National Land and Water Resources Audit

Extent and impacts of Dryland Salinity in Tasmania

Project 1A

VOLUME 1

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Tasmania

DEPARTMENT *of*
PRIMARY INDUSTRIES,
WATER *and* ENVIRONMENT

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SUMMARY

SUMMARY

EXTENT

- It is estimated that the area of salinity in agricultural land is as follows

Year	Area of salt affected land (ha)
1992	**45 000** (30 000 – 60 000)
2000	**53 500** (36 200 – 71 200).

- It is likely that some of the increase is salinity recorded since 1992 is due to increased detection of land previously affected.
- Assuming about half is an actual increase, the average rate of increase between 1992 and 2000 was 1.5% per year.
- Analysis of the 41 Land Systems identified in 1992 as containing areas of salinity has shown that the most frequently occurring are

93 series (Quaternary sands and sandstones)	55%
84 series (Tertiary mudstones)	25%
88 series (Tertiary complexes)	5%

- A further nine Land Systems were identified in 2000.
- Analysis of ground water bore data (to 1999) for EC* readings above 1 500 which indicates the level of salinity which makes water risky to use for irrigation shows:

Statewide	444 random bores	43% above 1 500 EC
Within saline areas	70 test bores	90% above 1 500 EC

*EC refers to microSiemens /cm and is one standard unit of salinity

- Time lapse recordings of surface water in rivers at 12 permanent monitoring sites since 1994 show that only one (the Coal River at Richmond) had readings above 800 EC at any time, with one reading of 1 455 EC.
- Analysis of other surface water data (random samples to 1999) for EC readings above 800 EC has shown instances in 20 of the 25 catchments sampled. Seventeen of these catchments contained some of the land systems containing areas of salinity.

TRENDS

- Assuming the present rate of increase in salinity, estimated to be 1.5%, is real and continues, the following predictions have been made:

Year	Area of salt affected land (ha)
2020	**69 550** (47 000 – 92 500)
2050	**93 625** (63 350 – 106 800)

- Shallow water tables, rising water levels and water quality as measured by EC are three Audit indicators of salinity risk.
- Standing water levels in piezometers and bores in two salt affected test areas measured over five years or more, the first indicator of risk, showed the following Audit Risk Rating for rising salinity

Risk	High	Moderate	Low	**Total**
Number	29	24	1	54
(%)	(54)	(44)	(2)	(100)

- Results from a statewide random sample of ground water bores showed Depth to Water Struck (DWS) which is the second indicator of salinity risk showed:

DWS (m)	**Number**	**%**	**Risk**
0 - 2	49	1.7	High
2 - 5	255	8.8	Medium
5 – 10	839	28.9	Low
Over 10	1760	60.6	Low
Total	2903	100.0	

IMPACTS

Agriculture

- There are about 1 950 000 ha of agricultural land,
  1 410 000 ha cleared
  540 000 ha uncleared
  100 000 ha irrigated
  75 000 ha cropped

  of which about 53 500 ha were possibly salt affected in 2000
- Thus, about three percent of agricultural land may be salt affected.
- Assuming an enterprise mix of 80% extensive and 20% cropping , and that in 1992 the average regional gross margin for this mix was $250, then the total Gross Margin for the same area as that assumed to be salt affected would have been $11 250 000.
- Assuming salinity continues to rise and decreases production by 40%

Estimated production losses due to salinity ($)			
Annual increase	Year		
	2000	**2020**	**2050**
1.5%	5 350 000	6 955 000	9 362 500
3.0%	5 350 000	8 560 000	13 375 000

Water Quality

- The only quantifiable impact is that on water in the Coal River in the South East Irrigation Scheme which is at times at EC threshold levels which make water risky to use for irrigation.

Biodiversity

- The Flinders and Northern Midlands BioRegions are potentially the most affected.
- The following occur in land systems containing areas of salinity and are considered to be of medium to high risk of rising salinity:

Wetlands	132	Vegetation – non forest	12
National significance	44	forest	12
International significance	6	Flora species	44
Reserves	25	Fauna species	17

Infrastructure

- Ten Local Government Areas contain 95 per cent of the land thought to be salt affected, and four contain 80 per cent.
- These four include 6 000km of roads which cost $19 000 000 annually to maintain including associated bridges.
- A very small proportion of these may be damaged but there is no evidence at present and little expertise to estimate risk.
- There is some evidence of damage to four golf courses which is being remediated at minimal cost, and to some sports ovals which has not been addressed. No assessments have been made on adjacent holdings.

LAND USE IMPLICATIONS

- Land clearance, rainfall, and irrigation which is not carefully managed, are generally accepted as being three major drivers of salinity.
- The rate of land clearance on private/freehold land has dropped statewide in the last decade from about 10 000 ha/year 1989 – 1993 to 4 750 ha/year 1994 – 1999.
- As most of this was in the higher rainfall areas and 40% was for plantations it is therefore unlikely to be a major driver of salinity.
- The decline of extensive agricultural enterprises, especially sheep, and the increased demand for crops such as vegetables and poppies has driven diversification and an expansion of irrigation into dryland areas.
- For agriculture, the most significant impact of rising salinity would therefore be the regional effect on diversification from marginal extensive enterprises into intensive irrigated cropping (especially into high value, salt sensitive crops) with the associated financial implications to individual landowners and agribusiness.

- It could also have an adverse effect on market perceptions of Tasmania as "Environmentally responsible" and thence affect market share in export markets.
- An increase in salinity levels in surface and ground water may lead to "no go areas" such as sources of domestic water supplies and ground and surface water for use for irrigation.
- If not addressed, increasing salinity could also lead to "no go" areas in catchments containing Wetlands of National and International Significance, have an impact on Tasmania's obligations under UN conventions and possibly have an adverse effect on potential future developments in ecotourism.
- **Key recommendations** relating to this include the need for:
  - Salinity Risk Assessments to be prepared for irrigation developments in identified saline areas;
  - the development of salinity assessment and identification skills in local government staff;
  - research aimed at understanding salinity processes and the development of appropriate management practices for Tasmania; and
  - the development of management plans for public lands, addressing the implications of salinity.

POLICY REQUIREMENTS

- Salinity has not been an issue in Tasmania and so at present there is no specific policy to guide its management.
- The **key recommendations** on policy are that the State should:
  - adopt a Whole of Industry /Government approach to the issue;
  - work with all key stakeholders to develop a State Salinity Management Strategy;
  - allocate resources for the implementation of key strategies identified in the Strategy; and
  - allocate resources for Tasmania's involvement in the National Dryland Salinity Program.

FUTURE ASSESSMENT AND MONITORING REQUIREMENTS

- **It is recommended** that strategic monitoring should be assured to enable results to be published in four iterations of the five year cycle of the "State of the Environment" reporting framework, and a central data base be established.
- **It is also recommended** that
  - there should be rapid field assessments to check some of the statements made in the report covering trend estimates, biodiversity, and damage to infrastructure
  - at least three Key Reference Sites should be established in which to integrate strategic monitoring and assessment.

Note :The Recommendations are described in full in Section 5 (pp 16 and 17) of the Report

EXTENT AND IMPACTS OF DRYLAND SALINITY IN TASMANIA

1. INTRODUCTION

- This report describes the work carried out to quantify the extent and impacts of dryland salinity in Tasmania for the National Land and Water Resource Audit.
- In 1993, with less than one percent of the total agricultural land considered to be salt affected, soil salinity in the State was considered to be a relatively small problem compared with mainland States such as Victoria and Western Australia.
- Expressing the saline area as a percentage of the total masks the concentration of salinity in certain districts, which is acknowledged to varying degrees.
- The purpose of the National Audit is to provide an objective assessment of dryland salinity at the regional level by using a consistent analytical approach.
- This assessment will be useful for making more informed decisions, not only in the context of policy at all levels but also in the context of land management.
- Given the district nature of salinity distribution in Tasmania, the emphasis has been on reporting by land systems containing salinity which can be related in particular to Local Government Authority boundaries, as well as catchments.
- These Authorities have a key responsibility for service delivery in contexts affected by the salinity issue, such as catchment management and the planning process as well as road maintenance and reticulated water supplies.
- The extent of dryland salinity is shown in this Report to be a small problem relative to some Mainland States but that it is an increasing problem.
- It is acknowledged that "prevention is better than cure" regarding salinity and so the Recommendations in this Report have been framed with this in mind.

2. METHODOLOGY

2.1 Land Systems

- Land systems are areas of land with the same annual rainfall, geology, altitude, topography, soils and vegetation, defined by a unique six digit code.(Table 1)
- Over 400 land systems were recorded in surveys conducted between 1975 and 1989 and published by the Department as seven Regional Reports.
- In 1992, maps of those systems which contained private and freehold land were used as a basis for recording the extent of eight types of land degradation, including salinity.
- The degradation was recorded by twenty Departmental officers, based on their collective detailed knowledge of local conditions, and published by Grice (1995).
- Grice defined levels of **salinity** as:

Nil	*no obvious visual signs.*
Moderate	*plant and tree vigour reduced, no salt sensitive species, bare patches in pasture usually less than one square metre.*
Severe	*extensive areas of bare ground and possibly salt crusts, trees dead or dying- only salt tolerant species present.*

- This report was used as the baseline for estimating the extent of salinity in 1992.

- Data collated by the Department's Salinity Officer, based on field work between 1995 and 2000 was used to identify new land systems not recorded as expressing salinity in 1992 and thence estimate the trend over eight years. (Appendix 1)

2.2 Workshop on Implications of Possible Rising Salinity

- Twenty-eight representatives attended from several Sections of the Department, Mineral Resources Tasmania, Forestry Tasmania, the Forestry Practices Board, the Tasmanian Farmers and Graziers Association, Greening Australia, the World Wide Fund for Nature, the University of Tasmania, local government, the food processing industry and agricultural consultants.
- The data on land systems containing areas of salinity together with the ground water data for bores with Depth to Water Struck of two metres or less was printed as a 1: 500 000 map and used as a basis for discussion at a Workshop.
- A set of maps was produced later at 1: 250 000 for subsequent work and as an Audit product to accompany this Report.
- The representatives were divided into four Special Interest Groups representing the four aspects of the reporting framework for the Audit, namely
    - Agriculture
    - Water – ground and surface
    - Biodiversity
    - Infrastructure

  and asked to consider the implications of possible rising salinity.
- Each group reported on their findings. The methods developed as a result for each of the four aspects of the Audit reporting framework are detailed below.

2.3 Agriculture

- Economic pressures on dryland agriculture, especially the decline in traditional enterprises based on sheep, are forcing farmers to consider the potential for diversifying into enterprise mixes which include irrigated annual cropping. This was identified early in the Audit as a potential driver of increased salinity.

- The Workshop highlighted some of this potential and formed the basis for a calculation of the losses which would possibly have been experienced by operating in a salt affected area. It has not been possible to consider in detail losses for the wide range of crops which can be grown in Tasmania, which vary considerably in gross margin.

- The possible losses shown in this calculation are therefore based on "best guesses" of existing enterprise mixes, and a production loss based on judgements made by three Departmental Officers. The calculation was framed with the assistance of a Departmental Economist, with comment from a private agricultural consultant.

- It must be stressed that the calculation is purely indicative, to fulfil the requirements of the Audit and no attempt has been made to fine tune it, in the absence of any accurate quantitative local data. (Appendix 2)

- Land clearance, generally considered to have the potential of being a driver of salinity, was estimated from figures provided by the School of Geography and Environmental Studies at the University of Tasmania.

- The trend in irrigation, also generally considered to have the potential for driving salinity, especially in dryland areas, was estimated from figures supplied by a specialist industry irrigation consultant.

2.4 Water

2.4.1 Ground Water

- Mineral Resources Tasmania provided a data set on all bores with records satisfying the minimum requirements of the Audit.
- GIS coordinates have been established for 4 340 bores, of which 2 908 have records of Depth to Water Struck (DWS) which have been used to plot the locations of bores with DWS falling within the Audit classes.
- The Department also provided a data set on test bores drilled in two areas known to be salt affected and monitored for up to eight years. (Appendix 3)

2.4.2 Surface Water

- Surface water quality has been monitored by the Department at a limited number of sites in selected catchments for some time.
- More recently, the work by Waterwatch volunteers has given "snapshots" of water quality in a wider range of locations.
- Details are presented by Miller for this Audit (Appendix 4a and b).

2.5 Biodiversity

- The Special Interest Group identified those endangered or threatened vegetation types, flora, fauna, as well as wetlands and conservation areas of national and international significance which occur in the land systems containing salinity.
- The GeoTemporal Species Point Observations data base (GTSpot) was used to relate native vegetation and threatened species to the land system map.
- Expert opinion was used to assess the potential risk from rising salinity.
- Details are presented by Gilfedder et al for this Audit (Appendix 5.

2.6 Infrastructure

- The Special Interest Group suggested a review of anecdotal evidence from personnel involved in infrastructure maintenance to see if there was a perceived problem. Whilst the group were aware of the implications of possible rising salinity, given time constraints it was decided to comment simply on roads and their maintenance costs as data on this was available in the 1999 / 2000 Annual Report of the State Grants Commission.

3. KEY FINDINGS

3.1 Agriculture

3.1.1 Extent

- The land systems containing areas of salinity are described in Appendix 1.

Table 1: Most frequently occurring land systems containing salinity, 1992

93 series (Quaternary sands and sandstones)	55%
North East	
Tamar Valley	
Cressy – Longford	
Flinders Island	
84 series (Tertiary mudstones)	25%
Tamar Valley	
Cressy – Longford	
88 series (Tertiary complexes)	5%
Coal River	

- In 1992, these land system components covered 177 400 ha. The salinity was rated severe in components of 8 200 ha, moderate in 169 200 ha.
- This was checked as part of the Audit giving figures of 7 211 ha and 172 562 ha respectively, and a total of 179 773 ha, a very close approximation.
- However, field verification in two of these areas indicates that the actual area of land affected was probably between one third and one sixth of the visual estimate.
- **The area of salt affected land in 1992 was therefore possibly 45 000 ha (between 30 000 and 60 000 ha.)**
- The total area of private and freehold land in Tasmania is now about 1 950 000 ha.
- Of this, about 1 410 000 ha is used for agriculture (grazing, pastures and cropping) and 540 000 ha includes remnant vegetation and forestry.
- Therefore, three percent of agricultural land may possibly have been salt affected.

3.1.2 Trend

<u>1992 -2000</u>

- In 2000, using a similar approach, it is estimated that a further 8 500 ha were possibly affected (between 5 600 and 11 300 ha).
- This implies that the area of salt affected land in 2000 was possibly 53 500 (between 35 600 and 71 300ha), an increase of around 1 000 ha/year or 2.4 percent.
- Some of the increase was probably due to detection of salinity already existing and some a real increase.

- Assuming the real increase was 1.5 percent / year, this implies an increase of 5 400 ha in eight years (around 675 ha / year**).**

Table 2: Estimated area of salt affected agricultural land, 1992 and 2000

Year	Area of salt affected land (ha)
1992	**45 000** (30 000 – 60 000)
2000	**53 500** (36 200 – 71 200)

2000 – 2020 and 2050

- Fifty land systems have been mapped as containing areas of salinity.
- Twenty-five of these systems, comprising about 25 percent of the area mapped, have been shown to contain areas of salinity wherever they occur in the State.
- Fifteen comprise about 75 percent of the area mapped and include areas where salinity has not yet been visually expressed.
- These areas can be considered at risk if the present rate of increase continues.
- Assuming that salinity is indeed increasing at 1.5 percent per year, this implies the following:

Table 3: Estimated area of salt affected agricultural land, 2020 and 2050

Year	Area of salt affected land (ha)
2020	**69 550** (47 000 – 92 500)
2050	**93 625** (63 350 – 106 800)

- Salinity will increase if ground water levels (one of the main Audit indicators of salinity risk) rise in these areas or if salt is introduced into production systems.
- Water levels will rise if rainfall, land clearance and / or irrigation increases.
- Tasmania has experienced lower than average annual rainfall in the past twenty years dropping to the present historic low in the South of the State and it is not considered that ground water levels are rising naturally at present. It is assumed that average annual rainfall will increase before 2050.
- It is generally accepted that land clearance, especially the removal of deep-rooted trees, can cause water tables to rise and therefore drive salinity.
- The total area of agriculture is around 1 410 000 ha of which 1 335 000 ha is traditional dryland extensive and 75 000 ha is cropping.
- Another 535 000 ha remain uncleared in these land holdings.
- The rate of land clearance on agricultural land has halved in the last decade from about 10 000 ha / year between 1990 – 1993 to 4 750 ha / year between 1994 and 1999, mostly in the higher rainfall areas and on Flinders Island.
- Almost 2 000 ha of the agricultural land cleared was put to tree plantations.

- Land clearance has therefore reduced markedly in the State and almost ceased in the dryland areas and so is unlikely to be a major driver of salinity.
- It is generally accepted that irrigation on soils which are not free draining can raise water tables and can therefore be a driver of salinity in some situations.
- In 1995, 100 000 ha of agricultural land was irrigated.
- There is some evidence from the Department's bore holes of shallow ground water levels rising in the Coal River, which is part of the South East Irrigation Scheme.
- There is a continuing trend for traditional dryland extensive grazing and pasture based enterprises to diversify into irrigated cropping, using centre pivot technology, as the gross margins for extensive agriculture fall.
- It is estimated that in 2000 there are 120 centre pivot irrigator units operating in Tasmania, covering 4 800 ha, none of which would have been operating in 1995.
- It is not known how many are replacing other forms of irrigation and how many are for "first time" users but informed opinion suggests a majority.
- The estimate is for an additional 300, covering 12 000 ha, by 2020 and a further 300 by 2050, bringing the total to 24 000 ha. Assuming that 10 000 and 20 000 ha respectively are for "first time users", this will increase the total area of dryland irrigation to 115 000 ha in 2020 and 125 000 ha in 2050.

3.1.3 Economic impact

- The enterprise mix for the affected areas in 1992 was probably 85 percent extensive pasture based (gross margin $120 / ha) and 15 percent cropping (gross margin $1 000), giving an average gross margin of $250 / ha and a total value of production of $11 250 000 from 45 000 ha.
- It has been assumed that salinity would have reduced this by 40 percent or $4 500 000.
- Assuming salinity increases at 1.5% (Best Guess) or 3.0% (Worst Case):

Table 4: Estimated production losses 2000 – 2050

Estimated production losses due to salinity ($)			
Annual Increase	Year		
	2000	**2020**	**2050**
1.5%	5 350 000	6 955 000	9 362 500
3.0%	5 350 000	8 560 000	13 375 000

3.1.4 Implications

- The fact of an emerging salt problem will restrict the possibilities for agribusiness to diversify into high value, salt sensitive crops using irrigation.
- It could also have an adverse effect on market perceptions of Tasmania as “Environmentally responsible” and thence affect market share in export markets linked to Quality Assurance programs based on ISO 14 000, if it is not seen to be addressed by the State.

3.2 Water

3.2.1 Extent and Trend

3.2.1.1 Ground Water Depth to Water Struck (DWS)

- Records from 2 908 production bores from 4 340 drilled by Mineral Resources Tasmania and private contractors over the whole State between 1922 – 1999 showed the following:

Table 5: Depth to Water Struck (DWS) – selected records Statewide

DWS (m)	**Number**	**%**
0 - 2	49	1.7
2 - 5	255	8.8
5 – 10	839	28.9
Over 10	1760	60.6
Total	2903	100.0

- These figures reflect the average of a sample of data collected over 80 years and it is not known what effect time and other variables, such as the land form in which the drill was bored and topography might be have on this.
- Results from 70 test bores drilled specifically in salt affected land in 1999 showed that 53 percent had "DWS less than 2m".
- Thirty percent showed "DWS 2 – 5m".
- Standing water levels (SWL) in 54 piezometers and bores in the two salt affected test areas (Cressy - Longford and the Coal River),measured over five years or more, showed that 35 percent were falling, 45 percent flat, and 20 percent rising. These, combined with SWL gave the following.

Table 6: Salinity Risk ratings based on standing water level trends in the Cressy – Longford and the Coal River districts

Risk	High	Moderate	Low	**Total**
Number	29	24	1	54
(%)	(54)	(44)	(2)	(100)

3.2.1.2 Ground Water quality

- The Murray Darling Commission uses the following benchmarks for salinity based on electroconductivity, measured in microsiemens/cm (EC):

- 800 EC is the upper limit recommended by the WHO for drinking water and for optimum irrigation;
- 800 – 1 500 EC, at which level it is increasingly difficult to manage for irrigation;
- 1500 – 5 000 EC at which level adverse biological effects are likely to occur in aquatic ecosystems, and irrigation becomes increasingly risky;
- 5 000 EC which is the accepted value for aquatic biology which divides fresh from saline water and which imposes very severe restrictions on irrigation.

- Four hundred and forty-four of the 4 340 MRT bores were measured for salinity. The results were as follows:

Table 7: EC levels in ground water from selected production bores Statewide

EC	Number	%
0 - 800	203	45
800 – 1 500	51	12
1 500 – 5 000	142	32
Over 5 000	48	11
Total	444	100

- 43 percent of the ground water in the bores comprising this data set are above 1 500 EC and therefore would be risky to use for irrigation.
- Results from the 70 bores in the areas known to contain salinity are as follows

Table 8: EC levels in ground water from test bores in known saline areas

EC	Number	%
0 - 800	4	5.7
800 – 1 500	4	5.7
1 500 – 5 000	20	28.6
Over 5 000	42	60.0
Total	70	100.0

- Eighty-nine percent of the ground water bores in salt affected areas therefore located water which is risky to use for irrigation.

3.2.1.3 Surface Water quality

- Twenty-five of the 48 catchment areas in the State have had some surface water salinity testing.
- In some cases this was simply one sample taken from a minor tributary.
- In 19 catchments, some rivers and streams have been shown to contain water with levels above 800 EC in isolated instances to date.
- In 12 of these, there have been instances of recordings above 1 500 EC.
- The DPIWE has taken time lapse recordings at 12 Permanent Monitoring Sites since 1994 which have shown that only the Coal River at Richmond was above 800 EC at any time.(Appendix 4a)

3.2.2 Implications

- This may lead to “no go “areas such as
  - sources of domestic water supplies
  - ground and surface water which can be used for irrigation.
- This may also lead to litigation if financial loss is incurred which can be shown to be attributed to planning approvals based on poor technical advice regarding salinity.

3.3 Biodiversity

3.3.1 Extent

3.3.1.1 Bioregions

The Flinders and Northern Midlands bioregions are potentially the most affected.

3.3.1.2 Land systems

- The Cape Portland (393124) and Central Flinders (493127) land systems, both of which are in the Flinders bioregion, contain four Ramsar wetlands and 27 wetlands of national significance.
- The four land systems with severe salinity risk contain six threatened flora species and five threatened fauna species at high risk and ten threatened flora species and four threatened fauna species at medium risk.
- The potential impacts on biodiversity are greatest in the low rainfall areas of Tasmania where there has already been considerable impact on biodiversity. These areas have little remaining native vegetation, and have the highest numbers of local plant and animal extinctions and threatened taxa.
- One land system (Tunbridge Flats 173121), which has severe salinity, has less than 20 percent of the original vegetation. This land system contains ten wetlands, six of which are of national significance.

- It also contains Township Lagoon Nature Reserve, which has the only lowland temperate grassland on public land in Tasmania and important populations of threatened plant and animal species.

- This is a land system with naturally high salinity levels and there are a number of salt lakes in the region, which is known as the Salt pan Plains. Many species of flora and fauna are adapted to the salt levels.

- This may mean that some species could be threatened by works undertaken to ameliorate salinity. For example, the endemic Midlands buttercup is a salt-tolerant species that grows on the margins of wetlands that may be threatened if salt levels were reduced.

- The remaining three land systems with a severe salinity risk (Morningside 298133, Lagoon 393111, Lulworth 393123) have twelve wetlands at risk, including Jocks Lagoon Ramsar site.

3.3.1.3 Reserves

- Twenty-five conservation reserves including five national parks and nature reserves occur in areas with a moderate to high risk of salinity.

3.3.1.4 Wetlands

- The greatest risk from salinity is to freshwater ecosystems, particularly wetlands.

- Over 130 wetlands occur in land systems containing areas of salinity, including
  – 44 wetlands listed on the Register of Wetlands of National Significance
  – six of the ten Ramsar sites (Wetlands of International Significance).

3.3.1.5 Vegetation

- Vegetation associated with wetlands and lowland plains and river flats is considered to be most at risk. These vegetation types include
  – herbaceous wetland communities
  – silver tussock and kangaroo grass grasslands
  – swamp gum, cabbage gum and swamp peppermint woodlands
  which are already some of Tasmania's most endangered vegetation types.

- Twelve forest types and 12 non-forest vegetation types are at medium risk.

3.3.1.6 Flora

- Forty-three plant species are considered to be at high risk , including 21 species which are listed as endangered and seven species as vulnerable in Tasmania.

- Forty-four species listed as medium risk, of which 15 are endangered and 13 are vulnerable. Plants at greatest risk are orchids which have mycorrhizal fungi associated with their root systems and are sensitive to changes in soil chemistry.

- Annual plants such as grass daisy, dwarf sunray, tiny daisy, and many aquatic species are also potentially at high risk.

3.3.1.7 Fauna

- Seventeen faunal species listed in the Threatened Species Protection Act (1995) occur in land systems at moderate ore severe risk of salinity. Thirteen of these species occur in freshwater systems or associated aquatic or riparian vegetation. The remainder are species of native grasslands. Three of these species are listed nationally as vulnerable in the Endangered Species Protection Act (1992)

- Most of the species (potentially) at risk are those directly dependent on freshwater
- e.g. frogs, fish, caddis flies, freshwater snails, crayfish, and some cave fauna.

- Others are at risk through their dependence on specific microclimate or small scale vegetative conditions which could change faster or more subtly than the more obvious landscape-scale effects of salinity (e.g. snails, trap door spiders, velvet worms, beetles, life stages of moths and butterflies, cave fauna).

- It is impossible to predict the effects on all these species from existing knowledge.

3.3.2 Trend

- No estimate has been possible at this time.

3.3.3 Economic impact

- No estimate has been possible at this time.

3.3.4 Implications

- If not addressed, increasing salinity could
  - lead to “no go” areas in catchments for Wetlands of National and International Significance;
  - have an impact on Tasmania’s obligations under UN conventions;
  - possibly have an adverse effect on future developments in ecotourism.

3.4 Infrastructure

3.4.1 Extent

- There are 29 Local Government Areas (LGA) in Tasmania, four of which contain 80 percent and ten 95 percent of the land possibly containing salt.

3.4.2 Trends

- A computer model has been developed as part of the National Audit program which can be used to estimate what proportion are at risk from structural damage (and therefore increased maintenance cost) if salinity increases.
- The model is based on trends in ground water levels for which there is very limited monitoring by any Agency in Tasmania.
- There are no recorded instances of salt induced damage to date and little expertise to collect it

3.4.3 Economic impacts

- The four LGAs with 80 percent of the land possibly salt affected include

  6 000 km roads and associated bridges which cost $19 000 000 annually to maintain.
- It is probable that a very small proportion of these roads traverse this land and so salinity could increase this cost but it has not been possible to estimate this proportion.
- Assuming that roads and associated bridges are evenly distributed in private and freehold land, and given that about three percent of this is possibly salt affected, it could be speculated that three percent of the total annual maintenance bill ($570 000) might rise for these four LGAs.
- There is some evidence of damage to golf courses, the cost of remediation at the time of the Audit being minimal.
- There has been no systematic reconnaissance for such damage or to associated holdings.

3.4.4 Implications

- Salinity damage develops very slowly over time and is much more expensive to remediate than to prevent.
- Relatively cheap monitoring and assessment will avoid expensive future remediation.
- It should minimise the chance of future litigation to seek compensation for damage attributable to planning decisions made in the absence of monitoring.

4. APPLICATIONS OF KEY FINDINGS

4.1 Limitations of the data

- In reviewing salinity assessment and management in Tasmania, Nulsen (1995) noted
- "given that on a statewide basis salinity affects less than one percent of the agricultural land, it may not be appropriate to devote a large effort to obtain production from it. Resources might be better expended on catchment management to prevent further salinisation."
- This Audit has shown that, at the time Nulsen was reporting, the figure may possibly have been about two percent, or about three percent if remnant vegetation and private forestry is deducted from the total freehold area.
- This estimate is based almost entirely on collective visual assessments. When a number of individuals somewhat subjectively provide data in this way it is difficult to maintain consistency. The estimate must be treated with caution.
- Three indicators suggest that salinity may possibly be rising, namely
    - the increase in the visual expression of salinity in agricultural land
    - shallow bore water levels which are within the Audit benchmark of Risk
    - isolated measurements of surface and ground water salinity levels above the WHO benchmark of Risk are triggers.
- Salinity emerges slowly, and the small annual changes which need to be measured to detect trends require systematic and continuous monitoring, which was not assured at the time of the Audit.

4.2 Future Monitoring Requirements

- There is no accurate, long-term trend data relating to the Salinity Audit indicators and there is limited understanding of the processes that are driving salinity. This is because work on salinity began comparatively recently and so there has been little emphasis on strategic salinity monitoring.
- In order to be able to establish a strategic approach to monitoring, a two pronged approach is needed. High priority activities to address particular issues need to be identified and key reference sites need to be established in which to monitor indicators of change in salinity across the State into the future.

4.2.1 High priority activities

- *A rapid field check of the major Land Systems identified in the Audit as containing areas of salinity.*

  This is necessary to verify that the newly identified land systems do contain areas of salinity; to obtain a firmer estimate of the percentage of each land system actually affected; and to provide a more accurate estimate of the area affected and at risk across the State.

- *A rapid survey of likely tributaries of rivers and streams in areas adjacent to critical Land Systems where there is limited or no current data on surface water salinity levels.*

The audit has established that out of 48 catchments, only 25 have any salinity data. Of the 25 with any data, approximately 20 have indications of salinities above 800 EC. As the earliest indications of rising salinities is likely to be in the small tributaries of rivers and not in the main streams, snap shot recordings as being used on major sections of rivers may not be picking up elevated salinities.

- *A rapid ground truthing of the Audit biodiversity data set and an initial assessment made of what aquatic ecosystems other than wetlands are at risk of changing salinity levels.*

  The main emphasis has been on wetlands and as yet no field assessment has been made of other aquatic ecosystems.

- *A rapid survey of roads and infrastructure which could be at risk of salinity, especially those areas adjacent to known salinity and in critical land systems.*

  Roads have been considered because quantitative data was available. Regarding infrastructure, there is some evidence of salinity which has been driven by irrigation in urban areas which may ultimately impact on adjacent infrastructure and holdings..

- *Establishing a systematic network of bores and piezometers for long-term monitoring of watertable trends.*

  Long term monitoring is needed in areas where there is rapid agricultural land use change, especially irrigation developments in high-risk land systems.

  Currently there are only limited networks of bores and piezometers which can be used for long term monitoring. In almost all cases the locations are adjacent to existing salinity patches. To establish robust trend information key indicator bore networks need to be established which include areas where no obvious surface salinity is now visible but where there are water tables present below 2.0 m.

4.2.2 Key Reference Sites

- Three Key Reference Sites should be established, covering possibly 100 square km, and based on critical regions and land systems as well as a representative set of natural ecosystems and agricultural land uses.
- These selected sites need to be established because it would be prohibitively expensive to continually monitor all current and potentially saline areas.
- These sites would combine the use of remote sensing by satellite, aerial surveys, salt storage assessment, hydrological analysis, as well as soil and vegetation surveys to measure selected change indicators for land management decisions.
- In the absence of such monitoring, it will be impossible to say how extensive the problem of salinisation might become.
- It will also be difficult to give credence either to any land management advice designed to prevent any increase at the local level, or to associated policy advice regarding natural resource management at the State level.

4.3 Application at the farm level

- The scale of the Audit results and the maps precludes using them at individual farm level for detailed decision making, other than as a risk assessment tool to identify potential areas requiring further detailed on farm investigation.

4.4 Application at the Catchment/Local Government/Regional level

- The results are most useful at this level, to assist in regional planning, priority setting for natural resource management, including the allocation of funds for on - ground preventative and / or remediation works.
- It must be stressed that maps based on land systems can only be used to indicate where further detailed investigations are needed, before final decisions are made.

4.5 Application at the State level

- The results and the maps will be essential in developing a State Salinity Management Strategy as well as policies in areas such as resource use, vegetation management, and infrastructure development.
- They should also find a use in the implementation of the State agricultural products marketing strategy, which emphasises Tasmania's reputation as environmentally responsible.

5. RECOMMENDATIONS

Salinity should be tackled on a Whole of Industry / Government basis

1 *The State should develop a Whole of Industry / Government approach to the salinity issue, strengthening the linkages between industry and the limited existing Government programs.*

This should involve key stakeholders, especially the Tasmanian Farmers and Graziers Association, the agricultural processing companies and agricultural consultants, to ensure that agricultural practices do not exacerbate this emerging threat to sustainable agriculture and that it is addressed as a Whole of Industry / Government program.

2 *As a matter or urgency, the State should decide on the appropriate level of resources to be allocated to ensure that the State's involvement in the National Dryland Salinity Program results in the effective management of the salinity risk in Tasmania.*

Salinity should be tackled through a long term approach

<u>Salinity Management Strategy</u>

3 *The State, in partnership with all stakeholders, should formulate an integrated State Salinity Management Strategy and jointly commit to providing adequate funding to implement the high priority strategies identified in it.*

There should be an in principle commitment to the Strategy for a minimum of ten years, with performance reviews of the key strategies linked to the five year time frame of the "State of the Environment" report.

The strategy would provide a framework for implementing Recommendations 4, 8 and 9 (below)

<u>Monitoring Framework</u>

4 *The State should ensure that adequate resources are allocated from Consolidated Revenue Funds for the development of a network to monitor the emerging salinity problem in order to assess its severity more accurately. This should include as a minimum the identification of*

- *areas of high salt storage*
- *locations where there are shallow watertables in these areas*
- *catchments containing surface water with emerging elevated salinity*
- *a representative sample of roads, railways and buildings*
- *at least three Key Reference Sites*

in which to monitor trends in soil and water salinity levels, yields of key crops, biodiversity, and damage to infrastructure.

The data should be centrally managed, the monitoring should be conducted and reported within the five year time frame of the "State of the Environment" *report and it should continue for at least four iterations, unless the situation changes.*

The implications of increasing salinity should be included in the planning process

5 *All irrigation developments in land areas recorded in the Audit as containing salinity include a Salinity Risk Assessment which addresses ways of monitoring and managing salinity.*

6 *The Department should develop contingency management plans for vulnerable areas, especially conservation reserves, which address the implications of rising salinity, with priority given to the Flinders and Northern Midlands bioregions.*

7 *Those Local Government Authorities administering areas shown by the Audit to contain salinity should be assisted in developing the technical skills necessary to assess if the issue has been addressed adequately within Planning Schemes.*

Research should be directed at both understanding and managing salinity

8 *In the absence of an understanding of the impacts of and linkages between rising salinity on wetlands and on flora and fauna already classified as threatened or endangered, the Department of Primary Industries, Water and Environment should allocate resources to develop this understanding.*

9 *Tasmanian Institute of Agricultural Research and other research bodies should be invited to use the State Salinity Management Strategy to develop focused R and D projects aimed at understanding salinity processes in the State and developing management practices designed to contain salinity.*

The present extent of salinity should be checked

10 *A rapid EC survey should be conducted of all streams which traverse land systems containing salinity and for which there is no data, to be used as a basis for establishing permanent monitoring sites.*

11 *A rapid survey should be conducted to check the accuracy of the visual assessment of salinity symptoms in land systems used for the trend estimate.*

12 *In its next Annual Report, the State Grants Commission should be invited to use the Mulholland Model to adjust upwards the Road Maintenance Disability Cost Factors for those Local Government Authorities with holdings containing salt affected land to fund a reconnaissance to find out if damage to infrastructure is emerging.*

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* More extensive references are given in the appropriate Appendix.