Mallee Seeps Farmer Survey 2017

A report for Mallee Sustainable Farming Inc,
to provide an Initial Assessment of the extent of Seep Issues affecting farmers across the South Australian and Victorian Mallee Farming region

by Chris McDonough,

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1 Project Summary

This report aims to provide an initial assessment as to the extent, potential causes and farmer's understandings of the current seep issues across the South Australian and Victorian Mallee Farming region. This provides important information to guide future activities of MSF, NR SAMDB, the Mallee CMA, funding organizations and farmers as to what is needed to better understand, manage and combat this growing issue with our farming communities.

The findings from this report are based on a survey of mallee farmers that have been impacted by seeps, conducted in Oct-Nov 2017. The 15 question survey gained farmers responses as to the areas of seep affected land, when they appeared, possible causes and the effectiveness of various management strategies implemented. It also asked of how concerned farmers were about the issues, and reasons they may not have taken action to address the problems as yet.

The clear results from this study are that mallee seeps are becoming a significant problem for a large number of mallee farmers. The majority of seeps have become evident within the last 10 years and appear to be due to changes in farming systems coupled with very high rainfall periods. Farmers identify that poor water use on deep sands (impacted by effective chemical summer weed control) has led to new seeps appearing in both mid-slope and swale areas below these sandy rises.

A range of management strategies have been employed by farmers to varying degrees of success. Strategic lucerne and tree planting were generally listed as more successful by some farmers. However, nearly half of the farmers surveyed reported that they had not done anything to control the seeps on their properties. The majority expressed that they needed more information to know what to do, and were unsure of who to ask or what management they should apply. For many the problem is only relatively small at this stage.

This report provides a strong indication that seeps are a rapidly growing land degradation problem that mallee farmers are very concerned about. If left uncontrolled and unmanaged it is conceivable that there could be a tenfold increase to current area of affected land, building to a cost in the vicinity of $100,000,000 in lost production over a 10 year period.

There is a clear need for farmers, farming groups and agricultural workers to better understand the dynamics of the seep issues in the Mallee, and the most practical and effective methods to manage and ameliorate the problems and impacts they cause. Farmers are wanting more information and are willing to get involved in ways to find these answers so that they can apply them successfully to their farms.

2 Introduction

Mallee Seeps have become an increasingly significant land management issue for many mallee farmers in recent years, leading to some of their most productive ground becoming, saturated, unproductive, weed infested and eventually totally degraded as bare saline scalds or water basins.

This report for Mallee Sustainable Farming Inc, commissioned by Natural Resources South Australian Murray Darling Basin and the Mallee Catchment Management Authority in Victoria, provides a summary and analysis of a survey of 80 mallee farmers with seeps issues across the South Australian and Victorian Mallee region. It is aimed at making an initial assessment as to the extent, severity and possible causes of Mallee Seeps. This information will be used to help find practical solutions and secure funding for further research, extension and assistance.

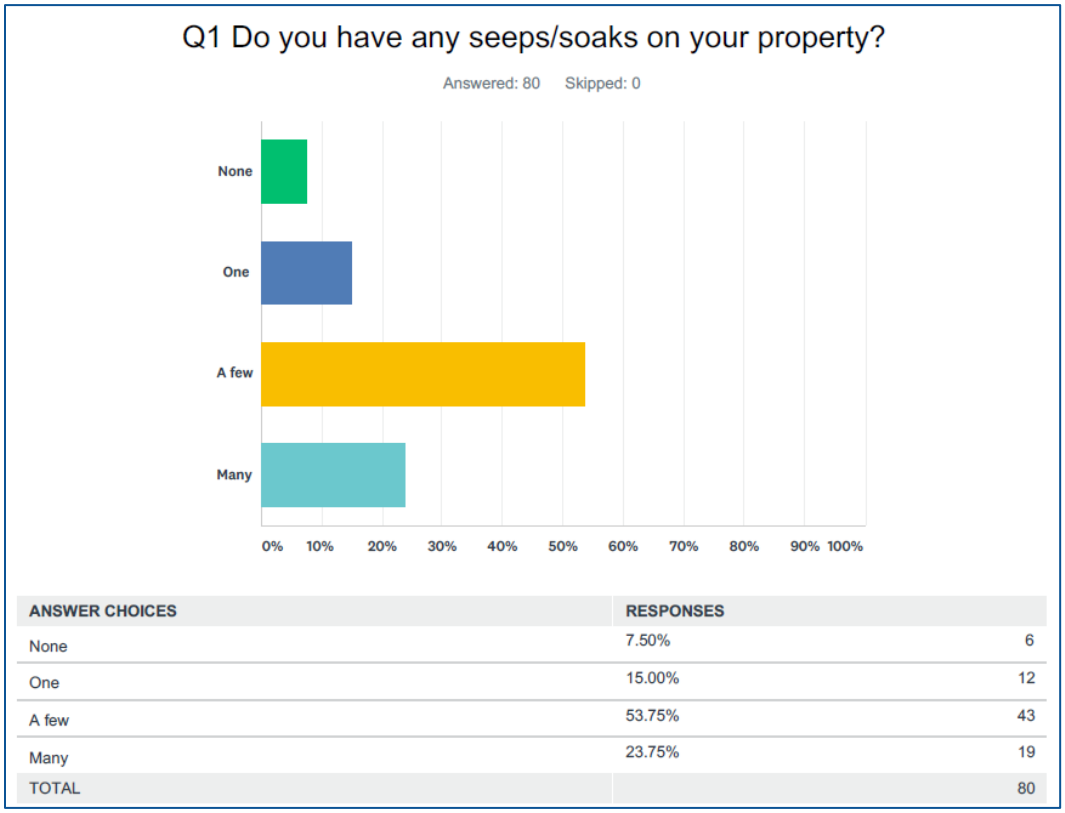
The Mallee Seeps Survey essentially comprised of 15 questions that either asked for specific responses of hectares involved of location details, or multiple answers farmers could choose appropriate responses from, with some questions allowing for more than one answer. There was also opportunity for farmers to provide other answers with personal comments. A copy of the Survey is shown below in Appendix 1. The majority of responses were recorded online by the farmers using a link to SurveyMonkey, while some completed paper surveys or were interviewed over the phone, after the survey was advertised at numerous field days and through emails, newsletters, rural media, social media and personal contact.

Of the 80 respondents, 70 gave a location of their nearest town, and these sites are generally represented within Map 1, revealing a wide spread of locations across the SA and Vic Mallee, with some areas being more concentrated than others. Agricultural workers from these regions have estimated that the survey has been answered by approximately 1/3 of known farmers with seep issues across the districts. This is therefore considered to be an excellent response rate across the district and very representative of the breadth of the issue, given that that these surveys were gathered over October/November 2017 at a time when farmers were either preparing for or undertaking harvesting activities.

The report concludes with some estimations as to the potential extent and costs that could result over time if the problem is allowed to progress without remedial management. This is based on the current information provided within this survey and then extrapolated into future possibilities based on realistic assumptions that have been discussed with colleagues working within this field. While it is difficult to make accurate predictions for the future with the application of many variables, it does provide a clear indication as to the need for research and development, demonstration, extension and assistance in the area of mallee seeps, if there is going to be significant action taken to remediate this serious issue.

3 Survey results

3.1 The size and extent of the problem of seeps across the mallee farms.



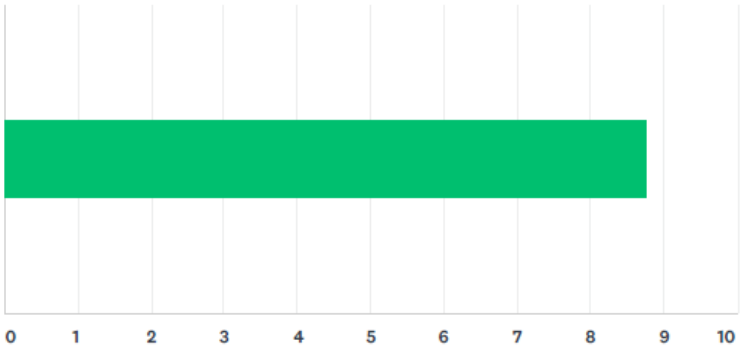
ANSWER CHOICES	RESPONSES	
None	7.50%	6
One	15.00%	12
A few	53.75%	43
Many	23.75%	19
TOTAL		80

Responses to Question 1 reveal that 54% of respondents have a few seeps and a further 24% have many seeps. This suggests that seeps are not just an isolated problem on the farm, but are appearing in multiple locations. This greatly increases the impact the issue has on paddock operations, disrupting efficiencies of machinery issues of blocking clear guidance runs for seeding, fertilizer, spraying and harvest, apart from the risk of bogging equipment.

It is noted that there were 6 respondents who did not record any seeps. This may be due to some farmers that are only beginning to experience waterlogging areas and may not have rated these areas as a permanent seep or scald areas as yet as they may still crop through these areas.

Q2 How big is area (in hectares) affected by seeps/soaks on your property?

Answered: 77 Skipped: 3



ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
Responses	9	675	77

Total Respondents: 77

BASIC STATISTICS

MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION
0.00	50.00	5.00	8.77	10.78

Question 2 shows a total of 675ha that were recorded across the 80 farmers as being seep affected, giving a current average of nearly 9ha/farm. While the biggest area recorded was 50ha, it is noted that the median figure was 5ha, meaning that the same number of the respondent recorded greater than 5ha as recorded less that 5ha affected.

While 5-10ha is not a large percentage of a whole farms, it is still a large degraded area of what is generally the most productive portion of land, and is rapidly increasing for many farmers. When considering that these seeps are spread across numerous individual farm areas (imposing direct production losses), they are actually significantly disrupting the farm operations across whole paddocks, impacting many hundreds of hectares.

Figure 1. Nearest town locations of farmers responding to the survey

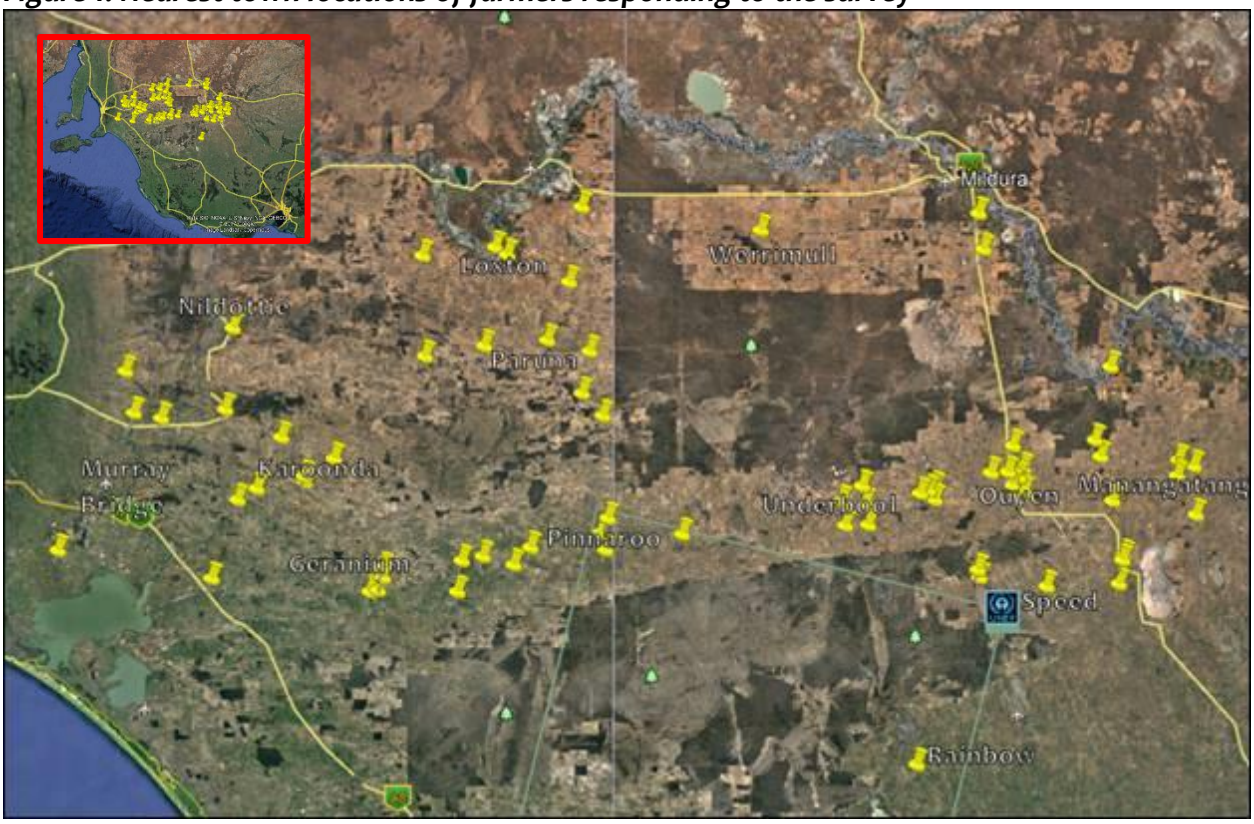


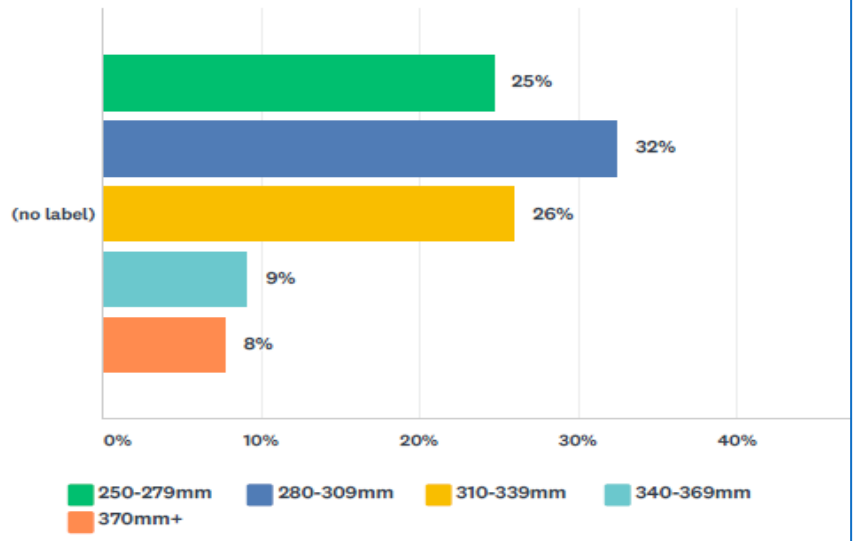
Figure 1 shows the locations of 70 farmers who indicated their closest towns in the survey. This shows a strong spread along the Mallee Highway from Tailem Bend to Manangatang, with numerous farms affected around Mannum, Karoonda, Paruna, and as far north as Loxton and Red Cliffs, down to Speed and Rainbow in the south. While the growing problems of agricultural seeps extend beyond these areas, this map reflects those within the targeted survey area.

Survey Questions 13 and 14 below show the average rainfall zones of the farmers concerned. This reveals that although this problem related to the underutilization of water, it is still occurring in the lowest rainfall farming districts, as low as 250-280 mm annual average rainfall, and 150-180 mm growing season rainfall. There was a reasonably even spread across the broader Mallee rainfall zone of 250-350 mm annual average rainfall.

This would suggest that the accumulation of excess water must be strongly influenced by when, where and even how intensely the rainfall is falling. It is likely that recharge is occurring mainly when there is little plant growth utilizing the water, on soil types that generally have very low water holding capacity and after large rainfall events over a short time period, for the this issue to be prevalent in such low rainfall environments.

Q13 What is you Ave Ann Rainfall?

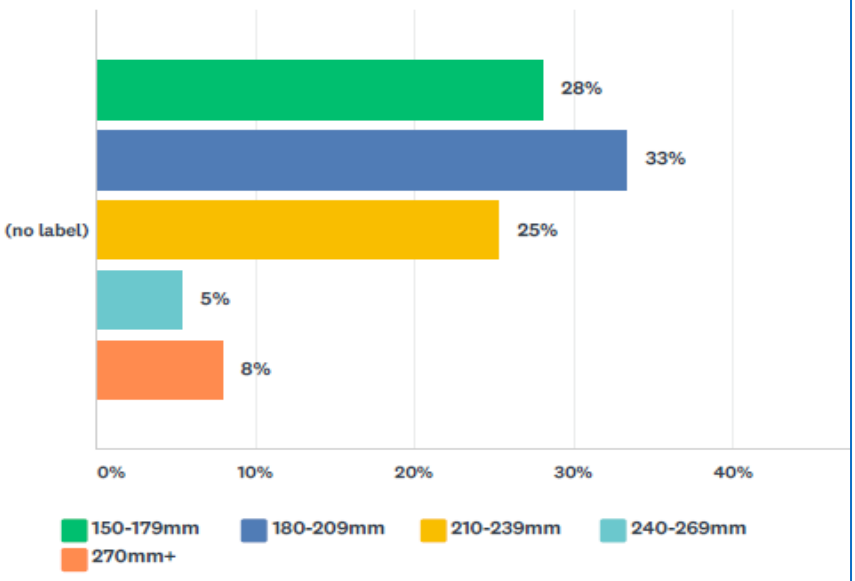
Answered: 77 Skipped: 3



250-279MM	280-309MM	310-339MM	340-369MM	370MM+	TOTAL
25%	32%	26%	9%	8%	
19	25	20	7	6	77

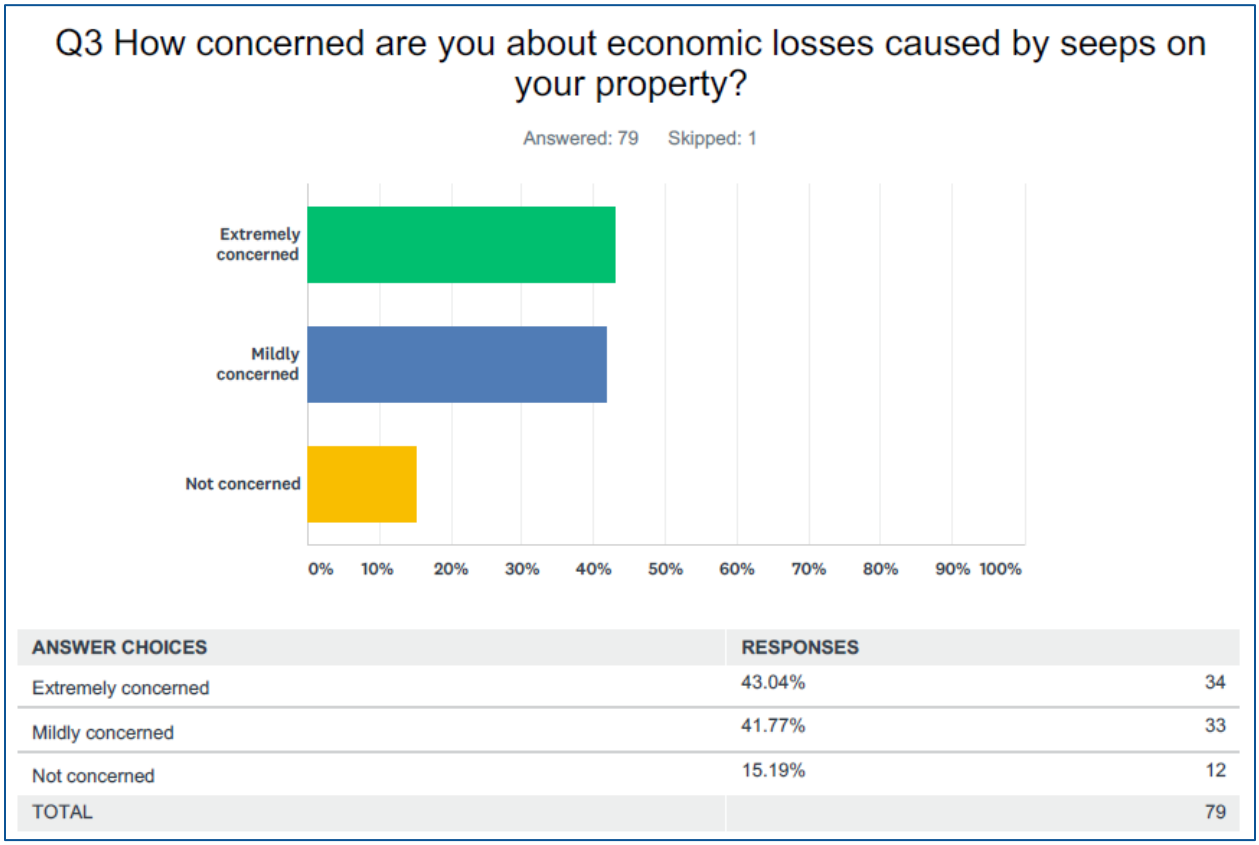
Q14 What is your Growing Season Rainfall?

Answered: 75 Skipped: 5



150-179MM	180-209MM	210-239MM	240-269MM	270MM+	TOTAL
28%	33%	25%	5%	8%	
21	25	19	4	6	75

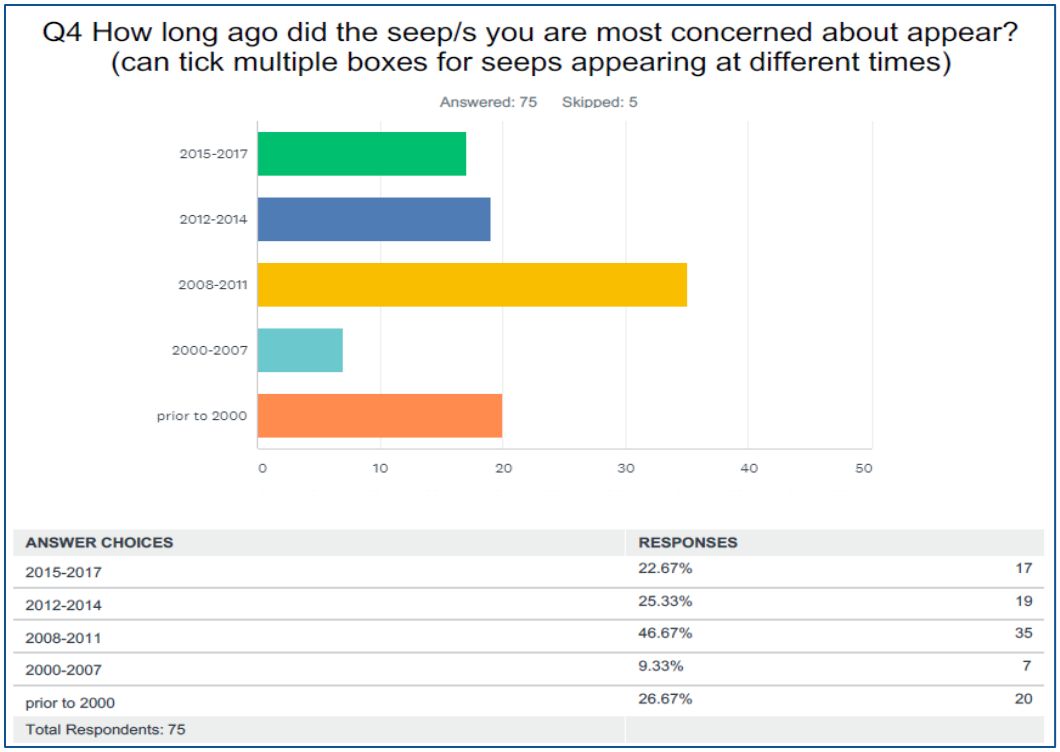
3.2 The recent growing concerns of mallee seeps



ANSWER CHOICES	RESPONSES	
Extremely concerned	43.04%	34
Mildly concerned	41.77%	33
Not concerned	15.19%	12
TOTAL		79

85% of respondents were either extremely or mildly concerned about the economic losses caused by seeps. This should be considered along with Q4, which reveals that this issue is clearly emerging as a recent and growing problem. Farmers are not only concerned about the current production losses to productive land, but also the land that could potentially become degraded. Many farmers have expressed that their seep affected area could increase tenfold.

Those that are only mildly concerned or not concerned at present, often only have less than 1 or 2ha affected, and/or are too busy managing all the other farm operations to be devoting too much energy into the seeps. There were also a few farmers who have contained their seep sites though management or fencing out and are less concerned about their current potential to spread.



ANSWER CHOICES	RESPONSES	
2015-2017	22.67%	17
2012-2014	25.33%	19
2008-2011	46.67%	35
2000-2007	9.33%	7
prior to 2000	26.67%	20
Total Respondents: 75		

It is clear that nearly half of the farmers identified that new seeps formed on their property between 2008 and 2011. This corresponds to the extremely wet rainfall period across the region surrounding 2010 (see Table 1.). Even higher rainfall periods were experienced in 1973/1974, along with other high summer rainfall periods, but without the same apparent impact on seep formation. This suggests that the causes of these issue in recent years are due to both high rainfall periods as well as changes to farming systems and water use.

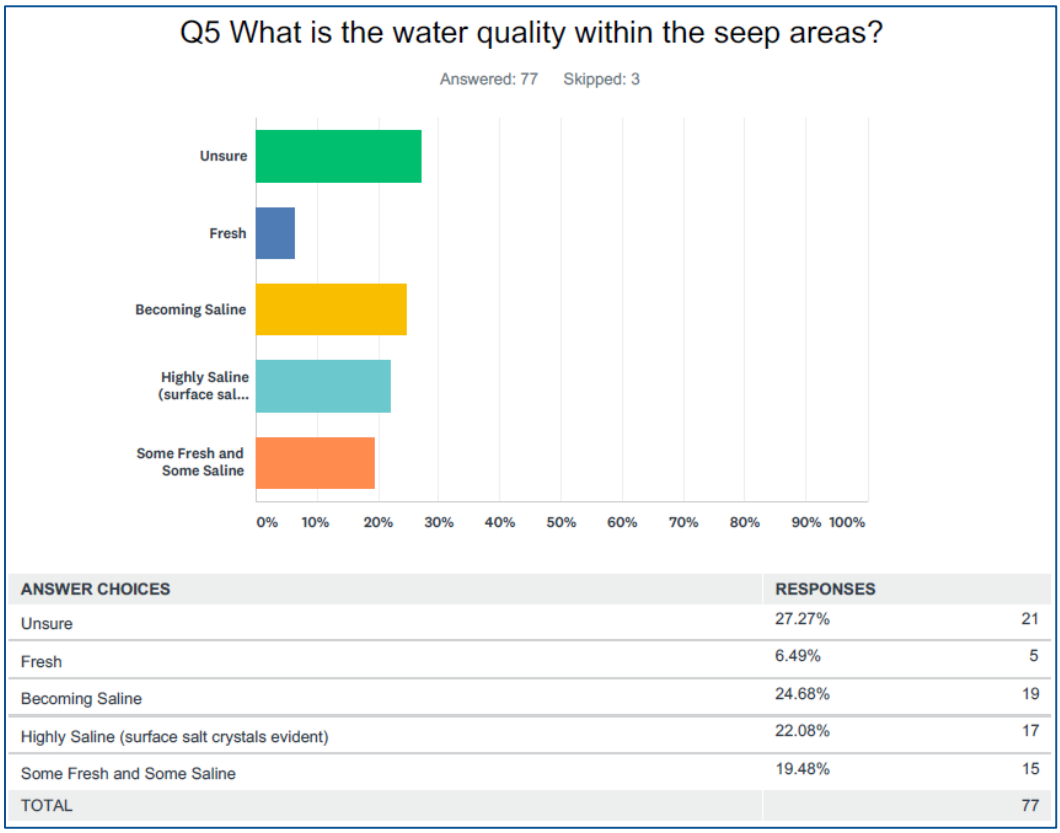
Table 1. Rainfall Data showing very high rainfall periods (Red) for 2010/2011 across region.

Location	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Karoonda	Ave	18	20	18	25	36	35	35	38	35	32	24	25	343
	2010	14	16	48	25	36	27	32	64	61	43	39	142	546
	2011	14	72	115	8	34	24	32	57	18	47	22	48	490
Murrayville	Ave	20	23	17	22	32	31	34	34	33	32	27	23	327
	2010	6	10	40	35	26	16	23	54	44	49	80	123	505
	2011	65	61	60	6	18	16	26	39	19	21	63	26	421
Manangatang	Ave	22	24	20	22	31	29	30	30	29	32	26	21	316
	2010	8	40	65	52	36	19	18	54	14	80	109	53	547
	2011	165	77	28	15	17	11	19	47	14	29	36	18	475

35 of the farmers have specifically identified new seeps forming since 2012. This may be indicative of the slow lateral movement of catchment water, as well as areas becoming gradually wetter at depth that then makes them more susceptible to saturation after lower rainfall events than in the past. 2016 was also a well above rainfall year across the region. Only 27 respondents reported seeps appearing prior to 2007, and many of these are from areas that have historic saline scald areas.

These responses clearly indicate that the seep issue across the Mallee is a recent issue, with many new seep areas forming and growing larger, impacting on more farming land.

3.3 Seep formation and water quality



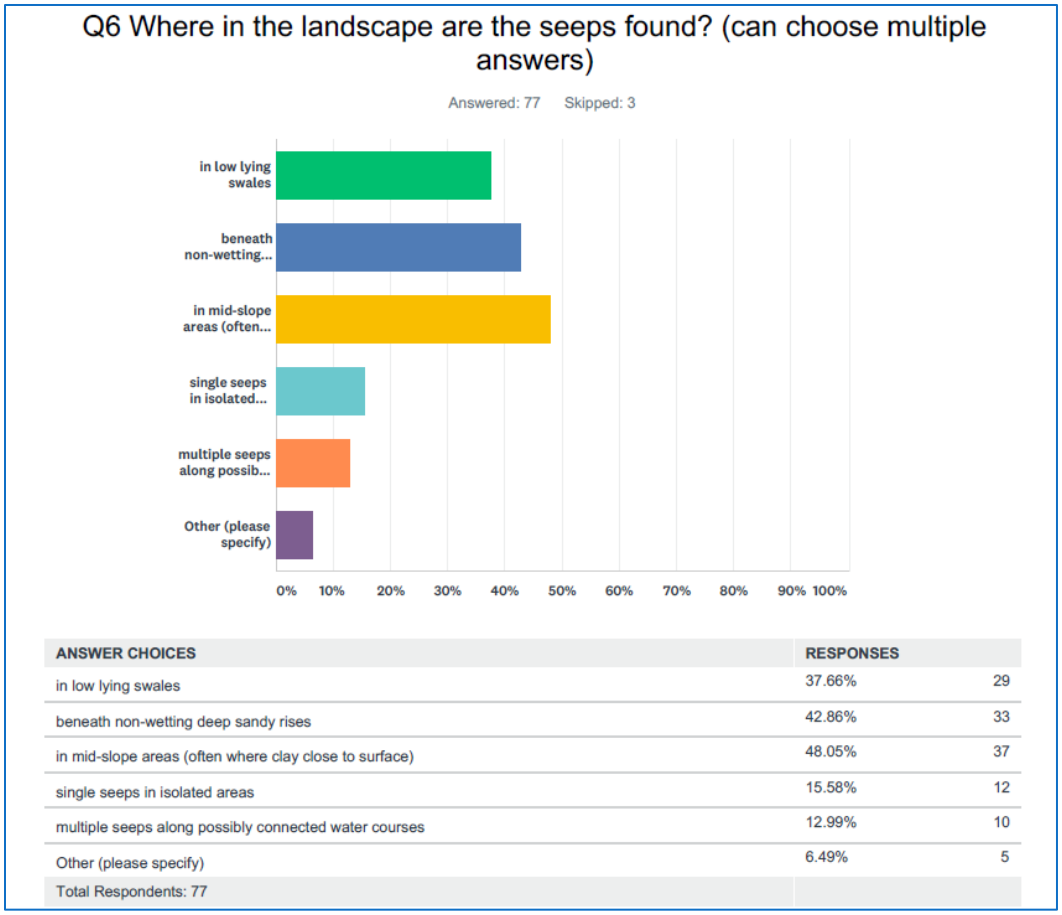
ANSWER CHOICES	RESPONSES	
Unsure	27.27%	21
Fresh	6.49%	5
Becoming Saline	24.68%	19
Highly Saline (surface salt crystals evident)	22.08%	17
Some Fresh and Some Saline	19.48%	15
TOTAL		77

22% of respondents have seep areas that are highly saline. This would indicate that they may be beyond rehabilitation, and if they are permanently wet or drying out to bare crystalline scalds, they are also unlikely to support salt tolerant pastures.

Areas that are still fresh water (6.5% identified) or just becoming saline (25% identified) or unsure (27%) may still be in a position for recovery or rehabilitation to some degree, by establishing cover on bare scalds and undertaking strategic higher water use management options. The key to future project work and useful farmer recommendations must be in the early identification of potential seep areas, so that practical/profitable management options can be employed before significant or terminal degradation occurs.

As indicated by the 20% of farmers with some fresh and some saline seeps, as well as the 25% with seeps becoming saline, if the problem is left unattended, land will become increasingly saline. This happens more rapidly once soil become bare, as the scalds experience high evaporation levels and concentration of salts at the surface.

The fact that 27% of farmers were not sure if their seep areas were fresh or saline is indicative that they are unsure of what is happening and what they can do about the problem, and that more information and training is required for farmers to be able to understand, measure, assess and strategically manage these problems. There must be far more urgency to address these problems as soon as possible, rather than waiting until it is too late for rehabilitation.



ANSWER CHOICES	RESPONSES	
in low lying swales	37.66%	29
beneath non-wetting deep sandy rises	42.86%	33
in mid-slope areas (often where clay close to surface)	48.05%	37
single seeps in isolated areas	15.58%	12
multiple seeps along possibly connected water courses	12.99%	10
Other (please specify)	6.49%	5
Total Respondents: 77		

Question 6 allowed for multiple responses and the various answers are not always exclusive to each other. Responses to this question reveal that a high percentage of seeps are forming in the midslope areas as well as at the very bottom of swales. Landscape studies have suggested that these seeps form perched water tables above impervious clay layers (Hall, 2015). Excess water moves vertically through the sandy topsoil layers and some clay layers until they reach the impervious clay layer. As water builds up it then moves laterally across this clay to lower portions of the landscape (see Figure 2). Where the impervious clay layers appear closer to the soil surface the laterally moving water may be expressed as a saturated, seep or ponded areas in the midslope of the landscapes, or in the lower swale areas.

There is a clear indication that deep sands have a strong association with seeps within the landscape (NB. The question referred to "non-wetting sands" which are prevalent in the SA landscape. Some "other responses just mentioned being at the base of deep sands, which is more indicative of the Victorian situation).

While most farmers concentrated on the first three response options, it would appear that many of the seeps are considered to be fairly isolated occurrences, while there are also many cases where there appears to be a series of seeps linked within the landscape. This is often an unknown factor that needs further investigation, particularly where management options are attempting to intercept the lateral water movement above the lower seep areas.

Figure 2. Model of SA Mallee Dune Seepage (adapted form Hall, 2015)

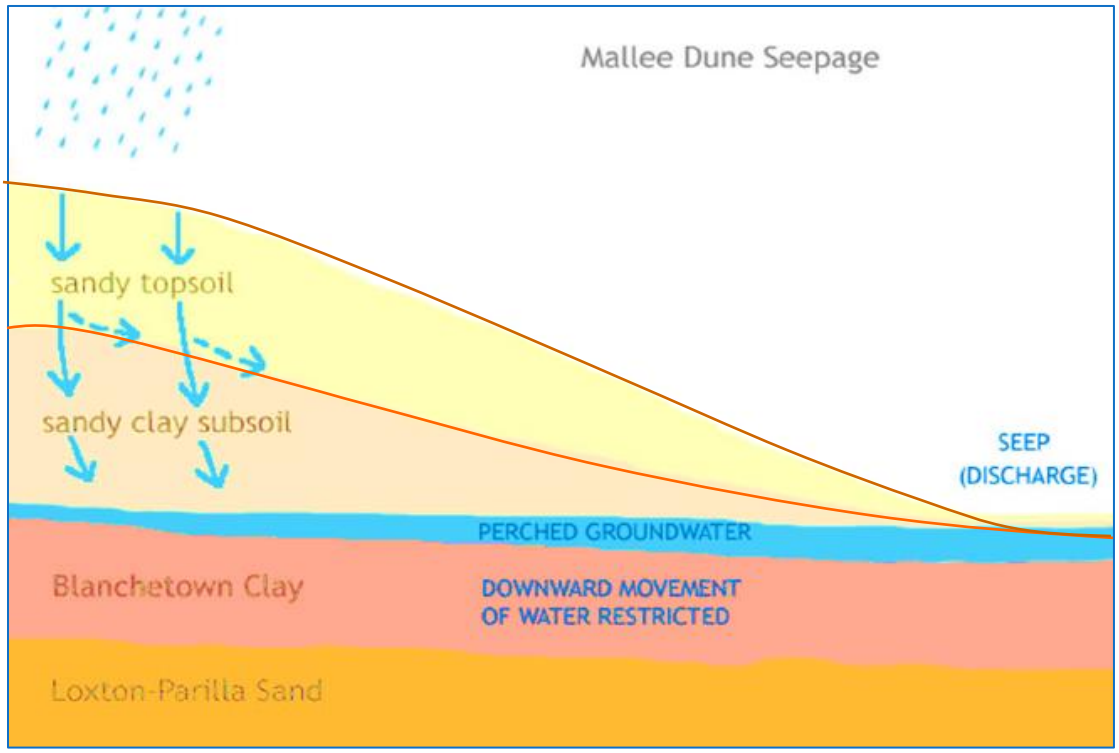
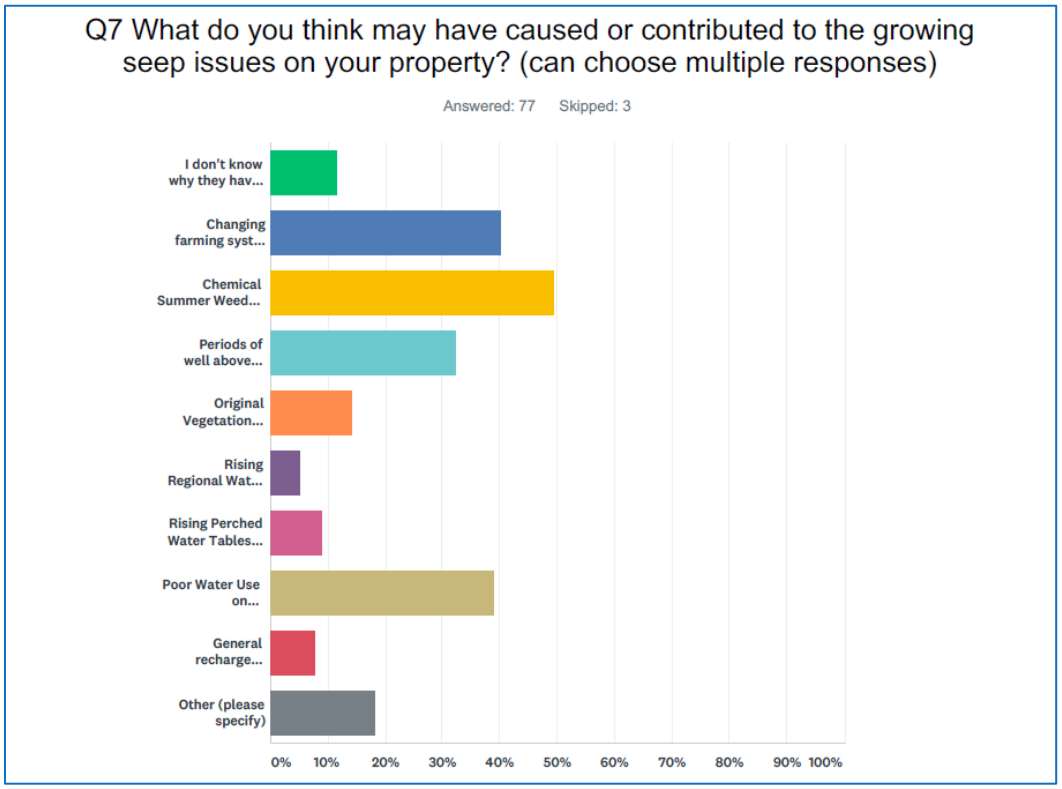


Photo 1. Mannum farmer viewing crop loss and growing scalded ground development due to Mallee Seeps

3.4 Perceived causes of seeps and considered management options.



ANSWER CHOICES	RESPONSES	
I don't know why they have appeared	11.69%	9
Changing farming systems	40.26%	31
Chemical Summer Weed Control	49.35%	38
Periods of well above average rainfall	32.47%	25
Original Vegetation Clearance	14.29%	11
Rising Regional Water Tables	5.19%	4
Rising Perched Water Tables in Localized Catchments	9.09%	7
Poor Water Use on Deep/Non-Wetting Sands causing recharge	38.96%	30
General recharge occurring across a range of soil types	7.79%	6
Other (please specify)	18.18%	14

The most popular reasons given that these farmers believe have most contributed to their seep issues include summer weed control, changing farming systems, poor water use on deep, non-wetting sand and periods of well above average rainfall. The key changes to mallee farming in recent years include the rapid move toward notill farming systems in the 2000's (see Fig 3.).

In the last 20 years, much of the mallee has moved from growing a crop one in every 2 or 3 years, towards more frequent or continuously cropped using Notill. This has led to considerable changes to the way deep rooted summer weeds on sandy soils like skeleton weed are managed. Before they were mainly grazed, with chemical control often only attempted prior to the cropping years. Now it is common practice to chemically remove them every year,

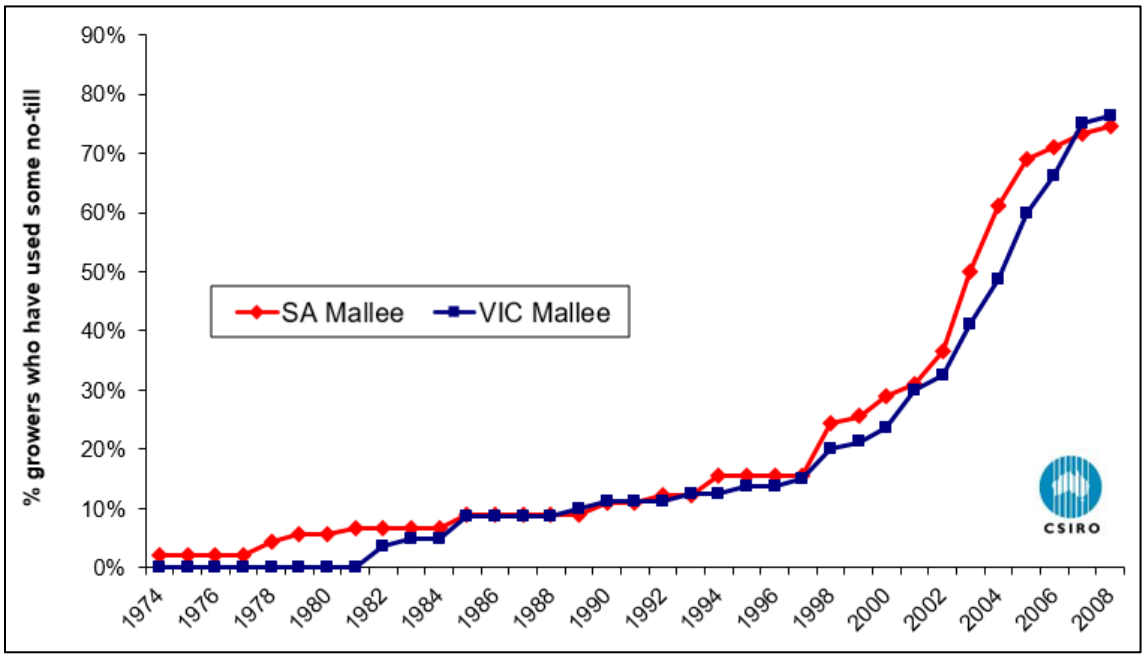
often early in the summer period, which has led to far greater control, even toward eradication for some farms. This is vital for the success of Notill farming, allowing for early sowing on minimal moisture, and preserving deep moisture for later in the growing season, especially in these very low rainfall environments. Many farmers are now spraying these summer weeds prior to pasture years to keep the weeds under control and to preserve moisture for their regenerating pastures.

These survey results confirm that one of the unexpected negative consequence of these changes is that many of these deep (and often non-wetting) sandy rises with relatively low water holding capacity, are now contributing excessive recharge water into the perched water tables in localized catchments.

This then makes these catchments far more susceptible to above average rainfall events, particularly through the non-growing season periods. Initially, these wetter soils can lead to higher crop growth, but as they become saturated the crops decline and invasive weeds such as ryegrass, or other salt tolerant plants begin to dominate. Soon, this ground will begin to bare out, leading to high water evaporation. Unfortunately the low concentration of salt from the soil and the water begin to get concentrated at the surface at the water evaporates and leaves the salts behind, which leads to bare saline scalds at the surface and total land degradation. The fact that this land is no longer utilizing moisture through vegetation means that it will often remain saturated and quickly spread in area, depending on the local terrain.

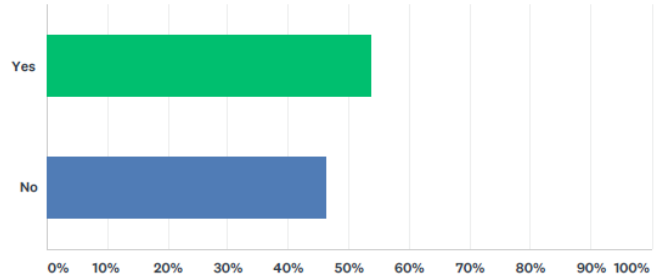
It is worth noting that only 14% of farmers listed that the clearing of native vegetation was a key cause of their seep issues. Much of this land was cleared for farming in the last 50-100 years, and it appears that many farmers feel that the current seep issues are more likely due to these more recent changes to mallee farming systems.

Figure 3. Changes towards Notill Farming Systems (adapted from Llewellyn & D'Emden 2012)



Q8 Have you done anything to control seeps or their impacts on your property?

Answered: 78 Skipped: 2



ANSWER CHOICES	RESPONSES	
Yes	53.85%	42
No	46.15%	36
TOTAL		78

Question 8 reveals that slightly over half of the respondents have applied some management of their seep issues. Question 9 shows that the most common management strategy used (24 farmers) has been strategic tree planting, of which nearly 30% said had worked well, while a further 33% have led to slight improvements. Nearly 30% said it was too early to tell and 8% thought that it had been unsuccessful. Tree planting has great potential for high water use that intercepts subsoil water flows, however, the positioning, establishment and the choice of species can all dramatically impact on their effectiveness.

Only 13 farmers said they had used strategic lucerne planting, but this clearly showed the highest rate of success at 61%, with most of the others reporting some success, or that it was too early to assess. This is very promising, as lucerne also can have excellent economic advantages in providing excellent summer or winter feed or hay cutting options.

Q9 If Yes, what have you tried around or within seep areas? How Successful has this been?

Answered: 42 Skipped: 38

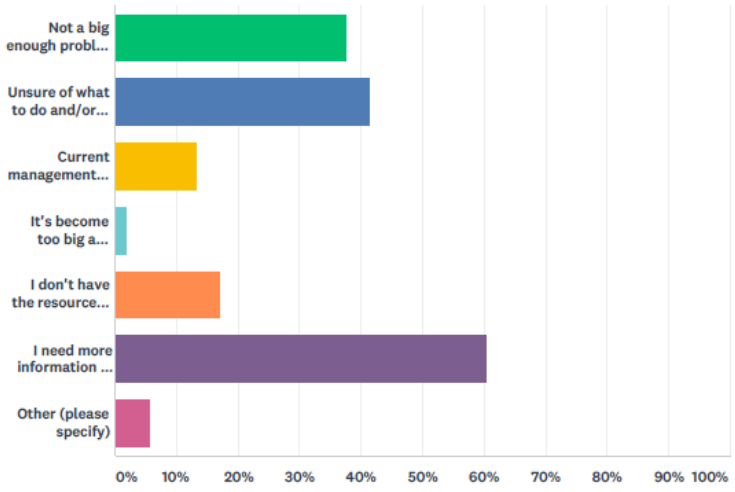
	HAS WORKED WELL	SLIGHT IMPROVEMENTS	TOO EARLY TO ASSESS	HAS NOT WORKED	TOTAL
Strategic Tree Planting	29.17% 7	33.33% 8	29.17% 7	8.33% 2	24
Strategic Lucerne Planting	61.54% 8	7.69% 1	23.08% 3	7.69% 1	13
Establishment of Salt/Water logging Tolerant Pastures	27.27% 3	27.27% 3	27.27% 3	18.18% 2	11
Soil Amelioration Techniques (eg Deep ripping, spading, organic matter incorporation)	10.53% 2	26.32% 5	31.58% 6	31.58% 6	19
Agronomic Improvements/Changes (to help maintain higher water use)	20.00% 2	20.00% 2	40.00% 4	20.00% 2	10

While 19 farmers had tried various forms of subsoil amelioration such as deep ripping, spading and organic matter incorporation, there were only 2 clear success story to report, with 6 suggesting that it was too early to assess the results. These operations can have very high up-front costs, and so can be risky to apply in not done effectively. While recent projects such as New Horizons are showing very positive yeild improvements and higher water use by addressing subsoil issues, there appears to be s strong need to further understand, develop, extend and practically apply these techniques amongst the famring community.

It is concerning that only 11 respondents have utilised salt/water logging tolerant pastures in their management of seeps. This would suggest that many areas have been allowed to become bare without the establishment of cover which is vital in reducing evaporation losses and the accumulation of toxic salt at the surface. Raising the awareness and application of suitable pastures on and immediately around the forming seep areas must be a high priority for future work, to help minimise the spread of degraded land.

Q10 If No, or if you have taken only limited action, what are your reasons for this?

Answered: 53 Skipped: 27

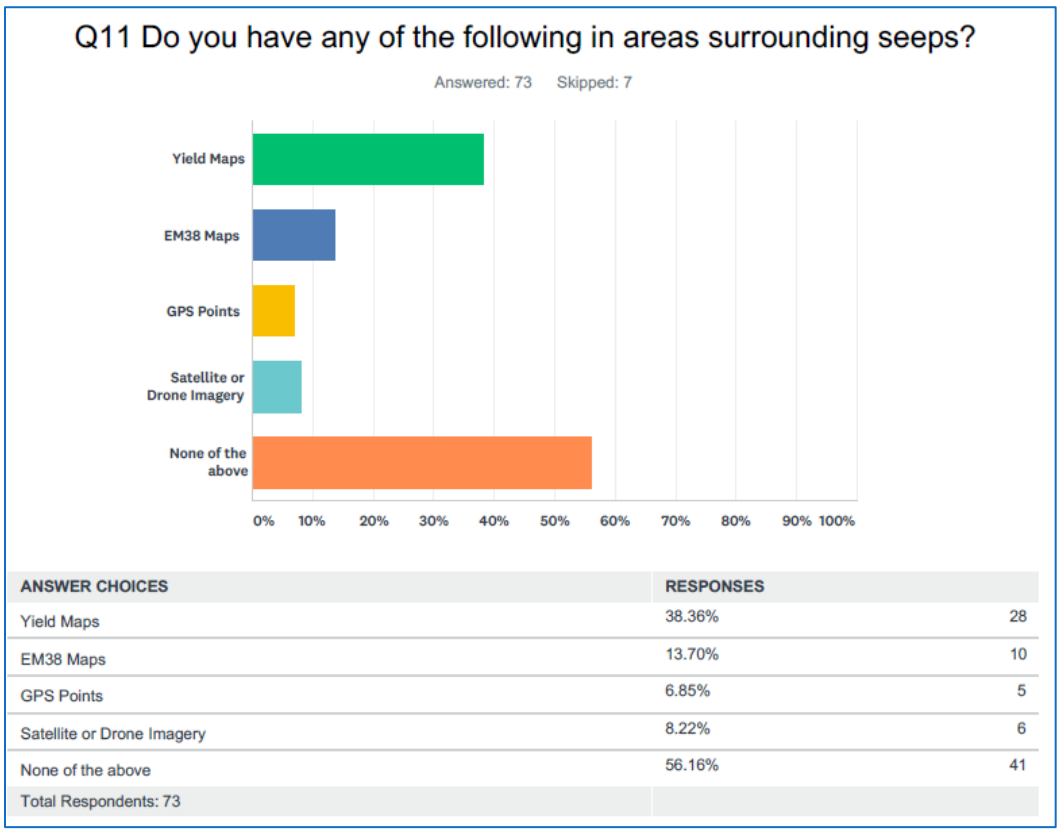


ANSWER CHOICES	RESPONSES	
Not a big enough problem yet	37.74%	20
Unsure of what to do and/or who to ask	41.51%	22
Current management solutions don't suit my farming system	13.21%	7
It's become too big a problem	1.89%	1
I don't have the resources to fix the problem	16.98%	9
I need more information to know what to do	60.38%	32
Other (please specify)	5.66%	3
Total Respondents: 53		

Question 10 reveals that most farmers require help to overcome seep issues. Of the 53 individuals that are yet to do anything to address the problem, or have only limited action, 42% revealed that they were unsure of what to do and/or who to ask. 60% stated that they needed more information to know what to do. This is a clear indication that there is far more work required in these areas, and that clear and effective messages need to be communicated, along with local demonstrations to help improve farmers understanding of seeps and how they can implement successful high water use strategies that suit their particular farming systems and situations.

It is also interesting that 20 farmers said that the problem was not quite big enough yet to cause them to take action. Simply leaving seeps alone is most likely to result in significant losses in farm production and efficiencies in time. With seeps clearly becoming a growing land degradation issue, early detection and preventative ameliorative action is vital.

3.5 On-farm data that may assist seep monitoring and management



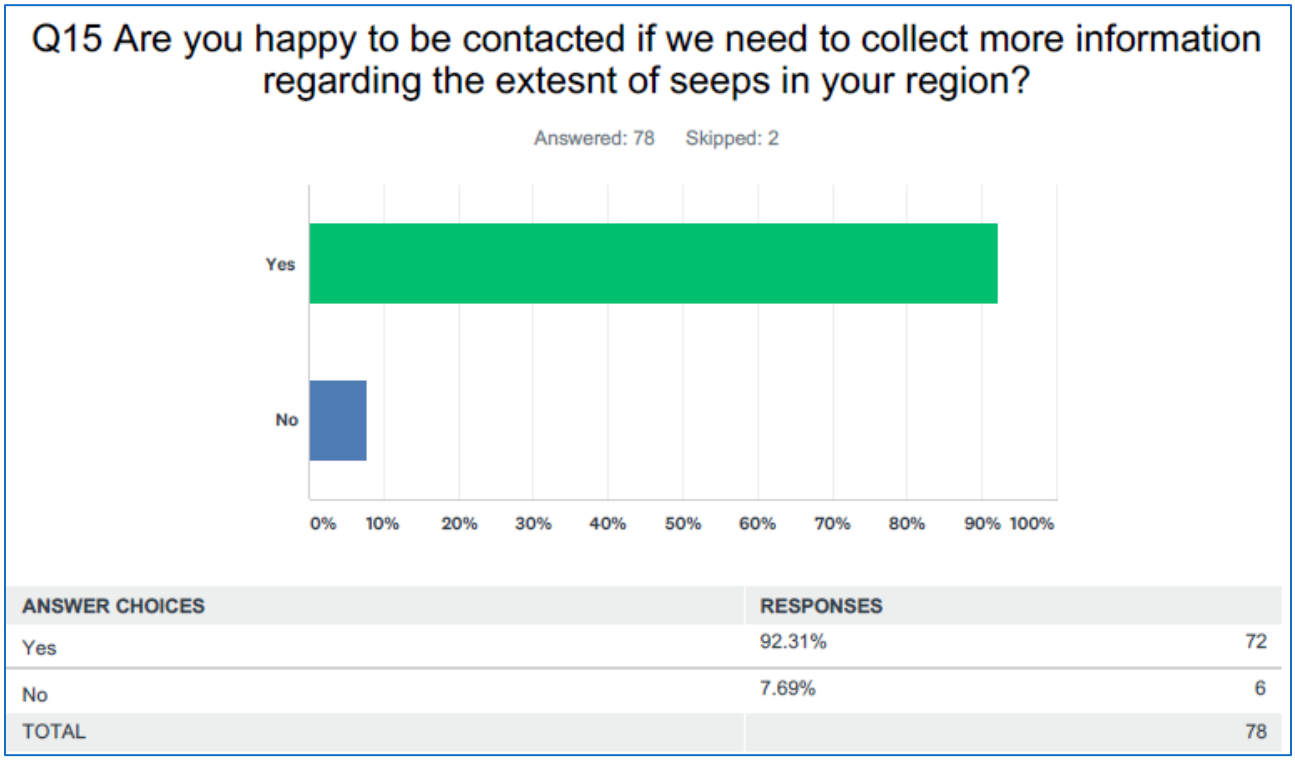
ANSWER CHOICES	RESPONSES	
Yield Maps	38.36%	28
EM38 Maps	13.70%	10
GPS Points	6.85%	5
Satellite or Drone Imagery	8.22%	6
None of the above	56.16%	41
Total Respondents: 73		

Question 11 reveals that nearly 40% of farmers surveyed have yield map information surrounding seep areas. It is possible that this could be used to further investigate both the growth and the costs of lost production over time of seep affected areas. Farmers with EM38 maps may be able to be utilized to better understand the catchment soil dynamics, leading to improved management strategies targeting the right areas in the landscapes

Farmers with access to drone photographic or NDVI imagery may well be able to utilize these technologies to better understand and target the early detection of saturated soil zones.

The identification of such farmers within this survey may be advantageous in developing further sites for future project work in these areas.

3.6 Farmer engagement and willingness to be involved in future work.



ANSWER CHOICES	RESPONSES	
Yes	92.31%	72
No	7.69%	6
TOTAL		78

92% of farmers surveyed expressed a willingness to be contacted and involved in future seep project work as it develops. This is a clear indication that seeps are a growing concern across the regions, and farmers are looking forward to working together to find practical solutions of overcome the issues of seeps on their farms and across their districts. This survey has resulted in a strong database of the farmers seep information and contact details, meaning there is already strong community support to address the issues and to implement on-farm demonstrations and strategies.

4 Estimations of potential seep developments and costs

This section involves some extrapolated information based on both the survey data obtained from the 80 respondents, as well as considered discussion with scientific officers and consultants working within these areas, directly with these farmers. Those reviewing the site locations of respondents suggest that the survey directly represnted about one third of farmers known to have seep related issues across these areas. It is therefore likely that there is 230-250 farmers that are currently experiencing seep issues within their properties across this region. Using this as a baseline, the following extrapolations and estimations have been made:

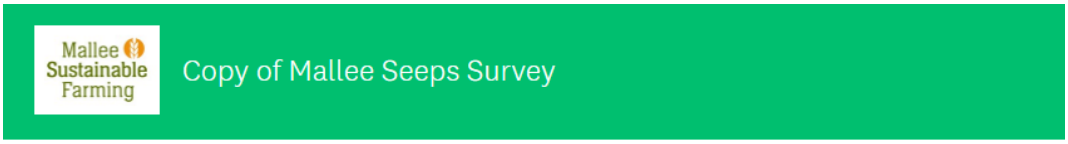
- Applying an average farm size of 4000ha, this means that there may be approximately 1,000,000ha of actual farms that are affected, having seeps within their properties.
- In terms of actual land currently affected by seeps, our survey revealed an average of 9 ha/farm seep affected, and a total of 675 ha (which is likely to be conservative as some farmers only indicated bare scalded areas rather than areas becoming wet). If this is representative 250 farmers affected, then this multiplies to 2250 ha, but the actual figure could be much greater.
- 43% of respondents were extremely concerned about the issue, with another 42% mildly concerned. With this 85% of concerned farmers, and the fact that 89% reported seeps having appeared since 2008, it is clear that this is a recently developing and rapidly growing issue and will continue to greatly impact farmer's ability to farm their land.
- With this clear indication of the fast growing nature of this problem, and after discussion with both farmers and technical advisors in the field that have witnessed the increases in this land degradation issue, it is not unrealistic to project that the current areas could increase tenfold over the next 5-10 years. This could therefore conceivably bring the affected land to 22,500ha across the region if left uncontrolled or unmanaged.
- 22,500ha of lost productive ground at an average yield of 1.7t/ha @ $250/t = $9,500,000/year or $95million over 10 years at this level (based on a range of rotation crops, prices and years on these most productive soil types). When adding in losses to grazing potential from stubbles and pastures this figure can easily be projected to potential losses of at least $100,000,000 over a 10 year period across the SA and Victorian Mallee to seeps.
- The cost to farmers is far more than the loss of farming land, which is usually their most productive soil types. There any many intangible faming cost such as the inconvenience and inefficiency of machinery having to avoid growing seep areas, as well as extract bogged machinery. Degraded land also decreases the value of the land. There are also aesthetic issues of saline land degradation along with the unpleasant odours caused.

5 References

D'Emden, L 2012, 'Adoption of no-till and conservation farming practices in Australian grain growing regions: current status and trends. In "Report for SA No-till Farmers Association and CAAANZ"',
https://grdc.com.au/__data/assets/pdf_file/0016/125206/grdcadoptionofnotillcroppingpracticesreportpdf.pdf.pdf

Hall, J. 2015, Mallee Dune Seeps Land, Soil and Water Investigations of Dune Seepage Systems in the South Australian Murray Mallee. A report for NR SAMBD, Project 1247C

6 Appendix



2017/18 Mallee Seeps Farmer Survey

Seeps are becoming an increasing problem for Mallee Farmers. **Please take a few moments to fill in this simple survey** that will allow MSF to make an initial assessment as to the extent, severity and possible causes of Mallee Seeps. This information will be used to help find practical solutions and secure funding for further research, extension and assistance.

1. Do you have any seeps/soaks on your property?

- ○ None
- ○ One
- ○ A few
- ○ Many

2. How big is area (in hectares) affected by seeps/soaks on your property?

0 100

3. How concerned are you about economic losses caused by seeps on your property?

- ○ Extremely concerned
- ○ Mildly concerned
- ○ Not concerned

4. How long ago did the seep/s you are most concerned about appear? (can tick multiple boxes for seeps appearing at different times)

- ☐ 2015-2017
- ☐ 2012-2014
- ☐ 2008-2011
- ☐ 2000-2007
- ☐ prior to 2000

5. What is the water quality within the seep areas?

- ◯ Unsure
- ◯ Fresh
- ◯ Becoming Saline
- ◯ Highly Saline (surface salt crystals evident)
- ◯ Some Fresh and Some Saline

6. Where in the landscape are the seeps found? (can choose multiple answers)

- ☐ in low lying swales
- ☐ beneath non-wetting deep sandy rises
- ☐ in mid-slope areas (often where clay close to surface)
- ☐ single seeps in isolated areas
- ☐ multiple seeps along possibly connected water courses
- ☐ Other (please specify)

6. Where in the landscape are the seeps found? (can choose multiple answers)

- ☐ in low lying swales
- ☐ beneath non-wetting deep sandy rises
- ☐ in mid-slope areas (often where clay close to surface)
- ☐ single seeps in isolated areas
- ☐ multiple seeps along possibly connected water courses
- ☐ Other (please specify)

7. What do you think may have caused or contributed to the growing seep issues on your property? (can choose multiple responses)

- [ ] I don't know why they have appeared
- [ ] Changing farming systems
- [ ] Chemical Summer Weed Control
- [ ] Periods of well above average rainfall
- [ ] Original Vegetation Clearance
- [ ] Rising Regional Water Tables
- [ ] Rising Perched Water Tables in Localized Catchments
- [ ] Poor Water Use on Deep/Non-Wetting Sands causing recharge
- [ ] General recharge occurring across a range of soil types
- [ ] Other (please specify)

8. Have you done anything to control seeps or their impacts on your property?

- ◯ Yes
- ◯ No

9. If Yes, what have you tried around or within seep areas? How Successful has this been?

	Has worked well	Slight improvements	Too early to assess	Has not worked
Strategic Tree Planting	◯	◯	◯	◯
Strategic Lucerne Planting	◯	◯	◯	◯
Establishment of Salt/Water logging Tolerant Pastures	◯	◯	◯	◯
Soil Amelioration Techniques (eg Deep ripping, spading, organic matter incorporation)	◯	◯	◯	◯
Agronomic Improvements/Changes (to help maintain higher water use)	◯	◯	◯	◯

Other (please specify)

10. If No, **or** if you have taken only limited action, what are your reasons for this?

- [ ] Not a big enough problem yet
- [ ] It's become too big a problem
- [ ] Unsure of what to do and/or who to ask
- [ ] I don't have the resources to fix the problem
- [ ] Current management solutions don't suit my farming system
- [ ] I need more information to know what to do
- [ ] Other (please specify)

11. Do you have any of the following in areas surrounding seeps?

- [ ] Yield Maps
- [ ] EM38 Maps
- [ ] GPS Points
- [ ] Satellite or Drone Imagery
- [ ] None of the above

12. Address

Name	
Company	
Closest Town	
State	
Email Address	
Phone Number	

13. What is you Ave Ann Rainfall?

250-279mm	280-309mm	310-339mm	340-369mm	370mm+
○	○	○	○	○

14. What is your Growing Season Rainfall?

150-179mm	180-209mm	210-239mm	240-269mm	270mm+
○	○	○	○	○

15. Are you happy to be contacted if we need to collect more information regarding the extesnt of seeps in your region?

- ○ Yes
- ○ No