated in good condition and the remainder in fair condition.



Map 4: Location of Sturt Plateau Pastoral District

Seasonal quality

“Seasonal quality” describes the relative value of recent rainfall in producing forage for livestock. It is judged with reference to the historical record. Two indicators are used: rainfall amount compared with the long term median and expected pasture growth based on rainfall received, simulated using AussieGRASS (www.longpaddock.qld.gov.au).

Descriptors of seasonal quality provide useful context for interpreting various measures of land condition at particular times. However, to the extent possible, land condition is assessed independently of seasonal conditions.

Rainfall statistics (Table 11) are based on gridded rainfall produced by the Bureau of Meteorology (www.bom.gov.au/jsp/awap/rain/index.jsp). Pixel (grid cell) values are calculated from rainfall amounts at recognised recording stations. Rainfall is from October of one year to September the following year thus incorporating one entire growing season. Modelled pasture growth is for the period November 2015 to April 2016. This growth is ranked as a percentile of the growth for all previous wet seasons back to 1957.

Table 11: Indicators of seasonal quality. Data spatially averaged for the Sturt Plateau Pastoral District.

Rainfall (mm)		AussieGRASS	
2015 - 2016	837	Growth (kg/ha)	1906
Long term median	636	Percentile	55

STURT PLATEAU PASTORAL DISTRICT

Spatially averaged rainfall for the Sturt Plateau Pastoral District was greater than the long term median (Table 11). Rainfall increased from south to north across the region (Figure 26, left hand panel) and was considerably greater than the spatial average in the north-west and towards the south-east (centred on the southern half of Kalala and the northern parts of Shenandoah and Shenandoah East pastoral leases). Further north, Forrest Hill and the western side of Maryfield had lower rainfall (<750 mm) in the 12 months between October 2015 and September 2016.

Modelled pasture growth over the last summer was average based on the spatial mean (Table 11). Growth reflected rainfall distribution, being mostly above average in the north-west and much below average in the south-west and far north-east (Figure 26, right hand panel). Areas centred on Banjo and Avago stations in the central and north-western parts of the region experienced very much above average growth.

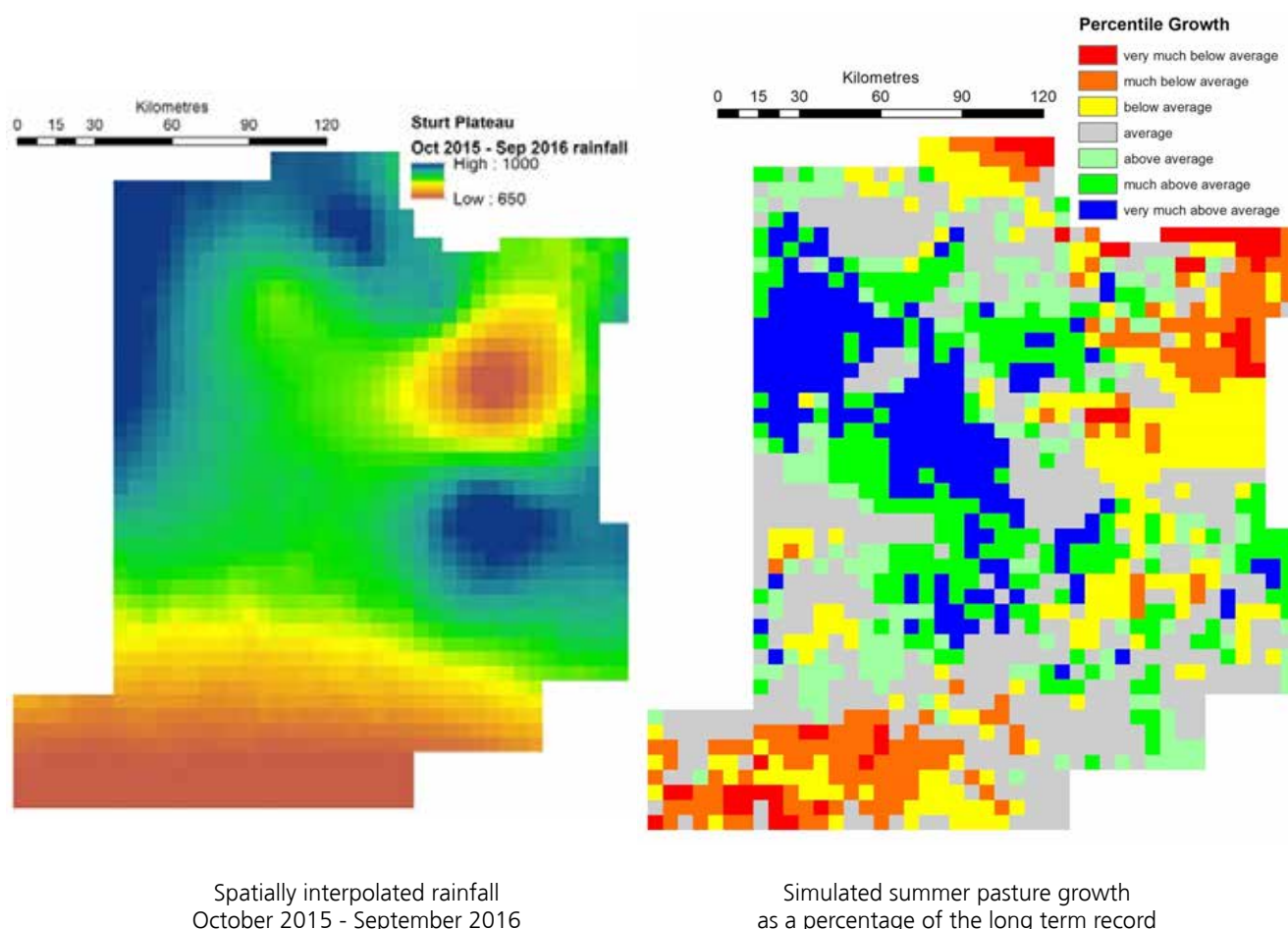


Figure 26: Maps of seasonal quality. Left, gridded rainfall, October 2015 to September 2016; right, AussieGRASS modelled pasture growth for the 2015-16 summer period as a percentage of previous summers.

STURT PLATEAU PASTORAL DISTRICT

Fire

The North Australian Fire Information website (www.firenorth.org.au/nafi3) reports that 9 394 km² (22% of the district) was burnt between October 2015 and September 2016. This was slightly more than twice the area burnt in the previous 12 months. Fire was most extensive in November 2015 (Figure 27) suggesting wildfire as this is typically when wildfires started by lightning occur. The limited fire activity between March and June 2016 was probably due to managed, early dry season burning.

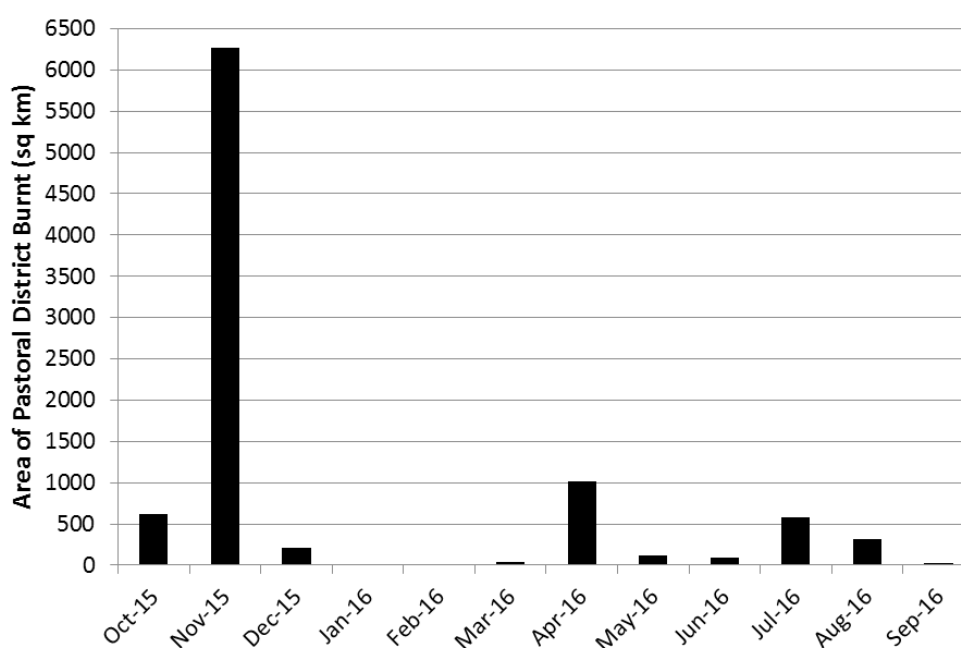


Figure 27: Monthly area burnt (km²) between October 2015 and September 2016 in the Sturt Plateau Pastoral District.

Bare soil dynamics

It is important to maintain adequate ground cover in the latter months of each year to minimise soil loss from wind erosion and intense wet season storms. It is also important to carry dry feed, and associated ground cover, into the latter months of each calendar year in case there is a late start to the usual wet season and/or monsoonal rains fail more generally.

The amount of bare soil present at any location changes from year to year depending on rainfall and its effectiveness, fire history and amount of grazing. The percentage of bare soil in each 30m square Landsat pixel (900 m² or 0.09 ha) was used to report the amount of bare soil across all pixels in the Sturt Plateau Pastoral District.

There were quite distinct boundaries between different categories of decile ranked vegetation cover (Figure 28); a similar feature to that reported in the 2014-15 Annual Report. This image depicts the amount of vegetation present in the late 2016 dry season relative to that present at the same time each year since 1988. Some areas of recent relatively lower vegetation cover,

STURT PLATEAU PASTORAL DISTRICT

compared with the previous 28 years, correspond with fire prior to image acquisition (i.e. areas shown with diagonal lines). Other north-south and east-west boundaries align with pastoral tenure and are seemingly related to management influences on fires and grazing management as they affect vegetation cover.

Fire effects apart, parts of the far southern region had much below average vegetation cover in the late 2016 dry season, compared with the last 28 years. This area broadly corresponds with the lower rainfall and modelled wet season pasture growth shown in Figure 26.

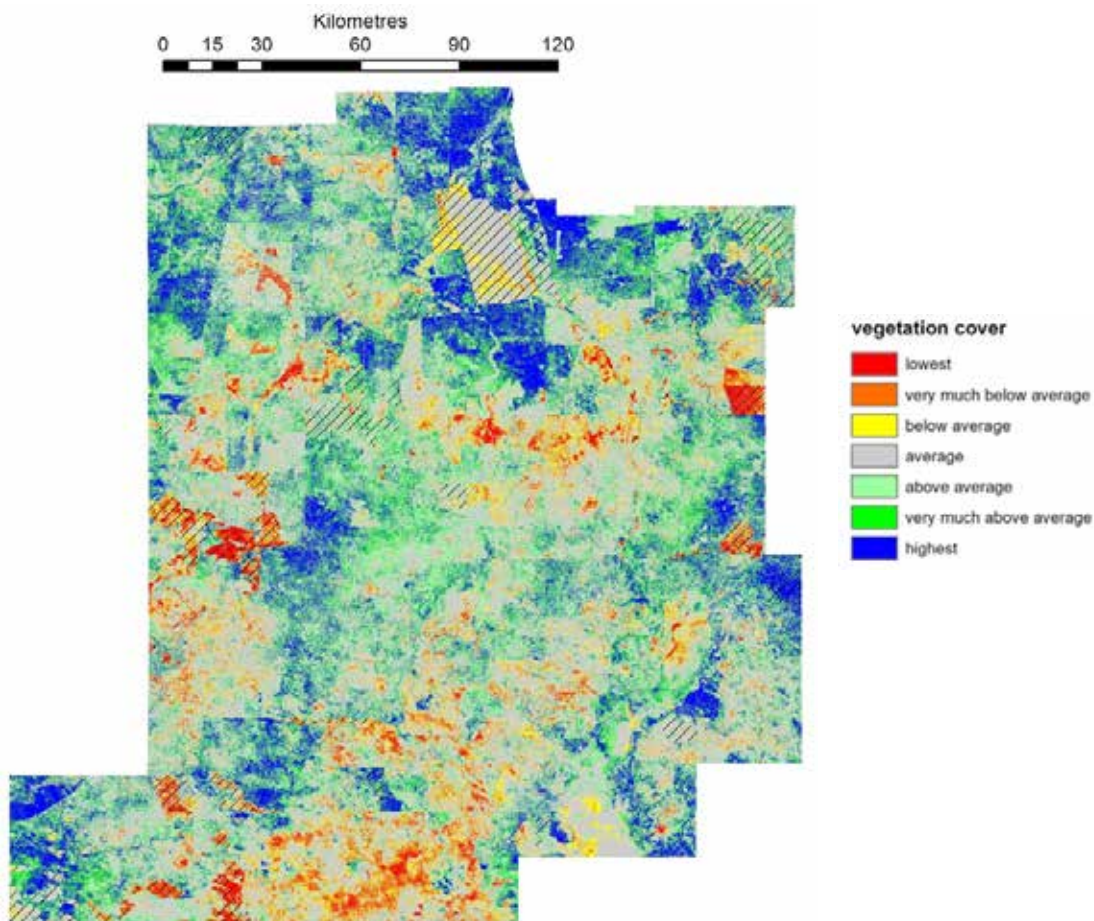


Figure 28: Rank of the amount of remotely-sensed vegetation cover present from September to November 2016 against that for previous years back to 1988. Diagonal lines show those areas burnt between January and November 2016.

Approximately one third of the pastoral district had negligible amounts of bare soil (<10% of the 30m Landsat pixel) towards the end of 2016 (Figure 29). Almost three quarters of the region had <20% (i.e. minor) bare soil. Slightly more than one quarter of the pastoral district had >20% bare soil in each Landsat pixel. This latter area is mapped in Figure 30 and includes areas burnt earlier in 2016. Parts of pastoral leases not recently burnt in the south of the pastoral district had concentrated areas of >20% bare soil per Landsat pixel. This area broadly aligns with the indicators of poor seasonal quality shown in Figure 26 and relatively lower vegetation cover in Figure 28.

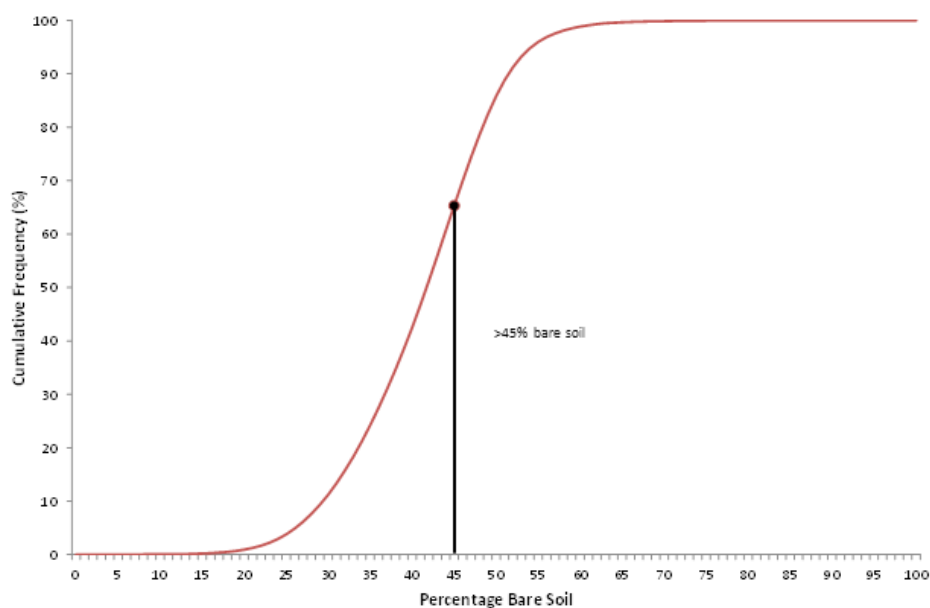


Figure 29: Percentage cumulative frequency of varying levels of bare soil in 30m square Landsat pixels in the Sturt Plateau Pastoral District between September and November 2016. Areas with greater than 20% bare soil are mapped in Figure 30.

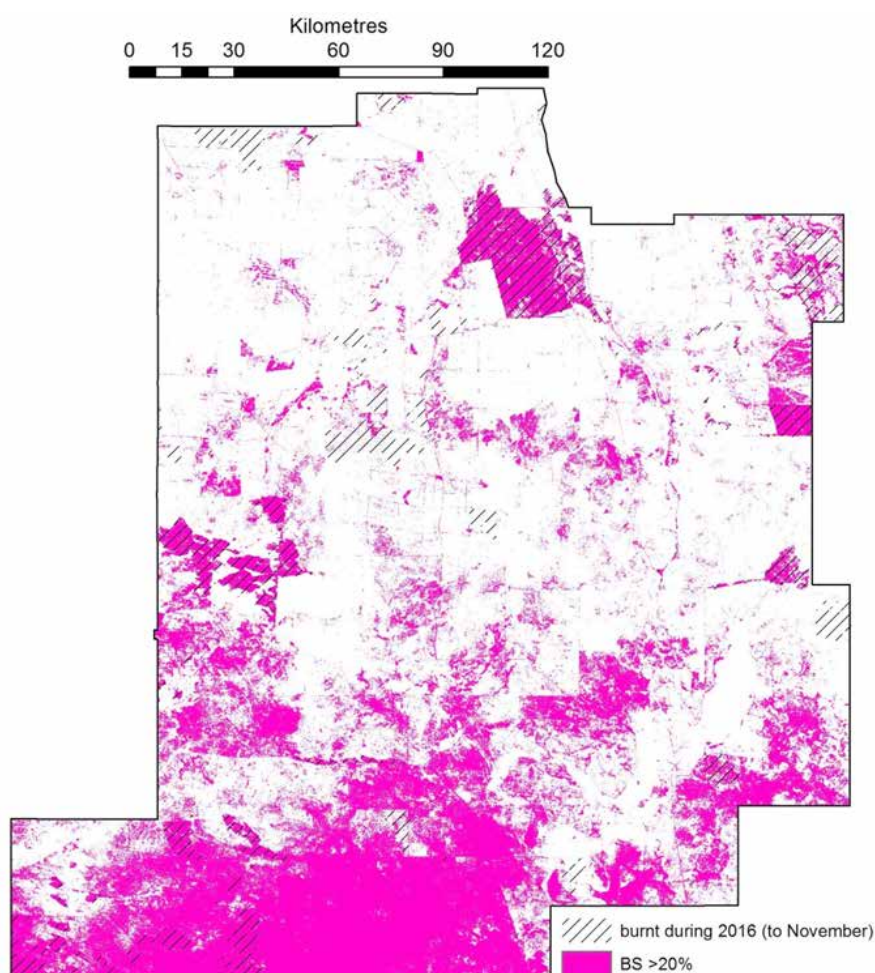


Figure 30: Parts of the Sturt Plateau Pastoral District having more than 20% bare soil per Landsat pixel in late 2016. Diagonal lines show areas burnt between January and November 2016.

Note that the threshold level of bare soil used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.

STURT PLATEAU PASTORAL DISTRICT

Site based monitoring

Three pastoral leases in the Sturt Plateau Pastoral District, comprising 18% of the pastoral lease area, were visited during 2016.

Vegetation cover of the ground layer was measured using the point intercept method at 19 sites across the three leases. Sites, on average, had a good cover of perennial grasses, a moderate amount of litter and a small amount of bare soil (Figure 31). Annual grasses and forbs (both annual and perennial) were minor components of the total ground cover. Perennial grasses are important because they protect the soil surface against wind and water erosion and, where palatable, provide persistent forage to carry livestock through dry times. Litter cover also protects the soil surface, assists infiltration of rain water and helps retain plant seeds in situ.

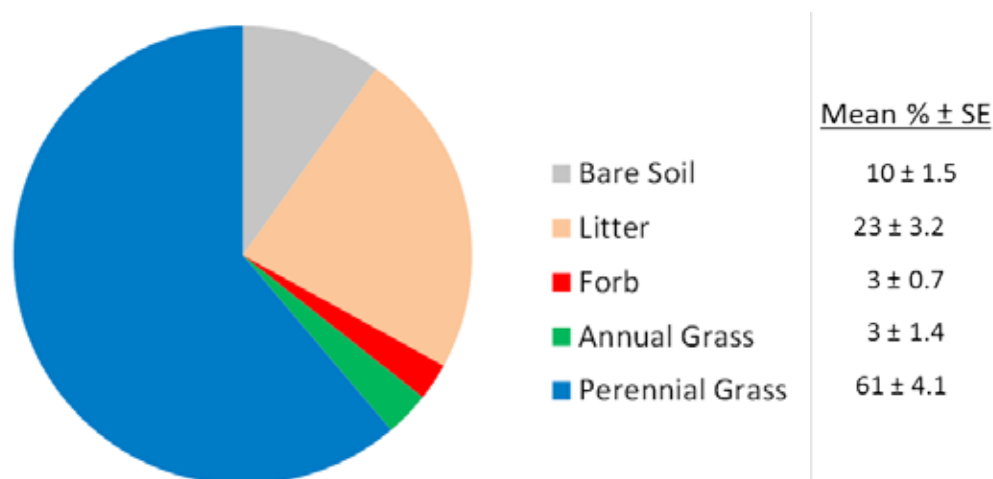


Figure 31: Mean percentage and standard error of measured components of vegetation cover in the ground layer from 19 sites on three pastoral leases in the Sturt Plateau Pastoral District.

The majority of sites were not grazed or minimally grazed at their time of assessment (Table 12). There was no evidence of erosion at any site.

Table 12: Levels of pasture utilisation assessed at 19 sites on three pastoral leases in the Sturt Plateau Pastoral District.

Pasture Utilisation	
Rank	% of sites
No grazing	26
Minimal	64
Moderate	5
Moderate to heavy	5

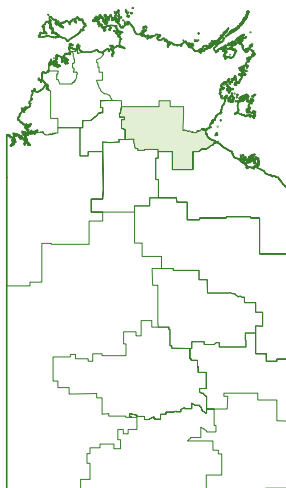
STURT PLATEAU PASTORAL DISTRICT

Land condition ratings assigned at monitoring sites and the more generalised assessment of land condition across those parts of pastoral leases traversed are summarised in Table 13. To the extent possible, these assessments are independent of the average to below average seasonal quality applying to the general area of each station.

Table 13: Assessed land condition at monitoring sites and traversed parts of three pastoral leases in the Sturt Plateau Pastoral District.

Station	Condition Rating	Comments with regard to pastoral lease
1	Good: 3 sites Poor: 1 site	Overall, the station is in good condition with a range of palatable, perennial and productive grasses plus annual grasses present. There were few signs of erosion.
2	Good: 3 sites Fair: 5 sites	Lease area in mostly good condition. Small areas were dominated by Sesbania pea (<i>Sesbania cannabina</i>) and these areas were rated in fair condition. Rubber bush (<i>Calotropis procera</i>) and Hyptis (<i>Hyptis suaveolens</i>) were observed in some areas.
3	Good: 6 sites Fair: 1 site	Property generally in good condition with a diversity of palatable perennial and annual grasses present and few signs of active erosion.

ROPER PASTORAL DISTRICT



Map 5: Location of Roper Pastoral District

The majority of the district experienced poor seasonal quality based on expected wet season pasture growth (from AussieGRASS simulation).

Despite uniformly poor seasonal quality, much of the western half had above average vegetation cover in late 2016, compared with the recent past, and considerable parts of the eastern half had much below average cover. Recent fire in the west of the region did not seem to suppress vegetation cover with some areas burnt earlier in 2016 having above average cover compared to that present in late dry seasons since 1988. In total, 17% of the region burnt between October 2015 and September 2016, which was considerably less than the 74% burnt in the preceding 12 months. Two sites, both in fair condition, were monitored on one pastoral lease. However this

is an insufficient sample to adequately indicate land condition of pastoral country elsewhere in the district.

Seasonal quality

“Seasonal quality” describes the relative value of recent rainfall in producing forage for livestock. It is judged with reference to the historical record. Two indicators are used: rainfall amount compared with the long term median and expected pasture growth based on rainfall received, simulated using AussieGRASS (www.longpaddock.qld.gov.au).

Descriptors of seasonal quality provide useful context for interpreting various measures of land condition at particular times. However, to the extent possible, land condition is assessed independently of seasonal conditions.

Rainfall statistics (Table 14) are based on gridded rainfall produced by the Bureau of Meteorology (www.bom.gov.au/jsp/awap/rain/index.jsp). Pixel (grid cell) values are calculated from rainfall amounts at recognised recording stations. Rainfall is from October of one year to September the following year. Modelled pasture growth is for the period November 2015 to April 2016. This growth is ranked as a percentile of the growth for all previous summers.

Table 14: Indicators of seasonal quality. Data spatially averaged for the Roper Pastoral District.

Rainfall (mm)		AussieGRASS	
2015 - 2016	841	Growth (kg/ha)	1630
Long term median	790	Percentile	16

ROPER PASTORAL DISTRICT

Spatially averaged 12 month rainfall (October 2015 to September 2016) for the Roper Pastoral District was a little above the long term median (Table 14) and progressively decreased from the west to the east (Figure 32, top panel). Aboriginal land in the far south of the region, neighbouring the Gulf Pastoral District, received higher rainfall (approximately 1000 mm).

Despite above median rainfall (October 2015 to September 2016) across parts of the Roper Pastoral District, modelled pasture growth over the last wet season was much below average (Table 14 and Figure 32, bottom panel). This was probably due to most of the rain falling in late 2015 and the remainder of the “wet” being relatively dry and not conducive to extended periods of pasture growth. The eastern part of the district also had much below average modelled pasture growth during the 2014-15 wet season.

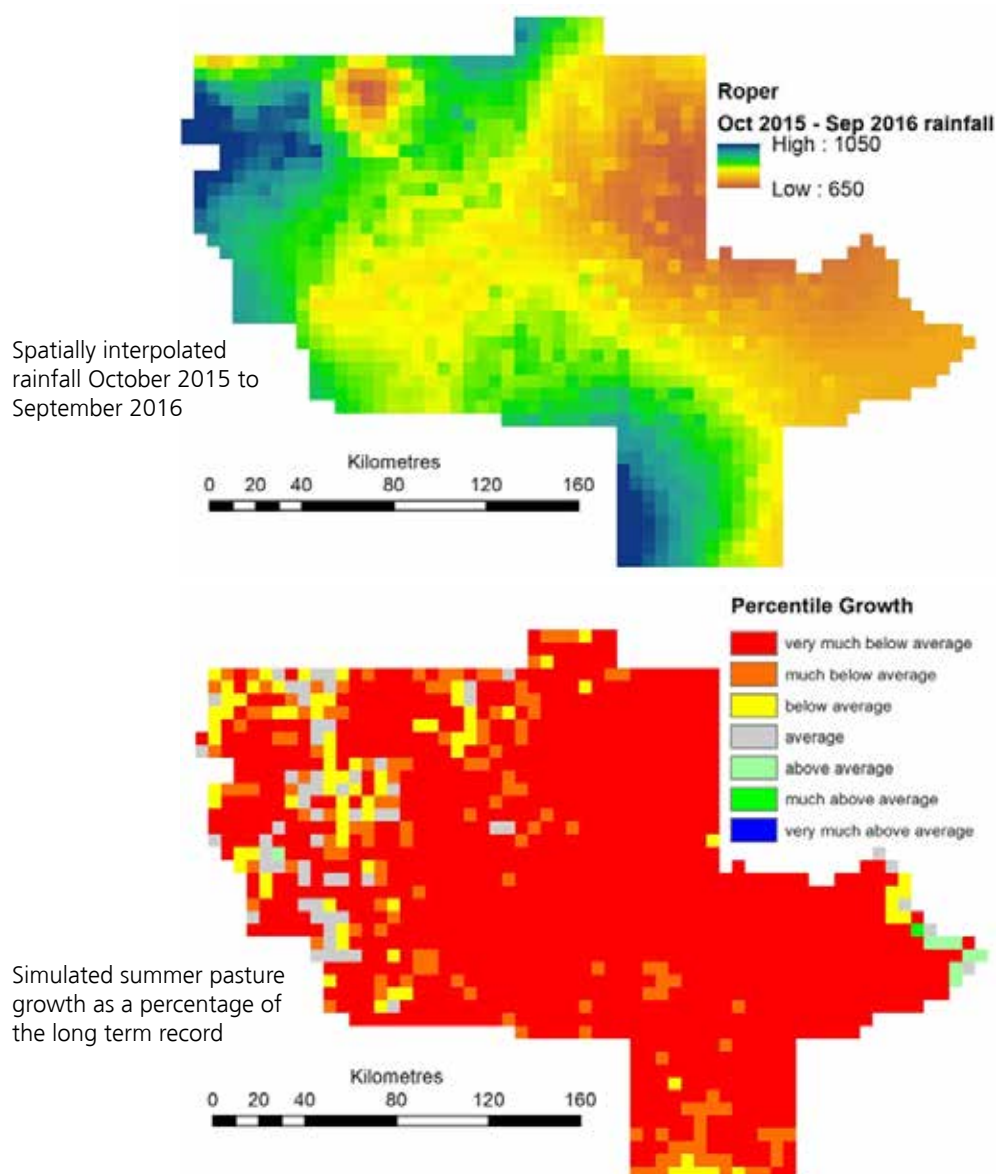


Figure 32: Maps of seasonal quality. Top, gridded rainfall, October 2015 to September 2016; bottom, AussieGRASS modelled pasture growth for the 2015-16 summer period as a percentage of previous summers.

ROPER PASTORAL DISTRICT

Fire

The North Australian Fire Information website (www.firenorth.org.au/nafi3) reports that 7238 km² (17% of the district) burnt between October 2015 and September 2016. This was considerably less than the 74% of the pastoral district burnt in the preceding 12 month period and was presumably attributable to a poor wet season in the east of the region in 2014-15 and the more general failure of the 2015-16 wet season. Peak fire activity was in November 2015 (Figure 33).

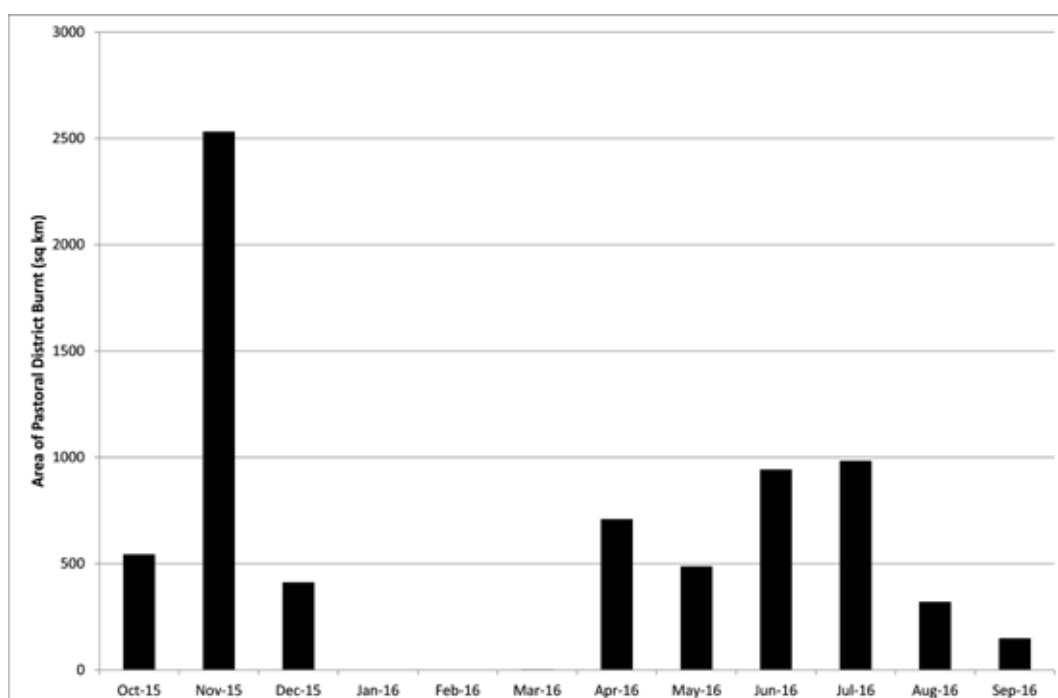


Figure 33: Monthly area burnt (km²) in the Roper Pastoral District between October 2015 and September 2016.

Bare soil dynamics

It is important to maintain adequate ground cover in the latter months of each year to minimise soil loss from wind erosion and intense wet season storms. It is also important to carry dry feed, and associated ground cover, into the latter months of each calendar year in case there is a late start to the usual wet season and/or monsoonal rains fail more generally.

The amount of bare soil present at any location changes from year to year depending on rainfall and its effectiveness, fire history and amount of grazing. The percentage of bare soil in each 30m square Landsat pixel (900 m² or 0.09 ha) was used to report the amount of bare soil across all pixels in the Roper Pastoral District.

Much of the western half of the pastoral district had above average vegetation cover in late 2016, compared with the recent past, and considerable parts of the eastern half had much below average cover (Figure 34). Recent fire in the west of the region did not seem to suppress vegetation cover compared with that present since 1988. Some areas burnt earlier in 2016 had above average cover compared to that present in previous years.

ROPER PASTORAL DISTRICT

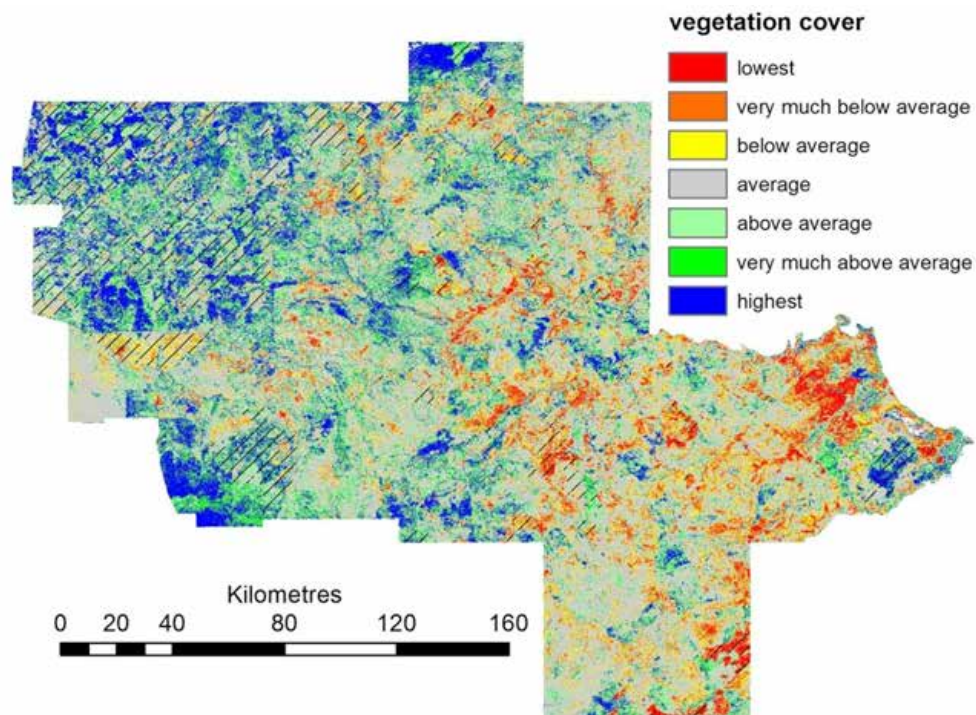


Figure 34: Rank of the amount of remotely sensed vegetation cover present from September to November 2016 against that for previous years back to 1988. Diagonal lines show those areas burnt between January and November 2016.

One quarter of the pastoral district had minor amounts of bare soil (<10% of the 30m Landsat pixel) towards the end of 2016 (Figure 35) and two thirds of the region had <20% bare soil per pixel. One fifth of the Roper Pastoral District had >25% bare soil in each Landsat pixel. This latter area is mapped in Figure 36 and includes some areas burnt earlier in 2016. However, significant areas with elevated bare soil were not burnt in 2016, particularly in the south-eastern part of the pastoral district.

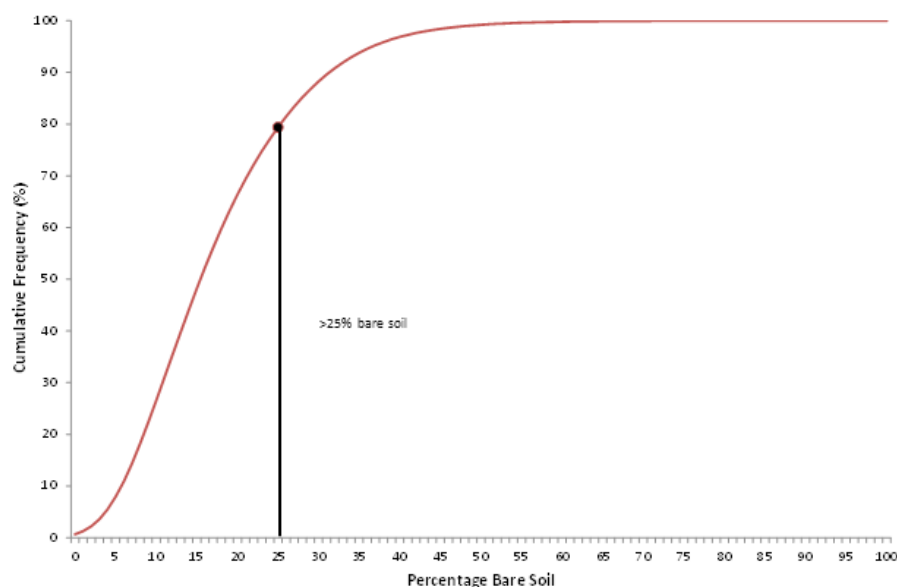


Figure 35: Percentage cumulative frequency of varying levels of bare soil in 30m square Landsat pixels in the Roper Pastoral District between September and November 2016. Areas with greater than 25% bare soil are mapped in Figure 36.

ROPER PASTORAL DISTRICT

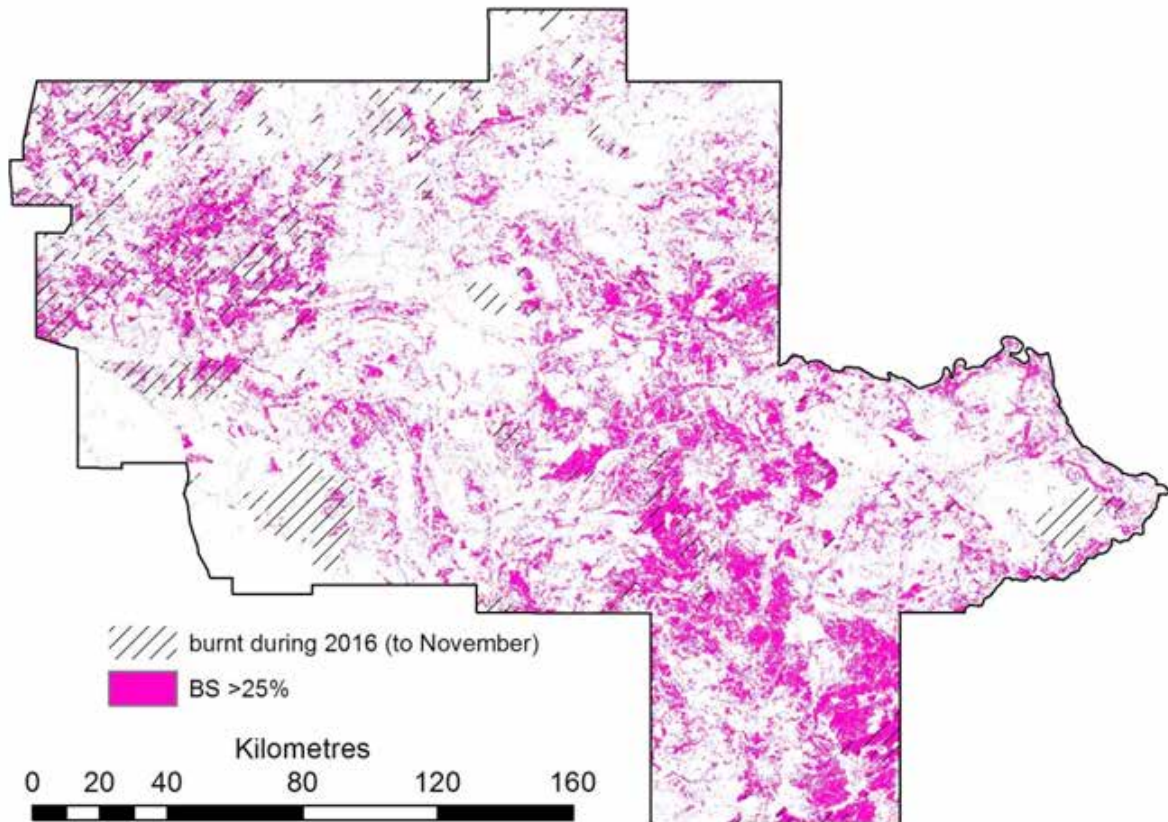


Figure 36: Parts of the Roper Pastoral District having more than 25% bare soil per Landsat pixel in late 2016. Areas burnt between January and November 2016 are shown with diagonal lines.

Note that the threshold level of bare soil used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.

Site based monitoring

One pastoral lease in the northern part of the Roper Pastoral District was visited late in the 2016 monitoring season. This lease comprises 12% of the district's pastoral lease area but the two sites assessed do not adequately indicate land condition across the remaining grazed country in the region.

Vegetation cover of the ground layer was measured using the point intercept method at the two sites present on the lease. The averaged components of cover are shown in Figure 37 but there was some difference between the two sites: similar amounts of perennial grass but considerable differences in bare soil (32% and 10%) and litter (17% and 33%) respectively. Perennial grasses are important in the Roper region because they protect the soil surface against wind and water erosion and, where palatable, provide persistent forage to carry livestock through dry times. Litter cover also protects the soil surface, assists infiltration of rain water and helps retain plant seeds in situ.

ROPER PASTORAL DISTRICT

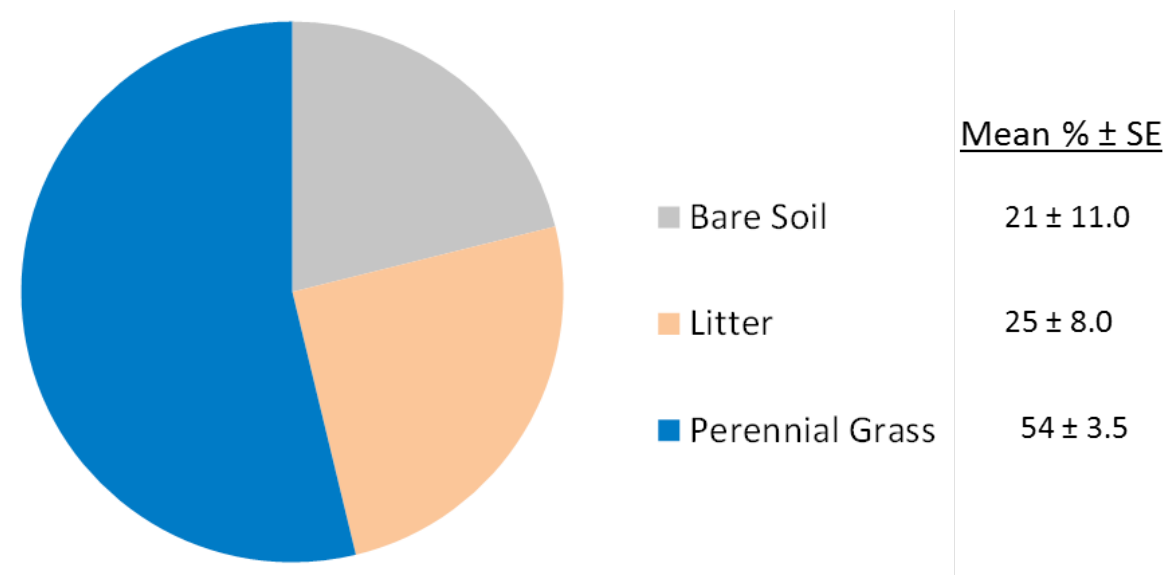
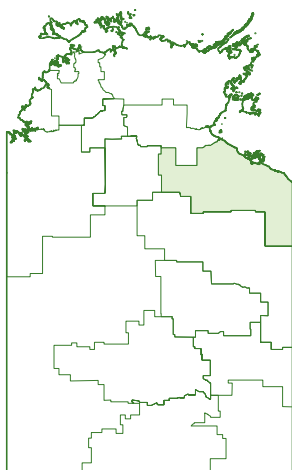


Figure 37: Mean percentage and standard error of measured components of vegetation cover in the ground layer from two sites on one pastoral lease in the Roper Pastoral District

The two sites were assessed in fair condition. They were minimally grazed with less than 10% of the seasonal pasture growth utilised. There was no evidence of erosion at either site.

The station, in general, was assessed to be in fair condition. Most areas had moderate ground cover with a range of perennial (including palatable) and annual grasses present. Erosion was limited in extent and, where present, occurred on older tracks and along some fence lines. There were scattered areas of Mimosa Bush (*Vachellia farnesiana*) and Hyptis (*Hyptis suaveolens*) observed along tracks, in yards and around waters, in various parts of the lease.

GULF PASTORAL DISTRICT



Map 6: Location of Gulf Pastoral District

As in 2014-15, the Gulf coast and hinterland extending up to 150 km inland experienced poor seasonal quality based on AussieGRASS modelled pasture growth.

Seasonal conditions were closer to, or above, the long term average in the south-west and south-east of the pastoral district. Fire is a feature of this savannah region with the main fire activity for the 12 months occurring in November 2015. In total, 15% of the district burnt between October 2015 and September 2016. Areas of much reduced vegetation cover, as monitored with remote sensing, were scattered throughout the district – and were not always associated with recent fire. Highest cover since 1988 in the south-west of the region corresponded with increased modelled pasture growth. One quarter of the region had more than 25% bare soil per Landsat pixel later in the 2016 dry season, mostly in the southern and south-eastern parts of the district. Three of nine sites on four leases were rated in good condition with the remaining six sites in fair condition. An additional lease was assessed based on existing Tier 1 sites and property inspection. Beyond monitoring sites, sections of tracks and fence lines showed evidence of erosion and various weed species were present.

Seasonal quality

“Seasonal quality” describes the relative value of recent rainfall in producing forage for livestock. It is judged with reference to the historical record. Two indicators are used: rainfall amount compared with the long term median and expected pasture growth based on rainfall received, simulated using AussieGRASS (www.longpaddock.qld.gov.au).

Descriptors of seasonal quality provide useful context for interpreting various measures of land condition at particular times. However, to the extent possible, land condition is assessed independently of seasonal conditions.

Rainfall statistics (Table 15) are based on gridded rainfall produced by the Bureau of Meteorology (www.bom.gov.au/jsp/awap/rain/index.jsp). Pixel (grid cell) values are calculated from rainfall amounts at recognised recording stations. Rainfall is from October of one year to September the following year. Modelled pasture growth is for the period November 2015 to April 2016. This growth is ranked as a percentile of the growth for all previous summers.

Table 15: Indicators of seasonal quality. Data spatially averaged for the Gulf Pastoral District.

Rainfall (mm)		AussieGRASS	
2015 - 2016	635	Growth (kg/ha)	1642
Long term median	658	Percentile	29

GULF PASTORAL DISTRICT

Spatially averaged rainfall for the Gulf Pastoral District was slightly below the long term median (Table 15). As in other pastoral districts, there was considerable variation in interpolated rainfall across the region (Figure 38, left hand panel) with the north-western part of the district receiving more rainfall than the central and eastern areas. An area extending south-east from the southern part of McArthur River to Calvert Hills received less than 500 mm of rainfall between October 2015 and September 2016.

Modelled pasture growth over the last wet season, as a percentage of the long term record, was very much below the long term average adjacent to the Gulf coast (Figure 38, right hand panel). This follows a similar poor wet season, based on modelled pasture growth, in 2014-15. Further inland, wet season growth ranked as mainly average to below average, except adjacent to the Sturt Plateau and Barkly pastoral districts in the south-west where relatively higher rainfall resulted in modelled growth being above average.

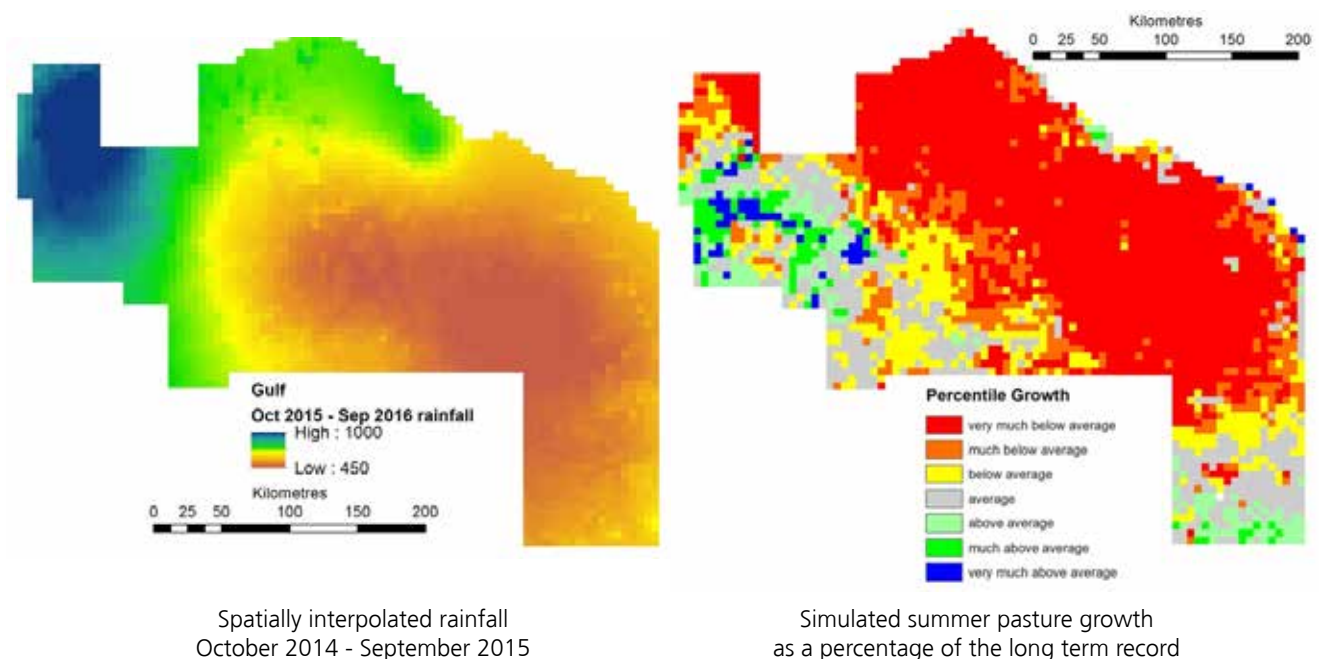


Figure 38: Maps of seasonal quality. Left, gridded rainfall, October 2015 to September 2016; right, AussieGRASS modelled pasture growth for the 2015-16 summer period as a percentage of previous summers.

Fire

The North Australian Fire Information website (www.firenorth.org.au/nafi3) reports that 13 755 km² (15% of the district) burnt between October 2015 and September 2016. Most of the area was burnt in November 2015 (9354 km², Figure 39), presumably in wildfire. The poor wet season in 2015-16 meant that there was very little fire activity throughout 2016 (to September).

GULF PASTORAL DISTRICT

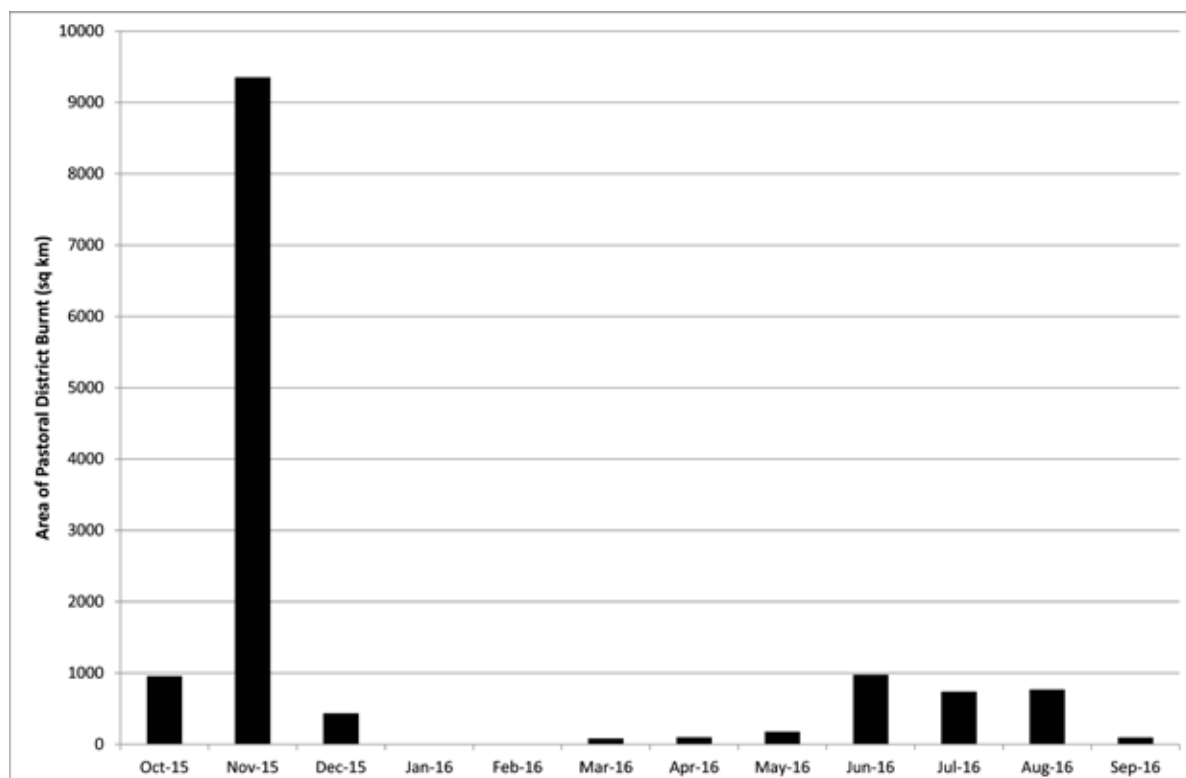


Figure 39: Monthly area burnt between October 2015 and September 2016 in the Gulf Pastoral District.

Bare soil dynamics

It is important to maintain adequate ground cover in the latter months of each year to minimise soil loss from wind erosion and intense wet season storms. It is also important to carry dry feed, and associated ground cover, into the latter months of each calendar year in case there is a late start to the usual wet season and/or monsoonal rains fail more generally.

The amount of bare soil present at any location changes from year to year depending on rainfall and its effectiveness, fire history and amount of grazing. The percentage of bare soil in each 30m square Landsat pixel (900 m² or 0.09 ha) was used to report the amount of bare soil across all pixels in the Gulf Pastoral District.

In a similar situation to 2015, the relative amount of vegetation cover present in the late dry season of 2016 (Figure 40) was not as much affected by rainfall deficiency as modelled pasture growth (right hand panel, Figure 38). This was probably largely due to the Landsat sensor detecting largely persistent tree and shrub cover that may have otherwise been concealing reduced ground cover due to poorer seasonal quality. Areas of much reduced vegetation cover, compared with that present in the late dry season since 1988, were scattered throughout the district – and these areas were not always associated with recent fire. Highest cover since 1988 in the south-west of the region corresponded with increased modelled pasture growth (Figure 38).

GULF PASTORAL DISTRICT

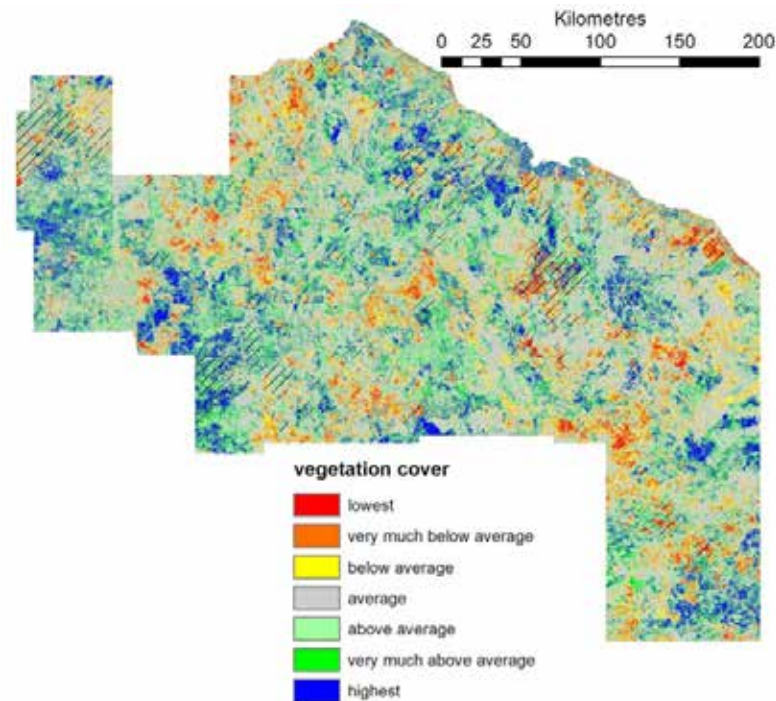


Figure 40: Rank of the amount of remotely-sensed vegetation cover present from September to November 2016 against that for previous years back to 1988. Diagonal lines show those areas burnt between January and November 2016.

Approximately 22% of the pastoral district had minor amounts of bare soil (<10% of the 30m Landsat pixel) towards the end of 2016 (Figure 41). Almost one quarter of the region had >25% bare soil (area mapped in Figure 42). This includes some areas burnt earlier in 2016. However the most extensive areas with elevated bare soil occurred in the southern and south-eastern parts of the district and these areas were mostly not affected by fire earlier in 2016.

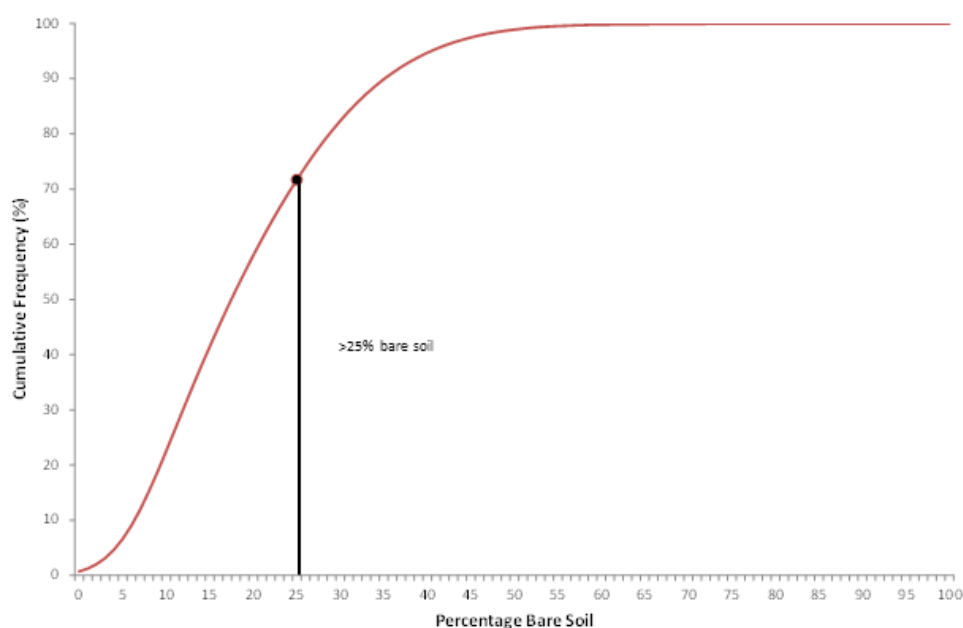


Figure 41: Percentage cumulative frequency of varying levels of bare soil in 30m square Landsat pixels in the Gulf Pastoral District between September and November 2016. Areas with greater than 25% bare soil are mapped in Figure 42.

GULF PASTORAL DISTRICT

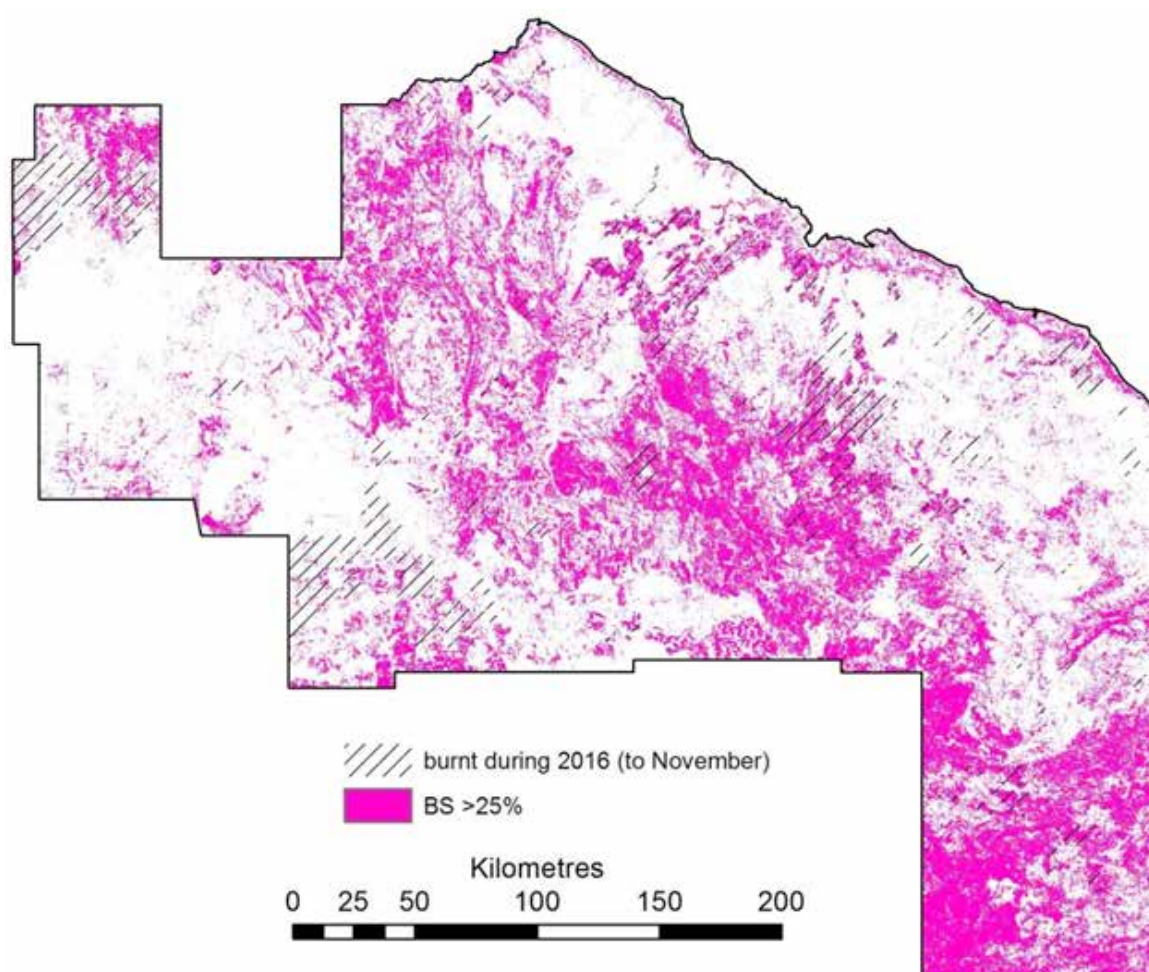


Figure 42: Parts of the Gulf Pastoral District having more than 25% bare soil per Landsat pixel in late 2016. Areas burnt between January and November 2016 are shown with diagonal lines.

Note that the threshold level of bare soil used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.

Site based monitoring

Five pastoral leases in the Gulf Pastoral District, comprising 17% of the pastoral lease area, were visited during 2016.

Vegetation cover of the ground layer was measured using the point intercept method at nine sites across four of the five leases. Sites, on average, had a small amount of bare soil, good litter cover, a good cover of perennial grasses and very small amounts of annual grasses and forbs (Figure 43). However there was some variation amongst sites with one site having 39% bare soil and two further sites with 21% bare soil. Perennial grasses are important in the Gulf country because they protect the soil surface against wind and water erosion and, where palatable, provide persistent forage to carry livestock through dry times. Litter cover also protects the soil surface, assists infiltration of rain water and helps retain plant seeds in situ.

GULF PASTORAL DISTRICT

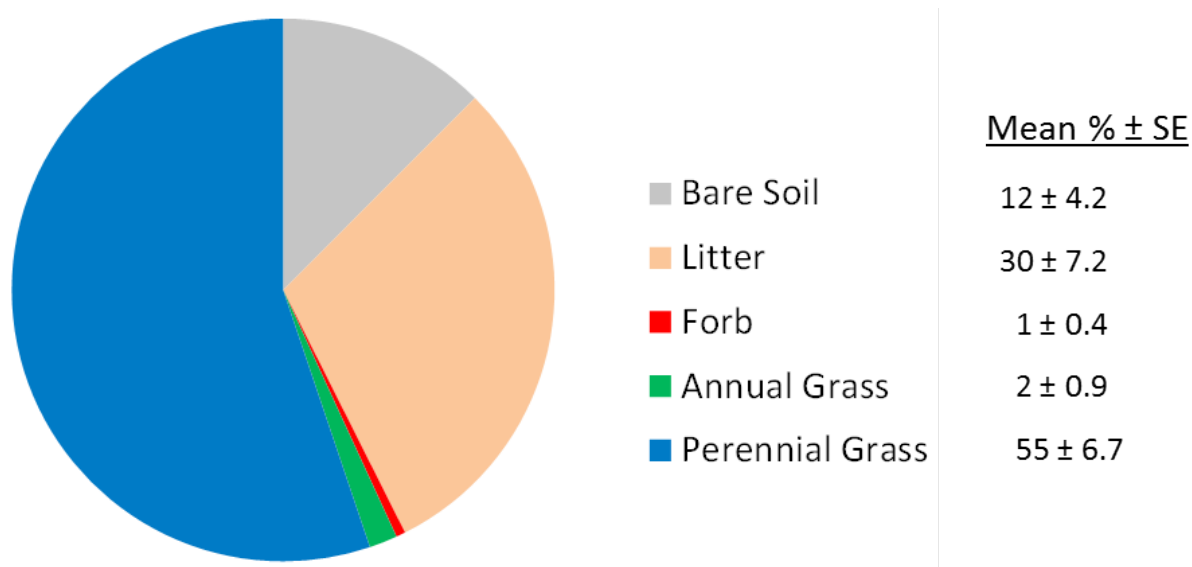


Figure 43: Mean percentage and standard error of measured components of vegetation cover in the ground layer from nine sites on four pastoral leases in the Gulf Pastoral District.

Seven of the nine sites (77%) were rated as being minimally grazed (Table 16). Three pastoral leases were visited later in the dry season (August – September 2016) when grazing effects are likely to be greater.

There was no evidence of erosion recorded at any of the sites in the region.

Table 16: Levels of pasture utilisation recorded at nine sites on four pastoral leases in the Gulf Pastoral District.

Pasture Utilisation	
Rank	% of sites
Minimal	78
Moderate	11
Moderate to heavy	11

The four pastoral leases with monitored sites experienced poor seasonal quality based on modelled pasture growth through the 2015-16 wet season.

Land condition ratings assigned at monitoring sites and the more generalised assessment of land condition across those parts of pastoral leases traversed are summarised in Table 17.

GULF PASTORAL DISTRICT

Table 17: Assessed land condition at monitoring sites and traversed parts of four pastoral leases in the Gulf Pastoral District.

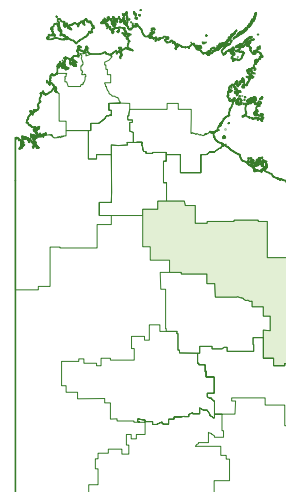
Station	Condition Rating	Comments with regard to pastoral lease
1	Good: 1 site Fair: 2 sites	Lease assessed in fair to good condition with a range of palatable perennial and annual grasses present. Weeds, whilst present, did not dominate any large areas of the property.
2	Good: 2 sites Fair: 1 site	Property in good to fair condition with palatable perennial and annual grasses present and only a few signs of active erosion; mostly on well used tracks. Bellyache bush (<i>Jatropha gossypifolia</i>) and Hyptis (<i>Hyptis suaveolens</i>) observed in parts of the lease.
3	Fair: 1 site	Widespread infestations of Hyptis and restricted access due to tracks not being maintained confined assessment to the more managed parts of the lease. Of those areas traversed, the majority was rated in fair or poor condition due to the limited occurrence of expected palatable, perennial species and presence of weeds.
4	Fair: 2 sites	Most of the lease assessed in fair condition, with a range of palatable perennial and annual grasses present. There were signs of active erosion on sections of track and along fence lines. Weeds were present near the homestead but did not dominate elsewhere on the property.

An additional lease was assessed based on existing Tier 1 sites and property traverse (i.e. no integrated monitoring sites established and thus not included above). Difficult access confined inspection to mainly well-drained sandy soils of river-frontage country. This land type was considered to be in fair condition with smaller areas in poor condition due to the abundance of weeds (mainly Hyptis [*Hyptis suaveolens*] and occasional Parkinsonia [*Parkinsonia aculeata*]).

BARKLY PASTORAL DISTRICT

Seasonal quality, based on expected pasture growth, was average to above average across much of the pastoral district apart from a small area in the far north-east which experienced poorer seasonal conditions

Analysis of Landsat imagery for the late dry season of 2016 showed that north-western and southern parts of the region had above average to highest levels of vegetation cover recorded since 1988 (the start of the Landsat record used for monitoring land condition). Much of the central and eastern parts had average vegetation cover based on the 28 year record. One quarter of the district had >45% bare soil (per Landsat pixel) in the late dry season, mainly in the east, south-east and south-west. Six pastoral leases were visited where 32 of 46 sites were rated in good condition and the remaining 14 in fair condition.



Map 7: Location of Barkly Pastoral District

Seasonal quality

“Seasonal quality” describes the relative value of recent rainfall in producing forage for livestock. It is judged with reference to the historical record. Two indicators are used: rainfall amount compared with the long term median and expected pasture growth based on rainfall received, simulated using AussieGRASS (www.longpaddock.qld.gov.au).

Descriptors of seasonal quality provide useful context for interpreting various measures of land condition at particular times. However, to the extent possible, land condition is assessed independently of seasonal conditions.

Rainfall statistics (Table 18) are based on gridded rainfall produced by the Bureau of Meteorology (www.bom.gov.au/jsp/awap/rain/index.jsp). Pixel (grid cell) values are calculated from rainfall amounts at recognised recording stations. Rainfall is from October of one year to September the following year. Due to the considerable north-south transition in long term median rainfall for this large pastoral district, rainfall statistics are reported based on an arbitrary split of the region into two sub-districts (Figure 44).

Table 18: Recent seasonal quality for the Barkly Pastoral District as indicated by spatially averaged rainfall relative to the long term median.

Rainfall (mm)	Barkly North	Barkly South
2015 - 2016	640	598
Long term median	424	302

BARKLY PASTORAL DISTRICT

Spatially averaged rainfall for the northern and southern sections of the Barkly Pastoral District was considerably above the long term median (Table 18). Within each part of the region, there was considerable west to east variation in interpolated rainfall (Figure 44). In particular, the north-western part of the Barkly North district centred on Beetaloo, Ucharonidge and Mungabroom pastoral leases received appreciably more rainfall than the south-west and north-east (Cresswell Downs, Benmarra and Mittiebah). Twelve month rainfall was also lower in the far south-east (Lake Nash and Georgina Downs), in line with the increasing aridity of this part of the Barkly region.

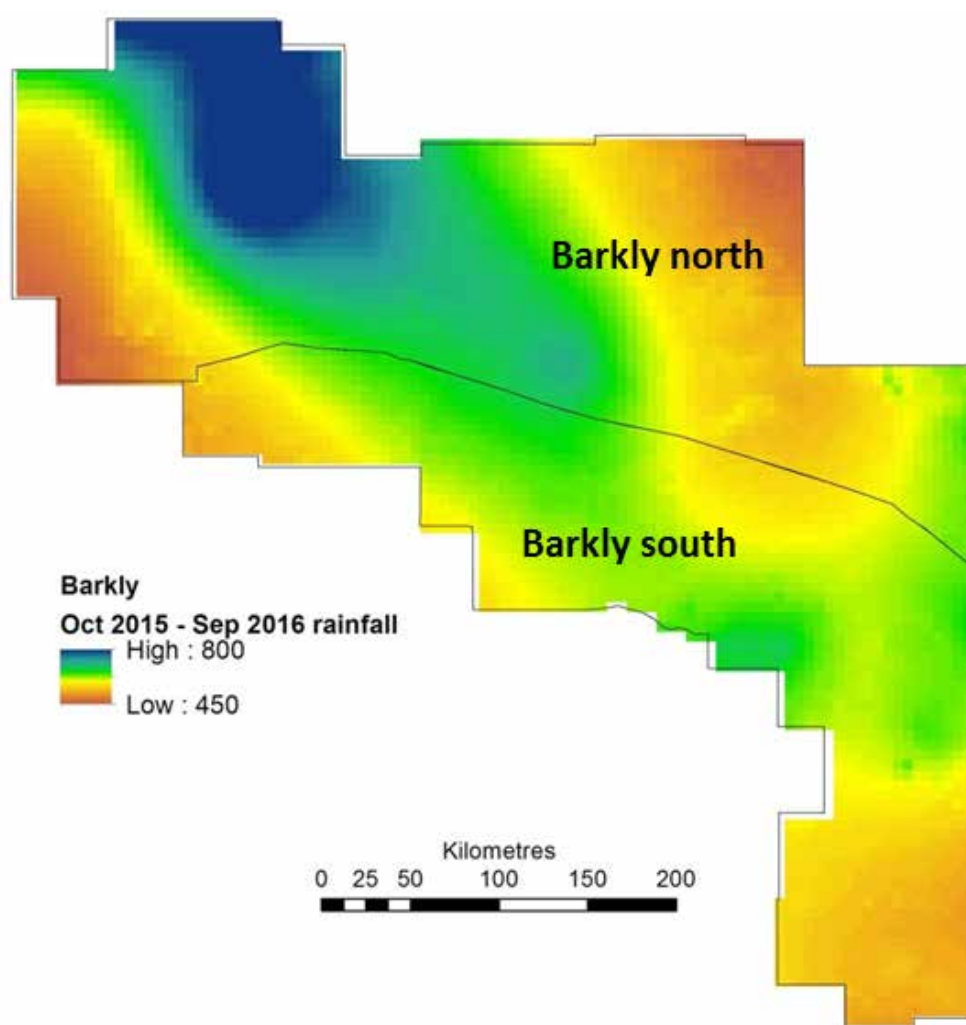


Figure 44: Spatially interpolated, gridded rainfall for the Barkly Pastoral District. Reporting period is October 2015 to September 2016.

AussieGRASS modelled pasture growth, as a second indicator of seasonal quality for the entire Barkly region, is for the period November 2015 to April 2016 (Table 19). This growth is ranked as a percentile of the growth for all previous summers. In this case, spatially-averaged growth through the 2015-16 wet season was ~960 kg/ha which was slightly above the long term median (Table 19).

BARKLY PASTORAL DISTRICT

Table 19: Recent seasonal quality averaged across the entire Barkly Pastoral District, as indicated by modelled pasture growth

Index of seasonal quality	Barkly Pastoral District
Growth (kg/ha)	964
Percentile	64

Modelled pasture growth over the 2015-16 wet season, as a percentage of the long term record, was average to above average across much of the pastoral district (Figure 45). A small area in the far northern parts of Benmarra and Creswell Downs experienced much below average seasonal quality.

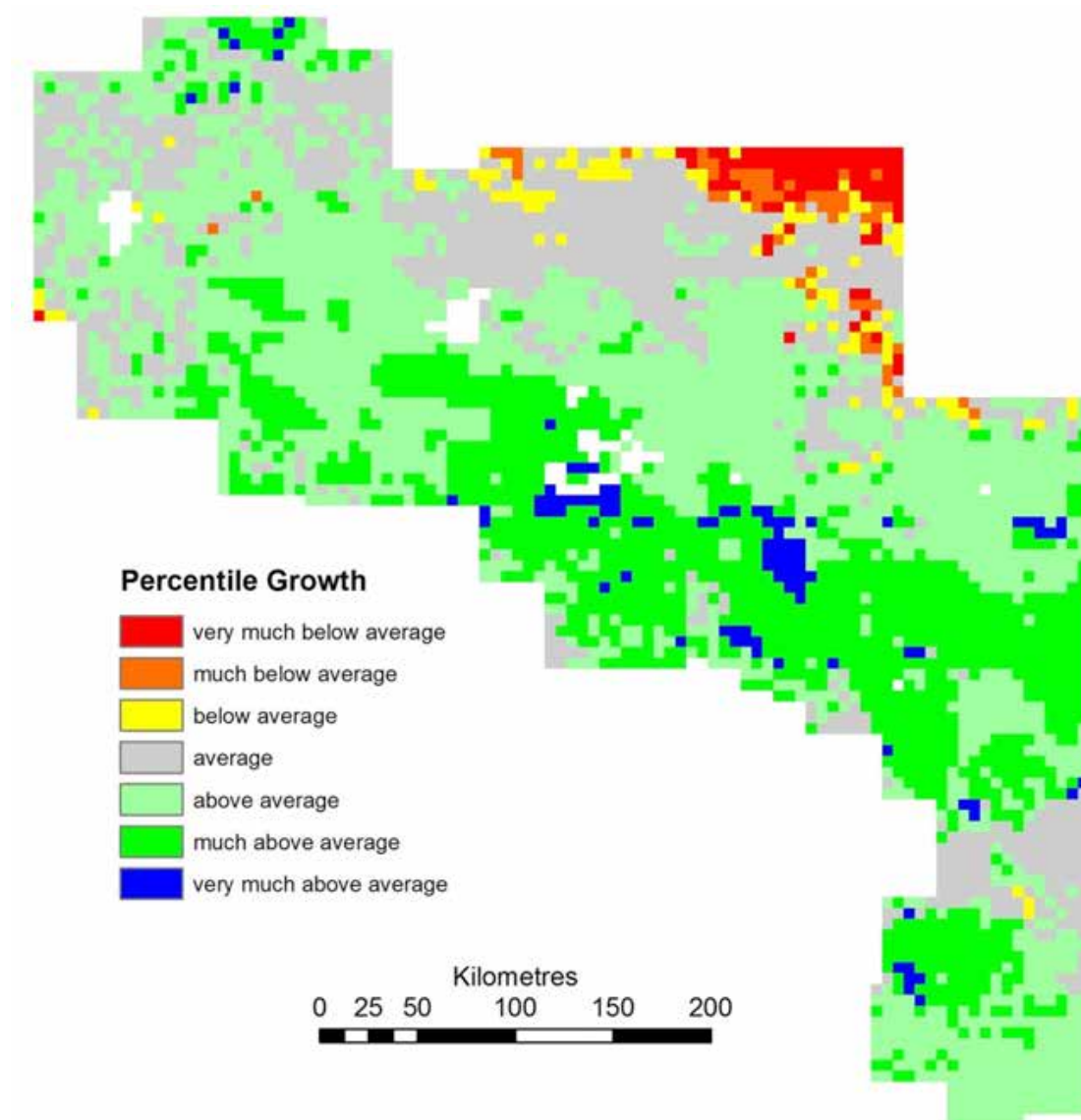


Figure 45: Simulated pasture growth for the 2015-16 wet season as a percentage of the long term record.

BARKLY PASTORAL DISTRICT

Fire

The North Australian Fire Information website (www.firenorth.org.au/nafi3) reports that 12 538 km² (9.4% of the Barkly Pastoral District) burnt between October 2015 and September 2016. Fire was most extensive in late 2015. Wildfire was much more extensive in the Barkly Pastoral District in 2011 and 2012 with 17% and 20% of the region burning in each year, respectively.

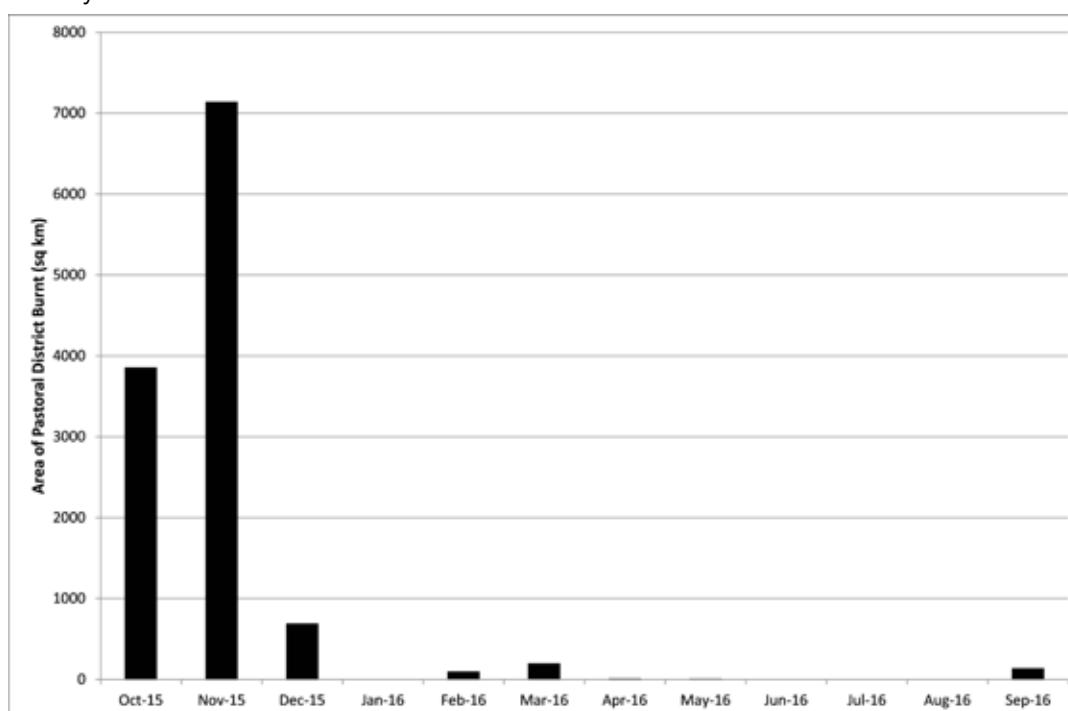


Figure 46: Monthly area burnt (km²) in the Barkly Pastoral District between October 2015 and September 2016.

Bare Soil Dynamics

It is important to maintain adequate ground cover in the latter months of each year to minimise soil loss from wind erosion and intense summer storms. It is also important to carry dry feed, and associated ground cover, into the latter months of each calendar year in case there is a late start to the usual wet season and/or monsoonal rains fail more generally.

The amount of bare soil present at any location changes from year to year depending on rainfall and its effectiveness, fire history and amount of grazing. The percentage of bare soil in each 30m square Landsat pixel (900 m² or 0.09 ha) was used to report the amount of bare soil across all pixels in the Barkly Pastoral District.

Corresponding with indicators of seasonal quality mapped in Figure 44 and Figure 45, parts of the north-western and southern Barkly Pastoral District had above average to highest levels of vegetation cover recorded since 1988 (Figure 47). Much of the central and eastern parts had average vegetation cover based on the 28 year record. However, relatively small and scattered areas of reduced vegetation cover (increased bare soil) occurred throughout this central band (from west of Lake Woods to the Queensland border).

BARKLY PASTORAL DISTRICT

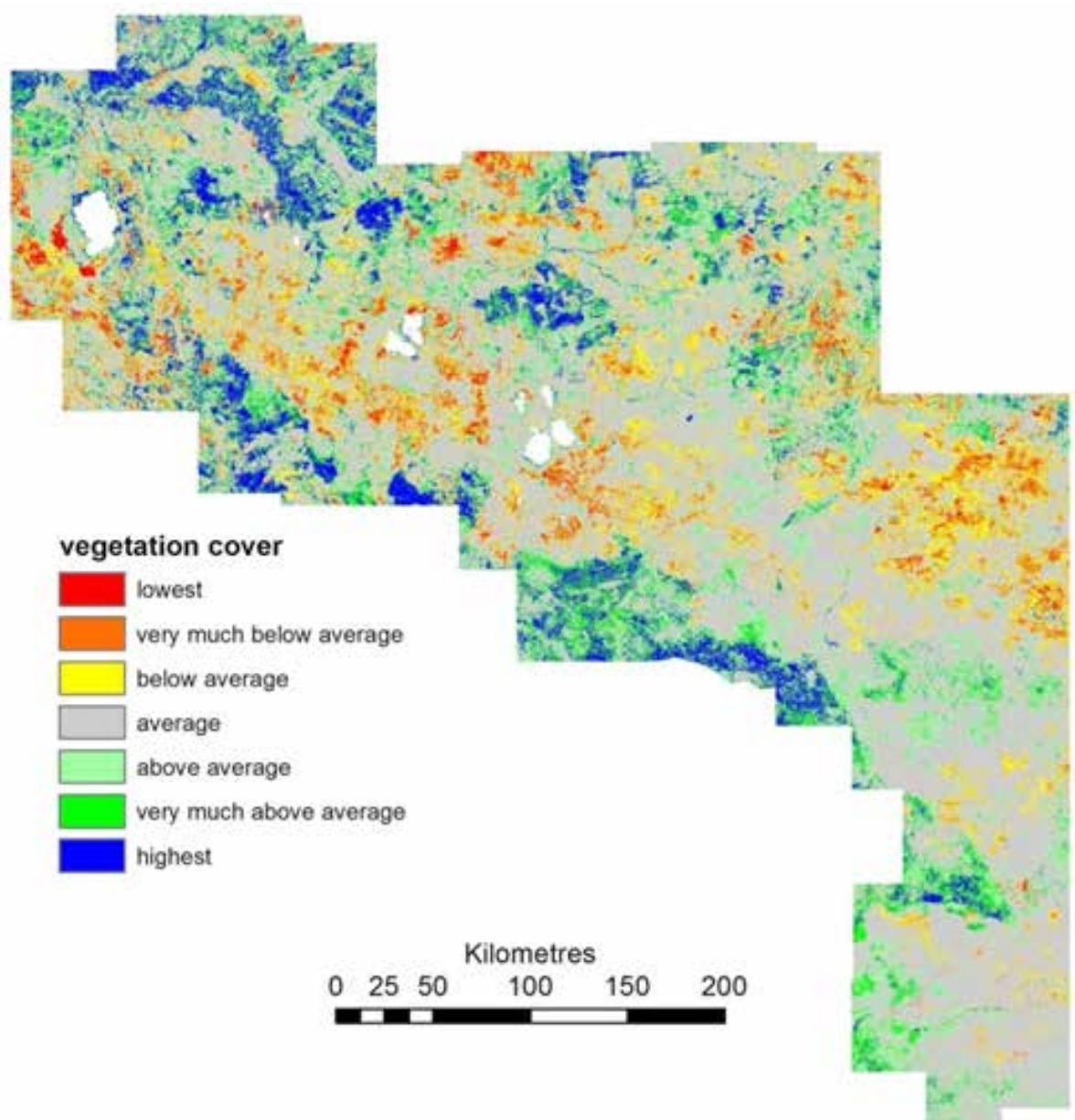


Figure 47: Rank of the amount of remotely-sensed vegetation cover present from September to November 2016 against that for previous years back to 1988. White areas show larger lakes.

Approximately one fifth of the pastoral district had minor amounts of bare soil (<20% of the 30m Landsat pixel) towards the end of 2016 (Figure 48). Forty percent of the region had <30% bare soil with one quarter of the district having >45% bare soil. This latter area was mostly in the east, south-east and south-west of the Barkly Pastoral District (Figure 49).

BARKLY PASTORAL DISTRICT

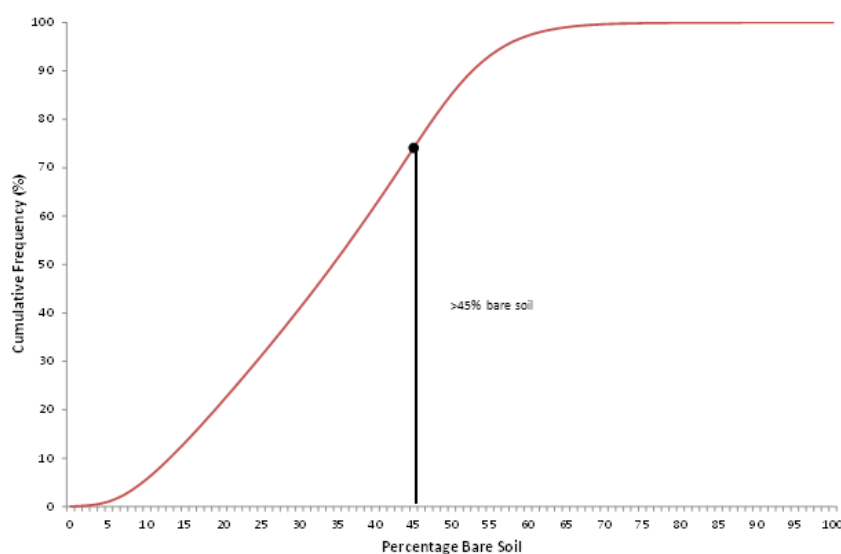


Figure 48: Percentage cumulative frequency of varying levels of bare soil in 30m square Landsat pixels in the Barkly Pastoral District between September and November 2016. Areas with greater than 45% bare soil are mapped in Figure 49.

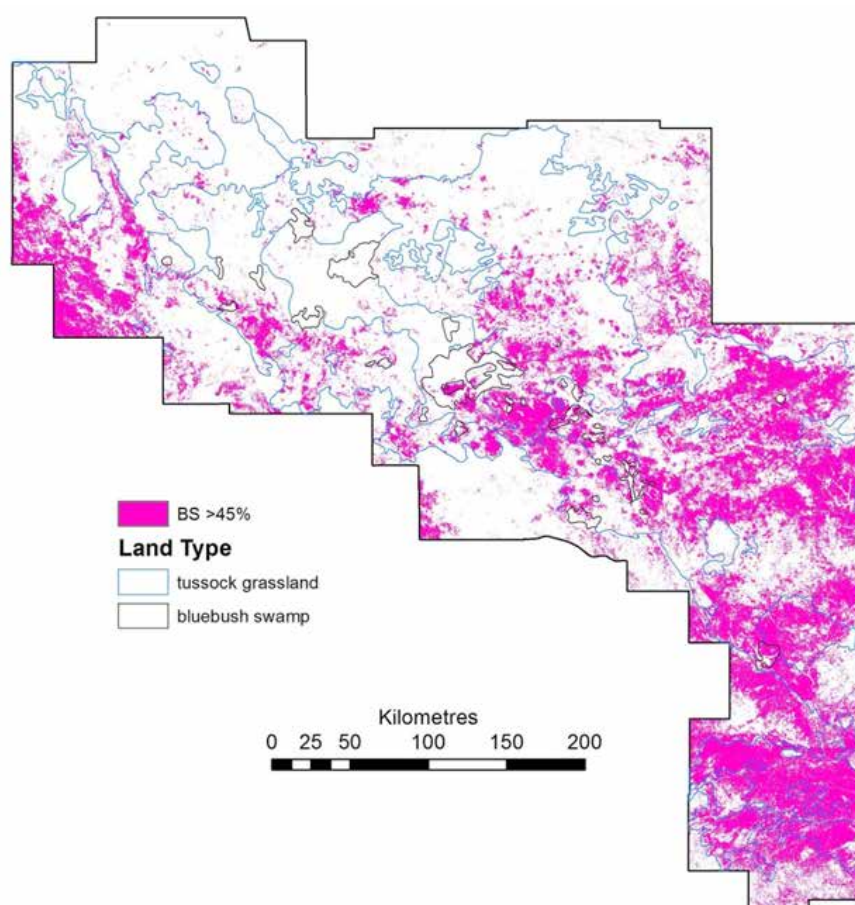


Figure 49: Parts of the Barkly Pastoral District having more than 45% bare soil per Landsat pixel in late 2016. Areas with higher pastoral value are shown with black and blue polygons.

Note that the threshold level of bare soil used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.

BARKLY PASTORAL DISTRICT

Site based monitoring

Six pastoral leases, comprising 27% of the pastoral lease area for the Barkly Pastoral District, were visited in the latter part of 2015 and during 2016.

Vegetation cover of the ground layer was measured using the point intercept method at 46 sites across the six leases. Sites, on average, had a good cover of perennial grasses, a lesser contribution of annual grasses, minor forbs and reasonable litter cover (Figure 50). Bare soil comprised about one fifth of the 1 ha site area, on average. Perennial grasses are particularly important on the Mitchell grass downs as the mainstay of the grazing industry. They also protect the soil surface against wind and water erosion and, where sufficiently dense, provide competition against invasive woody species such as *Parkinsonia* (*Parkinsonia aculeata*) and Rubber Bush (*Calotropis procera*). Litter cover also protects the soil surface, assists infiltration of rain water and helps retain plant seeds in situ.

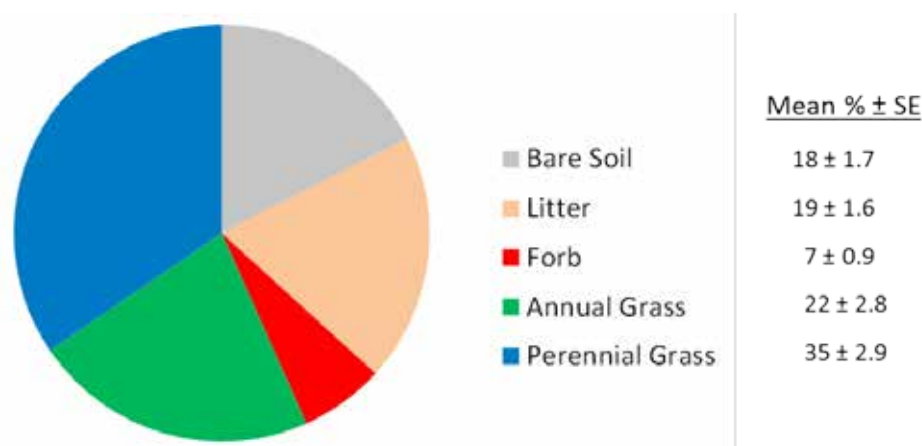


Figure 50: Mean percentage and standard error of measured components of vegetation cover in the ground layer from 46 sites on six pastoral leases in the Barkly Pastoral District.

Most sites were minimally grazed (Table 20), although this assessment is partly dependent on the time at which a lease is visited relative to the end of the growing season; later assessments may mean increased levels of pasture utilisation. Two sites had experienced more severe grazing.

There was no evidence of erosion recorded at any of the 46 sites.

Table 20: Levels of pasture utilisation recorded at 46 sites on six pastoral leases in the Barkly Pastoral District.

Pasture Utilisation	
Rank	% of sites
No grazing	7
Minimal	76
Moderate	9
Moderate to heavy	4
Heavy	4

BARKLY PASTORAL DISTRICT

Land condition ratings assigned at monitoring sites and the more generalised assessment of land condition across those parts of pastoral leases traversed are summarised in Table 21. The six stations experienced average to slightly above average seasonal quality, based on 12 month rainfall (to September 2016) and modelled wet season pasture growth. One lease was visited in late 2015 where land condition was assessed with regard to vegetation characteristics influenced by the 2014-15 wet season.

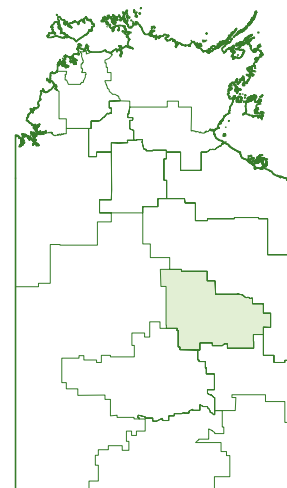
Table 21: Assessed land condition at monitoring sites and traversed parts of six pastoral leases in the Barkly Pastoral District.

Station	Condition Rating	Comments with regard to pastoral lease
1	Good: 2 sites Fair: 1 site	Much of the lease undeveloped and other areas inaccessible at the time of visit due to unmaintained fence lines and tracks. Most of the area accessed considered to be in good condition.
2	Good: 9 sites Fair: 4 sites	Most of the property was assessed to be in good condition with some paddocks rated in fair condition. Areas of Prickly Acacia (<i>Vachellia nilotica</i>) and Parkinsonia (<i>Parkinsonia aculeata</i>) are present, mostly around yards and bores. These weeds are actively being controlled.
3	Good: 6 sites	Most of the lease considered to be good condition. A significant portion of the station is less developed and utilised.
4	Good: 4 sites Fair: 5 sites	The property, in general, was assessed to be in good condition with some paddocks rated in fair condition. A diversity of palatable perennial and annual grass species was present across the property and there were only a few signs of active erosion.
5	Good: 7 sites Fair: 2 sites	This lease managed in conjunction with the above property and similar comments apply; i.e. most areas traversed assessed to be in good condition.
6	Good: 4 sites Fair: 2 sites	A diversity of palatable perennial and annual grass species was present across the more valuable grazing country on the property. Rubber Bush (<i>Calotropis procera</i>) is present near yards and bores, but appears to be actively managed. Some paddocks had evidence of heavy grazing but retained good ground cover with a variety of perennial and annual grasses and forbs present. New water points are being installed to expand the area available for grazing and to relieve grazing pressure on productive country surrounding older water points in the centre of the station.

TENNANT CREEK PASTORAL DISTRICT

Seasonal quality was much above average across most of the district based on rainfall and modelled pasture growth.

Eight percent of the region burnt between October 2015 and September 2016 with fire most active in October and November 2015. Based on Landsat imagery, most of the district had above average to highest levels of vegetation cover recorded since 1988. One third of the area had >45% bare soil per Landsat pixel, mainly in the east (Aboriginal Land Trust) and south-west. To some extent this increased bare soil is a legacy effect of extensive wildfire in 2011 and 2012. Twenty sites were monitored on three pastoral leases with six sites in good condition, nine fair and five poor.



Map 8: Location of Tennant Creek Pastoral District

Seasonal quality

“Seasonal quality” describes the relative value of recent rainfall in producing forage for livestock. It is judged with reference to the historical record. Two indicators are used: rainfall amount compared with the long term median and expected pasture growth based on rainfall received, simulated using AussieGRASS (www.longpaddock.qld.gov.au).

Descriptors of seasonal quality provide useful context for interpreting various measures of land condition at particular times. However, to the extent possible, land condition is assessed independently of seasonal conditions.

Rainfall statistics (Table 22) are based on gridded rainfall produced by the Bureau of Meteorology (www.bom.gov.au/jsp/awap/rain/index.jsp). Pixel (grid cell) values are calculated from rainfall amounts at recognised recording stations. Rainfall is from October of one year to September the following year. Modelled pasture growth is for the period November 2015 to April 2016. This growth is ranked as a percentile of the growth for all previous summers.

Table 22: Indicators of seasonal quality. Data spatially averaged for the Tennant Creek Pastoral District.

Rainfall (mm)		AussieGRASS	
2015 - 2016	512	Growth (kg/ha)	619
Long term median	284	Percentile	71

Spatially averaged rainfall for the Tennant Creek Pastoral District was much above the long term median (Table 22), mainly due to relatively high rainfall (>550 mm) in the central and eastern parts (Figure 51, left hand panel). Murray Downs and Singleton pastoral leases, and adjoining Aboriginal Land Trust in the south-west of the region had less than 450 mm for the 12 months.

TENNANT CREEK PASTORAL DISTRICT

Modelled pasture growth over the last summer, as a percentage of the long term record, was much above average across most of the pastoral district (Figure 51, right hand panel). An area of Aboriginal Land Trust north of Annitowa station had modelled pasture growth that was very much above average.

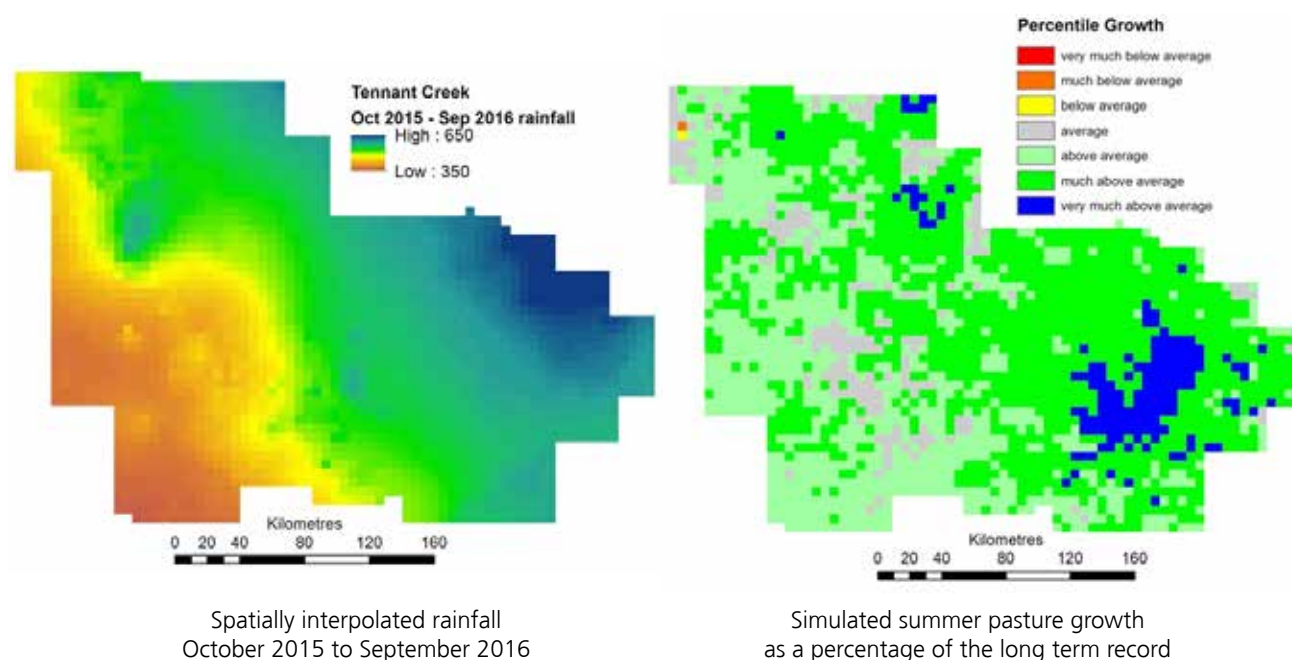


Figure 51: Maps of seasonal quality. Left, gridded rainfall, October 2015 to September 2016; right, AussieGRASS modelled pasture growth for the 2014-15 summer period as a percentage of previous summers.

Fire

The North Australian Fire Information website (www.firenorth.org.au/nafi3) reports that 5646 km² (8.2% of the district) burnt between October 2015 and September 2016. Fire was most active in October and November 2015 with greater than 2000 km² burning in each month.

Bare soil dynamics

It is important to maintain adequate ground cover in the latter months of each year to minimise soil loss from wind erosion and intense summer storms. It is also important to carry dry feed, and associated ground cover, into the latter months of each calendar year in case there is a late start to the usual wet season and/or monsoonal rains fail more generally.

The amount of bare soil present at any location changes from year to year depending on rainfall and its effectiveness, fire history and amount of grazing. The percentage of bare soil in each 30m square Landsat pixel (900 m² or 0.09 ha) was used to report the amount of bare soil across all pixels in the Tennant Creek Pastoral District.

TENNANT CREEK PASTORAL DISTRICT

Most of the pastoral district had above average to highest levels of vegetation cover recorded since 1988 (Figure 51). This pattern broadly corresponded with the above average modelled pasture growth shown in Figure 51 (right hand panel). Almost all areas in the north-west of the Tennant Creek Pastoral District with much below average vegetation cover in late 2016 were burnt at some stage in the preceding 12 months (fire scars not shown in Figure 52).

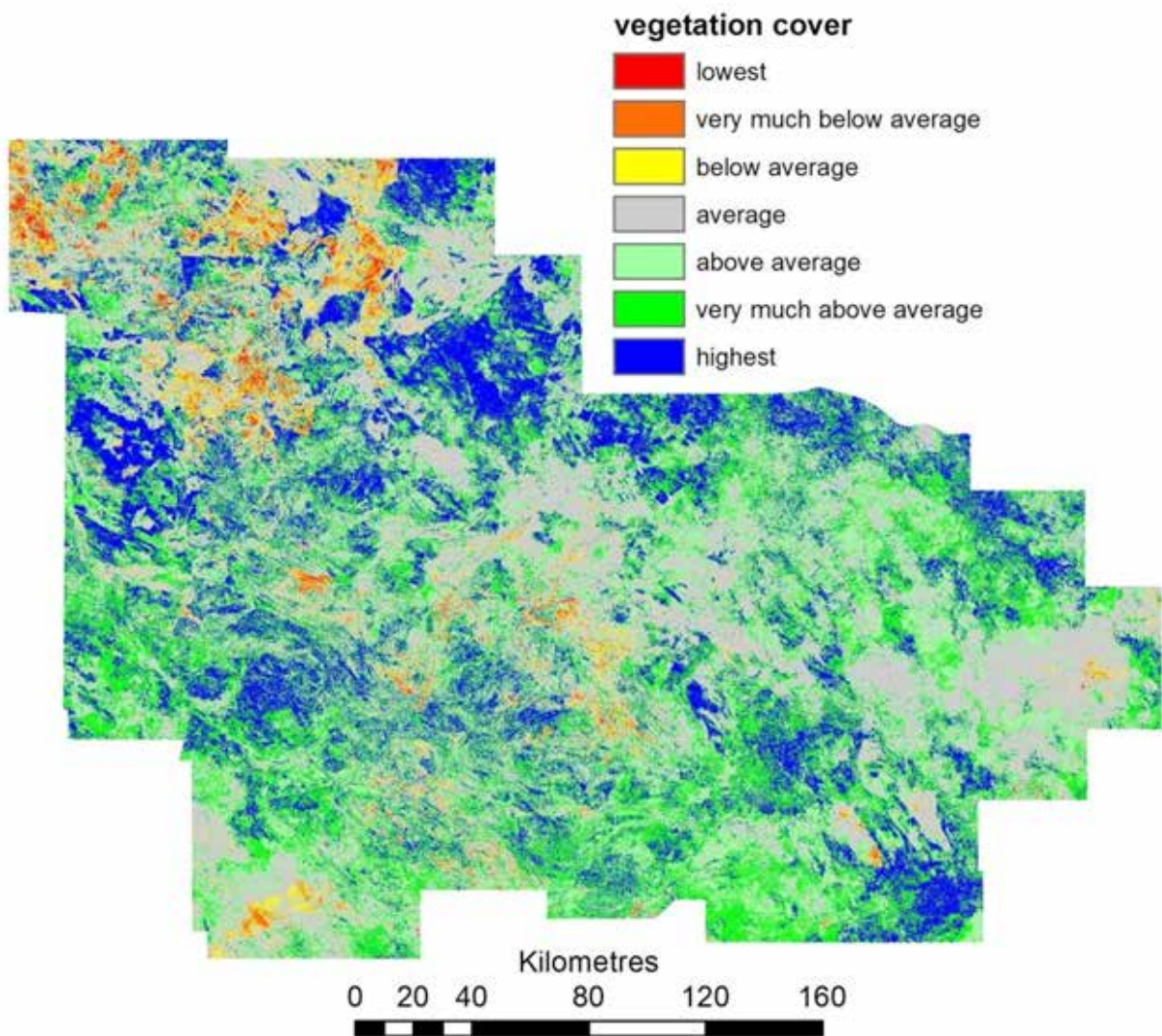


Figure 52: Rank of the amount of remotely-sensed vegetation cover present from September to November 2016 against that for previous years back to 1988.

Approximately 1% of the pastoral district had negligible bare soil (<20% of the 30m Landsat pixel) towards the end of 2016 (Figure 53). One quarter of the region had <35% bare soil (per Landsat pixel). One third of the district had >45% bare soil (area mapped in Figure 54).

TENNANT CREEK PASTORAL DISTRICT

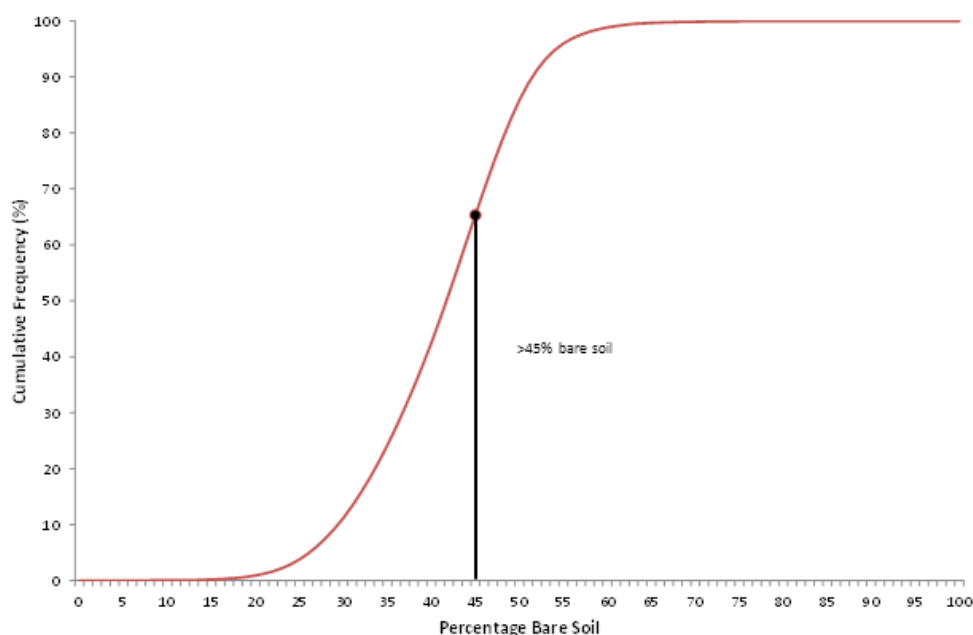


Figure 53: Percentage cumulative frequency of varying levels of bare soil in 30m square Landsat pixels in the Tennant Creek Pastoral District between September and November 2016. Areas with greater than 45% bare soil are mapped in Figure 54.

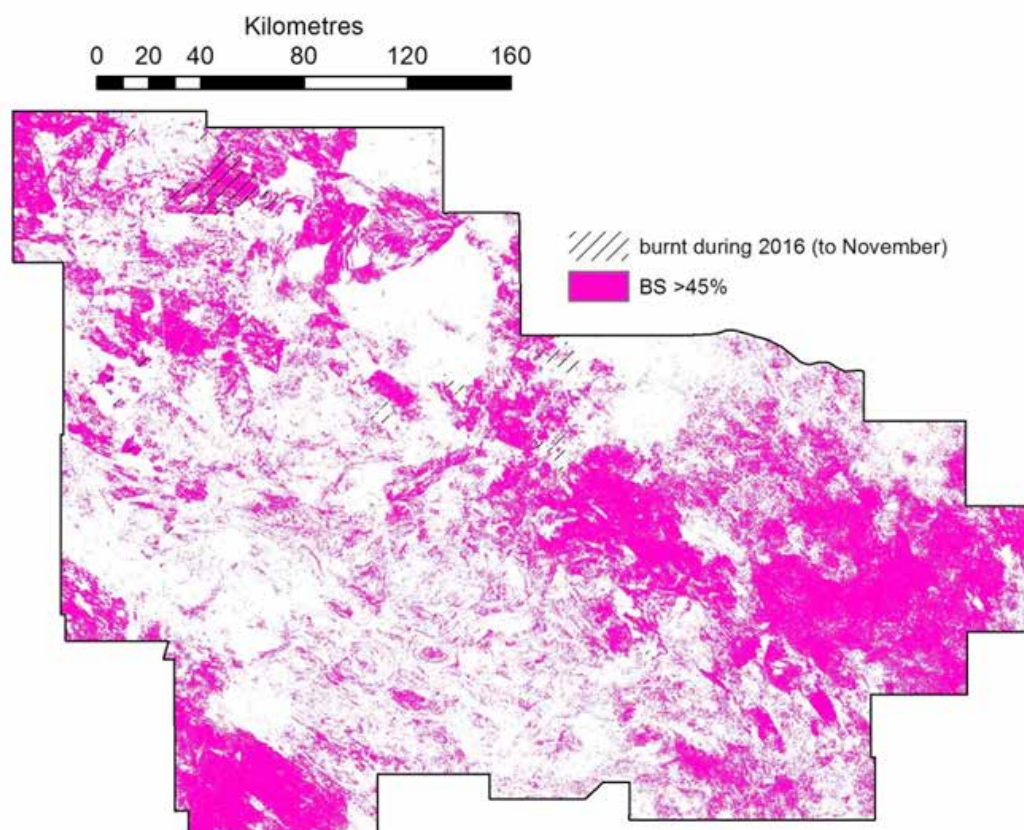


Figure 54: Parts of the Tennant Creek Pastoral District having more than 45% bare soil per Landsat pixel in late 2016. Areas burnt between January and November 2016 are shown with diagonal lines.

Note that the threshold level of bare soil used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.

TENNANT CREEK PASTORAL DISTRICT

Site based monitoring

Three pastoral leases in the Tennant Creek Pastoral District, comprising 40% of the pastoral lease area, were visited during 2016.

Vegetation cover of the ground layer was measured using the point intercept method at 20 sites across the three leases. Sites, on average, had a moderate level of bare soil, reasonable levels of litter cover and perennial grass, and small contributions of annual grasses and forbs (Figure 55).

There was, however, considerable variation in cover components amongst sites. Five sites had more than 50% bare soil, a high level for the Tennant Creek region. Perennial grasses exceeded 30% total cover at three sites but comprised <10% cover at five sites.

Perennial grasses are important because they protect the soil surface against wind and water erosion and, where palatable, provide persistent forage to carry livestock through dry times. Litter cover also protects the soil surface, assists infiltration of rain water and helps retain plant seeds in situ.

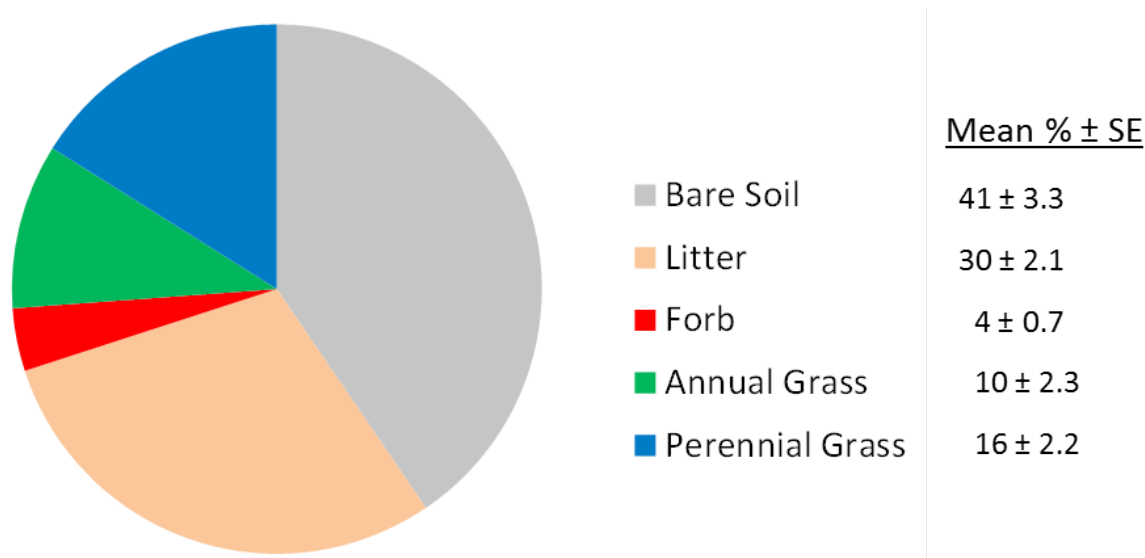


Figure 55: Mean percentage and standard error of measured components of vegetation cover in the ground layer from 20 sites on three pastoral leases in the Tennant Creek Pastoral District.

Six of the 20 sites (30%) were either not grazed or minimally grazed at the time of assessment (Table 23). More than 75% of the seasonal pasture growth had been consumed at eight sites, spread across the three leases.

Six sites (30%) showed evidence of erosion by wind sheeting with four sites (20%) affected by water sheeting.

TENNANT CREEK PASTORAL DISTRICT

Table 23: Levels of pasture utilisation and evidence of erosion assessed at 20 sites on three pastoral leases in the Tennant Creek Pastoral District.

Pasture Utilisation		Evidence of Erosion	
Rank	% of sites	Type	% of sites
No grazing	10	Wind	30
Minimal	20	Scalding	10
Moderate	15	Water sheeting	20
Moderate to heavy	5	Not apparent	40
Heavy	35		
Very Heavy	5		
Not Recorded	10		

Land condition ratings assigned at monitoring sites and the more generalised assessment of land condition across those parts of pastoral leases traversed are summarised in Table 24. All stations experienced above average seasonal quality, based on rainfall and modelled pasture growth. To the extent possible, condition assessments are independent of year-to-year variability in rainfall.

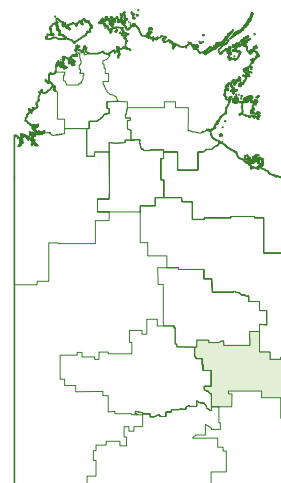
Table 24: Assessed land condition at monitoring sites and traversed parts of three pastoral leases in the Tennant Creek Pastoral District.

Station	Condition Rating	Comments with regard to pastoral lease
1	Good: 4 sites Fair: 2 sites Poor: 3 sites	Mitchell grass plains and alluvial country fringing major watercourses are in poor to fair condition. Some areas are actively eroding. Remaining parts of the lease are in generally good condition. Patches of Parkinsonia (<i>Parkinsonia aculeata</i>) are being actively controlled
2	Good: 2 sites Fair: 5 sites	Active erosion was recorded at one measured site. However during traverses of the property, severe active gully erosion was encountered at various points in alluvial country fringing larger drainage systems. Rubber Bush (<i>Calotropis procera</i>) and Parkinsonia are present and are being actively controlled.
3	Fair: 2 sites Poor: 2 sites	Extensive areas of spinifex sand plain are in good condition. Contrasting with their largely undisturbed state, smaller areas of highly preferred alluvial country were in mostly poor condition. Some areas were historically eroded, ground cover was generally lacking and minor erosion was continuing in parts. Buffel grass had established in some areas and was helping to stabilise the soil. Rubber Bush, Parkinsonia and Noogoora Burr (<i>Xanthium strumarium</i>) are present in different parts of the station.

PLENTY PASTORAL DISTRICT

The district experienced mainly above average seasonal quality based on AussieGRASS modelled pasture growth and, correspondingly, Landsat imagery indicated that most of the region had much above average vegetation cover relative to that present in the latter part of each year back to 1988.

Approximately half of the region had <40% bare soil and one tenth had >50% bare soil. Seven of 22 sites monitored on two pastoral leases were in good condition and a further 14 in fair condition. Four sites showed evidence of past erosion.



Map 9: Location of Plenty Pastoral District

Seasonal quality

“Seasonal quality” describes the relative value of recent rainfall in producing forage for livestock. It is judged with reference to the historical record. Two indicators are used: rainfall amount compared with the long term median and expected pasture growth based on rainfall received, simulated using AussieGRASS (www.longpaddock.qld.gov.au).

Descriptors of seasonal quality provide useful context for interpreting various measures of land condition at particular times. However, to the extent possible, land condition is assessed independently of seasonal conditions.

Rainfall statistics (Table 25) are based on gridded rainfall produced by the Bureau of Meteorology (www.bom.gov.au/jsp/awap/rain/index.jsp). Pixel (grid cell) values are calculated from rainfall amounts at recognised recording stations. Rainfall is from October of one year to September the following year. Modelled pasture growth is for the same period (October 2015 to September 2016) to take account of useful winter rainfall during 2016. This growth is ranked as a percentile of growth for all previous October – September periods.

Table 25: Indicators of seasonal quality. Data spatially averaged for the Plenty Pastoral District.

Rainfall (mm)		AussieGRASS	
2015 - 2016	478	Growth (kg/ha)	917
Long term median	205	Percentile	78

Spatially averaged rainfall for the Plenty Pastoral District was much above the long term median (Table 25) due to good falls in the central, northern and eastern parts (Figure 56, left hand panel). Argadargada and parts of the neighbouring Ooratippra, Lucy Creek and Manners Creek pastoral leases had greater than 500 mm between October 2015 and September 2016.

PLENTY PASTORAL DISTRICT

Twelve month rainfall was considerably less in the western part of the region (and particularly Ammaroo and Derry Downs in the north-west) and in the far south-east (southern half of Tobermorey).

Almost all the pastoral district experienced above average seasonal quality, based on modelled pasture growth, in the 12 months October 2015 to September 2016. Modelled pasture growth for Tobermorey and Marqua stations, in the far east of the District, was very much above average.

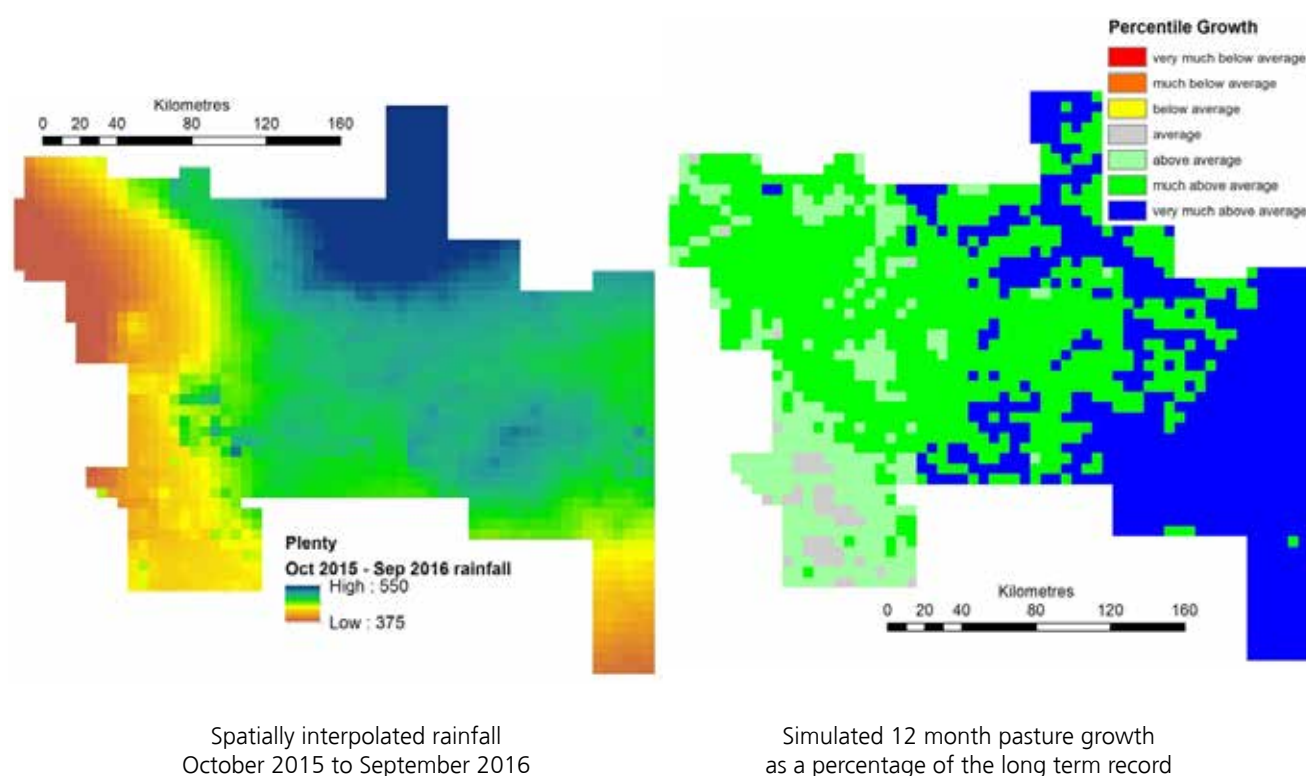


Figure 56: Maps of seasonal quality for the period, October 2015 to September 2016. Left, gridded rainfall; right, AussieGRASS modelled pasture growth as a percentage of similar periods.

Fire

The North Australian Fire Information website (www.firenorth.org.au/nafi3) does not report any fire activity in the Plenty Pastoral District between October 2015 and September 2016.

Bare soil dynamics

It is important to maintain adequate ground cover in the latter months of each year to minimise soil loss from wind erosion and intense summer storms. The highly variable nature of rainfall in the southern NT also means that it is necessary to carry dry feed, and associated ground cover, into the hotter months in case summer rains fail.

PLENTY PASTORAL DISTRICT

The amount of bare soil present at any location changes from year to year depending on rainfall and its effectiveness, fire history and amount of grazing. The percentage of bare soil in each 30m square Landsat pixel (900 m² or 0.09 ha) was used to report the amount of bare soil across all pixels in the Plenty Pastoral District.

Most of the pastoral district had much above average vegetation cover relative to that present in the latter part of each year back to 1988 (Figure 57). Good winter rainfall across much of the region was no doubt a contributing factor. The eastern part of Manners Creek and northern section of Tobermorey pastoral leases had average levels of vegetation cover compared with the recent past.

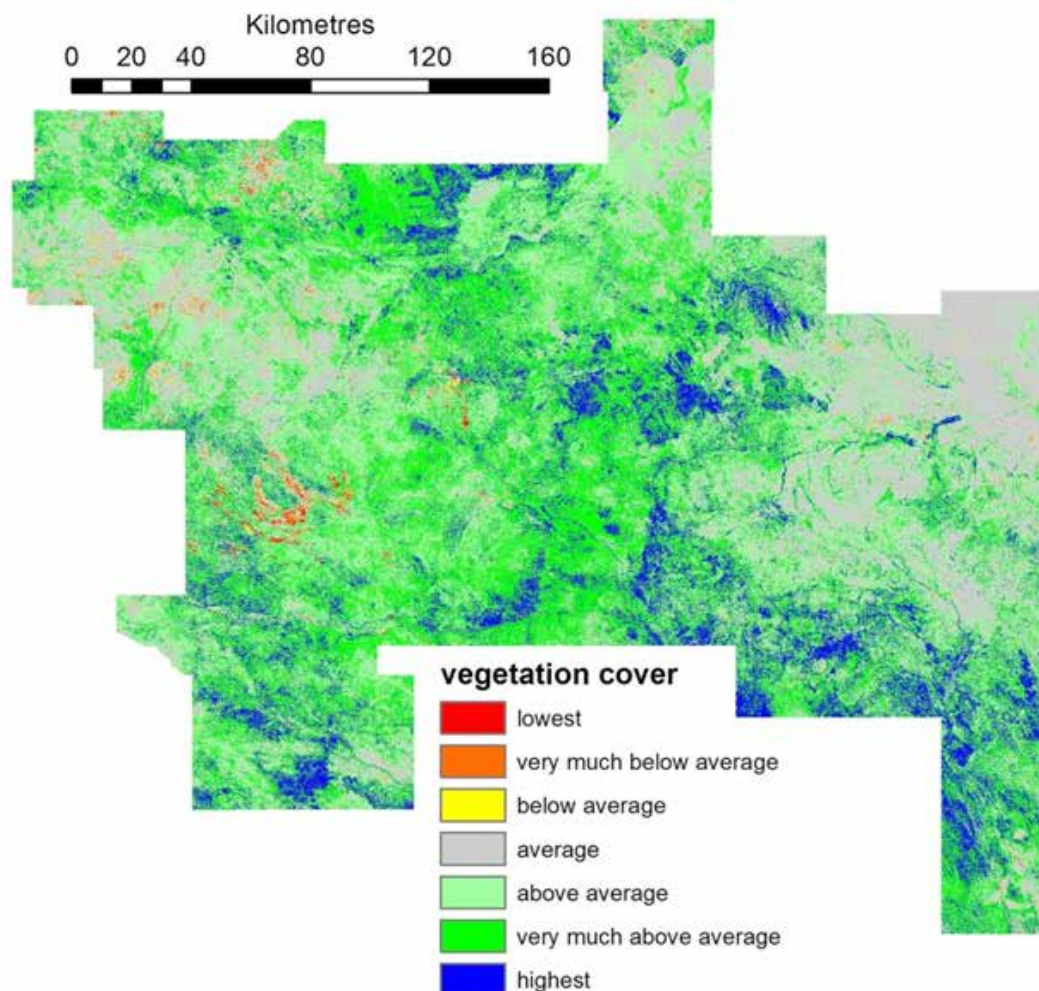


Figure 57: Rank of the amount of remotely-sensed vegetation cover present from September to November 2016 against that for previous years back to 1988.

Two per cent of the pastoral district had a small amount of bare soil (<20% of the 30m Landsat pixel) towards the end of 2016 (Figure 58). Approximately half of the region had <40% bare soil and one tenth had >50% bare soil. Areas with >45% bare soil are mapped in Figure 59.

PLENTY PASTORAL DISTRICT

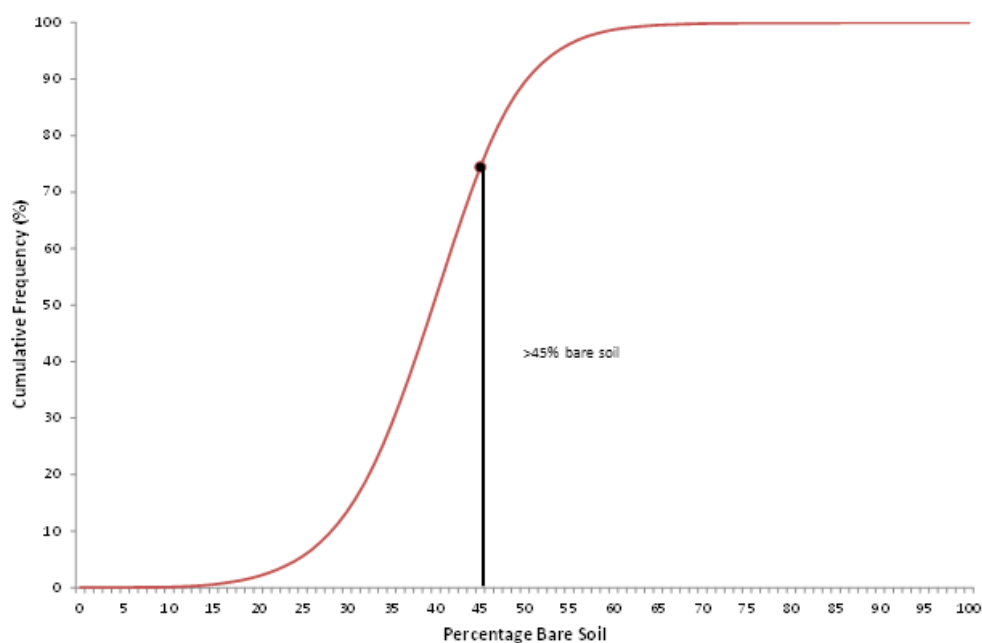


Figure 58: Percentage cumulative frequency of varying levels of bare soil in 30m square Landsat pixels in the Plenty Pastoral District between September and November 2016. Areas with greater than 45% bare soil are mapped in Figure 59.

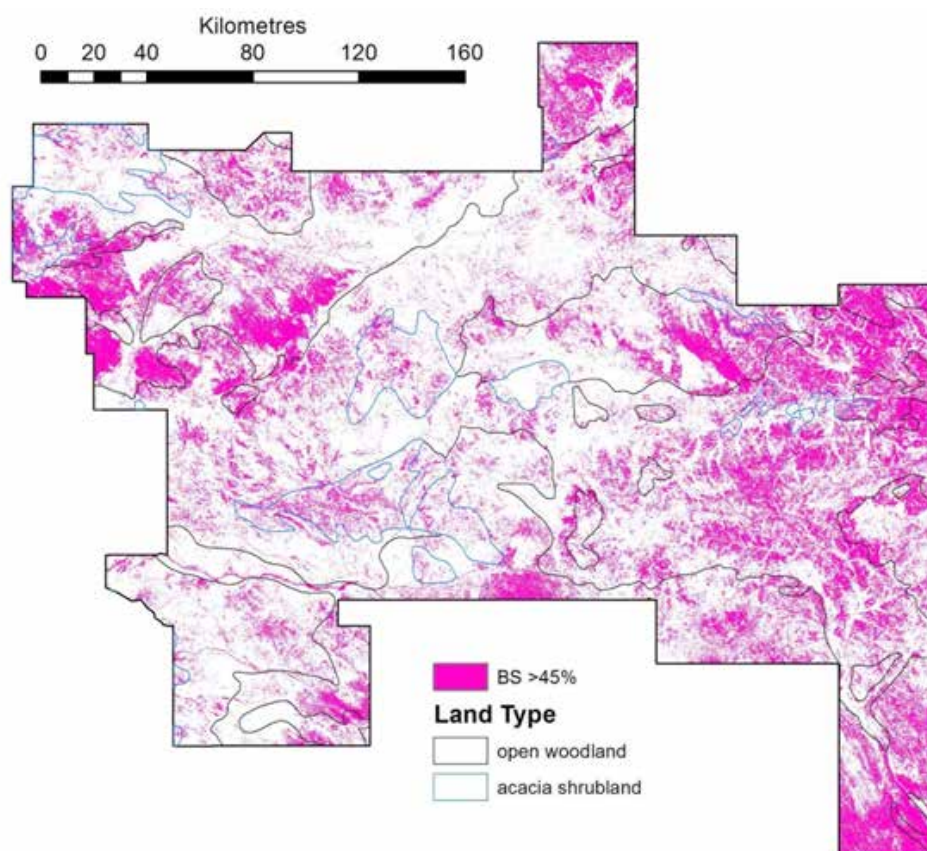


Figure 59: Parts of the Plenty Pastoral District having more than 45% bare soil per Landsat pixel in late 2016. Areas with higher pastoral value are shown with black and blue polygons.

Note that the threshold level of bare soil used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.

PLENTY PASTORAL DISTRICT

Site based monitoring

Two pastoral leases were visited in the Plenty Pastoral District during 2016, comprising 20% of the pastoral lease area in that district.

Vegetation cover of the ground layer was measured using the point intercept method at 22 sites across the two leases. Sites, on average, had a moderate amount of bare soil, reasonable litter cover and a moderate contribution of annual grasses (Figure 60). Perennial grasses also contributed usefully to total cover, on average, but there was considerable variation amongst sites. Two sites had >60% perennial grasses (as a proportion of total ground cover) and 12 sites had <10% perennial-grass cover.

Most of the 22 sites were either not grazed or minimally utilised at the time of assessment (Table 26).

Four sites showed evidence of past wind sheeting as a form of erosion (Table 26).

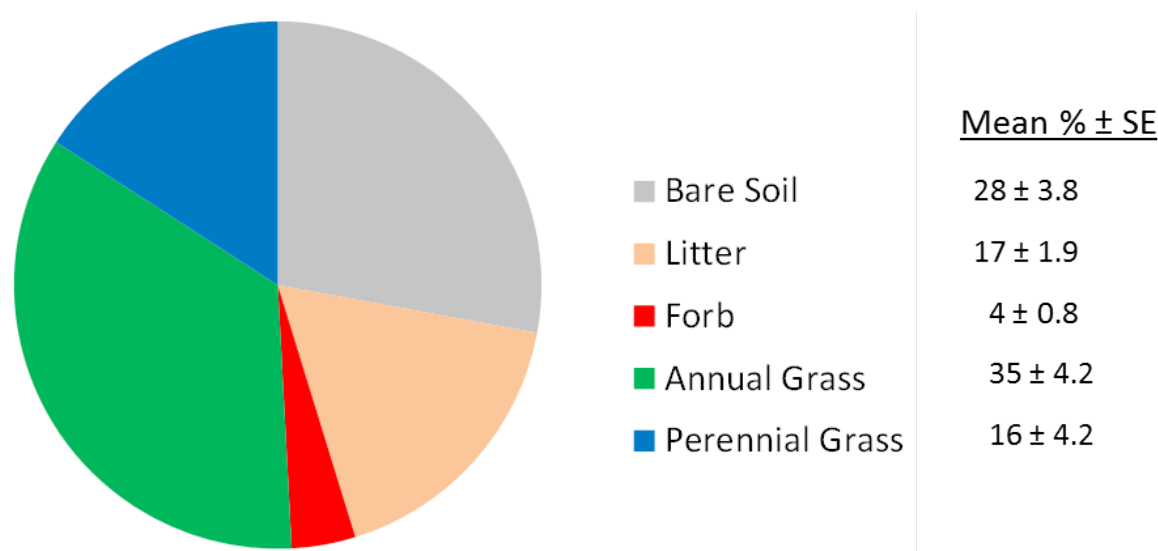


Figure 60: Mean percentage and standard error of measured components of vegetation cover in the ground layer from 22 sites on two pastoral leases in the Plenty Pastoral District.

Table 26: Levels of pasture utilisation and evidence of erosion assessed at 22 sites on two pastoral leases in the Plenty Pastoral District.

Pasture Utilisation		Evidence of Erosion	
Rank	% of sites	Type	% of sites
Not recorded	5	Wind	18
No grazing	32	Not apparent	82
Minimal	54		
Moderate	9		

PLENTY PASTORAL DISTRICT

Land condition ratings assigned at monitoring sites and the more generalised assessment of land condition across those parts of pastoral leases traversed are summarised in Table 27. The two pastoral leases experienced favourable seasonal conditions based on 12-month rainfall and modelled pasture growth. To the extent possible, condition assessments are independent of year-to-year variability in rainfall.

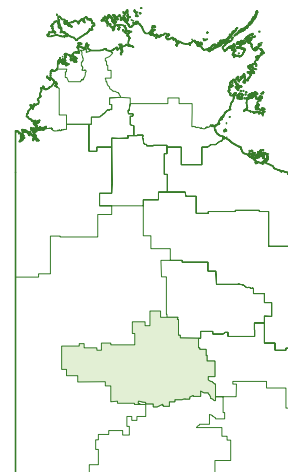
Table 27: Assessed land condition at monitoring sites and traversed parts of two pastoral leases in the Plenty Pastoral District.

Station	Condition Rating	Comments with regard to pastoral lease
1	Good: 5 sites Fair: 4 sites	The property, in general, was assessed to be in good to fair condition. There is evidence that extensive areas of productive, alluvial river-frontage have been heavily utilised in the past. This includes reduced cover and diversity of palatable perennial grasses and historical erosion. Overall, this area was considered to be in fair condition. Large areas of open gidgee woodland generally had good pasture growth and species composition with few signs of active erosion; these areas were considered to be in good to fair condition.
2	Good: 2 sites Fair: 10 sites Poor: 1 site	Of the more productive land types for grazing, Mitchell grass pastures ranged in good to poor condition and alluvial areas were in generally fair to good condition. Moderately productive areas, particularly annual grasslands, were also in fair to good condition. Of particular concern was serious gully erosion of tracks across much of the station.

NORTHERN ALICE SPRINGS PASTORAL DISTRICT

Much of the pastoral district experienced above average seasonal quality due to good winter rainfall. This was also quantified based on expected pasture growth (modelled using AussieGRASS).

Parts of the south-western area had seasonal conditions that were very much above average. From Landsat data, most of the district had more vegetation cover (relatively less bare soil) in the latter period of 2016 compared with previous years since 1988. There were, however, elevated levels of bare soil in some areas. Thirty per cent of the region had more than 45% bare soil at this time and a little more than a tenth of the district had >50% bare soil. On ground monitoring was conducted at 113 sites on 12 pastoral leases where there was, on average, a moderate to high level of bare soil, reasonable litter cover and small contributions of perennial and annual grasses, and forbs. Slightly less than half the sites showed evidence of erosion by wind or water and 35 sites (31%) were heavily grazed at the time of assessment. Sixty percent of sites were rated in fair or good condition.



Map 10: Location of Northern Alice Springs Pastoral District

Seasonal quality

“Seasonal quality” describes the relative value of recent rainfall in producing forage for livestock. It is judged with reference to the historical record. Two indicators are used: rainfall amount compared with the long term median and expected pasture growth based on rainfall received, simulated using AussieGRASS (www.longpaddock.qld.gov.au).

Descriptors of seasonal quality provide useful context for interpreting various measures of land condition at particular times. However, to the extent possible, land condition is assessed independently of seasonal conditions.

Rainfall statistics (Table 28) are based on gridded rainfall produced by the Bureau of Meteorology (www.bom.gov.au/jsp/awap/rain/index.jsp). Pixel (grid cell) values are calculated from rainfall amounts at recognised recording stations. Rainfall is from October of one year to September the following year. Modelled pasture growth is for the same period (October 2015 to September 2016) to take account of good winter rainfall across parts of the region during 2016. This growth is ranked as a percentile of growth for all previous October – September periods.

Table 28: Indicators of seasonal quality. Data spatially averaged for the Northern Alice Springs Pastoral District.

Rainfall (mm)		AussieGRASS	
2015 - 2016	378	Growth (kg/ha)	1067
Long term median	258	Percentile	69

NORTHERN ALICE SPRINGS PASTORAL DISTRICT

Spatially averaged rainfall for the Northern Alice Springs Pastoral District was above the long term median of 258 mm (Table 28) but showed considerable spatial variation across the region (Figure 61, upper left panel). The western and southern sections received considerably more rainfall between October 2015 and September 2016 with Narwietooma, and the area extending from Newhaven to the southern half of Mount Doreen having greater than 450mm.

Modelled pasture growth in the 12 months, October 2015 to September 2016, was average to above average compared with the long term record (Figure 61, lower right panel). Parts of the south-western area had seasonal conditions that were very much above average.

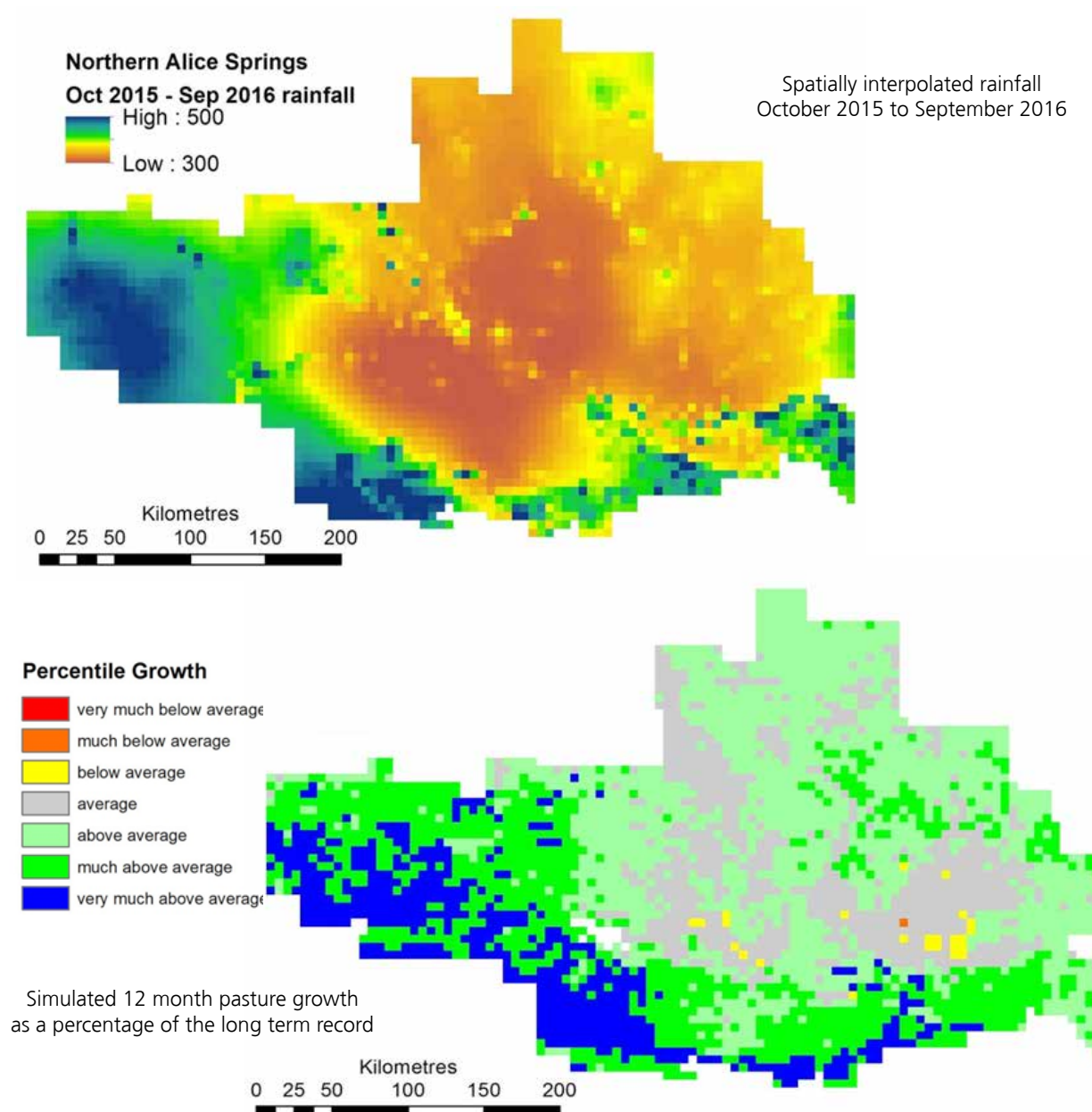


Figure 61: Maps of seasonal quality for the period, October 2015 to September 2016. Upper Left, gridded rainfall; Lower Right, AussieGRASS modelled pasture growth as a percentage of previous similar periods.

NORTHERN ALICE SPRINGS PASTORAL DISTRICT

Fire

Data available from the North Australian Fire Information website (www.firenorth.org.au/nafi3) shows that 2037 km² (2.0% of the district) burnt between October 2015 and September 2016 (the monthly distribution of burnt area is not graphed). Fire was most active in late 2015 with approximately 1000 km² burnt in October, 340 km² in November and 530 km² in December of that year.

Bare soil dynamics

It is important to maintain adequate ground cover in the latter months of each year to minimise soil loss from wind erosion and intense summer storms. The highly variable nature of rainfall in the southern NT also means that it is necessary to carry dry feed, and associated ground cover, into the hotter months in case summer rains fail.

The amount of bare soil present at any location changes from year to year depending on rainfall and its effectiveness, fire history and amount of grazing. The percentage of bare soil in each 30m square Landsat pixel (900 m² or 0.09 ha) was used to report the amount of bare soil across all pixels in the Northern Alice Springs Pastoral District.

Most of the district had more vegetation cover (relatively less bare soil) in the latter period of 2016 compared with previous years since 1988 (Figure 62). This pattern largely conformed with the spatial pattern of modelled above average pasture growth (lower right panel, Figure 61). The small areas of much below average vegetation cover in the central and north-eastern parts of the region correspond with 2013 fire scars and more extensive wildfire in 2012 and 2011.

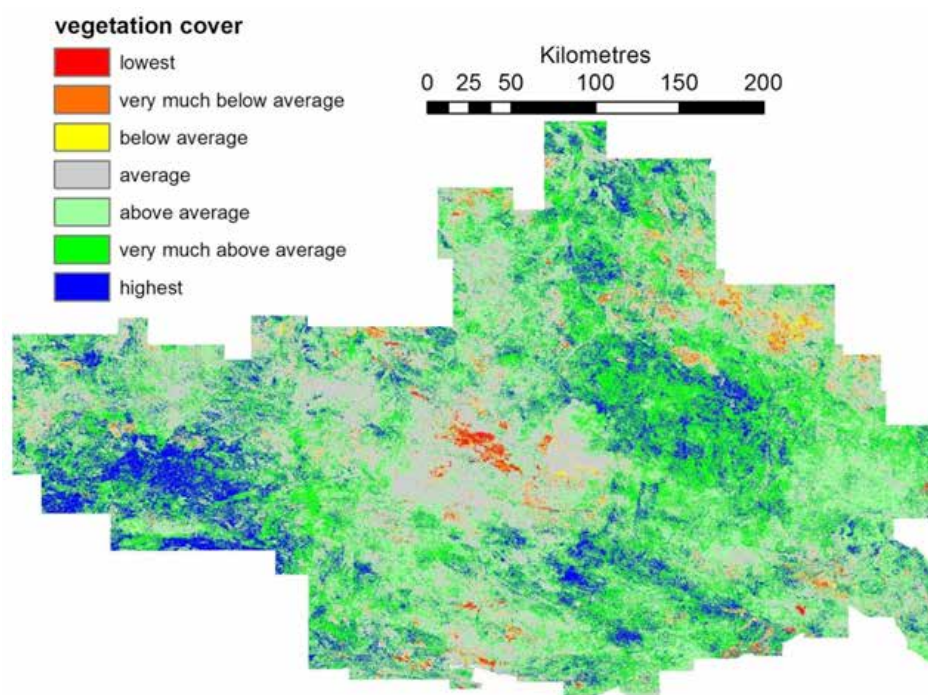


Figure 61: Rank of the amount of remotely-sensed vegetation cover present from September to November 2016 against that for previous years back to 1988.

NORTHERN ALICE SPRINGS PASTORAL DISTRICT

Approximately 0.5% of the pastoral district had small amounts of bare soil (<20% of the 30m Landsat pixel) towards the end of 2016 (Figure 63). Thirty per cent of the region had >45% bare soil (mapped in Figure 64) and a little more than a tenth of the district had >50% bare soil.

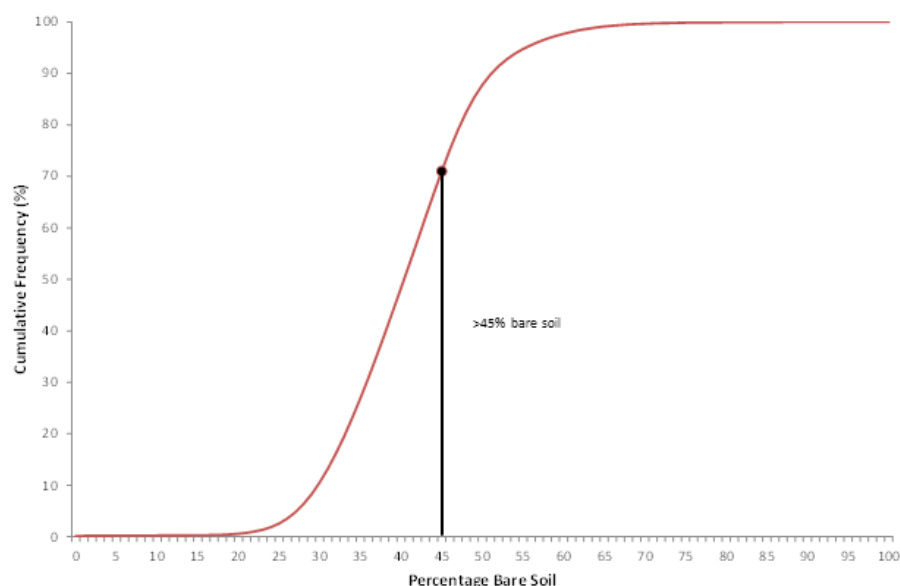


Figure 63: Percentage cumulative frequency of varying levels of bare soil in 30m square Landsat pixels in the Northern Alice Springs Pastoral District between September and November 2016. Areas with greater than 45% bare soil are mapped in Figure 64.

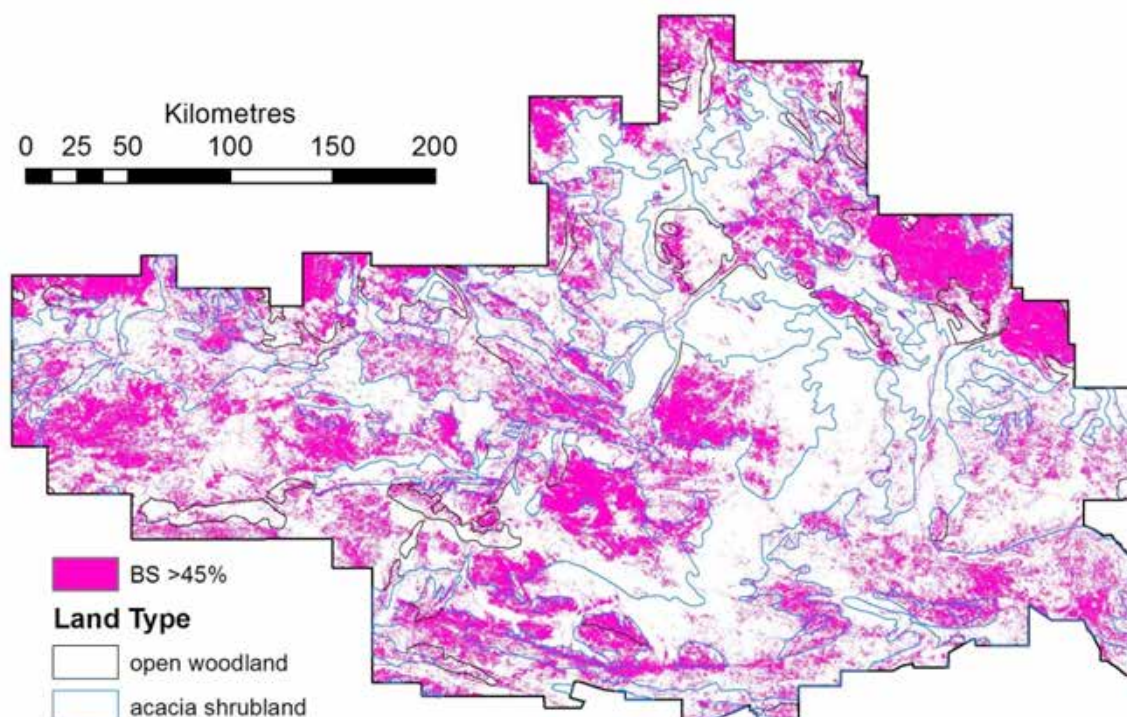


Figure 64: Parts of the Northern Alice Springs Pastoral District having more than 45% bare soil per Landsat pixel in late 2016. Areas with higher pastoral value are shown with black and blue polygons.

Note that the threshold level of bare soil used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.

NORTHERN ALICE SPRINGS PASTORAL DISTRICT

Site based monitoring

Twelve pastoral leases were visited in the Northern Alice Springs Pastoral District during 2016. The combined area of these leases comprises 53% of the pastoral lease area for the district.

Vegetation cover of the ground layer was measured using the point intercept method at 113 sites across the 12 leases. Sites, on average, had a moderate to high level of bare soil, reasonable litter cover and small contributions of perennial and annual grasses, and forbs (Figure 65). Litter cover is important because it assists infiltration of rain water, helps retain seed on site and reduces erosion risk.

There was, however, considerable variation in amounts of bare soil and perennial grass cover amongst sites. Twenty sites (18% of total) had more than 70% bare soil, a high level for the region. These sites were located on seven pastoral leases. As a more positive sign, 10 sites on six leases, had >30% perennial grass (much of which was palatable to cattle) as a component of total ground cover.

Almost half of the 113 sites were rated as being minimally grazed (Table 29). Of some concern, 35 sites (31%) were considered to be heavily or very heavily grazed (more than 75% of the seasonal growth utilised). These sites were spread across nine leases.

Slightly less than half the sites showed evidence of erosion by wind or water (Table 29) which, in the main, had stabilised (data not shown). One fifth of sites had been impacted by some degree of scalding. Some sites had multiple forms of erosion (i.e. summed percentages in Table 29 greater than 100)

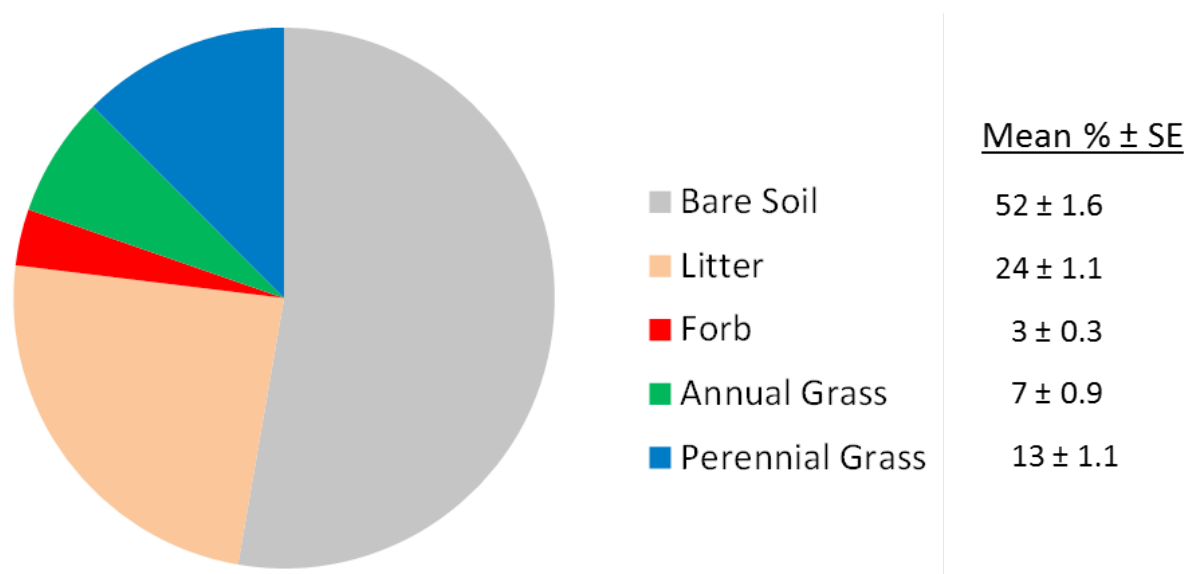


Figure 65: Mean percentage and standard error of measured components of vegetation cover in the ground layer from 113 sites on 12 pastoral leases in the Northern Alice Springs Pastoral District.

NORTHERN ALICE SPRINGS PASTORAL DISTRICT

Table 29: Levels of pasture utilisation and evidence of erosion assessed at 113 sites on 12 pastoral leases in the Northern Alice Springs Pastoral District.

Pasture Utilisation		Evidence of Erosion	
Rank	% of sites	Type	% of sites
Not recorded	4	Wind	46
No grazing	10	Scalding	21
Minimal	47	Water sheeting	43
Moderate	4	Gullying	7
Moderate to heavy	4		
Heavy	15		
Very Heavy	16		

Land condition ratings assigned at monitoring sites and the more generalised assessment of land condition across those parts of pastoral leases traversed are summarised in Table 30. Most leases received useful winter rainfall in 2016 and experienced above average seasonal quality based on modelled pasture growth in the 12 months, October 2015 to September 2016. To the extent possible, condition assessments are independent of year-to-year variability in rainfall and associated seasonal conditions.

Table 30: Assessed land condition at monitoring sites and traversed parts of twelve pastoral leases in the Northern Alice Springs Pastoral District.

Station	Condition Rating	Comments with regard to pastoral lease
1	Good: 3 sites Poor: 7 sites	Areas of more preferred grazing country were well utilised and were rated in poor condition. Ground cover was limited and the pasture was dominated by short-lived, low value species. Active erosion (severe in places) was observed at most sites. Less pastorally productive country (predominantly mulga woodland) varied between good and poor condition.
2	Good: 4 sites Fair: 3 sites Poor: 4 sites	Large areas of mulga country were rated in good condition with vegetation and litter providing good ground cover, and a good mix of perennial and annual species present. Elsewhere in the pastorally more productive country, past degradation is still affecting productivity – although much of this has stabilised and appears to be improving. These parts of the station were assessed to be in mostly fair condition.
3	Good: 1 site Fair: 3 sites Poor: 5 sites	Measured bare soil exceeded 60% at eight monitoring sites. Annual grasses were generally sparse, and pastures were mostly dominated by grasses of low pastoral productivity. Widespread increased density of woody species was observed in many areas, particularly in areas of alluvial country. Donkeys and feral horses were contributing to total grazing pressure at the time of assessment.

NORTHERN ALICE SPRINGS PASTORAL DISTRICT

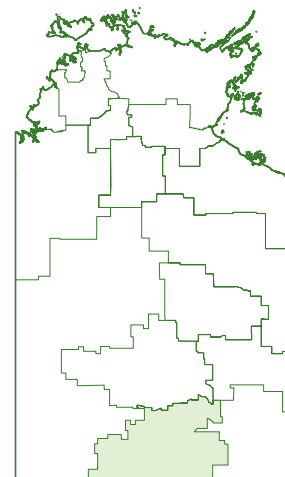
Station	Condition Rating	Comments with regard to pastoral lease
4	Fair: 1 site Poor: 3 sites	Productive parts of the property were rated in poor condition having limited ground cover and few useful forage species. Alluvial country is extensively scalded and recent active erosion evident. Some areas have severe thickening of Mimosa Bush (<i>Vachellia farnesiana</i>) and widespread establishment of Rubber Bush (<i>Calotropis procera</i>).
5	Fair: 4 sites Poor: 3 sites	Much of the lease comprises rugged mountainous and hilly country. Lower areas that are accessible to cattle show evidence of past, prolonged heavy utilisation. This assessment was based on elevated levels of bare soil, widespread moderate to severe active sheet and gully erosion, and lack of expected palatable species in the pasture.
6	Good: 1 site Fair: 1 site Poor: 15 sites	Much of the grazed area, across a range of land types, was assessed in overall poor condition. Expected palatable perennial grasses were generally absent with palatable annual species in low abundance. There was widespread evidence of prolonged heavy browsing of woody species. High levels of bare soil were observed across most of the property, combined with widespread sheet erosion and gulying of creeks and drainage lines. Contrasting with this, extensive areas of spinifex-dominated sand plain, which are of low grazing value, were considered to be in good condition.
7	Good: 15 sites	There was generally abundant pasture with low levels of utilisation and stable soils across all monitoring sites. Buffel grass is well established across much of the property where it provides high levels of ground cover but generally low diversity of palatable pasture species. Substantial effort has been invested in rehabilitating degraded areas, particularly with the use of ponding banks. Most areas were observed to be stable and, under current management, expected to recover in the long term.
8	Good: 7 sites Fair: 3 sites	The majority of the property was assessed to be in good condition with recent conservative stocking and rehabilitation efforts improving historically degraded areas. Relatively low utilisation at monitoring sites provided generally good levels of ground cover, stable soils and a diversity of palatable species.
9	Good: 3 sites Fair: 2 sites Poor: 7 sites	Large areas of pastorally less productive mulga and spinifex country were rated in fair to good condition. More productive alluvial and calcareous country was considered to be in poor condition, including widespread active erosion in drainage areas associated with major creeks.

NORTHERN ALICE SPRINGS PASTORAL DISTRICT

Station	Condition Rating	Comments with regard to pastoral lease
10	Good: 3 sites Fair: 6 sites Poor: 1 site	Most of the station was considered to be in good to fair condition. Annual grasses had responded well to average rainfall during the 2015-16 summer but palatable perennial grasses were often less abundant than expected. Large areas affected by historic scalding appear to be gradually recovering but continue to have reduced productivity.
11	Fair: 6 sites	Beyond monitoring sites, less productive sandy country was considered to be in generally good condition. More productive areas for grazing were rated in fair condition with reasonable ground cover and a mix of annual grasses. Productive perennial grasses were less abundant than expected. Slight erosion was observed in several places, but generally appears to have stabilised.
12	Fair: 1 site Poor: 1 site	Several existing Tier 1 sites and the two integrated monitoring sites established during this visit are deliberately located close to water (average distance of 1.5 km). Some sites are also located in formerly degraded areas so as to monitor recovery under long standing conservative grazing management. Extensive rehabilitation works and precise management of livestock and land resources over many years means that the majority of the lease is now considered to be in good condition.

SOUTHERN ALICE SPRINGS PASTORAL DISTRICT

Winter rains produced good herbage growth with grasses also responding in some areas. Based on expected pasture growth (modelled using AussieGRASS), the far south and south-east of the region experienced very much above average seasonal conditions – with seasonal quality being above average elsewhere.



Map 11: Location of Southern Alice Springs Pastoral District

Analysis of Landsat imagery acquired in the latter months of 2016 showed that most of the district had above average vegetation cover (i.e. less bare soil) in the latter part of 2016 compared with previous years since 1988. Despite this, one third of the region had more than 50% bare soil per Landsat pixel. Considerable areas of increased bare soil in the central and eastern portions of the region appear to be a continuing legacy effect of extensive wildfire in 2011. One fifth of the 58 sites visited on seven pastoral leases were rated in good condition with 40% in poor condition. Past wind sheeting was observed at almost half the sites with scalding and/or water sheeting evident at one fifth of sites.

Seasonal quality

“Seasonal quality” describes the relative value of recent rainfall in producing forage for livestock. It is judged with reference to the historical record. Two indicators are used: rainfall amount compared with the long term median and expected pasture growth based on rainfall received, simulated using AussieGRASS (www.longpaddock.qld.gov.au).

Descriptors of seasonal quality provide useful context for interpreting various measures of land condition at particular times. However, to the extent possible, land condition is assessed independently of seasonal conditions.

Rainfall statistics (Table 31) are based on gridded rainfall produced by the Bureau of Meteorology (www.bom.gov.au/jsp/awap/rain/index.jsp). Pixel (grid cell) values are calculated from rainfall amounts at recognised recording stations. Rainfall is from October of one year to September the following year. Modelled pasture growth is for the same period (October 2015 to September 2016) to take account of good winter rainfall during 2016. This growth is ranked as a percentile of growth for all previous October – September periods.

Table 31: Indicators of seasonal quality. Data spatially averaged for the Southern Alice Springs Pastoral District.

Rainfall (mm)		AussieGRASS	
2015 - 2016	323	Growth (kg/ha)	848
Long term median	174	Percentile	80

SOUTHERN ALICE SPRINGS PASTORAL DISTRICT

Spatially averaged rainfall for the Southern Alice Springs Pastoral District was much above the long term median (Table 31), largely due to good falls in May and useful follow-up in the following winter months. The far north-eastern part of the region (Numery and Undoolya leases, and Loves Creek – now Aboriginal Land Trust) had greater than 350 mm in the 12 months between October 2015 and September 2016.

Modelled pasture growth in the 12 months, October 2015 to September 2016, was very much above average in the far south and south-east of the region (Figure 66, lower right hand panel). Seasonal quality, based on modelled growth, was above average elsewhere.

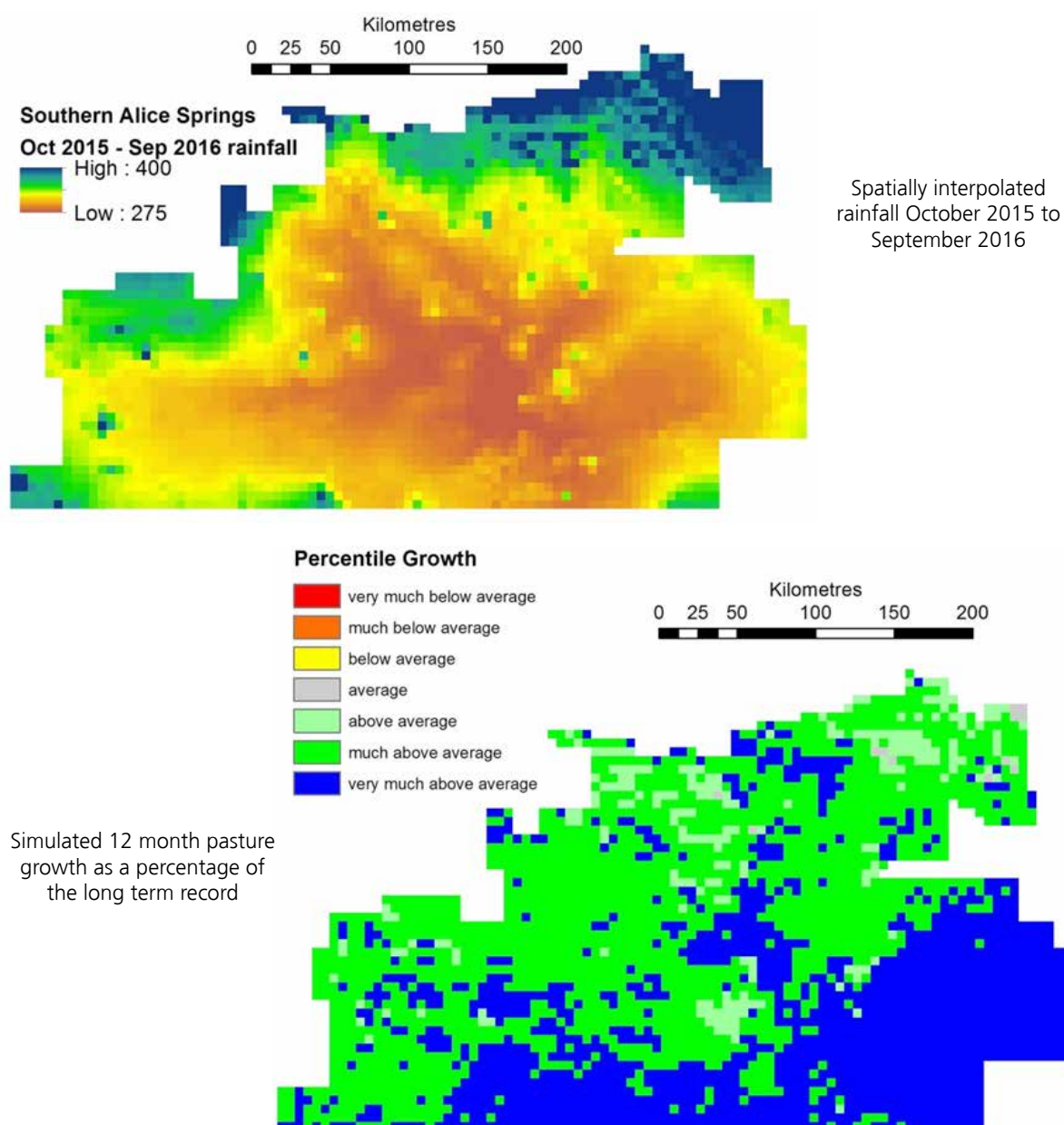


Figure 66: Maps of seasonal quality for the period, October 2015 to September 2016. Upper Left, gridded rainfall; Lower right, AussieGRASS modelled pasture growth as a percentage of previous similar periods.

SOUTHERN ALICE SPRINGS PASTORAL DISTRICT

Fire

There was minimal fire in the region during 2015-16 based on data available from the North Australian Fire Information website (www.firenorth.org.au/nafi3). Twenty-six km² burnt in December 2015 and a further six km² in April 2016.

Bare soil dynamics

It is important to maintain adequate ground cover in the latter months of each year to minimise soil loss from wind erosion and intense summer storms. The highly variable nature of rainfall in the southern NT also means that it is necessary to carry dry feed, and associated ground cover, into the hotter months in case summer rains fail.

The amount of bare soil present at any location changes from year to year depending on rainfall and its effectiveness, fire history and amount of grazing. The percentage of bare soil in each 30m square Landsat pixel (900 m² or 0.09 ha) was used to report the amount of bare soil across all pixels in the Southern Alice Springs Pastoral District.

Most of the district had above average vegetation cover (i.e. less bare soil) in the latter part of 2016 compared with previous years since 1988 (Figure 67). The far south-west and sections in the east of the region had their highest cover compared with the last 28 years. Winter rains that produced good growth of herbage (and grasses in some areas) contributed to the relatively high level of vegetation cover present across most of the region in late 2016.

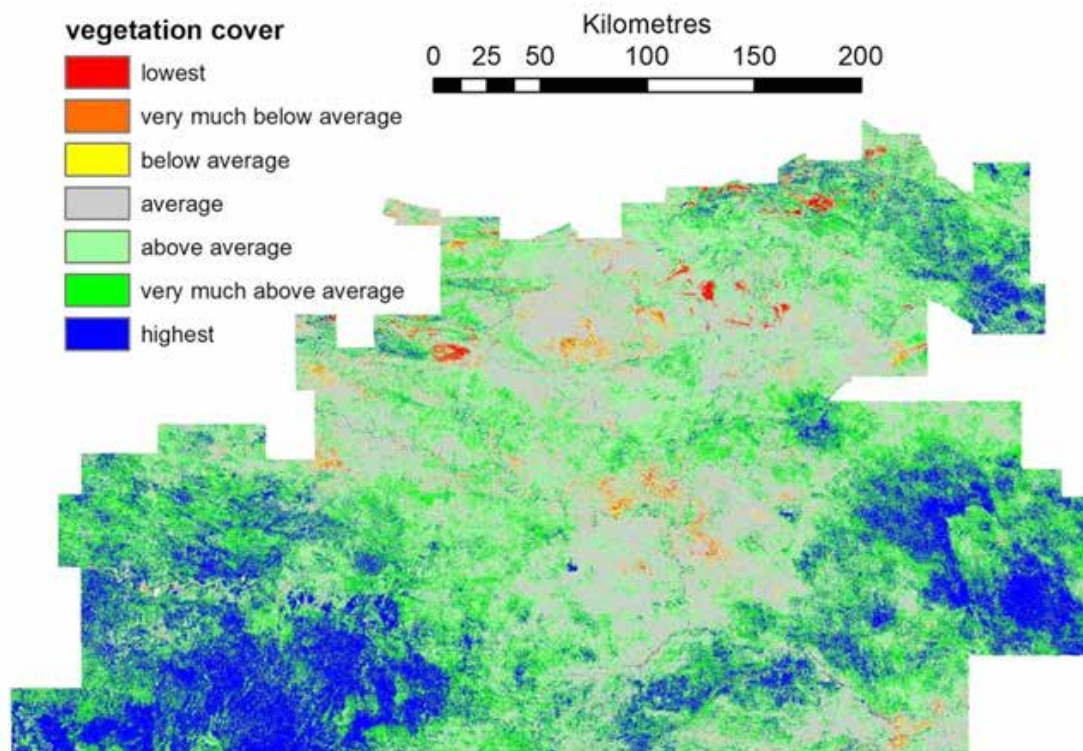


Figure 67: Rank of the amount of remotely sensed vegetation cover present from September to November 2016 against that for previous years since 1988.

SOUTHERN ALICE SPRINGS PASTORAL DISTRICT

Less than 1% of the pastoral district had minor to moderate amounts of bare soil (<25% of the 30m Landsat pixel) towards the end of 2016 (Figure 68). One third of the region had >50% bare soil (shown in Figure 69). Considerable areas of increased bare soil in the central and eastern portions of region appear to be a continuing legacy effect of extensive wildfire in 2011.

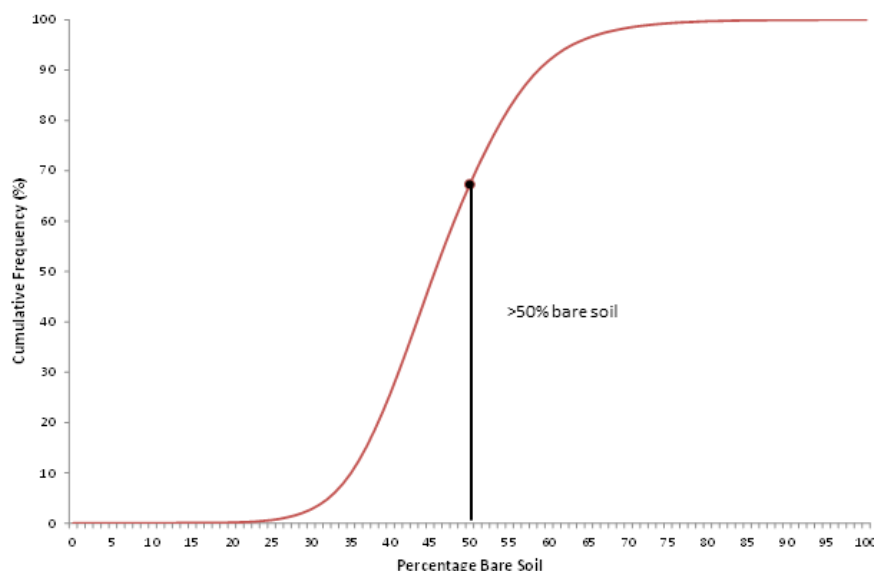


Figure 68: Percentage cumulative frequency of varying levels of bare soil in 30m square Landsat pixels in the Southern Alice Springs Pastoral District between September and November 2016. Areas with greater than 50% bare soil are mapped in Figure 69.

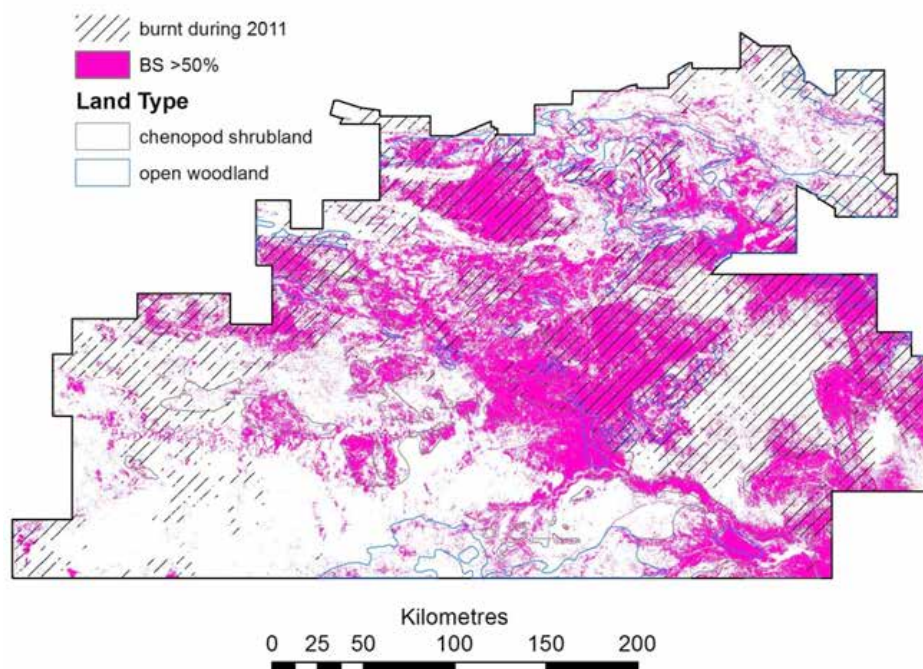


Figure 69: Parts of the Southern Alice Springs Pastoral District having more than 50% bare soil per Landsat pixel in late 2016. Areas with higher pastoral value are shown with black and blue polygons. Diagonal lines show areas burnt during 2011.

Note that the threshold level of bare soil used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.

SOUTHERN ALICE SPRINGS PASTORAL DISTRICT

Site based monitoring

Seven pastoral leases, comprising 24% of the area of pastoral leases in the Southern Alice Springs Pastoral District, were visited in the latter part of 2015 and during 2016.

Vegetation cover of the ground layer was measured using the point intercept method at 58 sites across the seven leases. Sites, on average, had a high level of bare soil, moderate litter cover and small contributions of grasses and forbs (Figure 70). Litter cover is important because it assists infiltration of rain water, helps retain seed on site and reduces erosion risk.

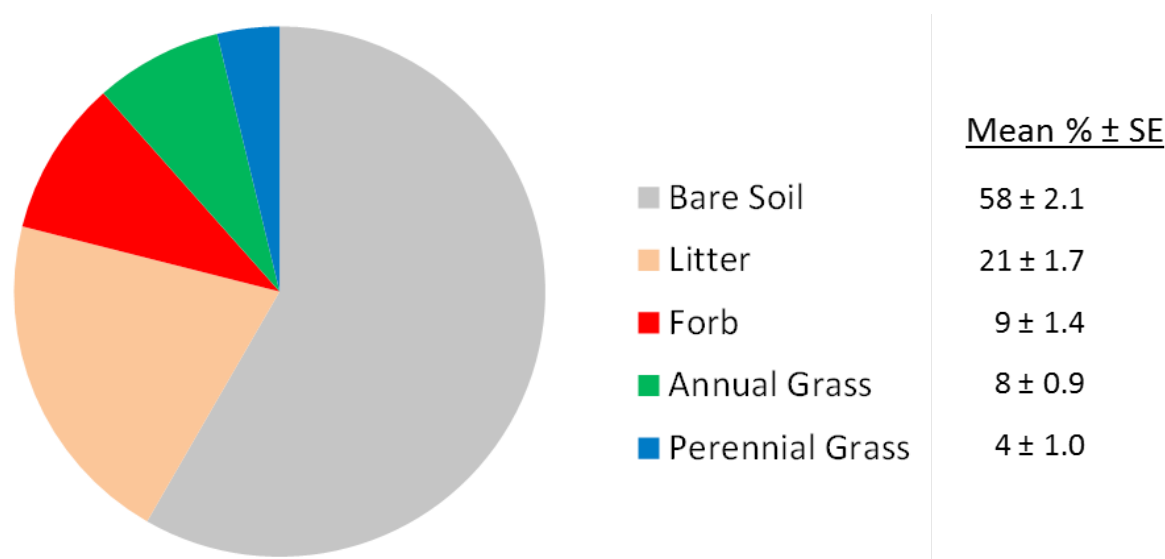


Figure 70: Mean percentage and standard error of measured components of vegetation cover in the ground layer from 58 sites on seven pastoral leases in the Southern Alice Springs Pastoral District.

The majority of the sites (63%) were assessed as having nil or minimal levels of grazing (Table 32). Eight sites on two leases visited in late 2015 had heavy or very heavy pasture utilisation (>75% of seasonal pasture growth removed).

Past disturbance due to wind sheeting was observed at almost half the sites (Table 32). Past erosion by water (scalding and water sheeting) was also visible at approximately one fifth of sites.

SOUTHERN ALICE SPRINGS PASTORAL DISTRICT

Table 32: Levels of pasture utilisation and evidence of erosion assessed at 58 sites on seven pastoral leases in the Southern Alice Springs Pastoral District.

Pasture Utilisation		Evidence of Erosion	
Rank	% of sites	Type	% of sites
Not grazed	29	Wind	46
Minimal	34	Scalding	20
Moderate	9	Water sheeting	23
Moderate to heavy	9	Gullying	5
Heavy	9	Not apparent	6
Very heavy	5		
Not recorded	5		

Land condition ratings assigned at monitoring sites and the more generalised assessment of land condition across those parts of pastoral leases traversed are summarised in Table 33. Two leases in the north-eastern part of the district were visited in the latter part of 2015 when less than favourable seasonal conditions were experienced. The 2016 visits were either prior to, or following, good winter rainfall across much of the region. However, to the extent possible, assessment of land condition is independent of recent seasonal conditions.

Table 33: Assessed land condition at monitoring sites and traversed parts of seven pastoral leases in the Southern Alice Springs Pastoral District.

Station	Condition Rating	Comments with regard to pastoral lease
1	Good: 3 sites Fair: 3 sites Poor: 4 sites	A substantial part of the lease burnt in 2012 and following dry years (to 2016) combined with periods of high grazing pressure (including feral camels) have delayed pasture recovery. At the time of inspection, pasture availability was sparse on pastorally more productive country in the main paddocked area on the station. Much of this paddocked area was in fair condition with preferentially-grazed calcareous country in mostly poor condition. Less developed parts of the lease were considered to be in good condition with small areas of preferentially grazed calcareous or semi-saline country closer to the main waterpoints in fair condition.
2	Good: 4 sites Fair: 2 sites Poor: 2 sites	The station, overall, was rated in mostly fair condition with many areas of more productive country having reasonable ground cover and species composition. Smaller areas in poor condition lacked palatable species, had low ground cover and showed signs of erosion. Some sections of roads and tracks were seriously eroded. Some parts of the station appear to have woody thickening and the continued growth of trees and shrubs in these areas may further reduce pastoral productivity over time.

SOUTHERN ALICE SPRINGS PASTORAL DISTRICT

Station	Condition Rating	Comments with regard to pastoral lease
3	Good: 1 site Fair: 3 sites Poor: 7 sites	Parts of the more useful grazing country were considered to be in poor condition with sparse ground cover, poor species composition in the pasture and large areas of serious gully erosion. Other areas of woodland and shrubland were rated in fair to poor condition. Parts of annual grassland country in the swales of extensive sand dunes were also in fair to poor condition. Much of the degradation on the lease is historical with the station appearing to be conservatively stocked at the time of this assessment.
4	Fair: 5 sites Poor: 2 sites	Much of the more productive calcareous country was rated in fair to poor condition with the worst areas being historically and extensively scalped. Less severely impacted areas in fair condition had past wind and water sheeting with minor water sheeting continuing on areas with limited ground cover. The lease has been lightly stocked in the recent past under new ownership and improved ground cover and recruitment of productive forage species provide encouraging signs that formerly degraded areas are slowly recovering.
5	Good: 3 sites Fair: 1 site	This inspection covered a currently sub-leased portion of a former larger pastoral lease. The majority of area was considered in good or fair condition with palatable grasses generally comprising a major component of the moderate growth response by pastures following average summer rainfall.
6	Good: 1 site Fair: 4 sites Poor: 3 sites	Pastorally more productive areas were rated in fair to poor condition. These areas often had large amounts of bare ground and/or short-lived species that only provide ground cover for limited periods of time. There was active erosion in some areas. Less productive, 'desert'-like parts of the lease were assessed to be in fair to good condition.
7	Fair: 4 sites Poor: 6 sites	Most of the station was considered in poor or fair condition. There was generally low cover with the sparse pasture dominated by annual forbs and relatively short-lived, unproductive grasses. Thickening of woody species is also leading to a loss of productivity, which may worsen over time. Erosion was observed on different parts of the lease.

PASTORAL LAND MONITORING PROGRAM

The Department of Environment and Natural Resources is chartered with the assessment, monitoring and reporting of land condition on behalf of the Pastoral Land Board.

Integrated Monitoring Program

The integrated monitoring program was introduced in 2013 to provide objective, whole of landscape reporting of changes in land cover across the pastoral estate. It comprises a network of ground based sites, incorporating the existing Tier 1 sites where suitable, with newly established ground sites to validate and inform satellite data and products.

New sites are established at or near relocated Tier 1 sites to maintain consistency in the photographic and data records. In some cases, it is not appropriate to locate a site nearby due to factors such as proximity to infrastructure, land system boundaries and changes in vegetation structure and type. Where Tier 1 sites are not appropriate for inclusion in the integrated monitoring program, sites continue to be photographed to expand the Tier 1 photo archive.

The integrated monitoring program, like the previous Tier 1 system, is heavily reliant upon the knowledge and experience of land managers and lessees. Both the ground data collected and information products produced from satellite data require on-ground local knowledge and understanding to explain changes and gain a further understanding of landscape dynamics. Measured field data is used to better calibrate Landsat derived products to NT conditions and then validate their accuracy for specific locations. The two sources of information (ground based and remote sensing) are then interpreted with regard to the knowledge and experience of practical land managers to enable reporting of land condition at property, landscape and regional scales.

As the number of revisits increase at a site, the expanding monitoring record will allow changes in the vegetation and soils, and their probable causes, to be documented – in a similar way to that which is now possible for vegetation cover using remote sensing.

Remote sensing of the dynamics of vegetation cover

The remote sensing or satellite based data component of the integrated monitoring program has been developed through a collaborative research program between DENR and the Queensland Department of Science, Information Technology and Innovation. Through this collaboration, DENR officers are contributing to an internationally recognised method for systematically monitoring change in vegetation cover and its converse, bare soil, at a range of spatial and temporal scales. The 900 m² pixel size of Landsat satellite imagery allows change in vegetation cover to be analysed at site level (1 ha) through to pastoral districts (~10 000 km² to >130 000 km²) and the entire NT (~1 346 500 km²). Reporting intervals can be as short as three months over a 28 year period (1988 to current).

Fractional cover

Analysis of the dynamics of vegetation cover (conversely, bare soil) within this report is based on fractional cover. This is a model of the three components of land cover that can be discriminated from the spectral data collected by the Thematic Mapper instrument carried on the Landsat satellite (i.e. Landsat TM). The three components are bare soil (comprising soil, rocks and gravels), actively growing (photosynthetic) vegetation and senescent (non-photosynthetic) vegetation (including litter).

The level of vegetation cover or bare soil present and their change over time are reported in three ways:

1. As the actual amount present during a specified period of time. For this report, this is September - November 2016, the latter part of the dry season for central and northern pastoral districts and the time when early summer storms may promote pasture growth in the southern NT. It is important to maintain adequate ground cover in the latter months of each year to minimise soil loss from wind erosion and intense, early wet season storms. It is also important to carry dry feed, and associated ground cover, into the latter months of each calendar year in case there is a late start to the usual wet season and/or monsoonal rains fail more generally.
2. As a decile rank of vegetation cover present in late 2016 compared with that present at similar times back to 1988, a 28 year period.
3. The percentage area of each pastoral district having various categories of bare soil between September and November 2016. Categories of bare soil are:
 - minor, $\leq 20\%$ of Landsat pixel is bare soil;
 - moderate, 21% - 40% bare soil in pixel;
 - high, 41% - 60% bare soil in pixel; and
 - very high, $>60\%$ of pixel is bare soil.

The number of pixels in each category are counted, multiplied by pixel area (0.09 ha) and converted to the percentage of pastoral district area.

Rainfall

The amount, timing and effectiveness of rainfall are major drivers of the quantity, composition and quality of pastures across the NT pastoral estate. Monitoring data collected using ground and remote sensing-based methods must account for the effects of variable rainfall (seasonal quality) in understanding the impacts of stocking rates and grazing management on the vegetation resource.

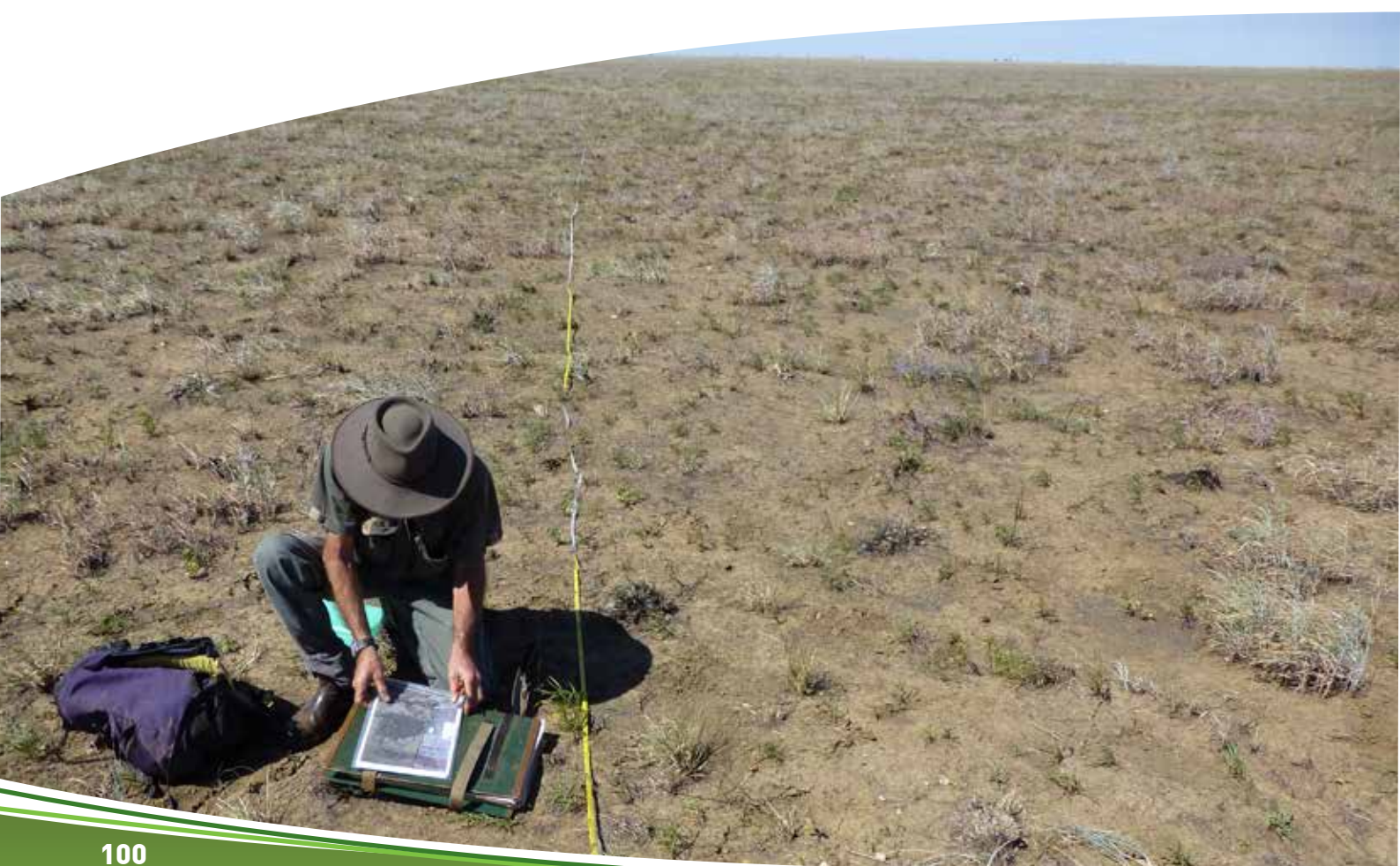
Due to the large variation in annual rainfall across the NT, a comparison of location-specific rainfall against its longer term history is a useful way of illustrating recent seasonal conditions. A NT map of decile-ranked rainfall for the current reporting cycle (October 2015 to September 2016) is shown on page 10. Rainfall is ranked on a baseline of approximately 100 years.

Fire

Fire and its effect on vegetation cover across the NT cannot be understated. This can be seasonal in the savannah landscapes of the central and northern parts of the NT or relatively infrequent and episodic in the southern arid region. Mapped fire scars and associated statistics accessible from the North Australian Fire Information website (www.firenorth.org.au/nafi3) are used to report spatial and temporal information on burnt area.

Woody cover

The density of trees and shrubs changes over time in many rangeland environments, but generally at a slower rate than changes in the pasture layer. A particular issue facing long term sustainability of the pastoral industry in some landscapes is woody thickening which can suppress pasture growth and reduce opportunities to use fire for broadscale control of problem tree or shrub species. Two remote sensing products are being adapted to NT conditions to improve monitoring of vegetation cover dynamics. The first is a foliage projective cover product that discriminates woody cover from ground cover. The second is a probability based model that allows ground cover under trees to be estimated. Both will allow improved monitoring of cover dynamics in woodland / savannah environments when suitably refined and validated.



CRITERIA USED TO ASSESS PASTURE CONDITION

Three classes are used to assess pasture condition: good, fair and poor.

These classes are based on indicators of pasture condition such as the abundance of perennial plants known to increase or decrease following grazing, and ground surface indicators such as the exposure of bare soil to wind and water and its subsequent erosion. These indicators of pasture condition and associated assessment criteria have largely been determined from historical information, local knowledge, cross fence comparisons and stock grazing gradients out from water. The further from water the less intense the stock grazing pressure and the higher the condition class rating tends to be. The condition classes can be described as follows:

Good

There is close to maximum diversity and cover of annual and perennial plant species possible for that pasture type with perennial species of various ages. There is no active erosion other than natural features and processes. Plant and litter cover protects the soil from wind and water in all seasons except following fire. Pastures in good condition are stable and are at, or close to, their productive potential. Pastoral managers should be aiming for good pasture condition, which necessitates careful management practices that maintain or improve pasture condition.

Fair

Reduced cover and regeneration of palatable perennial species and there has been some establishment of less preferred unpalatable plants. Productivity remains high in good seasons but is markedly reduced in dry seasons. Lower plant cover increases the susceptibility of soil to erosion in most seasons and there is evidence of moderate erosion on susceptible land types. Pastures in fair condition are productive, but below their productive potential. They are sometimes actively eroding and can rapidly deteriorate to poor condition. Maintaining pastures in fair condition is not a satisfactory status quo, as long term damage to their productive capacity will result. They should be managed with the aim of improving condition and ultimately achieving good condition status.

Poor

The palatable component of the pasture is depleted and the pasture is dominated by annual, ephemeral and unpalatable perennial species. There is no, or markedly reduced, regeneration of desirable perennial plants, productivity is impaired and the seasonal response is poor. Soils are unstable and susceptible to erosion in all seasons and past erosion leaves the site susceptible to further soil movement if grazed. Pastures in poor condition have severely reduced productivity, which is most noticeable during dry periods. They require a very long period of spelling to improve condition or mechanical intervention such as erosion control earthworks or reseeding.

BUSHFIRE ACTIVITY

Information supplied by the Department of Environment and Natural Resources Bushfires NT Division

The end of 2015 saw a large number of lightning strikes occur mainly across the Savannah and Barkly regions. Many of these fires required little response as pastoralists affected had well grazed paddocks or were not overly concerned due to wetter conditions being expected to commence early.

MITIGATION EFFORTS

Programmed visits were prioritised to a considerable percentage of stations prior to the fire season to discuss individual station preparedness. Also understanding training and other support required, and what was planned to minimise the potential effects of bushfires later in the year. The program of supporting early burning with supply of incendiaries had a good uptake in the Savannah and Arafura regions, and the utilisation of these by pastoral fire managers was obvious with good fuel reduction burns undertaken as conditions permitted. Bushfires NT staff conducted further aerial prescribed burning in the Top End to support pastoralists where requested and it was evident the burning would be of some strategic importance and benefit the area as a whole.

Through the National Disaster Resilience project, Bushfires NT were able to support strategic firebreak establishment across many areas of the NT, much of which was in the pastoral estate. Firebreaks were installed in the Sturt Plateau, Roper, Katherine, Plenty, MacDonnell, Barkly and Darwin bushfire areas. These firebreaks will be maintained by the pastoral fire managers and will assist landholders and Bushfires NT staff to manage fire, especially large unchecked wildfires more effectively across tenures.

Central Australian regions began mitigation efforts, but 2015 rains ensured minimal fire was possible earlier in the season.

WILDFIRES

The reporting year saw a number of large wildfires across the Territory though not to the same scale or intensity of 2014. This range of events reflected the generally considerably lower rainfall over the wet season of 2015-16. Bushfires NT managed to support an average number of pastoral fires, both with physical resources and follow up work and advice, including monitoring and coordination with neighbours. The level and type of input as usual, depends a great degree on the type of assistance requested by the station, and the potential for the incident to spread to neighbouring tenure.

A significant area of the Top End received mostly unseasonal rain amounts in September 2015 which greatly eased the risks, at a time usually considered one of the worst months for the incidence of bushfires.

Whilst Central Australian properties prepared for some fire activity, it was generally quite limited in extent and a mild 2015 fire season was recorded. Mitigation is planned and has commenced with pastoral property visits, regional fire planning, and fire break maintenance programs well underway. Further rains indicate some fire activity is expected for the upcoming summer / fire season.



WEED ACTIVITY

Information supplied by the Department of Environment and Natural Resources Weed Management Branch

The Weed Management Branch (WMB) of the Department of Environment and Natural Resources has Weed Management Officers based in the Darwin, Katherine, Tennant Creek and Alice Springs regions, and assists landholders to manage weeds by providing technical advice, assisting with weed management plans, conducting weed surveys and controlling emergency incursions.

In 2016 the WMB commenced a compliance and enforcement program to complement its extension and education activities. A compliance and enforcement manager was engaged and all staff completed training for a Certificate IV in Government (Investigations). While the first priority will always be education and extension, the Branch now has the capability to take stronger action against recalcitrant landowners whose negligence impacts on neighbours and the community.

The WMB has developed the document **Preventing Weed Spread is Everybody's Business** to build capacity for multi-tenure compliance prior to enforcement on private lands. It highlights the areas of risk for all activities associated with weed spread, details the pathways through which weeds are spread and provides actions to reduce weed spread for major sectors in the NT, including pastoralists. It is available at: www.denr.nt.gov.au/land-resource-management/rangelands/publications/weed-management-publications.

For more information email the Weed Management Branch at weedinfo@nt.gov.au or phone 8999 4567 (Darwin), 8973 8100 (Katherine) or 8951 9210 (Alice Springs).

WEED THREATS

Weeds are a significant threat to pastoral productivity and profits in the NT. Many of the weed problems that cause serious losses to the pastoral industry in other states are only in the very early stages of invasion in the Territory and eradication or spread prevention are feasible and cost-effective options. Examples include prickly acacia and mesquite, which occupy millions of hectares of pastoral land in Queensland.



Other species threaten our borders but have not yet become established in the NT. Examples include:

Rubbervine (*Cryptostegia grandiflora*) smothers pastures and trees, hinders mustering and damages watercourses. It is estimated to cause losses to the Queensland pastoral industry of more than \$18 million per year. It occurs within 3 km of the Queensland border and within 20 km of the Western Australian border with the NT. So far all known incursions in the NT have been eradicated. The WMB works actively with landcare groups and government agencies in those two states to survey and monitor infestations.

Parthenium (*Parthenium hysterophorus*) causes losses of over \$22 million per year to the Queensland pastoral industry. Parthenium is toxic to stock and contact with parthenium weed, particularly its pollen, can cause allergic reactions such as dermatitis, hay fever and asthma in people. It is spread by machinery and cattle. So far all incursions in the NT have been eradicated, but the WMB continues to monitor sites to detect any seedling emergence.

DARWIN REGION

Mimosa (*Mimosa pigra*) remains the major weed impacting on the pastoral industry in the Top End, having infested the Mary, Adelaide, Finnis, Reynolds and Daly River catchments. Major infestations negatively impact on pastoral production and land condition.

The biological control agent 'Nessie' (*Nesaecrepida infusca*) continues to increase in distribution, in part on its own, and with some human assistance. There are opportunities to monitor and redistribute Nessie in other parts of the NT in 2017. Where it is established, Nessie damages seedlings and adult plants which reduces growth and seed production.

WEED ACTIVITY

The Finnis Reynolds Rivers Management Project is a five-year Australian Government Biodiversity Fund project initiated in August 2012. The project is managed by Territory Natural Resource Management (TNRM) with contribution from the WMB. The project is into its 4th year, and has resulted in a significant reduction of mimosa over pastoral properties.

Bellyache Bush (*Jatropha gossypifolia*) infestations continue to threaten properties within the Daly and Mary River catchments. One Daly River catchment property is involved in the Biodiversity Fund Bellyache Bush project, with significant on-ground actions conducted to manage this weed.

The leaf-mining moth, *Stomphastis* sp, is currently being tested for suitability as a Bellyache Bush-specific biocontrol agent. If this agent proves to be specific to Bellyache Bush, then it may be available for release in 2018. Other potential biocontrol agents include a rust fungus and another moth.

Parkinsonia (*Parkinsonia aculeata*) has been increasing in the lower Daly River catchment. Biological control agents, the moths *Eueupithecia cisplatensis* and *Eueupithecia vollonoides* (affectionately called 'UU' and 'UU2') have been released at Snake Creek Station. The moths have established and are persisting at densities below that required to cause significant impact. It is hoped that these leaf feeding moths will become more widespread at higher densities to reduce parkinsonia's reproductive output and competitive ability.

Prickly Acacia (*Vachellia nilotica*) The Darwin region still has only a single pastoral lease known to have prickly acacia. An isolated population in the Adelaide River catchment was treated in 2015, with monitoring continuing.

Weedy rats tail grasses (*Sporobolus* spp) continue to increase in prevalence. Wide records of distribution and increased reporting have increased awareness of the impacts of this weed amongst pastoralists. These grasses dramatically lower the production value of pasture and reportedly reduce the grazing life of cattle through increased wearing of teeth.

The WMB continues to conduct trials to evaluate herbicide options to contribute to better management of this, and other grassy weeds. Herbicide found to work well on rats tail grasses are now being tested for effects on native and improved pastures on Top End pastoral properties.

Other weeds. The aquatic weed *Sagittaria* (*Sagittaria platyphylla*) was discovered in the Top End during September 2016, and is the subject of an intensive 'seek and destroy' campaign. *Sagittaria* is known to choke waterways and irrigation channels in other states, and could have significant impacts if it reached NT pastoral properties.

A suite of other weeds continue to be abundant in areas where disturbance has been caused by intense fires, feral animal damage and over-grazing, or in old cropping areas. Commonly encountered weeds include *Hyptis* (*Hyptis suaveolens*), *Sida* spp., Gamba Grass, Perennial Mission Grass (*Cenchrus polystachios*), Grader Grass (*Themeda quadrivalvis*) and various *Senna* spp.

WEED ACTIVITY

KATHERINE REGION

The Katherine Region weed management area covers approximately 386 000 km², encompassing 95 pastoral leases. The region includes the VRD, Katherine, Roper, Sturt Plateau and Gulf Pastoral Districts. Through consideration of weed risk assessment outcomes and current distribution, the Katherine Regional Weed Reference Group has determined a list of priority and alert weeds for the region, which are identified in the Katherine Regional Weed Management Plan. Of these weeds, the following were the key focus on pastoral land in the region for the 2015-16 reporting year:

Mesquite (*Prosopis spp.*) No new plants have been found within the Katherine Region however surveillance has continued by the WMB which conduct visits to properties each year.

Grader grass (*Themeda quadrivalvis*) is becoming an issue of great concern to the region, although the extent of spread is still to be established. However awareness of the risks posed by this weed is increasing. The NT statutory Weed Management Plan for Grader Grass was launched at the Katherine Show in July 2016. Grader grass trials have been undertaken and results are currently being reviewed.



Prickly acacia (*Vachellia nilotica*) in the region is still an increasing concern and is still widespread, however there is a noted reduction in the size and densities of some known infestations. New infestations have been found on three additional pastoral properties. Infestations in the Roper River catchment have been controlled and are now monitored for new seedlings. A new infestation has been identified at Bulman which could mean that plants have been spread further. The WMB have been successful in obtaining funding through the Agricultural Competitiveness White Paper for a Prickly Acacia Project Officer who will work to engage landholders and develop innovative survey and control methods.

Parkinsonia (*Parkinsonia aculeata*) is still generally widespread predominately throughout the VRD and Gulf Districts. There has been a concerted effort by many pastoralists with one property treating over 13 000 plants. Significant die back has occurred on Nongra Lake where the biological control agent "UU" (*Eueupithecia cisplatensis*) had been released.

Mimosa (*Mimosa pigra*) has now been found on eight properties within the Katherine region, all of which are isolated infestations and considered to have high feasibility of control. The WMB engages with the landholders to ensure adequate control programs are implemented. One property has eradicated all Mimosa plants and will now continue with ongoing surveillance. The WMB have been successful in obtaining funding through the Agricultural Competitiveness White Paper for a Mimosa Project Officer who will be implementing a strategic and coordinated effort to engage landholders in the management of this weed.

Bellyache Bush (*Jatropha gossypifolia*) is found growing on 18 properties within the Katherine region and continues to spread. Large infestations at the top of the Roper River Catchment are still proving to be unmanageable despite continued efforts and funding. The upper Daly Catchment has continued to receive Commonwealth funding to strategically reduce the spread of Bellyache Bush down the catchment.

In December 2015, an unprecedented amount of rain fell on the upper Daly catchment resulting in flooding. The damage caused by this event and the further spread of Bellyache bush is still to be determined with surveys to take place in December 2016. The cost to pastoral infrastructure has also been significant. Funding for the Upper Daly Catchment Bellyache bush project finishes in June 2017 however the stakeholder group are committed to explore further funding options to keep the momentum of the project going.

Biological control options are outlined in the Darwin section.

Neem (*Azadirachta indica*) is an emerging threat. A concerted control effort has been made in the VRD Pastoral District.

TENNANT CREEK REGION

The WMB Tennant Creek region comprises the Barkly and Tennant Creek Pastoral Districts. The WMB in conjunction with regional stakeholders implements the Barkly Regional Weed Management Plan. The Plan identifies the declared weeds prickly acacia, mesquite, parkinsonia, bellyache bush, and rubber bush as priority species that require management in this region.

Prickly acacia (*Vachellia nilotica*) has been the major focus for the Tennant Creek WMB and as a Class A weed the goal is eradication. There are currently three large infestations in the Barkly region, all of which were treated during this year. Two of these were treated under a Memorandum of Understanding between cattle stations, TNRM, the WMB and the Corella Creek Aboriginal community contracting company - MTP. Follow up work is planned, to treat missed plants and emerging seedlings. The Agriculture Competitiveness White Paper funded project officer will assist with the push towards eradication of Prickly Acacia in the Barkly region.

Rubber Bush (*Calotropis procera*) continues to pose a significant risk to productivity of grazing land. The Meat and Livestock Australia (MLA) funded Rubber Bush Project officially ended in June 2015 with a final report submitted to MLA outlining the recommendations from the herbicide trials conducted in Queensland and the Northern Territory. Basal bark, cut stump and soil applied granular herbicides treatments were all successful. Further trials of granular treatments are proposed. These results will assist Barkly land managers in gaining a more thorough understanding of the control options available to them.

Parkinsonia (*Parkinsonia aculeata*) continues to be the most widespread and common serious weed on the Barkly and remains a major concern for many properties. Most properties in the Barkly region have developed management plans and have begun treatment. The biological control agent, "UU" was released for evaluation and to date has established at Newcastle Waters Station. Further evaluation will determine impacts on infestations.

WEED ACTIVITY

The bioherbicide “Di-bak”, a combination of three fungal pathogens inserted as a capsule into the trunk of *Parkinsonia*, has been trialled at strategic locations, with kill rates of over 40% on some Barkly properties.

Mesquite (*Prosopis* spp.). As there is only one large infestation of Mesquite left on the Barkly it is important that a Weed Management Plan be implemented for it. The only other large infestation of Mesquite was treated earlier this year. Eradication is feasible if a high priority is given to follow up treatment of the large infestations and control of low level infestations.

ALICE SPRINGS REGION

The Alice Springs region covers an area of approximately 576 00km². The pastoral estate covers approximately 40% of the land area and encompasses 66 pastoral leases. Aboriginal land makes up approximately 50% of the total land area. The Alice Springs Regional Weed Management Plan lists Athel Pine, Cacti, *Parkinsonia* and Rubber Bush as the priority weed species for management across the region and all of these species have undergone a weed risk assessment which has determined that all have a high feasibility of control for management across the region.

Athel Pine (*Tamarix aphylla*). Residual infestations of athel pine continue to be managed strategically on the upper managed 420 km of the Finke River, which traverses Henbury, Idracowra, Maryvale and Horseshoe Bend Stations. Eradication is a feasible goal in the short term (5-10 years).

Cactus (*Opuntioids*) Monitoring of previously treated infestations of Opuntioid cactuses, Prickly Pear (*Opuntia stricta*), and Rope Cactus (*Cylindropuntia imbricata*), continues on the pastoral properties Orange Creek, Pine Hill, Yambah, and Henbury Stations. All regrowth and seedlings are treated and eradication is a foreseeable outcome. There are currently mainly isolated infestations of cacti on pastoral leases; consequently, these weed species should be a target for management leading to eradication.



FERAL ANIMALS

Information supplied by the Department of Environment and Natural Resources Flora and Fauna Division



Camels

No aerial culling operations were undertaken in 2016. An aerial survey was undertaken west of Alice Springs in June 2016 to assess the density of feral horses and feral camels. The overall density of feral camels was broadly consistent with the density recorded in 2013 (0.18 camels per km²) in the latter stages of the Australian Feral Camel Management Project in a broader area (40 778 km²) immediately adjacent to the western edge of the area surveyed in 2016. At the observed density in the survey area, the impacts of feral camels are likely to be relatively minor. Anecdotal reports from landholders suggest that feral camel density remains relatively low across the broader western desert region

of the NT although there have been some small-scale incursions onto pastoral leases in recent months. Anecdotal reports also suggest that feral camel numbers remain very low in the Simpson Desert.

In May 2016 the Northern Territory Government released a report into the viability of establishing a commercial camel industry in central Australia. The report was written by Agriknowledge, South Australia. The report gives up-to-date information that will inform potential investors. A key finding of the report is that harvesting wild camels would only be viable for a few years, after which there would need to be a transition to farmed camels to maintain market supply.

Wild dogs

In 2015 the then Minister for Land Resource Management and Primary Industry and Fisheries appointed a committee of industry and agency representatives to review administrative arrangements for wild dog management. As a result, the process for administering 1080 solution for the management of wild dogs has been streamlined.

In June 2016, the Northern Territory Government signed a Project Agreement with the Australian Department of Agriculture and Water Resources to deliver the project "Best practice management of wild dogs in the Northern Territory". The project is funded through the Australian Government's Agriculture White Paper and was jointly developed by DENR and the Department of Primary Industry and Resources in consultation with industry. The project will document the negative impacts of wild dogs on cattle and review the information which will underpin the development of best practice guidelines for managing wild dog impacts. The project will ensure that dog impact measures are broadly consistent with the objectives of the National Wild Dog Action Plan.

FERAL ANIMALS

Horses and donkeys

No aerial culling operations were undertaken for horses in 2016. An aerial survey was undertaken west of Alice Springs in June 2016 to assess the density of feral horses and feral camels. The mean density of horses in the southern half of the survey area was between 0.5 and 1.0 horse per km² with highly localised densities in excess of 5 horses per km². Horses are likely to be having substantial negative impacts on vegetation and wetlands at these densities. The results of this survey are already being used by the Central Land Council to guide negotiations with traditional owners in respect of horse management in the Hermannsburg area. As a consequence, in October 2016, Aboriginal work crews were actively trapping horses at water points around Hermannsburg. The horses were loaded onto trucks destined for an interstate abattoir.

There is a large-scale horse and donkey management program in the VRD Pastoral District (mostly through the Victoria River District Conservation Association), where horses and donkeys have been declared as a pest and landholders are required to manage horse and donkey populations on their property under the *Territory Parks and Wildlife Conservation Act*. This program achieved substantive reductions in the horse and donkey populations between 1999 and 2006 and current activity is directed at maintaining those reductions.

The private sector has expressed some interest in recent months in establishing a donkey industry in the NT to supply skins and other products to China. Initial stock would be taken from the wild.



FERAL ANIMALS



Feral pigs

Feral pig management is undertaken on some pastoral properties in the Top End using an integrated program of 1080 baiting, trapping, aerial and ground shooting. There is increasing interest from pastoral properties to undertake pig management using 1080 baiting. The Parks and Wildlife Commission is currently undertaking a pig and banteng management program on the Cobourg Peninsula, which is having considerable success in the management of these species. Some pig management is being undertaken in Arnhem Land, particularly in the Blue Mud Bay area, to manage the impacts of pigs on the environment. Parks and Wildlife staff provide free assistance to landholders who wish to conduct 1080 management for pigs.

Feral cats

Exclusion fences are used to protect small populations of the endangered mala (rufous hare wallaby) from foxes and cats on Watarrka and Uluru Kata Tjuta National Parks.

A multifaceted research effort is underway in the Top End to investigate the role of feral cats in mammal declines, funded by the National Environmental Science Program. Two 64 ha experimental cat exclusion plots have been constructed in Kakadu National Park to investigate the natural population responses of *in situ* small mammal and reptile populations in comparison to unfenced paired areas. Analysis of data from the first two years of enclosure show that there was no observable recovery of native small mammals, but that cat predation was having negative impacts on the reptile fauna. Sampling will continue until 2017.

In 2016 DENR carried out experimental cat control with the 1080 Eradicat bait in core central rock-rat refuge habitat in the Tjoritja / West MacDonnell National Park. Baits were deployed aerially at a density of 50 per km² in two 4000 hectare areas during winter months. Baiting will reoccur in 2017, and the occurrence of cats and rock-rats is being monitored using remote cameras.

A research program is also continuing to investigate cat ecology and management on Groote Eylandt, which is an important refuge for threatened species. This includes testing whether cat baiting will also impact native species, including the northern quoll.

FERAL ANIMALS

Rabbits

Rabbit numbers in central Australia appear to have increased in recent years but are not at levels recorded prior to the arrival of Rabbit Haemorrhagic Disease (RHD). RHD and myxomatosis are periodically active throughout the region and help keep rabbit numbers in check. Very little additional rabbit management is undertaken anywhere in central Australia. The new K5 strain of RHD will be released nationally in 2017 and is expected to increase the level of control across some parts of Australia.

Water buffalo

Current estimates put the feral water buffalo population across Arnhem Land at a minimum of 100 000 at an overall density of approximately 1 buffalo per km². Localised densities in excess of 10 buffalo per km² have been recorded in some areas.

Local Indigenous land managers have reported severe land degradation from the impact of feral water buffalo, and buffalo densities and impact are a major concern for traditional owners across Arnhem Land. During 2015 local Indigenous land managers undertook broad-scale removal operations in Blyth / Cadell River floodplain and Arafura Swamp floodplain regions of Arnhem Land. Ongoing removal of feral water buffalo in the Blyth / Cadell River floodplain and Arafura Swamp has been undertaken opportunistically by local Indigenous land managers.



MEETINGS OF THE BOARD

Seven meetings of the Pastoral Land Board were held between 1 October 2015 and 30 September 2016 as follows:

104th Meeting: teleconference held 5 November 2015

The Board considered two non-pastoral use permit applications and one application to vary an existing permit. The permits were granted allowing for agricultural/horticultural and retail activities, and amended an existing permit allowing additional tourism activities. The Board also considered three land clearing applications and determined to grant the three permits.

105th Meeting: held 18 November 2015 in Katherine

Following three property inspections by a delegation of the Board, two subdivisions and one lease conversion were considered. The Board determined to recommend one of the subdivisions and the lease conversion be approved by the Minister. Three land clearing permit applications were considered with the Board approving two of those applications to amend existing permits due to transfers and subdivisions and requesting further information regarding the final application. The Board also discussed the issuance of land clearing permits and determined to register permits to the Lease allowing for the permit to transfer if the lessee changed. The Manager of the Rangeland Monitoring Branch met with the Board and provided an overview of the 2015 field season and related matters. The Board considered requiring management plans for two properties, determining to seek further information.

106th Meeting: teleconference held 23 February 2016

The Board considered two land clearing applications with both being granted. The Board also considered a stock route inclusion application from two neighbouring properties and determined the appropriate pastoral lease for the stock route to be incorporated into.

107th Meeting: held 16 March 2016 in Alice Springs

The draft 2014-15 Annual Report was considered. The Board considered and approved a land clearing and non-pastoral use application for the same property. The Board heard from Rangeland Monitoring Branch Manager on the proposed rangeland monitoring field program for 2016, and also heard from Department Primary Industry and Ressources Regional Manager Katherine on changes in the pastoral industry. The Board also considered a draft Land Tenure Report and requested some further detail be incorporated.

MEETINGS OF THE BOARD

108th Meeting: held 21 June 2016 in Darwin

The Executive Director of Rangelands attended the meeting to thank the outgoing Chairman for his service during his three year term. Three land clearing applications were considered and granted with an additional two non-pastoral use permits also being granted. The Board discussed two voluntary management plans as well as the requirements for erosion and sediment control plans and weed management plans with land clearing applications. The Board considered reviewing the Land Clearing Guidelines and the Subdivision Guidelines.

109th Meeting: teleconference held 26 July 2016

One Land Clearing permit application was considered and granted by the Board. The Board discussed site visits and upcoming applications.

110th Meeting: teleconference held 22 August 2016

Five Land Clearing applications were considered with the Board determining to issue one permit and to defer making a decision on the remaining four applications. The Board requested further information for three applications and determined to complete a site visit prior to considering the final application.

APPLICATIONS CONSIDERED BY THE BOARD

Land Clearing Applications

Station	Pastoral District	Purpose	Total Area (approx.)	Decision
Neutral Junction	Northern Alice Springs	Agriculture / Horticulture	90 hectares	Approved
Bloodwood Downs	Sturt Plateau	Improved pasture	2372 hectares	Approved
Elizabeth Downs	Darwin	Improved pasture	2061 hectares	Approved
Koolpinyah	Darwin	Improved pasture	1686 hectares	Approved
Western Creek	Sturt Plateau	Improved pasture	1232 hectares	Approved
Mount Keppler	Darwin	Improved pasture / rice	2881 hectares	Approved
Douglas	Darwin	Improved pasture	5394 hectares	Approved
Ban Ban Springs	Darwin	Improved pasture	1296 hectares	Approved

Station	Pastoral District	Purpose	Total Area (approx.)	Decision
Legune	VRD	Trial Aquaculture Pond	5 hectares	Approved
Larrizona	Sturt Plateau	Improved pasture	509 hectares	Approved
Banjo	Sturt Plateau	Improved pasture	6612 hectares	Approved

Non-Pastoral Use Applications

Station	Pastoral District	Purpose	Term	Decision
Neutral Junction	Northern Alice Springs	Agriculture / Horticulture	30 years	Approved
Macdonald Downs	Northern Alice Springs	Station Store	30 years	Approved
Mount Keppler	Darwin	Agriculture	30 years	Approved
Tipperary	Darwin	Agriculture	30 years	Approved
Tipperary	Darwin	Horticulture	30 years	Approved

Subdivision Applications

Under section 61 of the *Pastoral Land Act*, the Minister refers applications for subdivision of pastoral leases to the Board for consideration and recommendation. During 2015-16 the Board considered two applications for subdivision.

Perpetual Pastoral Lease Applications

Under section 62 of the *Pastoral Land Act*, the Minister refers applications for conversion of term pastoral leases to perpetual tenure to the Board for consideration and recommendation. During 2015-16 the Board considered one application for lease conversion.

APPENDICES

Appendix 1: NT Cattle Industry	119
Gross Value of Production	119
NT Farm Performance	120
Rural Land	120
Appendix 2: National Cattle Outlook	121
Prospects for Interstate Movement	122
Prospects for Live Cattle Trade	122
Appendix 3: DPIR Pastoral Production Activities	123
Pastoral Feed Outlook Bulletin	123
Carrying Capacity Research and Application	124
Grazing Systems	124
Sustainable Grazing Practices	125
Future Developments	126



APPENDIX 1

NT Cattle Industry

Source: Department of Primary Industry and Resources Livestock Industry Development Group

The NT cattle population has historically accounted for an estimated 1.9 million head, or over 7.0% of the Australian total. NT cattle herd by pastoral district, Alice Springs has 20.0%, Barkly Tablelands and Tennant Creek 30.0%, VRD and Katherine 32.0%, and Darwin, Elsey and Gulf 18.0% of the total NT herd.¹

In 2014-15, an estimated 607 343 head of cattle were turned off from NT pastoral properties, a decrease of 14.4% on 2013-14.

Of the total NT cattle turned off in 2014-15, 45% were destined for interstate trade, and 55% were exported live overseas reflecting the favourable conditions in live export markets. 37 529 cattle were slaughtered in abattoirs. AAco has a large-scale, state of the art meat processing facility at Livingstone (outside Darwin) and is currently ramping-up operations in 2015.

More recent figures for NT live cattle exports through the Port of Darwin show that in 2014-15, 332 371 head of NT cattle were exported, a increase of 9.8% compared to 2013-14. Facing escalating domestic prices for beef, the Indonesian Government has subsequently eased import quotas on beef imports.

Interstate movements rose to 237 443 a 7% increase on 2013-14 as domestic buyers demanded more cattle.

Gross Value of Production

The estimated gross value of production for the cattle industry was \$333.5 million in 2014-15, a 14.8% increase compared to the previous year. This was mainly due to increases in the value of cattle movements interstate, exports and slaughterings. In 2015-16, cattle production value is projected to increase by 3.4% to \$345 million.

Cattle contributed 58.2% of the total value of NT rural industries and fisheries production in 2014-15.

(a) Direct Contribution to Gross State Product (GSP)

NT cattle industry's value adding direct contribution (output) to NT GSP in 2014-15 is estimated to be \$170.1 million, or approximately 0.76% of total NT GSP.

(b) Flow-on Value (Direct and Indirect Contribution)

The flow-on effects of additional output (direct contribution) of \$170.1 million and additional income (indirect contribution) of \$42.2 million by the pastoral industry on the rest of the NT economy is estimated to be \$212.3 million.

NT Farm Performance

Many farm businesses in the upper Northern Territory derive a large share of their total cash receipts from selling cattle for live export, particularly to Indonesia. Numbers of cattle sold for live export declined between 2009-10 and 2012-13, before rebounding strongly in 2013-14. They are expected to remain high in 2014-15. As a result of the expansion of the live export trade in 2013-14 and 2014-15, cattle for this market are now also being sourced from a much expanded area of northern Australia.

In 2014-15 beef cattle receipts increased by 54%, as a result of a 19% increase in average price received for beef cattle and a 29% increase in number of beef cattle sold. The average total cash costs increased by 16% partly offsetting higher farm receipts, while expenditure was higher on beef cattle purchases, hired labour, contracts, freight and livestock selling costs. The value of cattle transferred onto stations by businesses with properties interstate also increased.

Further increases in prices of beef cattle and a small increase in beef cattle turn-off are projected to result in further increases in average farm cash income in all regions in 2015-16. Overall farm cash incomes in the NT are projected to increase to average \$1 238 000 a farm in 2015-16, compared with the 10-year average to 2014-15 of \$395 000 a farm and the highest farm cash income recorded for the NT in the past 20 years in real terms.²

Rural Land

The market has evolved surprisingly quickly over the last 18 months – but most significant for large stations. During 2015, rural property sales recorded increased activity of 15 sales (four to foreign interests, two to Australian based corporates, eight to established pastoral families looking to expand (NT QLD, SA) and one to an industry newcomer (Bullo River)). Despite strong export prices, demand is steady for small to medium scale stations (ie. \$5 to \$15M), unless there is potential for diversification (due to favourable land/water/location factors) then the market is seeing premium prices. The Alice Springs regional values appear to be strengthening but properties generally tightly held.³

1. NT Herd figure based on Colliers International North Australia Beef Market Overview p3

2. ABARES Australian farm survey results 2013–14 to 2015–16 April 2016 p30

3. Herron Todd White National Rural Market Update March 2016
http://www.htw.com.au/industry_presentations/2016-National-Rural-Overview-1-March-2016

APPENDIX 2

National Cattle Outlook (to 2020-21)

Source: Department of Primary Industry and Resources Livestock Industries Development Group

Following relatively high turn-off over the past two years, Australian cattle and calf slaughter is forecast to fall by 11.0% in 2015-16 to 9 million head. The majority of the forecast decline is expected to be from lower female cattle slaughter, which declined by 13.0% in the first half of the year. Under the assumption of favourable seasonal conditions in the second half of the year, female cattle slaughter is expected to decline markedly as producers increase herd rebuilding activity.



Even with this forecast decline in slaughter, the national beef cattle herd is still expected to fall by 2.0% to 23.7 million head by the end of 2015-16. The number of female cattle at the end of 2015-16 is estimated to be at its lowest in more than a decade following relatively high slaughter between 2011-12 and 2014-15.

In 2016-17 Australian cattle and calf slaughter is forecast to fall by a further 7.0% to 8.4 million head, as rebuilding of the cattle herd continues under the assumption of favourable seasonal conditions. Branding rates are also assumed to increase. However, the rate of herd rebuilding is expected to be relatively slow because low female cattle numbers will limit the number of calves born. Favourable saleyard prices and strong international demand will continue to encourage producers to turn off mainly male cattle. Reflecting this, the national herd is forecast to continue to decline by 3.0% in 2016-17 to 23.1 million head.

Over the remainder of the projection period (to 2020-21) female cattle numbers are projected to increase gradually under the assumption of favourable seasonal conditions. This is expected to result in an increasing number of additions to the national herd towards the end of the projection period despite gradual increasing slaughter. By the end of 2020-21 the national beef cattle herd is projected to reach 26.4 million head. This compares with an average 25.7 million head in the five years ending 2014-15.¹

1. ABARES Agricultural commodities – vol. 6 no. 1 • March quarter 2016 p103 to105

APPENDIX 2

Prospects for Interstate Movement

Australian exports of beef and veal are forecast to fall by 12.0% in 2015-16 to 1.2 million tonnes (shipped weight), in response to the forecast reduction in domestic beef production. A further decline in beef exports is forecast in 2016-17, to around 1.1 million tonnes. At this level, beef exports in 2016-17 would be 20.0% lower than the record volume of 1.35 million tonnes in 2014-15. Over the latter part of the outlook period, beef production is projected to rise gradually in response to increasing beef cattle numbers and higher slaughter. Australian beef and veal exports are projected to reach close to 1.3 million tonnes in 2020-21. In 2015-16 the value of Australian beef and veal exports is forecast to increase by 4.0% to \$9.2 billion. This is followed by a 4.0% decline in 2016-17 to \$8.8 billion as the forecast decline in export shipments more than offsets rising export prices.

By 2020-21 the value of Australian beef exports is projected to reach \$8.5 billion in real terms, with declining export unit values offsetting a recovery in beef export volumes. This compares with the average value of \$6.1 billion for the five years ending 2014-15.³

Prospects for Live Cattle Trade

In 2015-16 Australian live feeder and slaughter cattle exports are forecast to decline by 9.0% to 1.18 million head. This largely reflects the effect of the reduction in permits allocated by the Indonesian Government for the first quarter of 2015-16 and the supply constraints that restricted Australian exporters from filling allocated quotas in the second quarter.

Demand for Australian live cattle continues to be strong, particularly in Indonesia and Vietnam, where beef consumption continues to exceed domestic production. This is expected to accelerate live cattle exports in 2016-17, with the number of feeder and slaughter cattle exported forecast to increase by 4.0% to 1.23 million head.

Over the medium term, feeder and slaughter cattle exports are projected to increase annually by an average of 2.0% to reach close to 1.33 million head in 2020-21. Indonesia is expected to remain the primary market for Australian live cattle exports, while growth in exports to Vietnam is expected to slow gradually. Live cattle exports to China are also expected to increase over the medium term as supply chains improve and import protocols are met. However, cattle sent to China are expected to be sourced primarily from southern Australia and loaded at southern Australian ports so this trade will not compete directly with the northern Australian cattle trade.⁴

3. ABARES Agricultural commodities – vol. 6 no. 1 • March quarter 2016 p106

4. ABARES Agricultural commodities – vol. 6 no. 1 • March quarter 2016 p110



APPENDIX 3

Pastoral Production Activities

Source: Department of Primary Industry and Resources Livestock Industries Development Group

The Department of Primary Industry and Resources (DPIR) Livestock Industries Development group provides research, development and extension services to facilitate the sustainable development of the Northern Territory pastoral industry. Areas of expertise include rangeland management, animal production, genetics, improved pastures and market development. DPIR also plays a role in Indigenous economic development

through its partnership in the Indigenous Pastoral Program

The DPIR Rangeland Program's research and extension activities aim to optimise the sustainable and productive use of native pastures. Recent research efforts have focussed on investigating the benefits and costs of a range of grazing systems and land management practices. Over the past 15 years, DPIR has developed a nationally-significant catalogue of pasture growth models for the important pastoral land types of the NT. These models are used to estimate sustainable livestock carrying capacity and to test management scenarios with potential to increase the resilience of pastoral businesses to seasonal variability and climate change. The following sections summarise the outcomes of some of the main activities undertaken by the Rangeland Program in the past year.

Pastoral Feed Outlook Bulletin

Since late 2011 DPIR has produced a quarterly bulletin that summarises the seasonal outlook, recent forage growth and current standing pasture biomass in each of the 11 pastoral districts of the NT. The bulletin can alert the industry and its advisers to issues such as low pasture levels, increasing drought risk and high fire risk. The bulletin is available on the DPIR website at: DPIR Publications System. Or by searching DPIR publications at: www.dpir.nt.gov.au/primary-industry/primary-industry-publications/publications-search.

When a new Pastoral Feed Outlook is released, an alert is emailed to DPIR staff, the NTCA, NT Drought Committee, selected DENR staff and the Minister for Primary Industry and Resources. The availability of the Outlook is also advertised in the DPIR newsletters. Increasingly, producers are asking to be added to the distribution list. Anyone wishing to be added to the distribution list can contact caroline.pettit@nt.gov.au.

APPENDIX 3

Carrying Capacity Research and Application

The DPIR continues to provide carrying capacity assessments to property owners on request. This often involves property visits and inspections of all relevant land types to assess pasture growth and land condition. The agency also provides advice to the PLB on subdivision applications. In 2016 we also provided technical advice to the consultants undertaking the valuations for the Valuer General.

The DPIR has calibrated pasture growth models for more than 20 pasture types across the NT. Median pasture growth estimates from these models are routinely used for property carrying capacity assessments, Grazing Land Management workshops and for testing the performance of management options/practices in research projects.

The DPIR have been working with the CRC Spatial Information on the Spatial Hub Project to provide carrying capacity information for 7 properties across the NT. The Hub provides land managers with access to online mapping and spatial data for their properties. They can then use the tools within the system to make management decisions that improve the landscape productivity and condition.

It continues to be difficult for the DPIR to undertake objective assessments of carrying capacity in some areas of the NT due to inadequate land type mapping. This is particularly the case for parts of the Roper, Gulf and southern Sturt Plateau Districts. The DPIR values the assistance of DENR staff in supplying customised land type mapping from remotely sensed data interpretation (via an informal arrangement) in these regions. Recent investments by DENR to produce improved mapping for the northern Barkly have improved the spatial data available, but the need for high quality land type mapping in other areas of the NT remains.

Grazing Systems

Beyond Continuous Set Stocked Grazing

Current DPIR grazing systems trials and demonstrations are being conducted at Old Man Plains Research Station near Alice Springs and Douglas Daly Research Farm. An intensive development and carrying capacity project on Mungabroom Station (Barkly) was completed in 2016. Updates on these projects will be published by the end of 2016 and can be found in the DPIR Annual Research Achievement report at:
www.dpir.nt.gov.au/primary-industry/primary-industry-publications/publications-search

The “Quality Graze” trial at Old Man Plains is testing and demonstrating recommendations that have been identified from recent research projects and promoted through the Grazing Land Management (GLM) workshops. The strategies being investigated include using the GLM methodology to set sustainable stocking rates, annual stocking rate adjustment based on seasonal variability, and pasture spelling achieved via rotational grazing. Pasture productivity, land condition and animal performance are regularly measured. Key findings to date include:

- Our current carrying capacity methodology appears to be sustainably matching stocking rate to land capability and maintaining land condition regardless of spelling or annual stocking strategy, and provides a buffering strategy for cattle production over a dry period of at least 12 months.

APPENDIX 3

- Consistent production of steers for premium beef markets is possible in terms of growth rate and fat development across a range of seasons when stocking rates are matched to forage supply.
- Meat Standards Australia (MSA) compliance is possible under conditions similar to those experienced over the past 5 years however more research is required to determine how to achieve more consistent levels of compliance.
- 84% of the 2014-branded steers graded MSA.
- Spelling has had no detectable effect on pasture dynamics over the trial period. Although it would be expected that spelling may be important in land condition recovery, no clear evidence has been found to date because all paddocks were spelled to some extent prior to the trial starting.

More information about this trial can be obtained by contacting chris.materne@nt.gov.au.

The DPIR (in partnership with the Barkly Landcare and Conservation Association) has been evaluating the intensive development and rotational grazing system implemented by the owners of Beetaloo & Mungabroom stations since 2012. We have measured the pasture productivity, land condition and live weight performance across 47 paddocks ranging in size from 2.4 to 25 km². The rotation was stocked with a single mob of 5,000-7,000 young bulls which are moved every 2-4 days. The performance of adjacent set-stocked country was monitored for comparison. The results show that there are no statistical differences in average pasture yields, ground cover or pasture composition emerging between the two grazing systems. Live weight and economic performance has been quite variable depending on wet season rainfall. The trial is funded by the Australian Government until May 2016. A field day was held in May 2016 and the results are being compiled into a final report due in early 2017. More information about this trial can be obtained by contacting jane.douglas@nt.gov.au.

A cell grazing trial has been conducted on improved pastures at the Douglas Daly Research Farm since 2009. The treatments include cell grazing, set stocking at the long term safe carrying capacity and set stocking at a variable stocking rate equivalent to the effective stocking rate in the cell grazing treatment. Young cattle enter the trial shortly after weaning and remain in it for about one year at which time they are replaced by the next year's group of weaners. The cattle are rotated around 26, 6ha paddocks while the set stocked animals remain in the same 6ha paddock. Preliminary results indicate that individual animal performance is highest in the set stocking group with the lowest stocking rate; production per hectare is highest in the set stocking group with the highest stocking rate. More information about this trial can be obtained by contacting tim.schatz@nt.gov.au.

Sustainable Grazing Practices

The "Shruburn" experiment at Kidman Springs has been investigating the impact of fire management on woody vegetation cover and pasture condition for 22 years. The trial plots are replicated on red and black soil sites, with grazed experimental plots burnt early or later in the dry season, every two, four and six years, and these are compared to unburnt control plots. More information about this experiment can be found by contacting robyn.cowley@nt.gov.au.

APPENDIX 3

Future Developments

The latter part of 2015 and into 2016 has seen a consolidation in industry confidence. Many stations have been sold and property prices appear to be increasing. The *Pastoral Land Act* changes that facilitate diversification appear to be taking effect. A number of new and existing owners have expressed an intention to greatly increase herd numbers. The DPIR is therefore anticipating an increase in development advice, related to pastoral intensification, improved pastures and crops.

DPIR has started a project to estimate the potential for a sustainable increase in cattle numbers in the Northern Territory and the developments that would be needed to achieve this increase in the different production zones. This project is being prioritised in 2016.



