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Natural resource management issues for the south coast regional strategy

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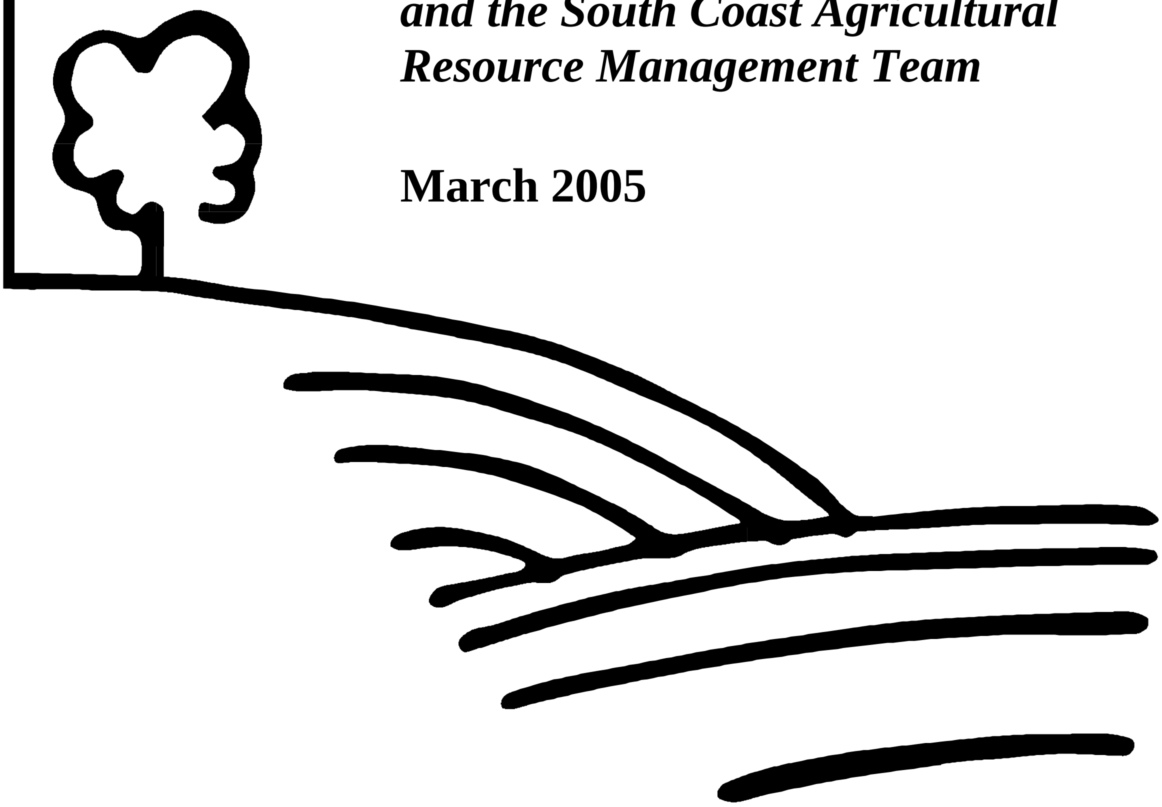
Department of Agriculture
Government of Western Australia

NATURAL RESOURCE MANAGEMENT ISSUES FOR THE SOUTH COAST REGIONAL STRATEGY

Brendan Nicholas
and the South Coast Agricultural Resource Management Team

March 2005



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Summary

- The SCRIPT (South Coast Regional Initiative Planning Team) region covers 5.4 million hectares from Frankland in the west to Cape Arid in the east.
- Agriculture is the dominant land use in the region with farmland occupying 70% of the landscape.
- The gross value of agricultural production in the Southern Agricultural Region, which is closely aligned to the SCRIPT region, is $997 M, which highlights its importance to the economy.
- Of NRM issues examined for the agricultural areas of the SCRIPT region, subsurface acidity is the most widespread, predicted to have a high risk in five of the six sub-regions.
- Water repellence will have a high risk in the Albany Hinterland, Esperance Sandplain and Fitzgerald Biosphere sub-regions and a moderate risk in the Kent-Frankland and Pallinup North Stirling sub-regions.
- Phosphorus export will be a high risk in the Albany Hinterland and Kent-Frankland sub-regions and a moderate risk in the Esperance Sandplain and Fitzgerald Biosphere sub-regions.
- Salinity will have a high risk in the Fitzgerald Biosphere and a moderate risk in Albany Hinterland, Esperance Sandplain, Kent-Frankland and Pallinup-North Stirlings. Salinity risk will be low in the Mallee.
- Wind erosion and waterlogging have moderate and low risks across the sub-regions as there are management strategies available that mitigate against them.
- Continued and increased investment in biosecurity is required to protect the biodiversity of the South Coast.
- Taking suggested management actions on agricultural land will be the key to addressing the risk of NRM hazards.

Contents

1. Introduction

The South Coast Regional Initiative Planning Team (SCRIPT) is preparing a regional strategy to guide the overall management of natural resources in the South Coast. The strategy will detail key issues, set targets, suggest management actions and guide investment to better manage natural resources.

This report has been prepared by the Agricultural Resource Management Program of the Department of Agriculture to assist SCRIPT in preparing the regional strategy. It records the key Natural Resource Management (NRM) issues threatening agricultural land on the South Coast.

Agricultural activities can have significant off-site impacts on environmental and infrastructure assets as well as on adjacent agricultural land.

Managing agricultural land effectively should be a priority in reducing the risks of land degradation on all assets in the region – productive agricultural land, biodiversity, waterways and infrastructure. Management actions are suggested as a basis for building key projects as part of regional investment frameworks.

The SCRIPT region

The SCRIPT region includes the catchments of all the southerly-flowing rivers between the Frankland in the west and Cape Arid in the east. Some internally drained areas to the north have also been included (Figure 1).

The region contains 10 local government areas: Denmark, Plantagenet, Albany, Cranbrook, Tambellup, Broomehill, Gnowangerup, Jerramungup, Ravensthorpe, Esperance, and parts of the Kojonup, Manjimup, Kent and Dundas Shires.

Table 1 shows that dryland agriculture is the dominant land use occupying 70% of the region (NLWRA 2001). Most of the remaining land, such as reserves and unallocated Crown land, is set aside for the conservation and protection of the natural environment.

The region covers 5.44 million hectares and has been divided into six sub-regions - Albany Hinterland, Esperance Sandplain, Fitzgerald Biosphere, Kent-Frankland, Mallee and Pallinup-North Stirling (SCRIPT 1996).

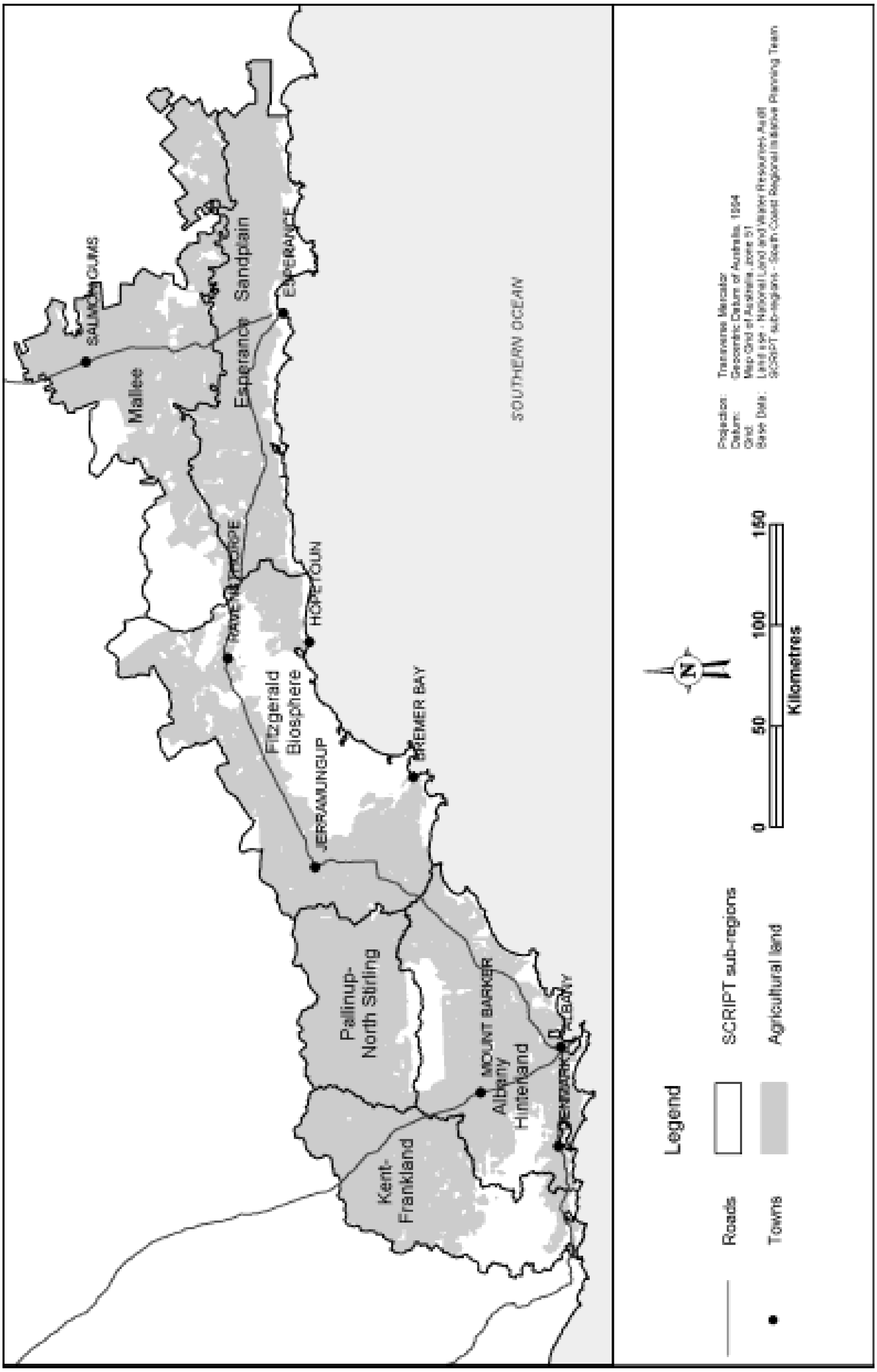

Figure 1: SCRIPT sub-regions showing extent of agricultural land

Table 1: Land use in the SCRIPT sub-regions

SCRIPT sub-region	Agricultural area		Other land use		Total ('000 ha)
	('000 ha)	(%)	('000 ha)	(%)	
Albany Hinterland	580	64	320	36	900
Esperance Sandplain	690	80	180	20	870
Fitzgerald Biosphere	730	54	630	46	1,360
Kent-Frankland	450	64	250	36	700
Mallee	780	70	330	30	1,110
Pallinup-North Stirling	440	88	60	22	500
Total	**3,670**	**67**	**1,770**	**33**	**5,440**

Sub-regions

Albany Hinterland
Sandy duplex soils, ironstone gravels and pale deep sands are the most common soils. Annual rainfall ranges from 1,200 mm in the south-west to 450 mm in the north. Annual cropping with annual and perennial pastures for sheepmeat and wool production are the dominant agricultural activities. Near the coast, established beef production competes with increasing areas of timber plantation.

Esperance Sandplain
Esperance Sandplain stretches from the coast to 40–60 km inland. It is characterised by sandy soils of varying depth overlying gravels or clays. The average annual rainfall ranges from 650 mm on the coast to 450 mm along the boundary with the Mallee. Agricultural activities are diverse with beef production and increasing areas of timber plantations near the coast. Annual cropping makes up the bulk of agriculture along with annual and perennial pasture production for sheepmeat and wool production.

Fitzgerald Biosphere
Fitzgerald Biosphere has a diverse range of soils with shallow sandy and loamy duplex soils, occasionally alkaline, with minor areas of deep sands and shallow gravels. Average annual rainfall varies from over 500 mm in coastal areas to 350 mm in northern parts. Agriculture is predominantly annual crops and wool production on annual pastures.

Kent-Frankland
The Kent-Frankland sub-region is characterised by a range of sandy duplex and, ironstone gravels soils. Annual rainfall is in excess of 1,200 mm at Walpole dropping to 450 mm at Broomehill in the north. Agriculture is predominantly annual cropping and wool production on annual pastures in the upper Frankland area. Viticulture, farm forestry, timber and olive plantations are increasing in the south with only small areas cleared for agriculture.

Mallee
The Mallee contains numerous salt lakes and mallee vegetation. Alkaline grey shallow sandy duplex soils are dominant. Yearly average rainfall ranges from 450 mm in the south to 300 mm in the north. Agriculture is predominantly annual crops and wool production on annual pastures.

Pallinup-North Stirling
A wide variety of sandy and loamy duplex soils occur across the area. It receives about 450 mm annual average rainfall. Agriculture is primarily cereal cropping in the north and east, with more livestock (sheep grazing) to the south-west.

Value of agriculture

The gross value of agricultural production (GVAP) for the Department of Agriculture's Southern Agricultural Region (SAR), which roughly coincides with the SCRIPT region (see Figure 2), is $997 million (Department of Agriculture 2003). The major industry is grain growing worth $580 M followed by sheep at $204 M. Beef production makes a significant contribution with $69 M. For the SAR farm businesses are showing an average return of capital of 4.5%. Detail on the value of agriculture can be found in the Southern Agriculture Regional Plan (Department of Agriculture 2003).

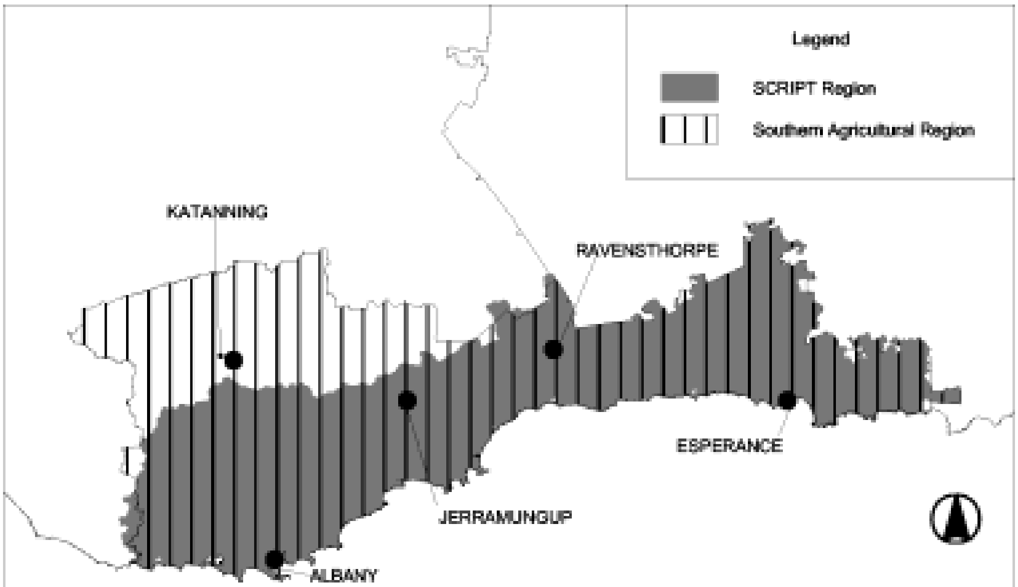

Figure 2: Comparison of the Southern Agricultural Region and SCRIPT Region

2. Natural resource management issues and risks

Nine NRM issues were examined to determine the risk posed to agricultural land in the SCRIPT region. These issues also have off-site impacts on water quality and biodiversity. This assessment considers the risk of NRM issues to agricultural land. Table 3 presents the risk assessment for the six SCRIPT sub-regions.

Data sources

The analysis was confined to the agricultural area of the SCRIPT region. The National Land and Water Resources Audit land use theme (NLWRA 2001) was used to define the agricultural area.

Soil-related land quality information was accessed from the Department of Agriculture's (2003a) soil-landscape mapping database (see Tables A1-8). For a summary of soil-landscape mapping, refer to Schoknecht, Tille and Purdie (2004). Definitions of land qualities and their values are documented in van Gool and Moore (1999).

For salinity-related issues a summary of low-lying areas with the risk of shallow watertables was developed (Table A9). The assessment is based on data from the Land Monitor project and National Land and Water Resources Audit (NLWRA). Land Monitor used a digital elevation model (DEM) to determine low-lying areas. The risk of shallow watertable is based on groundwater depth and trend data from the AgBores database (Short and McConnell 2001). Where groundwater levels are rising the low-lying areas have potential to develop shallow watertables causing dryland salinity. To assess the risk of shallow watertables on agricultural land, low-lying areas were intersected with data on the risk of shallow watertables.

Assessing risk

Table 2 describes the definitions used to assess the risks to agricultural land. A rating has been applied to each NRM issue. The risk from a particular hazard is a combination of the timeframe in which the hazard will occur and the area of land at risk. For example, a risk is rated as high if the hazard is likely in the next 20 years over a large part of the landscape, but lower if the area is smaller and unlikely to take effect for 50 years or more.

The assessment process, while guided by the rules in Table 2, is still subjective. When considering an NRM hazard the current availability of viable management options to address the issue was taken into account. The ease with which these options could be implemented was also considered. For example, the risk of wind erosion could be classified as high as the threat is inherent over a large part of the South Coast due to the sandy nature of topsoils. However a range of management options from no-till farming to guidelines on maintaining groundcover can mitigate the threat. On the other hand, salinity impacts on a relatively small part of the landscape but there are few economically viable options to manage it.

Table 2: Risk rankings for natural resource management threats

Risk	Definition
High	Current/imminent risk of high impact
Moderate	Current/imminent risk of moderate impact OR Medium-term risk of high impact
Low	Current/imminent risk of low impact OR Medium-term risk of low–moderate impact OR Long-term risk of low–high impact

Time scale	Impact scale
Current/imminent (within 0–20 years)	High impact (majority of asset at risk)
Medium-term (within 20–75 years)	Moderate impact (some of asset at risk)
Long-term (greater than 75 years)	Low impact (minority of asset at risk)

The assessment of risk is based on regional data summarised to agricultural land within the SCRIPT sub-regions and applies to the average of the sub-region. However sub-regions are heterogeneous and within each there will be areas that range in risk from high to low. These can be identified using the detailed data from the soil-landscape mapping database.

NRM risks

The assessed risk to agricultural land from each NRM issue is presented in Table 3. *Subsurface acidity* poses the greatest threat to land condition in the region. A high threat was recorded in all sub-regions except for the Mallee. The reason is the low buffering capacity and inherently low pH of the sandy topsoils and the acidifying effect of agriculture. Reduced plant growth caused by low pH also has potential to increase the impact of other NRM issues, particularly salinity and phosphorus export.

Water repellence is considered to pose a high risk in the Esperance Sandplain, Albany Hinterland and Fitzgerald Biosphere. The sandy topsoils have an inherent risk due to their low clay content.

There is a high risk from *phosphorus export* in the Albany Hinterland and Kent-Frankland sub-regions. Their higher rainfall increases nutrient loss in comparison to drier areas. High phosphorus export increases off-site impacts such as eurtrophication of waterways.

Salinity will have a high risk in the Fitzgerald Biosphere, as it will develop in a short timefame with a new equilibrium[1] reached before 2020 (Table 4). Moderate risk is expected in the Albany Hinterland, Esperance Sandplain, Kent-Frankland and Pallinup-North Stirling sub-regions, due to a longer timeframe to equilibrium. For the Mallee, salinity will have a low risk with a long timeframe before potential salinity develops fully.

[1] Equilibrium is when recharge and discharge of water from an aquifer are in balance.

Table 3: NRM risks for sub-regions (ordered by priority)

Sub-region NRM Issue	Albany Hinterland	Esperance Sandplain	Fitzgerald Biosphere	Kent-Frankland	Pallinup-North Stirling	Mallee
Subsurface acidity	High	High	High	High	High	Low
Water repellence	High	High	High	Moderate	Moderate	Low
Phosphorus export	High	Moderate	Moderate	High	Low	Low
Salinity	Moderate	Moderate	High	Moderate	Moderate	Low
Wind erosion	Moderate	Moderate	Moderate	Moderate	Moderate	Low
Waterlogging	Moderate	Moderate	Moderate	Low	Low	Low
Water erosion	Low	Low	Moderate	Moderate	Moderate	Low
Structural decline	Low	Low	Low	Low	Low	Low
Subsurface compaction	Low	Low	Low	Low	Low	Low

Wind erosion has traditionally been an issue associated with the sandy topsoils across the South Coast. All sub-regions were rated as having a moderate risk from wind erosion except the Mallee, which was low. This may be lower than expected given the history of wind erosion events. While the sandy topsoils face an inherent risk of erosion, the development of minimum tillage, groundcover monitoring guidelines, stubble retention and claying have lessened the likelihood of occurrence.

Waterlogging provides a moderate risk in the Albany Hinterland, Esperance Sandplain and Fitzgerald Biosphere. These sub-regions have higher rainfall and waterlogging-prone duplex soils are being cropped. Waterlogging, even of short duration, can have a severe impact on crop production. Techniques such as raised bed farming can reduce the risk in cropping systems.

Water erosion is predicted to have a moderate risk in three sub-regions where there is more landscape relief.

Subsurface compaction and *structural decline* are predicted to have low risk across the region because of soil particle size distribution.

An assessment of off-site risks from NRM issues would see reversed order of the four major issues with salinity and phosphorus export becoming top priority. As part of strategy development, the off-site risks will be more comprehensively assessed in cooperation with other agencies and SCRIPT.

3. Suggested activities

The Department of Agriculture reviewed the NRM issues and risks to agricultural assets and developed possible targets and management options.

Subsurface acidity

- Participative research and development by land managers on:
  - ⇒ use of lime to increase land use options;
  - ⇒ subsurface placement of lime;
  - ⇒ investigate extent of acid sulfate soils; and
  - ⇒ optimal treatment methods.
- Investigate links between acidity and other management issues (salinity, water quality).
- Develop and deliver decision support tools with agribusiness that quantify risk of subsurface acidity on agriculture.

Water repellence

- Identify suitable clay types for claying.
- Develop best management practices (BMPs) for agronomy on clayed soils.
- Develop BMPs that minimise or ameliorate water repellence.
- Investigate biological control of water repellence.
- Analyse economics of claying and other amelioration strategies.

Phosphorus export

- Establish nutrient balance models and industry benchmarks.
- Identify and quantify priority areas and priority actions for study catchments.
- Identify and quantify key nutrient sources for study catchments.
- Identify and quantify soil nutrient saturation constraints.
- Identify nutrient balance indicators, standards, targets and benchmarks for different enterprises.
- Establish BMP implementation and nutrient point source audit methodology, database, web interface, tracking and reporting system.
- Establish nutrient balance methodology and models and industry benchmarks.
- Develop catchment BMP models.
- Prepare BMP documentation and verification.
- Investigate approaches for implementation and adoption.

Salinity

- Investigate and characterise groundwater flow systems affecting assets and determine resource condition baselines.
- Determine, monitor and evaluate management options (engineering and biological) for groundwater recharge and discharge areas.
- Provide technical support to salinity management planning and evaluation.
- Improve groundwater monitoring and establish remote-sensing training sites.

Wind erosion

- Participative research and development examining:
  - ⇒ amelioration of non-wetting soils;
  - ⇒ levels of groundcover needed to protect land in adverse seasons; and
  - ⇒ adoption of perennials and practices suitable for sustaining groundcover on erosion-prone areas.

Waterlogging

- In a participative research and development process:
  - ⇒ implement BMPs for waterlogging landscapes;
  - ⇒ develop agronomic packages for new systems such as raised beds, soil amelioration, tramlines etc;
  - ⇒ implement best practice surface water management;
  - ⇒ apply seasonal forecasting to adaptive management strategies for seasonal variability; and
  - ⇒ match land use to land capability.
- Research and develop a method to predict areas susceptible to water erosion, using spatial data techniques.
- Continue extension and promotion of best management practices that minimise risk of water erosion.
- Review best management practices for water erosion.
- Develop linkages to nutrient export management.

Structural decline

- Participative research and development on:
  - ⇒ gypsum, organic matter ameliorants;
  - ⇒ subsurface applications of gypsum and other ameliorants;
  - ⇒ gypsum response on highly sodic surface crusting soils; and
  - ⇒ raised bed farming and application of precision agriculture.
- Develop decision support tools using agribusiness.

Subsurface compaction

- Participative research and development of:
  - ⇒ tramline farming and farm-scale testing by industry;
  - ⇒ perennials and phase farming systems;
  - ⇒ progressive tillage to ameliorate compacted soils;
  - ⇒ impacts of claying and minium tillage on compaction; and
  - ⇒ zone farming for compaction amelioration.

4. Biodiversity and biosecurity threats

Biodiversity and biosecurity threats (Table 4) were analysed using local expert knowledge. The same level of information is not available on a uniform basis for these threats. The threats and strategic actions were assessed using a workshop environment.

Table 4: Biodiversity and biosecurity threats for sub-regions

	Albany-Hinterland	Esperance Sandplain	Fitzgerald Biosphere	Kent-Frankland	Mallee	Pallinup-North Stirling
Biodiversity	High	High	High	High	Moderate	High
Biosecurity	High	High	Low	Moderate	Low	Moderate

Biodiversity

Biodiversity is linked to environmental stewardship within the agricultural industry. In the long-term agriculture will profit from maintaining and enhancing biodiversity. Good agricultural practices include activities that maintain and enhance native systems both on farms and in adjoining lands. To this end, the Department of Agriculture, charged with accelerating the success of Western Australia's agriculture, has a role in biodiversity management through improving the ecological sustainable development of agriculture.

- Fence creeklines and corridors to increase connectivity.
- Commercialise biodiversity assets (new crops).
- Increased sowings of native pastures and native forage species.
- Develop BMPs to buffer biodiversity assets.
- Increased links with the indigenous communities' current and proposed projects.
- Develop links between biodiversity and biosecurity management.
- Develop partnerships with the lead biodiversity agency.

Biosecurity

Biosecurity threats were difficult to determine due to difficulty in predicting the risk in terms of timeframe. Biosecurity is one of the core activities of the Department of Agriculture. One of the main factors used to assess biodiversity risk was the increasing number of visitors to the region, leading to increased risk of pests and disease being accidentally introduced and spread.

- Collaboration to identify conservation and sustainable land use biodiversity threats.
- Management actions target key pests and weeds in priority areas.

- Invest in management of pest, diseases and weeds of regional significance that impact on native ecosystems and agricultural landscapes using the following actions:
  - ⇒ Invest in community-based surveillance projects;
  - ⇒ Invest in community projects to manage pests, diseases and weeds.

5. Acknowledgments

The inputs of Nick Middleton and Phil Goulding from the Client and Resource Information System (CRIS) program are especially acknowledged for data provision and analysis.

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Appendix 1. Threats to selected land qualities for the agricultural area of SCRIPT sub-regions

Table A1: Phosphorus export threat in '000 ha and percentage of total (%)

Threat	Albany Hinterland	Esperance Sandplain	Fitzgerald Biosphere	Kent-Frankland	Mallee	Pallinup-North Stirling
Extreme	25 (4)	12 (2)	6 (<1)	14 (3)	4 (<1)	8 (2)
Very high	20 (3)	4 (<1)	40 (5)	32 (7)	1 (<1)	15 (3)
High	44 (8)	23 (3)	20 (3)	18 (4)	10 (1)	9 (2)
Moderate	174 (30)	155 (22)	258 (35)	89 (20)	64 (8)	68 (15)
Low	309 (53)	496 (72)	387 (53)	290 (64)	701 (90)	333 (76)
NA	8 (1)		19 (3)	7 (2)		7 (2)
Total	580 (100)	690 (100)	730 (100)	450 (100)	780 (100)	440 (100)

Table A2: Structural decline threat in '000 ha and percentage of total (%)

Threat	Albany Hinterland	Esperance Sandplain	Fitzgerald Biosphere	Kent-Frankland	Mallee	Pallinup-North Stirling
High	0 (<1)	0	11 (2)	0	0	1 (<1)
Moderate	559 (96)	688 (100)	616 (84)	442 (98)	779 (100)	430 (98)
Low	12 (2)	2 (<1)	83 (11)	2 (<1)	0	3 (<1)
NA	9 (2)		20 (3)	6 (1)	1 (<1)	6 (1)
Total	580 (100)	690 (100)	730 (100)	450 (100)	780 (100)	440 (100)

NA = areas where map units were unattributed (no information)

Table A3: Subsurface acidity threat in '000 ha and percentage of total (%)

Threat	Albany Hinterland	Esperance Sandplain	Fitzgerald Biosphere	Kent-Frankland	Mallee	Pallinup-North Stirling
High	334 (58)	451 (65)	249 (34)	216 (48)	88 (11)	122 (28)
Moderate	57 (10)	56 (8)	263 (36)	42 (9)	649 (83)	143 (33)
Low	164 (28)	177 (26)	184 (25)	176 (39)	38 (5)	155 (35)
NA	18 (3)	6 (<1)	27 (4)	14 (3)	5 (<1)	19 (4)
Presently acid	5 (<1)	0	7 (<1)	2 (<1)	0	1 (<1)
Total	578 (100)	690 (100)	730 (100)	450 (100)	780 (100)	440 (100)

Table A4: Subsurface compaction threat in '000 ha and percentage of total (%)

Threat	Albany Hinterland	Esperance Sandplain	Fitzgerald Biosphere	Kent-Frankland	Mallee	Pallinup-North Stirling
High	107 (18)	87 (13)	189 (26)	136 (30)	499 (64)	182 (41)
Moderate	89 (15)	49 (7)	156 (21)	47 (10)	19 (2)	46 (10)
Low	373 (64)	554 (80)	366 (50)	261 (58)	262 (34)	206 (47)
NA	11 (2)		19 (3)	6 (1)		6 (1)
Total	580 (100)	690 (100)	730 (100)	450 (100)	780 (100)	440 (100)

NA = areas where map units were unattributed (no information)

Table A5: Water erosion threat in '000 ha and percentage of total (%)

Threat	Albany Hinterland	Esperance Sandplain	Fitzgerald Biosphere	Kent-Frankland	Mallee	Pallinup-North Stirling
Extreme	18 (3)	9 (1)	4 (<1)	9 (2)	4 (<1)	7 (2)
Very high	5 (<1)	3 (<1)	14 (2)	7 (2)	0 (<1)	3 (<1)
High	8 (1)	16 (2)	13 (2)	13 (3)	7 (<1)	6 (1)
Moderate	115 (20)	64 (9)	131 (18)	79 (18)	58 (7)	36 (8)
Low	119 (21)	148 (21)	281 (38)	111 (25)	64 (8)	190 (43)
Very low	306 (53)	450 (65)	268 (37)	224 (50)	647 (83)	191 (43)
NA	9 (2)		19 (3)	7 (2)		7 (2)
Total	580 (100)	690 (100)	730 (100)	450 (100)	780 (100)	440 (100)

Table A6: Water repellence threat in '000 ha and percentage of total (%)

Threat	Albany Hinterland	Esperance Sandplain	Fitzgerald Biosphere	Kent-Frankland	Mallee	Pallinup-North Stirling
High	159 (27)	185 (27)	170 (23)	84 (19)	485 (62)	116 (26)
Moderate	239 (41)	462 (67)	264 (36)	201 (45)	76 (10)	141 (32)
Low	6 (1)	0 (<1)	59 (8)	0 (<1)	0 (<1)	4 (<1)
Nil	157 (27)	38 (6)	211 (29)	153 (34)	215 (28)	160 (36)
NA	19 (3)	5 (<1)	26 (4)	12 (3)	4 (<1)	19 (4)
Total	580 (100)	690 (100)	730 (100)	450 (100)	780 (100)	440 (100)

NA = areas where map units were unattributed (no information)

Table A7: Waterlogging threat in '000 ha and percentage of total (%)

Threat	Albany Hinterland	Esperance Sandplain	Fitzgerald Biosphere	Kent-Frankland	Mallee	Pallinup-North Stirling
Very high	58 (10)	12 (2)	11 (2)	22 (5)	38 (5)	14 (3)
High	25 (4)	5 (<1)	19 (3)	24 (5)	2 (<1)	11 (3)
Moderate	45 (8)	17 (2)	137 (19)	71 (16)	3 (<1)	41 (9)
Low	159 (27)	141 (20)	168 (23)	33 (7)	354 (45)	48 (11)
Very low	103 (18)	243 (35)	103 (14)	92 (20)	19 (2)	166 (38)
Nil	182 (31)	272 (39)	273 (37)	200 (44)	364 (47)	153 (35)
NA	8 (1)		19 (3)	8 (2)		7 (2)
Total	580 (100)	690 (100)	730 (100)	450 (100)	780 (100)	440 (100)

Table A8: Wind erosion threat in '000 ha and percentage of total (%)

Threat	Albany Hinterland	Esperance Sandplain	Fitzgerald Biosphere	Kent-Frankland	Mallee	Pallinup-North Stirling
Extreme	1 (<1)	0	<1 (<1)	<1 (<1)	0	0
Very high	45 (8)	60 (9)	29 (4)	33 (7)	44 (6)	33 (8)
High	155 (27)	188 (27)	115 (16)	125 (28)	31 (4)	106 (24)
Moderate	191 (33)	362 (52)	264 (36)	158 (35)	40 (5)	89 (20)
Low	179 (31)	80 (12)	306 (42)	127 (28)	665 (85)	207 (47)
NA	9 (2)		16 (2)	7 (2)		5 (1)
Total	580 (100)	690 (100)	730 (100)	450 (100)	780 (100)	440 (100)

NA = areas where map units were unattributed (no information)

Table A9: Low-lying areas with the risk of shallow watertables in 2020 and 2050 in '000 ha and percentage (%)

Risk	Year	Albany Hinterland	Esperance Sandplain	Fitzgerald Biosphere	Kent-Frankland	Mallee	Pallinup-North Stirling
High	2020	2 (<1)	25 (4)	39 (5)	0 (<1)	10 (1)	11 (3)
	2050	37 (6)	105 (15)	39 (5)	44 (10)	18 (2)	43 (10)
Moderate	2020	68 (12)	94 (14)	20 (3)	50 (11)	137 (18)	32 (7)
	2050	33 (6)	14 (2)	20 (3)	7 (2)	129 (17)	0 (<1)
Low	2020	5 (1)	0 (<1)	2 (<1)	0 (<1)	35 (4)	0 (<1)
	2050	5 (1)	0 (<1)	2 (<1)	0 (<1)	35 (4)	0 (<1)
Nil	2020	396 (68)	423 (61)	402 (55)	319 (71)	577 (74)	245 (56)
	2050	396 (68)	423 (61)	402 (55)	319 (71)	577 (74)	245 (56)
NA	2020	109 (19)	147 (21)	267 (37)	80 (18)	20 (3)	152 (35)
	2050	109 (19)	147 (21)	267 (37)	80 (18)	20 (3)	152 (35)
Total		580 (100)	690 (100)	730 (100)	450 (100)	780 (100)	440 (100)

Risk[2]	***Water level depth and trend***
High	<2 m; 2–5 m and rising
Moderate	<2 m and falling; 2–5 m and flat or falling; 5–10 m and rising; >10 m and rising
Low	5–10 m and flat or falling; >10 m and flat
Nil	Outside of the 0.5 m 'average height above valley floor' class
NA	Data not available

[2] Adapted from Short and McConnell (2001)