Soil erosion protection field survey manual

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Acknowledgements

The field survey methods were originally developed by Andy McCord (then Primary Industries South Australia).

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Use of this manual

The methods described in this manual were designed for the purpose of longer term regional scale assessment of erosion risk (hazard) within the agricultural cropping zone of South Australia. The field observations were designed to be suited to rapid roadside survey where a large number of sites are assessed over large areas at a regional scale at any survey period. Observational assessments of this type, even with photo standards, have inherent subjectivity, so some observer error is inevitable even with experienced, trained observers. Validity of the survey data is achieved through the relatively large number of sites (surveyed four times per year) aggregated into regions (and state), then analysed in the context of seasonal and longer term trends.

This field survey methodology aims to monitor soil erosion *risk* rather than actual erosion. Significant wind and water erosion events in the agricultural zone of SA are usually very episodic, and difficult to measure. Erosion risk (i.e. likelihood) is monitored as a surrogate indicator of actual erosion, as any change in erosion risk over the longer term will inevitably result in a change in the amount of actual erosion. The erosion severity observations done in these field surveys are essentially opportunistic, but are included as a secondary component to the erosion risk assessments. Evidence of soil erosion that may occur between survey dates can easily be obscured or obliterated by tillage. Any systematic survey of the extent of soil erosion would need to be done immediately after an erosion event.

1 Field survey method

1.1 Survey design

1.1.1 Transect selection

Survey transects were chosen within the monitoring regions using the following criteria:

- Representative of the range of land zones (based on data from the DEW State Soil and Land Information Framework) and annual rainfall zones in the region, containing soil types with inherent susceptibility to wind or water erosion
- Representative of the rain-fed agricultural land use systems in the region
- Roads are traversable in all seasons, do not have major obstruction to view of farming paddocks, and do not pose a major safety hazard for survey vehicle
- Where possible roads run perpendicular rather than parallel to linear dune/swale landforms to optimise view of land facets
- Transects provide an adequate number of paddock sites within land zones, rainfall zones and regions for statistical purposes.

1.1.2 Site selection

When transects were initially designed, each paddock on both sides of the road was considered as a potential monitoring site. Exclusions were small holding paddocks (less than 200m x 200m), non-agricultural uses, or where a clear, representative 200m x 200m area could not easily be seen from the road due to paddock topography, roadside vegetation etc.

The monitoring site is a visually estimated 200m × 200m area in the paddock that is clearly visible from the road and is representative of the landform(s) (including dune and swale) and land use in the paddock. The site boundary is at least 50m beyond the fence denoting the start of the paddock (so as to avoid, where possible, headland effects) and at least 10m in from the road fence (to avoid tracks etc.). Where both a "dune" (including part of a dune) and "flat" facet occur at a site, site data is recorded for both.

At the March survey in 2006, all monitoring sites were geo-located by GPS (roadside location with left/right side designation for actual paddock site) to establish fixed sites for future surveys. This eliminated variability in the exact position sites were viewed (i.e. consistent soils/landforms) and number of sites assessed due to fence removals, and hence improved statistical robustness of site data. Fixed Topographic Ratings were also recorded at each site in the March 2006 survey.

1.1.3 Survey times

Surveys are done four times each year corresponding to critical periods for groundcover and soil exposure through the annual growth cycle of winter crops/pastures. This data time sequence is also used to estimate cumulative erosion risk/protection indices throughout the cropping year.

- **First week in March** — Groundcover levels declining due to grazing, stubble management, natural breakdown, autumn fallowing etc.
- **First week in May** — Around break of the season, groundcover may be at lowest level
- **First week in June** — Or when most of crops have just been sown, if this occurs after first week in June – groundcover usually at lowest level in cropping paddocks
- **First week in October** — Maximum groundcover levels at time of crop and pasture maturity, before crop harvest/hay cut.

1.2 General survey protocol

1.2.1 Survey protocol

Each survey team comprises at least two people in a vehicle (for road safety) where the passenger records site data using the survey App on a smart device (ideally a tablet/IPad). It is an advantage if both the driver and passenger are trained in the survey methods so they can confer and agree on observational ratings, and regularly swap roles during surveys to reduce fatigue.

The survey vehicle should be driven slowly enough to adequately assess each site. In the May and June surveys, it may be necessary to take more time to identify sites that have been recently sown using No-Till with narrow points or discs into stubbles (to distinguish Current Phase rating of fallow vs. pasture), which are often hard to see when travelling at speed. Where site visibility is limited, or aspects of paddock condition are not clear, it may be necessary for the vehicle to stop briefly at the site. Vehicles with a higher vantage point give a better view of observation sites.

WHS vehicle driving/travel guidelines must be followed.

Separate survey teams in each of the four cropping regions operate concurrently at each survey time so that all transects across the state are completed within the desired time frame (normally one week where logistically possible, with the exception of the June/sowing time survey).

When surveying, the approach to assessing a site is to record *what can be seen at the site* on the day (i.e. what is the condition of the site), rather than being concerned about what management might have been carried out. Sometimes on the day of survey a site paddock might be being cut for hay, windrowed, reaped, cultivated etc. so a decision needs to be made as to what recordings need to be made on the site form. If it appears that the whole paddock is being done, then recordings would reflect what the condition of the paddock would be at the end of the operation.

Prior to each new survey period, it is recommended that surveyors undertake some refresher or review of survey attribute photo standards, to ensure they are 'in tune' with the appropriate rating categories.

As part of its data quality assurance program, DEW has conducted "audit surveys" in which the Senior Project Officer, Sustainable Soils and/or independent survey teams independently assess parts of other transects normally done by other teams. Both sets of survey data are then compared and analysed, and steps are taken to overcome recorder variability in subsequent surveys. This helps to manage observer biases that can gradually creep into the observations over time.

1.3 Observations and data fields

1.3.1 Date of survey

The survey data collection App automatically records the survey date.

1.3.2 Site number

This is a unique 5 digit number that incorporates the transect number.

The site number is embedded in the site data on the survey App.

1.3.3 Transect number

Transect numbers were arbitrarily assigned to sections of the survey routes generally corresponding to parts that are surveyed within one day.

The transect number (1 – 14) is embedded in the site data on the survey App.

1.3.4 Land type (dune/flat)

For this data field a dune is defined according to the Topography Rating – Wind categories of 4 or 5.

When the field sites were geo-located in 2006, fixed site characterisation data was created according to whether the site contained a dune or flat facet or both. This is embedded for each site in the survey App, and the facets that need to be assessed at each site is shown when the site is opened in the survey App.

Where a site has a dune facet but only part of a dune is actually visible/present, that part of the dune is assessed to represent a complete dune.

1.3.5 Topographic rating – wind (soil x land type)

This is an estimate of the relative inherent susceptibility of the site to wind erosion, based on soil type and topography. These ratings are approximately equivalent to Land Classes for wind erosion potential (8 Class system as described in Maschmedt 2002[1]). When the sites were geo-located, the Topographic Rating – Wind was recorded as a fixed characteristic of each site, and is embedded in the site data on the survey App.

This rating is relevant for wind erosion prone land in the agricultural areas of SA, e.g.

- dune swale country - Eyre Peninsula/Mallee/Upper South east
- other known areas eg. Calcareous loams at Booleroo.

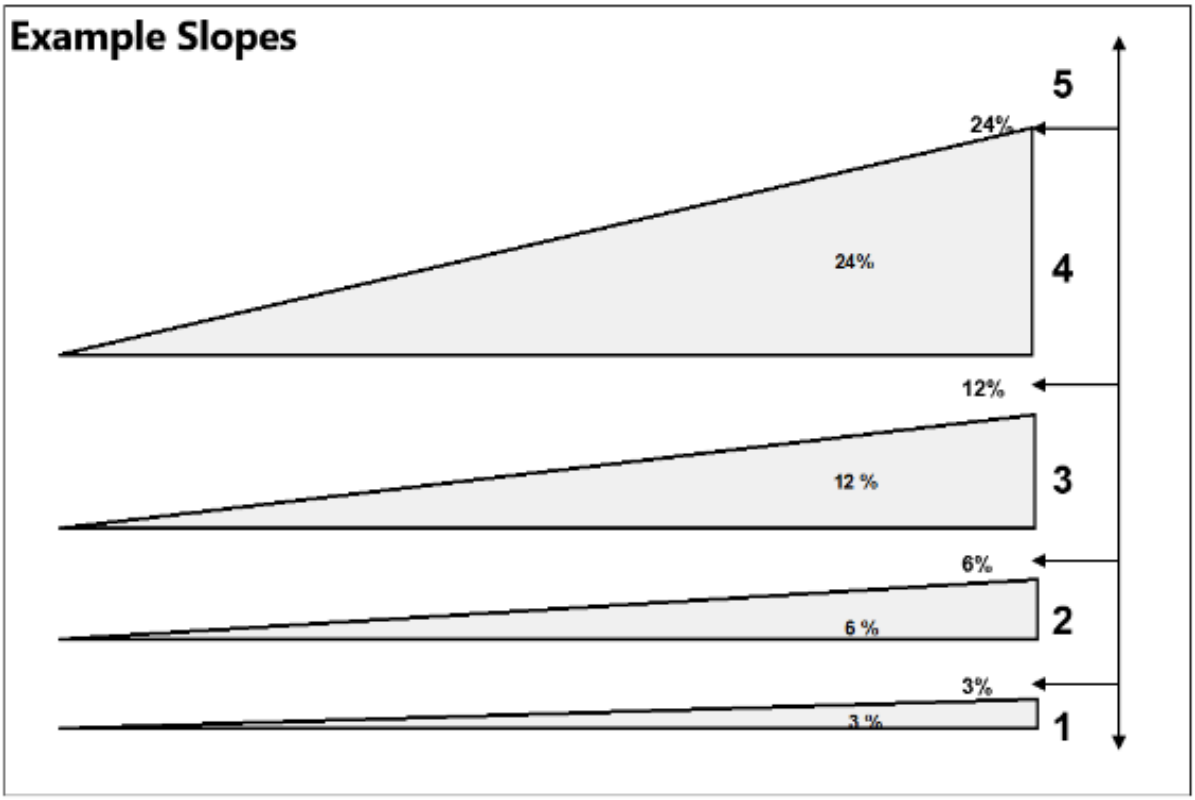
Land type	Wind Erosion Topography Rating
Loam/Clay Flat/slope/rise	**1** **(Essentially no risk)**
Sandy or Calcareous Loam Flat/slope/rise	**2** **(Low/moderate risk)**
Sandy Flat/Slope	**3** **(Moderate/high risk)**
Low Sandhills (<5m)	**4** **(High risk)**
Mod/Large Sandhills (>5m)	**5** **(Very high risk)**

[1] Maschmedt DJ, 2002, Assessing Agricultural Land, DWLBC

1.3.6 Topographic rating – water (slope)

This is an estimate of the relative inherent susceptibility of the site to water erosion, based on slope, relevant to the sloping cropping lands in SA. These ratings are approximately equivalent to Land Classes for wind erosion potential (8 Class system[1]). When the sites were geo-located, the Topographic Rating – Water was recorded as a fixed characteristic of each site, and is embedded in the site data on the survey App.

Water Erosion Topography Rating	Slope
1	0-3%
2	3-6%
3	6-12%
4	12-24%
5	> 24%



1.3.7 Current phase

The current rotation/management phase at the observation site is recorded, according to the following categories.

Category	Code	Definition/when to use
Fallow (cultivated)	**f**	Evidence of cultivation or mechanical disturbance of soil (includes un-emerged sown crop)
Chemical Fallow (sprayed)	**cf**	Evidence of herbicide used
Pasture	**p**	Any pasture type including stubble ***excluding March survey***
Stubble	**s**	First year crop stubble – ***March survey only***
Crop	**c**	Cereal, or any emerged crop if unable to differentiate type (eg. May-June surveys)
Grain legume	**gl**	In October survey or when crops can be differentiated
Canola (and other oilseeds)	**ca**	In October survey or when crops can be differentiated

1.3.8 Disturbance rating (cultivation/grazing)

The apparent surface disturbance on the observation site is recorded, according to the following definitions.

Disturbance Rating	Description
1	No significant disturbance evident
2	***Some*** of soil surface disturbed, e.g. • narrow row-width disturbance by No-Till/Zero Till implement etc. • by hooves of grazing stock • cultivated but some plants/ residues remain anchored to soil • some of soil surface actively drifting/eroding Or, All soil surface partly consolidated following a full disturbance e.g. • after rain, crop/pasture establishment
3	Full soil disturbance e.g. • full cut cultivation/sowing • heavy grazing on sandy soil • all soil surface actively drifting

1.3.9 Cover rating (combined dry and green material on the soil surface)

The cover rating on the observation site is recorded. Refer to the figure table below and the following photostandards figures. Where cover is variable, estimate the ***average*** cover rating over the 200m x 200m site.

Definitions for cover rating table

Height	Height of the surface cover. This is the primary factor to use to assess sites with inherent susceptibility to wind erosion (TRwind >=2).
Cover %	Percentage of the soil surface covered with plant material or stones etc. as viewed from the roadside (oblique view). This is the primary factor to use to assess areas with inherent susceptibility to water erosion (TRwater >=2). At sites where TRwater >=2 and TRwind >=2, assess these as inherently prone to wind erosion.
Bulk	This is the overall amount (volume) of the surface cover material. For example, canola stubble vs. cereal stubble, both with similar height of cover will have different bulks. This is a secondary factor to assess cover rating at all sites.
Anchorage	The degree to which the **surface cover** is attached to the soil (e.g. undisturbed plant crowns) or detached (unanchored) by cultivation, grazing etc. This is a secondary factor to assess cover rating at all sites.

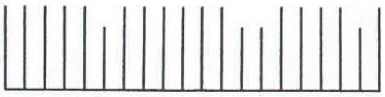
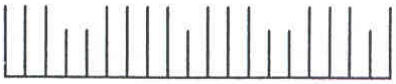
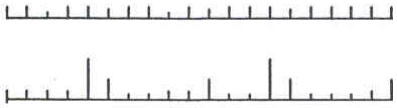
Rating	Height (wind erosion)	Cover % (water erosion)	
1	Residues **40cm or higher**.	**75 to 100%**	
	Bulk: Very high level of plant matter Anchorage: Majority of cover is anchored and stable, not (easily washed or blown away).		
2	Residues **between 10cm and 40cm.**	Even coverage of approx. **75 to 100%**	
	Bulk: high amount of plant matter, most of which is standing Anchorage: Majority of cover is anchored.		
3	Residue height variable from **less than 10cm to 40cm**.	More variable cover of approx. **75 to 100%**	
	Bulk: moderate to high but more variable across the paddock Anchorage: Cover often slightly flattened and damaged		
4	Residues **2cm-10cm,** but of moderate bulk. Residues a mixture of upright and flattened.	**50 to 75%** cover, residue colour dominates	
	Bulk: Moderate Anchorage: Majority of residues are anchored, although often flattened or damaged.		
5	**2cms of relatively even but thin residue** cover remain; or, **cover variable from sparse 40cm to less than 2cm** cover	**50 to 75%** cover, **Residue colour still dominates**	
	Bulk: Low, damaged through moderately heavy grazing or traffic by animals and/or machinery. Anchorage: majority of residues are anchored, most residues are damaged.		
6	**Height is variable** and **less than 10cm high to bare.**	**Soil colour dominates, 25 to 50%** cover	
	Bulk: Low amounts of plant material. Anchorage: some residues are anchored; most are damaged through grazing or cultivation.		
7	Mostly bare although **some residues can be seen**. Grazed or cultivated virtually **bare.**	**Soil colour dominates, 1 to 25%** Scattered residues (and/or rocks) remain.	
	Bulk: minimal amount of plant material. Anchorage: Any residues probably unanchored		
8	Nil cover **(bare**)	**0%** cover	
	Bulk: Nil Anchorage: Nil		

Figure 1.1. Cover rating descriptions

Figure 1.2. Wind erosion cover rating photostandards (stubble/fallow examples)

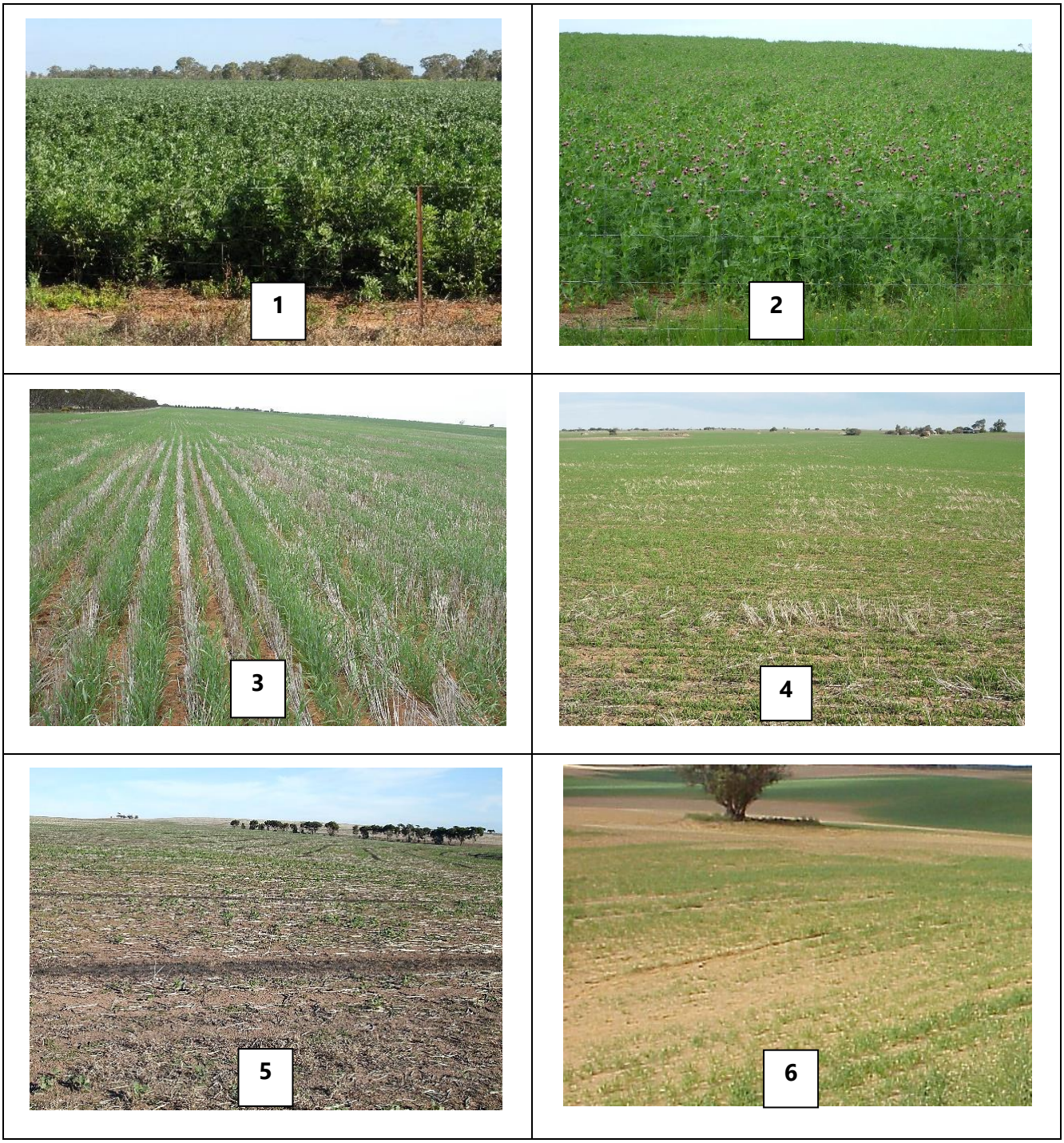


Figure 1.3. Wind erosion cover rating photostandards (crop examples)

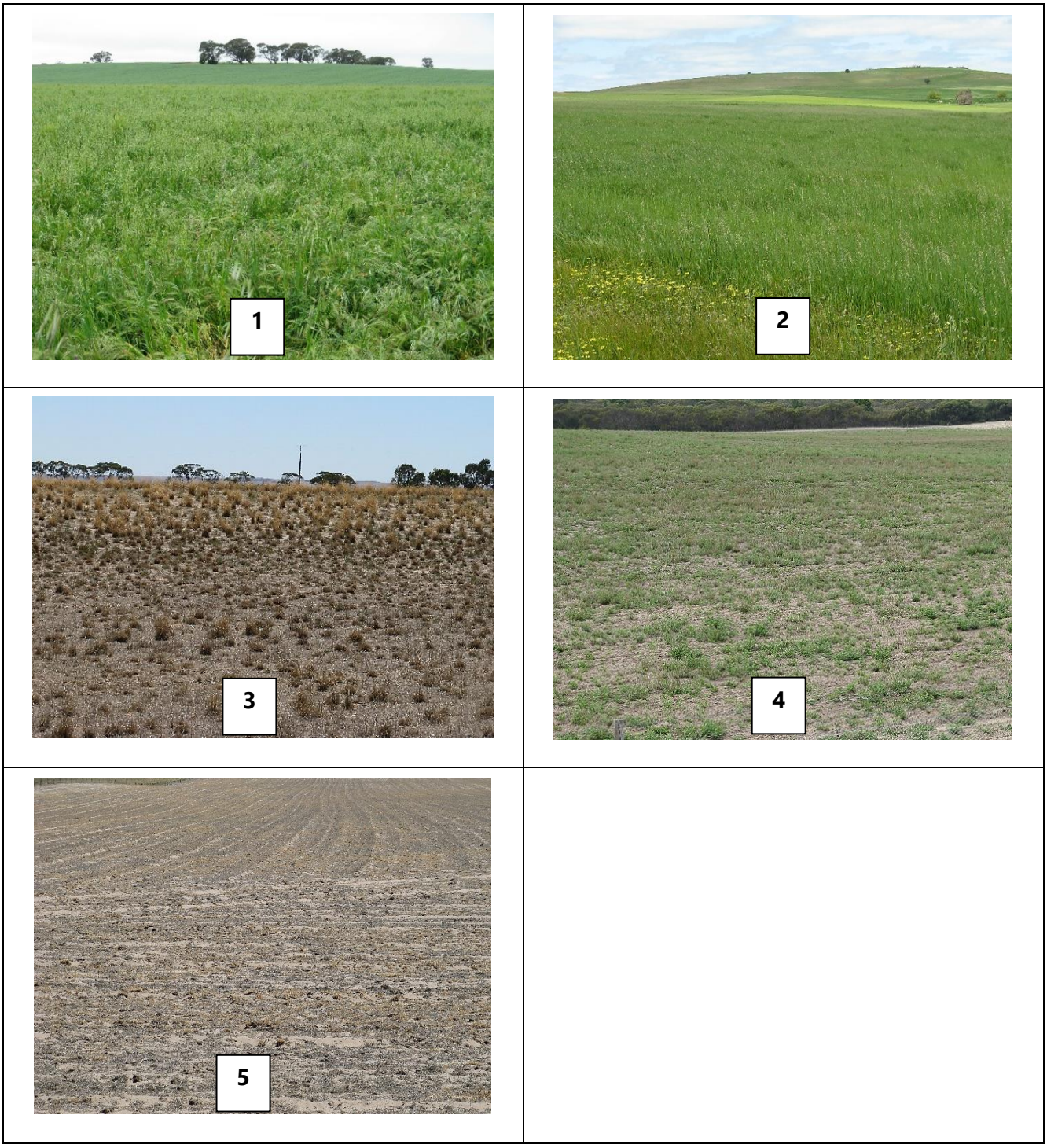


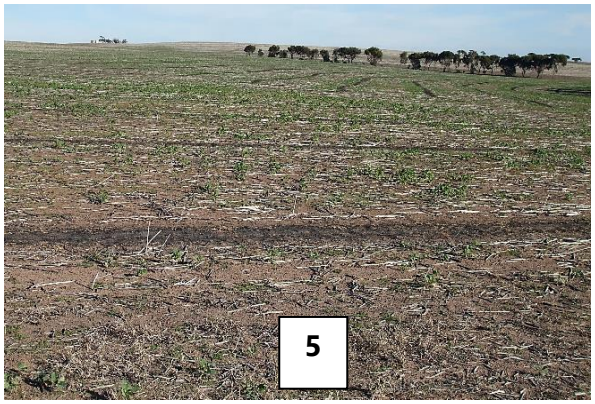
Figure 1.4. Wind erosion cover rating photostandards (pasture examples)

75% - 100% cover

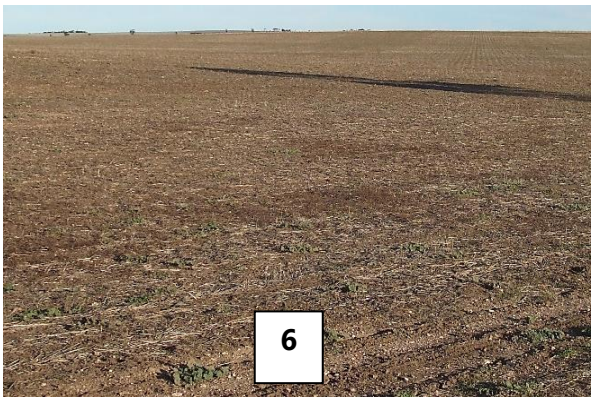
75% - 100% cover

75% - 100% cover

50% - 75% cover

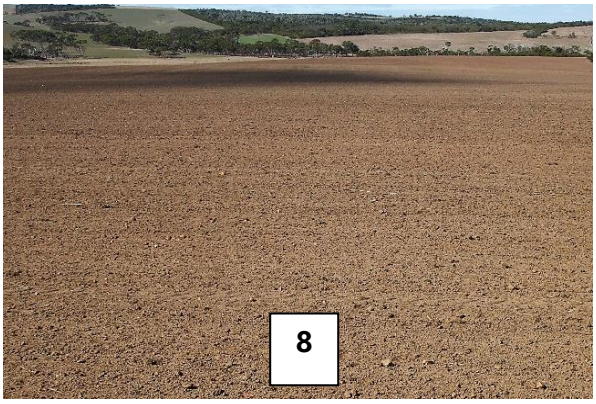


50% - 75% cover



25% - 50% cover

1% - 25% cover



0% cover

Figure 1.5. Water erosion cover rating photostandards

1.3.10 Wind severity (wind erosion severity)

Where there is evidence of wind erosion on the observation site having occurred recently, or since the date the site was last surveyed, the wind erosion severity is recorded according to the following definitions.

Rating	Severity	Description	Photostandard
1	Nil, or Insignificant	Nil	
2	Minor	Only minor evidence of erosion. Small areas affected. No crop damage or extremely rare. Slight but observable levelling of ridges or soil surface and some associated dusting may occur.	
3	Moderate	Evidence of significant sweeping on sandy soils particularly rises. Dusting associated with levelling of ridges/smoothing of soil surface, minor fenceline deposition. Occasional small areas of crop damage.	
4	High	Evidence of severe erosion of sandhills and significant sweeping on flats. Levelling of ridges/smoothing and gouging of soil surface in places, and associated frequent/severe dusting. Erosion is usually extended over a period of months. Significant fenceline deposition. Significant crop damage.	
5	Severe	Extreme stage of 4. Extended period of bare soil or strong wind has caused massive soil sweeping and deep gouging of surface in places.	

Figure 1.6 Wind erosion severity rating photostandards

1.3.11 Sheet and rill severity (sheet/rill water erosion)

Where there is evidence of wind erosion on the observation site having occurred recently, or since the date the site was last surveyed, the wind erosion severity is recorded according to the following definitions. Rills are by definition <30cm deep.

Rating	Severity	Description	Photostandard
1	**Nil, or Insignificant**	Nil. < 1 t/ha	
2	**Minor**	Very little erosion. Some sporadic evidence of soil movement but not obvious. (1 - < 5 t/ha soil loss).	
3	**Moderate**	Significant erosion and obvious soil movement/ washing. 5-6 cm deep rills 4-5m apart or equivalent. (5 - < 10 t/ha soil loss).	
4	**High**	Severe erosion. Significant soil movement/washing and obvious deposition in flats, swales, fencelines or creeks/gullies. 5-6cm deep rills 2m apart or equivalent. (10 - <25 t/ha soil loss).	
5	**Severe**	More extreme than 4. Severe erosion. 5-6cm deep rills <2m apart or equivalent. (> 25 t/ha soil loss).	

Figure 1.7. Water erosion severity rating photostandards

1.3.12 Residue burning

The incidence and extent of burning of stubbles/pasture residues on the observation site is recorded as follows.

Rating	Code	Photostandard
Nil	**n**	
Minor Burn (<25%) Typically the header or harrow rows	**mb**	
Partial Burn (25-50%) Usually more widespread patches	**pb**	
Complete Burn (> 50%) Complete burn over the majority of paddock	**cb**	

Figure 1.8. Paddock burning rating photostandards

1.3.13 Crop type and pasture type

Optional drop-down menus to record specific crop type or pasture type were added to the survey App site form in October 2020. These can be used where specific crop or pasture type data is sought, primarily in the October survey, for purposes such as crop type or land use mapping and modelling. The range of crop or pasture types that can be selected from the drop-down menus is filtered by what button is tapped for the 'Current phase', for example if current phase 'gl' is selected, then only grain legume crop types will be available in the crop type drop-down menu.

1.3.14 Optional comments

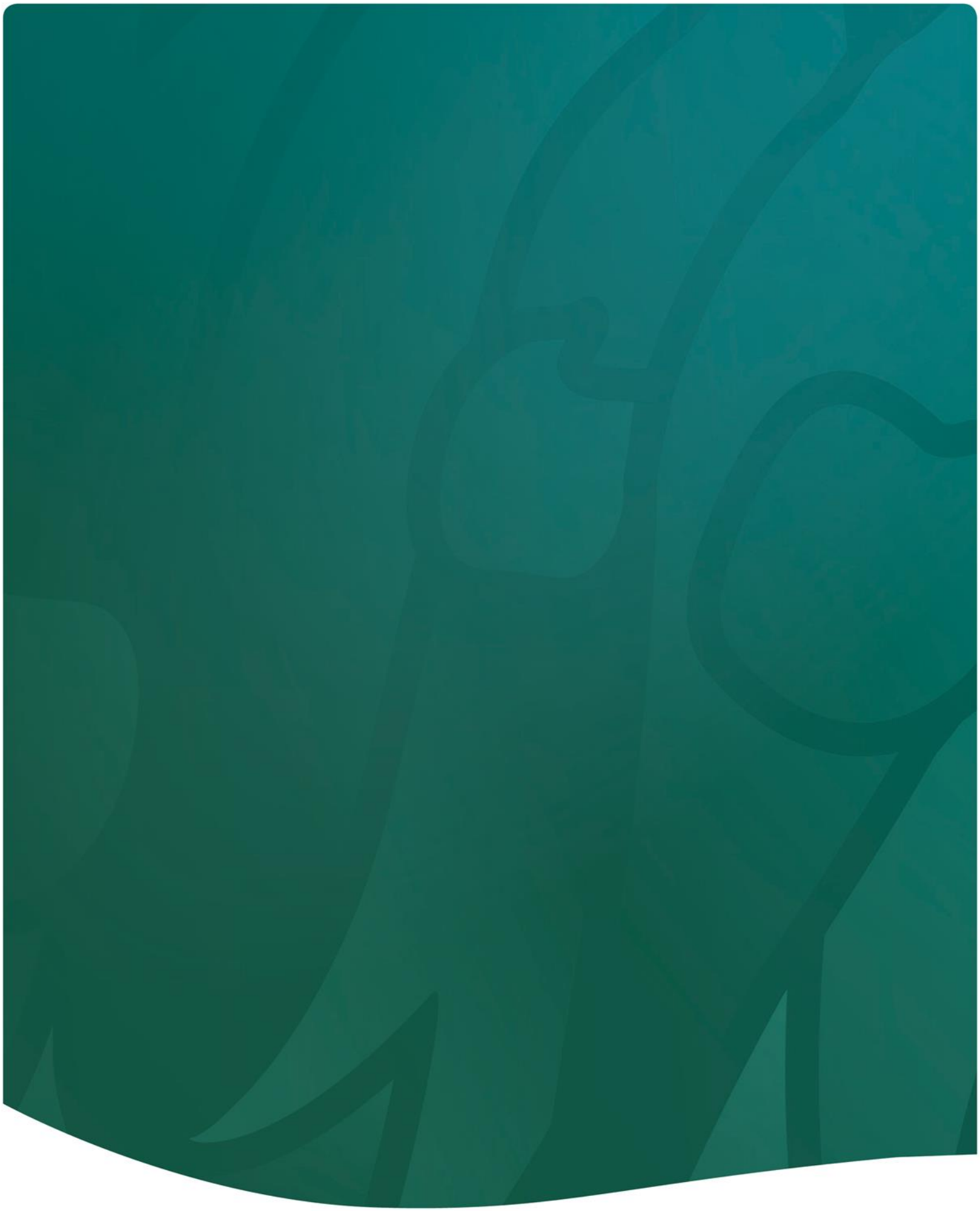
Some additional, optional observations of management practices that may affect soil surface condition can be entered by tapping on the "Comments" buttons for each site (including dune/flat facets), as follows.

Hay cut	Crop/pasture cut for hay (October survey)
Grazing	Evidence of grazing of sown crop or pasture (October survey: Pasture or Crop type recording)
Clay spread	• Old • New
Irrigation	• Pivot • Flood • Other

Survey teams can also provide other general comments about seasonal conditions, land condition, erosion, farming operations (eg. hay cutting, windrowing, spraying, grazing, confinement feeding) etc. to the DEW field survey coordinator after each survey.

2 References

Maschmedt, DJ, 2002, Assessing agricultural land, Department of Water, Land and Biodiversity Conservation. https://data.environment.sa.gov.au/Content/Publications/Assessing-Agricultural-Lands.pdf



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