Mallee Dune Seepage near Karoonda

Report to SAMDB NRM Board

Chris Henschke and Rebecca Tonkin
Rural Solutions SA
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The occurrence of dune seepage has reportedly been increasing at some locations in the mallee in recent times.

A site inspection of affected properties near Karoonda was carried out on October 12th , 2011 by R Tonkin (Rural Solutions SA), B Lawson (SA MDB NRM Board) and C Henschke. Visits were made to the properties of Peter Rose and Stuart Pope. It was noted that similar issues are being experienced this season in dune-swale country at Parilla.

Figure 1: Satellite image of the area affected on Stuart Pope's property (circled), -35.130193,139.830422 (decimal latitude and longitude, image from Google Maps, accessed 21/11/11).

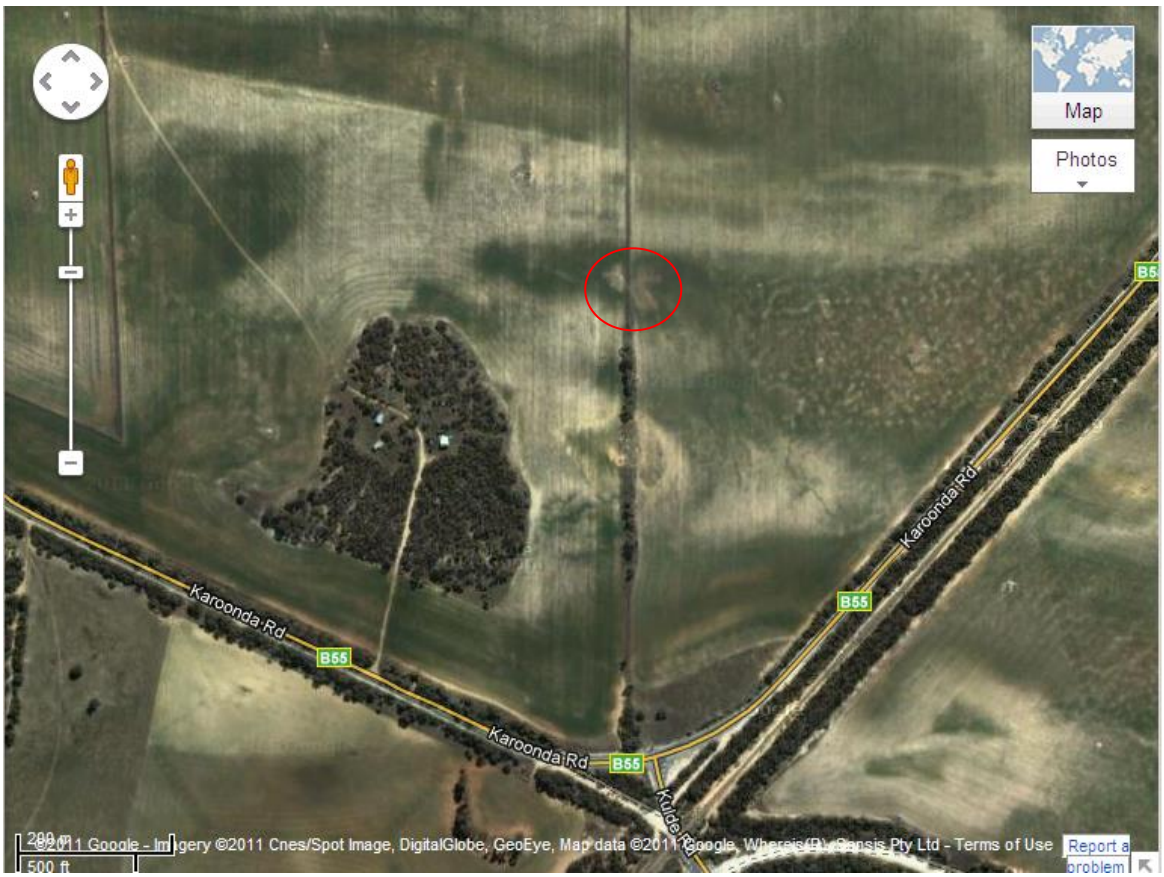

Figure 2: Satellite image of the area affected (circled) near Wynarka, -35.152302,139.663632 (decimal latitude and longitude, image from Google Maps, accessed 21/11/11).

Figure 3: Close up satellite view of scalded area. Note light sandy areas on the dunes and greener area in the swale.

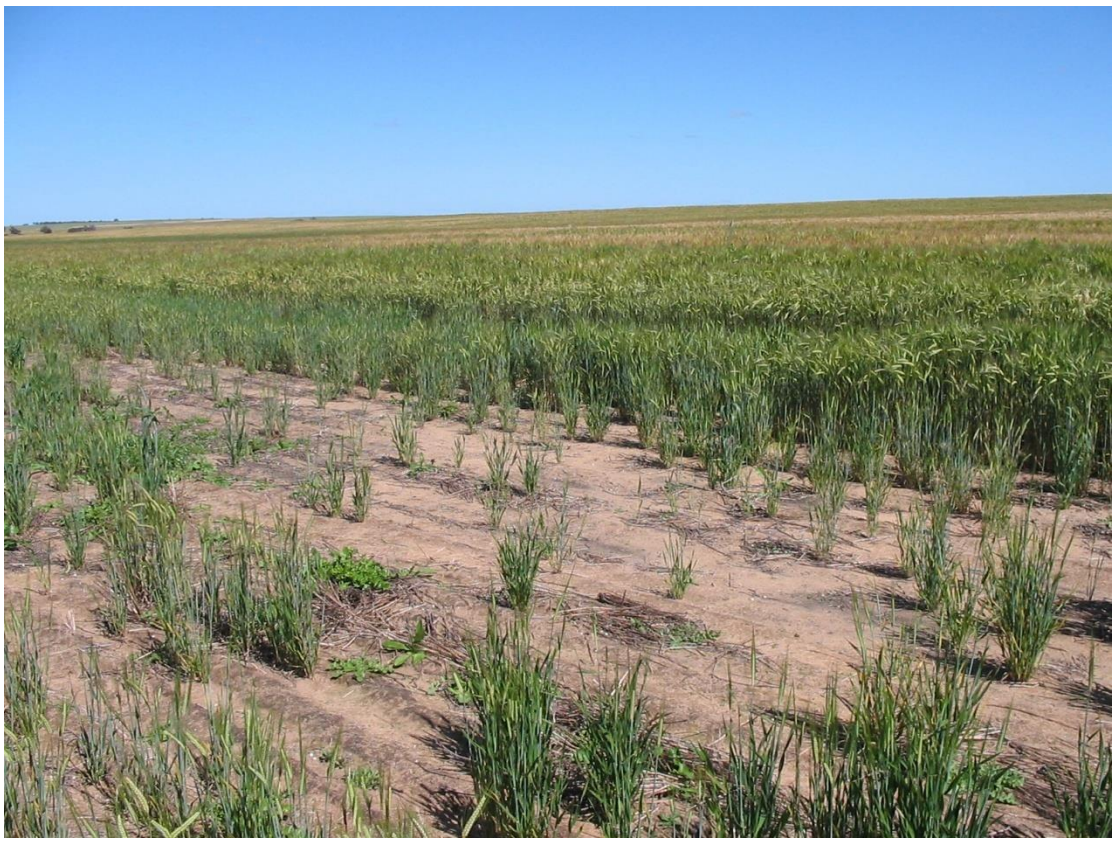

Figure 4: Dune seepage on property of S Pope, Karoonda

The photo in Figure 4 shows poor germination of a barley crop in a land-locked depression at the base of a sand dune. Lush crop growth is observed surrounding the wet depression at the base of the slope where the crop has likely tapped into a fresh perched watertable. There is currently no visible expression of salt in the seepage area (soil samples were taken to confirm this).

Figure 5: Soil profile within a dune seepage showing anaerobic staining on the surface and saturated sand at 20 to 30cm.

The seepage areas at Stuart Pope's occur in land-locked depressions at the base of large sand dunes. Soil profiles in affected areas (Figure 5) comprise of sandy loams with a dark anaerobic staining indicating waterlogged conditions. The topsoil is underlain by pale brown saturated sand, containing water which appears to be quite fresh. The perched watertable overlays red slightly mottled calcareous light to medium silty clay at 30 to 40cm.

A well dug to 6 m near Stuart Pope's farmhouse many years ago was fresh enough to be used as a domestic water supply.

The situation is different on the land located near Wynarka, currently being leased by Peter Rose. Here salinity is evident as the ground is bare and scalded (Figure 6), with salt crystals visible on the surface (Figure 7). The area is too soft for machinery to be driven over for most of the year, and so cannot be sown to crops or pasture. No plants are growing on the most severely affected parts, and around it are mostly growing rye-grass, brome, and thistles.
Until a few years ago this area was apparently not saline although tending to be boggy, and grew good crops, but it has gradually turned saline, and the area has become larger. There is concern that it may continue to expand.

Figure 6: Scalded land area leased near Wynarka.

Figure 7: Bare soil with salt crystals visible on surface.

Soil pits dug with a spade showed that the general profile consists of a dark grey-brown sandy loam in the topsoil (0-15 cm), showing anaerobic staining from waterlogging. This sandy layer has a crust on it which may contain salt crystals, and is dry to about 10cm, after which it is damp. This lies over a reddish brown sandy light clay (15-30 cm), which is wet to touch. After 30cm, there is a mixture of light clay (becoming heavier with depth) and calcrete. The clay varies from reddish-brown at about 30cm, to cream/yellow/grey further down the profile as more lime is mixed with the clay. The calcrete may be in large rocks (Figure 8, higher ground) or a soft gravel (Figure 9, low in the scalded area). The water table is at ~63 cm below the lowest part of the scald as at 16/11/11.

Figure 8: Soil profile in upper scalded area near Wynarka.

Figure 9: Soil profile in lowest part of scald near Wynarka. Water has seeped into the pit at about 63 cm.

Soil samples taken from the 0-10 and 40-50 cm layers in the profile showed high salinity in the topsoil, but much lower salinity further down (Table 1).

Depth	EC1:5 ms/cm	Texture	Texture Conversion Factor	ECe – estimated from 1:5
0-10cm	2.3	SL-	9.5	21.8
40-50 cm	0.34	SLC	6.5	2.2

Table 1: Soil salinity test results from Rose pit.

This indicates that mildly saline water has been wicked up from the lower layers in the soil and the water evaporated, leaving increasingly concentrated salt on the surface.

Hydrological processes

The zone of dune seepage west and south of Karoonda (as mapped by PIRSA Land Information, 2001) occurs in the Wynarka and Karoonda land systems. These systems are characterised by shallow calcareous sandy loams and deep sands on sandhills. The soils are underlain by either *Blanchetown Clay* or sandy sediments of the *Loxton*/*Parilla Sand*. The *Murray Group Limestone* (MGL) occurs beneath the clayey sand sediments (see Figure 3). The regional aquifer occurs mainly in the MGL formation.

Groundwater flow systems (GFS) operating in this area are regional flow systems in limestone aquifers. In some areas they are overlain by local flow systems in aeolian sediments.

The depth to regional groundwater is estimated at 20 to 50 metres; hence it is unlikely that there is any interaction between shallow local watertables and the deeper limestone aquifer systems.

Sand dunes (code 1 in Fig. 10) characteristically contain non-wetting sands and this promotes surface runoff which funnels down and concentrates into hollows and depressions at the foot of the dune (code 4 in Fig. 10). Rainfall may also infiltrate the dune in places and seep along the clay interface, eventually discharging into land-locked depressions ('pans') at the base of the dune.

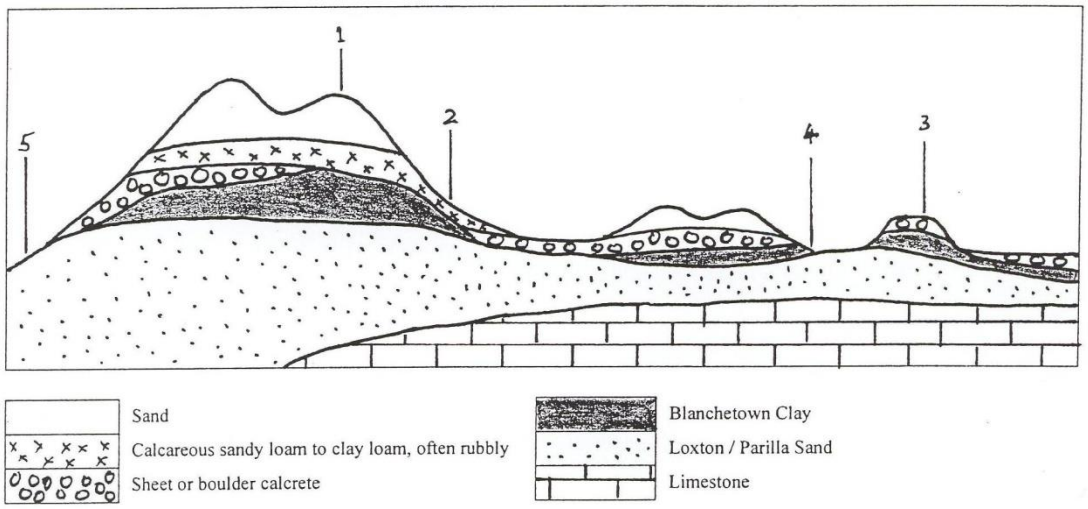

Figure 10: Generic cross-section showing typical sequence of soils and geology in the mallee, where 1 = deep sand on sandhill, 2 = calcareous sandy loam at break of slope and 4 = loam over clay on a flat or swale/depression (after Maschmedt, 199?)

In these seepage areas the crop suffers from 'wet feet' and the 'pans' become bare due to lack of cover. The landholders also mentioned that summer weeds used to inhabit these areas and so would help to dry them out. This is no longer the case with more effective chemical weed control and hence these areas tend to remain bare as the excess water is no longer being used up in the 'pans'.

The poor drainage in the landlocked depressions means that water has nowhere to go, being constrained by the surrounding sand dunes and by the sub-soil clay. There is minimal vegetative cover in the 'pans' to use up the excess water.

It is likely that wetter seasons in the past couple of years has seen a re-emergence of dune seepage across the mallee.

The problem is locally driven and is therefore treatable with good land management practices.

Prognosis

At Stuart Pope's, it is unlikely that these seepage areas will expand, but may be sustained by future out-of-season large rainfall events. However, it would pay to keep an eye on the 'pans' to see if they become saline over time. Revegetation along the road side or fence line would increase water use in the area, reducing the risk of developing salinity, and drawing down the water table to make it easier to get heavy machinery over the site.

Subsoil boron and salinity is indicated in the Calcic Red Chromosol soils of the mallee and hence it is possible that salt may begin to "wick-up" the from the deeper saline subsoil clays in the future if these areas remain wet and bare. These soils are typically sandy loams over red calcareous sandy clays at 30cm over Blanchetown Clay or clayey Parilla/Loxton sand at 80cm. The Blanchetown Clay is almost universally impermeable while the clay component of the Parilla/Loxton sand is generally sodic.

At the property leased by Peter Rose, it is probable that unless action is taken, the area will continue to expand and remain saline. Salinity is already evident, and salt will continue to wick up from lower layers if the topsoil remains bare and water is drawn up and evaporated from the surface.

Revegetating the site with salt-tolerant species is likely to be successful as long as plants are placed in soil which is not too saline. This may require a gradual approach, planting at the edges of the saline waterlogged area and moving in as the area becomes drier and less salty. Once plants have established and roots have accessed the deeper moisture, they should do well. Salt on the surface should leach away over time with normal rainfall.

Management

Areas affected by dune seepage are usually not very large and appear to reflect a local waterlogging issue.

If the problem is transient (i.e. comes and goes depending on seasons), it may not be necessary to do anything.

However, if the affected areas are expanding they can be managed both on-site by revegetation with perennials and off-site by improving water use on the sand dune immediately upslope of the discharge site.

Clay spreading, clay delving and spading are all techniques currently being trialled to improve productivity on sand dunes. Improved productivity and water use should result in less water ending up in the land-locked depressions on the flats.

Future Action

A survey of the areas around Wynarka and Karoonda could be done to see if this is an increasing problem in the area. A desk-top study using GIS is possible, or a land-holder survey.

Increased landholder awareness now could prevent increasing problems in the future.

Promotion of NRM activities/grants to combat salinity, waterlogging and association problems could assist farmers to treat these problems.