



PASTORAL  
LAND BOARD

NORTHERN TERRITORY

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ANNUAL REPORT  
**2017-18**



# LETTER OF TRANSMITTAL



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Hon Eva Lawler 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 2018.

Yours sincerely

A handwritten signature in black ink, appearing to read "Paul Zlotkowski". The signature is written in a cursive style and is positioned above the printed name and title.

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 at least 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 km<sup>2</sup>, the NT Pastoral Estate comprises 45% of the Northern Territory's land mass held under 224 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 2017-18 reporting season and including the end of 2018, mapping and monitoring was undertaken at 399 sites on 49 properties across 10 of the 11 pastoral districts. Of the 399 sites assessed, 190 were assessed in Excellent/Good condition, 150 were assessed in Fair condition and 59 were assessed in Poor condition. Seasonal quality varied across the Territory, but was average to below average across the majority of the NT including areas within the Victoria River, Roper, Barkly, Tennant Creek, Plenty, Northern and Southern Alice Springs Pastoral Districts. The Sturt Plateau, Katherine and southern Gulf Districts were mostly average. The Darwin District and through the central and northern Gulf District were mostly above average to very much above average.

The Board held four meetings during this reporting period, including one in Darwin and one in Alice Springs. The Board visited Mount Ebenezer, Lyndavale and Henbury Stations in the Southern Alice Springs District and a sub-committee of the Board visited Tipperary West Station in Darwin District.

The Board assessed and approved two new land clearing permits for improved pasture and two non-pastoral use permits for tourism purposes.

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# CHAIRMAN'S FOREWORD



As Chairman of the NT Pastoral Land Board, I have the pleasure in presenting the Annual Report of the Board for 2017-18.

It's been another busy year for the Pastoral Land Board, and it appears the next is shaping up to be busier than ever. The past year saw the Board hold meetings in both Darwin and Alice Springs, as well as via teleconferences. Four properties were visited, three in the Alice Springs District where dry conditions continue to be a challenge for pastoralists, and the Bureau of Meteorology indicates no relief into the medium term.

The most important task associated with this Annual Report is reporting on the condition of pastoral land across the NT. The monitoring of our pastoral estate, and ensuring its general condition, would not be possible without our very efficient Rangelands Monitoring team, who visited and provided informative reports on 49 pastoral leases this past season.

During this time, the Board also issued two permits to clear native vegetation for the purpose of establishing improved pastures. Two non-pastoral use permits were issued for tourism related activities, three development plans and five applications for conversion of term leases to perpetual leases were considered. We had the task of reviewing the Pastoral Land Clearing Guidelines, relative to pending gas development, and providing input into the aligned NT Planning Scheme's Land Clearing Guidelines (2019), which the Board must consider when assessing a clearing application.

It appears the first half of the 21st century is following the pattern set by the 20th century, with a series of long devastating droughts. The shortage of water in the Murray-Darling complex, and the continuing drought in the eastern states, is driving enquiries to us from cotton farmers who want to utilise our more reliable annual monsoonal rains. With the Board already considering multiple non-pastoral use applications, we continue to strive to achieve the important balance between sustainable cattle production and diversification of the pastoral estate. We remain grateful for the professional advice we receive from all service authorities in this regard.

In conclusion, I would like to thank all the Board members for their dedication and contributions to our decisions, and finally I am in awe of the work load achieved by Pastoral Lease Administration staff, in assisting the Board to carry out its extensive work.

**Paul Zlotkowski**

# MEMBERSHIP OF THE BOARD



**Mr Paul Zlotkowski - Chairman**

Commenced with the Board on 25 June 2016



**Mr Steven Craig - Member**

Commenced with the Board on 25 June 2002



**Mr David James - Member**

Commenced with the Board on 28 September 2015



**Dr Leigh Hunt - Member**

Commenced with the Board on 28 September 2015



**Mrs Anne Kilgariff Stanes - Member**

Commenced with the Board on 20 June 2016

## Executive Officers

Mrs Tammy Smart 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;
- i. 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 provisions 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 consent to transfer a pastoral lease or sub-lease should the advice of the Board be sought [section 68(2)].

# LAND CONDITION

Land condition is 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 where pastoral land has been degraded or otherwise damaged it may require a remedial management 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. There are currently no remedial plans in place.



# PASTORAL LAND MONITORING PROGRAM

The Northern Territory Government's Department of Environment and Natural Resources (DENR) 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 appropriate to validate and inform satellite data and products.

New sites are established at or near existing 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 are used to better calibrate Landsat-derived products to Northern Territory 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 (DSITI). 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 30m pixel size of Landsat imagery allows change in vegetation cover to be analysed at site level (1 ha) through to pastoral districts (~10 000 km<sup>2</sup> to >130 000 km<sup>2</sup>) and the entire Northern Territory (~1 346 500 km<sup>2</sup>). Reporting intervals can be as short as three months over a 30 year period (1988 to current).

## Fractional cover

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

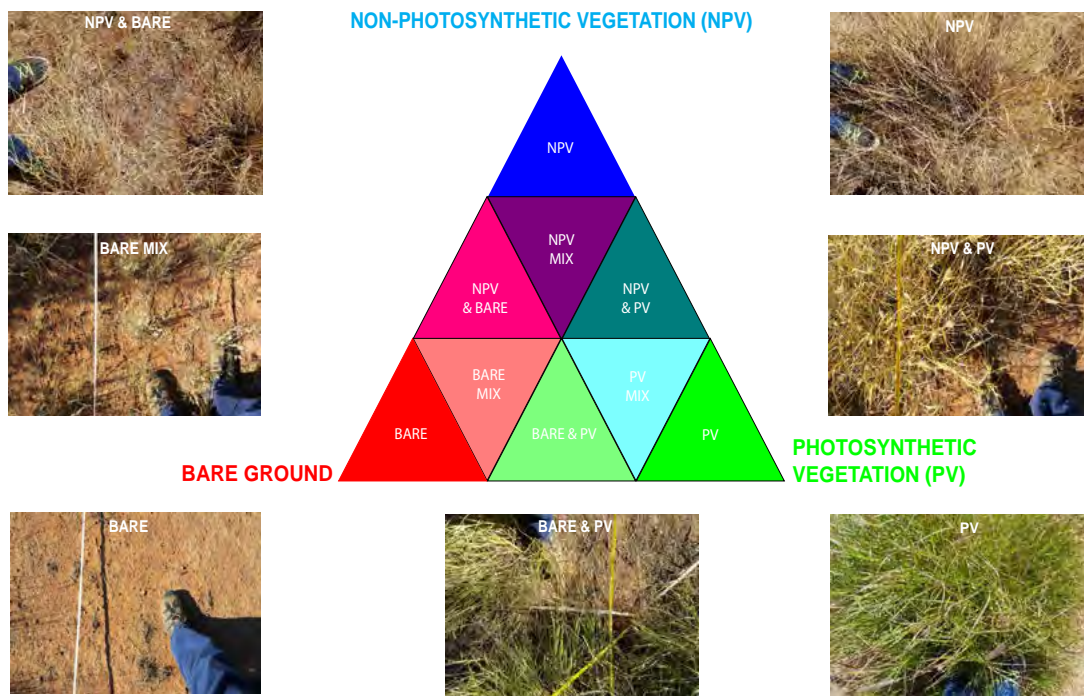


Diagram 1: The three components of fractional cover and the various combinations illustrated in the associated ground cover photos.

The level of vegetation cover or bare ground present and its change over time is reported in three ways:

1. As the actual amount present during a specified period of time. For this report, this is September to November 2018, termed 'spring composite', coinciding with 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/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/summer and/or rains fail more generally.
2. As a decile rank of vegetation cover present in late 2018 (spring composite) compared with that present at similar times back to 1988, a 30 year period.
3. The percentage area of each pastoral district having various categories of bare ground between September and November 2018 (spring composite). Categories of bare ground are:
  - minor,  $\leq 20\%$  of Landsat pixel is bare ground;
  - moderate, 21% - 40% bare ground in pixel;
  - high, 41% - 60% bare ground in pixel; and
  - very high,  $>60\%$  of pixel is bare ground

The number of pixels in each category are counted, multiplied by pixel area (900 m<sup>2</sup> or 0.09 ha) and converted to the percentage of pastoral district area.

The bare ground threshold for each district is based on the frequency distribution of all 30m Landsat bare ground fractional ground cover pixels at the end of 2018 (spring composite). A threshold was determined which represents 75% of a district's bare ground. The remaining 25% is considered to have above-threshold bare ground.

A 75% threshold bare ground value of 48% equates to 48% actual bare soil of a Landsat fractional ground cover pixel.

## Rainfall

The amount, timing and effectiveness of rainfall is a major driver 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 Northern Territory, a comparison of location-specific rainfall against its longer term history is a useful way of illustrating recent seasonal conditions. A Northern Territory map of decile-ranked rainfall for the current reporting cycle (October 2017 to September 2018) is shown on Figure 5a and for the preceeding season (2016-17) in Figure 5b. 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 Australia and Rangelands Fire Information website ([www.firenorth.org.au/nafi3](http://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 LAND CONDITION

## Assessing land condition

The following table summarises how the pasture and woody layers, soil surface features and presence of any weeds are considered to assess land condition.

Land Condition	Soil	Pasture	Weed	Woodland & Shrubland
A (= Excellent) All of these features	No erosion and good surface condition	Good coverage of palatable perennial grasses in the north and annual forage species in the south, minimal bare ground in most years	No weeds	No signs of woody thickening
B (= Good) At least one or more of these features	Minimal evidence of previous erosion or of current erosion risk	Some decline in the presence of palatable grasses and other forage species, a small increase in bare ground	Small infestations of weeds	Some thickening in the density of woody plants
C (= Fair) One or more of these features	Evidence of past erosion and/or current susceptibility to erosion	General decline in palatable perennial and annual grasses, obvious increase in the amount of bare ground	Obvious presence of weeds	General thickening in the density of woody plants
D (= Poor) One or more of these features	Severe erosion, scalding or compaction resulting in a hostile environment for plant growth	General lack of palatable forage species	Large weed infestations covering significant areas	Thickets of woody plants that cover significant areas

# INTEGRATED MONITORING AND LAND CONDITION

This section illustrates how integrated monitoring is used to determine land condition combining on-ground monitoring with satellite imagery over time.

## Good land condition

There are several examples of properties that have maintained or improved their land condition over time, generally due to management of burning practices, stocking rates and paddock rotation. The use of remotely sensed imagery products aid in assessing ground cover changes over time. The Landsat Fractional Ground Cover (LFGC) images are shown in Figure 1, a-d respectively for a monitoring site (yellow cross) at a time corresponding to a 'poor' season, a 'good' season, and the two most recent monitoring visits (2013 and 2018) on a property in the Barkly Pastoral District. The corresponding monitoring site photos for the time of visits in 2013 and 2018 are shown in Figure 2. There is the obvious seasonal difference between the Dry season (blue colour indicating dried-off vegetation) and the Wet season (green colour indicating active photosynthetic vegetation). However, the images show a reduction in areas of bare ground (red colour) and improvement in vegetative cover consistently between the 'poor' season, the time of the 2013 monitoring visit, and the most recent 2018 visit. The on-ground monitoring indicated that ground cover and species composition improved between the 2013 and 2018 visits.

## Not so good land condition

There are a number of properties in the southern region where monitoring sites have been assessed in Poor condition for an extended period of time, generally attributed to near-continuous heavy grazing pressure on the more productive land systems. The Landsat Fractional Ground Cover (LFGC) images are shown in Figure 3, a-d respectively for a monitoring site (yellow cross) at a time corresponding to a 'poor' season, a 'good' season, and the two most recent monitoring visits (2013 and 2018) on a property in the Southern Alice Springs District. The corresponding monitoring site photos for the time of visits in 2013 and 2018 are shown in Figure 4. There are extensive areas of bare ground (indicated by the red colour) in the area surrounding the monitoring site across the four images, irrespective of season, with little indication of vegetation recovery. It is acknowledged that the sporadic rainfall in the southern NT can contribute to extended periods of low levels of vegetation, and that a rain event can lead to marked changes in vegetation cover and species composition. The site is situated on Renners land system. This is generally characterised by calcareous shrubby grasslands with southern bluebush (*Maireana astrotricha*) and mainly annual grasses and forbs with native perennial grasses in depressions and small watercourses. The bluebush now persists in very low densities in the area, and the expected annual grasses are absent. The persistent high levels of remotely sensed bare ground on an otherwise productive land system, even following good seasonal conditions, in conjunction with species composition change, are indicative of Poor land condition.



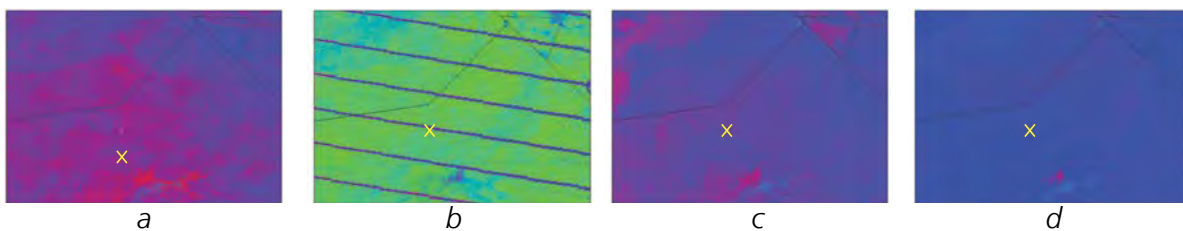


Figure 1. Remotely sensed changes in vegetation dynamics (bare ground = red colour; dried-off vegetation = blue colour; and photosynthetic vegetation = green colour) using Landsat Fractional Ground Cover (LFGC) imagery from a) 2008 Sept-Nov (spring) composite following below-median rainfall; b) 2012 Mar-May (autumn) composite following above-median rainfall; c) 2013 Sept-Nov (spring) composite coinciding with time of October monitoring visit, and; d) 2018 June-August (winter) composite coinciding with the June monitoring visit. The yellow cross indicates the location of the monitoring site on a property in the Barkly District.



Figure 2. On-ground site assessment and photographs at the time of the monitoring inspection in October 2013 (left) and; June 2018 (right) for the monitoring site, corresponding to the location of the yellow cross in the LFGC image above for the Barkly District property. Observations on-ground were consistent with the LFGC imagery over time presented in Figure 1 which indicated persistent vegetation cover, a significant component of Good land condition.

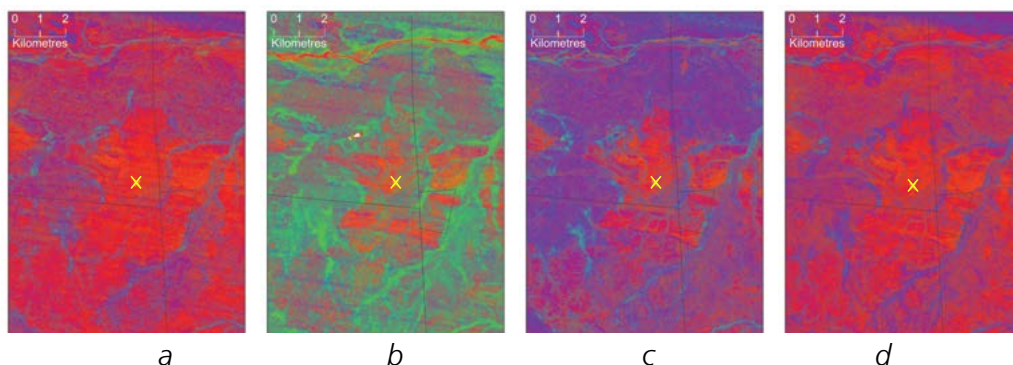


Figure 3. Remotely sensed changes in vegetation dynamics using Landsat Fractional Ground Cover (LFGC) imagery from a) 2008 June-August (winter) composite following below-median rainfall; b) 2010 Sept-Nov (spring) composite following above-median rainfall; c) 2013 June-August (winter) composite coinciding with time of August monitoring visit, and; d) 2018 March-May (Autumn) composite coinciding with the June monitoring visit. The yellow cross indicates the location of the monitoring site on a property in the Southern Alice Springs District.



Figure 4. On-ground site assessment and photographs at the time of the monitoring inspection from June 2013 (on left), and; July 2017 (on right) for the monitoring site, corresponding to the location of the yellow cross in Figure 3. Observations on-ground were consistent with the LFGC imagery in Figure 3 which indicated persistent high bare ground over time, a significant component of Poor land condition.

# 2017-18 MONITORING SEASON AND PASTORAL DISTRICTS

The Rangeland Monitoring Branch within the Department of Environment and Natural Resources visited 49 pastoral leases in 10 Pastoral Districts during the 2017-18 reporting cycle, from 1 October 2017 to 30 September 2018<sup>1</sup>.

Assessed land condition for each district is summarised in this section. This overview is drawn from the analysis of vegetation-cover dynamics based on Landsat imagery, data collected at 399 integrated monitoring sites and more general assessment of land condition during lease visits.



The criteria and methods used to monitor land condition are explained on pages 9-11.

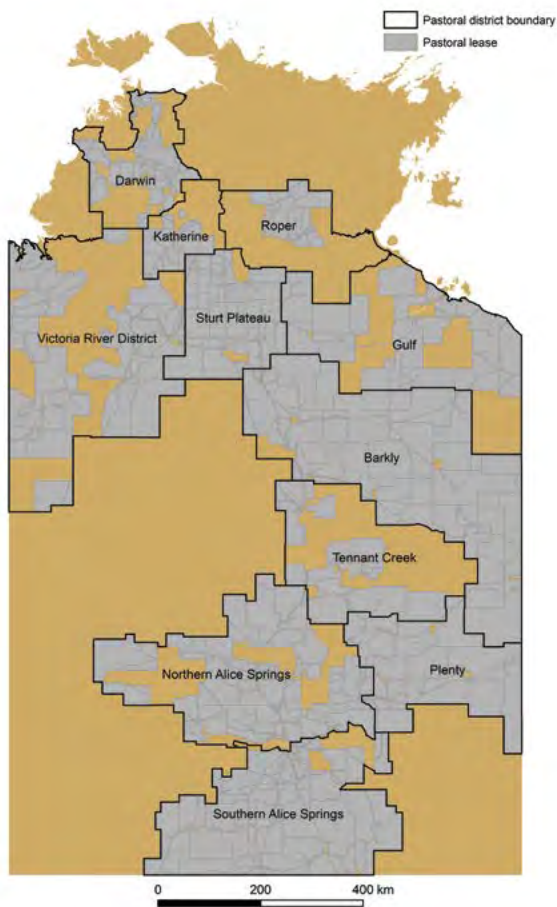
## Seasonal conditions

Seasonal conditions for 2017-18, based on rainfall amount compared with the long-term record (Figure 5a), were:

- Average to below average for the majority of the Northern Territory including most areas within the Victoria River, Roper, Barkly, Tennant Creek, Plenty, Northern and Southern Alice Springs Pastoral Districts.
- Mostly average across the southern Gulf, Katherine and Sturt Plateau Pastoral Districts.
- Above average to very much above average through the central and northern Gulf District and across the Darwin District.
- The preceding season (2016-17) for which the majority of the Northern Territory had above average to very much above average rainfall is shown in figure 5b for comparison.

1. Two leases were inspected during October 2018; they are included in reporting figures for completeness for the 2018 season. Five leases were inspected during late 2017, and are included as part of this formal reporting period.





Map 1: Pastoral Districts

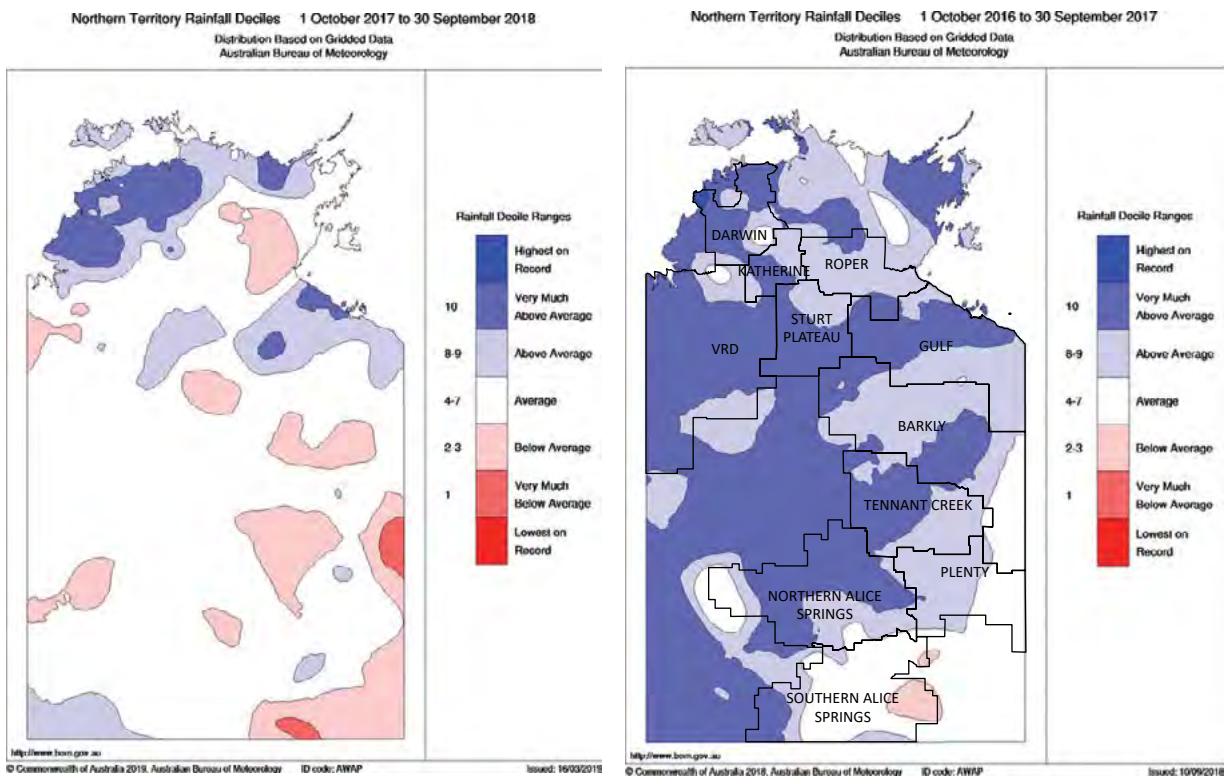


Figure 5. Decile-ranked rainfall for the 5a) October 2017 to September 2018 reporting period and 5b) October 2016 to September 2017 previous reporting period

## 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 ground 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 30 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 usual Wet season/summer rains and/or monsoonal rains fail more generally. Figure 6 illustrates the percentage of bare ground present in 0.09-ha Landsat pixels in the latter part of 2017 or 2018 compared with the pixel-level rank of vegetation cover over time. The latter compares vegetation cover in late 2017 and 2018 against that present at the same time each year since 1988. The pair of images together indicates:

- Increased amounts of bare ground (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 ground) 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, where not recently burnt.

Comparing the images separately shows a general decrease in vegetation cover (i.e. more bare ground) from late 2017 to the same period in 2018 across most of the pastoral estate. In particular:

- The increase in the extent of yellow and tan colouring across most of the southern NT, including non-pastoral land in the south-west, and also large areas of the southern Barkly Pastoral District, the Northern and Southern Alice Springs Pastoral Districts, and the Plenty District indicates more bare ground than 12 months previously and a lower (decile) rank of vegetation cover relative to that present since 1988.
- 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.

In summary, Figure 6 shows the contrast and relative change in levels of vegetation cover (conversely, bare ground) 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.



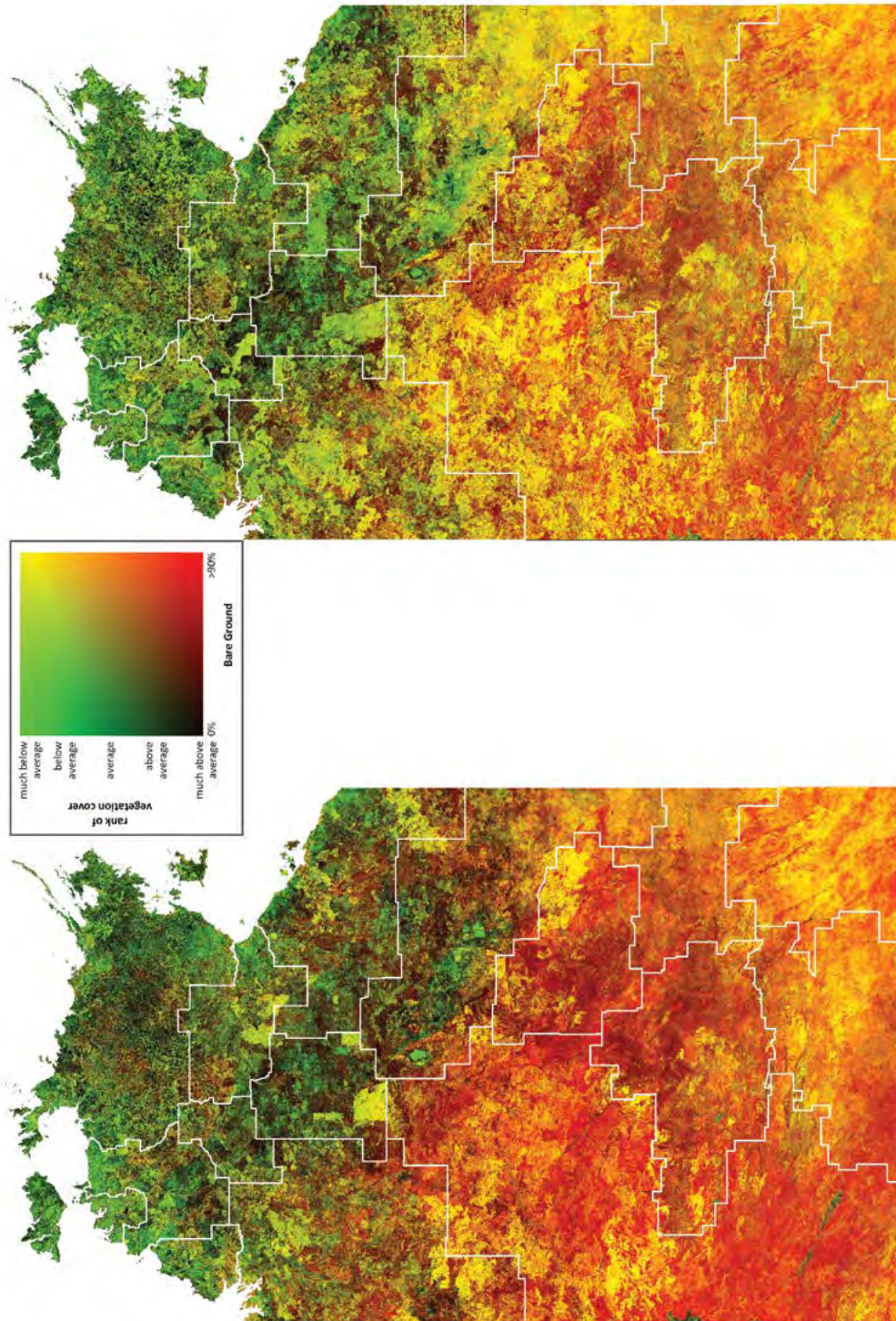


Figure 6. Change in the amount of bare ground and rank of vegetation cover between late 2017 (left) and 2018 (right). The amount of bare ground is shown in shades of red (see legend); high bare ground = bright red, little bare ground = dark red). The rank of vegetation cover is depicted in green; relatively less cover in late 2017 or 2018 = bright green, relatively more cover = dark green. Mixing of green and red indicates other possible responses (see legend); dark brown represents less bare ground in the Landsat pixel and more vegetation cover in 2017 or 2018 compared with the recent past; yellow means high levels of bare ground and less vegetation cover relative to the recent history (since 1988). White polygons show pastoral districts (see Figure 5 for their names).



## 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 7). 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 ground, we would expect bare ground 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 7. When it is known what is expected, it is then possible for monitoring and management to focus on unexpected change (the ✓✓ and ✕✕ cells in Figure 7). For example, at landscape and regional scales, the amount of bare ground 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 ground may be associated with heavy stocking. A decrease in the amount of bare ground 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	✕✕	✕	~
Average	✕	~	✓
Below average	~	✓	✓✓

Figure 7. Seasonal quality matrix used to interpret change in bare ground 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 ground: 2017 to 2018

Change in vegetation cover (conversely, bare ground) in the NT between late 2017 and 2018 is illustrated in Figure 6. This change, for bare ground, 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](http://www.longpaddock.qld.gov.au)). Modelled growth between October 2017 and September 2018 was ranked as a percentile of the growth for all previous 12-month periods (back to 1957).

Areas (5km by 5km 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 ground was split between 'increase', 'no change' and 'decline' according to pastoral district.

In the southern NT (Southern and Northern Alice Springs, Plenty, Tennant Creek and Barkly Pastoral Districts), 'no change' was interpreted as bare ground (for each Landsat pixel) in 2018 being within  $\pm 15$  percentage points of that present in 2017. An increase in bare ground 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 ground of more than  $\pm 5$  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 7) was then calculated for each pastoral district. The percentage areas showing unexpected change (decline in bare ground with below average seasonal quality or increase in bare ground with above average seasonal quality) is summarised in Table 1. Percentage areas for increased bare ground 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 ground from 2017 to 2018 accorded with seasonal expectations in most pastoral districts (Table 1).

The Katherine District however had an eleven percent bare ground increase with above average seasonal quality. The North Australia and Rangelands Fire Information website (NAFI) reports that 40.2% of the Katherine District burnt between October 2017 and September 2018. This would contribute to the unexpected increase in bare ground, given above average seasonal quality. Fire dynamics play an important role in vegetation dynamics in these environments.

The threshold used for assigning 'no change' in bare ground obviously influences the percentage area calculated as exhibiting unexpected change. This is also applicable to threshold 'bare ground' based on the frequency distribution of all 30m pixels within each district; arbitrarily determined as the value which represents 75% of a district's bare ground.

Table 1. The percentage area of pastoral leases within pastoral districts showing unexpected change in bare ground with respect to seasonal quality between the latter parts of 2017 and 2018. 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; except for recent effects of fire, bare ground 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 ground has decreased following unfavourable seasonal conditions.

Pastoral District	Percentage area showing unexpected change		
	Increase in bare ground following average seasonal quality	Increase in bare ground following above average seasonal quality	Decline in bare ground following below average seasonal quality
Darwin	8	5	10
Katherine	9	11	0
VRD	10	1	7
Sturt Plateau	6	6	4
Roper	10	2	6
Gulf	8	4	5
Barkly	0	0	3
Tennant Creek	0	0	0
Plenty	0	0	2
Northern Alice Springs	0	0	0
Southern Alice Springs	0	0	0

## 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 ground dynamics including mapped areas exceeding specified thresholds of bare ground
- 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 <sup>1</sup> Growth Percentile	% PD <sup>2</sup> Burnt	% PD with category of Bare Ground <sup>3</sup>				# <sup>4</sup> stations	Site Data		# <sup>5</sup> sites	Summary of Pastoral District
			minor	moderate	high	very high		Rating	Excellent/Good		
Darwin	54	51	65	32	3	0	4	Excellent/Good	15	Seasonal quality, based on AussieGRASS-modelled pasture growth, varied from much below to much above average. The total area burnt between October 2017 and September 2018 was 18 701 km <sup>2</sup> . Based on the Landsat record for the last 30 years, most areas of reduced vegetation cover were related to recent fire. One quarter of the District had more than 24% bare ground per Landsat pixel (bare ground threshold) late in the 2018 Dry season, again, strongly associated with fire. Minor amounts of bare ground were present in the late Dry season of 2018, with perennial grasses dominating the ground cover at the majority of the integrated sites. Weeds, where present, include Hyptis, Sida, Parkinsonia and Mimosa.	
Katherine	73	40	67	29	4	0	2	Excellent/Good	4	Seasonal quality, as indicated by AussieGRASS-modelled pasture growth, was very much above average for most of the south and south-west of the District. Approximately 40% of the District was affected by fire between October 2017 and September 2018, with the most extensive areas being burnt in April, May, and August 2018. One quarter of the District had bare ground above 25% per 30m pixel (bare ground threshold) late in the 2018 Dry season. Most of the District had minor occurrence (< 20%) of bare ground at this time. Sites, on average, had a moderate cover of perennial grasses, low bare ground, and moderate amounts of litter, as would be expected from more timbered country in this District. Bellyache bush and grader grass were recorded as the main weed issues, with gamba grass noted as a future weed management issue.	

Summary of Pastoral District

% PD with category of Bare Ground<sup>3</sup> #<sup>4</sup> stations Rating #<sup>5</sup> sites

AG<sup>1</sup> Growth Percentile % PD<sup>2</sup> Burnt

Pastoral District

Pastoral District	AG <sup>1</sup> Growth Percentile	% PD <sup>2</sup> Burnt	% PD with category of Bare Ground <sup>3</sup>	high	moderate	minor	# <sup>4</sup> stations	Rating	# <sup>5</sup> sites
VRD	57	29	24	47	26	2	2	Excellent / Good	11
								Fair	14
								Poor	2

The District experienced mostly above average seasonal quality in the north, and average to below average in the south, based on slightly below median rainfall and slightly above median modelled pasture growth through the 2017-18 Wet season. Almost 29% of the District burnt between October 2017 and September 2018. One quarter of the District had > 42% bare ground per Landsat pixel (bare ground threshold), which was strongly associated with fires in either 2017 or 2018. This area includes 'desert-like' country of low pastoral value that is periodically burnt. On-ground monitoring was conducted at 27 sites on two pastoral leases, one at the end of 2017, and the other in 2018. Sites, on average, had only a moderate cover of perennial grasses and approximately half the site was comprised of bare ground and litter. Parkinsonia was the main weed issue, and was generally being actively controlled, with noogoora burr to a lesser extent.

Pastoral District	AG <sup>1</sup> Growth Percentile	% PD <sup>2</sup> Burnt	% PD with category of Bare Ground <sup>3</sup>	high	moderate	minor	# <sup>4</sup> stations	Rating	# <sup>5</sup> sites
Sturt Plateau	69	18	73	24	3	0	9	Excellent / Good	28
								Fair	11
								Poor	0

Modelled pasture growth generally reflected rainfall distribution across the District, with average to well above average seasonal quality, although there was lower rainfall and below average pasture growth in the south-west. One quarter of the District had > 21% bare ground (threshold bare ground). Monitoring was conducted at 39 sites on nine leases, four at the end of 2017, and five in 2018. Sites, on average, had a good cover of perennial grasses, a moderate amount of litter as would be expected with the more timbered land systems in this District, and a small amount of bare ground. Pasture utilisation was generally well-aligned with pasture availability. Weed infestations were minimal, generally Sida and Hyptis restricted to watering points.



Pastoral District	AG <sup>1</sup> Growth Percentile	% PD <sup>2</sup> Burnt	% PD with category of Bare Ground <sup>3</sup>				# <sup>4</sup> stations	Site Data		Summary of Pastoral District
			minor	moderate	high	very high		Rating	# <sup>5</sup> sites	
Roper	67	27	66	30	3	0	1	Good	4	The District experienced above average seasonal quality based on expected Wet season pasture growth (from AussieGRASS simulation) and rainfall, but was variable, including a north-south band of below median rainfall through the centre and associated patches of reduced modelled pasture growth. Much of the western half had above average vegetation cover in late 2018; areas with low ranking cover were often strongly related to incidence of fire. In total, 27% of the District burnt between October 2017 and September 2018, which was similar to the preceding 12 months. A single lease was assessed in 2018, of which its four integrated monitoring sites were all assessed as in Good land condition, and with active weed and fire management programs in place.
								Fair	0	
								Poor	0	

Gulf	62	31	53	38	8	1	2	Excellent/ Good	9	The Gulf coast and hinterland extending up to 100km inland experienced good seasonal quality based on AussieGRASS-modelled pasture growth, consistent with above average rainfall in this area. Areas adjoining the Sturt Plateau and Barkly Districts also experienced good seasonal quality, even though rainfall in these areas was below average. Areas of much reduced vegetation cover, as monitored with remote sensing, were scattered throughout the District – and were mostly, but not always associated with recent fire. One quarter of the District had more than 29% bare ground per Landsat pixel (threshold bare ground) later in the 2018 Dry season, mostly in the central and south-eastern parts of the District. There were isolated infestations of Parkinsonia, noogoora burr and neem.
								Fair	5	
								Poor	0	

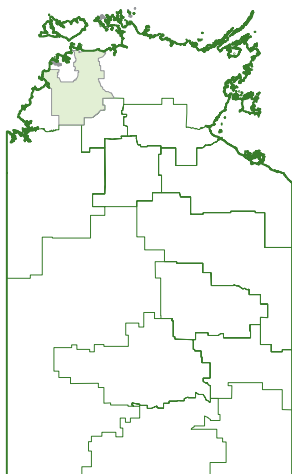
Pastoral District	AG <sup>1</sup> Growth Percentile	% PD <sup>2</sup> Burnt	% PD with category of Bare Ground <sup>3</sup>					Site Data		Summary of Pastoral District
			minor	moderate	high	very high	# <sup>4</sup> stations	Rating	# <sup>5</sup> sites	
Barkly	51	7	23	33	36	9	11	Excellent/ Good	67	The majority of most leases were in Good land condition, with lesser areas in Fair condition. Seasonal quality, based on expected pasture growth, was average to above average across most of the pastoral district, although rainfall was below the long term median. There was a small area in the far north which experienced well above average seasonal conditions and the southern-most portion had significantly lower than average simulated pasture growth. One quarter of the district had > 51% bare ground per Landsat pixel (threshold bare ground) in the late Dry season, mainly in the east, south-east and south-west. Less than seven percent of the District burnt over the reporting period, with the majority of this occurring from October to December 2017. Parkinsonia and rubber bush were present on most leases, mostly around waterpoints and yards. Asbestos grass (non-declared) noted in some areas.
								Fair	57	
								Poor	0	
Tennant Creek	53	12	1	32	61	6	6	On-ground monitoring not conducted in 2017-18 reporting period.		Seasonal quality based on rainfall and modelled pasture growth was generally above average in the west and below average in the east of the District. This was broadly consistent with analysis of Landsat imagery of vegetation cover rank, although northern parts of the District had significantly below average vegetation cover recorded since 1988 (based on Landsat imagery). One quarter of the District, primarily in the north-east on non-pastoral tenure, had a relatively high level of bare ground (>51% of 30m Landsat pixel), some of which was not attributed to fire in 2018.

Pastoral District	AG <sup>1</sup> Growth Percentile	% PD <sup>2</sup> Burnt	% PD with category of Bare Ground <sup>3</sup>					Site Data # <sup>4</sup> stations	Site Data # <sup>5</sup> sites	Summary of Pastoral District
			minor	moderate	high	very high	Rating			
Plenty	33	0	0	18	71	11	1		4	Mainly below average seasonal quality based on rainfall and modelled pasture growth, with the exception of the south-west pocket. Vegetation cover rank across the District was generally average with patches of 'above to well above average' in the north and patches of 'below to well below average' in the south, compared to vegetation cover recorded since 1988 (based on Landsat imagery). There was minimal incidence of fire across the District. One quarter of the District had a relatively high level of bare ground (>54% of 30m Landsat pixel, bare ground threshold). Productive grazing country was generally in Good to Fair land condition with some areas of alluvial country in poorer condition, and erosion recorded at four of the ten sites.
								Good		
								Fair	3	
								Poor	3	
Northern Alice Springs	40	4	0	38	57	5	4		4	Much of the District experienced average or below average seasonal quality based on expected pasture growth (modelled using AussieGRASS), and variable rainfall. Parts of the south and west had seasonal conditions that were very much below average. From Landsat data, most of the District had similar or less vegetation cover (relatively less bare ground) in the latter period of 2018 compared with previous years since 1988. One quarter of the District had more than 50% bare ground at this time (threshold bare ground). On-ground monitoring resulted on average, with a moderate to high level of bare ground, reasonable litter cover and small contributions of perennial and annual grasses, and forbs. Slight to moderate sheet erosion was recorded at approximately two thirds of the sites and 60% of sites were moderately to heavily grazed at the time of assessment.
								Good		
								Fair	19	
								Poor	7	

Pastoral District	AG <sup>1</sup> Growth Percentile	% PD <sup>2</sup> Burnt	% PD with category of Bare Ground <sup>3</sup>					Site Data		Summary of Pastoral District
			minor	moderate	high	very high	# <sup>4</sup> stations	Rating	# <sup>5</sup> sites	
Southern Alice Springs	42	0	0	7	64	29	13	Good	44	There was considerable spatial variation in rainfall across the District, and this was generally reflected in the modelled pasture growth which was above average in the west of the region and below average in the south-east. There were extensive areas of high bare ground; one quarter of the District had >61% bare ground per pixel, most of which through the central region appeared to be a continuing legacy of extensive 2011 wildfires. Past wind sheeting was recorded at three quarters of the monitoring sites with scalding and/or water sheeting also evident at most sites.
								Fair	35	
								Poor	46	

- 1 AussieGRASS modelled pasture growth for the period November 2017 to April 2018 or October 2017 to September 2018 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 5km square 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 2017 and September 2018. Fire scars sourced from the North Australia and Rangelands Fire Information website ([www.firenorth.org.au/nafi3](http://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 ground present between September and November 2018 (spring composite), as a percentage of the area of the pastoral district. Bare ground 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 m<sup>2</sup> 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 between October 2017 and October 2018.
- 5 Number of integrated monitoring sites in each land condition rating score measured in the pastoral district.

# DARWIN PASTORAL DISTRICT



Map 2: Location of Darwin Pastoral District

Seasonal quality based on AussieGRASS-modelled pasture growth, varied from much below to much above average across the Darwin District which encompasses nearly 37 000 km<sup>2</sup>.

The District experiences extensive and frequent fire. The total area burnt between October 2017 and September 2018 was similar to the preceding reporting period (2016-17, 15 808 km<sup>2</sup>; 2017-18, 18 701 km<sup>2</sup>). Based on the Landsat record for the last 30 years, most areas of reduced vegetation cover were related to recent fire. Minor amounts of bare ground were present in the late Dry season of 2018. One quarter of the District had bare ground above 24% per 30m pixel (bare ground threshold) late in the 2018 Dry season. On-ground monitoring for land condition was conducted on 18 sites on four pastoral leases. Perennial grasses dominated at the majority of sites, with bare ground, on average, comprising approximately 7% of total ground cover. The more common weeds were gamba grass, which was managed primarily by grazing, Hyptis and Sida. Land condition was rated as Excellent at three sites, Good at 12 sites, and Fair at the remaining three 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](http://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](http://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 summer/Wet season period November 2017 to April 2018. This growth is ranked as a percentile of the growth for all previous summers.

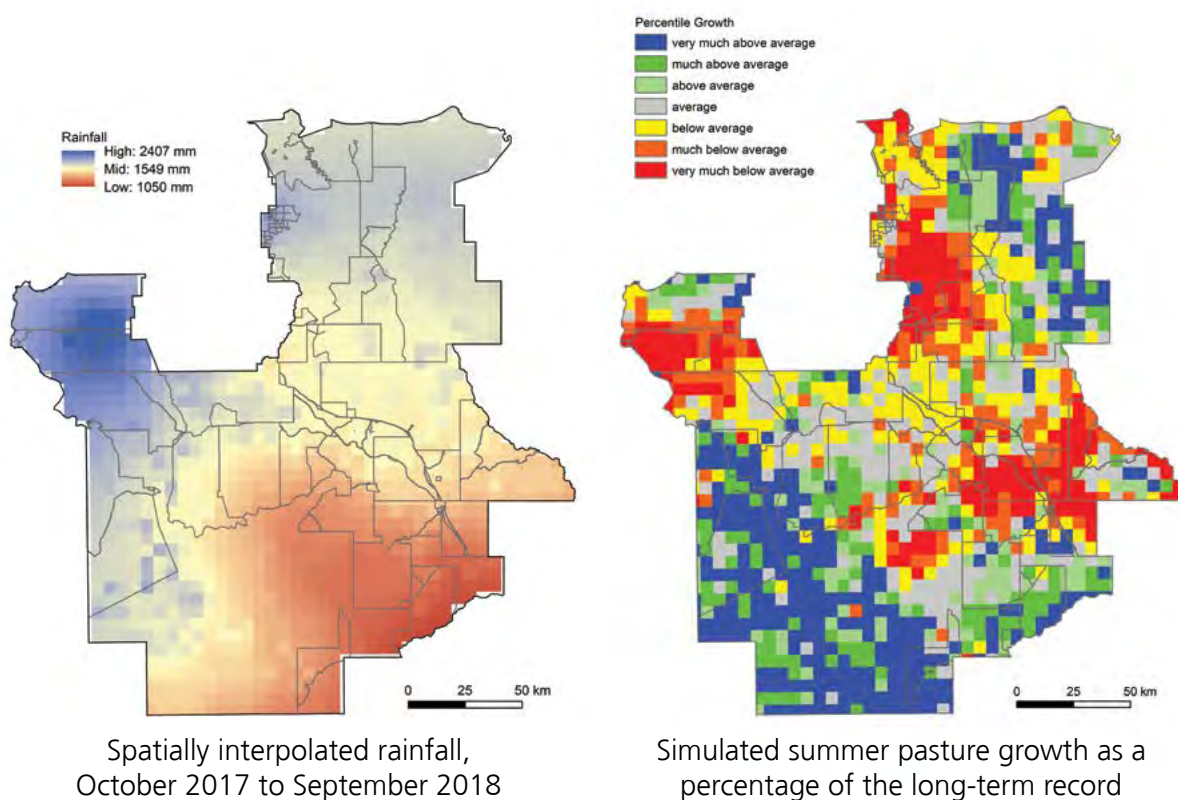
Table 3. Indicators of seasonal quality. Data spatially averaged for the Darwin Pastoral District.

	Rainfall (mm)		AussieGRASS
2017 – 2018	1 665	Growth (kg/ha)	1 964
Long-term median	1 271	Percentile	54

# DARWIN PASTORAL DISTRICT

Spatially averaged rainfall for the Darwin Pastoral District was greater than the long-term median (Table 3) but displayed considerable spatial variation (Figure 8, left-hand panel). Rainfall increased from east to west (drier inland to wetter coastal areas) across the District with areas near the Western Australia border having more than 2 400 mm, significantly greater than the long term median District rainfall.

Modelled pasture growth over the last summer was slightly above the long term average based on the spatial mean (Table 3), although there were areas with ‘very much below average’ pasture growth.



Maps of seasonal quality. Left, gridded rainfall, October 2017 to September 2018; right, AussieGRASS-modelled pasture growth for the 2017-18 summer (Wet season) period as a percentage of previous summers. (Note: these images do not account for impact from fire or geographic influence variations across a district).



# DARWIN PASTORAL DISTRICT

## Fire

The North Australia and Rangelands Fire Information website ([www.firenorth.org.au/nafi3](http://www.firenorth.org.au/nafi3)) reports that 18 791 km<sup>2</sup> burnt (51% of Darwin Pastoral District) between October 2017 and September 2018 (Figure 9). This was similar to the 15 808 km<sup>2</sup> and 17 533 km<sup>2</sup> burnt in the previous two reporting periods (October 2016 to September 2017 and October 2015 to September 2016).

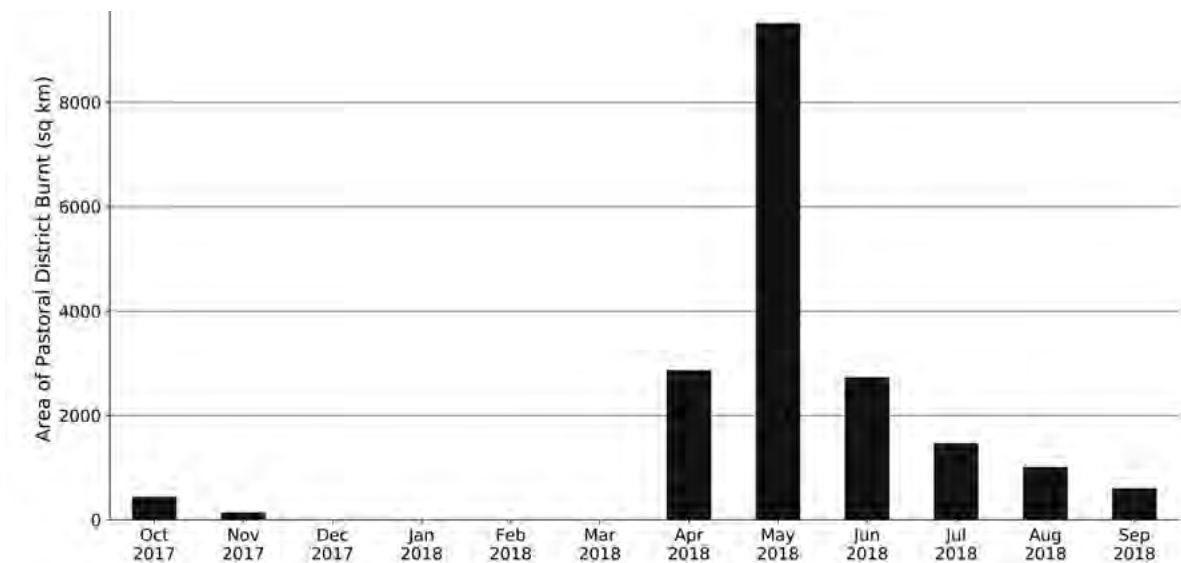


Figure 8. Monthly area burnt (km<sup>2</sup>) in the Darwin Pastoral District between October 2017 and September 2018.

## Bare ground dynamics

It is important to maintain adequate ground cover in the latter months of each year to minimise ground 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 ground 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 ground in each 30m square Landsat pixel (900 m<sup>2</sup> or 0.09 ha) was used to report the amount of bare ground across all pixels in the Darwin Pastoral District for the end of Dry season (September to November spring composite).

Vegetation cover in the Darwin Pastoral District is strongly correlated with incidence of fire which is a recurrent (almost annual) event across the Top End region. Most areas of reduced vegetation cover, compared with the last 30 years, across much of the District were associated with recent fire (Figure 10, burnt areas shown with diagonal hatching). Ignoring 2018 fire effects on the dynamics of vegetation cover, parts of the northern section of the District had relatively less cover in late 2018 compared with the same period back to 1988. Contrasting with this decreased cover, areas in the south of the District, often coinciding with non-pastoral lease tenure, had their highest late Dry season cover since 1988.

# DARWIN PASTORAL DISTRICT

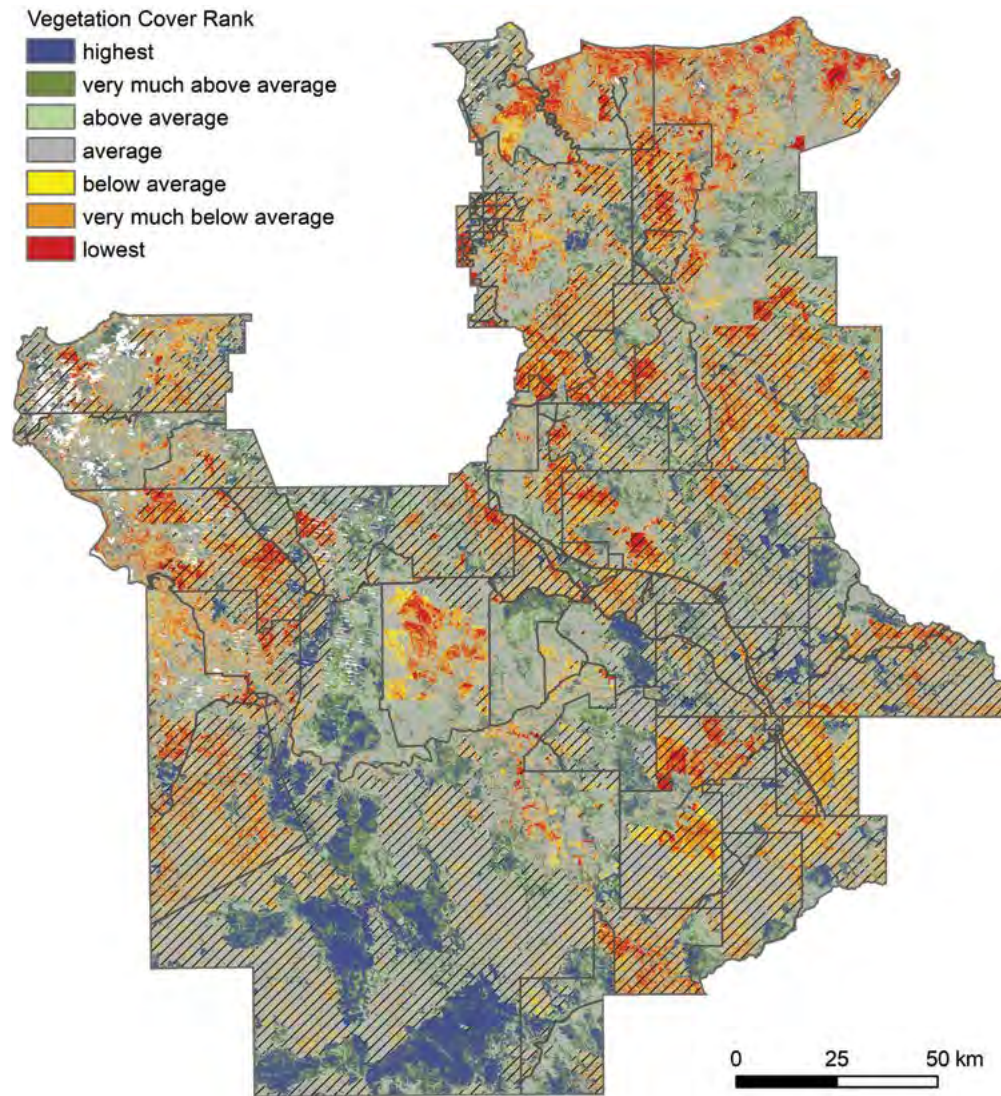


Figure 9. Rank of the amount of remotely-sensed vegetation cover present from September to November 2018 against that for previous years back to 1988. Diagonal lines show those areas burnt between January and November 2018.

# DARWIN PASTORAL DISTRICT

Approximately 65% of the District had minor amounts of bare ground (< 20% of the 30m Landsat pixel) towards the end of 2018 (Figure 11). The threshold level of bare ground used for mapping purposes is selected to show at what level approximately 25% of the district is affected; for the Darwin District, this was calculated as 24% bare ground in each Landsat pixel with this latter area mapped in Figure 11. It includes areas burnt earlier in 2018.

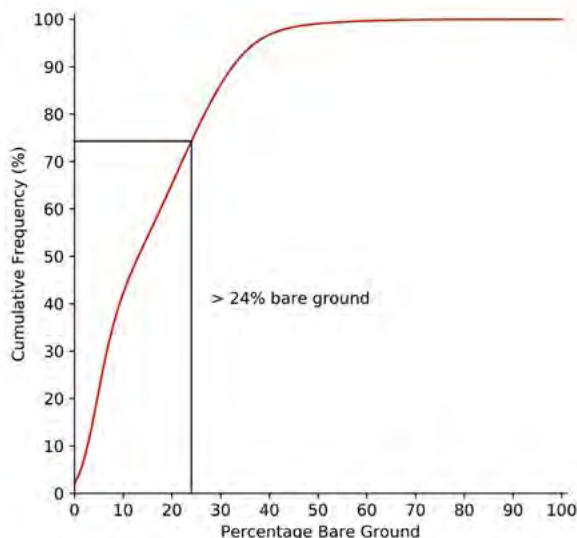


Figure 10. Percentage cumulative frequency of varying levels of bare ground in 30m square Landsat pixels in the Darwin Pastoral District between September and November 2018. Areas with greater than 24% bare ground are mapped in Figure

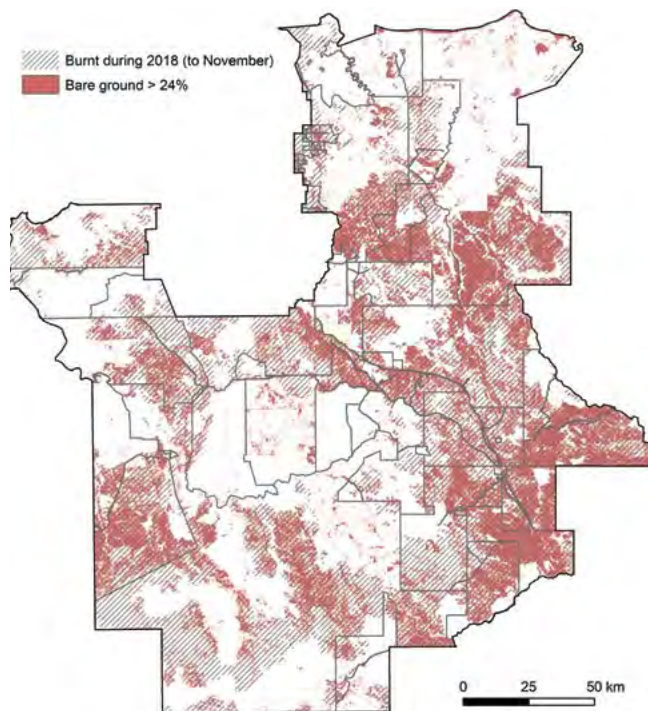


Figure 11. Parts of the Darwin Pastoral District having more than 24% bare ground per Landsat pixel in late 2018. Areas burnt between January and November 2018 shown with diagonal lines. Note that the threshold level of bare ground used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.

# DARWIN PASTORAL DISTRICT

## Site-based monitoring

Four pastoral leases in the Darwin Pastoral District were visited during late 2017 and 2018.

Vegetation cover of the ground layer was measured at 18 sites across the four 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, consistent with the more timbered land systems, with basal area recorded in 11 of the 18 sites, and bare ground, on average, comprised approximately 7% of total ground cover.

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

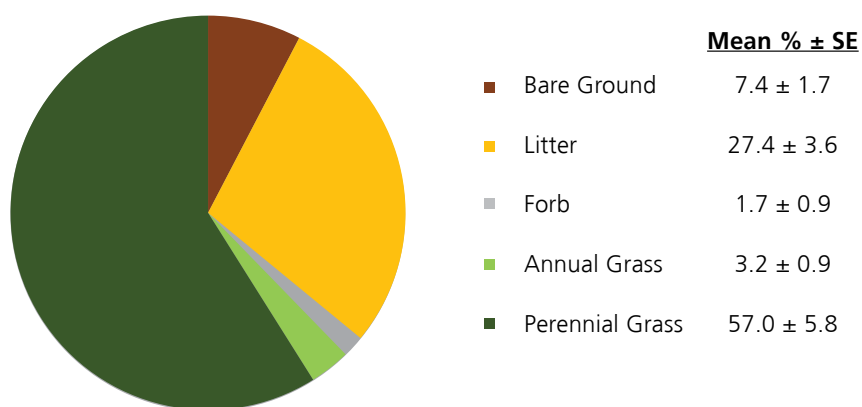


Figure 12. Mean percentage and standard error of measured components of vegetation cover in the ground layer from 18 sites on four pastoral leases in the Darwin Pastoral District.

# DARWIN PASTORAL DISTRICT

The majority of sites (72%) had minimal grazing (Table 4). There was no evidence of erosion recorded at any of the monitoring sites, consistent with the high cover provided by perennial grasses and litter.

*Table 4. Levels of pasture utilisation recorded at 18 sites on four pastoral leases in the Darwin Pastoral District.*

<b>Pasture Utilisation</b>	
<b>Rank</b>	<b>% of sites</b>
No grazing	0
Minimal (<25%)	72
Moderate (26-50%)	11
Moderate to heavy (51-75%)	17
Heavy (76-90%)	0
Very heavy (>90%)	0

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 2017-18 (described above).

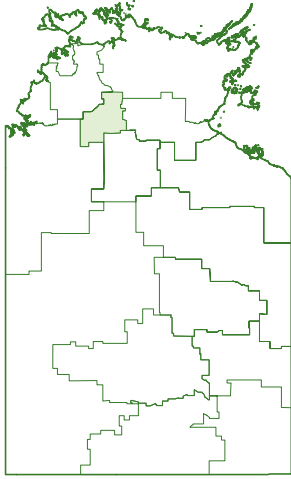


# DARWIN PASTORAL DISTRICT

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

Station	Condition Rating (number of sites)	Comments with regard to pastoral lease
1	Excellent: 1 Good: 3	Land condition across the property was assessed as Good which is improved from the previous monitoring conducted in 2015. Land condition assessment for the four sites was based on robust densities of desirable, 3P (perennial, palatable, productive) grasses including kangaroo grass and native millet, with infill of desirable annual species (e.g. native Sorghum) and minimal less desirable species. The 2017-18 above average Wet season was reflected in good pasture growth. There were areas of erosion particularly along the heavily utilised river flats, and, in areas associated with the more pastorally productive alluvial plains, however access to northern parts of the property was limited due to tracks being inaccessible. There were isolated patches of weed infestations including Hyptis and Sida across the property, however ground based herbicide application control programs are in place, targeting areas around the homestead as well as roads and tracks across the property. Any buffalo present are mustered and sold as a part of the pastoral operation.
2	Excellent: 2 Good: 4 Fair: 2	This property was generally assessed as in Good to Fair land condition, with the monitoring sites and general observations indicating good densities of desirable 3P grasses / improved pasture species with infill of desirable annual species and minimal undesirable increaser species. There was good access throughout the property with roads and tracks in very good condition. The 2017-18 very above average Wet season was reflected in good pasture growth. There were isolated patches of rubber bush and significant areas of gamba grass, which was being managed to varying degrees by grazing. Substantial tracts of native vegetation have been cleared and sown with improved pasture species (Jarra and Cavalcade).
3	Good: 4	The areas inspected were generally considered to be in Good condition, which appears to have been maintained since the last monitoring conducted in 2008. Despite incidence of fires the seasonal response of vegetation to average rainfall produced good ground cover across all assessed sites and general observations. There was a good diversity of palatable desirable perennial grass species, and few signs of erosion.
4	Good: 1 Fair: 1	Land condition across the property was assessed as Good, which appears to have been maintained since the last monitoring conducted in 2008. The above average Wet season and average wet-Dry seasonal fires contributed to good ground cover and diversity of desirable 3P grass species, with infill of annual species pan wanderrie or annual Sorghum, which was also reflected in both monitoring sites. There were no areas observed that were of concern in regards to weeds, erosion or woody thickening.

# KATHERINE PASTORAL DISTRICT



Map 3: Location of Katherine Pastoral District

The Katherine Pastoral District encompasses just over 19 000 km<sup>2</sup>. Seasonal quality, as indicated by AussieGRASS-modelled pasture growth, was very much above average for most of the south and south-west of the District.

Approximately 40% of the District was affected by fire between October 2017 and September 2018, with the most extensive areas being burnt in April, May, and August 2018. One quarter of the District had bare ground above 25% per 30m pixel (bare ground threshold) late in the 2018 Dry season. Most of the District had minor occurrence (< 20%) of bare ground at this time.

On-ground monitoring was conducted at eight sites on two pastoral leases, with two sites rated as Excellent, two as Good, three as Fair and one as Poor. Sites, on average, had a moderate cover of perennial grasses, low bare ground, and moderate amounts of litter, as would be expected from more timbered country in this District. Forbs and annual grasses were minor components of total ground cover. Bellyache bush and grader grass were recorded as the main weed issues, with gamba grass noted as a future weed management issue.

## 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](http://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](http://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 2017 to April 2018. This growth is ranked as a percentile of the growth for all previous summers.

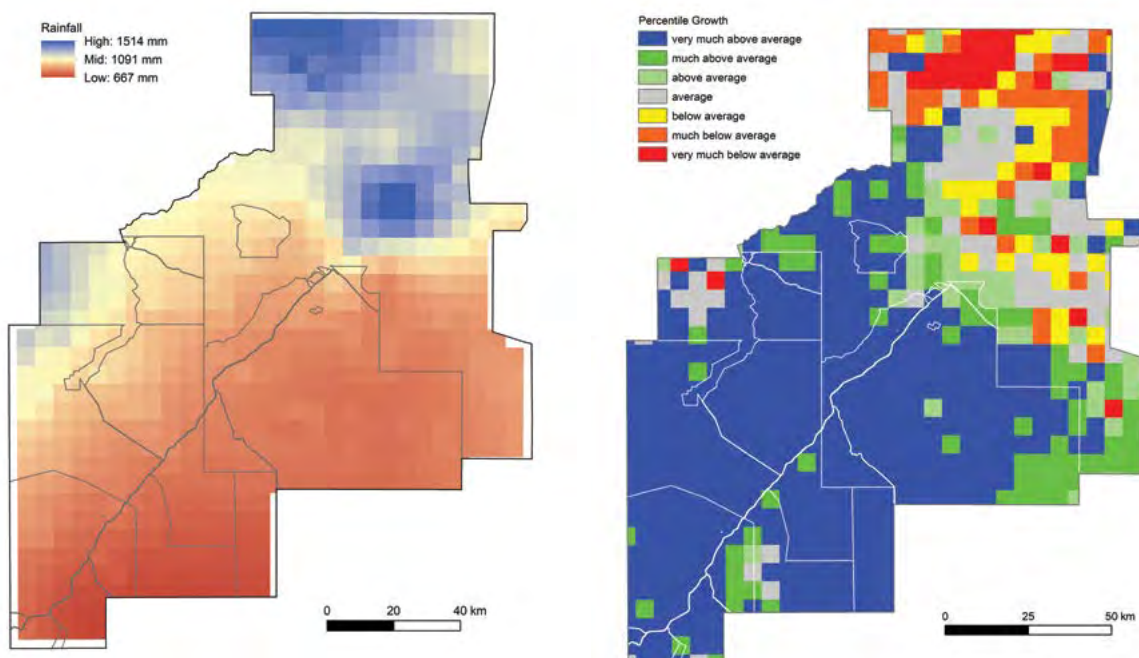
Table 6. Indicators of seasonal quality. Data spatially averaged for the Katherine Pastoral District.

Rainfall (mm)		AussieGRASS	
2017 – 2018	956	2017 – 2018	2 120
Long-term median	914	Long-term median	73

# KATHERINE PASTORAL DISTRICT

Spatially averaged rainfall for the Katherine Pastoral District was above the long-term median (Table 6) with most of the north receiving more than 1 200 mm between October 2017 and September 2018. The south and south-west parts of the region had notably lower rainfall at less than 850 mm (Figure 14).

Modelled pasture growth over the last summer was above average based on the spatial mean (Table 6), although there was some variation across the District; very much above average for much of the southern and western portion of the District; very much below average to average for the east and north (Figure 14, right-hand panel).



Spatially interpolated rainfall, October 2017 to September 2018

Simulated summer pasture growth as a percentage of the long-term record

Figure 13. Maps of seasonal quality. Left, gridded rainfall, October 2017 to September 2018; right, AussieGRASS-modelled pasture growth for the 2017-18 summer period as a percentage of previous summers. (Note: these images do not account for impact from fire or geographic influence variations across a district).

# KATHERINE PASTORAL DISTRICT

## Fire

The North Australia and Rangelands Fire Information website ([www.firenorth.org.au/nafi3](http://www.firenorth.org.au/nafi3)) reports that 7 777 km<sup>2</sup> (40.2% of the District) burnt between October 2017 and September 2018. There was some fire activity in October and November 2017 (Figure 15) suggesting wildfire was the main reason (as this is typically when wildfires started by lightning occur). The main peak in fire activity over the reporting period was in April, May and August 2018, probably due to managed early- and mid-dry-season burning.

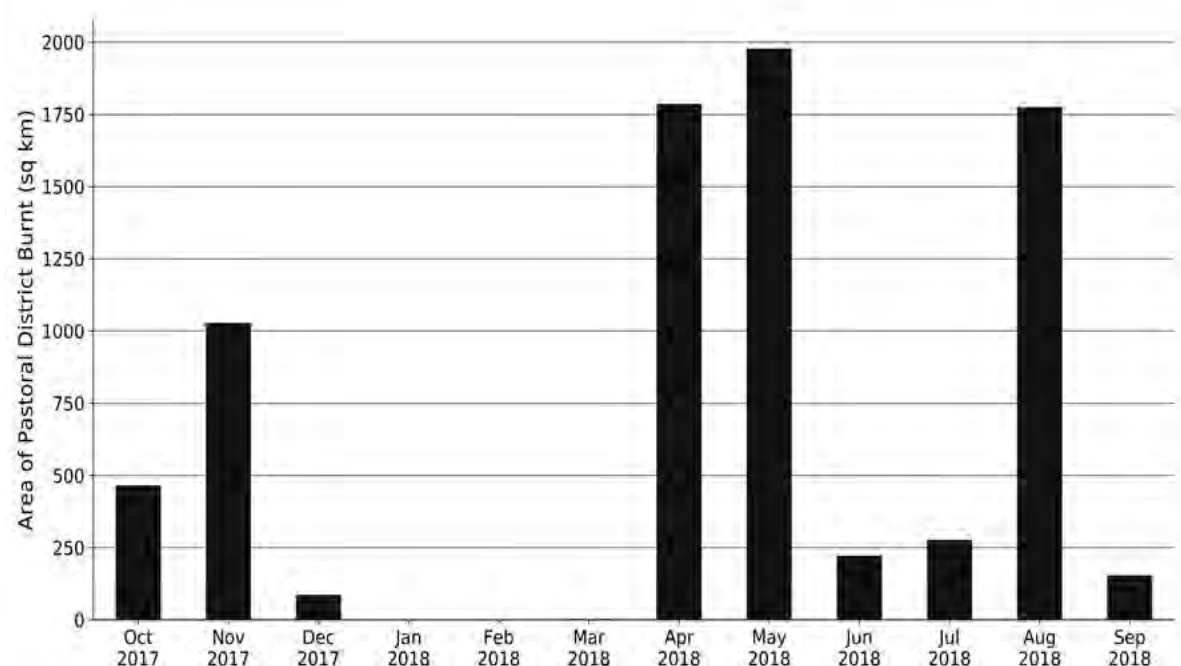


Figure 14. Monthly area burnt (km<sup>2</sup>) in the Katherine Pastoral District between October 2017 and September 2018.

## Bare ground 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 ground 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 ground in each 30m square Landsat pixel (900 m<sup>2</sup> or 0.09 ha) was used to report the amount of bare ground across all pixels in the Katherine Pastoral District.

The bare ground threshold is based on the frequency distribution of all 30m Landsat bare ground cover pixels at the end of 2018 (spring composite). A threshold was determined which represents 75% of a district’s overall bare ground. The remaining 25% is considered to have above-threshold bare ground.

Most areas of reduced vegetation cover compared with the last 30 years, were associated with recent fire. There were considerable areas not affected by fire which had their highest late Dry season cover since 1988 (Figure 16).

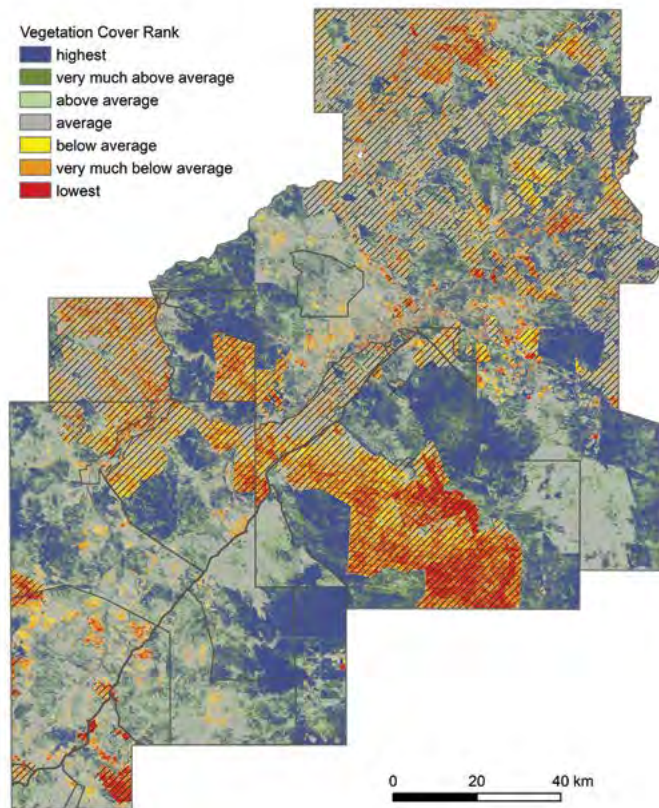


Figure 15. Rank of the amount of remotely-sensed vegetation cover present in late 2018 against that for previous years back to 1988. Diagonal lines show those areas burnt between January and November 2018.

Sixty seven percent of the District had minor amounts of bare ground (< 20% of the 30m Landsat pixel) towards the end of 2018 (Figure 17). The bare ground threshold value for the Katherine Pastoral District was 25%; one quarter of the District had bare ground per pixel greater than this value (Figure 18) and includes areas burnt earlier in 2018.

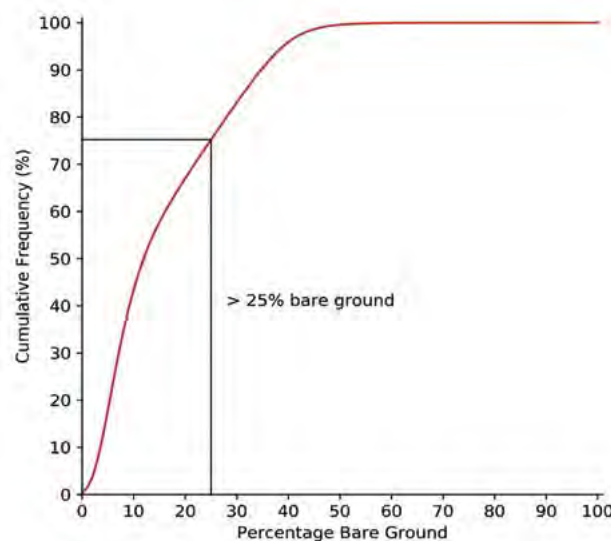


Figure 16. Percentage cumulative frequency of varying levels of bare ground in 30m square Landsat pixels in the Katherine Pastoral District between September and November 2018. Areas with greater than 25% bare ground are mapped in Figure 18.



# KATHERINE PASTORAL DISTRICT

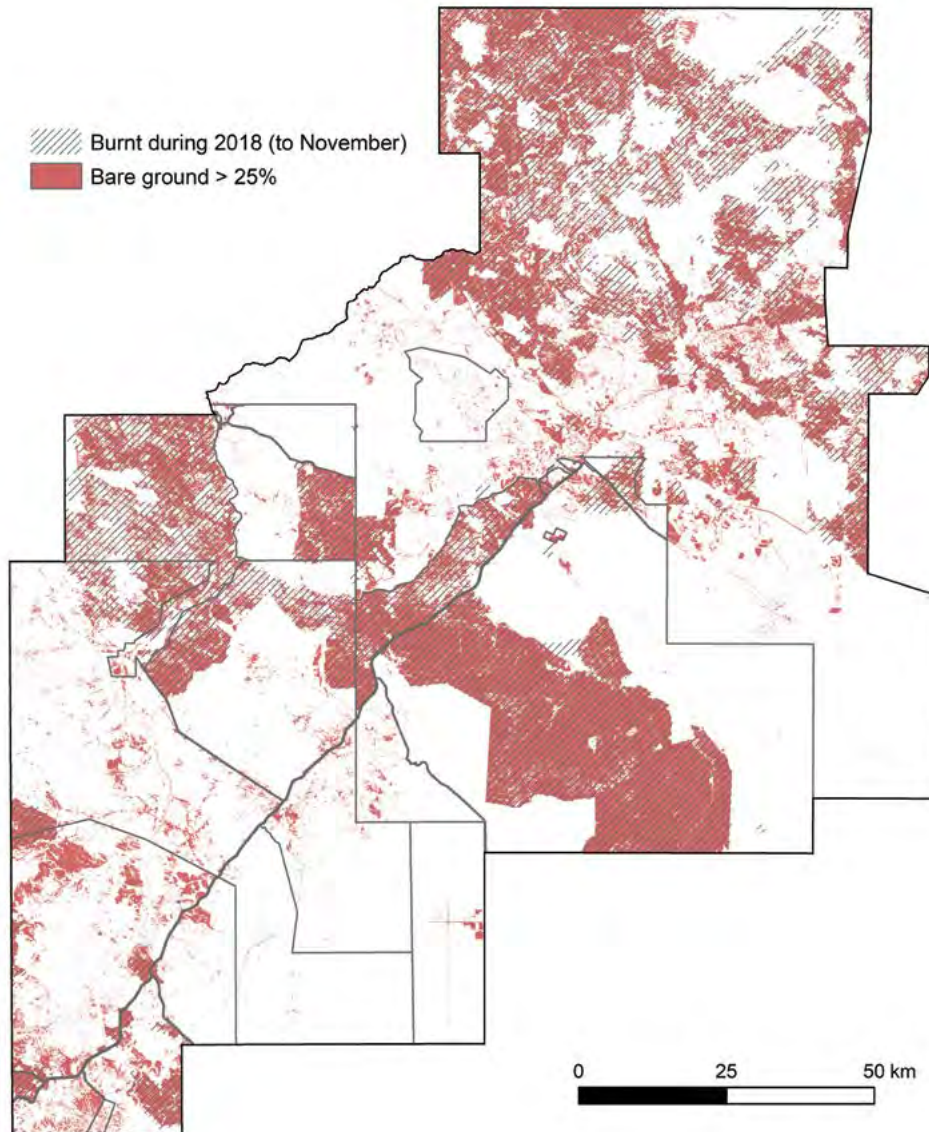


Figure 17. Parts of the Katherine Pastoral District having more than 25% bare ground per Landsat pixel in late 2018. Areas burnt between January and November 2018 shown with diagonal lines. Note that the threshold level of bare ground used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.

# KATHERINE PASTORAL DISTRICT

## Site-based monitoring

Two pastoral leases within the Katherine Pastoral District were visited during 2018.

Vegetation cover of the ground layer was measured at eight sites across the two leases. Perennial grasses, on average, comprised approximately half of the site (Figure 19). Annual grasses and forbs (both perennial and annual) were a minor component, partly due to the late Dry season timing of the monitoring, by which time, annual species have generally dried off and disintegrated. Moderate amounts of litter were generally present, which is not unexpected given the timbered landscapes in this District, and contributed to the low levels of bare ground as a percentage of 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.

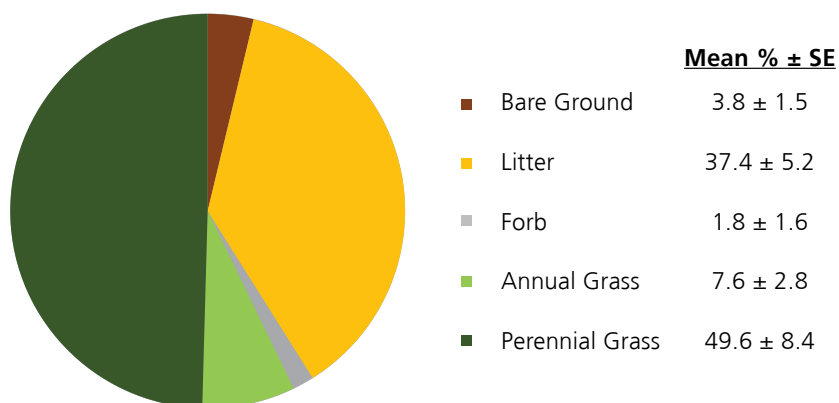


Figure 18. Mean percentage and standard error of measured components of vegetation cover in the ground layer from eight sites on two pastoral leases in the Katherine Pastoral District.

# KATHERINE PASTORAL DISTRICT

The majority of integrated monitoring sites had minimal or no grazing (Table 7). There was no evidence of erosion recorded at any of the integrated monitoring sites, although isolated gullying was observed on tracks and natural drainage lines.

Table 7. Levels of pasture utilisation recorded at eight sites on two pastoral leases in the Katherine Pastoral District.

Pasture Utilisation	
Rank	% of sites
No grazing	12
Minimal (<25%)	75
Moderate (26-50%)	13
Moderate to heavy (51-75%)	0
Heavy (76-90%)	0
Very heavy (>90%)	0

Land condition ratings assigned at monitoring sites and the more generalised assessment of land condition across those parts of the pastoral lease traversed are summarised in Table 8. To the extent possible, these assessments are independent of the variable seasonal quality across the Katherine Pastoral District during 2017-18 (described above).

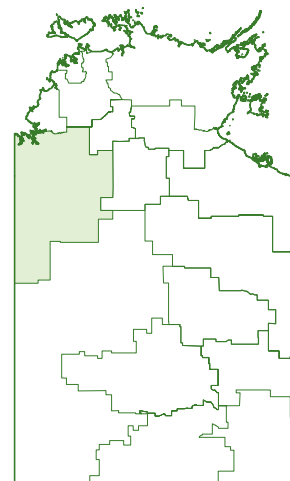
Table 8. Assessed land condition at monitoring sites and traversed parts of two pastoral leases in the Katherine Pastoral District.

Station	Condition Rating (number of sites)	Comments with regard to pastoral lease
1	Excellent: 2 Good: 1 Fair: 0 Poor: 1	The property was found to be in generally Good land condition with some areas assessed as Fair due to occurrence of weeds. Despite a relatively poor Wet season, pasture density and variety was good with only a couple of heavily grazed paddocks. Much improvement had been made to the homestead area since the previous inspection. Plans are underway for further paddock development. Weed management programs are in place for major weeds including bellyache bush and grader grass. Fire is a regular problem from the highway and neighbouring non-pastoral lease.
2	Good: 1 Fair: 3	Land condition across the property was generally assessed as Fair. A wildfire that impacted a large paddock necessitated a change in pasture management with planned spelling unable to be undertaken. Improved and new infrastructure since the previous inspection was evident and the addition of new waters and reduction in paddock size is planned over the coming years. Graded fencelines and smaller paddocks are expected to assist in fire management. Weeds including gamba grass and bellyache bush were observed on the property and pointed out to the manager. Plans for improved pastures and Non-Pastoral Use (NPU) activities are being explored.

# VRD PASTORAL DISTRICT

The Victoria River District (VRD) Pastoral District encompasses nearly 134 000 km<sup>2</sup>.

The District experienced mostly above average seasonal quality in the north, and average to below average in the south, based on slightly below median rainfall and slightly above median modelled pasture growth through the 2017-18 Wet season. Almost 29% of the District burnt between October 2017 and September 2018. One quarter of the District had > 42% bare ground per Landsat pixel (bare ground threshold), which was strongly associated with fires in either 2017 or 2018. This area includes 'desert-like' country of low pastoral value that is periodically burnt. On-ground monitoring was conducted at 27 sites on two pastoral leases, one at the end of 2017, and the other in 2018. Sites, on average, had only a moderate cover of perennial grasses and approximately half the site was comprised of bare ground and litter. Forbs and annual grasses were minor components of total ground cover. Eleven sites were in Good condition, 14 in Fair condition and two in Poor condition. Parkinsonia was the main weed issue, and was generally being actively controlled, with noogoora burr to a lesser extent.



Map 4: Location of Victoria River 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 the rainfall received, simulated using AussieGRASS ([www.longpaddock.qld.gov.au](http://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 9) are based on gridded rainfall data produced by the Bureau of Meteorology ([www.bom.gov.au/jsp/awap/rain/index.jsp](http://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 District, rainfall statistics are reported based on an arbitrary split of the region into two sub-districts (Figure 20).

Table 9. 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
2017 – 2018	707	411
Long-term median	758	464

# VRD PASTORAL DISTRICT

Spatially averaged rainfall for the north and south sub-districts of the VRD Pastoral District was slightly below the long-term median across each sub-district (Table 9). In the north of the District, there was a considerable north-to-south decrease in the spatial distribution of rainfall (Figure 20), whereas this was more uniformly distributed in the south, as indicated by the colour shading. Land fringing the Tanami Desert in the south-east of the District had lower rainfall (< 400 mm) for the 12 months October 2017 to September 2018.

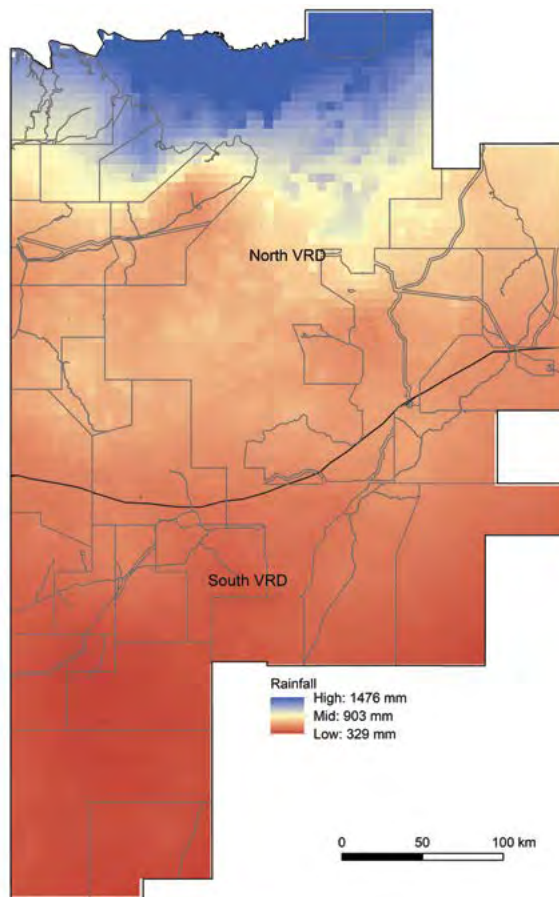


Figure 19. Spatially interpolated, gridded rainfall for the Victoria River Pastoral District. Reporting period is October 2017 to September 2018.\*

AussieGRASS-modelled pasture growth, as a second indicator of seasonal quality for the entire VRD Pastoral District, is for the period November 2017 to April 2018. 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 2017-18 Wet season was slightly above the long-term median (Table 10).

Table 10. Recent seasonal quality averaged across the entire VRD Pastoral District, as indicated by modelled pasture growth.

<b>AussieGRASS</b>	
Growth (kg/ha)	1 749
Percentile	57



# VRD PASTORAL DISTRICT

Modelled pasture growth over the 2017-18 Wet season, as a percentage of the long-term record, was mostly average to below average in the south and above average with considerable areas of well above average, in the north of the District (Figure 21).

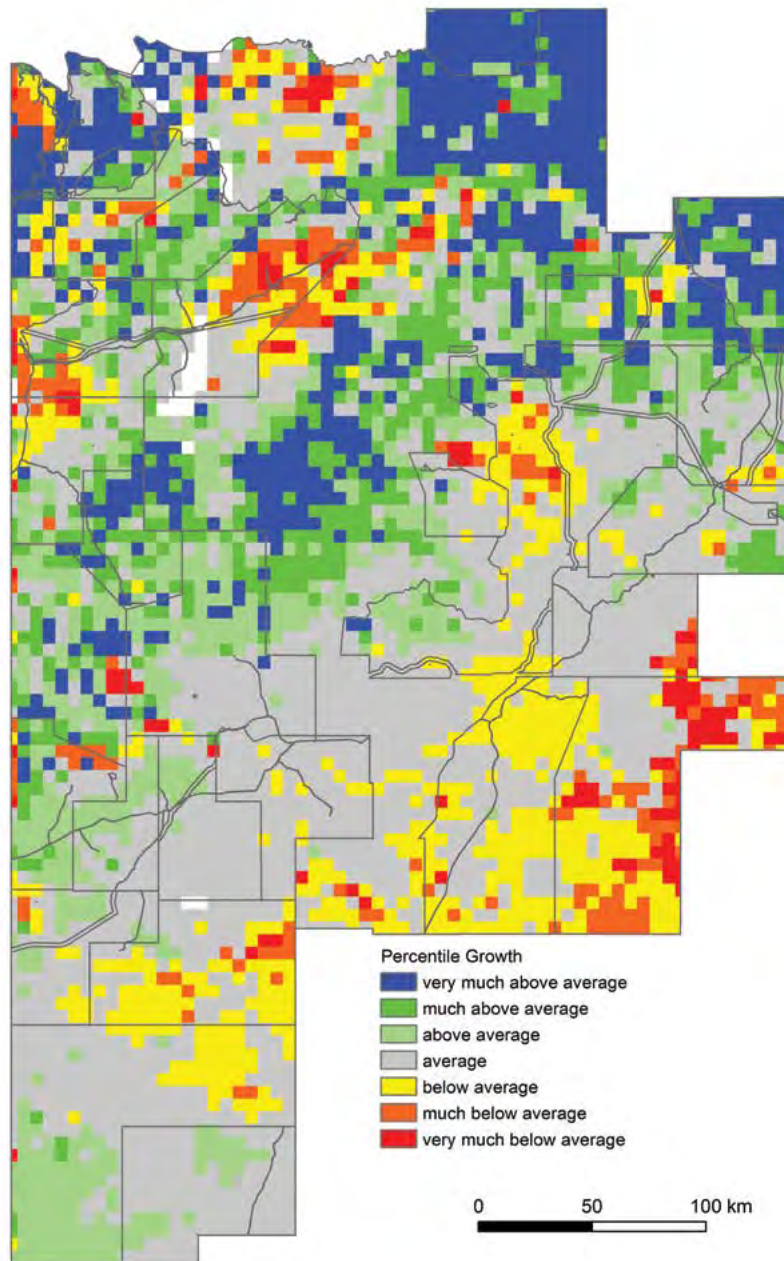


Figure 20. Simulated pasture growth for the 2017-18 Wet season as a percentage of the long-term record.\*

\*(Note: these images do not account for impact from fire or geographic influence variations across a district).

# VRD PASTORAL DISTRICT

## Fire

The North Australia Rangelands and Fire Information website ([www.firenorth.org.au/nafi3](http://www.firenorth.org.au/nafi3)) reports that 38 687 km<sup>2</sup> (28.8%) of the District was burnt between October 2017 and September 2018. This was a greater area to that burnt in the previous (2016-17) reporting period (26 871 km<sup>2</sup>). Fire was most extensive between April and May 2018, which may have been due to controlled burning.

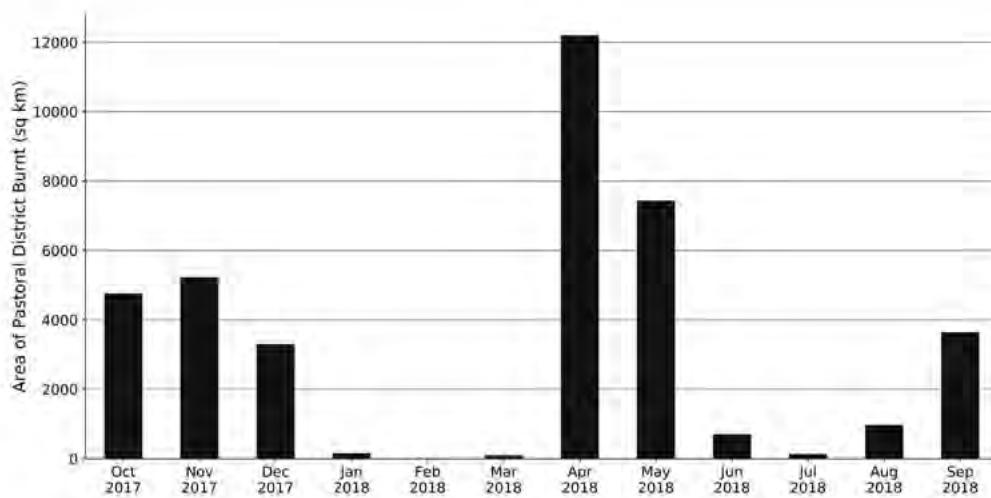


Figure 21. Monthly area burnt (km<sup>2</sup>) in the VRD Pastoral District between October 2017 and September 2018.

## Bare ground 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 ground 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 ground. The percentage of bare ground in each 30m square Landsat pixel (900 m<sup>2</sup> or 0.09 ha) was used to report the amount of bare ground across all pixels in the VRD Pastoral District.

Fire during 2018 contributed to reduced vegetation cover, compared with the last 30 years, across most of the northern parts of the District (Figure 23). Fire was also a contributing factor to much below average vegetation cover elsewhere, with extensive fires in the south during 2017 (fire scars not shown), followed by the lower rainfall and modelled pasture growth in 2018.

# VRD PASTORAL DISTRICT

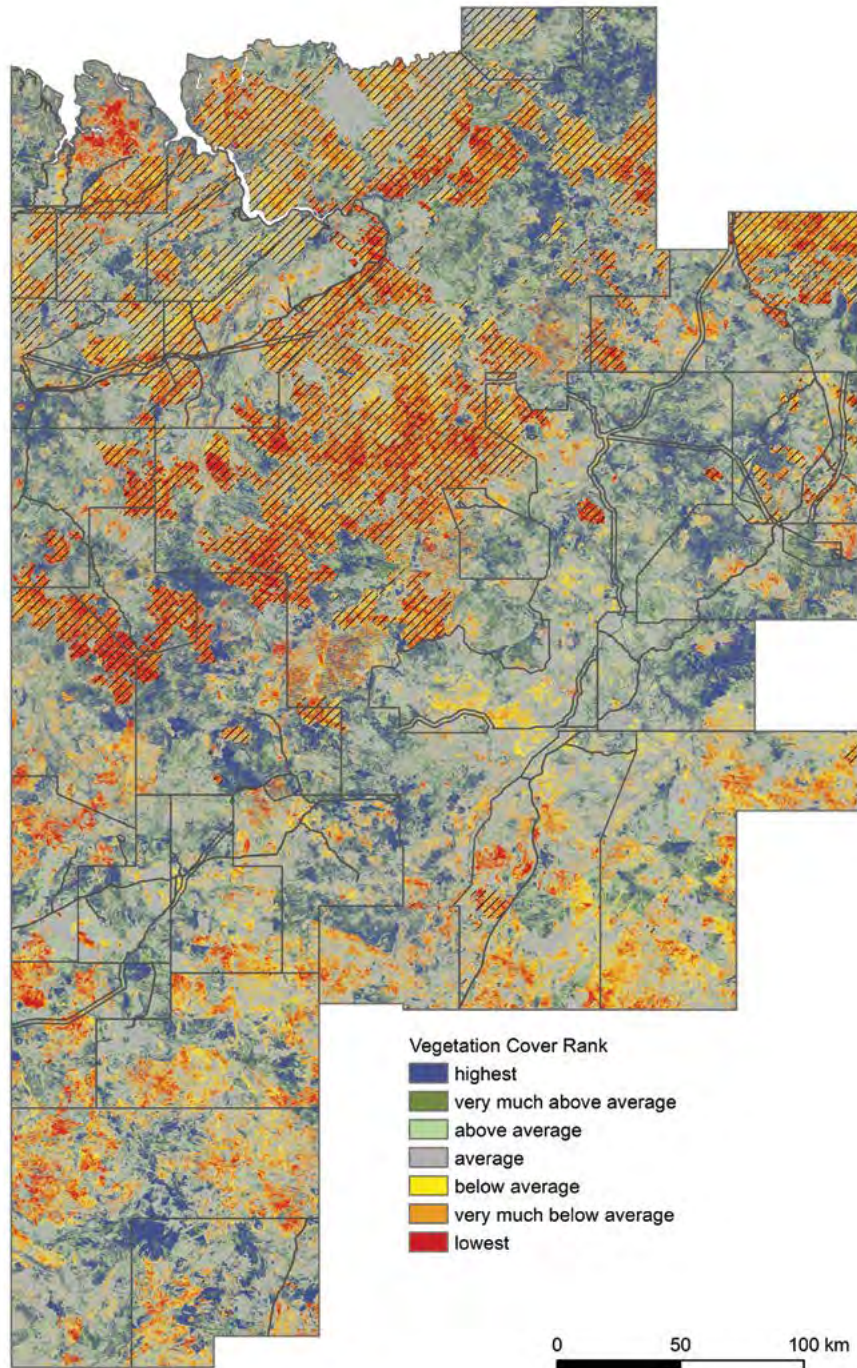


Figure 22. Rank of the amount of remotely-sensed vegetation cover present from September to November 2018 against that for previous years back to 1988. Diagonal lines show those areas burnt between January and November 2018.



## VRD PASTORAL DISTRICT

Approximately 24% of the District had minor levels of bare ground (< 20% of the 30m Landsat pixel) towards the end of 2018 (Figure 24). The bare ground threshold value for the VRD Pastoral District was 42%; one quarter of the District had bare ground per pixel greater than this value (Figures 24 and 25) and includes some of the country burnt in 2018 (until November).

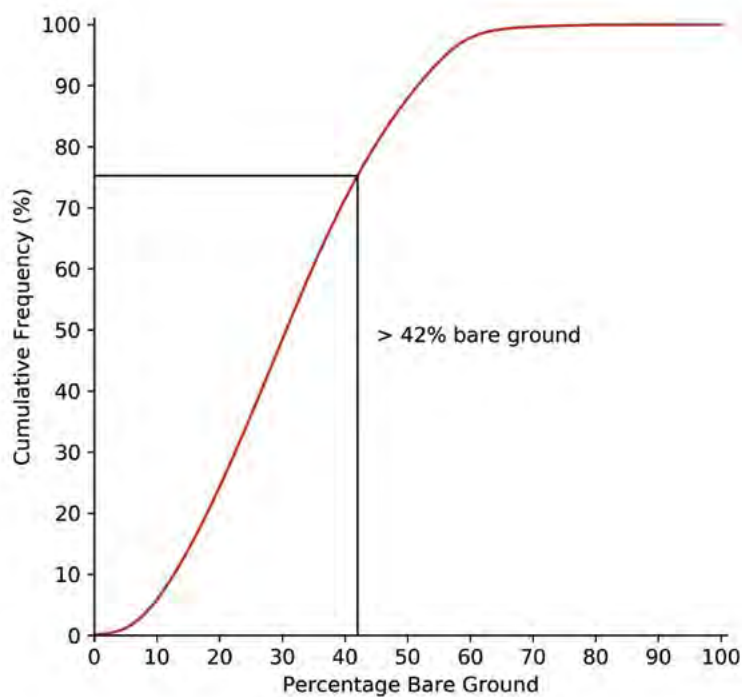


Figure 23. Percentage cumulative frequency of varying levels of bare ground in 30m square Landsat pixels in the VRD Pastoral District between September and November 2018. Areas with greater than 42% bare ground are mapped in Figure 7.

# VRD PASTORAL DISTRICT

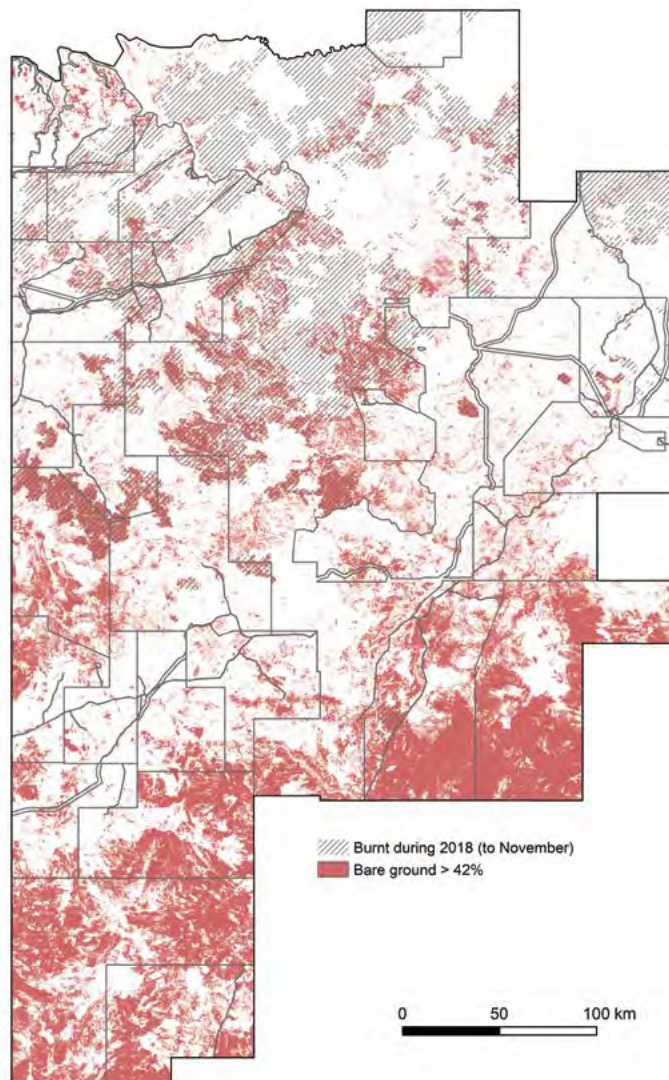


Figure 24. Parts of the VRD Pastoral District having greater than 42% bare ground per Landsat pixel in late 2018. Country burnt between January and November 2018 is shown with diagonal lines. Note that the threshold level of bare ground used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.

Concentrated areas exceeding the 42% bare ground threshold in the 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 ground, compounded by poor seasonal quality, based on modelled pasture growth in this south-eastern area (Figure 21).



# VRD PASTORAL DISTRICT

## Site-based monitoring

Two pastoral leases in the VRD Pastoral District were visited by monitoring officers in late 2017 and during 2018.

Vegetation cover of the ground layer was measured at 27 sites across the two leases. Sites, on average, had only a moderate cover of perennial grasses and approximately half the site was comprised of bare ground and litter (Figure 26). Only one of the 27 sites had bare ground measured at more than 40%, but this was likely to increase as the season progressed and litter disappeared. Annual grasses and forbs (both perennial and annual) were minor components of 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.

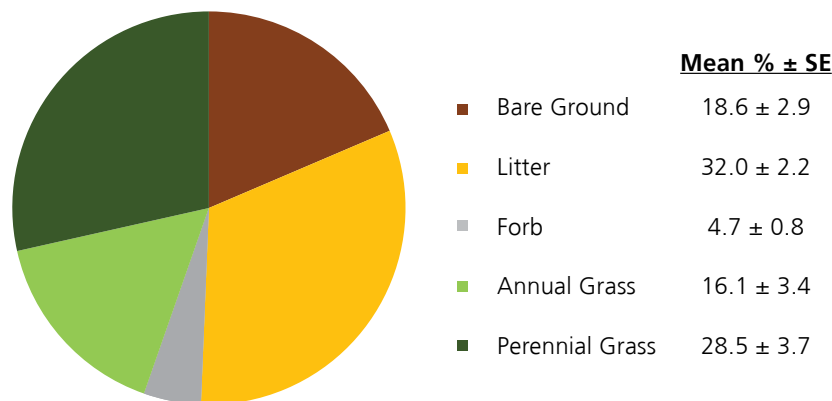


Figure 25. Mean percentage and standard error of measured components of vegetation cover in the ground layer from 27 sites on two pastoral leases in the VRD Pastoral District.

Most sites were minimally grazed at the time of assessment (Table 11). Slight sheet erosion on a single site was the only recorded erosion across the 27 monitoring sites.

Table 11. Levels of pasture utilisation and evidence of erosion assessed at 27 sites on two pastoral leases in the VRD Pastoral District.

<b>Pasture Utilisation</b>	
<b>Rank</b>	<b>% of sites</b>
No grazing	7
Minimal (<25%)	56
Moderate (26-50%)	11
Moderate to heavy (51-75%)	11
Heavy (75-90%)	15
Very heavy (>90%)	0

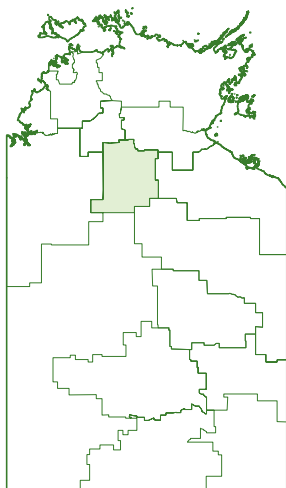
# VRD PASTORAL DISTRICT

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 12. 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 12. Assessed land condition at 27 monitoring sites and traversed parts of two pastoral leases in the VRD Pastoral District.

Station	Condition Rating	Comments with regard to pastoral lease
1	Good: 1 Fair: 2	This property was visited at the end of 2017, and was generally considered in Fair condition, which indicates no significant decline or improvement since the previous monitoring conducted in 2007. A number of poor Wet seasons which may have effected pasture growth preceded the 2016-17 above average Wet season. A moderate amount of palatable desirable perennial grass species were observed across most of the property indicating adequate pasture recovery after the 2016-17 season. However, some riparian areas showed signs of heavy pasture utilisation, and this was supported by remotely sensed imagery. There were areas of weed infestations that had not been controlled including Parkinsonia and noogoora burr. Station management are considering options to manage these weeds, as well as, strategies to mitigate the impact of grazing on riparian zones.
2	Good: 10 Fair: 12 Poor: 2	This property was generally assessed as in Fair land condition, but is divided into four management zones. The southernmost zone was in Good condition. This is attributed to light stocking in previous years to allow recovery of perennial grasses. A large fire effecting the eastern areas meant cattle had to be moved to the southern and northern zones which influenced planned spelling of pastures. The interaction of fire with low rainfall was reflected in pasture growth and consequently grazing management across the property. Weeds including parkinsonia, prickly acacia and rubber bush were present in all four zones and are being actively controlled and managed. Others such as noogoora burr and Sida appear to have been sporadically treated. Historic erosion along tracks is still evident. New tracks have erosion control measures. Despite average rainfall up until February, the early finish to the 2017-18 Wet season led to a long Dry season. This has contributed to high bare ground at the time of inspection in paddocks with a high composition of annual grass species, which have hayed off and disintegrated as the Dry season has progressed. This was evident on-ground and through remotely sensed imagery.

# STURT PLATEAU PASTORAL DISTRICT



Map 5: Location of Sturt Plateau Pastoral District

This District encompasses just over 43 000 km<sup>2</sup>.

Modelled pasture growth generally reflected rainfall distribution across the Sturt Plateau Pastoral District, with average to well above average seasonal quality, although there was lower rainfall and below average pasture growth in the south-west of the District. Approximately a fifth of the region burnt between October 2017 and September 2018, similar to the area burnt in the previous 12 months. One quarter of the District had > 21% bare ground (in each Landsat pixel for the spring composite fractional cover). Monitoring was conducted at 39 sites on nine leases, four at the end of 2017, and five in 2018. Sites, on average, had a good cover of perennial grasses, a moderate amount of litter as would be expected with the more timbered land systems in this District, and a small amount of bare ground. Pasture utilisation was generally well-aligned with pasture availability. Weed infestations were minimal, generally *Sida* and *Hyptis* restricted to watering points. Three sites were rated in Excellent condition, 25 sites in Good condition and 11 in Fair condition. No sites were assessed as in Poor condition.

## 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](http://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 13) are based on gridded rainfall produced by the Bureau of Meteorology ([www.bom.gov.au/jsp/awap/rain/index.jsp](http://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 2017 to April 2018. This growth is ranked as a percentile of the growth for all previous Wet seasons back to 1957.

Table 13. Indicators of seasonal quality. Data spatially averaged for the Sturt Plateau Pastoral District.

	Rainfall (mm)		AussieGRASS
2017 – 2018	638	Growth (kg/ha)	2 007
Long-term median	639	Percentile	69

# STURT PLATEAU PASTORAL DISTRICT

Spatially averaged rainfall for the Sturt Plateau Pastoral District was similar to the long-term median (Table 13). Rainfall increased from north to south across the District (Figure 27, left-hand panel).

Modelled pasture growth over the 2017-18 summer was above average based on the spatial mean (Table 13). Growth generally reflected rainfall distribution (Figure 27, right-hand panel), although there was a band of 'very much above average' growth through the central areas of the District.

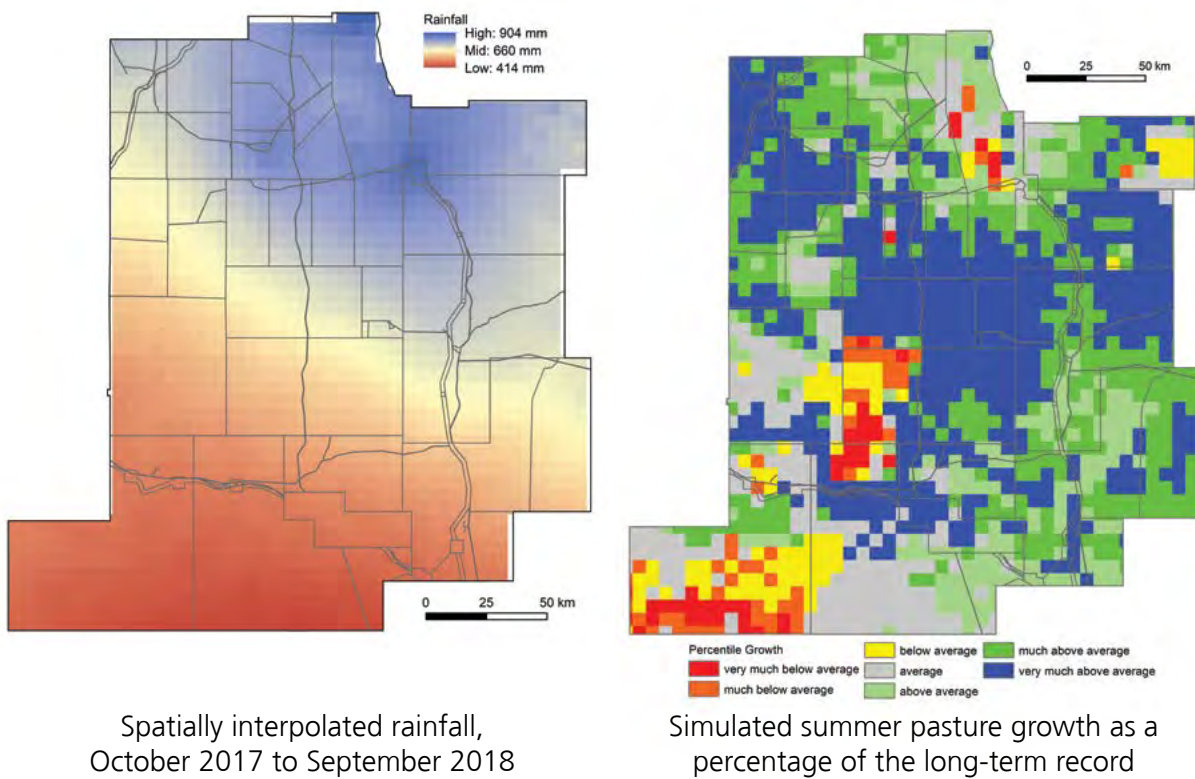


Figure 26. Maps of seasonal quality. Left, gridded rainfall, October 2017 to September 2018; right, AussieGRASS-modelled pasture growth for the 2017-18 summer as a percentage of previous summers. (Note: these images do not account for impact from fire or geographic influence variations across a district).

# STURT PLATEAU PASTORAL DISTRICT

## Fire

The North Australia and Rangelands Fire Information website ([www.firenorth.org.au/nafi3](http://www.firenorth.org.au/nafi3)) reports that 7 724 km<sup>2</sup> (18%) of the Sturt Plateau Pastoral District was burnt over the reporting period, with a significant area burnt in December 2017 (Figure 28). This was similar to the area burnt in the 2016-17 reporting period (8 537 km<sup>2</sup>).

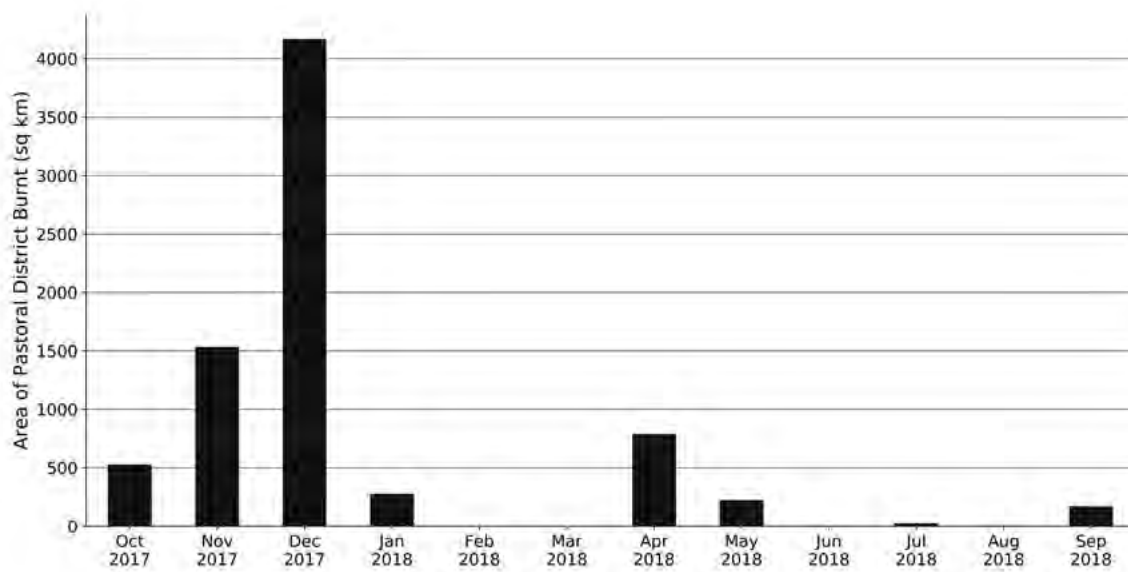


Figure 27. Monthly area burnt between October 2017 and September 2018 in the Sturt Plateau Pastoral District.

## Bare ground 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 ground 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 ground in each 30m square Landsat pixel (900 m<sup>2</sup> or 0.09 ha) was used to report the amount of bare ground across all pixels in the Sturt Plateau Pastoral District.

There were quite distinct boundaries between different categories of decile-ranked vegetation cover (Figure 29); a similar feature to that reported in previous Annual Reports. This image depicts the amount of vegetation present in the late 2018 Dry season relative to that present at the same time each year since 1988. Some areas of recent relatively lower vegetation cover, compared with the previous 30 years, correspond with fire prior to image acquisition (i.e. areas shown with diagonal lines). The distinct linear change in vegetation cover rank in the south is also associated with infrastructure and tenure boundaries. Excluding the fire affected areas, the District as a whole had higher amounts of above average to highest vegetation cover in the 2018 Dry season, compared with the last 30 years.



# STURT PLATEAU PASTORAL DISTRICT

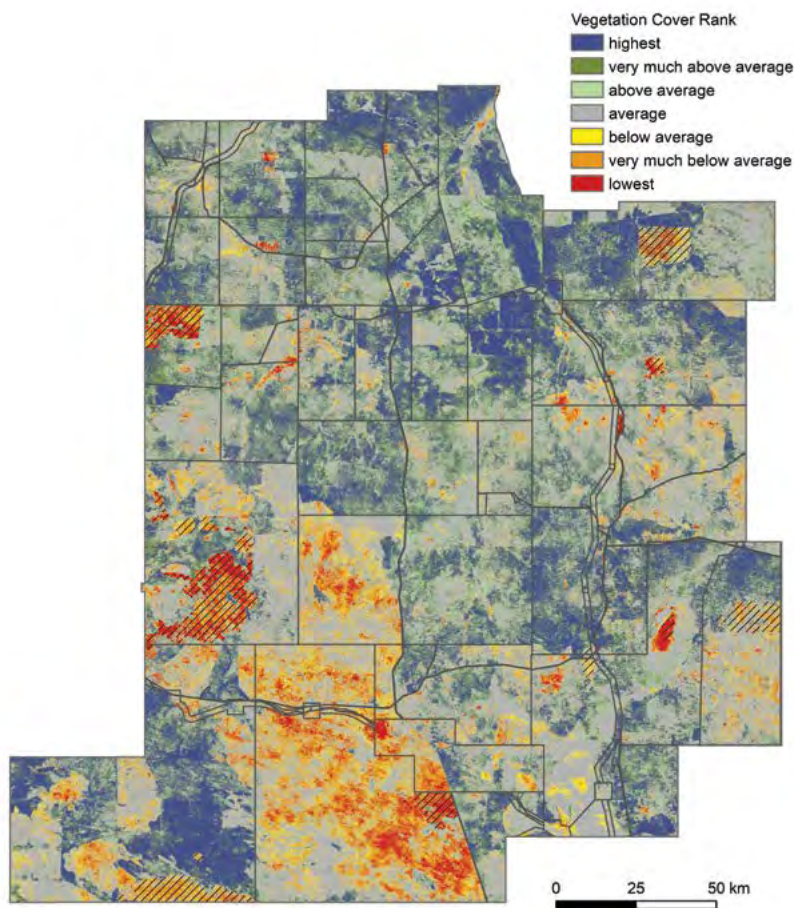


Figure 28. Rank of the amount of remotely-sensed vegetation cover present from September to November 2018 against that for previous years back to 1988. Diagonal lines show those areas burnt between January and November 2018.

The bare ground threshold is based on the frequency distribution of all 30m Landsat bare ground cover pixels at the end of 2018 (spring composite). A threshold was determined which represents 75% of a district’s overall bare ground. The remaining 25% is considered to have above-threshold bare ground.

Approximately 73% of the District had negligible amounts of bare ground (< 20% of the 30m Landsat pixel) towards the end of 2018. The bare ground threshold value for the Sturt Plateau Pastoral District was 21%; one quarter of the District had bare ground greater than this value (Figure 30), mostly in the south-west of the District (Figure 31), and includes areas burnt earlier in 2018.

# STURT PLATEAU PASTORAL DISTRICT

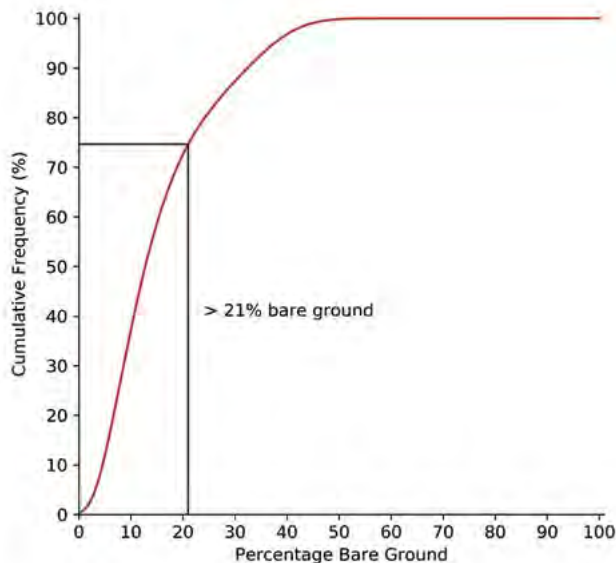


Figure 29. Percentage cumulative frequency of varying levels of bare ground in 30m square Landsat pixels in the Sturt Plateau Pastoral District between September and November 2018. Areas with greater than 21% bare ground are mapped in Figure 31.

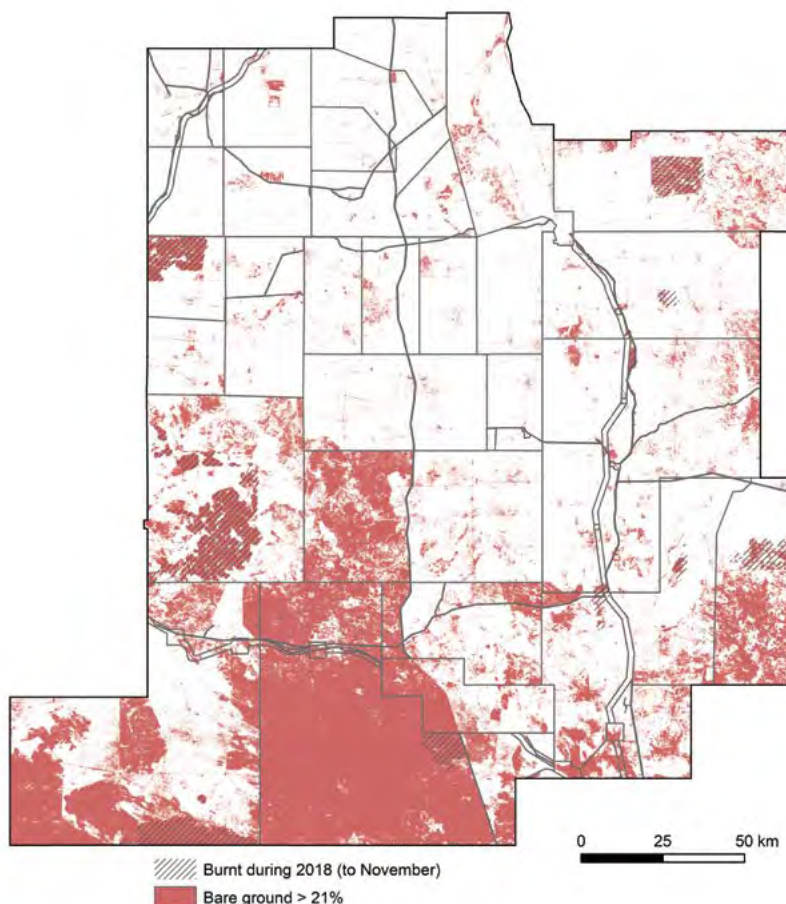


Figure 30. Parts of the Sturt Plateau Pastoral District having more than 21% bare ground per Landsat pixel in late 2018 (threshold bare ground). Diagonal lines show areas burnt between January and November 2018. Note that the threshold level of bare ground used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.

# STURT PLATEAU PASTORAL DISTRICT

## Site-based monitoring

Nine pastoral leases in the Sturt Plateau Pastoral District were visited in the 2017-2018 reporting period.

Vegetation cover of the ground layer was measured at 39 sites across the nine leases. Sites, on average, had a good cover of perennial grasses, a moderate amount of litter as would be expected given the predominance of wooded land systems, and a small amount of bare ground (Figure 32). 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.

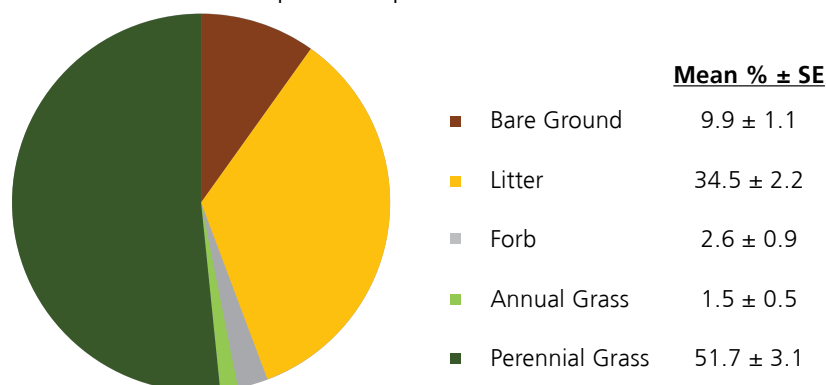


Figure 31. Mean percentage and standard error of measured components of vegetation cover in the ground layer from 39 sites on nine pastoral leases in the Sturt Plateau Pastoral District.

The majority of sites were minimally or not grazed at the time of assessment (Table 14). There was no evidence of erosion at any site.

Table 14. Levels of pasture utilisation assessed at 39 sites on nine pastoral leases in the Sturt Plateau Pastoral District.

<b>Pasture Utilisation</b>	
<b>Rank</b>	<b>% of sites</b>
No grazing	15
Minimal (<25%)	46
Moderate (26-50%)	26
Moderate – heavy (51-75%)	10
Heavy (76-90%)	3
Very heavy (>90%)	0

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 15. To the extent possible, these assessments are independent of the average to below average seasonal quality applying to the general area of each station.

# STURT PLATEAU PASTORAL DISTRICT

Table 15. Assessed land condition at integrated monitoring sites and traversed parts of nine pastoral leases in the Sturt Plateau Pastoral District. (# Property was visited at the end of the 2017 Dry season, constituting part of the 2017-18 reporting period).

Station	Condition Rating (number of sites)	Comments with regard to pastoral lease
1	Good: 3	Land condition was generally assessed as Good condition. This was based on the condition of the assessable country in the south and north east of the property having robust cover of palatable perennial grasses while the north-west section was unable to be assessed due to wildfire.
2	Good: 2 Fair: 2	Land condition across the property was assessed as in Good to Fair condition, which is improved from the previous (Fair to Good) land condition assessment conducted in 2011. Dialogue with the lessee helped inform site selection to represent utilised areas of the property. Land condition assessment was based on good densities of desirable 3P (perennial, palatable, productive) grasses; golden beard grass, Queensland blue grass, silky browntop, and kangaroo grass, with infill of productive annual species and minimal undesirable increaser species (e.g. feathertop wiregrass. Rainfall (876 mm) over the 2017-2018 Wet season was close to average. Hyptis was the main weed of concern, however khaki weed, caltrop, rubber bush and Sida were also targeted annually in weed control programs. Erosion was not an issue on the property, and tracks and firebreaks were well-maintained including 'whoa-boys'. A significant new infrastructure program is in place (bores, laneways, fences).
3	Excellent: 1 Good: 3	The property was assessed overall as in Good land condition, which is improved from the previous (Fair to Good) assessment conducted in 2011. Dialogue with the lessee helped inform site selection to represent utilised areas of the property. Land condition was primarily based on species composition and vigour, with robust densities of desirable 3P (perennial, palatable, productive) grasses, and minimal undesirable increaser species. The property received nearly 1 000 mm rainfall spread evenly throughout the 2017-18 Wet season (annual average 895 mm). Sida occurred mainly around watering points, otherwise weeds were not a significant issue on the property. Erosion was observed, sometimes associated with the clearing of fire breaks and fencelines, but 'whoa-boys' had been constructed. Woody thickening of Acacia species was identified, and actively being addressed using fire and herbicide. Significant new infrastructure development is occurring (shed, tanks, solar bores).
4	Good: 3 Fair: 1	Land condition across the property was generally assessed as Good condition. This was based on a consistent cover of palatable perennial grasses across the majority of the property. Areas around water points and high traffic areas were in generally Fair condition which is not unexpected. There appears to be little change in land condition since the previous monitoring conducted in 2014.

# STURT PLATEAU PASTORAL DISTRICT

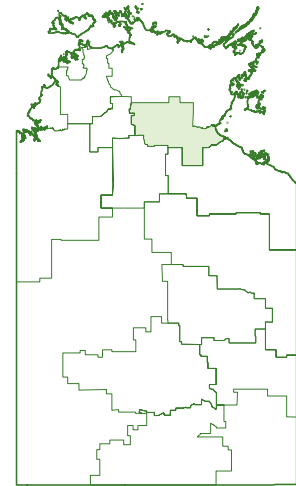
Station	Condition Rating (number of sites)	Comments with regard to pastoral lease
5	Good: 5 Fair: 3	Land condition was generally assessed as being in Good condition with a diverse and robust cover of palatable perennial grasses. Weed species were in low abundance and erosion was negligible. Many improvements in the infrastructure have been made since the previous inspection with new waters and yards established. While rainfall for the previous season was at average levels the majority fell in a small period. Despite this the pasture growth was good and grazing utilisation aligned with pasture availability with minimal bare areas visible on-ground or via satellite imagery.
6#	Good: 2 Fair: 1	The property was generally considered in Good condition, which appears to have been maintained since the last monitoring conducted in 2010, supported by satellite imagery products which showed minimal areas of bare ground (in non-cultivated paddocks) over the last decade. The property received 1 276 mm rainfall for the 2016-17 Wet season (average Wet season rainfall 1 018 mm). Recent good Wet seasons were reflected in the pasture growth with a good diversity and cover of palatable desirable perennial grass species. Pasture utilisation appeared well-distributed across the property. There was no evidence of significant erosion with well-maintained tracks. No areas of weed infestations were observed, although sucker regrowth may be developing as a management concern in the previously cleared cultivated paddocks.
7#	Excellent: 1 Good: 4 Fair: 2	The property was generally considered in Good condition, which appears to have been maintained since the last monitoring conducted in 2011. The recent above average Wet season was reflected in the pasture growth with a diversity of palatable desirable perennial grass species and minimal undesirable 'increaser' species. There were smaller areas which had lower levels of vegetation cover. There was an isolated case of major gully erosion associated with an old track, but otherwise tracks were well-maintained. There were areas of weed infestations that had been controlled including rubber bush and small amounts of Sida around yards.
8#	Excellent: 1 Good: 2	This pastoral lease was generally considered in Good condition, which appears to have been maintained since the last monitoring conducted in 2011. A series of good seasons, including an above average 2016-17 Wet season (972 mm) was reflected in the overall condition of the property. There was a good diversity of palatable desirable perennial grass species, including barley Mitchell grass, high ground cover and minimal signs of erosion. There were no obvious areas of weed infestations although prickly acacia has been historically controlled, and there are some areas where woody thickening of native Acacia species was observed. There was slight impact of wildfires preceding the inspection.
9#	Good: 1 Fair: 2	Land condition on this pastoral lease was generally assessed as Fair, which appears to have reduced since the last monitoring conducted in 2010. This is consistent with a number of poor Wet seasons over this period, and also an increase in cattle numbers which was reflected in moderate rather than good pasture biomass. This was supported by satellite imagery which showed areas of bare soil-vegetation mix, indicating less vigorous stands of perennial pasture with only moderate vegetation cover being maintained. There was a fair diversity of palatable desirable perennial grass species but also a moderate level of the undesirable kerosene grass. There were minimal signs of erosion and no areas of weed infestations were observed. Tracks were well-maintained.



# ROPER PASTORAL DISTRICT

The Roper Pastoral District encompasses just over 42 000 km<sup>2</sup> and includes 11 pastoral leases.

The District experienced above average seasonal quality based on expected Wet season pasture growth (from AussieGRASS simulation) and rainfall, but was variable, with a north-south band of below median rainfall through the centre and associated patches of reduced modelled pasture growth. Much of the western half had above average vegetation cover in late 2018; areas with low ranking cover were often strongly related to incidence of fire. In total, 27% of the District burnt between October 2017 and September 2018, which was similar to the preceding 12 months. A single lease was assessed in 2018, of which its four integrated monitoring sites were all assessed as in Good land condition, and with active weed and fire management programs in place.



Map 6: Location of Roper 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](http://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 16) are based on gridded rainfall produced by the Bureau of Meteorology ([www.bom.gov.au/jsp/awap/rain/index.jsp](http://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 2017 to April 2018. This growth is ranked as a percentile of the growth for all previous summers.

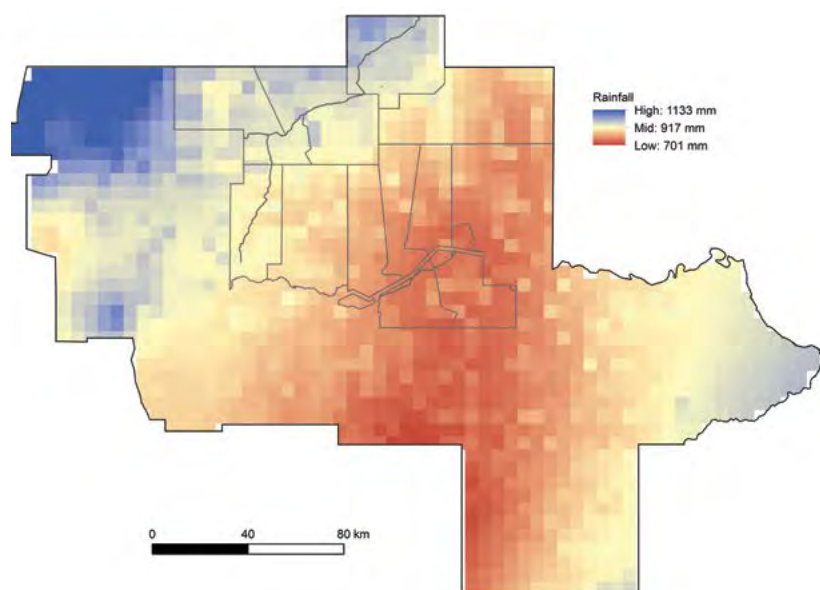
Table 16. Indicators of seasonal quality. Data spatially averaged for the Roper Pastoral District.

	Rainfall (mm)		AussieGRASS
2017 – 2018	852	Growth (kg/ha)	2 209
Long-term median	797	Percentile	67

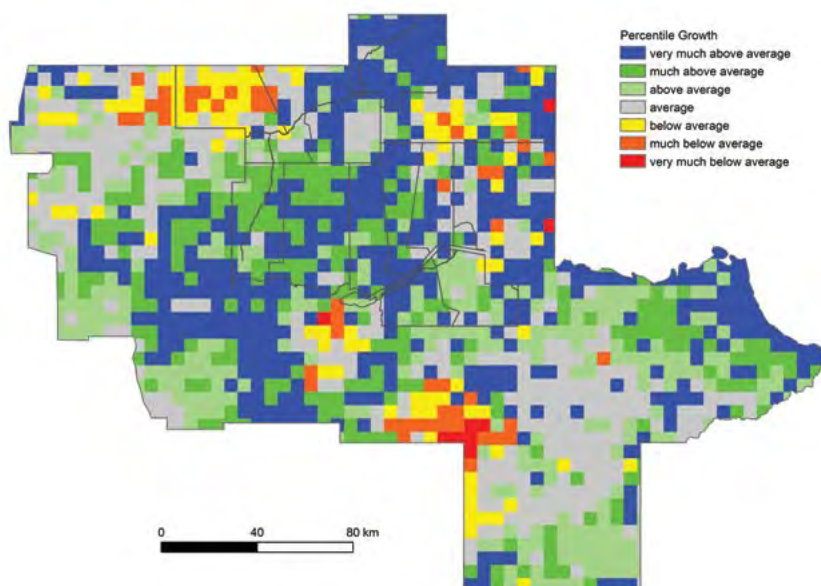
# ROPER PASTORAL DISTRICT

Spatially averaged rainfall for the Roper Pastoral District was above the long-term median (Table 16) and progressively decreased from the north-west towards the east (Figure 33, top panel).

Above median rainfall across most of the Roper Pastoral District was reflected by mostly average to very much above average modelled pasture growth over the 2017-18 Wet season with smaller patches of relatively poor growth compared to long-term records (Table 16 and Figure 33, bottom panel) .



Spatially interpolated rainfall, October 2017 to September 2018



Simulated summer pasture growth as a percentage of the long-term record

Figure 32. Maps of seasonal quality. Top, gridded rainfall, October 2017 to September 2018; bottom, AussieGRASS-modelled pasture growth for the 2017-18 summer period as a percentage of previous summers. (Note: these images do not account for impact from fire or geographic influence variations across a district).

# ROPER PASTORAL DISTRICT

## Fire

The North Australia and Rangelands Fire Information website ([www.firenorth.org.au/nafi3](http://www.firenorth.org.au/nafi3)) reports that 11 258 km<sup>2</sup> (26.7% of the District) burnt between October 2017 and September 2018. This was similar to the 11 218 km<sup>2</sup> area burnt during the previous reporting period (October 2016 to September 2017) and considerably less than the 74% of the District burnt between October 2014 and September 2015. Peak fire activity was in May 2018, which may have been due to controlled burning for wildfire mitigation (Figure 34).

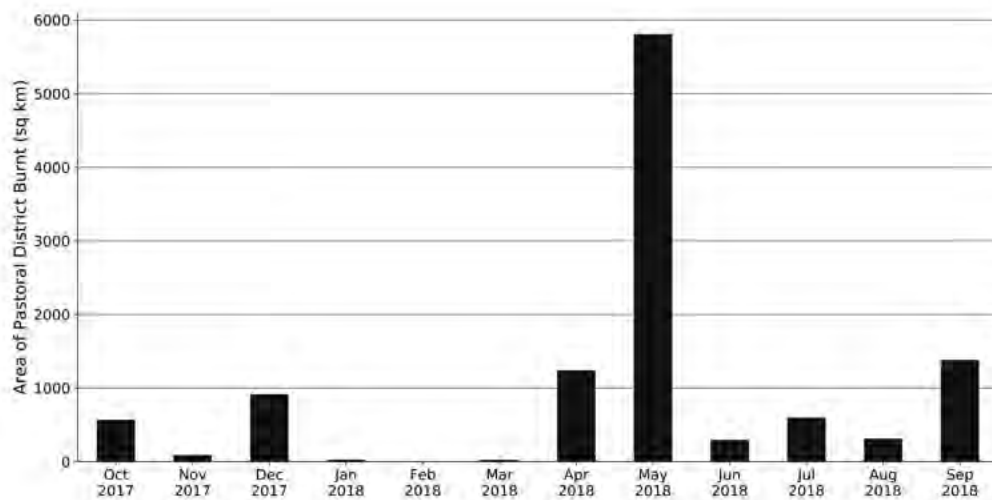


Figure 33. Monthly area burnt (km<sup>2</sup>) in the Roper Pastoral District between October 2017 and September 2018.

## Bare ground 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 ground 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 ground in each 30m square Landsat pixel (900 m<sup>2</sup> or 0.09 ha) was used to report the amount of bare ground across all pixels in the Roper Pastoral District.

The bare ground threshold is based on the frequency distribution of all 30m Landsat bare ground cover pixels at the end of 2018 (spring composite). A threshold was determined which represents 75% of a district's overall bare ground. The remaining 25% is considered to have above-threshold bare ground.

Much of the western half of the District had above average vegetation cover in late 2018 which may be due to confounding interactions with timing and incidence of fire over time (may typically be burnt each year). The majority of the rest of the District had average cover (Figure 35), except areas which were obviously attributed to fire, including non-pastoral lease tenures in the south.

# ROPER PASTORAL DISTRICT

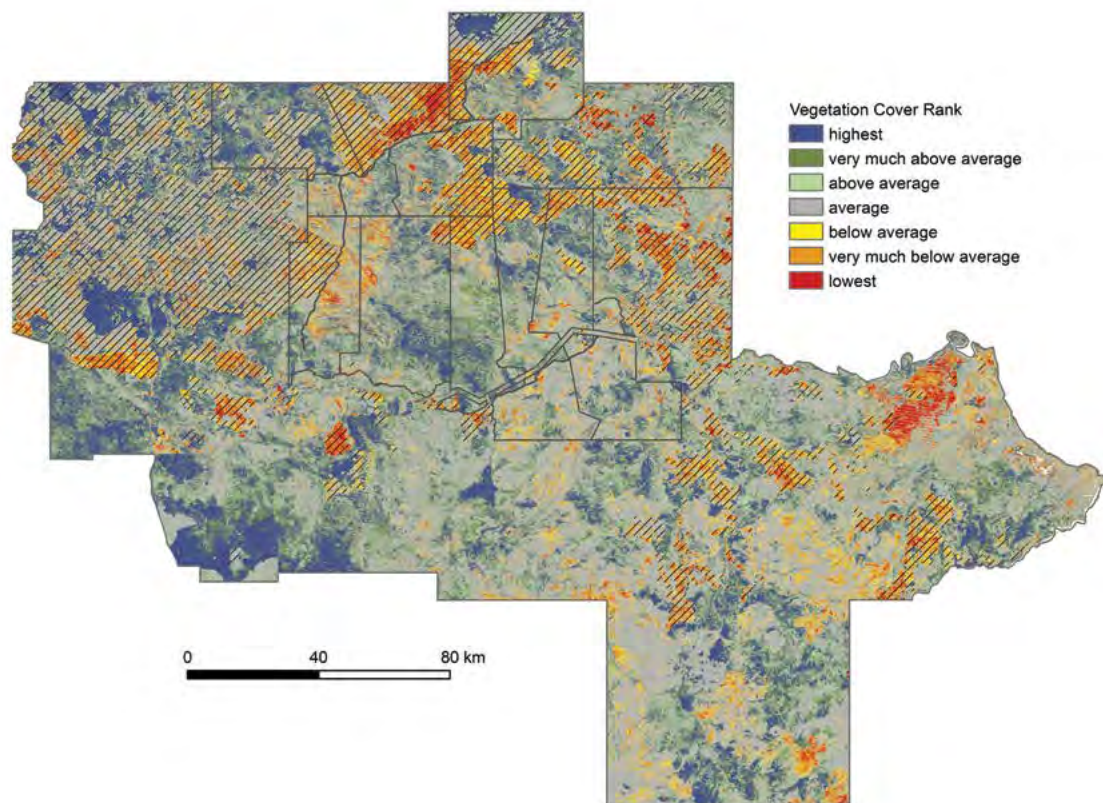


Figure 34. Rank of the amount of remotely-sensed vegetation cover present from September to November 2018 (spring composite) against the average cover since 1988. Diagonal lines show those areas burnt between January and November 2018.

Approximately 66% of the District had negligible amounts of bare ground (< 20% of a 30m Landsat pixel) towards the end of 2018 (Figure 36). The bare ground threshold value for the Roper Pastoral District was 24%; one quarter of the District had bare ground greater than this value (Figures 36 and 37).

Bare ground threshold across the District is presented in Figure 37 and includes areas burnt earlier in 2018; areas with elevated bare ground are strongly associated with incidence of fire in 2018, although this is not always the case, such as patches in the south-eastern part of the District .



# ROPER PASTORAL DISTRICT

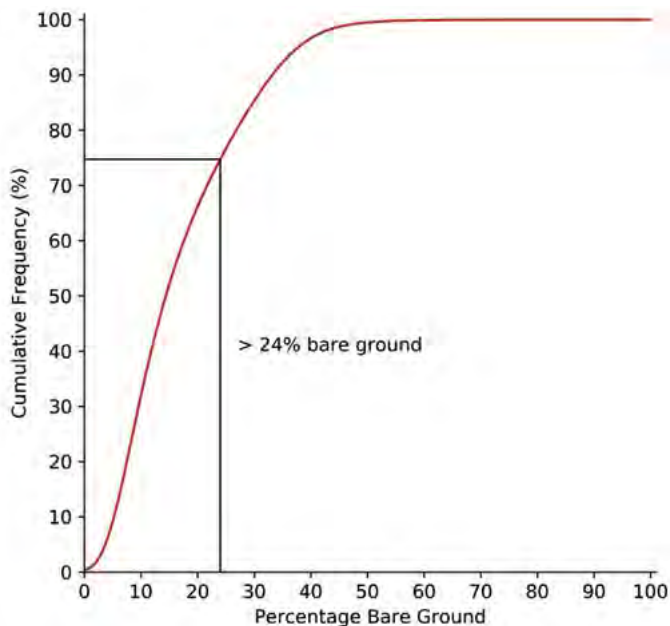


Figure 35. Percentage cumulative frequency of varying levels of bare ground in 30m square Landsat pixels in the Roper Pastoral District between September and November 2018 (spring composite). Areas with greater than the calculated threshold 24% bare ground are mapped in Figure 37.

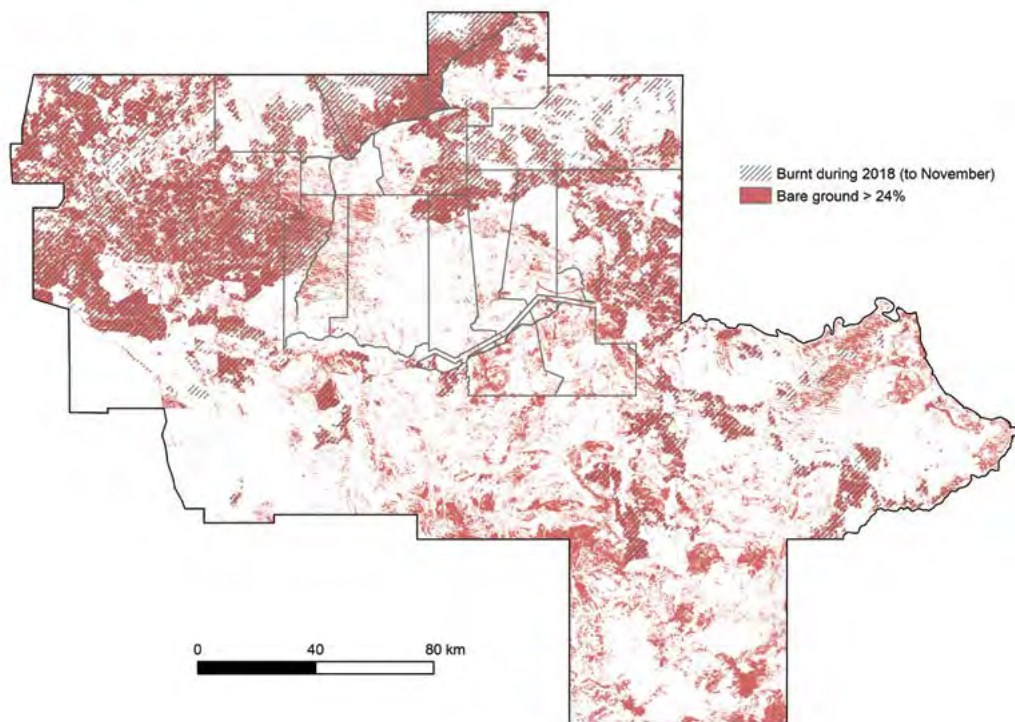


Figure 36. Parts of the Roper Pastoral District having more than 24% bare ground per Landsat pixel in late 2018 (threshold bare ground). Areas burnt between January and November 2018 shown with diagonal lines. Note that the threshold level of bare ground used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.



# ROPER PASTORAL DISTRICT

## Site-based monitoring

A single pastoral lease in the Roper Pastoral District was visited in 2018.

Vegetation cover of the ground layer was measured at the four sites across the lease; the averaged components of cover are shown in Figure 38. Litter, on average, contributed to a quarter of the ground cover, associated with the more timbered land types in this District.

Perennial grasses are important in the Roper Pastoral District 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.

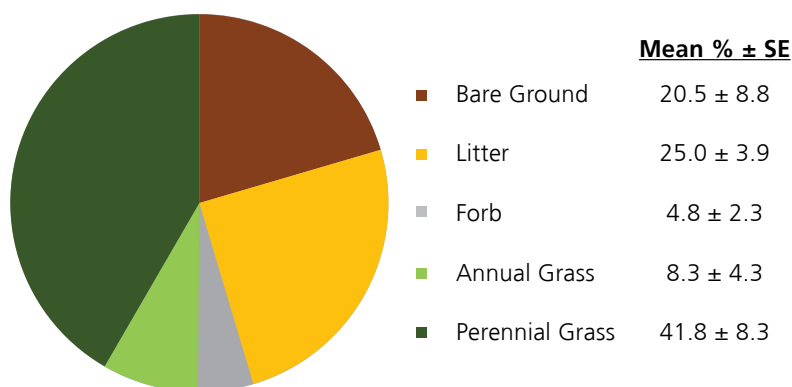


Figure 37. Mean percentage and standard error of measured components in the ground layer from the single monitored pastoral lease in the Roper Pastoral District.

All sites were minimally grazed (Table 17). There was no evidence of erosion at any integrated monitoring site.

Table 17. Levels of pasture utilisation recorded at four sites on one pastoral lease in the Roper Pastoral District.

Pasture Utilisation	
Rank	% of sites
No grazing	0
Minimal (<25%)	100
Moderate (26-50%)	0
Moderate to heavy (51-75%)	0
Heavy (75-90%)	0
Very heavy (>90%)	0

Land condition ratings assigned at monitoring sites and the more generalised assessment of land condition across those parts of the pastoral lease traversed are summarised in Table 18. To the extent possible, these assessments are independent of the variable seasonal quality across the Roper Pastoral District during 2017-18 (described above).

# ROPER PASTORAL DISTRICT

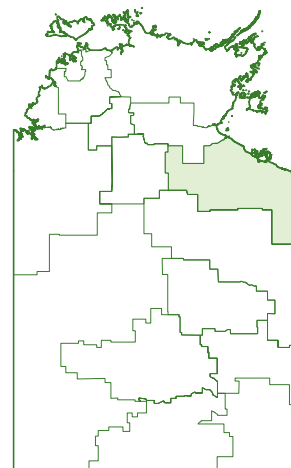
Table 18. Assessed land condition at integrated monitoring sites and traversed parts of the single pastoral lease in the Roper Pastoral District.

Station	Condition Rating (number of sites)	Comments with regard to pastoral lease
1	Good: 4	<p>Land condition was generally assessed as Good condition, which is an improvement on the previous monitoring conducted in 2011. The 2017-18 below average rainfall was not reflected in the pasture production which had robust growth and diversity of palatable desirable perennial grass species across the varied land systems. Vegetation cover was consistently high across the property with the reduction in herd size and has the potential to be a wildfire risk. Current management relies on extensive mitigation through aerial and on-ground early season burning to control late season wildfires. The presence of a moderate number of feral species comprising buffalo, horses, donkeys and scrub cattle may contribute to unconventional grazing dynamics. While areas of erosion were observed, generally in historically well used areas near waterways, management have implemented strategies to halt and ultimately reclaim these areas. There were low levels of grader grass which was observed to be actively controlled.</p>

# GULF PASTORAL DISTRICT

This District encompasses more than 92 000 km<sup>2</sup> and includes 16 pastoral leases, two of which were visited in 2018.

The Gulf coast and hinterland extending up to 100km inland experienced good seasonal quality based on AussieGRASS-modelled pasture growth, consistent with above average rainfall in this area. Areas adjoining the Sturt Plateau and Barkly Districts also experienced good seasonal quality, even though rainfall in these areas was below average. Fire is an important feature of this savanna region with just over 31% of the District burnt between October 2017 and September 2018. Areas of much reduced vegetation cover, as monitored with remote sensing, were scattered throughout the District – and were mostly, but not always associated with recent fire. One quarter of the region had more than 29% bare ground per Landsat pixel later in the 2018 Dry season, mostly in the central and south-eastern parts of the District. Nine of 14 sites across two leases were rated in Excellent / Good condition with the other five sites in Fair condition.



Map 7: Location of Gulf 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](http://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 19) are based on gridded rainfall produced by the Bureau of Meteorology ([www.bom.gov.au/jsp/awap/rain/index.jsp](http://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 2017 to April 2018. This growth is ranked as a percentile of the growth for all previous summers.

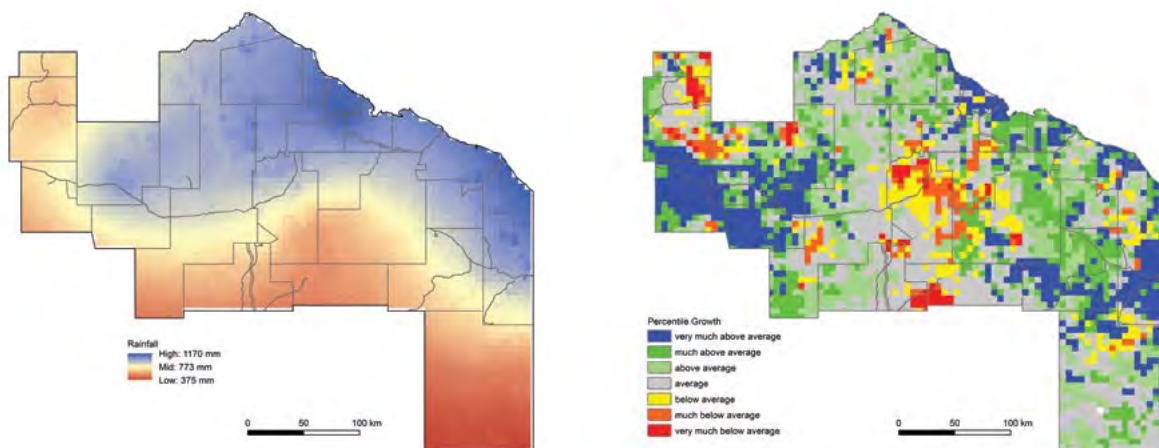
Table 19. Indicators of seasonal quality. Data spatially averaged for the Gulf Pastoral District.

	Rainfall (mm)		AussieGRASS
2017 – 2018	801	Growth (kg/ha)	2 085
Long-term median	664	Percentile	62

# GULF PASTORAL DISTRICT

Spatially averaged rainfall for the Gulf Pastoral District was above the long-term median (Table 19), and generally increased from south to north. Most pastoral leases received at least average annual rainfall; non-pastoral lease in the southern-most area of the District received well below average rainfall (Figure 39, left hand panel).

Modelled pasture growth over the last Wet season, as a percentage of the long-term record, was mostly much or very much above the long-term average adjacent to the Gulf coast (Figure 39, right hand panel). This is consistent with the high rainfall along the Gulf coast and some way inland. Modelled growth in the west bordering the Sturt Plateau and Barkly Pastoral Districts was very much above average, despite only receiving average to below average rainfall, whereas in parts of the central District, pasture growth was much below average.



Spatially interpolated rainfall, October 2017 to September 2018

Simulated summer pasture growth as a percentage of the long-term record

Figure 38. Maps of seasonal quality. Left, rainfall, October 2017 to September 2018; right, AussieGRASS-modelled pasture growth for the 2017-18 summer period as a percentage of previous summers. (Note: these images do not account for impact from fire or geographic influence variations across a district).

# GULF PASTORAL DISTRICT

## Fire

The North Australia Fire and Rangelands Information website ([www.firenorth.org.au/nafi3](http://www.firenorth.org.au/nafi3)) reports that 29 101 km<sup>2</sup> (31.4% of the District) burnt between October 2017 and September 2018, which was significantly more than the 17 388 km<sup>2</sup> in the preceding reporting period. Most of the area was burnt in December 2017 (Figure 40).

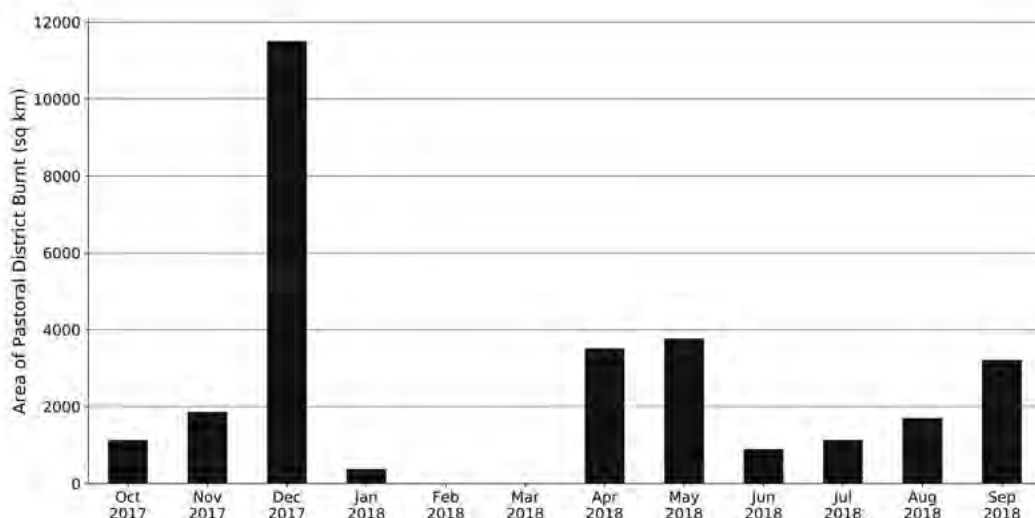


Figure 39. Monthly area burnt (km<sup>2</sup>) between October 2017 and September 2018 in the Gulf Pastoral District.

## Bare ground 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 ground 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 ground in each 30m square Landsat pixel (900 m<sup>2</sup> or 0.09 ha) was used to report the amount of bare ground across all pixels in the Gulf Pastoral District.

The relative amount of vegetation cover present in the late Dry season of 2018, compared with that present in the late Dry season since 1988, was significantly influenced by incidence of fire during the year although there were some scattered areas of much reduced vegetation cover where this was not the case (Figure 41). Some areas of high vegetation cover were consistent with rainfall distribution and with modelled pasture growth (Figure 39), although interactions with the Landsat sensor detecting largely persistent tree and shrub cover does influence differences between vegetation cover and modelled pasture growth.



# GULF PASTORAL DISTRICT

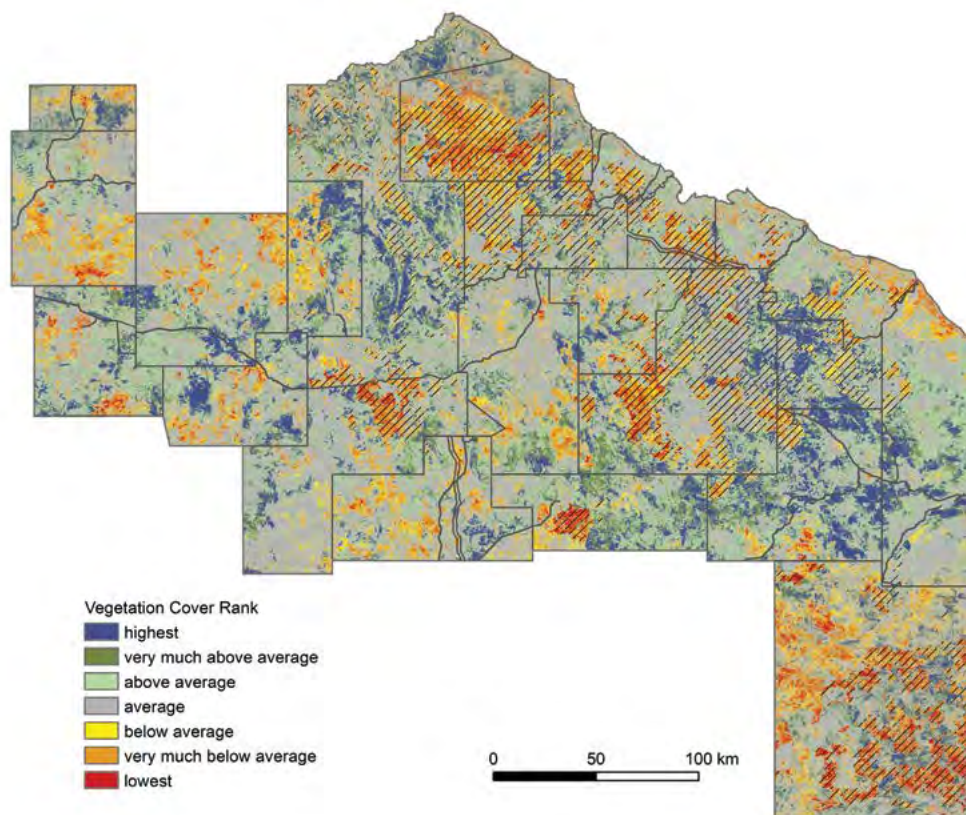


Figure 40. Rank of the amount of remotely-sensed vegetation cover present from September to November 2018 against that for previous years back to 1988. Diagonal lines show those areas burnt between January and November 2018.

The bare ground threshold is based on the frequency distribution of all 30m Landsat bare ground cover pixels at the end of 2018 (spring composite). A threshold was determined which represents 75% of a district's overall bare ground. The remaining 25% is considered to have above-threshold bare ground.

Approximately 53% (Figure 43) of the District had minor amounts of bare ground (< 20% of the 30m Landsat pixel) towards the end of 2018. The bare ground threshold value for the Gulf Pastoral District was 29%; one quarter of the District had bare ground greater than this value (Figure 42). This includes some areas burnt earlier in 2018. However the most extensive areas with relatively high bare ground occurred in the southern and south-eastern parts of the District and these areas were mostly not affected by fire earlier in 2018.

# GULF PASTORAL DISTRICT

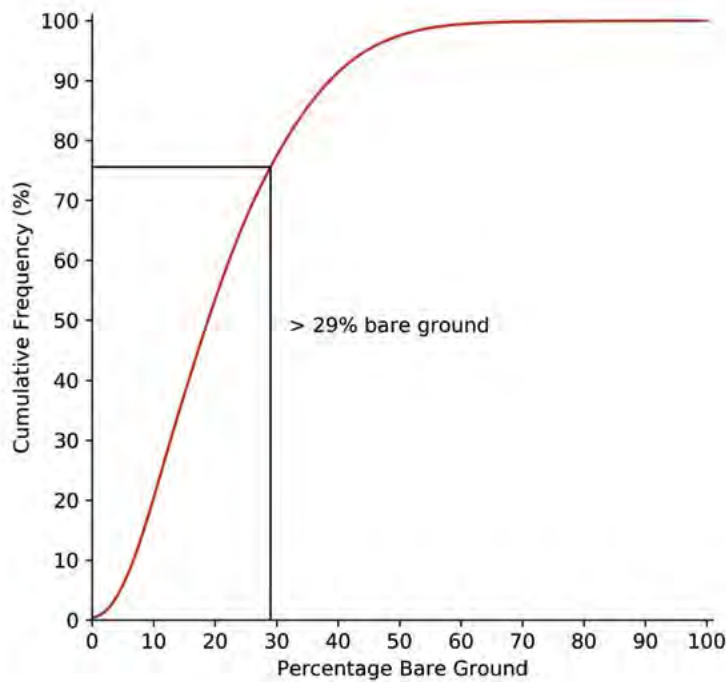


Figure 41. Percentage cumulative frequency of varying levels of bare ground in 30m square Landsat pixels in the Gulf Pastoral District between September and November 2018. Areas with greater than 29% bare ground are mapped in Figure 43.

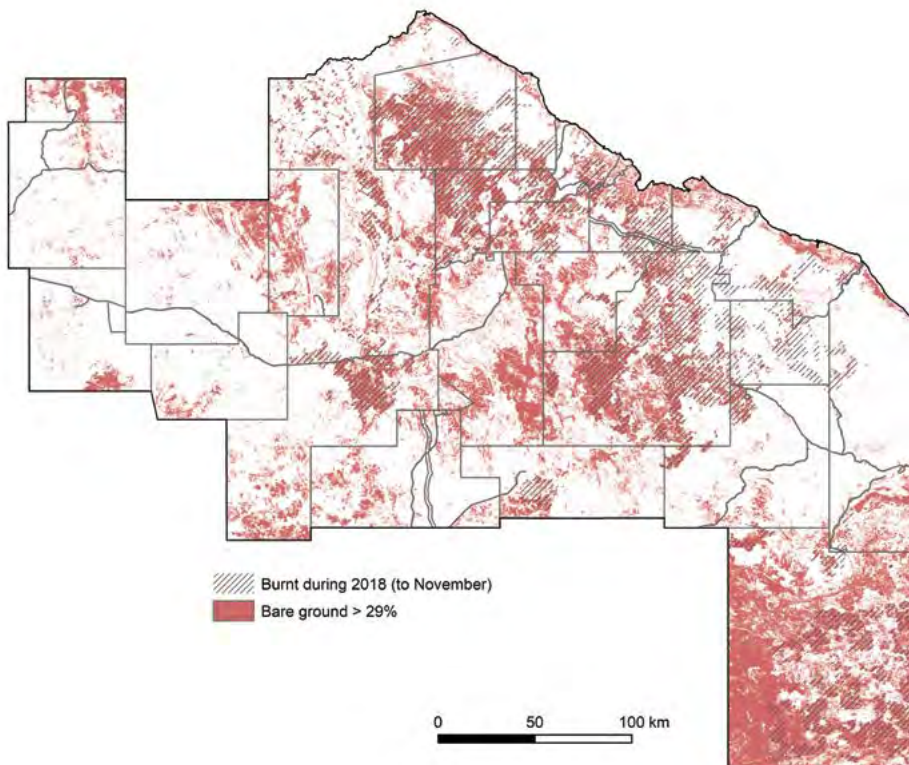


Figure 42. Parts of the Gulf Pastoral District having more than 29% bare ground per Landsat pixel in late 2018 (bare ground threshold). Note that the threshold level of bare ground used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected. Areas burnt between January and November 2018 shown with diagonal lines.

# GULF PASTORAL DISTRICT

## Site-based monitoring

Two pastoral leases in the Gulf Pastoral District were visited during 2018.

Vegetation cover of the ground layer was measured at 14 sites across the two leases. Sites, on average, had nearly one-fifth bare ground, reasonable litter cover as may be expected with more timbered land systems in the north, and fair to moderate cover of perennial grasses (Figure 44). Values ranged across the 14 sites for bare ground from 6% to 38% and for perennial grass from 10% to 74%, but were mostly around the mean values. 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.

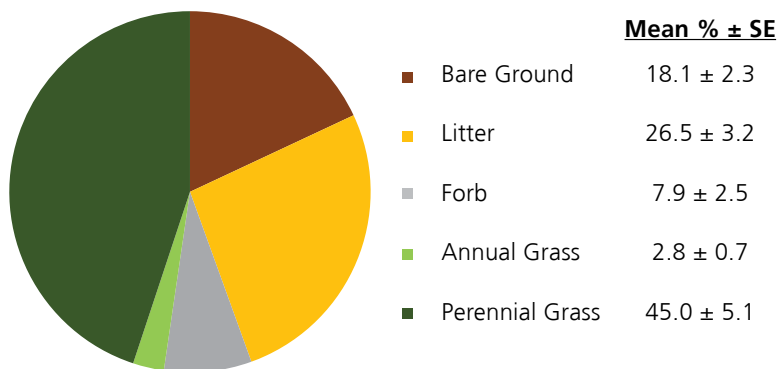


Figure 43. Mean percentage and standard error of measured components of vegetation cover in the ground layer from four sites on two pastoral leases in the Gulf Pastoral District.

The majority of the sites had minimal or no grazing (Table 20). There was no evidence of erosion recorded at any of the sites.

Table 20. Levels of pasture utilisation recorded at 14 sites on two pastoral leases in the Gulf Pastoral District.

<b>Pasture Utilisation</b>	
<b>Rank</b>	<b>% of sites</b>
No grazing	7
Minimal (<25%)	64
Moderate (26-50%)	14
Moderate to heavy (51-75%)	7
Heavy (75-90%)	7
Very heavy (>90%)	0

The two pastoral leases with monitored sites experienced above average seasonal quality based on modelled pasture growth through the 2016-17 Wet season.

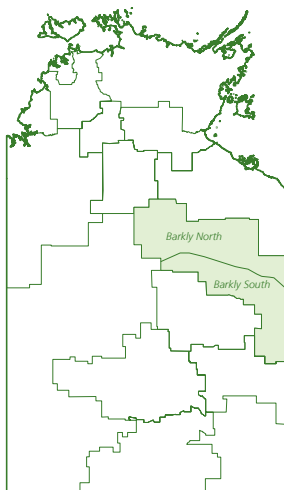
Land condition ratings assigned at monitoring sites and the more generalised assessment of land condition across those parts of pastoral leases traversed are summarised in Table 21.

# GULF PASTORAL DISTRICT

Table 21. Assessed land condition at 14 monitoring sites and traversed parts of two pastoral leases in the Gulf Pastoral District.

Station	Condition Rating	Comments with regard to pastoral lease
1	Excellent: 1 Good: 3 Fair: 1	Land condition across the property was assessed as Good condition, which is improved from the previous (Fair to Good) assessment conducted in 2014. Land condition assessment was based on robust densities of desirable 3P (perennial, palatable, productive) grasses, such as golden beard grass, native millet, and silky browntop, combined with infill of preferred annual species, such as fairy grass and fire grass and minimal undesirable increaser species feathertop wiregrass. There was good access throughout the property with well-maintained roads and new tracks in very good condition. There were areas of erosion particularly along the heavily utilised river flats. 2017-18 was very above average Wet season although more than half fell during end-January resulting in a major flood event with reduced contribution towards pasture growth. Hyptis or Sida, common throughout the District, were not observed, however, Parkinsonia was noted.
2	Good: 5 Fair: 4	Land condition was generally assessed as Good. Based on overall dense cover of palatable perennial grasses across the majority of the productive land systems. There appears to be an improvement in pasture condition since the previous monitoring conducted in 2013 (May). The increase in pasture cover in 2018 (September) is notable due to the different time of the visit; earlier in the Dry season in 2013 means more pasture is still available after the Wet season growing period. However, photos from on-ground monitoring sites, bare ground time traces, and trends from satellite imagery (fractional cover products) indicate that bare ground in productive land systems has not persisted since 2013, which was a below average Wet season. There are minor infestations of Parkinsonia, neem and noogoora burr, and also an active eradication program for prickly acacia. There was minimal gully erosion associated with tracks and drain lines.

# BARKLY PASTORAL DISTRICT



Map 8: Location of Barkly Pastoral District

The Barkly Pastoral District encompasses nearly 134 000 km<sup>2</sup> and includes 32 pastoral leases, of which 11 were visited in the 2018 season.

Seasonal quality, based on expected pasture growth, was average to above average across most of the Pastoral District, although rainfall was below the long term median. A small area in the far north experienced well above average seasonal conditions and the southern-most portion had significantly lower than average simulated pasture growth. Analysis of Landsat imagery for the late Dry season of 2018 showed that the north-western part of the District 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 30-year record. One quarter of the District had > 51% bare ground (per Landsat pixel) in the late Dry season, mainly in the east, south-east and south-west. Less than seven percent of the District burnt over the reporting period, with the majority of this occurring from October to December 2017. Eleven pastoral leases were visited where 67 of 124 sites were rated in Good condition and the remaining 57 in Fair condition. No sites were assessed as Poor condition.

## 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](http://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](http://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 45).



# BARKLY PASTORAL DISTRICT

Table 22. 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
2017 – 2018	406	238
Long-term median	758	464

Spatially averaged rainfall for the northern and southern sections of the Barkly Pastoral District was considerably below the long-term median (Table 22). Twelve-month rainfall was lower (less than 100 mm) in the far south-east, in line with the increasing aridity of this part of the Barkly region.

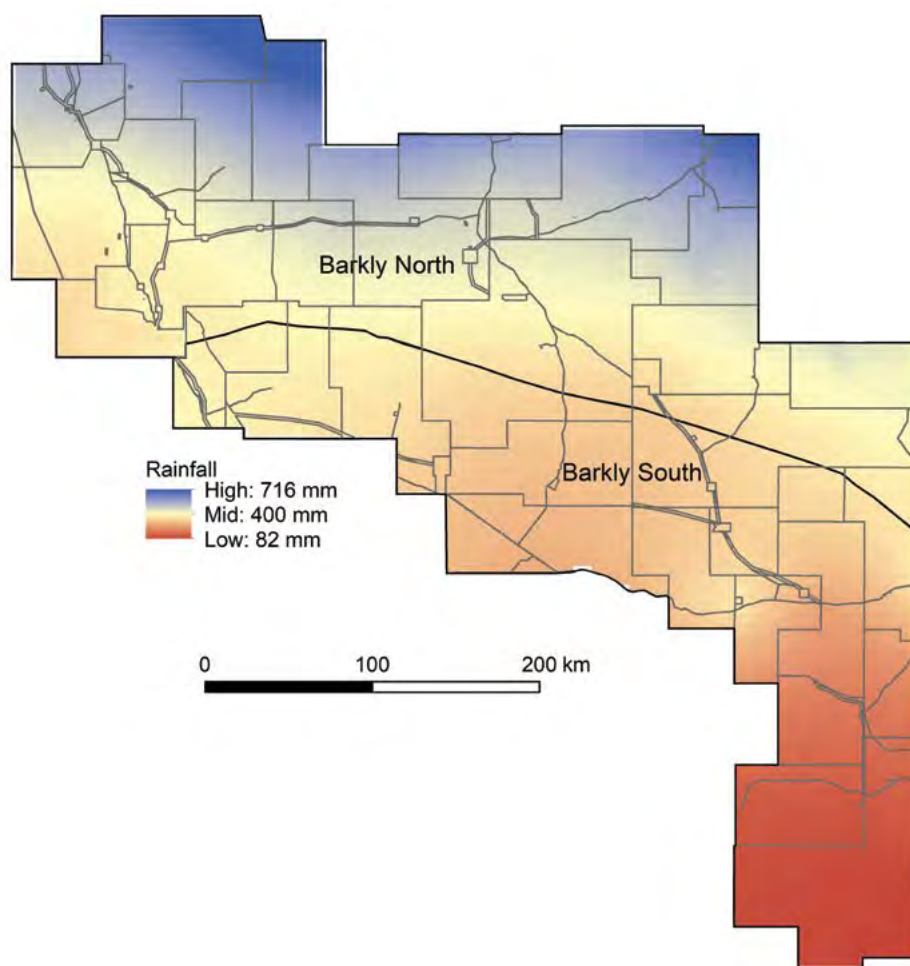


Figure 44. Spatially interpolated, gridded rainfall for the Barkly Pastoral District. Reporting period is October 2017 to September 2018.\*

AussieGRASS-modelled pasture growth, as a second indicator of seasonal quality for the entire Barkly region, is for the period November 2017 to April 2018. This growth is ranked as a percentile of the growth for all previous summers. In this case, spatially-averaged growth through the 2017-18 Wet season was approximately 818 kg/ha which was similar to the long-term median (Table 23).

# BARKLY PASTORAL DISTRICT

Table 23. 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)	818
Percentile	51

Modelled pasture growth over the 2017-18 Wet season, as a percentage of the long-term record, was average to above average across much of the District, except for the southern-most area which was well below average (Figure 46). Smaller areas in the northern-most of the District were modelled as having significantly above average rainfall.

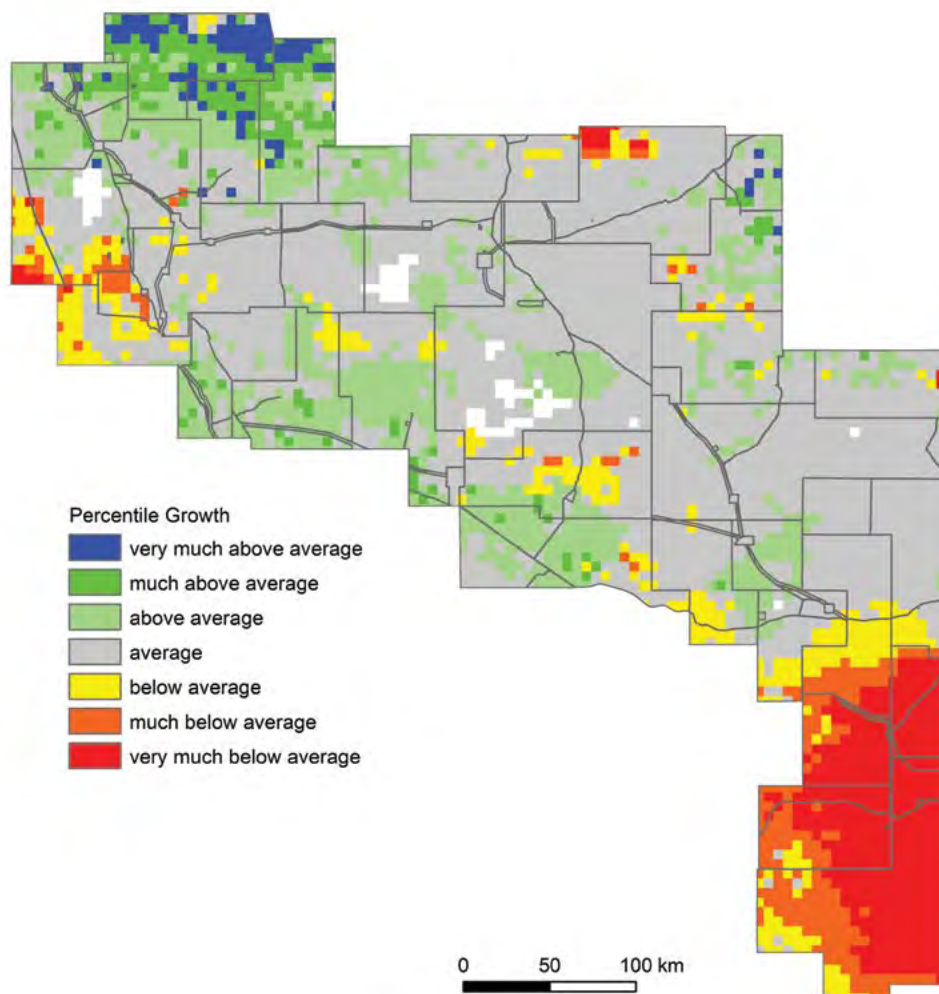


Figure 45. Simulated pasture growth for the 2017-18 Wet season as a percentage of the long-term record.\*

\*(Note: these images do not account for impact from fire or geographic influence variations across a district).

# BARKLY PASTORAL DISTRICT

## Fire

The North Australia and Rangelands Fire Information website ([www.firenorth.org.au/nafi3](http://www.firenorth.org.au/nafi3)) reports that 9 159 km<sup>2</sup> (6.9% of the Barkly Pastoral District) burnt between October 2017 and September 2018. Fire was most extensive in late 2017 (Figure 47), and may be correlated with controlled burns in the early Wet season targeting non-Mitchell grass country.

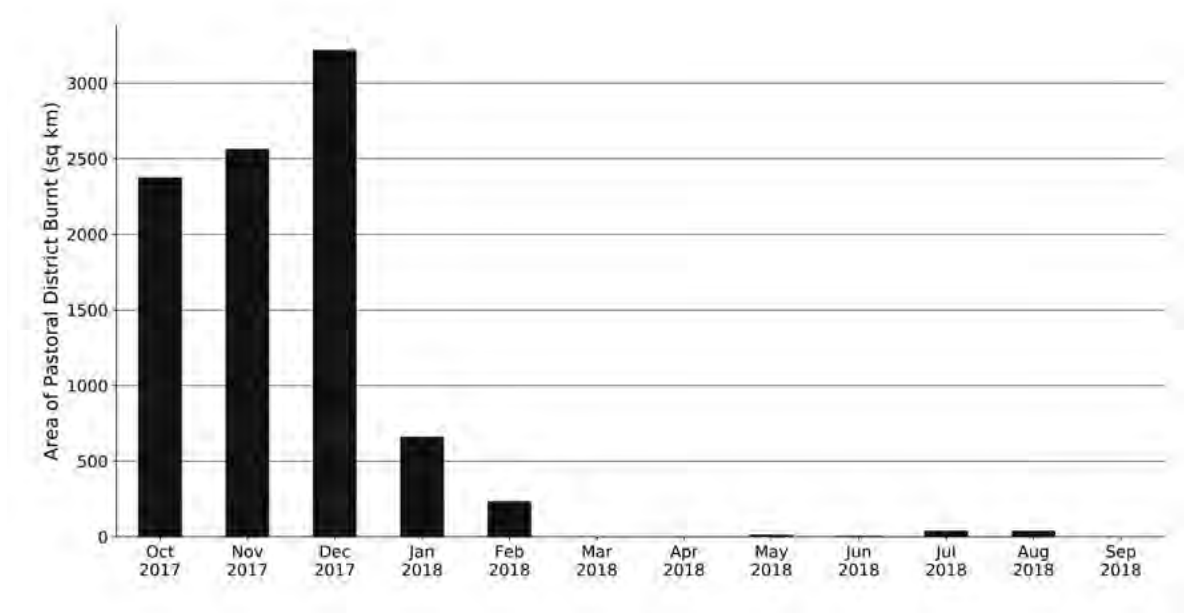


Figure 46. Monthly area burnt (km<sup>2</sup>) in the Barkly Pastoral District between October 2017 and September 2018.

## Bare-ground 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 ground 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 ground in each 30m square Landsat pixel (900 m<sup>2</sup> or 0.09 ha) was used to report the amount of bare ground across all pixels in the Barkly Pastoral District.

Corresponding with indicators of seasonal quality mapped in Figures 45 and 47, parts of the north-western Barkly Pastoral District had above average to highest levels of vegetation cover recorded since 1988 (Figure 48). Much of the central and eastern parts had average to below average vegetation cover based on the 30-year record, with scattered areas of significantly reduced vegetation cover (increased bare ground).

# BARKLY PASTORAL DISTRICT

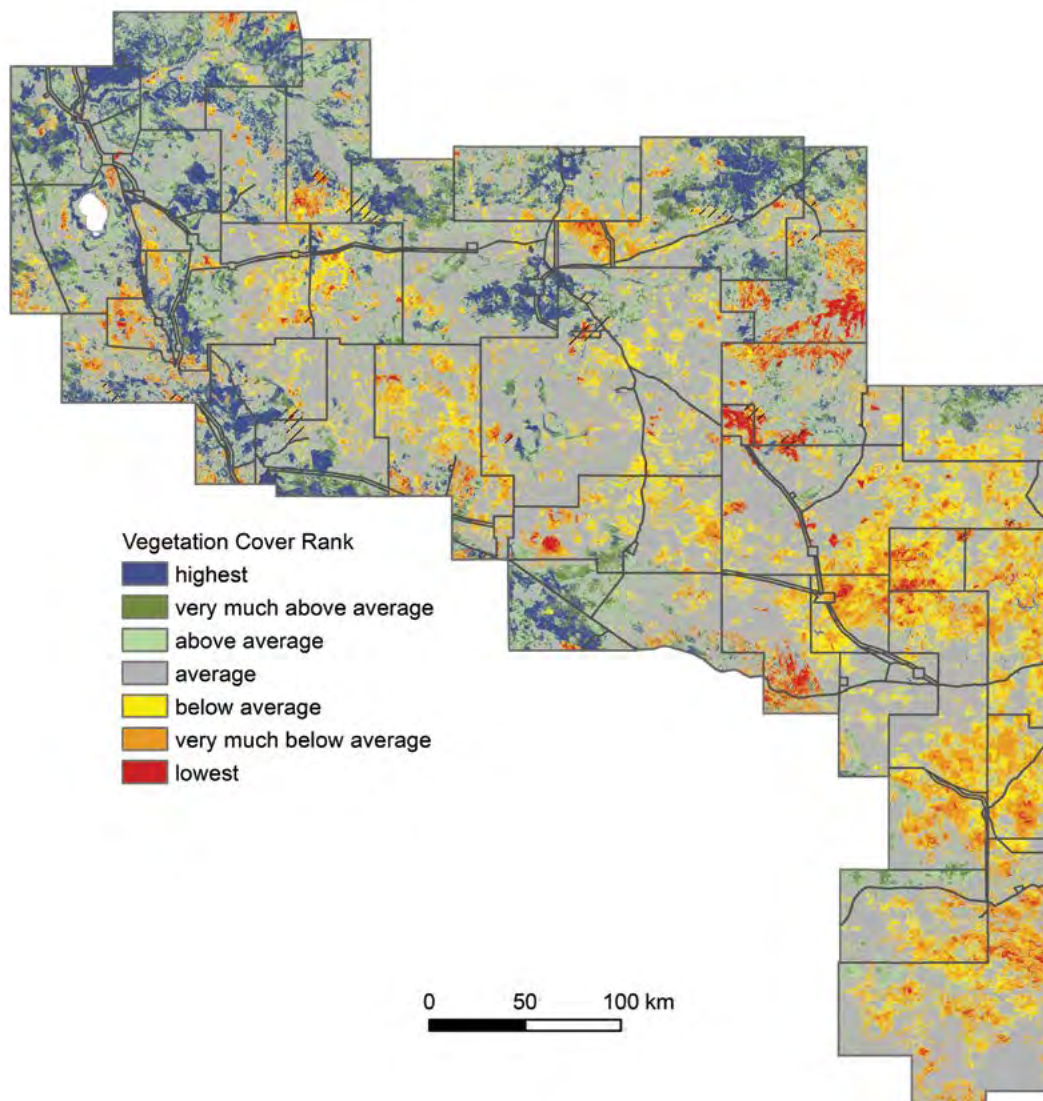


Figure 47. Rank of the amount of remotely-sensed vegetation cover present from September to November 2018 against that for previous years back to 1988. White areas show larger lakes.

The bare ground threshold is based on the frequency distribution of all 30m Landsat bare ground cover pixels at the end of 2018 (spring composite). A threshold was determined which represents 75% of a district’s overall bare ground. The remaining 25% is considered to have above-threshold bare ground.

The bare ground threshold value for the Barkly District was 51%; one quarter of the District had bare ground greater than this value (Figure 49) mostly in the east, south-east and south-west of the District (Figure 50). Approximately 23% of the District had minor amounts of bare ground (< 20% of the 30m Landsat pixel) towards the end of 2018.



# BARKLY PASTORAL DISTRICT

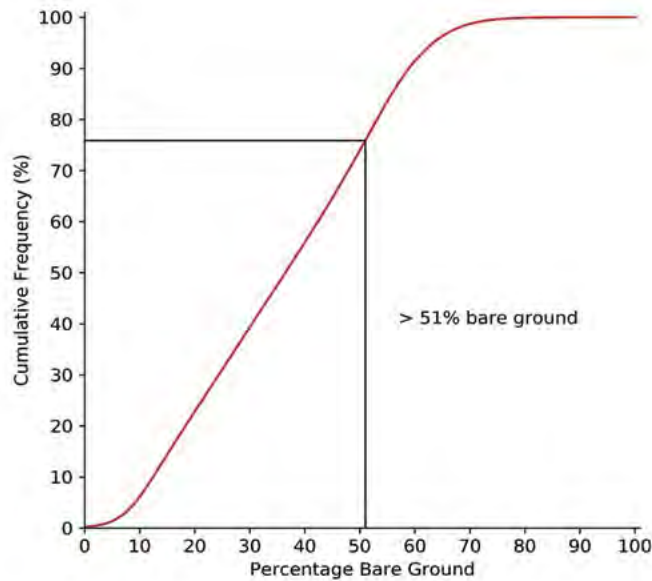


Figure 48. Percentage cumulative frequency of varying levels of bare ground in 30m square Landsat pixels in the Barkly Pastoral District between September and November 2018. Areas with greater than 51% bare ground are mapped in Figure 50.

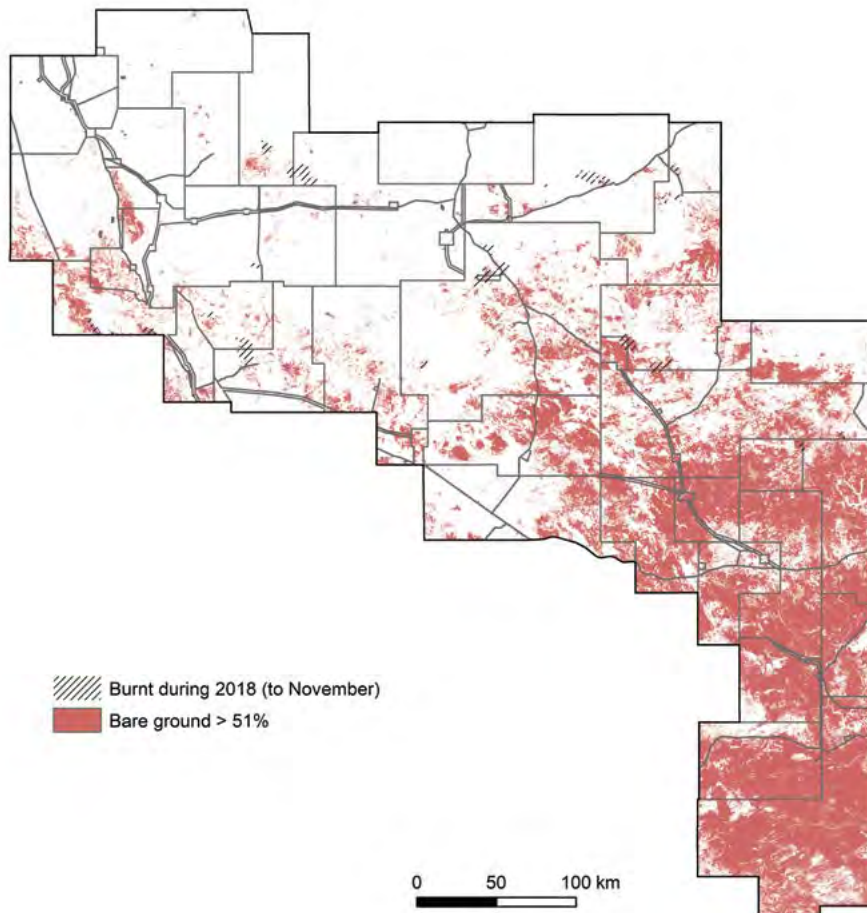


Figure 49. Parts of the Barkly Pastoral District having more than 51% bare ground per Landsat pixel in late 2018 (threshold bare ground). Note that the threshold level of bare ground used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.



# BARKLY PASTORAL DISTRICT

## Site-based monitoring

Eleven pastoral leases in the Barkly Pastoral District were visited during 2018.

Vegetation cover of the ground layer was measured at 124 sites across the 11 leases. Sites, on average, had a moderate cover of perennial grasses, largely due to the predominance of Mitchell grasses in this District (Figure 51). Litter contributed, on average, about one-fifth of the ground layer, which was associated with seasonal perennial versus annual grass dynamics. The percentage of litter and subsequently bare ground, will likely increase as the annual grasses, mainly Red Flinders grass, disintegrate as the Dry season progresses. Bare ground comprised on average, about 15% of the 1ha site area. 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 and rubber bush. Litter cover also protects the soil surface, assists infiltration of rain water and helps retain plant seeds in situ.

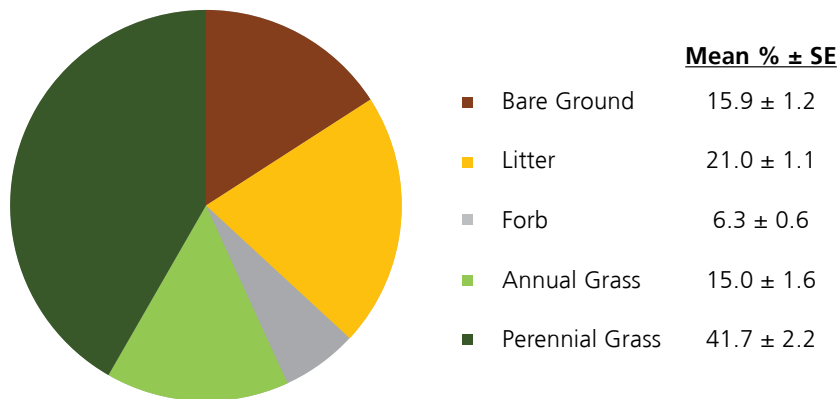


Figure 50. Mean percentage and standard error of measured components of vegetation cover in the ground layer from 124 sites on 11 pastoral leases in the Barkly Pastoral District.

Most sites were minimally or not grazed (Table 24), 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.

Erosion was not recorded at any of the 124 sites.

Table 24. Levels of pasture utilisation recorded at 124 sites on 11 pastoral leases in the Barkly Pastoral District.

Pasture Utilisation	
Rank	% of sites
No grazing	13
Minimal (<25%)	63
Moderate (26-50%)	9
Moderate to heavy (51-75%)	8
Heavy (75-90%)	7
Very heavy (>90%)	0

## 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 25. The 11 stations visited in 2018 were all in the northern Barkly District, and experienced average to slightly above average seasonal quality, based on 12-month rainfall and modelled Wet season pasture growth.

Table 25. Assessed land condition at monitoring sites and traversed parts of 11 pastoral leases in the Barkly Pastoral District.

Station	Condition Rating (number of sites)	Comments with regard to pastoral lease
1	Good: 6 Fair: 8	Land condition was assessed as being Fair across most of the property, which appeared to be an improvement since the previous visit despite lower than average rainfall in the 2017-18 Wet season. There was robust cover of Mitchell grasses across the black soil, however heavy grazing effects were noted along the Stock Route. There were isolated patches of Parkinsonia with larger areas of rubber bush, which are both being actively managed. The presence of asbestos grass, while not a declared weed, requires ongoing awareness as this is an important pasture weed in Queensland.
2	Good: 5 Fair: 1	There was below average total rainfall and poor rainfall distribution over the 2017-2018 Wet season, but land condition was generally assessed as Good, based on a consistent cover of desirable 3P (perennial, palatable, productive) grasses (barley Mitchell grass, golden beard grass and silky browntop) across the majority of the property. This was also reflected in the monitoring sites. There was good infill of compatible annual species, with minimal increaser species feathertop wire grass. Weeds were not identified as an issue on the property, although grader grass had been noted as a potential threat, as was also woody thickening of turpentine and turkey bush. Wildfires were an issue in 2017. There was considerable infrastructure development occurring at the time of the 2018 inspection.
3	Good: 4 Fair: 5	Land condition was generally assessed as Good, based on overall stands of palatable perennial grasses across the majority of the productive land systems (e.g. Cresswell and Joanundah). In the less productive lancewood dominated land systems, pasture was limited but in Good condition with relatively low bare areas detected on-ground or spatially. There appears to be a slight improvement in pasture condition since the previous monitoring conducted in 2013. There were patches of Parkinsonia around the homestead that showed evidence of treatment and also die back in some infestations.

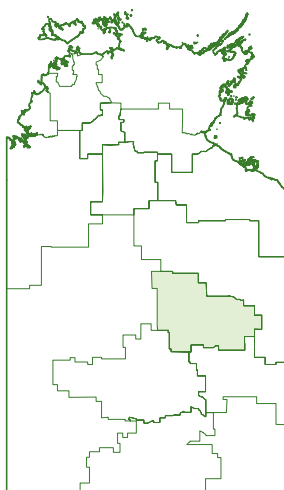
# BARKLY PASTORAL DISTRICT

Station	Condition Rating (number of sites)	Comments with regard to pastoral lease
4	Excellent: 1 Good: 4 Fair: 5	Land condition was generally assessed as Good to Fair condition, primarily based on pasture species composition and vigour. This appears to be an improvement from the previous monitoring conducted in 2013. The below average rainfall was reflected in pasture growth with some areas showing less than expected biomass and high utilisation. Five of the ten sites were assessed as Excellent/Good based on robust densities of desirable 3P (perennial, palatable, productive) grasses (primarily Mitchell grasses) with infill of desirable annual species (e.g. red Flinders grass) and minimal undesirable increaser species (e.g. feathertop wiregrass). The other five sites assessed as Fair condition generally had lower proportions of desirable perennial species with lower tussock densities and tussock vigour. The undesirable asbestos grass, an increaser species, especially in wetter areas, was noted. No areas of erosion were observed, there were isolated patches of the weed Parkinsonia, and some well-established infestations of rubber bush around the station, particularly around bores.
5	Good: 3 Fair: 13	There was below average total rainfall and poor rainfall distribution over the 2017-2018 Wet season, which was reflected in the pasture growth with relatively low biomass and high utilisation. Irrespective of season, inter-tussock spacing and tussock vigour of extensive Mitchell grassland resulted in land condition generally assessed as Fair across the property, which was reflected in measured assessments of the monitoring sites.
6	Good: 5 Fair: 4	Land condition was generally assessed as Fair condition. This was based on overall reasonable stands of palatable perennial grasses across the majority of the productive land systems (e.g. Cresswell and Joanundah). In the less productive lancewood-dominated land systems, pasture was limited but in Good condition with relatively low bare areas detected on-ground or spatially.
7	Excellent: 1 Good: 5 Fair: 3	This property was generally assessed as in Good land condition, which was reflected in the monitoring sites, based on robust densities of desirable 3P (perennial, palatable, productive) grasses (primarily Mitchell grasses) with infill of desirable annual species (e.g. red Flinders grass) and minimal undesirable increaser species (e.g. feathertop wiregrass). The sites assessed as Fair condition generally had lower proportions of desirable perennial species with lower tussock densities and tussock vigour, with bare ground or high proportions of annual species between tussocks. These annual species do provide valuable feed, especially early in the Dry season, but hay off and can disappear quickly, resulting in areas of bare ground as the season progresses. No areas of erosion were observed. There were isolated patches of Parkinsonia and rubber bush.
8	Good: 6 Fair: 3	This property was generally assessed as in Good condition, with robust densities of desirable 3P (perennial, palatable, productive) grasses (primarily Mitchell grasses) with infill of desirable annual species (e.g. red Flinders grass) and minimal undesirable increaser species (e.g. feathertop wiregrass). Some areas had lower proportions of desirable perennial species with lower tussock densities and tussock vigour, with bare ground or high proportions of annual species between tussocks. No areas of erosion were observed. There were isolated patches of Parkinsonia and rubber bush.

# BARKLY PASTORAL DISTRICT

Station	Condition Rating (number of sites)	Comments with regard to pastoral lease
9	Excellent: 1 Good: 6 Fair: 3	Land condition across the property was assessed as Good, with robust densities of desirable 3P (perennial, palatable, productive) grasses, Mitchell grass, golden beard grass and Queensland blue grass, with infill of desirable annual species (e.g. red Flinders grass) and minimal undesirable increaser species (e.g. feathertop wiregrass). This is an improvement from the previous monitoring conducted in 2013. No areas of erosion were observed. There were isolated patches of weed infestations including Parkinsonia and rubber bush, with weed control programs in place. Asbestos grass, although not a declared weed in the NT can reduce pasture productivity, was noted around bores and troughs.
10	Excellent: 1 Good: 13 Fair: 4	Land condition was generally assessed as Good condition, consistent with the majority of the 18 monitoring sites, with robust densities of desirable 3P (perennial, palatable, productive) grasses (primarily Mitchell grasses) with infill of desirable annual species (e.g. red Flinders grass) and minimal undesirable increaser species (e.g. feathertop wiregrass). Some areas were assessed as Fair condition due to lower proportions of desirable perennial species with lower tussock densities and tussock vigour. No areas of erosion were observed. There were isolated patches of rubber bush around the station, particularly around bores and were away from the monitoring sites. Land condition appears consistent from the previous monitoring conducted in 2013, which also followed a comparably below average Wet season rainfall of approximately 337 mm. The pasture growth responded reasonably well to the 2017-18 below average Wet season.
11	Good: 6 Fair: 8	Land condition was generally assessed as Good to Fair condition, primarily based on pasture species composition and vigour. The below average rainfall was reflected in pasture growth with some areas showing less than expected biomass and high utilisation. Six sites were assessed as Good condition based on robust densities of desirable 3P (perennial, palatable, productive) grasses, across a range of land types (Mitchell grasses, 'coolibah' country and red soil Eucalyptus) with infill of desirable annual species (e.g. red Flinders grass) and minimal undesirable increaser species (e.g. feathertop wiregrass). The other sites assessed as Fair condition reflected areas on the property which had lower proportions of desirable perennial species with lower tussock densities and tussock vigour. There had been a significant effort in the control of prickly acacia, with isolated patches of Parkinsonia, and some well-established infestations of rubber bush. No areas of erosion were observed. There was extensive and ongoing infrastructure improvement which will have implications for future grazing management and associated land condition.

# TENNANT CREEK PASTORAL DISTRICT



Map 9: Location of Tennant Creek Pastoral District

The Tennant Creek Pastoral District encompasses approximately 69 200 km<sup>2</sup> and includes eight pastoral leases.

Seasonal quality based on rainfall and modelled pasture growth was generally above average in the west and below average in the east of the District. Twelve percent of the District burnt between October 2017 and September 2018 with fire most active in November and December 2017. Based on Landsat imagery, most of the District had average to highest levels of vegetation cover recorded since 1988. One quarter of the District had > 51% bare ground per Landsat pixel (threshold bare ground), mainly in the east (non-pastoral lease tenure). No pastoral leases were visited for site-based monitoring over this reporting period.

## 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](http://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 26) are based on gridded rainfall produced by the Bureau of Meteorology ([www.bom.gov.au/jsp/awap/rain/index.jsp](http://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 2017 to April 2018. This growth is ranked as a percentile of the growth for all previous summers.

Table 26. Indicators of seasonal quality. Data spatially averaged for the Tennant Creek Pastoral District.

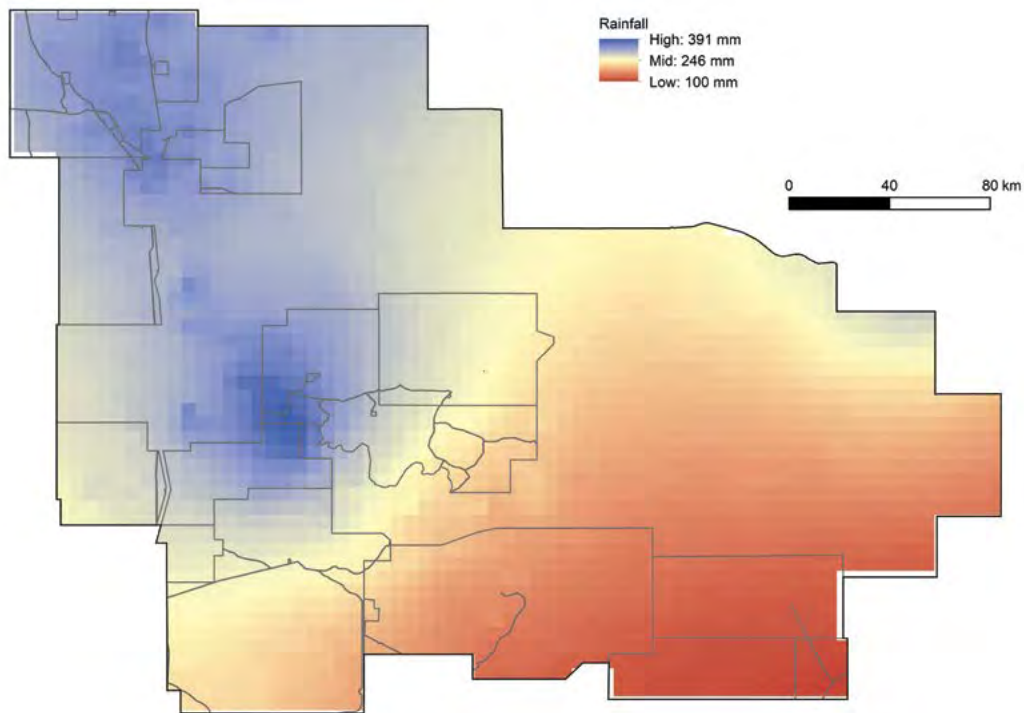
	Rainfall (mm)		AussieGRASS
2017 – 2018	242	Growth (kg/ha)	405
Long-term median	286	Percentile	53

Spatially averaged rainfall for the Tennant Creek Pastoral District was slightly below the long-term median (Table 26), with a distinct trend from significantly below median rainfall in the south-east to median rainfall in the north-west of the District. (Figure 52, top panel).

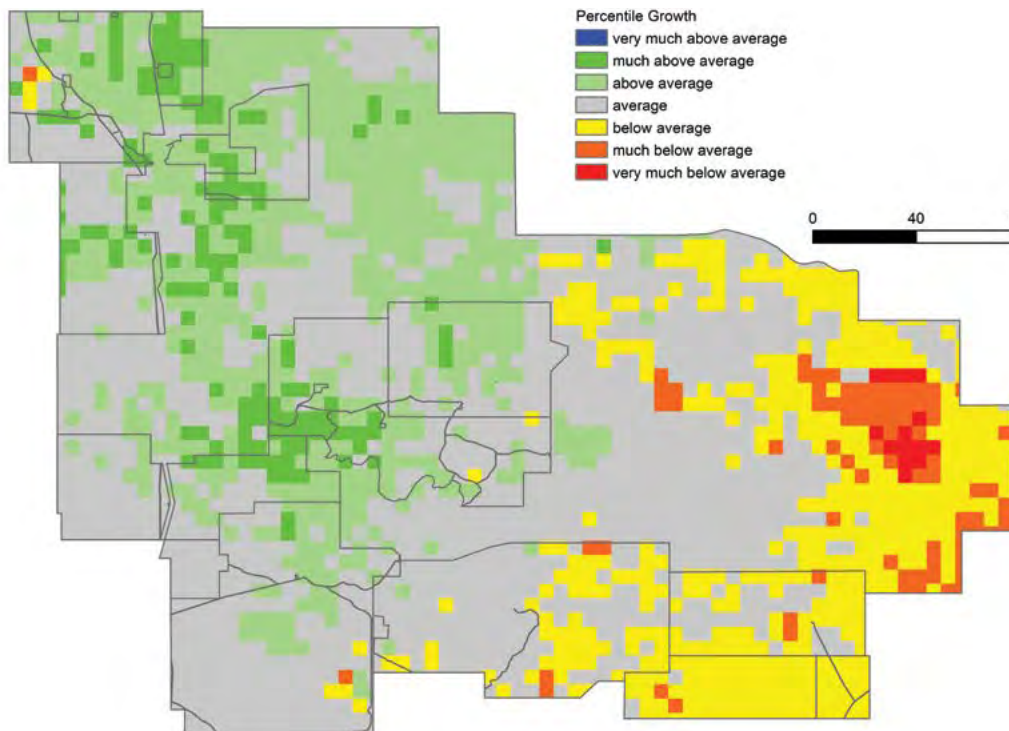
Modelled pasture growth over the last summer, as a percentage of the long-term record, was average to above average in the west and north-west, but declined to below average and very much below average towards the east and south-east of the District, generally following annual rainfall patterns (Figure 52, bottom panel).



# TENNANT CREEK PASTORAL DISTRICT



Spatially interpolated rainfall, October 2017 to September 2018



Simulated summer pasture growth as a percentage of the long-term record

Figure 51. Maps of seasonal quality. Top, gridded rainfall, October 2017 to September 2018; bottom, AussieGRASS-modelled pasture growth for the 2017-18 summer period as a percentage of previous summers. (Note: these images do not account for impact from fire or geographic influence variations across a district).

# TENNANT CREEK PASTORAL DISTRICT

## Fire

The North Australia and Rangelands Fire Information website ([www.firenorth.org.au/nafi3](http://www.firenorth.org.au/nafi3)) reports that 8 043 km<sup>2</sup> (11.6%) of the Tennant Creek Pastoral District burnt between October 2017 and September 2018. This was less than the area burnt during the 2016-17 reporting period (11 034 km<sup>2</sup>) and more than the 2015-16 reporting period (5 646 km<sup>2</sup>). Most of the area was burnt in November and December (Figure 53).

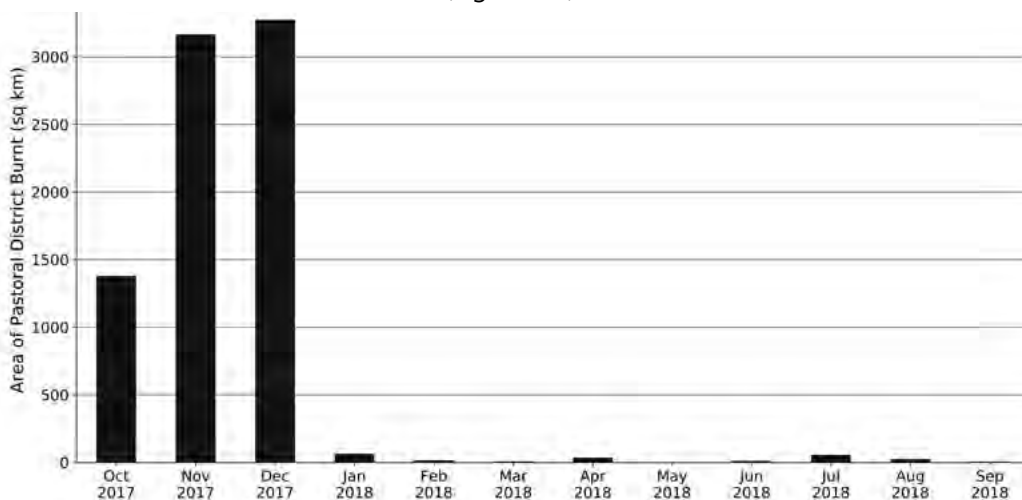


Figure 52. Monthly area burnt (km<sup>2</sup>) in the Tennant Creek Pastoral District between October 2017 and September 2018.

## Bare ground 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 ground 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 ground in each 30m square Landsat pixel (900 m<sup>2</sup> or 0.09 ha) was used to report the amount of bare ground across all pixels in the Tennant Creek Pastoral District.

The bare ground threshold is based on the frequency distribution of all 30m Landsat bare ground cover pixels at the end of 2018 (spring composite). A threshold was determined which represents 75% of a district’s overall bare ground. The remaining 25% is considered to have above-threshold bare ground.

Most of the District had average to highest levels of vegetation cover recorded since 1988, with patches of below average to lowest cover rank across northern parts of the District, generally associated with non-pastoral use tenure. Fire during 2018 accounted for only a small proportion of those areas which had much below average vegetation cover (fire scars shown in Figure 54).

# TENNANT CREEK PASTORAL DISTRICT

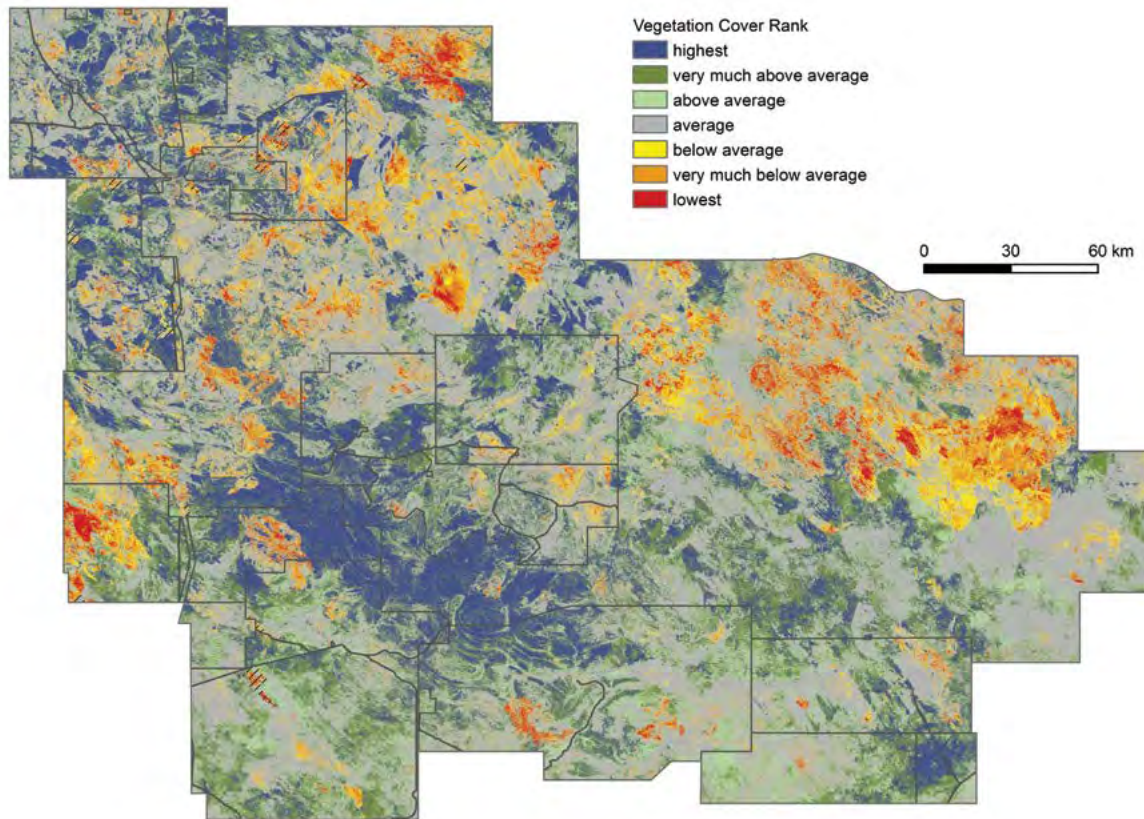


Figure 53. Rank of the amount of remotely-sensed vegetation cover present from September to November 2018 against that for previous years back to 1988. Diagonal lines show those areas burnt between January and November 2018.

Only approximately one percent of the District had minor bare ground (< 20% of the 30m Landsat pixel) towards the end of 2018 (Figure 55) and one quarter of the District had > 51% bare ground (bare ground threshold) (Figures 55 and 56).



# TENNANT CREEK PASTORAL DISTRICT

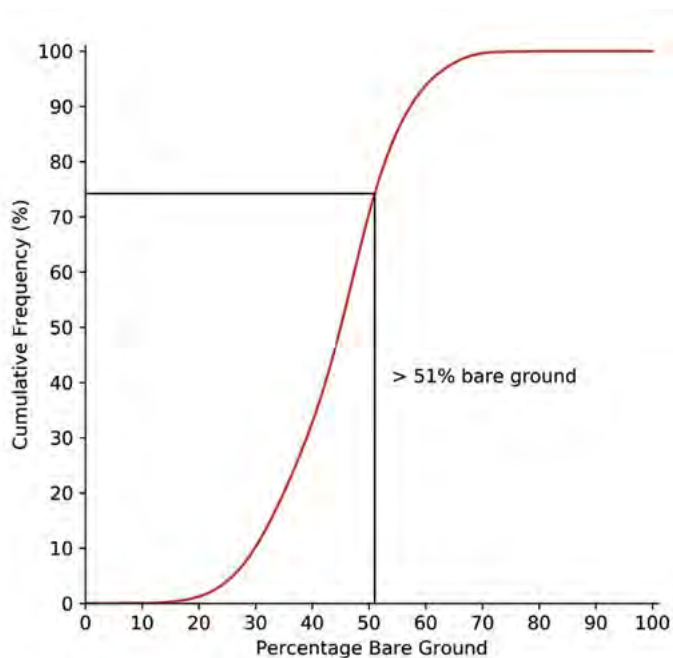


Figure 54. Percentage cumulative frequency of varying levels of bare ground in 30m square Landsat pixels in the Tennant Creek Pastoral District between September and November 2018. Areas with greater than 51% bare ground are mapped in Figure 56.

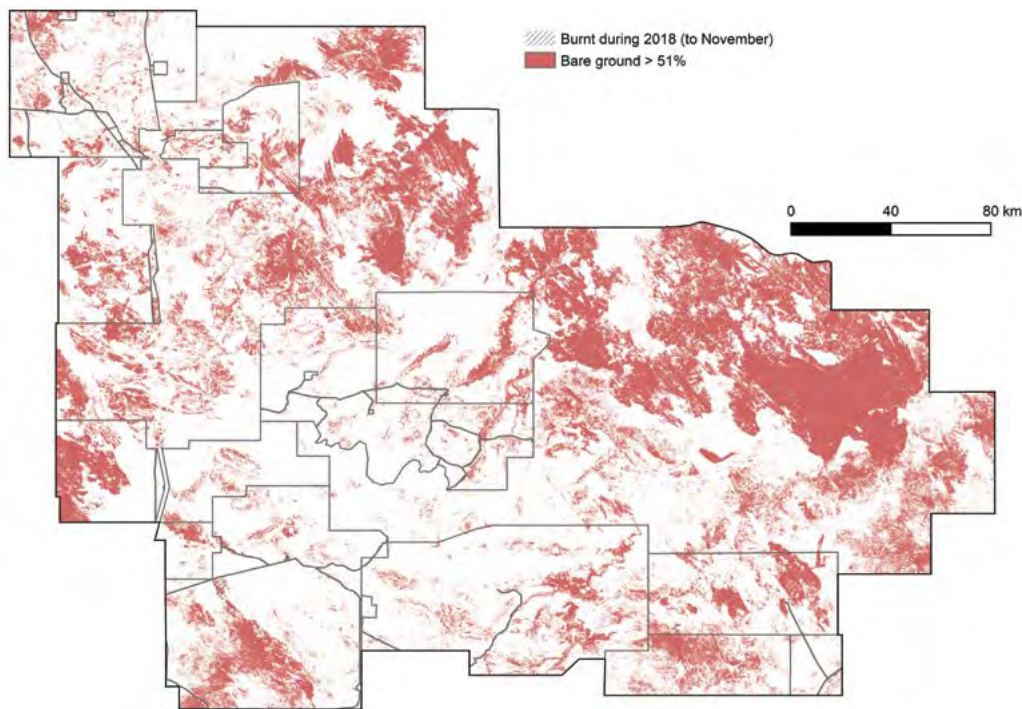
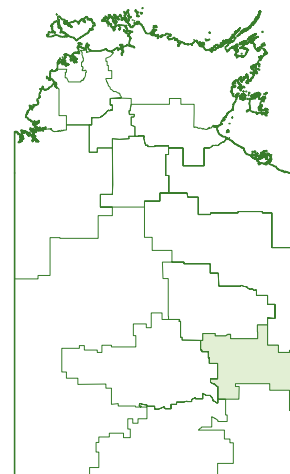


Figure 55. Parts of the Tennant Creek Pastoral District having more than 51% bare ground per Landsat pixel in late 2018 (threshold bare ground). Areas burnt between January and November 2018 shown with diagonal lines. Note that the threshold level of bare ground used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.

# PLENTY PASTORAL DISTRICT

The Plenty Pastoral District encompasses approximately 54 240 km<sup>2</sup> and includes 14 pastoral leases.

The District experienced mainly below average seasonal quality based on AussieGRASS-modelled pasture growth and below average rainfall, with the exception of the south-west pocket which experienced better seasonal conditions. Correspondingly, Landsat imagery indicated that most of the District had average to very much below average vegetation cover relative to that present in the latter part of each year back to 1988. There was minimal incidence of fire across the District between October 2017 and September 2018. Just over 18% of the District had < 40% bare ground and one quarter had > 54% bare ground (bare ground threshold). Only a single pastoral lease was assessed in this District in 2018, with the majority of the ten assessed sites in Good to Fair land condition, although erosion was noted at four of the sites.



Map 10: 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](http://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 27) are based on gridded rainfall produced by the Bureau of Meteorology ([www.bom.gov.au/jsp/awap/rain/index.jsp](http://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 2017 to September 2018) to take account of useful winter rainfall during 2017. This growth is ranked as a percentile of growth for all previous October – September periods.

Table 27. Indicators of seasonal quality. Data spatially averaged for the Plenty Pastoral District.

	Rainfall (mm)		AussieGRASS
2017 – 2018	126	Growth (kg/ha)	222
Long-term median	205	Percentile	33



# PLENTY PASTORAL DISTRICT

Spatially averaged rainfall for the Plenty Pastoral District was well below the long-term median (Table 27). Rainfall was below average (less than 220 mm) for most of the District, especially in the north-east and east. Above average rainfall was received in portions of the west, south-west and south. (Figure 57, left hand panel).

Most of the District experienced below average seasonal quality, based on modelled pasture growth, in the 12 months October 2017 to September 2018.

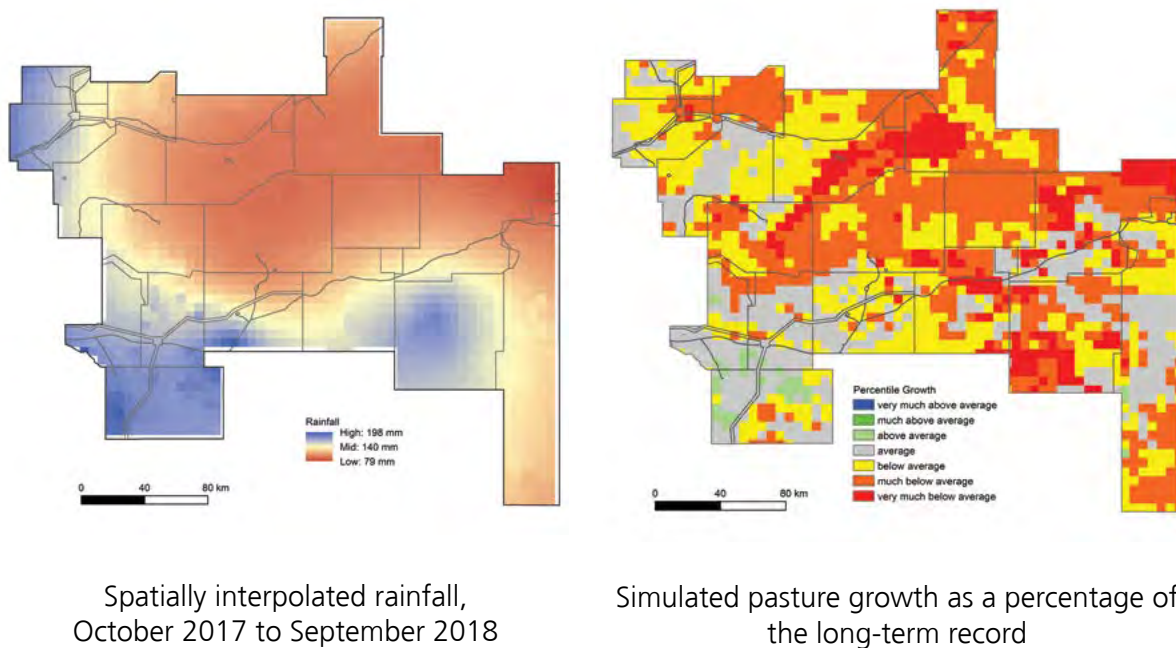


Figure 56. Maps of seasonal quality for the period, October 2017 to September 2018. Left, gridded rainfall; right, AussieGRASS-modelled pasture growth as a percentage of previous similar periods. (Note: these images do not account for impact from fire or geographic influence variations across a district).

## Fire

There was minimal fire in the Plenty Pastoral District between October 2017 and September 2018 based on data from the North Australia and Rangelands Fire Information website ([www.firenorth.org.au/nafi3](http://www.firenorth.org.au/nafi3)). Approximately 380 km<sup>2</sup> burnt mostly between October and December 2017, which represented less than one percent of the District.

## Bare ground 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 ground 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 ground in each 30m square Landsat pixel (900 m<sup>2</sup> or 0.09 ha) was used to report the amount of bare ground across all pixels in the Plenty Pastoral District.

# PLENTY PASTORAL DISTRICT

Most of the District had average vegetation cover relative to that present in the latter part of each year back to 1988 (Figure 58). There were patches across the north-west where vegetation cover was above average to highest since 1988, whereas there were patches in the south of well below average vegetation cover.

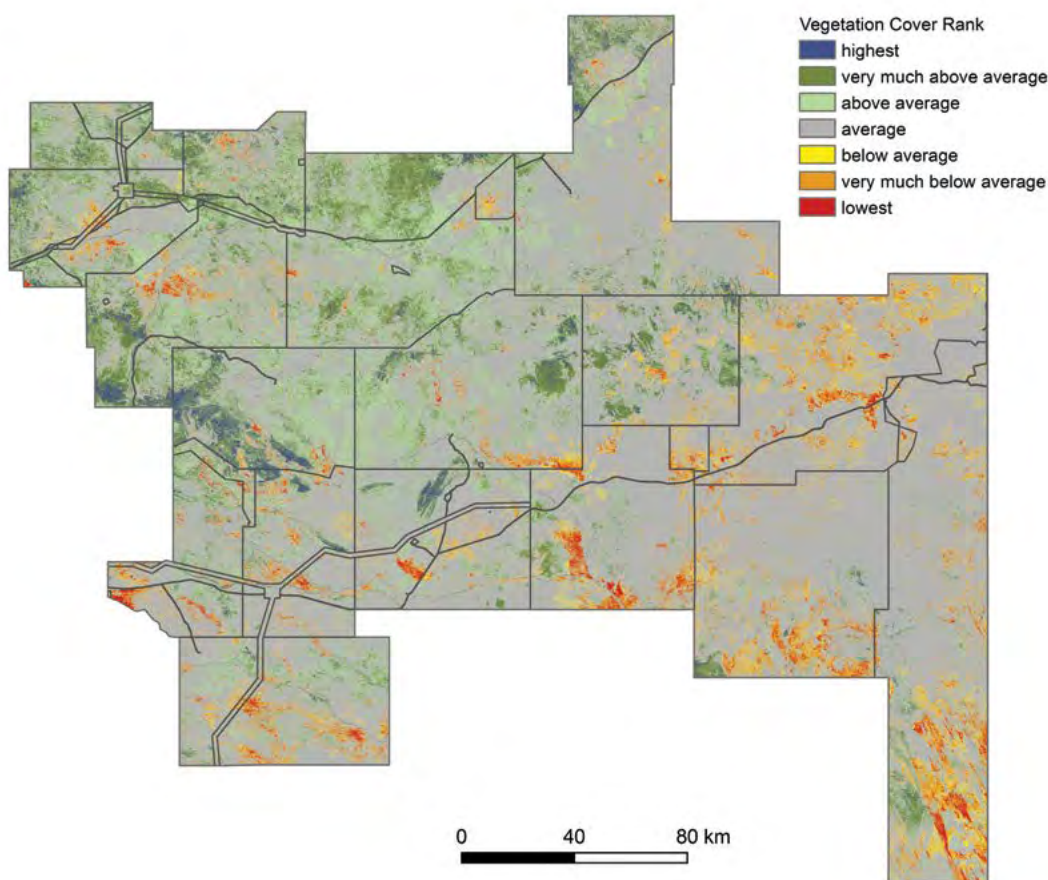


Figure 57. Rank of the amount of remotely-sensed vegetation cover present from September to November 2018 against that for previous years back to 1988.

Less than one per cent of the District had a small amount of bare ground (< 20% of the 30m Landsat pixel) towards the end of 2018 and just over 18% of the District had < 40% bare ground (Figure 59). The bare ground threshold value for the Plenty Pastoral District was 54%; one quarter of the District had bare ground per pixel greater than this value (Figures 59 and 60).

# PLENTY PASTORAL DISTRICT

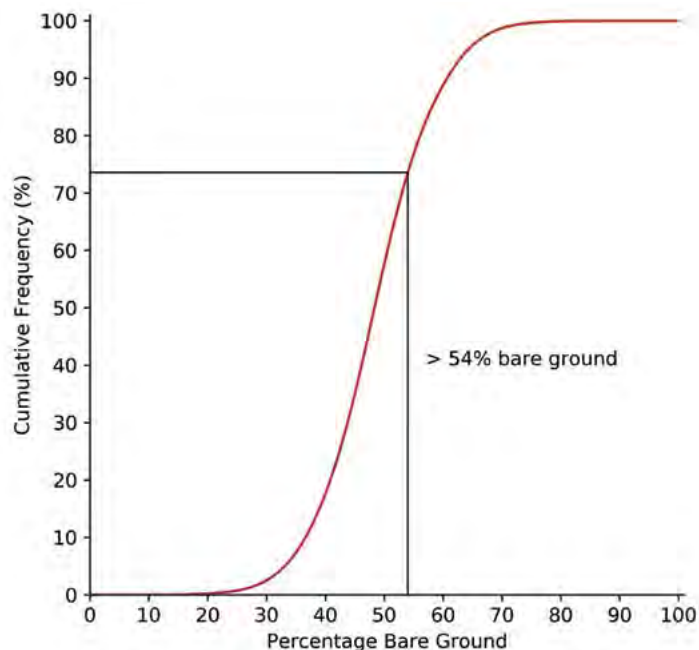


Figure 58. Percentage cumulative frequency of varying levels of bare ground in 30m square Landsat pixels in the Plenty Pastoral District between September and November 2018. Areas with greater than 54% bare ground are mapped in Figure 60.

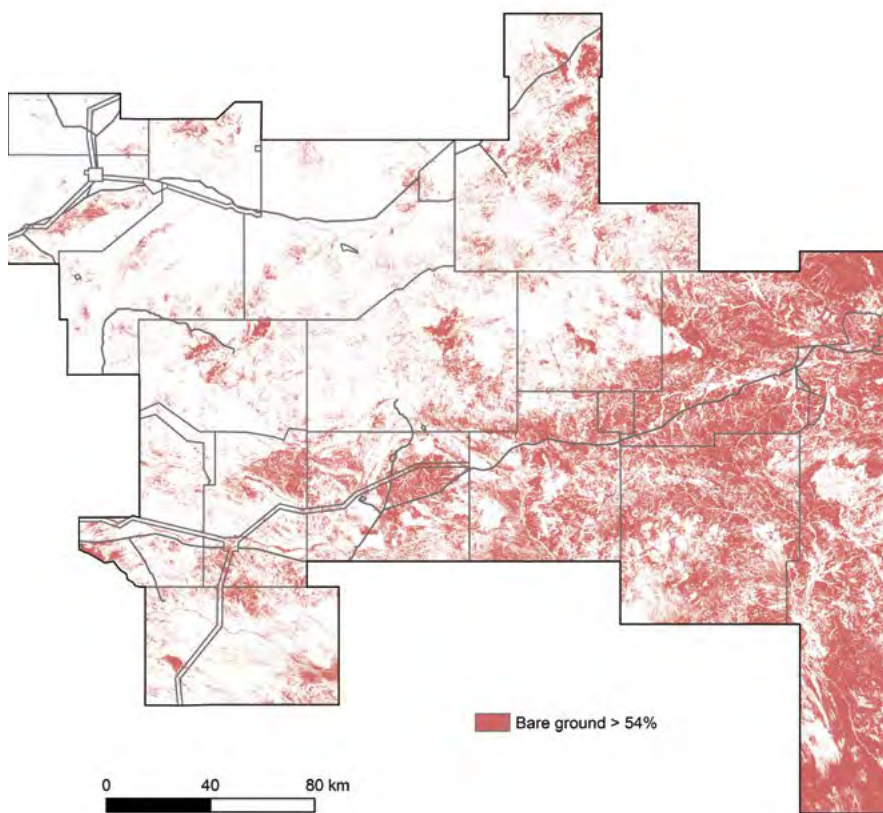


Figure 59. Parts of the Plenty Pastoral District having more than 54% bare ground per Landsat pixel in late 2018 (bare ground threshold). Note that the threshold level of bare ground used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.

# PLENTY PASTORAL DISTRICT

## Site-based monitoring

A single pastoral lease was visited in the Plenty Pastoral District during 2018.

Vegetation cover of the ground layer was measured at ten sites across the lease. Sites, on average, had a approximately one third of bare ground, one third litter cover and a one third of annual and perennial grasses (Figure 61).

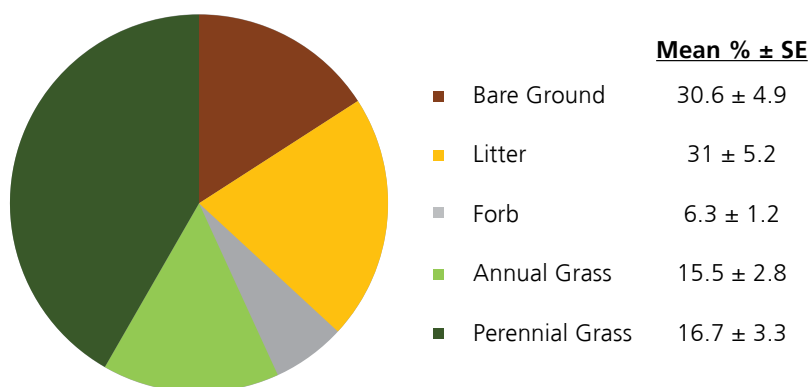


Figure 60. Mean percentage and standard error of measured components of vegetation cover in the ground layer from ten sites on one pastoral lease in the Plenty Pastoral District.

Most sites were minimally grazed (Table 28), 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. Slight wind or gully erosion was recorded at four of the ten sites.

Table 28. Levels of pasture utilisation and evidence of erosion recorded at ten sites on one pastoral lease in the Plenty Pastoral District.

<b>Pasture Utilisation</b>	
<b>Rank</b>	<b>% of sites</b>
No grazing	0
Minimal (<25%)	80
Moderate (26-50%)	10
Moderate to heavy (51-75%)	0
Heavy (75-90%)	0
Very heavy (>90%)	10

# PLENTY PASTORAL DISTRICT

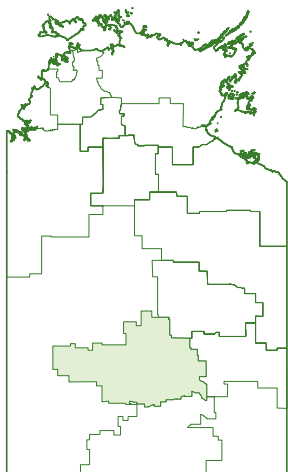
Land condition ratings assigned at monitoring sites and the more generalised assessment of land condition across those parts of the pastoral leases traversed are summarised in Table 29. The pastoral lease experienced average to poor seasonal conditions based on 12-month rainfall and modelled pasture growth. To the extent possible, condition assessments are independent of year-to-year variability in rainfall.

Table 29. Assessed land condition at monitoring sites and traversed parts of one pastoral lease in the Plenty Pastoral District.

Station	Condition Rating (number of sites)	Comments with regard to pastoral lease
1	Good: 4 Fair: 3 Poor: 3	Land condition at integrated monitoring sites ranged from Good to Poor. The four sites assessed in Good condition were within the northern half of the property. Levels of bare ground were relatively low here, with an average of 31%. Three sites were assessed in Fair condition. The remaining three sites assessed in Poor condition were in the southern half of the property. Productive alluvial country and plains close to the base of the central ranges were, in general, in poorer condition. Levels of pasture utilisation were low at most sites at the time of this inspection. Gully erosion was common in drainage lines and alluvial plains around the south-eastern part of the central ranges in areas close to the base of hillslopes. There was a low density of feral camels present.



# NORTHERN ALICE SPRINGS PASTORAL DISTRICT



Map 11: Location of Northern Alice Springs Pastoral District

The Northern Alice Springs Pastoral District encompasses just under 103 000 km<sup>2</sup> including 28 pastoral leases, four of which were visited in 2018.

Much of the District experienced average or below average seasonal quality based on expected pasture growth (modelled using AussieGRASS), and variable rainfall. Parts of the south and west had seasonal conditions that were very much below average. From Landsat data, most of the District had similar or less vegetation cover (relatively more bare ground) in the latter period of 2018 compared with previous years since 1988. One-quarter of the District had more than 50% bare ground per 30m pixel at this time (bare ground threshold). On-ground monitoring for land condition was conducted

at 30 sites on four pastoral leases, with four sites rates as Good, 19 as Fair, and seven as Poor. Sites, on average, had a moderate to high level of bare ground, reasonable litter cover and small contributions of perennial and annual grasses, and forbs. Approximately four per cent of the District burnt over the reporting period, primarily over the late 2017 Dry season. Slight to moderate sheet erosion was recorded at approximately two-thirds of the sites and 60% of sites were moderately to heavily-grazed at the time of assessment.

## 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](http://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 30) are based on gridded rainfall produced by the Bureau of Meteorology ([www.bom.gov.au/jsp/awap/rain/index.jsp](http://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 2017 to September 2018) to take account of any winter rainfall across parts of the District during 2018. This growth is ranked as a percentile of growth for all previous October – September periods.

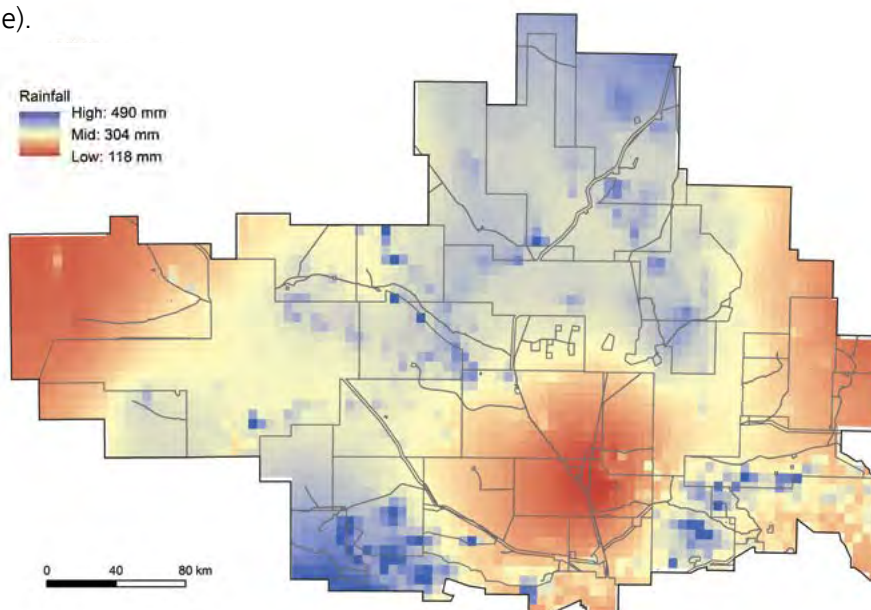
Table 30. Indicators of seasonal quality. Data spatially averaged for the Northern Alice Springs Pastoral District.

	Rainfall (mm)		AussieGRASS
2017 – 2018	208	Growth (kg/ha)	440
Long-term median	258	Percentile	40

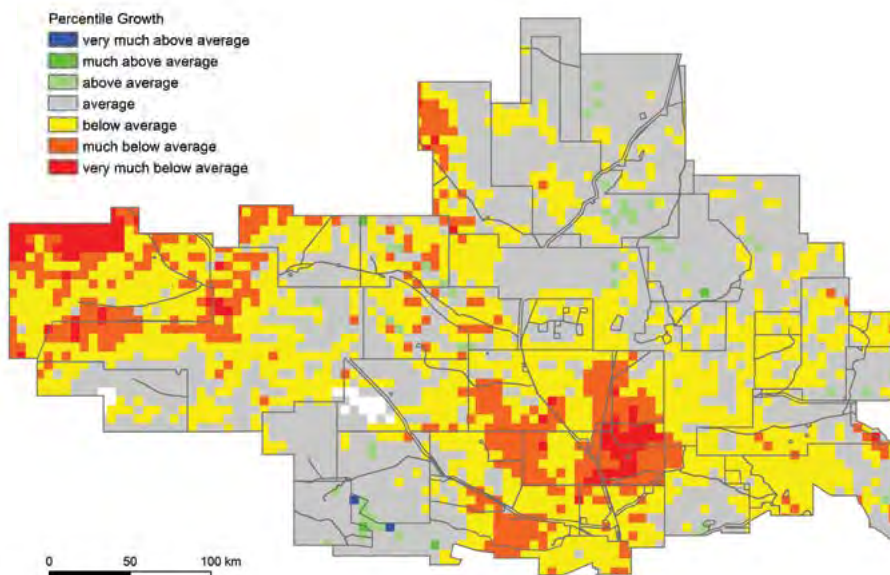
# NORTHERN ALICE SPRINGS PASTORAL DISTRICT

Spatially averaged rainfall for the Northern Alice Springs Pastoral District was average to above average across most of the District, but below the long-term median (Table 30) across west, south-central and eastern parts (Figure 62, top image).

Modelled pasture growth in the 12 months, October 2017 to September 2018, was generally well correlated with rainfall distribution, with below to well below average pasture growth in the central-southern and western areas, compared with the long-term record (Figure 62, bottom image).



Spatially interpolated rainfall, October 2017 to September 2018



Simulated pasture growth as a percentage of the long-term record

Figure 61. Maps of seasonal quality for the period, October 2017 to September 2018. Top, gridded rainfall; bottom, AussieGRASS-modelled pasture growth as a percentage of previous similar periods. (Note: these images do not account for impact from fire or geographic influence variations across a district).

# NORTHERN ALICE SPRINGS PASTORAL DISTRICT

## Fire

Data available from the North Australia and Rangelands Fire Information website ([www.firenorth.org.au/nafi3](http://www.firenorth.org.au/nafi3)) shows that 4 175 km<sup>2</sup> (4.1% of the District) burnt between October 2017 and September 2018. Fire was most active at the end of the 2017 Dry season (Figure 63).

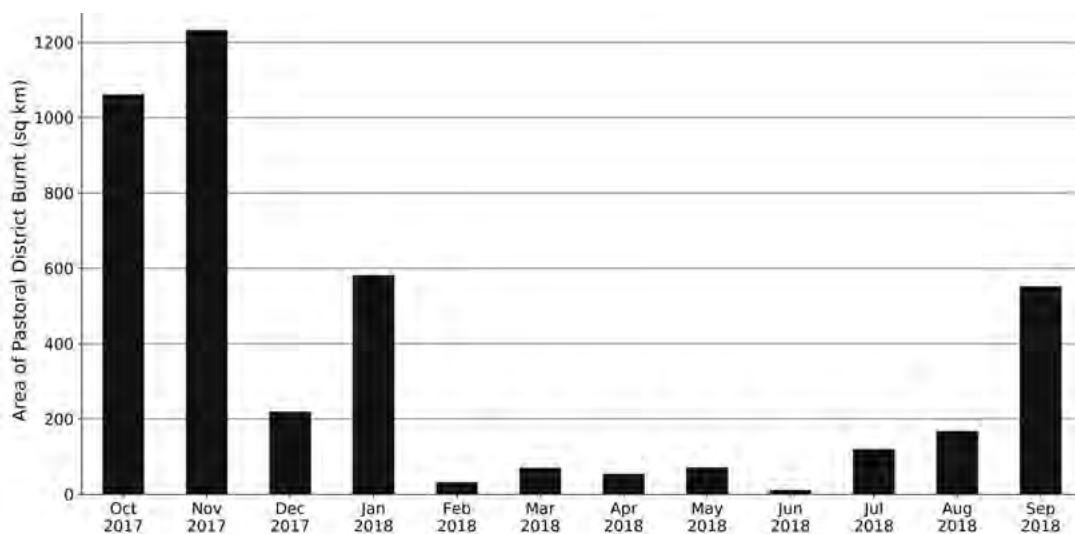


Figure 62. Monthly area burnt (km<sup>2</sup>) in the Northern Alice Springs Pastoral District between October 2017 and September 2018.

## Bare ground 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 ground 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 ground in each 30m square Landsat pixel (900 m<sup>2</sup> or 0.09 ha) was used to report the amount of bare ground across all pixels in the Northern Alice Springs Pastoral District.

The bare ground threshold is based on the frequency distribution of all 30m Landsat bare ground cover pixels at the end of 2018 (spring composite). A threshold was determined which represents 75% of a district's overall bare ground. The remaining 25% is considered to have above-threshold bare ground.

Most of the Northern Alice Springs District had average vegetation cover with some areas in the north-east with well above average (relatively less bare ground) in the latter period of 2018 compared with previous years since 1988 (Figure 64). This pattern was consistent with the spatial pattern of modelled average to above average pasture growth (bottom panel, (Figure 62). Some patches of 'lowest' vegetation cover were associated with 2018 fire. This was not the case in other areas, including non-pastoral lease tenure in the west.

# NORTHERN ALICE SPRINGS PASTORAL DISTRICT

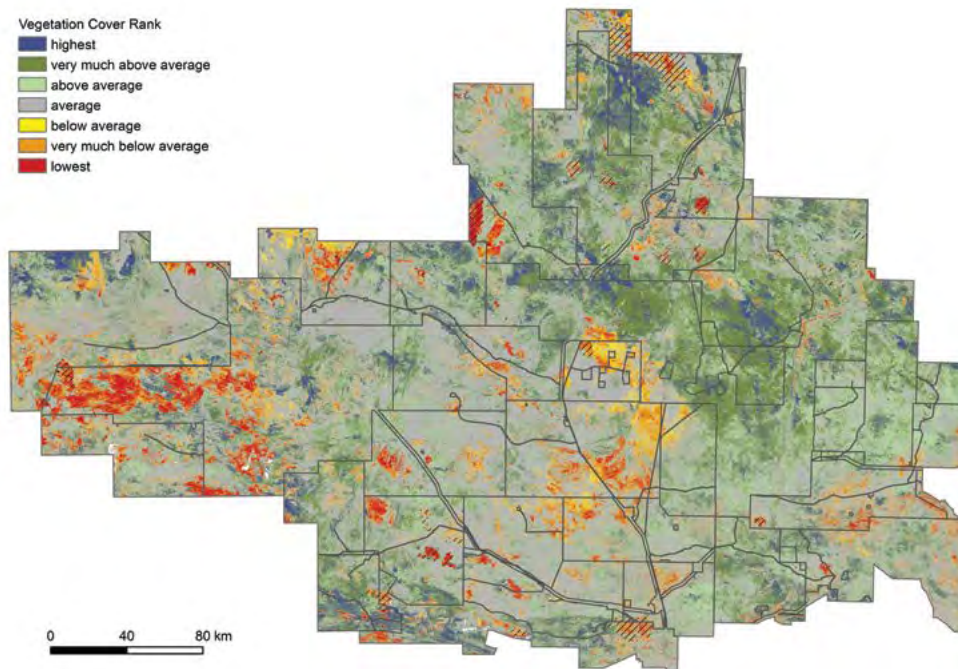


Figure 63. Rank of the amount of remotely-sensed vegetation cover present from September to November 2018 against that for previous years back to 1988. Diagonal lines show those areas burnt between January and November 2018.

Less than one percent of the Northern Alice Springs Pastoral District had small amounts of bare ground (< 20% of the 30m Landsat pixel) towards the end of 2018 (Figure 65). The bare ground threshold value for the Northern Alice Springs Pastoral District was 50%; one quarter of the District had bare ground greater than this value (Figures 65 and 66).

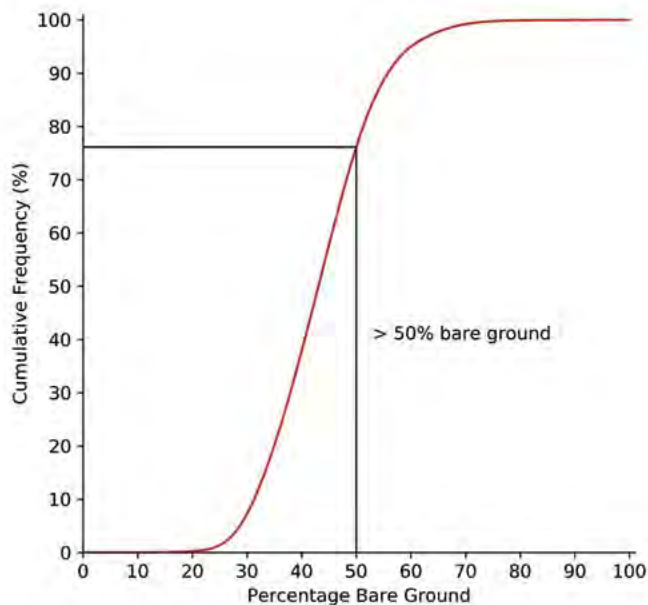


Figure 64. Percentage cumulative frequency of varying levels of bare ground in 30m square Landsat pixels in the Northern Alice Springs Pastoral District between September and November 2018. Areas with greater than 50% bare ground (threshold) are mapped in Figure 66.



# NORTHERN ALICE SPRINGS PASTORAL DISTRICT

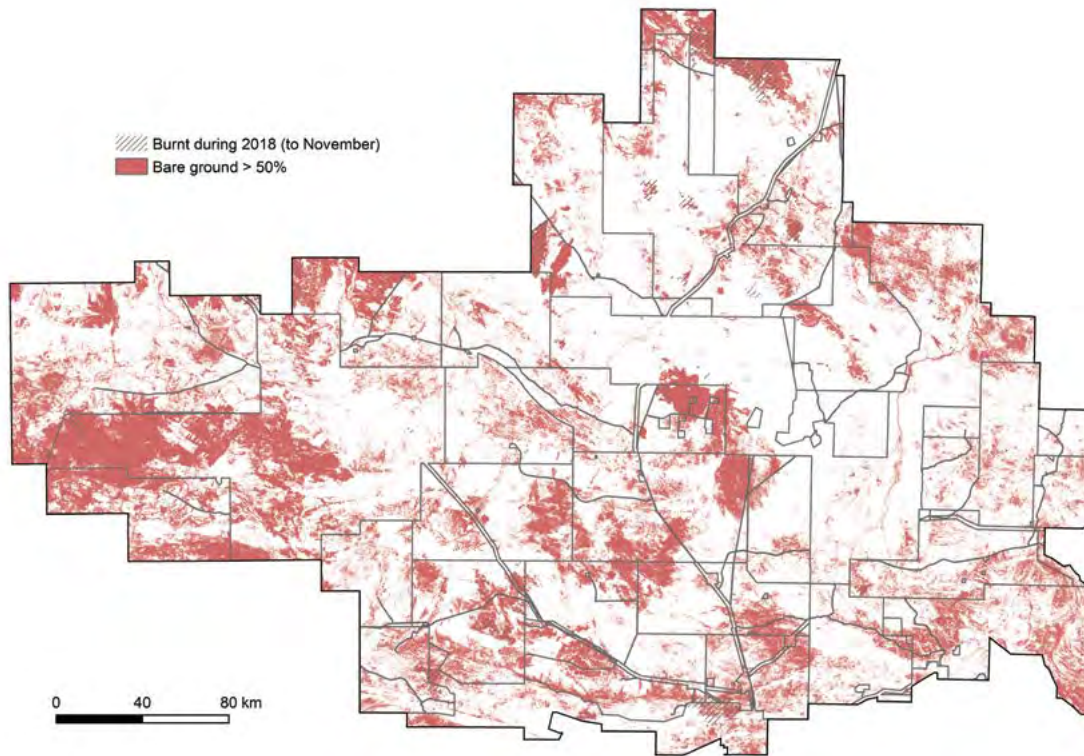


Figure 65. Parts of the Northern Alice Springs Pastoral District having more than 50% bare ground per Landsat pixel in late 2018 (bare ground threshold). Note that the threshold level of bare ground used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the District is affected.

## Site-based monitoring

Four pastoral leases were visited in the Northern Alice Springs Pastoral District during 2018.

Vegetation cover of the ground layer was measured at 30 sites across the four leases. Sites, on average, had a moderate to high level of bare ground, reasonable litter cover and small contributions of perennial and annual grasses, and forbs (Figure 67). Litter cover is important because it assists infiltration of rain water, helps retain seed on site and reduces erosion risk.

There was considerable variation in ground cover components between sites, and between properties; amounts of bare ground ranging from 28% to 93%, which was generally inversely correlated to proportion of perennial species, which is not unexpected.



# NORTHERN ALICE SPRINGS PASTORAL DISTRICT

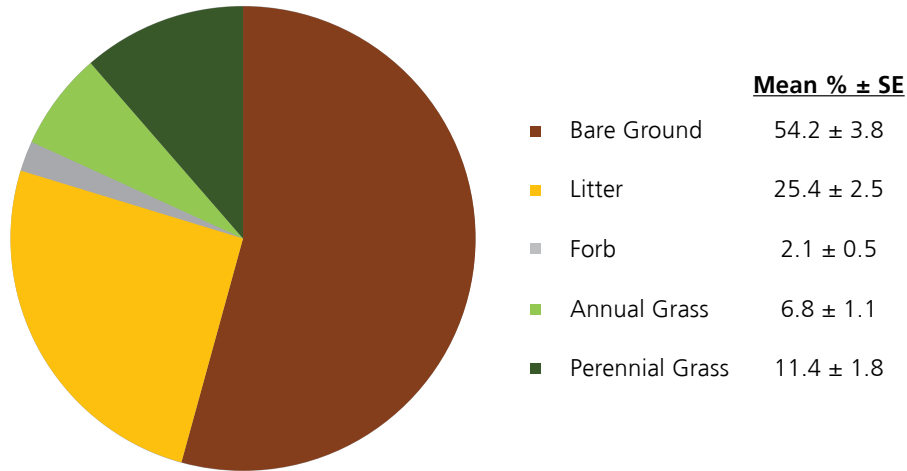


Figure 66. Mean percentage and standard error of measured components of vegetation cover in the ground layer from 30 sites on four pastoral leases in the Northern Alice Springs Pastoral District.

More than half of the 30 sites were rated as being moderate to heavily grazed indicative of more than 25% of the seasonal growth utilised at the time of assessment (Table 31). Slight to moderate sheet erosion was recorded in 22 of the 30 sites.

Table 31. Levels of pasture utilisation assessed at 30 sites across four pastoral leases in the Northern Alice Springs Pastoral District.

<b>Pasture Utilisation</b>	
<b>Rank</b>	<b>% of sites</b>
No grazing	7
Minimal (<25%)	33
Moderate (26-50%)	20
Moderate to heavy (51-75%)	17
Heavy (76-90%)	20
Very heavy (>90%)	3

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 32. Most leases did not receive useful winter rainfall and experienced average to below average seasonal quality based on modelled pasture growth in the 12 months from October 2017 to September 2018. To the extent possible, condition assessments are independent of year-to-year variability in rainfall and associated seasonal conditions.

# NORTHERN ALICE SPRINGS PASTORAL DISTRICT

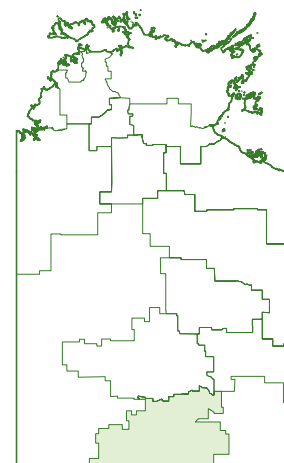
Table 32. Assessed land condition at monitoring sites and traversed parts of four pastoral leases in the Northern Alice Springs Pastoral District.

Station	Condition Rating (number of sites)	Comments with regard to pastoral lease
1	Good: 2 Fair: 4 Poor: 3	Land condition was assessed as Fair to Poor in the pastorally productive areas in the south-west of the property closer to the homestead where the factors contributing to poorer land condition mostly predate current management. Land condition was considered to be mostly Good elsewhere, with generally abundant pastures, and buffel grass well established. This assessment was broadly consistent with the assessment in 2015 however increases in bare ground were recorded at most sites since the 2015 visit. The current lessees have been very active in establishing new water points to spread grazing pressure and reduce utilisation at older water points.
2	Good: 0 Fair: 6 Poor: 2	Land condition was assessed as Fair at most integrated monitoring sites, which represents a slight improvement since the last inspection. The productive country in the south was in Fair to Poor condition. The majority of the station is composed of mulga over harder perennial grasses (e.g. woollybutt) which was in Fair condition. The northern part of the station consisted of less productive spinifex country which was in Good condition.
3	Good: 1 Fair: 6 Poor: 1	Land condition was assessed as Fair at most integrated sites, which represents a marginal improvement since the last inspection. The alluvial country in the south of the station was in Good condition supporting an abundance of buffel grass. The central parts of the station were generally in Fair condition across variable land types; areas with buffel and oatgrass, gidgee over palatable annual grasses, and Mitchell grass plains. The central part is separated from the northern part by ranges/hilly country. The northern part was generally in Fair to Poor condition, comprising ex-Mitchell grass plains and areas dominated by palatable annual grasses that have had a poor seasonal response.
4	Good: 1 Fair: 3 Poor: 1	Land condition was assessed as Fair at most integrated sites, which is consistent with the previous inspection. The productive alluvial country at the heart of the station supported palatable perennial grasses (Mitchell grass or buffel grass) and annual grasses (bunched kerosene grass and woolly oatgrass), but generally had very little feed available and high levels of bare ground, putting them in Fair to Poor condition. The area surrounding this area supported perennial grasses (e.g. neverfail) under mulga trees and was in Fair to Good condition. The spinifex dominated range and sandplains in the northeast were in Good condition.

# SOUTHERN ALICE SPRINGS PASTORAL DISTRICT

The Southern Alice Springs Pastoral District encompasses approximately 92 500 km<sup>2</sup>. Thirteen pastoral leases were assessed for land condition in 2018.

The south-west of the District experienced very much above average seasonal conditions based on rainfall and expected pasture growth (modelled using AussieGRASS), but was average or below average elsewhere across the District. Analysis of Landsat imagery acquired in the latter months of 2018 showed a band of 'lowest' vegetation cover (i.e. more bare ground) across the centre of the District, whereas most of the District had above average vegetation cover compared to the same period in previous years since 1988. Despite this, one quarter of the District had more than 61% bare ground per 30m Landsat pixel. Increased bare ground in parts of the central and eastern portions of the District appear to be a continuing legacy effect of extensive wildfire in 2011. Forty-four of the 125 sites measured on 13 pastoral leases were rated in Good condition, 35 sites in Fair condition and 46 sites in Poor condition. Erosion by wind and/or water, most of which still remained active, was observed at most sties.



Map 12: Location of Southern 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](http://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 33) are based on gridded rainfall produced by the Bureau of Meteorology ([www.bom.gov.au/jsp/awap/rain/index.jsp](http://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 2017 to September 2018) to take account of winter rainfall during 2018. This growth is ranked as a percentile of growth for all previous October – September periods.

Table 33. Indicators of seasonal quality. Data spatially averaged for the Southern Alice Springs Pastoral District.

	Rainfall (mm)		AussieGRASS
2017 – 2018	158	Growth (kg/ha)	229
Long-term median	174	Percentile	42

# SOUTHERN ALICE SPRINGS PASTORAL DISTRICT

Spatially averaged rainfall for the Southern Alice Springs Pastoral District was below the long-term median (Table 33), but there was considerable spatial variation across the District (Figure 68) with a trend from well below average in the eastern parts to above average in the south-west and smaller areas in the north.

Modelled pasture growth in the 12 months from October 2017 to September 2018, was above average in the south-west pocket (Figure 68, bottom panel), but generally average to very much below average across the rest of the District, consistent with rainfall distribution.

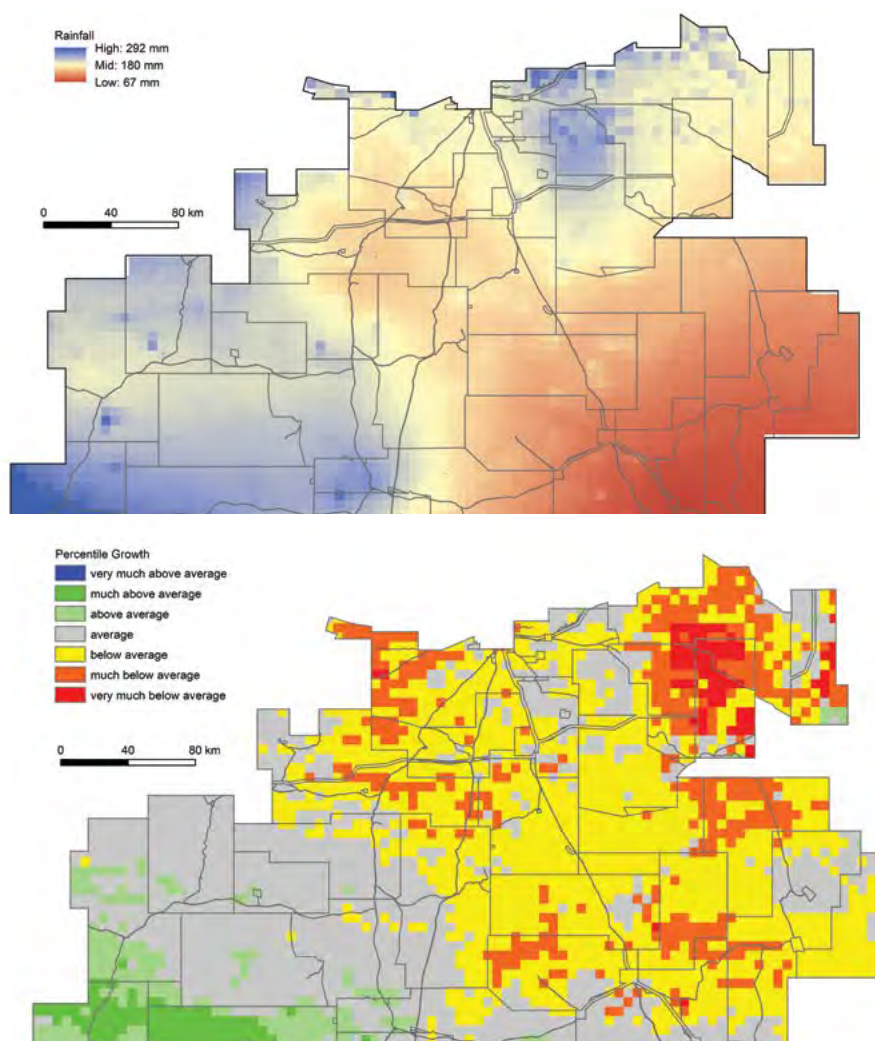


Figure 67. Maps of seasonal quality for the period, October 2017 to September 2018. Top, spatially interpolated rainfall; bottom, AussieGRASS-modelled pasture growth as a percentage of previous similar periods. (Note: these images do not account for impact from fire or geographic influence variations across a district).

## Fire

There was minimal fire activity in the Southern Alice Springs Pastoral District between October 2017 and September 2018 (<1% of the District burnt) based on data available from the North Australia and Rangelands Fire Information website ([www.firenorth.org.au/nafi3](http://www.firenorth.org.au/nafi3)).

# SOUTHERN ALICE SPRINGS PASTORAL DISTRICT

## Bare ground 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 ground 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 ground in each 30m square Landsat pixel (900 m<sup>2</sup> or 0.09 ha) was used to report the amount of bare ground across all pixels in the Southern Alice Springs Pastoral District.

The bare ground threshold is based on the frequency distribution of all 30m Landsat bare ground cover pixels at the end of 2018 (spring composite). A threshold was determined which represents 75% of a district's overall bare ground. The remaining 25% is considered to have above-threshold bare ground.

Most of the District had average to above average vegetation cover (i.e. less bare ground) in the latter part of 2018 compared with previous years since 1988 (Figure 69). Some small patches in the north-east and south-west had well above average vegetation cover.

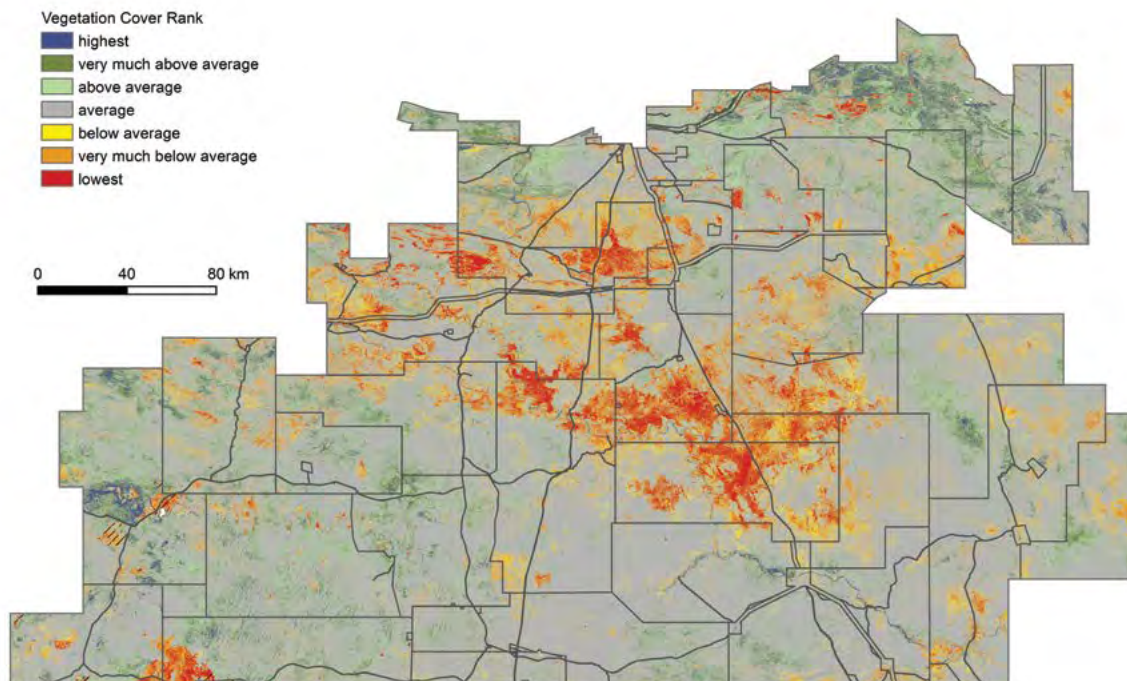


Figure 68. Rank of the amount of remotely-sensed vegetation cover present from September to November 2018 against that for previous years since 1988.



# SOUTHERN ALICE SPRINGS PASTORAL DISTRICT

A very small proportion (< 1% of the Pastoral District had minor to moderate amounts of bare ground (< 40% of the 30m Landsat pixel) towards the end of 2018 (Figure 70). The bare ground threshold value for the Southern Alice Springs Pastoral District was 61%; one quarter of the District had bare ground greater than this value (Figures 70 and 71). Increased bare ground in parts of the central and eastern portions of the District appear to be a continuing legacy effect of extensive wildfire in 2011.

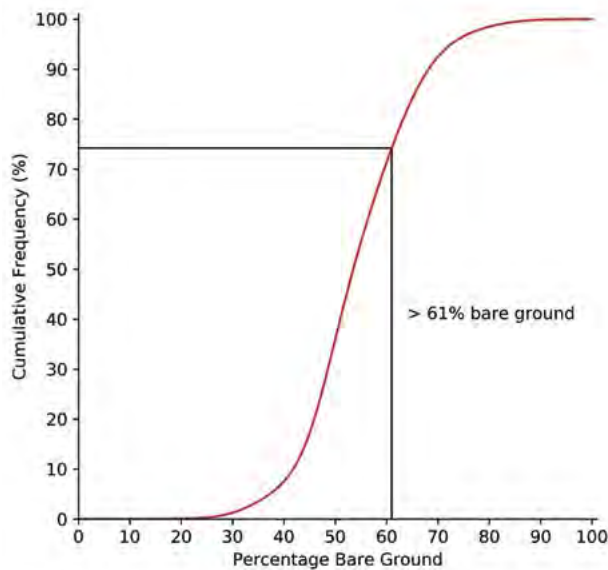


Figure 69. Percentage cumulative frequency of varying levels of bare ground in 30m square Landsat pixels in the Southern Alice Springs Pastoral District between September and November 2018. Areas with greater than 61% bare ground (threshold) are mapped in Figure 71.

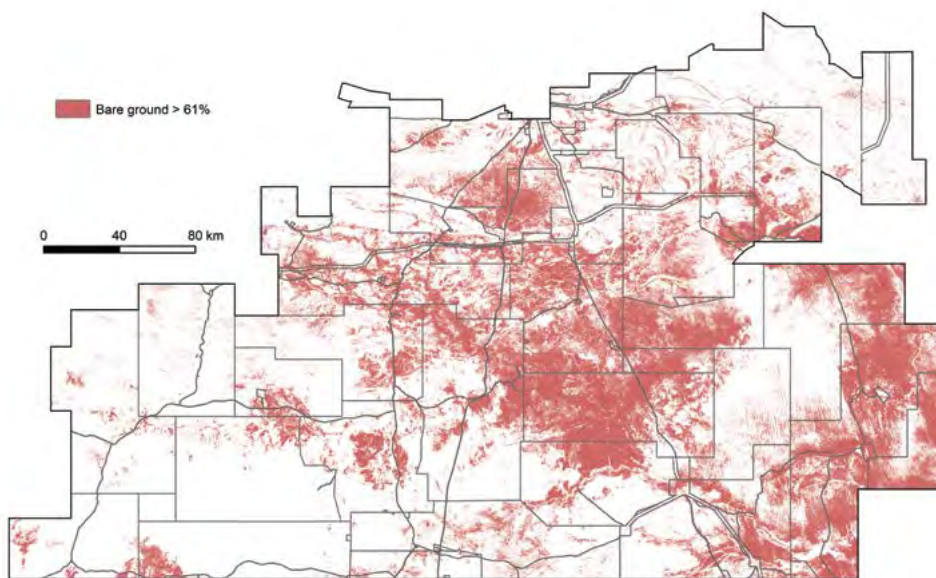


Figure 70. Parts of the Southern Alice Springs Pastoral District having more than 61% bare ground per Landsat pixel in late 2018. Note that the threshold level of bare ground used for mapping purposes varies between pastoral districts. It is selected to show at what level approximately 25% of the district is affected.

# SOUTHERN ALICE SPRINGS PASTORAL DISTRICT

## Site-based monitoring

Thirteen pastoral leases were visited during 2018.

Vegetation cover of the ground layer was measured at 125 sites across the 13 leases. Sites, on average, were comprised of more than half bare ground, moderate litter cover and small contributions of grasses and forbs (Figure 72). Litter cover is important because it assists infiltration of rain water, helps retain seed on site and reduces erosion risk.

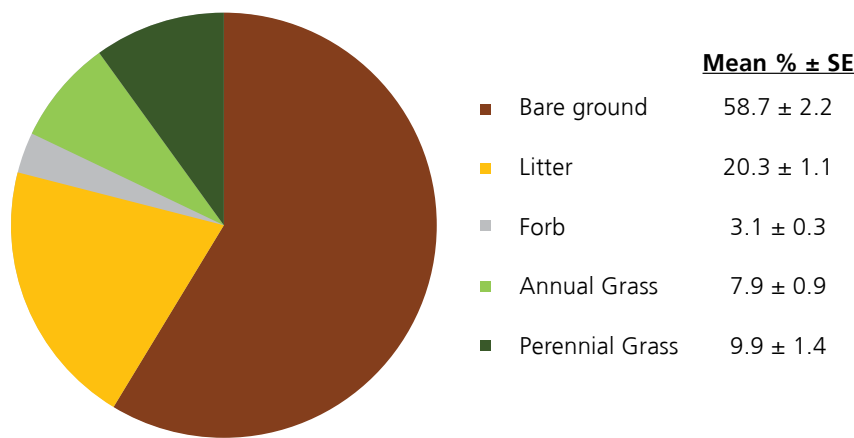


Figure 71. Mean percentage and standard error of measured components of vegetation cover in the ground layer from 125 sites on 13 pastoral leases in the Southern Alice Springs Pastoral District.

Approximately half of the sites were assessed as having minimal levels of grazing, and one quarter of the sites were very heavily utilised (Table 34).

Erosion, by wind and/or water, was observed at most sites. This was generally associated with past disturbances, but in the majority of sites, this erosion was observed as still being active, with only a minority now appearing to have stabilised.

Table 34. Levels of pasture utilisation and evidence of erosion assessed at 125 sites across 13 pastoral leases in the Southern Alice Springs Pastoral District.

<b>Pasture Utilisation</b>		<b>Evidence of Erosion</b>	
<b>Rank</b>	<b>% of sites</b>	<b>Type</b>	<b>% of sites</b>
Not grazed	2	Wind	72
Minimal (<25%)	49	Scalding	18
Moderate (26-50%)	6	Water sheeting	75
Moderate-heavy (51-75%)	6		
Heavy (76-90%)	12		
Very heavy (>90%)	25		

# SOUTHERN ALICE SPRINGS 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 35. Thirteen leases were visited in 2018, after average rain across most of the western areas of the District, so seasonal conditions were generally favourable for vegetation growth, although the south-east had poorer seasonal conditions. However, to the extent possible, assessment of land condition is independent of recent seasonal conditions.

*Table 35. Assessed land condition at monitoring sites and traversed parts of 13 pastoral leases in the Southern Alice Springs Pastoral District.*

Station	Condition Rating (number of sites)	Comments with regard to pastoral lease
1	Good: 2 Fair: 3 Poor: 3	Land condition on the station was generally assessed as in Fair condition, which is consistent with the previous inspection. The southern part was Poor with high levels of bare ground and very little feed available. This is the station's more productive country and has probably experienced prolonged periods of high levels of utilisation. The Poor land condition in the south, may also reflect the low levels of rainfall over the last year. The northern part had lots of feed in the form of buffel grass and was generally in Good condition. The pastorally less productive spinifex country in the west and central parts of the station were in general in Good condition. Athel pine was observed at the homestead and was being actively controlled. Ongoing erosion as a result of high levels of bare ground in the southern parts of the station was observed.
2	Good: 1 Fair: 8 Poor: 4	Land condition at integrated sites were generally assessed as in Fair condition, which is consistent with the previous inspection. Three of the sites were dominated by perennial grasses; a buffel grass site in the north was in Good condition, while two woollybutt sites in the south were in Fair condition. Eight of the sites were southern bluebush sites located in the centre of the station; five were in Fair condition; three were in Poor condition, all of which were in Ebenezer land system (calcareous country). The remaining two sites were dominated by annual grasses. Most of the sites were similar in having very high levels of utilisation and the bluebush sites in Poor condition had levels of bare ground >88%. Significant areas of erosion were observed, especially in the central part of the station associated with the pastorally productive Ebenezer land system. High levels of bare ground is leading to loss of nutrients and topsoil through sheet erosion. Old roads and drainage lines have gullied out in this area. This was supported by satellite imagery products over time, which highlighted persistent areas of high bare ground in this area. Athel pine was recently treated on the station.

# SOUTHERN ALICE SPRINGS PASTORAL DISTRICT

Station	Condition Rating (number of sites)	Comments with regard to pastoral lease
3	Good: 2 Fair: 2 Poor: 9	Land condition was generally Poor across the more pastorally productive land types. With the exception of range country less accessible to grazing in the far north of the property, remote sensing products indicated high levels of bare ground across the lease, supported by on-ground measurements at monitoring sites which also indicated high levels of bare ground and limited response to rainfall. High levels of pasture utilisation were also observed in most areas, including alluvial country where the productive potential had increased with the establishment of buffel grass. Severe and extensive erosion has been noted in various reports since 2007. Erosion remains an on-going serious concern. Athel pine was noted in river systems and is being actively treated. Prickly pear has been appropriately managed.
4	Good: 0 Fair: 4 Poor: 4	Land condition was generally assessed as in Fair to Poor condition, which represents a deterioration in condition compared with the previous monitoring visit in 2013, which was largely in Fair condition. This may reflect current dry conditions. Integrated sites were placed in pastorally more productive country. The sites were similar in having limited feed available and high levels of bare ground (bare ground averaged 75% at sites). Almost 70% of the station is made up of pastorally less productive country (spinifex dunes or sandplains). These areas were in general in Fair to Good condition. Athel pine is present in the river system and being actively treated. Stock is being taken off to reduce grazing pressure. Erosion is an issue on some of the more productive systems with high levels of bare ground.
5	Good: 6 Fair: 3 Poor: 1	Land condition was mostly assessed as Good. The average level of measured bare ground at integrated monitoring sites was relatively low at 41%. Monitoring sites in mulga sandhill country, which occupies a majority of the station, were all assessed in Good condition. These areas had a good representation of palatable, productive, perennial grasses. The three sites assessed in Fair condition, and the one in Poor condition were all in the more pastorally productive calcareous plains in the north-eastern portion of the property. Analysis of remote sensing products across a range of seasonal conditions indicated persistently higher levels of bare ground in this productive area. There was some evidence of feral camel activity.
6	Good: 4 Fair: 2 Poor: 2	Land condition was generally assessed as in Good-Fair condition, which is consistent with the previous monitoring visit in 2013. Three of the sites in Good condition had an abundance of palatable annual grasses, while the other site was dominated by perennial grasses. Sites in Fair condition had less vegetation cover or more unpalatable annual grass than desired. Sites in Poor condition were located in the central part of the station and had high levels of utilisation and bare ground. This area in Poor condition, appeared in better condition during the 2013 visit, both through on-ground observations and satellite imagery. Athel pine was observed at the homestead and approximately 100 Parkinsonia trees at a dam.

# SOUTHERN ALICE SPRINGS PASTORAL DISTRICT

Station	Condition Rating (number of sites)	Comments with regard to pastoral lease
7	Good: 9 Fair: 0 Poor: 0	Land condition was assessed as in Good condition, which has improved since the previous monitoring visit in 2013. Of the ten integrated sites, nine were in Good condition, while one was recently burnt and as such was not assessed. Eight integrated sites were very similar, having an abundance of the perennial grasses woollybutt or bandicoot grass under mulga trees. One site was dominated by palatable annual grasses. Woody thickening between areas depended heavily on past fires; areas that were more recently burnt were more thinned out. These field observations were consistent with remote sensing products. Athel pine was noted at the homestead. The station had many camels and donkeys.
8	Good: 1 Fair: 0 Poor: 10	Land condition across the more pastorally productive land types was mostly assessed in Poor condition. This was broadly consistent with the assessment made in 2013. Ten of the eleven integrated monitoring sites were assessed in Poor condition. The expected palatable pasture species were low in density, and seven sites had bare ground measured at more than 75%. Remote sensing products also showed high levels of bare ground across much of the lease at the time of this assessment. Longer term analysis of remote sensing products across a range of seasonal conditions revealed extensive areas of persistently bare ground in the more productive land types in the northern half of the lease. Erosion remained active over extensive areas, particularly in this part of the lease. Evidence of recent feral horse, donkey and camel activity suggested a considerable contribution to recent total grazing pressure. Athel pine is present in the river system.
9	Good: 5 Fair: 5 Poor: 1	Land condition was generally assessed as in Fair to Good condition, which represents an improvement in condition from the previous visit in 2014, which was generally in Poor condition. Much of the station comprises ironwood or whitewood over annual grasses (and to a lesser extent forbs), with buffel grass establishing in varying amounts. The alluvial area in the south of the station had an abundance of buffel. Annual grasses tended to be dominated by erect kerosene grass, with some oatgrass, which varied from site to site. In very general terms, the southern, northern and western sides of the station were in Good condition. The eastern and central parts of the station were in Fair condition. An area in the northeast, in alluvial country, was in Poor condition with high levels of bare ground.

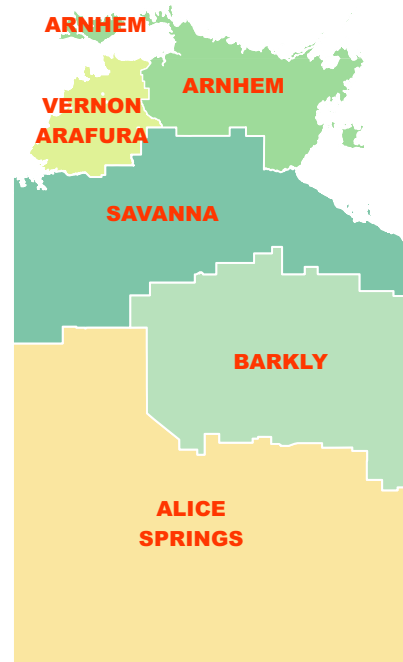


# SOUTHERN ALICE SPRINGS PASTORAL DISTRICT

Station	Condition Rating (number of sites)	Comments with regard to pastoral lease
10	Good: 0 Fair: 1 Poor: 11	Land condition across the more pastorally productive areas was mostly assessed in Poor condition. This was broadly consistent with the assessment made in 2013. Eleven of the twelve integrated monitoring sites were assessed in Poor condition with an average of 89% bare ground and a pasture composed of mostly ephemeral and less productive species. Remote sensing products also showed high levels of bare ground across much of the lease at the time of this assessment. Longer term analysis of remote sensing products across a range of seasonal conditions revealed extensive areas of persistently bare ground in the more productive land systems in the southern part of the lease. Whilst past efforts at erosion control are acknowledged, soil erosion remained active over extensive areas, particularly in this part of the lease. Devil's rope cactus, prickly pear, and Mexican poppy were present and were being actively managed. Little mustering has occurred here since 2016.
11	Good: 2 Fair: 2 Poor: 0	Land condition was assessed as Good to Fair, which is consistent with the previous visit in 2016. Integrated sites in the northern part of the lease were in general in Good condition, while those in the southern half were in Fair condition. The alluvial country in the north supported a high proportion of buffel grass along with palatable annual grasses, the calcareous central part had useful amounts of palatable annual grasses. The southern sites were placed in pastorally more productive parts of spinifex-dominated sand dunes (i.e. mulga swale between dunes and calcareous plain between dunes). Gully erosion remains a concern on parts of the lease.
12	Good: 8 Fair: 2 Poor: 1	Land condition was assessed as mostly Good. This was broadly consistent with the assessment in 2013. Monitoring sites and analysis of remote sensing products indicated poorer condition in the central eastern part of the station. Other parts of the station were considered to be in mostly Good condition. This included extensive pastorally productive calcareous and granite pasture types, along with less pastorally productive and more resilient perennial grass pastures. There was little evidence of feral animals, and no known weeds. Limited and localised gully erosion of old roads and drainage lines was observed.
13	Good: 4 Fair: 3 Poor: 0	Land condition was assessed in mostly Good condition. Four of the seven integrated monitoring sites were assessed in Good condition, and the remainder in Fair condition. All of these sites were assessed in Fair condition in 2013. Decreases in bare ground since the 2013 visit were recorded at most integrated monitoring sites during the current assessment. These may be associated with improvements in land condition but are also consistent with more favourable conditions for pasture growth in 2018. In perennial grass pastures, occupying a majority of the property, there was a good density of robust grass tussocks and a low rate of pasture utilisation. Mulga thickening is occurring in parts of the station and is associated with the long-term absence of fire in these parts.

# BUSHFIRE ACTIVITY

Following the introduction of the new Bushfires Management Act (the Act) in late 2016, 2017-18 saw full implementation of some of the key changes. The Act continues the key underlying principle of the previous legislation; landholders are responsible for the management of fire on their land. There are significant changes around recognition and protections for volunteer firefighters, and new requirements for regional planning.



Changes that will have the most significant impact on the pastoral estate include new requirements for Bushfires NT to prepare regional fire management plans in consultation with landholders, and a new requirement to obtain a permit and advise neighbouring properties before conducting any aerial planned burning. The new regional planning arrangements provide an important opportunity to document key regional risks and develop specific plans for dealing with those risks.

The introduction of a new software platform during 2017-18 has had a significant impact on the way Bushfires NT operates. The first stage of the Bushfires Emergency Management System (BEMS) has digitised several key tasks that were previously performed manually using pen and paper. Internally, instant access to information about fire incidents and the issuing of permits has greatly improved mitigation planning and the effectiveness of fire response arrangements. The system also allows for the distribution of timely and accurate public information and warnings.

Bushfires NT has continued its work to support the continuation of the North Australian and Rangelands Fire Information (NAFI) website: <http://www.firenorth.org.au/nafi3/>. The NAFI site utilises satellite based remote sensing data to record fire activity across northern Australia, and is a vital tool for managing fire across the broad landscape. The site currently receives short term funding support from the Commonwealth Government on the basis that it provides vital information for assessing the effectiveness of carbon emission abatement projects. Funding has been identified to engage a consultant to develop a business strategy that will allow long term financial security for NAFI. The consultancy will conclude in mid-2019.

Fire weather conditions in 2017-18 were less severe than the previous year in much of the Territory, although there were several days of extreme fire weather in the Vernon Arafura, Arnhem and Savanna Fire Management Zones. Emergency Warnings, the highest level of bushfire warning, were issued on two occasions in the rural area near Darwin when dangerous fires threatened homes in conditions that made it extremely difficult to control those fires.

# BUSHFIRE ACTIVITY

## VERNON ARAFURA REGION

	Area burned km <sup>2</sup>	% of total area	10 year average (%)
Early burns April 18-June 18	24 787	41.5	37.5
Late burns July 18-September 18	5 625	9.4	10.8
TOTAL	30 412	50.9	48.3

Land managers commenced early burns when the ground began to dry up following the end of the monsoon. In late April and early May 2018 the Vernon Arafura and Arnhem regions were affected by a surge of hot, dry windy weather. These conditions led to a number of early wildfires, and planned burning for fuel reduction in many areas was placed on hold. Despite the difficult conditions, Bushfires NT completed 646 km of early season aerial planned burning through Ban Ban, Bonrook, Dorisvale, Elizabeth Downs, Mary River East and Twin Hill stations.

As the Dry season progressed, the Top End experienced record breaking daytime temperatures through June, July, August and September. In August and September, mean daytime temperatures were the fifth warmest on record. Due to these conditions, Bushfires NT declared 27 Fire Ban days through the season. On each of these days of severe fire danger, Bushfires NT established an Incident Management Team operating out of the Incident Control Centre located at their Batchelor Headquarters. Between June and October, Bushfires NT managed 140 significant wildfire incidents across the Region. Although it was a challenging season, there were some positive outcomes. The Vernon Arafura Region is approximately 60,000 km<sup>2</sup>. A total of 41.5% of this area experienced early burns, compared to 33% in 2017. There was a slight drop in late burns from 13% of the region in 2017, to 9.4% in 2018.

Prior to the fire season, Bushfires NT staff met with all 16 volunteer brigades in the Top End to deliver information about key changes to fire management following the commencement of the new Bushfires Management Act. A series of Fire Fighter 1 courses were delivered with high attendance rates from new volunteers and land managers. The new BEMS was introduced to staff in June. BEMS allows users to simultaneously view and input information from their computer or handheld device. Information about planned burns and wildfires are now published online for public view on the Department of Environment and Natural Resources' NR Maps and the Police Fire and Emergency Service's Incident Map.

# BUSHFIRE ACTIVITY

## SAVANNA AND ARNHEM REGIONS

Savanna Region	Area burned km <sup>2</sup>	% of total area	10 year average (%)
Early burns April 18-June 18	37 737	12.6	10.1
Late burns July 18-September 18	14 986	5.0	6.2
TOTAL	52 723	17.6	16.3

Arnhem Region	Area burned km <sup>2</sup>	% of total area	10 year average (%)
Early burns April 18-June 18	34 144	27.1	19.9%
Late burns July 18-September 18	21 148	16.8	16.4%
TOTAL	55 292	43.9	36.3%

Due to below average rainfall, the Savanna Region dried out more quickly than usual resulting in a reduced window of opportunity to conduct mitigation burns. Despite this restriction, 250 km of roadside burns and 280 km of aerial incendiary planned burning was completed. While the number of mitigation burns was below average, the dry conditions led to a higher than average area burnt.

In the period from April to September 2018, 52 723 km<sup>2</sup> or 17.6% of the Savanna Region was impacted by fire (both planned burns and wildfires). While the total area burnt was greater than 2017, there was more early mitigation burning resulting in reduced incidence of late season destructive fires. Bushfires NT staff and volunteers provided assistance and technical advice on 50 late season fires in the 2018 fire season, well down on the average of around 70. A total of 15 Fire Ban Days were declared, including four in the Arnhem Region.

Higher than average fuel loads, combined with several periods of difficult fire weather conditions, led to a challenging 2018 fire season in Arnhem Land. The growth of the carbon farming industry in recent years has seen over 80 000 km<sup>2</sup> of Arnhem Land now contracted for emissions reduction projects. Despite the challenging conditions, late season wildfires were held to the long term average, largely as a result of the extensive low intensity early season burning.

There has been a significant turnover of staff in the Katherine office, with a series of temporary appointments to key positions while permanent recruitment action was underway. By late 2018 all positions had been filled on a permanent basis. The Katherine and Edith Farms Volunteer Brigades have also been actively recruiting new members, and both brigades are in a strong position to continue to provide fire management support in the Fire Protection Zone around Katherine.



# BUSHFIRE ACTIVITY

## BARKLY REGION

Rainfall was significantly down through the Barkly Region for this reporting period. Many stations reported having less than 40% of the average rainfall for that period, and average temperatures for the period were also above average. These conditions meant that fuel cured earlier than usual.

Following higher than average rainfall during the 2016-17 Wet season, the 2017 fire season saw 23.6% of the land affected by fire compared with the long term average of 15%. The lower rainfall and early curing in the 2017-18 Wet season led to a reduced, but still above average, amount of fire activity in 2018.

Fire activity in the last two seasons suggests that there will be a reduced number of large regional fires within the Barkly Region during the 2019 fire season.





# BUSHFIRE ACTIVITY

## ALICE SPRINGS REGION

The Alice Springs Region experienced drier than average conditions in most areas, with the town of Alice Springs recording a period of 157 days without rain. Bushfires NT continued to work with the Department of Infrastructure, Planning and Logistics to reduce bushfire risk along road corridors outside of the Fire Protection Zone. Approximately 50 km of mitigation burning was completed by landholders adjoining road corridors northeast of Alice Springs along the Sandover Highway and north of Alice Springs along the Tanami and Stuart Highways.

The aerial planned burn program continued to implement strategic fuel reduction across the pastoral estate with 205 km of burning completed on Umbeara, Victory Downs and Erldunda pastoral properties.

Two Fire Ban Periods were declared for areas within the Lasseter, Simpson and Alice Springs Regions, the first since 2013. Contributing factors to this included the increased fine fuel load in those areas along with the significant fire weather conditions that saw strong and gusty winds coincide with high temperatures. No major fires occurred on those two days.

Fine Fuel Monitoring has been introduced to provide more accurate data that will greatly assist in understanding different seasonal influences and assessing bushfire risk and potential fire behaviour. Seven monitoring plots have been established within the Alice Springs Fire Protection Zone.

For this reporting period, approximately 2.1% of the Alice Springs Fire Management Zone has been impacted by fire (both planned and wildfires) compared with 6% for the same period last year.

Bushfires NT extension staff visited 31 pastoral stations during the reporting period. Training and fire awareness programs also continued with five training courses provided for pastoralists, Government, Aboriginal rangers and Non-Government Organisations across the region.

In collaboration with Regional Councils, the remote community fire management program saw the development of 118 fire action plans for small remote communities and outstations. This program has provided clear reduction of risk in these communities, and is contributing to a broad improvement in fire management and fire risk awareness. These fire action plans are regularly reviewed following each 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 assists landholders to manage weeds by providing technical advice, assisting with weed management plans, conducting weed surveys and controlling emergency incursions.



## NT WIDE

### Gamba grass

Gamba grass (*Andropogon gayanus*) was originally introduced as an improved pasture through the mid 1900's. It was promoted and planted widely on the Darwin pastoral areas through the latter half of the century. Unfortunately, the weedy potential of the plant was not given enough attention and it has led to

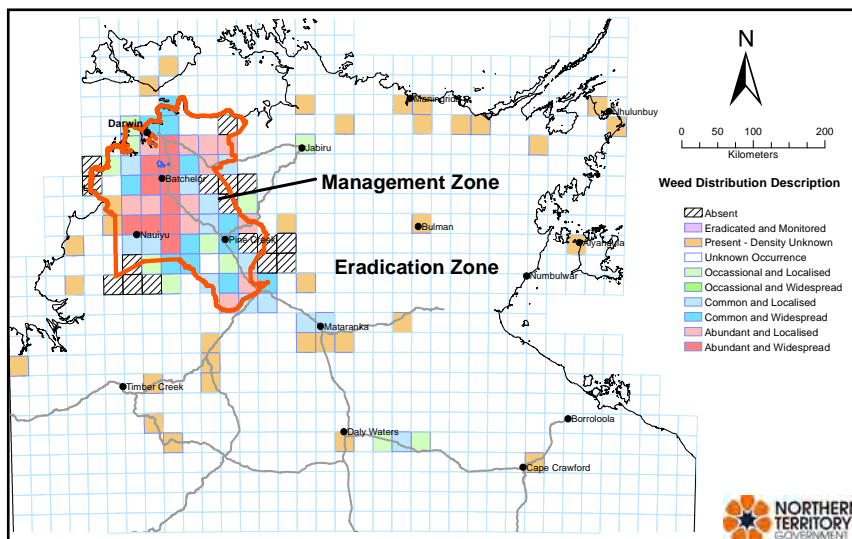


Figure 72. Gamba grass zones

severe infestations in areas where gamba is not controlled and maintained through appropriate grazing regimes. Gamba continues to destroy infrastructure, native bushland and wildlife. With its large biomass and late curing, it results in high intensity fires.

The first statutory Weed Management Plan for Gamba Grass was prepared in 2010. In accordance with this Plan, gamba grass has a 'split zoning' (Figure 1). Where a property falls in relation to the zoning, determines legislated requirements for control. The two zones reflect the varying feasibility of control between the two areas. Low density, high feasibility of eradication and control (Class A), and high density, lower feasibility of eradication or control (Class B).

The Weed Management Branch works with landholders in the eradication zone to first locate gamba infestations, then works towards their eradication. In the management zone, landholders with gamba grass that is not actively maintained by grazing are obligated to treat the plant as a weed. Lessees and other land holders are required to prevent spread of gamba from their properties and not to promote the spread of the grass over their property.



*Control burn (hazard reduction)*

## WEED ACTIVITY

For the last few years, the Weed Management Branch has been actively enforcing landholder compliance with the NT Weeds Management Act. Gamba grass and Darwin rural area properties are the main focus of the compliance program; however, compliance and enforcement activities have also commenced around Katherine.

The Weed Management Plan for Gamba Grass was revised in 2017-18. The revised document includes a new format that presents the required management actions in a clearer, simpler layout. Requirements have been split into easy to follow tables based on land parcel sizes, tenures or industries and can be used as a checklist. Gamba grass-free buffer distances have been introduced or amended to prevent further spread of gamba grass into clean areas or neighbouring properties. The amendments also aim to better protect some of the NT's iconic landscapes, including Kakadu and Nitmiluk National Parks, and recognise sacred sites and carbon abatement programs in Arnhem Land.

Gamba may still be utilised for hay by pastoral lessees; however, it must only be used internally on the property it was cut on. Gamba hay should be cut whilst the plant is vegetative and prior to flowering. Hay containing gamba must not be sold or traded, or transported along roadways.



# WEED ACTIVITY

## DARWIN REGION

The Darwin Region weed management area covers approximately 150 000 km<sup>2</sup>, encompassing 21 pastoral leases that make up 13% of the Region's land area. Aboriginal land accounts for 73% of the Region and includes Arnhem Land, Kakadu and the Daly/Port Keats Aboriginal Lands Trust and most of the NT's islands. Many of the NT's high value floodplain pastoral properties are in the Region. Priority weeds identified in the Darwin Regional Weed Management Plan 2015-2020 have been the critical focus for Weed Management Branch business. During 2017-18, apart from five active eradication programs, gamba grass management has been a major focus within the Region, along with mimosa. There has been an ongoing focus on working with managers of government-owned land to ensure gamba is managed in accordance with statutory obligations.

### Mimosa

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, stocking rates and land condition.

The biological control agent 'Nessie' (*Nesaecrepida infuscata*) continues to increase its distribution. Nessie is having a dramatic effect reducing the vigour of mimosa plants especially in the lower Daly, Mary, Adelaide, Finnis and Reynolds river areas.

Although the Finnis Reynolds Mimosa Program funding has been allocated, pastoral properties in the Region continue to see the benefits from their mimosa control programs. With all stations spraying similar amounts of mimosa as when the project was in full swing. This has allowed them to significantly capitalise on the resources used in the program and these properties continue to see an ongoing reduction in mimosa's impact over their properties.

### Mimosa herbicide resistance

Pastoral properties in the Mary, Daly and Finnis catchments have continued to report mimosa being resistant to metsulfuron-methyl (Brush Off™) herbicide.

Any suspected resistance should be reported to the Weed Management Branch and alternative herbicides should be used. It must be realised that resistant plants produce resistant seedlings. Treatment of suspected resistance plants is a long term program.

Alternative herbicides permitted for aerial application include:

- Fluroxypyr (Starane Advanced™)
- Tebuthiuron (Graslan™)
- Dicamba (Kamba™)
- Aminopyralid and metsulfuron-methyl (Stinger™) *But not recommended for resistant mimosa as product contains metsulfuron-methyl*

# WEED ACTIVITY

## Rat's tail grasses

Two new infestations of giant rat's tail grass (*Sporobolus natalensis*) were controlled by Weed Management Branch during 2018 (with only two previous records in the NT). This introduced grass causes many millions of dollars' worth of damage to the Queensland and New South Wales pastoral industries. Other than reducing available pasture, this tough unpalatable grassy weed can reduce grazing life of cattle through increased wear of teeth.

The related American rat's tail grass (*S. jacquemontii*) continues to spread across Top End properties. Pastoralists need to know to recognise and control this weed in new areas. Yarding, laneways and high traffic areas such as water points and gates are very prone to infestation and it is from these areas that it is spread to wider pasture. Glyphosate control in the first instance can be effective in preventing further spread.

In late 2017 aerially dispersed flupropanate was trialled on the rat's tail grasses on several pastoral estates with good results shown thus far in humidicola pasture. The end of the 2018-19 Wet season should reveal if the residual chemical has benefits beyond a single season application.

## Grader grass

Grader grass (*Themeda quadrivalvis*) continues to spread north into the Darwin Region pastoral areas. It is important that pastoralists:

- ensure heavy machinery and vehicles are clean of seeds, vegetative materials and soils before entering their property
- do not spread or introduce soils from known grader grass contaminated areas
- do not let anybody drive through seeding grader grass.

It is vital that hay is sourced from grader grass free paddocks. As grader grass seeds early in the Wet season, it easily contaminates hay product cut later in the year. Once cut into product it can easily be transported from property to property.

Grader grass identification and control is very difficult. Being an annual grass it is almost impossible to identify until flowering. However, the time between flowering and seed set is very short. Stations need to be ready to treat the grass as soon as it becomes noticeable, or have measures in place to treat known infestation areas prior to flowering.



*Rat's tail grass infested paddock.*



# WEED ACTIVITY

## KATHERINE REGION

The Katherine Region weed management area covers approximately 386 000 km<sup>2</sup>, encompassing 95 pastoral leases. The region includes the VRD, Katherine, Roper, Sturt Plateau and Gulf Pastoral Districts. Priority weeds identified in the non-statutory Katherine Regional Weed Management Plan 2015-2020 have been the critical focus for Weed Management Branch business in this region. During the 2017-18 reporting year there has been an ongoing focus on working with managers of government-owned land and corridors to ensure these priority weeds are managed in accordance with statutory obligations. There has also been a focus on pastoral land with ongoing extension activities and some property visits taking place.

### Parthenium

Parthenium weed (*Parthenium hysterophorus*) is an issue of increasing concern for the Northern Territory. Considering one parthenium weed plant can produce 15 000 seeds and that it currently costs the Australian pastoral industry an estimated \$16.5 million per year (Queensland Government, 2016), the early detection and destruction of parthenium weed remains a priority.

### Parkinsonia

Parkinsonia (*Parkinsonia aculeata*) is widespread throughout the Region. Due to other priorities, this weed has not been a particular focus for the Katherine Weed Management Branch during the reporting period. Many properties are continuing control efforts with recognition that management of parkinsonia is a long-term commitment.



Figure 73. NRM Champions Stephanie McArthur and Dustin Hutley travelled to Port Augusta to attend the 2017 Australian Rangeland Society Conference. This was a great opportunity for them to expand their NRM knowledge and networks.

### Rubber Vine

Rubber vine (*Cryptostegia grandiflora*) is not known to be present in the Territory, however it constantly threatens our eastern border as it spreads westward from core infestations in Queensland. For over 10 years the Weed Management Branch has been collaborating with the Queensland Government, ranger groups and natural resource management groups to support management on the Queensland side of the border, with the ultimate aim of preventing incursion into the Territory. Weed Management Officers remain heavily reliant on land managers as the first line of defence to rubber vine. The importance of knowing how to identify rubber vine, and reporting any suspected findings, cannot be understated if we are to keep this highly invasive weed at bay.

# WEED ACTIVITY

## Grader grass

Grader grass is a significant threat to the sustainability of pastoral production in the Katherine Region. It has spread extensively throughout the Roper River and in the upper reaches of the Daly River catchments. Pastoralists can be caught unaware by grader grass due to its similar appearance to kangaroo grass (*Themeda triandra*). Weed management officers in Katherine work to raise awareness of the threat posed by this weed and encourage pastoralists to ensure adequate spread prevention measures are being implemented.

## Prickly acacia

Prickly acacia (*Vachellia nilotica*) remains a key concern for pastoral land in the Katherine Region. The Weed Management Branch is currently delivering the project '*Increased productivity of high value grazing lands through management of Prickly Acacia with improved stakeholder capacity*'. Key activities include a cost benefit analysis for prickly acacia control, investigating the feasibility of prickly acacia detection via remote sensing and delivery of the Natural Resource Management (NRM) Champions Program. This project is funded through the Established Pest Animals and Weeds initiative, part of the Australian Government's Agricultural Competitiveness White Paper, the government's plan for stronger farmers and a stronger economy.

## Bellyache bush

Bellyache bush (*Jatropha gossypifolia*) impacts an estimated 20 000 hectares of land in the Katherine region, across 18 properties. It has invaded the upper reaches of both the Daly River and Roper River catchments and has proven to be immensely difficult to control. It has proven its ability to establish away from the riparian corridor resulting in production impacts. Diligence regarding early detection and effective management of this weed is encouraged with industry.

## Mimosa

Mimosa is known to occur on six pastoral properties in the Katherine region. Weed Management officers inspected the incursions on all of these properties during the reporting period (some of which received multiple visits). Improved management outcomes have been observed; however, it is evident that in some instances greater diligence is required. Even though all mimosa infestations in the region are contained and considered feasible for eradication, mimosa is identified as a long term challenge. Given the high feasibility of control this weed is identified in the Region's Compliance Program.

# WEED ACTIVITY

## TENNANT CREEK REGION

The Tennant Creek Region weed management area encompasses the Mitchell Grass Downs and Davenport Murchison Ranges Bioregions and parts of the Tanami and Sturt Plateau. The Barkly region covers an area of 283 648 km<sup>2</sup>. The Weed Management Branch, in conjunction with regional stakeholders, implements the Barkly Regional Weed Management Plan. The Plan identifies the declared weeds prickly acacia, mesquite, bellyache bush, parkinsonia and rubber bush as priority species that require management in this Region.

### Prickly acacia

The Class A weed, prickly acacia, continued to be a major focus for management in 2018 within the Barkly Region. The three largest infestations of prickly acacia, located on three separate pastoral leases within the Barkly Region, have all dramatically reduced in size and density over the last two years. The ongoing annual follow-up and monitoring of these previously large infestations will ensure that the gains made in management of these areas is not lost into the future. Ongoing monitoring and control of the remaining properties on the Barkly with isolated occurrences of this weed continues to be a priority for the region with the end goal of eradication of all prickly acacia from the region by 2020.

### Mesquite

The Class A weed, mesquite (*Prosopis* spp.), has limited distribution within the Barkly Region. Weed Management Branch has recently been negotiating with the management of the property with the largest known infestation, to initiate a strategic management program to contain further spread and reduce infestation levels in the longer term. All of the more isolated occurrences of mesquite on the remaining Barkly Region properties are currently under active management programs.

### Bellyache bush

There are currently only two small isolated infestations of the Class A weed Bellyache bush located within the Barkly Region. These two infestations are now at a maintenance level where residual seedbanks are continually monitored for signs of further recruitment hinging on seasonal conditions.



# WEED ACTIVITY

## Parkinsonia

Parkinsonia is a Class B weed and is extremely widespread across the Barkly Region. The majority of properties within the region have plans in place to manage this weed. A naturally occurring dieback (soil-borne fungus) is having dramatic effects on what were once large dense infestations across several catchment areas, including the Lake Sylvester catchment which incorporates several large pastoral holdings in the Region. To complement the success of the naturally occurring dieback, a commercial bioherbicide: Di-Bak™, continues to be used to inoculate infestations at various locations where natural dieback has not been shown to occur.

## Rubber bush

Rubber bush (*Calotropis procera*) continues to be a significant concern for landholders within the Region. Weed Management Branch are continuing to undertake herbicide trials for an effective convenient means of controlling this weed. The ongoing herbicide trials follow on from, and expand on, the results of an earlier Meat and Livestock Australia-funded project which investigated the ecology and management options for rubber bush. It is hoped the ongoing trials will provide land holders with a more effective range of herbicide options for managing the species.

## The Barkly Stock Route

The Barkly Stock Route connects with the Stuart Highway and Tablelands Highway. It is approximately 260 km long and 1.6 km wide and includes an unsealed 'beef road'. The Barkly Stock Route is the only transport corridor in the Barkly Region that has major weed infestations, comprising parkinsonian, rubber bush, and smaller amounts of mesquite and prickly acacia. Negotiations between the Weed Management Branch and the Department of Planning, Infrastructure and Logistics (DIPL) resulted in a commitment of \$70 000 by DIPL towards a one-off weed treatment program for the entire route in 2018-19. The Weed Management Branch will provide technical and project advice and assistance.



*Parkinsonia (Parkinsonia aculeata)*

# WEED ACTIVITY

## ALICE SPRINGS REGION

The Alice Springs Region weed management area covers a vast area of approximately 576 000 km<sup>2</sup> bordered by Western Australia, Queensland and South Australia. The pastoral estate in Central Australia is made up of 66 pastoral leases which cover approximately 40% of the land area. Aboriginal land in the Region makes up 50% of the total land area. The Alice Springs Regional Weed Management Plan 2013-18 lists priority weed species and landscapes across the Region, which are the focus for weed management activities. The priority weeds listed for management within the Region includes athel pine, cacti, parkinsonia and rubber bush; all of which have undergone a rigorous scientific weed risk assessment process, which has determined their weed risk and potential for effective management.

### Athel pine

The Weed Management Branch continue to work collaboratively with affected landholders in the upper managed 420 km of the Finke River catchment to manage residual infestations of athel pine. The success of the ongoing management of residual levels of athel pine in the upper catchment areas of the Finke River presents a real opportunity for eradication within the next 5-10 years.

### Cacti

There are several species of declared Class A weedy opuntioid cacti within Central Australia which have become naturalised at several different locations. All of the known cacti infestations located on the pastoral estate are currently under active management programs, with ongoing monitoring and controls in place, with eradication at all sites a distinct possibility in the next five years. An ongoing awareness and education campaign is currently underway with local Alice Springs residents and landholders to assist with the identification and removal of amenity plantings of declared cacti from gardens. Ongoing surveillance for the presence of declared cacti has continued across the Region in 2017-18 with continued education and awareness.

### Mesquite

Mesquite within the Region occurs as one isolated infestation to the northwest of Alice Springs. Previous issues with organic certification hampered the use of chemicals for the control of this known infestation but these have now been resolved. On-ground management of this infestation is to be initiated following a significant rainfall event to facilitate chemical uptake, with an ongoing monitoring program to follow.



# FERAL ANIMALS

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

## Camels

About 450 feral camels were aurally culled in 2017-18 in the vicinity of Mt Liebig and Newhaven Reserve. Anecdotal reports from landholders suggest that feral camel density remains relatively low across the broader western desert region of the NT, although there were some small-scale incursions onto pastoral leases in the past six months. Some pastoral landholders conduct on-ground shooting of feral camels as the need arises. Anecdotal reports also suggest that feral camel numbers remain very low in the Simpson Desert. A small number of camels are being harvested from the wild in the southern NT and used for crocodile food in the Top End.

## Horses and donkeys

About 130 horses were aurally culled in 2017-18 in the Tjoritja/West MacDonnell National Park and in the Davenport Ranges. Aboriginal work crews continued to trap horses at water points around Hermannsburg. The horses were loaded onto trucks destined for Peterborough abattoir.

There is a large-scale horse and donkey management program in the Victoria River 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 substantial reductions in the horse and donkey populations between 1999 and 2006 and current activity is directed at maintaining those reductions.

The Department of Primary Industry and Resources (DPIR) continues to field enquires from foreign interests regarding potential farming of donkeys in the NT for the supply of skins and other products. Donkey skins are used for ejiao production, a gelatin used in desserts, cosmetic products and traditional medicine. Some commercial enterprises have commenced accumulating feral donkeys behind wire on pastoral land in order to build commercial herds. A protocol for export of donkey skins is yet to be negotiated between the Australian and Chinese Governments, and the Australian Government Department of Agriculture and Water Resources continues to work towards establishing this protocol.

DPIR has also acquired 20 donkeys to conduct research into the husbandry of farmed donkeys in a pastoral environment. This research is being conducted at the DPIR Victoria River Research Station.

# FERAL ANIMALS

## Water buffalo

The trade of buffalo has again been strong in the 2017-18 financial year, with approximately 9000 animals exported live to Malaysia, Indonesia, Vietnam and Brunei. Interest in NT buffalo continues to gain strength, especially in Vietnam and Indonesia. The vast majority of animals are feral buffalo harvested from Arnhem Land and the surrounding regions; however, the industry is seeking to build the number of farmed buffalo to provide consistent supply.

The NT Buffalo Industry Council has recently released a Code of Practice, a practical handbook to inform buffalo livestock industry stakeholders along the supply chain of their obligations under Commonwealth and Territory law and associated standards. The document also promotes public safety, industry productivity and efficiency, and encourages innovative, safe and collaborative business practices. A copy of the Code of Practice can be found on the NT Buffalo Industry Council's website [www.ntbuffalo.com/code-of-practice](http://www.ntbuffalo.com/code-of-practice).

## Rabbits

While rabbit numbers in central Australia have increased in recent years, numbers are still well below levels recorded prior to the arrival of Rabbit Haemorrhagic Disease (RHD) in the mid-1990s. 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 was released nationally in 2017 including at one site in central Australia. This strain is expected to increase the level of control across some parts of Australia.

## Wild dogs

Department of Environment and Natural Resources (DENR) and DPIR continue to collaborate on the project "Best practice management of wild dogs in the Northern Territory". The project is funded through the Australian Government's Agriculture White Paper. The project is documenting the negative impacts of wild dogs on cattle and current approaches to managing these impacts. Wild dog management practices have been documented for over 60 pastoral properties, and producers encouraged to submit records on the proportion of dog-bitten cleanskin calves and weaners recorded at muster, up to 'Round 1' in 2019. This research will underpin the development of best practice guidelines for managing wild dog impacts. The project will ensure that dog impact management in the NT is consistent with the objectives of the National Wild Dog Action Plan. The theft of 1080 concentrate from a cattle station in May 2018, and the suspected 1080 poisoning of some domestic dogs near Katherine and Alice Springs during the middle of the year prompted investigations by DPIR. From August 2018, the DPIR Chemicals Coordinator instigated a review of the Agricultural and Veterinary Chemicals (Control of Use) Act, including the use of vertebrate poison.

# 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. 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 assistance to landholders who wish to conduct 1080 management for pigs on a cost recovery basis.



## Feral cats

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

A multifaceted research effort in the Top End to investigate the role of feral cats in mammal declines, funded by the National Environmental Science Program, was completed in 2017.

In 2017 and 2018, DENR again carried out experimental cat control with the 1080 Eradicator 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 km<sup>2</sup> in two 4000 ha areas during winter months. Preliminary results are inconclusive.

A research program is 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 cats are close to being eradicated on West Island as a result of trapping, baiting and hunting efforts undertaken by Aboriginal rangers and researchers.

## Hunting on parks

The Parks and Wildlife Commission has instigated a Back Country Hunting programme at Litchfield National Park. Participants must successfully undertake the Hunter Accreditation Course after meeting other specific requirements before they can apply for a permit to access three allocated hunting areas in the Park. Participants undertake the humane hunting of feral animals (including pigs, horses and donkeys) on foot. In addition, the Sporting Shooters Association Conservation Pest Management Group undertakes feral animal control at Judbarra / Gregory National Park.

# MEETINGS OF THE BOARD

Four meetings of the Pastoral Land Board were held between 1 October 2017 and 30 September 2018 as follows:

## **116th Meeting: teleconference held 3 November 2017**

Three land clearing applications were considered by the Board, with a permit being granted for one. The Board was briefed on the status of a fourth land clearing application and also endorsed amendments to reduce the area associated with a non-pastoral use permit. The Board agreed to make a submission to the Economic and Policy Scrutiny Committee in relation to the Pastoral Land Legislation Amendment Bill.

## **117th Meeting: held 10 and 11 May 2018 in Darwin**

One non-pastoral use and four land clearing applications were considered by the Board, with the Board consenting to grant a permit for one non-pastoral use application and one land clearing application. The Board noted briefings on the status of the Pastoral Land Legislation Amendment Bill, legal matters and the current status of two voluntary management plans, considered an application for a change of tenure to Crown lease, reviewed land condition reports from the Rangeland Monitoring Program and endorsed an erosion and sediment control plan and amendments to the Northern Territory Non-pastoral Use Guidelines for sacred site requirements and native title. Consideration was also given to clearing not in accordance with permits, with the Board discussing two instances of non-compliance and determining the most appropriate course of action.

## **118th Meeting: teleconference held 30 July 2018**

Briefings were provided on legal advice relating to access to waterways and clearing for infrastructure on pastoral land. The Board reviewed a development plan required due to subdivision, endorsed a weed management plan, further considered a land clearing application and deliberated over a land clearing permit non-compliance matter. The Board was also briefed on recent changes to pastoral lease administration processes in Western Australia to support best practice and methods that could be adopted to benefit the NT.

# MEETINGS OF THE BOARD

## 119th Meeting: held 20 and 21 September 2018 in Alice Springs

The Board was briefed on the upcoming commencement of the Pastoral Land Legislation Amendment Act 2018 and the resultant changes to the Pastoral Land Act, including rent methodologies, increased Board membership capacity, transfers and penalties for late payments. The Board considered amendments to the Pastoral Land Act's Northern Territory Land Clearing Guidelines to ensure suitable and timely processes for land clearing applications for the purpose of gas pipeline construction and associated activities and the new Northern Territory Planning Scheme's Land Clearing Guidelines (2019). Three development plans were considered, with one being endorsed for the purpose of applying to convert a term pastoral lease to perpetual tenure. The Board endorsed an erosion and sediment control plan, considered the voluntary management plan process for two pastoral leases and agreed to vary a land clearing permit, and an associated non-pastoral use permit, to relocate ancillary infrastructure. Presentations about weed management and remote sensing were provided to the Board and a workshop to consider Board processes, appropriate actions to deal with land condition concerns and compliance was also conducted, with one matter of non-compliance with a land clearing permit considered.

## APPLICATIONS CONSIDERED BY THE BOARD

### Land clearing applications

Station	Pastoral District	Purpose	Total Area (approx.)	Decision
Maryfield	Sturt Plateau	Improved pasture	20 432 hectares	Approved
Tanumbirini	Gulf	Improved pasture	1 499 hectares	Approved

### Non-pastoral use applications

Station	Pastoral District	Purpose	Term	Decision
Mainoru	Roper	Tourism	30 years	Approved
Conways	Roper	Tourism	30 years	Approved



# MEETINGS OF THE BOARD

## 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 2017-18 no applications for subdivision were lodged with the Board.

## 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 2017-18 five applications for lease conversion were lodged, with one related development plan being considered by the Board.

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## APPENDIX 1

### Economic performance of the NT pastoral industry

#### Markets

In the reporting period 1 October 2017 – 30 September 2018, 375 375 cattle were shipped from the Port of Darwin to Southeast Asian markets. This included an estimated 255 998 Northern Territory cattle. In this period 8741 buffalo were also shipped.

This was a very strong result. For the calendar year, 2018 was the third busiest year on record for the Darwin Port, eclipsed only by the bumper years of 2014 and 2015. For buffalo, 2018 was the best export year on record except for 2017 when 9916 were exported.

Indonesia remained the major export destination (80% of the cattle exported from Darwin) followed by Vietnam (12%) and Malaysia and the Philippines each on 3%. For buffalo, Indonesia, Vietnam and Malaysia were the main destinations.

After three record years, cattle prices moderated in 2017-18 as world beef prices eased. From a height of \$3.80 per kg during the 2017-18 Wet season, the price for live export steers in Darwin went as low as \$2.50 per kg in the middle of the Dry season before recovering to \$3.00 per kg by the end of the reporting period.

For interstate movements, figures for the reporting period 1 October 2017 – 30 September 2018 are not available, but for the calendar year 2018, the waybill records

show that a total of 257 003 head were trucked interstate. Of these 148 000 went to Queensland, 48 000 to South Australia, 27 000 to Victoria, 23 000 to Western Australia and 10 000 to New South Wales. It is expected that the Queensland figures would largely comprise young animals to be finished on Queensland stations and feedlots within large company supply chains. The stock travelling to Western Australia would mainly have been exported through the Port of Wyndham. Those heading to South Australia, Victoria and New South Wales would have been slaughter cattle. The prices offered by abattoirs in the southern states in 2017-18 were often sufficient to attract cattle from the northern half of the NT as well as Central Australia.

The Australian Agricultural Company (AACo) announced the closure of its abattoir at Livingstone near Darwin on 21 May 2018 after three years of operation, and its last shift operated on 26 July 2018. The closure of this plant was a great loss to the northern NT cattle industry as it left no significant outlet for cull cows except for abattoirs in the southern states; an average distance of about 3000 km. It is hoped that this problem may be partially solved by the re-opening of the abattoir at Batchelor in 2019 with new management and a significant upgrade. The capacity of the Batchelor plant may be about a third of that of the Livingstone plant.

## NT farm performance

Projected<sup>1</sup> farm financial performance in 2017-18, is expected to remain high in historical terms, while varying markedly across states and regions. Many farm businesses in the upper NT derive a large share of their total cash receipts from selling cattle for live export, particularly to Indonesia. The expansion of the live export trade between 2013-14 and

2015-16 resulted in cattle being sourced from a much expanded area of northern Australia. In 2016-17 average farm cash income decreased as a result of lower total cash receipts and a small increase in total cash costs. Average farm cash income increased in each region (Table 36).

Table 36. Farm cash income, broadacre farms, by region, Australia, 2016–17 to 2017–18 (Average per farm)

Northern Territory	Five years ending 2015-16	2016-17p	2017-18y
711: NT Alice Springs District	\$276 750	\$854 500	\$871 000
712: NT Barkly Tablelands	\$3 132 210	\$3 927 400	\$3 935 000
713: NT Victoria River District – Katherine	\$520 620	\$1 496 000	\$659 000
714: NT Top End Darwin and the Gulf	\$170 090	\$486 500	\$538 000

p Preliminary estimates. y Provisional estimates. Source: ABARES Australian Agricultural and Grazing Industries Survey

Overall, farm cash income in the NT is projected to decrease to average \$1 341 000 per farm in 2017-18, compared with the 10-year average to 2016-17 of \$722 000 per farm (Figure 75). This result would be 86 per cent above the 10-year average to 2016-17.

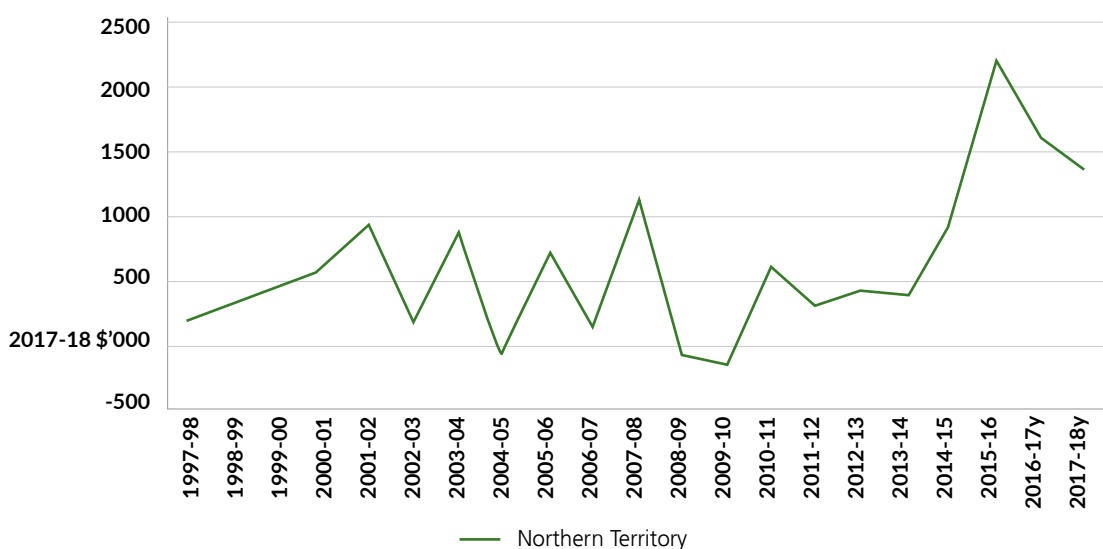


Figure 74. Farm cash income, all broadacre farms, Northern Territory.

p Preliminary estimates. y Provisional estimates. Source: ABARES Australian Agricultural and Grazing Industries Survey

1. ABARES Australian farm survey results: [www.agriculture.gov.au/abares/research-topics/surveys/farm-performance](http://www.agriculture.gov.au/abares/research-topics/surveys/farm-performance)

## APPENDIX 2

### Grazing land management research and advisory services

*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 grazing land management, carrying capacity assessment, animal production, genetics, improved pastures and market development. During 2017-18, DPIR also continued to support Aboriginal economic development through its partnership in the Indigenous Pastoral Program.

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 17 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 highlight some of the main activities undertaken in the past year.

### NT pastoral feed outlook

Since late 2011 DPIR has produced a quarterly bulletin that summarises the seasonal outlook, recent forage growth and current estimated standing pasture biomass in each of the 11 pastoral districts of the NT. The Outlook can alert producers and industry advisers to issues such as low pasture levels, increasing drought risk and high fire risk.

The Outlook is available as a free subscription service on the DPIR website [www.dpir.nt.gov.au/primary-industry/primary-industry-publications](http://www.dpir.nt.gov.au/primary-industry/primary-industry-publications)

The Feed Outlook data for 2017-18 showed that pasture growth was similar to the long-term median throughout most of the Darwin, Katherine, VRD, Roper and Gulf Pastoral Districts. Most of the Sturt Plateau District experienced pasture growth slightly higher than the long-term median. The Tennant Creek and Northern Alice Springs Districts ranged from similar to, to slightly below, long-term median pasture growth. The Barkly District was quite variable. Pasture growth was similar to (or slightly higher than) the long-term median in central and northern parts of the Barkly but very much below the long-term median in the south-eastern corner. This latter area experienced pasture growth levels in the lowest 30% years on record. Similarly, the Plenty and Southern Alice Springs Districts generally experienced pasture growth similar to the long-term median but there were some parts that experienced pasture growth very much below the long-term median (in the lowest 30% of years on record).

## APPENDIX 2

### Carrying capacity research and advice

DPIR provides carrying capacity assessments to property owners on request. This typically involves a property visit to verify infrastructure and land type mapping and to assess pasture growth and land condition. The agency also fields numerous requests each year from both family-owned and corporate enterprises to provide advice on property development and land management. DPIR also provides advice to the Pastoral Land Board on subdivision and land clearing applications.

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 arising from research projects.

High quality land type mapping is essential for carrying capacity assessment. Ongoing investment by the Department of Environment and Natural Resources (DENR) to improve the land type mapping in the Roper, Gulf and southern Sturt Plateau Districts, in particular, has been welcomed by DPIR.

### Beyond continuous grazing

DPIR grazing systems trials and demonstrations continue to be conducted at Old Man Plains Research Station near Alice Springs, Douglas Daly Research Farm and Victoria River Research Station (Kidman Springs). Updates on these projects are included in the latest DPIR Annual Research Achievement Report.

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.

- Consistent production of steers for premium beef markets is possible in terms of growth rate and fat deposition 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 five years; however, more research is required to determine how to achieve more consistent levels of compliance.
- 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.



## APPENDIX 2

More information about this trial can be obtained by contacting [chris.materne@nt.gov.au](mailto:chris.materne@nt.gov.au).

A trial of intensive rotational grazing (IRG) has been conducted on improved pastures at the Douglas Daly Research Farm since 2009. The original comparisons included IRG, set stocking at the long-term safe carrying capacity (SSC) and set stocking at a variable stocking rate (SSV) equivalent to the effective stocking rate in the IRG system. Following advice from the IRG grazing consultant who helped design the trial, the SSC comparison was discontinued in mid-2015 to allow more paddocks to be added to the IRG system in an attempt to improve animal and pasture performance. The trial has now concluded and the results clearly show that individual animal performance and production per hectare were consistently higher under set-stocking. No obvious differences in pasture condition were observed. More information about this trial can be obtained by contacting [tim.schatz@nt.gov.au](mailto:tim.schatz@nt.gov.au).

In 2018 DPIR commenced a trial at Kidman Springs to test 'Rangelands Self Herding', which is a grazing approach developed by Dean Revell (WA) and Bruce Maynard (NSW). The trial aims to demonstrate how positive reinforcement (e.g. food rewards) can be used to modify grazing patterns in paddocks. Many producers already move lick around their paddocks, but this method amplifies that approach by offering a variety of feed attractants and using intermittent and unpredictable timing and locations. This has the effect of increasing interest for a broader range of animals in a mob. GPS collars have been fitted to ten heifers so that DPIR can track their paddock usage patterns. The results show that DPIR have been able to draw cattle to graze in areas that have traditionally not been used very much. DPIR's goal is to see if the techniques have potential for creating a form of rotational grazing which does not rely on permanent fencing. The trial will continue throughout 2019. More information can be obtained by contacting [dionne.walsh@nt.gov.au](mailto:dionne.walsh@nt.gov.au).

### Prescribed burning research

The 'Shruburn' experiment at Kidman Springs (established in 1993) has been investigating how to use prescribed burning to manage woodland thickening and optimise pasture production. The trial plots are replicated on red and black soil sites, with the experiment testing the influence of season of burning (early vs late Dry season) and frequency of burning (every two, four and six years). The experiment also includes a series of unburnt control plots for comparison. The major findings can be found in the Rangeland Journal (Cowley et al. 2014, Rangeland Journal 36(4): 323-345). More information about this long-term experiment can be found by searching "Shruburn" at [www.futurebeef.com.au](http://www.futurebeef.com.au) or by contacting [robyn.cowley@nt.gov.au](mailto:robyn.cowley@nt.gov.au). The local industry has asked DPIR to continue this research because it is providing rigorous data to demonstrate that four-yearly late Dry season burning is an environmentally sound management practice in grazed savannas.

DPIR commenced an experiment in 2017 with the Barkly Landcare and Conservation Association and Newcastle Waters Station to investigate whether prescribed burning can be used as a tool for controlling feathertop wiregrass (*Aristida latifolia*) in Mitchell grass pastures. Research previously conducted in Queensland has shown that burning in about July or August can reduce feathertop whilst not adversely affecting the preferred grasses. However, burning Mitchell grass plains at that time of the Dry season is very risky so the experiment aimed to determine whether the rewards outweigh the risks in the Barkly Region.

## APPENDIX 2

DPIR undertook burns in July 2017 and September 2017 and completely spelled the site from grazing over the Wet season. When DPIR returned in April 2018 staff compared the burnt plots to unburnt (control) plots and found that:

- Burning reduced the plant size and biomass of feathertop.
- The fires had only killed 1% of the feathertop plants.
- Burnt plots had lower pasture yields and ground cover overall.
- Burnt plots had more “weedy” annuals like sensitive plant (*Neptunia* spp.).
- No desirable perennial grasses were killed.
- Burning increased seed production in the valued pasture species curly bluegrass (*Dichanthium fecundum*).

DPIR concluded that fire can kill feathertop wiregrass, but it’s not a “sure bet” that you will get a good kill – some years it will work and some years it won’t. To maximise the chances of success, you will require high fuel loads (>2,000kg/ha), very good fuel continuity, low humidity and low soil moisture levels for several weeks before and after burning.

### Industry training opportunities

DPIR continues to provide a range of grazing management training opportunities to industry. These include the EDGE Network Grazing Land Management (GLM) course, the new one-day Grazing Fundamentals workshop, Rangeland Management Courses for first-year stock-camp staff and the Barkly Herd Management Forum. Producers can contact their local DPIR office to find out more.



## APPENDIX 3

### Plant Species List (common and scientific names)

Common Name	Scientific Name	Common Name	Scientific Name
Athel Pine	<i>Tamarix aphylla</i>	Red Flinders Grass	<i>Iseilema vaginiflorum</i>
Barley Mitchell Grass	<i>Astrebla pectinata</i>	Rubber Bush	<i>Calotropis procera</i>
Bellyache Bush	<i>Jatropha gossypifolia</i>	Rubber Vine	<i>Cryptostegia grandiflora</i>
Black Spear Grass	<i>Heteropogon contortus</i>	Sedge	<i>Cyperus</i> spp.
Buffel Grass	<i>Cenchrus ciliaris</i>	Sida	<i>Sida acuta</i>
Bunched Kerosene Grass	<i>Aristida contorta</i>	Silky Browntop	<i>Eulalia aurea</i> spp.
Cacti	<i>Opuntioideae</i> spp.	Spinifex	<i>Triodia</i> spp.
Copperburrs	<i>Sclerolaena</i> spp.	Wiregrass	<i>Aristida</i> sp.
Feathertop Wiregrass	<i>Aristida latifolia</i>		
Gamba Grass	<i>Andropogon gayanus</i>		
Gidgee	<i>Acacia georginae</i>		
Golden Beard Grass	<i>Chrysopogon fallax</i>		
Grader Grass	<i>Themeda quadrivalvis</i>		
Hyptis	<i>Hyptis suaveolens</i>		
Kangaroo Grass	<i>Themeda triandra</i>		
Lions Tail	<i>Leonotis nepetifolia</i>		
Mesquite	<i>Prosopis</i> spp.		
Mimosa	<i>Mimosa pigra</i>		
Mission Grass	<i>Cenchrus pedicellatus</i> (annual) <i>Cenchrus polystachios</i> (perennial)		
Mulga	<i>Acacia aneura</i>		
Noogoora Burr	<i>Xanthium strumarium</i>		
Oat Grass	<i>Enneapogon</i> spp.		
Old Man Saltbush	<i>Atriplex nummularia</i>		
Para Grass	<i>Urochloa mutica</i>		
Parkinsonia	<i>Parkinsonia aculeate</i>		
Parthenium	<i>Parthenium hysterophorus</i>		
Prickly Acacia	<i>Vachellia nilotica</i>		
Queensland Bluebush	<i>Chenopodium auricomum</i>		
Rat's Tail Grass	<i>Sporobolus</i> spp.		

