

HOUSE OF REPRESENTATIVES STANDING
COMMITTEE ON SCIENCE AND INNOVATION

INQUIRY INTO COORDINATION OF THE
SCIENCE TO COMBAT THE NATION'S
SALINITY PROBLEM

NATIONAL DRYLAND SALINITY
PROGRAM SUBMISSION



The National Dryland Salinity Program is a national initiative jointly sponsored by State and Commonwealth Governments and Australia's leading rural industries.

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EXECUTIVE SUMMARY

Preliminary

In 1992, there was no nationally coordinated dryland salinity research effort. Moreover, there was no national strategy for dealing with dryland salinity; few statewide strategies existed; experts argued about the size and cost of the emerging problem; catchment management was in its infancy; and Landcare and production interests were inadequately integrated.

The role for research in this institutional environment was seen as crucial, but was poorly directed and coordinated. There were few frameworks or set of priorities, except within the Murray Darling Basin, to assist research funding agencies such as Land & Water Australia — then known as the Land & Water Resources R&D Corporation (LWRRDC) — to invest rationally in dryland salinity R&D. Cooperative Research Centres were not yet engaged in the field of dryland salinity.

Whilst there was no shortage of research effort, much of it was poorly conceived and misdirected, lacked rigour, duplicated efforts undertaken elsewhere, or was undertaken in isolation from other essential pieces of the puzzle or from those expected to implement the results.

Ten years on much has improved in the field of national salinity coordination. Recent surveys show that awareness of salinity within both urban and rural populations has increased substantially over this period. Catchment management programs now exist in all states and the Landcare ethic has permeated into mainstream rural institutions. As the political profile of salinity has risen, so too has the number of government and industry initiatives for addressing salinity, to the extent that there is now a degree of 'crowding-out' among the various programs and initiatives. While the growth in research and extension effort is welcome, it does add complexity to the network of funding organisations, research providers and extension programs. The 1990's saw a burgeoning in the number of organisations becoming involved in salinity research and extension. A nationally focused Cooperative Research Centre (CRC) was set up in 2001 to investigate plant-based management of dryland salinity. At least three other CRCs have also conducted research into certain aspects of the problem.

However, despite the increase of R&D effort into the salinity problem and the increase in the number of organisations involved in salinity management, there remains significant work to bridge the gap between coordination at the research level and coordination of salinity programs on-ground level. The National Dryland Salinity Program (NDSP) is one of the few nationally focused programs which is involved in bridging this gap. Upon its commencement in 1993, there were no other institutions in the salinity arena that contained a partnership basis of Commonwealth, State and industry agencies aimed at coordinating the research effort to the on-ground level. Over the past ten years, the focus

on salinity has increased and the number of players has also increased. The NDSP, however, stills remain one of the few nationally focused programs aiming at coordination of R&D with extension.

What is the National Dryland Salinity Program?

The NDSP is a collaborative research, development and extension program investigating the causes of, and solutions to, the problem of dryland salinity. It was instigated and is still managed by Land & Water Australia and includes partnerships with both Commonwealth and State agencies and industry bodies. Current partners include Land & Water Australia, Murray-Darling Basin Commission, the Department of Agriculture, Fisheries and Forestry, CSIRO, Grains R&D Corporation, Rural Industries R&D Corporation, Meat & Livestock Australia, and the six state governments of New South Wales (Dept of Infrastructure, Planning and Natural Resources), Victoria (Dept of Sustainability and Environment, Dept of Primary Industries), South Australia (Dept of Water, Conservation and Biodiversity), Western Australia (Dept of Agriculture), Queensland (Dept of Natural Resources and Mines) and Tasmania (Dept of Primary Industries, Environment and Water).

Over the past ten years the NDSP has seen the implementation of two phases. Phase 1 (1993 – 1998) received around \$10m in funding whilst Phase 2 (1998 – 2003) has received approximately \$24 million in funding for the research, development and extension effort. Land & Water Australia has been the lead agency for the NDSP and has contributed \$6 million to the Program in its second phase. Other funding sources (in-kind contributions) have been received from partners. The first phase was strongly focused on technical issues and aimed at improving the knowledge of causes and impacts of salinity. Under this phase, an initial appraisal of the extent and cost of dryland salinity in Australia was made, as well as improved research methods and the engagement of communities in catchment management planning. Other accomplishments of this phase included the generation of more strategic and informed debate, the breakdown of disciplinary and institutional barriers and getting salinity recognised as a core business by industry.

The second phase of the NDSP (1998-2003) evolved out of the findings and accomplishments of Phase 1. This phase took on a different focus and encompassed a broader range of issues. These reflected the growing awareness of the wide-ranging impacts of salinity and the diversity of approaches that would be needed to address the problem. Under this phase, catchment processes, industry, engineering, policy, local government, environmental and regional dimensions of salinity were all examined.

The period of July 2003 to June 2004 has seen the emergence of the NDSP Enhanced Communication Year, which is aimed at collating and synthesising all of the information garnered from the life of the NDSP (in particular Phase 2), together with other complementary research activities to 'enhance the uptake of knowledge generated by the Program and its partners and lay the foundation for long-term exchange of salinity

knowledge between government, community and industry – all in a highly targeted way, focusing at the regional level’ (NDSP ECY Management Plan 2003-04).

Examples of NDSP tools and outcomes

The past five years under the second phase of the NDSP have seen major developments impacting significantly on the salinity research and extension community. The NDSP has funded, coordinated or supported the following:

- (with NAPSWQ support) development of a widely distributed catchment management planning CD – Practical Index of Salinity Models (PRISM), providing catchment planners with a full understanding of the strengths and limitations of an array of catchment planning tools;
- (again with NAPSWQ support) documentation of a definitive review of salinity hazard mapping techniques in the form of a user friendly guide to the advantages and pitfalls of different techniques;
- development of the Groundwater Flows System, a framework that has radically changed how State governments and catchment management bodies across Australia devise salinity management strategies to take into account the many different expressions salinity takes;
- compilation of the National Land and Water Resources Audit salinity theme results, resulting in Australia’s most comprehensive assessment of dryland salinity to date and which has formed the basis of resource allocation decisions by both Commonwealth and State governments;
- the successful bid of the CRC for Plant-based Management of Dryland Salinity, ensuring that the bid process was financially supported and obtained industry backing prior to its commencement;
- development of decision support tools for designing environmentally sensitive engineering (including drainage) works and living with salt options (indeed, the NDSP is about the only institution significantly involved in coordinating these areas of research);
- a vast array of reports, training packages, decision support tools, factsheets etc that have successfully been incorporated into local government, industry, extension and policy materials.

At Appendix A is a copy of the NDSP’s Achievements report, outlining in further detail the outputs and use (adoption) of these outputs across Australia. Appendixes B (2002-03 Annual Report of the NDSP) and C (NDSP Communications Report) also show how an effectively coordinated research and communication program can provide substantial benefits through enhanced adoption of research results.

In assessing the achievements of the NDSP, it is important to note that these reflect the coordinated nature of the NDSP operation. The NDSP provides not one, but three levels

of coordination – the Management Board, the Operations Committee and the Communications Team. The Management Board is made up of representatives from each of the partners who are responsible for developing strategic policies and priorities for achieving the program's objectives. The Operations Committee comprises the nation's leading salinity researchers, advisers, planners and extension officers. This group plays an important role in sharing cutting edge knowledge as well as practical experience across State and other jurisdictional borders. It is a nationally recognised group that brings industry and government together to provide independent analysis of the state of current salinity research. Most importantly, the Program supports a national network of salinity communication experts who operate on-the-ground. This group comprises five state-based communication coordinators, and a national leadership team. The team is responsible for not only synthesising and sharing NDSP-generated knowledge, but also knowledge generated elsewhere across the nation. Recently this team has benefited further by working closely with the communications team of the CRC for Plant-based Management of Dryland Salinity. This means that the NDSP now oversees a team of 12 communicators responsible for preparing and distributing salinity information across Australia.

New challenges for efficient coordination

Despite the entry of numerous players into the salinity scene and the best efforts of these players, there is still a gap between the coordination of salinity research and the on-ground effort. Whilst the NAPSWQ and the Natural Heritage Trust (NHT) have increased the demand for salinity information, there are still some critical issues which are not addressed and for which there is an immediate requirement.

First, the main charter of the NAPSWQ is to fund on-ground works for addressing salinity in 21 priority regions. This is an admirable aspiration and there is certainly much information that has resulted from recent research that can be immediately adopted. The NAPSWQ does not, however, have a charter to fund salinity R&D, nor has it given itself the leverage or buying power to strategically generate knowledge to address the gaps and priorities important to its sound investment in outcomes. As the NDSP has concluded there is a vital need to support further R&D if the problem is to be managed at the scales required.

Second, there is an exclusion of industry partners from the NAPSWQ planning, management, monitoring and evaluation processes. As a result a significant number of institutions involved in salinity management at a policy, R&D and on-ground level are distanced from the coordination efforts of what has been to date the most significant public investment in managing the salinity problem in Australia. The NDSP has demonstrated the importance of having industry partners 'on board' when dealing with salinity issues and without these partners, the impetus for many on the ground (mainly Australia's primary producers) to become involved has been absent.

Third, the NAPSWQ only covers 21 regions and therefore excludes many other areas in Australia affected by salinity. It then becomes even more important that there is some

form of coordination effort which can bring the information not just to those NAPSWQ regions, but also to regions which fall outside the boundaries. The problem, however, does not simply lie with the geographic gaps but the disaggregated approach diminishing the capacity to invest in R&D at the cross-regional level and to facilitate appropriate levels of R&D investment in all regions.

Fourth, NAPSWQ has undergone a series of drawn out negotiations between the many institutions involved and this had delayed its implementation and its ability to effectively coordinate across its own jurisdictions of interest, let alone industry and other interests.

The challenges that the NAPSWQ has itself had to undergo, given its magnitude and innate complexity, have led to unintended consequences for coordination that were hard to foresee. For many salinity experts engaged in national coordination, regional focus became the priority. Limited expertise also meant that these experts were stretched just managing their local constituencies. The initial uncertainty about research funding also gave false hope to some that there may be large pools of local funds available to support their specific interests. At the same time, coordination of R&D was perceived as a Government responsibility tied to the NAPSWQ, presenting a dilemma for handling the significant amount of activity supported by industry.

The NDSP partners remain committed to achieving better coordination of research and development undertaken on dryland salinity and to enhancing adoption of existing knowledge by the on-ground managers of salinity. The partners believe that they have the appropriate government/industry framework to fulfill these objectives.

Summary of Conclusions

This submission makes four key points:

- 1) The National Dryland Salinity Program has made a critical contribution to the coordination of industry, Commonwealth and State government research and communication on dryland salinity throughout the 1990's. This coordination role has led to an increased understanding of the causes of salinity and an increased understanding and dissemination of knowledge concerning the extent, costs and solutions of salinity. It has been instrumental in reshaping the way salinity management is looked at (including mindfulness of complementary strategies dealing with rehabilitation, prevention and living with salt), in involving industry partnerships and in sharing information across a broad range of networks and target audiences;
- 2) An unintended consequence of the National Action Plan for Salinity and Water Quality has been that it has focused Australia's limited research resources into regional contexts resulting in an increased amount of activity at the regional level whilst causing the focus at the national level to be fragmented. In some cases, researchers are overstretched coping with their own backyards and lack the capacity to engage in national level coordination.

In other cases, it has become apparent that there is a perception among some that the NAP will increase research resources at the State level, encouraging a view among certain agencies that they can now afford to 'go it alone';

- 3) The NDSP has concluded a ten year phase of supporting research nationally, and has just completed a synthesis of its findings. These findings, summarized in this submission, clearly indicate an ongoing need for nationally coordinated research, development, communication and knowledge brokering. In particular, the Groundwater Flow Systems work, which has been rapidly endorsed by many as the most appropriate planning and decision making framework for dealing with salinity, remains limited by the expertise available to properly use and interpret it, the number of case-studies upon which it is based, and the paucity of data that exists in some States. These are issues of coordination and skill sharing as much as they are of new research investment demand;
- 4) The charter and framework of the NDSP remains highly relevant within the new institutional environment and is supported by a range of other submissions to this Inquiry as the most appropriate framework to coordinate across jurisdictional and industry boundaries.

Further to these four key points, this submission also outlines six key messages to emerge from ten years of intensive research and research coordination:

1. Salinity costs are significant and rising: Protection must be strategic.
2. Profitable options for reversing the trend are lacking (but are under development).
3. There is no one salinity problem: As the ultimate in diffuse pollution, it challenges us to look beyond traditional policy instruments.
4. Integrated catchment management must be seen as only one approach to deal with dryland salinity.
5. Vegetation management remains the key to managing water resources although the benefit-cost of revegetating catchments requires careful analysis.
6. Lack of capacity is an important but a secondary constraint, to managing salinity.

These messages advocate what we must now build upon to adequately deal with salinity issues and how future coordination efforts may take shape. Finally, the conclusions made in this report over and above the four key points are as follows:

1. Salinity remains a significant unsolved issue and it is understandable that governments and industries want solutions 'right here, right now'. There is a considerable body of knowledge in existence that can already contribute to some positive landscape change. This has prompted a focus on on-ground action in preference to further research support or coordination.

2. Irrespective of this the NDSP has learnt that, for most landscapes, we have yet to identify profitable solutions that are likely to be adopted at the scale necessary to make significant inroads into addressing salinity.
3. Living with salt and financing major engineering works will be inevitable elements of managing salinity into the future.
4. This, however, will require intelligent resource allocation not only within regions but across them. Identifying assets of high value worth investing heavily in to protect will be part of an intelligent response that takes into account a triage approach.
5. Research will remain critical for developing the profitable solutions that are required to manage salinity at the scale required. This research, however, should not be limited to plant-based solutions. Given salinity's impact on infrastructure, aquatic environments, water quality (and quantity) and terrestrial biodiversity, investment into and coordination of salinity R&D needs to be thought of in its broadest context.
6. The NDSP has enjoyed the support of State and Commonwealth governments and a range of industries in the past. The unintended consequences of the NAPSQ have focused the minds of some partners inwardly and the coordination role of the NDSP has been challenged. Crowding-out appeared an initial problem after the NAPSQ was first introduced.
7. The NDSP will cease operation from 30 June 2004 unless alternative resource to those provided by Land & Water Australia can be found. LWA has provided the critical mass of funds for ten years now and is under pressure to redirect its funds towards other under-resourced imperatives.
8. Because of its strengths in regional communication networks, the NDSP remains the best placed institution to coordinate research, in a way that connects current knowledge with action, while fostering new generation of knowledge.

INTRODUCTION

It is now known that dryland salinity is principally a function of rising groundwater tables, caused by increased recharge following the replacement of native vegetation with annual crop / pasture systems. Salts deposited below ground are brought to the surface causing damage to agricultural yields, infrastructure and contaminating streams.

While the basic processes underpinning dryland salinity have been known for some time, the capacity to predict the location and future spread of salinity has been limited because of the hydrological complexity of the Australian landscape. Similarly, early efforts to model the impact of different control treatments were frustrated by the complexity and lack of data with which to establish biophysical relationships. The variable time lags associated with salinity and groundwater flows have added to the challenge of developing predictive tools.

It has become apparent that salinity is not one challenge but consists of many challenges which are dealt with or need to be dealt with through a coordinated effort either at a national, state or regional level. In attaining true coordination into the salinity issues there is a challenge for us to look beyond traditional management and policy instruments. For example, the results from the National Dryland Salinity Program (NDSP) funded Groundwater Flow Systems project confirm that the many forms of salinity expression require a corresponding diversity in responses, including non-responses. The NDSP has advocated, at the most simple level of analysis, strategic responses based on prevention, recovery and adaptation. Following on from this, it has also become more and more obvious that there is no one answer to the many challenges of salinity in Australia and for many of the salinity issues, no answers have yet been forthcoming. Whilst research is working towards solutions and answers to problems it will still take many years to achieve all of the answers required to effectively combat salinity in Australia.

The first hurdle in dealing with the salinity issues in Australia and leading to a growth in salinity management programs has been the increase in awareness of salinity over the last ten years within both urban and rural populations. Catchment management programs now exist in all states and the Landcare ethic has permeated into mainstream rural institutions. Salinity risk mapping and related activities, notably the National Land and Water Resources Audit report on Dryland Salinity (NLWRA, 2000) and the MDBC's Salinity Audit (MDBC, 1999), has raised awareness among policy makers and the wider community about the potential extent of the problem. There is also a heightened recognition that dryland salinity is a major contributor to water salinity in the Murray Darling Basin and that rising river salinity is not solely caused by poor irrigation practices.

As the political profile of salinity has risen so too has the number of government and industry initiatives for addressing salinity. There is now a degree of 'crowding-out' among the various programs and initiatives. While the growth in research and extension effort is welcome, it does add complexity to the network of funding organisations,

research providers and extension programs. In order to deal with the maze of information forthcoming from these networks, organisation and research providers it is imperative that there is some coordinated form of managing the science in relation to Australia's salinity programs. This coordination is essential not only to manage 'crowding', but also to relieve the pressure placed upon existing research talent where expertise is still lacking or only just emerging.

Background to the National Dryland Salinity Program

The National Dryland Salinity Program (NDSP) is a collaborative research, development and extension (R, D & E) program investigating the causes of and solutions to, the national problem of dryland salinity. The NDSP was established as a means of funding and coordinating dryland salinity R&D and promoting the implementation of practices to combat salinity through a variety of strategies. Its primary goal was to provide a national framework for stakeholders to invest collaboratively and efficiently in addressing dryland salinity. The program adopted a partnership approach to achieve its goals. This was consistent with the concept of reducing duplication through collaboration, raising funds and exploiting synergies.

The origins of the NDSP date back to 1993 with the commencement of the first five-year phase of the program. This initial phase had a strong technical focus and it aimed to improve the knowledge of causes and impacts of salinity. It made significant headway in developing better research methods, coordinating research efforts and engaging rural communities in catchment management planning. It also helped break down the barriers between different disciplinary groups and government institutions and elevated awareness of salinity issues.

It made an initial appraisal of the extent and cost of dryland salinity in Australia, improved research methods and effectively engaged communities in catchment management planning. Its partnership approach to funding and orchestrating collaborative research improved the efficiencies with which R&D was carried out and delivered.

Less overt accomplishments included the generation of more strategic and informed debate, the breakdown of disciplinary and institutional barriers and getting salinity recognised as a core business issue by industry. Most significantly, the first phase of the NDSP established that salinity was more than just a problem for agriculture and underpinned the report of the Prime Minister's Science, Engineering and Innovation Council Report on Dryland Salinity (PMSEIC 1999).

The second phase of the NDSP, which commenced in 1998 and finished in June 2003, evolved out of the findings and accomplishments of NDSP Phase 1. The new phase took on a different focus and encompassed a broader range of issues. This reflected a growing awareness of the wide-ranging impacts of salinity and the diversity of approaches that would be needed to address the problem. Phase 2 examined catchment processes,

industry, engineering, policy, local government, environmental and regional dimensions of salinity.

The program was funded by a consortium of government and industry organisations with a stake in salinity which included:

- Land & Water Australia (LWA)
- Murray-Darling Basin Commission (MDBC)
- The Commonwealth Department of Agriculture, Fisheries and Forestry (DAFF)
- CSIRO
- Grains R&D Corporation (GRDC)
- Rural Industries R&D Corporation (RIRDC)
- Meat & Livestock Australia (MLA)
- The six state governments of Queensland, New South Wales, Victoria, Tasmania, South Australia and Western Australia.

The NDSP mission during Phase 2 was to “Research, develop and extend practical approaches to effectively manage dryland salinity across Australia”. In pursuing this mission the program set out to fulfill three main tasks;

- Improve the coordination of R&D and extension efforts;
- Influence the direction of R&D by setting priorities and leading by example; and
- Fill R&D gaps at the national level by funding a portfolio of projects.

Later during the phase it was recognised that the NDSP had an important role as a knowledge broker of salinity information to various target audiences. Indeed, the NDSP has aimed to place itself as ‘Australia’s lead knowledge broker of R&D and extension efforts to combat dryland salinity’. The fulfillment of this role required the NDSP to place greater emphasis on improving information sharing, increasing the capacity of decision makers and informing public and industry policy.

The NDSP is currently in its final year of operation. The year 2003-04 constitutes the program’s Enhanced Communication Year, a year in which the program will synthesise and communicate even further than previously the knowledge that it has accumulated over the past ten years.

How does the NDSP nationally coordinate research and communication?

The NDSP comprises three levels of coordination.

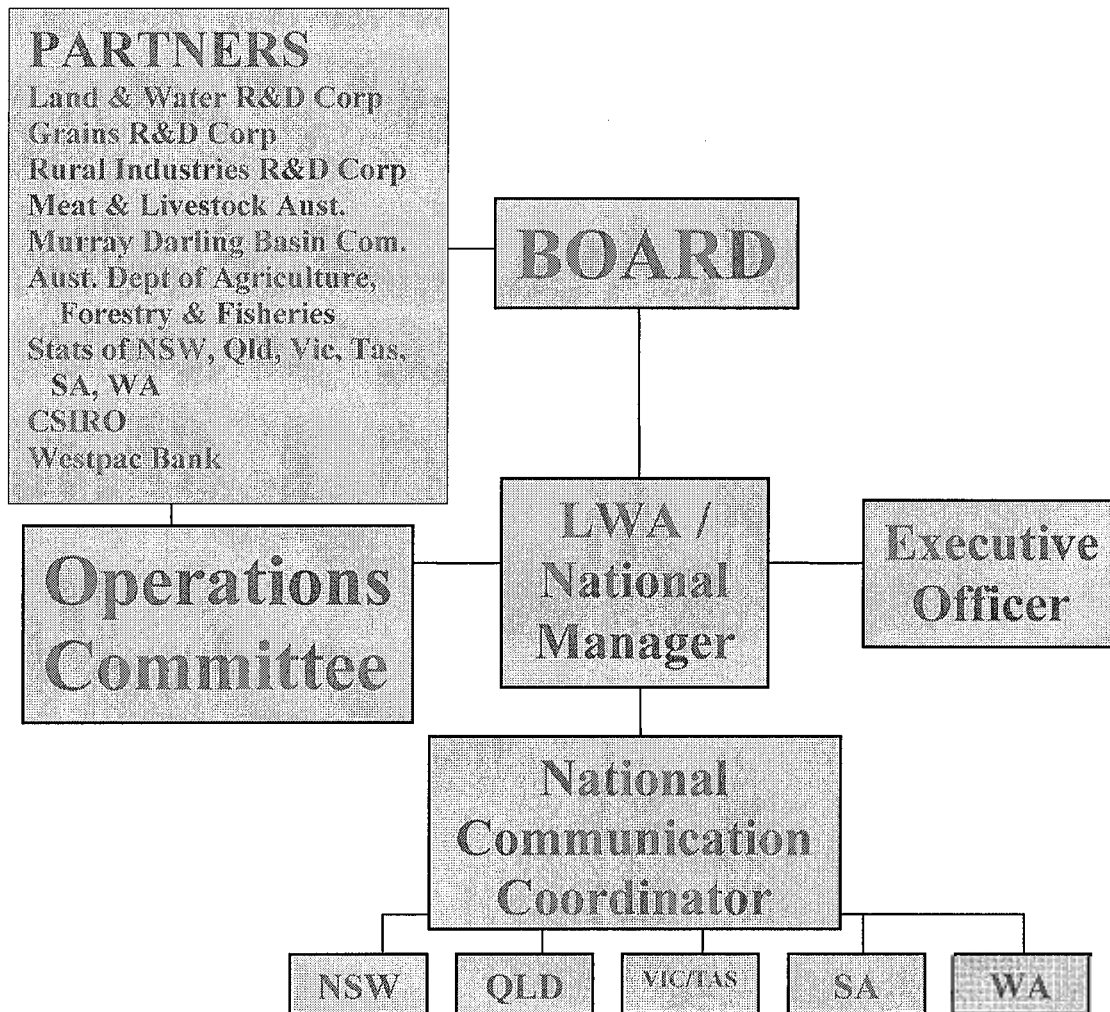
First, the Program has a nationally constituted Board of Management responsible for setting strategic directions for salinity R&D and then allocating program funds towards priority research areas. The funds are derived from a pooling of partner (industry and government) commitments to the program. Board members reflect representation from

agencies funding the program. Given the pre-eminence of the board members in their State and industry-based salinity networks, the NDSP is very well connected to the most significant elements of what is happening nationally.

Second, the Program has a nationally constituted Operations Committee, comprising the nation's leading salinity researchers, advisers, planners and extension officers. This group plays a vitally important role in sharing cutting edge knowledge as well as practical experience across State and other jurisdictional borders. It is a nationally recognised group that brings industry and government together in a non-political way to provide independent analysis of the state of current salinity research.

Third, and perhaps most importantly, the Program supports a national network of salinity communication experts who operate on-the-ground. This group comprises five State-based communication coordinators, and a national leadership team. The team is responsible for not only synthesising and sharing NDSP knowledge, but salinity knowledge in general. Recently this team has been expanded by partnering with the communications team of the CRC for Plant-based Management of Dryland Salinity. It is, without a doubt, one of the most comprehensive and nationally connected communication teams dealing with any aspect of natural resource management existing in the country.

Diagram 1: Structure of the NDSP



ADDRESSING THE TERMS OF REFERENCE

Use of salinity science base and research data

Term of Reference 1

Use of the salinity science base and research data (including the development of new scientific, technical and engineering knowledge) in the management, coordination and implementation of salinity programs.

There is no one answer nor one solution to the problem of salinity. Responses in salinity management become dependant upon the issue itself, the region and the information which is available and accessible at the time. It then becomes critical that any research outcomes or data are made accessible to salinity programs for incorporation into their plans and strategies, thereby providing more extensive and comprehensive information to salinity managers. However, without ongoing research answers and solutions for salinity management will either be lacking altogether or will be losing the critical detail. In order to achieve the on-flow of information from the researchers, to the developers of salinity programs, to the implementers of salinity solutions, it is important for there to be either an organisation or a program whose responsibility it is to have a coordination and management role in receiving and disseminating the outcomes and knowledge garnered from the research.

Despite the in-roads made in salinity research and the level of information available, it is still prudent to be aware that there is a trade-off between the immediate need for information to make policy decisions and the accuracy of information available. Putting off the decision until better information is available is often not an option. Therefore, there is a need for judicious use of existing information combined with an efficient and effective means of updating the knowledge base over time.

Despite a current lack of coordination between the research and those implementing on-ground solutions, there is still evidence that some research outcomes are making their way into salinity programs, policy developments and to the on-ground extension workers. The NDSP has played a major management and coordinating role spanning ten years in the funding of new science, technical and engineering knowledge. In fulfilling this management and coordination role on behalf of its partners, the NDSP has funded numerous research projects aimed at answering the major questions in salinity management and in so doing, has produced a wealth of information currently being used in the management, coordination and implementation of salinity programs. Major research findings and outcomes which have been funded by the NDSP have had an

enormous influence upon salinity programs and continue to be incorporated into the research and extension bases of these programs.

Investment in the NDSP by partner organisations was promoted by developing seven distinct themes. The seven themes were designed to examine all aspects of dryland salinity, ranging from the physical causes of salinity and its impacts, through to innovative solutions to tackling the problem — including institutional arrangements and technical treatments. The themes are as follows:

- **Audit and monitoring:** This theme sought to examine the extent and rate of change in dryland salinity and its impacts at regional and national scales.
- **Policy and operating environment:** The intent of this theme was to generate knowledge which would support better policies, institutional structures and incentives for promoting appropriate management of dryland salinity.
- **Industry solutions:** This theme recognised that agricultural industries are in the 'front line' with respect to suffering losses from salinity. These industries are also part of the solution and are in a position to contribute significantly to salinity management. The NDSP had a significant focus on the grains industry, as this sector of agriculture is expected to be the most at risk from salinity. However, Meat and Livestock Australia also contributed to a program focus on perennial pastures.
- **Productive use of saline resources:** This theme set out to look at ways to 'live with salt' by viewing salinity as a new resource. Projects that examined new farming systems and industries, which profitably use or rehabilitate saltland, were canvassed under this theme.
- **Environmental protection:** Salinity has the potential to threaten natural areas, resulting in a loss of biodiversity, habitat and landscape amenity values. This theme focuses on developing ways of measuring the environmental impacts of salinity and understanding how to control them.
- **Infrastructure management:** This theme was orientated towards engineering aspects of salinity, and its impact on public and private infrastructure.

- **Regional and community initiatives:** The aim of this theme was to promote investment into the provision of a national network that would link different state, regional and community activities.

The NDSP can demonstrate how the research outcomes funded through these seven themes is currently being used in the management, coordination and implementation of salinity programs. Attachment A is a copy of the NDSP Achievements Report, which presents a summary of NDSP outcomes over the past ten Years. Appendix B, a copy of the latest Annual Report, shows what can be accomplished within a single year of research investment and coordination through the NDSP. Both provide examples of adoption of latest research results on-the-ground.

Perhaps one of the profound achievements of the NDSP has been the outcome of its Catchment Classification project, which showed that we are not dealing with one salinity problem. Through this project it is now known that there are at least three different types of groundwater flow systems (GFS), defined as local, intermediate and regional systems. Each has different characteristics in terms of distance between recharge and discharge sites, the time lags involved in reaching a new water table equilibrium and the responsiveness of water tables to salinity control treatments. The hydrogeological and topographical features associated with each GFS provide a basis for evaluating the effectiveness of salinity management options in particular catchments.

The outcomes from this project in terms of the use of the data in managing, coordinating and implementing other salinity programs have been enormous. It has provided a low-cost means of understanding, at a broad level, the hydrological processes at work in a given catchment without having to collect detailed information. This has been achieved by transferring knowledge from well-documented catchments to other, less studied catchments. It has also provided a national map that classifies catchments according to the three types described above, which is a significant advance in guiding regional management strategies. More detailed assessments have been conducted in the Murray Darling Basin and Queensland. These assessments are assisting communities to identify priority areas for treatment.

Of more fundamental importance are the new principles established by this work. First it has led to a new appreciation of the long time lags between changes in land use and subsequent responses in the water table. Even with significant reductions in recharge it would take decades to establish a new equilibrium in most groundwater systems. Second, there is now evidence to show that the 'externalities' concept does not universally apply with respect to salinity. That is, in many circumstances the impacts of one farmer's actions are localised and do not cross the farm boundary. These two findings have profound implications for salinity management.

In terms of coordination and the use of salinity science base and research data in the management, coordination and implementation of salinity programs, the GFS is now being incorporated into various salinity management plans across Australia. All regions

within NSW now have maps of the Groundwater Flows Systems and the maps are being used regionally to help Catchment Management Boards to prioritise salinity investment. Elsewhere, the Salt Action Team in South Australia has produced 15 catchment salinity plans, all based on catchment classification and groundwater flow systems. This has now become a platform for salinity management across the state. In Victoria, by using the Groundwater Flows System and the Flowtube approach, the Corangamite CMA has a new method to describe how the catchment works and what intervention methods are possible. The CCMA has identified 17 systems and is using the approach to help match investment decisions with different system requirements.

Many other examples of the use of latest science knowledge in on-ground action can be cited in Attachments A and B. The example provided here on the GFS is intended to demonstrate that when science is coordinated nationally, as it was with the GFS, then adoption can occur rapidly as a network of system developers operates to provide guidance and support to colleagues and others across agency and jurisdictional borders.

Linkages between researchers and extension

Terms of Reference 2

Linkages between those conducting research and those implementing salinity solutions, including the coordination and dissemination of research and data across jurisdictions and agencies, and to all relevant decision makers (including catchment management bodies and land holders)

Despite the levels of funding currently going into salinity research and on-ground activities to combat the problem of salinity, there is an overriding gap between the coordination and linkages between those conducting the research, agencies, policy-makers and those implementing salinity solutions on-ground. Without this coordination the attempts to combat the salinity problem will always fall short of the target. Coordination between researchers and salinity managers is vital in achieving a sound response to this issue as it allows for all information to be disseminated culminating in the avoidance of duplication and the application for those on-ground to make well-informed decisions based on the latest, integrated information available.

The linkages between researchers and other parties, whether formal or informal vary enormously depending on the state, the agency, the region and the parties involved. It will also depend upon the researcher themselves. In many circumstances there are few linkages between the researcher and other parties outside of their own agency. It appears that the role of coordinating, integrating and disseminating information based on research outcomes is either left to the investor or other salinity programs to provide. This then leads to a lack of the available knowledge being disseminated as there is no program or agency in Australia who has the responsibility or the funds available to take on the task of

integrating and disseminating all research outcomes or information from each agency that is involved in salinity research. Each research agency biases utilisation and dissemination of information outputs from their own researchers.

The NDSP has recognised the importance of a knowledge brokering role within the salinity management community in order to provide the research information to various target audiences and therefore has attempted to overcome this problem. As part of its mission the NDSP aspires to be 'Australia's lead knowledge broker of R&D and extension efforts to combat dryland salinity'. In taking on this role the NDSP has relied upon its partners to also assist in the dissemination of information back to their states and agencies which in turn can be used to inform their salinity programs or be provided to catchment management bodies, Landcare bodies and land holders etc. This has been a mixed success for the program, and three key issues have contributed to this:

- All key players need to be involved in the salinity programs or informed of the research so that they can in turn inform their salinity management plans, extension providers or other salinity managers. For example, players who have direct links to catchment boards or Landcare bodies need to be informed. These players such as the Commonwealth Departments of Agriculture, Fisheries and Forestry and Environment and Heritage, or the state agencies responsible for these bodies need to be more adept in playing a direct role in disseminating information or providing guidance on where to go for the information. At present this is not occurring.
- There needs to be a commitment from the research agencies in getting their information out in a form that is easily understood by those implementing the salinity solutions and this commitment needs to be funded by the appropriate investors. This level of commitment varies. For example, in some cases there may be a strong commitment by the researcher to get the information out to the main target audiences and they will implement communication strategies into their projects, however in other cases once the funding for a particular project has ended, the researcher is required to move onto other research tasks and leave the job to someone else. Many researchers do not see the importance of a communication strategy to help link their information into on-ground networks. The NDSP does not necessarily advocate that the researchers themselves undertake the communication effort – they are often the least qualified to do so. What is required, however, is a commitment to a process of research that incorporates communication and learning expertise into all activities. Increasingly, we are seeing appropriate communication plans incorporated into project submissions and being funded. However, there are still many occasions where it is assumed that the research will be communicated and paid for by other means. Often, there is also a general expectation that because someone was funded to do a project over a particular timeframe, then those researchers can be called on ad infinitum to continue to speak about the results of that project. This is an unrealistic expectation as staff are funded to work on projects, and when they are working on new projects, they do not have the time to continue to work on old projects whose

funding has finished. This applies equally to private sector research agencies as well as the public sector research agencies.

- Another issue in the lack of linkages between those conducting research and those implementing solutions concerns the number of players entering the salinity arena. As already mentioned, as the political profile of salinity has risen, so too has the number of government and industry initiatives for addressing salinity. So much so, there is now a degree of 'crowding-out' among the various programs and initiatives. While the growth in research and extension effort is welcome, it does add complexity to the network of funding organisations, research providers and extension programs. In saying this, however, it should be recognised that there are shortages in some fields of rigorous scientific expertise that must be addressed at a time when the demand for such expertise is increasing. Hydrological expertise to interpret and improve upon the current Groundwater Flow System framework is one example.

Table 1.0 below summarises the range of organisations involved in salinity management and their respective roles. It is not comprehensive, but covers the major institutions involved in salinity management. Perhaps the most significant new player is the National Action Plan for Salinity and Water Quality (NAPSWQ). The main charter of the NAPSWQ is to fund on-ground works for addressing salinity in 21 priority regions. It is intended that the NAPSWQ expenditures will be targeted to areas expected to yield high returns on investment and regions will be held accountable for salinity outcomes. There are a number of issues already identified with the NAPSWQ. First, the NAPSWQ does not have a charter to fund R&D, although it can fund R&D where it is closely related to implementation at the regional level. Secondly, there is an exclusion of industry players from the NAPSWQ. Therefore, a large number of players in salinity management are excluded from even the coordination efforts of the NAPSWQ. Third, the NAPSWQ only covers 21 regions and therefore excludes many other areas in Australia affected by salinity. Fourthly, the NAPSWQ has been held up due to the drawn out negotiation process and has not been effective in its role of Commonwealth, State, and regional coordination.

Despite the crowded market in salinity management, there is also the advantage that by having more players there is more funding going into research and the extension effort. Most of the States have now devised formal strategies for dealing with salinity and government agencies responsible for NRM have an active R&D program to support their strategies. Furthermore, there are now four CRCs that are tackling particular aspects of salinity – the CRC for Plant Based Management of Dryland Salinity; the CRC for Catchment Hydrology; the CRC for Landscape Environments and Mineral Exploration, and; the CRC for Water Quality & Management. The MDBC is also a funder of salinity R&D as is the Grains R&D Corporation, CSIRO, Meat & Livestock Australia and Australian Wool Innovation Ltd.

Table 1.0 Major players in salinity management and their respective roles

<i>Roles</i>	<i>NDSP</i>	<i>NAP</i>	<i>CRC's</i>	<i>LWA</i>	<i>MDBC</i>	<i>NLWRA</i>	<i>RDC's</i>	<i>CSIRO</i>	<i>AFFA</i>	<i>EA</i>	<i>State agencies</i>	<i>Regional management bodies</i>
National Coordination												
▪ R&D coordination	✓✓✓	✓	✓✓	✓✓✓	✓	✓✓	✓	✓				
▪ Communication coordination												
– Broad	✓✓✓	✓✓	✓✓	✓✓	✓		✓✓	✓	✓	✓		
– Project specific	✓✓✓	✓	✓✓	✓✓		✓✓		✓✓				
▪ Knowledge exchange coordination	✓✓	✓✓	✓✓	✓✓	✓		✓✓	✓✓	✓			
▪ Quality assurance coordination	✓✓	✓	✓					✓			✓	
Funder or provider of R&D												
▪ Generic principles	✓✓	✓	✓✓✓	✓✓✓	✓✓✓	✓	✓✓✓	✓✓✓	✓	✓	✓✓	
▪ Catchment specific	✓	✓	✓		✓✓	✓	✓✓	✓			✓✓	✓✓
Extension provider	✓✓	✓	✓✓	✓✓	✓✓	✓	✓✓	✓✓	✓	✓	✓✓✓	✓✓
Funder of on-ground works												
▪ National level		✓✓						✓				
▪ State level		✓✓✓	✓				✓✓	✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
▪ Regional level		✓✓✓	✓		✓✓		✓✓		✓✓	✓✓	✓✓	✓✓✓
Public policy development												
▪ National level	✓✓	✓✓		✓	✓✓	✓	✓	✓✓	✓✓✓	✓✓✓	✓	
▪ State level	✓	✓✓	✓		✓✓	✓	✓	✓			✓✓✓	
▪ Regional level	✓	✓✓			✓✓						✓✓	✓✓✓

Key to organisations:

National Dryland Salinity Program (NDSP); National Action Plan for Salinity & Water Quality (NAP); Cooperative Research Centres (CRC's); Land & Water Australia (LWA); Murray Darling Basin Commission (MDBC); National Land & Water Resources Audit (NLWRA); Research and Development Corporations (RDC's); Commonwealth Scientific Industry Research Organisation (CSIRO); Agriculture, Fisheries and Forestry — Australia (AFFA)

However with this many players in the salinity research game, how effective are the linkages from these R&D providers and the researchers to the on-ground workers? The existing array of institutions and management structures aimed at addressing salinity do not provide all the tools and services required to tackle the problem due to poor linkages amongst agencies and between the researchers and on-ground workers. The main gaps include knowledge access, coordination, R&D and communication.

The Knowledge Access Gap

The formation of the NAPSOW has changed the funding landscape such that regional groups now hold the 'purse strings'. Along with this shift in funding arrangements will come a new demand for region-specific R&D and knowledge. At present regional bodies do not have access to credible information that is tailored to their needs – or at least information that is in a format that would allow an assessment of its validity for local relevance. In commissioning R&D, regions should start from the best generic knowledge base.

What is needed is an organisation that can help regional groups assess how much information they need and what type of information they require. Furthermore, given the plethora of contractors offering technical services and advice, there is a need for quality assurance. These tasks require the services of a qualified and credible 'knowledge broker'.

The role of knowledge broker goes beyond passing on information. It includes packaging, interpreting and filtering information to promote its use. The knowledge broker not only has to make decisions about the significance of particular information to meet the demands of a range of clients, they also have to consider the appropriateness of specific information and the value of that information to individuals and organisations. That is, they need to turn information into knowledge. Key characteristics of a successful knowledge broker role are:

- A degree of independence from the main parties, which should be reflected in funding and employment arrangements;
- Recognition and trust of all clients they deal with – from primary producers and planners to extension workers and researchers;
- High class facilitation and networking skills, values and attitudes, and;
- A 'can do' mentality.

The Coordination Gap

Despite the positive inroads made by some programs and organisations, there is still a coordination gap. It is not uncommon for industry advisors to propose different salinity treatments for any given region, which is confusing to farmers and other on-ground people, and could result in inaction. There is an on-going need for coordination, at least of the informal kind to let people know what other people are doing and to put people with common interests in touch.

The demand for better coordination is coming from policy makers and managers on the ground. Large salinity funders must lead by example, for example by setting R&D priorities and seed projects. The effectiveness of this approach depends on selecting the right priorities that demonstrate usefulness.

One of the primary goals of the NDSP was to improve the coordination of salinity research efforts across Australia. It aimed to steer the direction of research through strategic investment, fund multi-disciplinary work, develop national R&D priorities and communicate these priorities to funding bodies. By providing a forum for networking among researchers it was hoped that there would be less wasteful duplication of research effort. This was attempted in two ways. One was the formation of the Operations Committee and the other with the formation of a national communication network.

The Operations Committee brings together key researchers and advisors to discuss issues regarding salinity management and to discuss the latest research going on either within their state, region or agency. This grouping allows for knowledge exchange and then the information is taken back and disseminated to those on-ground extension workers where necessary. By bringing together the researchers and advisors from each partner it allows for the ability to tap into the shared knowledge base and improve. It becomes a dynamic interaction exchange. It becomes about the exchange of information, coordination of effort, peer review and looks at other products and projects for badging.

The formation of a national communication network incorporating communication experts from within agencies and from the private sector is critical to the success of bridging both the coordination gap and in establishing effective links between the research outcomes and on-ground users. The NDSP's national communication network has been a crucial component of the Program in getting key messages out into the field and promoting research outcomes. A communicator needs to have a good understanding of the main outputs and of the 'big picture' implications of the findings. However, of the utmost importance is the ability to synthesis results across all research projects and this is lacking in the current environment. The role of a communicator and that of a knowledge broker are becoming more closely intertwined.

Developing an effective coordinating group whether it is at a national or state level is paramount to the success of dealing with salinity. Such groups can help provide the necessary links between those undertaking the research and those utilising the research on-ground. A coordinating body enables information to be brought across the jurisdictions and the range of Commonwealth and State bodies involved in salinity research and finding a single way ahead. All agendas and needs are then discussed and the risks of duplication can be reduced. A coordinating body can also set in place information and consistent advice within state policies and strategies. However care does need to be taken to ensure that the information provided is not just generalised information valued at a national level, but also information of a more specific nature which is valued by the people who require this type of information.

The R&D Gap

There remains a need for technology development and industry development. There is a lack of R&D being conducted at the 'pointy end' – that is helping farmers and other land managers develop and promote properly evaluated technologies. Products and services need to be delivered in a user-friendly and ready form. Future R&D demands in salinity will be more user-driven than in the past. Close communication with eventual end-users will be a fundamental part of developing a project TOR.

There is also a need for a whole of system approach to investigating salinity issues and developing solutions. That is, the options for managing salinity should be developed in the context of the farming system, biophysical system, and off-farm environmental system. At the same time the R&D needs to be relevant to the end user. The demand for R&D of this kind is always there if someone else funds it. Thus the true test is whether organisations are willing to fund the R&D. For them to be willing to do so requires that there are:

- Considerable synergies among the research providers;
- Good project management structures in place;
- Good advice is available to guide the development of the project design, and;
- That there is good access to avenues for communication of the results – including quality assurance and credibility.

The Communication Gap

In order to establish good linkages between those conducting the salinity research and those implementing solutions, it is critical to establish a good communication base or network. However, despite some in-roads into linking research findings with on-ground extension there is still a number of issues that need addressing before full and effective coordination can be attained. In many cases messages from projects have not been forthcoming or are limited as to who receives it. Communication of tools or products from research needs to be properly communicated and stronger links made with current items such as newsletters, media releases, websites, factsheets, brochures, research reports etc.

There appears to be some effectiveness at coordinating the articulation of R&D priorities and the promotion of multidisciplinary research however, there is not the confidence about the effectiveness of salinity programs to reduce duplication and facilitating knowledge exchange. Two factors can limit the effectiveness of these linkages. One, if a salinity program is focused primarily on national, generic issues rather than regional or local issues (and vice versa), researchers working on a national (or local) level may not perceive the relevance of national (or local) priorities in their work, particularly if these needs are different. Second, the influence and leverage exerted by these salinity programs is likely to influence only those organisations/agencies etc that are directly linked to it either through funding or research providers.

Information transfer is a highly desirable aim, yet often an instrumentalist approach to communication does not necessarily allow for a two-way process of communication that actively engages audiences and promotes change. Rather it is limited to awareness-raising activities, which may have little impact in terms of changing behaviour. Other methods of engagement such as developing organisation arrangements that promote interaction and communication between different sectors (eg project researchers and demonstration sites and farmers, policy makers or local government) are possible alternatives that are likely to promote sustained links and relationships that inspire learning and understanding.

Because salinity management concepts are often not 'black and white' there is a need for new information to be debated among stakeholders and transformed into knowledge that is applicable to the circumstances of particular interest groups. The instrumentalist approach adopted by the NDSP in its early stages may have been appropriate for explaining biophysical aspects of dryland salinity. However, when issues arise that are highly debatable – such as the benefits of different treatment options – there should be scope within the networks and coordination activities (etc) for people with different views to examine different responses to the issues for different contexts.

The NDSP feels confident that it can address these gaps in future if afforded the opportunity and appropriate support.

Adequacy of Technical and Scientific Support

Terms of Reference 3

Adequacy of technical and scientific support in applying salinity management options

The central issue in addressing the adequacy of technical and scientific support in applying salinity management options is how to ensure that the best scientific knowledge is and continues to be used to address the problems presented by the nation's greatest challenge.

Despite the appearance of 'crowding' at the institutional level, a major inadequacy that continues is the limited scientific skills and expertise in many of the disciplines of salinity based research across the country. These skills are limited to both discipline and to state expertise. A lack of skills, management expertise, poor access to information and financial difficulties are often cited as reasons why salinity control treatments are not adopted by farmers. In being able to deliver on-ground benefits, a coordinated approach to salinity management would provide that one step forward in allowing these skills and expertise to flow and be accessible across agencies, states, regions and therefore the country.

However, whilst these factors do play a role, findings from the NDSP indicate that they are by no means the most significant factor in constraining land use change. This is because, in the absence of commercially attractive treatment options, it is unrealistic to expect farmers to change their current annual farming systems in favour of perennials or agroforestry. Under these circumstances no amount of capacity building or training will facilitate change.

The biggest constraints for moving forward lie in the lack of clarity of rights and responsibilities, nailing attribution between cause and effect and being able to clearly specify the benefits and costs of different courses of action. Policies that halt land-clearing can have the biggest positive impact on impact on watertables and biodiversity in some regions, but need to be complemented by measures that take into account who bears the costs and gains the benefits.

A significant challenge in making further gains in salinity management lies in facing up to some very simple but critical findings of the NDSP over the past ten years. While on the face of it these findings appear axiomatic, it is questionable whether the current research and policy directions are really taking these truths into account to the degree required. These findings are outlined below.

BUILDING ON WHAT WE KNOW

In looking further at the adequacy of technical and scientific support in applying salinity management options, outputs and findings from the NDSP suite of projects have challenged conventional thinking on dryland salinity and how the problem should be managed. Out of the recent review of the NDSP, six key messages have emerged. These messages provide clues as to where future coordination is best placed.

7. Salinity costs are significant and rising: Protection must be strategic

- Current costs of dryland salinity are significant and are projected to increase by 60 to 70 per cent over the next 20 years.
- New findings suggest that the best we can hope for from recharge control treatments is a slowing down of the rate of future salinisation. Rehabilitation of existing salinity damage is generally not economic owing to the sluggish response of water tables to recharge reductions.
- Because current costs are mostly unrecoverable, they should not have a large bearing on policy responses to salinity. Instead, the focus should be on preventing future damage to high value assets — using cost effective treatments. The NDSP findings have shown that it will be imperative to carefully prioritise on-ground investment so as not to waste money.

- Close attention will need to be paid to the cost-benefit of protecting public assets versus private assets. In some situations, direct investment in public works to protect public assets (for example, wetlands and heritage buildings) may be more efficient than efforts to protect agricultural land.
- Engineering works will be an important and inevitable part of protecting high value assets. Such works should proceed with caution, but there is knowledge and there are tools that can assist design such interventions in a way that will minimise downstream consequences.

2. Profitable options for reversing the trend are lacking (but are under development)

- The notion that salinity will be comprehensively 'fixed' with targeted revegetation treatments or discharge management should be dispelled. There is no silver bullet. Previous hopes of finding a clever, low cost solution such as planting a relatively small proportion of the landscape with trees in strategic areas no longer hold.
- This is not to say that there are not some catchments where profitable interventions could be made — either from a social or private perspective or both. The NDSP work has confirmed that the hydrogeology of the Australian landscape is extremely complex, with multiple processes at work. Thus, there will be parts of the landscape (principally overlying local aquifers) where treatments could yield a net benefit.
- To make major ground in extensive treatments to prevent further salinisation, it will be important to develop solutions that are profitable for those managing the great majority of land: farmers and graziers. Improved farming options that increase perennial vegetation are likely to remain the most likely means of attaining salinity management responses at the scale needed, and the research of the CRC for Plant-based Management of Dryland Salinity and others will be critical.
- Living with salt will also become an inevitable consequence of not having profitable plant-based solutions immediately to hand. Some saltland pasture systems already have proven to be viable, as well as profitable, but these systems need both refinement and a mindset change among many farmers.

3. There is no one salinity problem: As the ultimate in diffuse pollution, it challenges us to look beyond traditional policy instruments

- Groundwater flow system results confirm that the many forms of salinity expression require a corresponding diversity in responses (including non-responses). The NDSP has advocated, at the most simple level of analysis, strategic responses based on prevention, recovery and adaptation.

- The NDSP has developed a range of approaches to move forward, from analysing appropriate responses using groundwater flow system and Flowtube tools, among others, to implementing strategies based on perennial farming systems, engineering works and productive uses of saline lands.
- However, policy responses remain problematic. The concept of salinity being an ‘externality’ problem whereby the actions of one group of landholders impose salinity costs on others is no longer strongly supported. On farms overlying local aquifers, recharge and discharge areas will often be within the same farm boundary, thus removing some disincentive for farmers to implement salinity treatments. Under these circumstances, salinity credit trading would not be effective.
- Even for regional and intermediate aquifers, where the discharge sites are more remote from the recharge areas, the externalities principle does not always hold. This is because in these aquifers the lateral movement of groundwater tends to be very slow (up to thousands of years), meaning that the benefits of recharge control are usually localised — at least in the short term. Again, the gains from internalising off site costs by defining salinity credits (or recharge rights) and allowing trade between farmers appear to be smaller than previously thought.

4. Integrated catchment management must be seen as only one approach to deal with dryland salinity

- The new information on groundwater systems also downplays the need for integrated catchment management. The finding that groundwater movement across farm boundaries is either slow or relatively uncommon means that collaboration among landholders to manage groundwater is not always a necessary prerequisite for salinity management. Instead, targeted, location-specific interventions are likely to be more cost-effective in many instances. In many regions, productive adaptation to salinity — that is living with salinity — will be the best option. In other regions, the protection of high value assets (such as infrastructure or wetlands) with engineering solutions will provide the best pay-off.
- However, tools do exist to inform management options at the regional and catchment levels that can help target specific interventions and to predict their likely responses. In particular, modelling supported both within the NDSP and by the CRC for Catchment hydrology can support better vegetation management decisions. The groundwater flow system work and FLOWTUBE modelling by NDSP provides some broad guidance for investment decisions at a regional level.

5. Vegetation management remains the key to managing water resources, although the benefit–cost of revegetating catchments requires careful analysis

- Stream salinity is clearly an externality issue. Salt carried by surface water run-off and saline groundwater discharge into waterways does impose costs on downstream users. However, there is mixed evidence about the responsiveness of streams to catchment revegetation. In water supply catchments, revegetation of cleared land also has the unwanted effect of reducing water yield and possibly increasing stream salinity due to less dilution.
- Therefore, careful benefit-cost analysis is needed before revegetation policies are implemented for the purposes of protecting water resources. In some circumstances, where water is scarce, desalination may be a more cost-effective option.
- The difference in water use between trees (or woody perennials) and grasses (perennial or otherwise) is significant. In some parts of the landscape only trees (or woody perennials) will reduce leakage to the required levels. These trees are best placed where leakage intercepts salt stores. In much of the remaining landscape we need to run high volumes of clean water. Management of native grasses as low input systems may provide high volumes of clean water and biodiversity benefits as well. These systems need to be explored as much as the more popular perennial-based pasture systems such as lucerne.

8. Lack of capacity is an important, but a secondary constraint, to managing salinity

- Lack of skills, management expertise, poor access to information and financial difficulties are often cited as reasons why salinity control treatments are not adopted by farmers.
- While these factors do play a role, findings from the NDSP indicate that they are by no means the most significant factor in constraining land use change. This is because, in the absence of commercially attractive treatment options, it is unrealistic to expect farmers to change their current annual farming systems in favour of perennials or agroforestry. Under these circumstances no amount of capacity building or training will facilitate change.
- The biggest constraints for moving forward lie in the lack of clarity of rights and responsibilities, nailing attribution between cause and effect and being able to clearly specify the benefits and costs of different courses of action.

CONCLUSIONS

1. Salinity remains a significant unsolved issue, and it is understandable that governments and industries want solutions 'right here, right now'. There is a considerable body of knowledge in existence that can already contribute to some positive landscape change. This has prompted a focus on on-ground action in preference to further research support or coordination.
2. Irrespective of this, the NDSP has learnt that for most landscapes, we have yet to identify profitable solutions that are likely to be adopted at the scale necessary to make significant inroads into addressing with salinity.
3. Living with salt and financing major engineering works will be inevitable elements of managing salinity into the future.
4. This, however, will require intelligent resource allocation not only within regions, but across them. Identifying assets of high value worth investing heavily in to protect will be part of an intelligent response that takes into account a triage approach.
5. Research will remain critical for developing the profitable solutions that are required to manage salinity at the scale required. This research, however, should not be limited to plant-based solutions. Given salinity's impact on infrastructure, aquatic environments, water quality (and quantity) and terrestrial biodiversity, investment into and coordination of salinity R&D needs to be thought of in its broadest context.
6. The NDSP has enjoyed the support of State and Commonwealth governments, and a range of industries in the past. The unintended consequences of the NAPSWQ have focused the minds of some partners inwardly, and the coordination role of the NDSP has been challenged. Crowding-out appeared an initial problem after the NAPSWQ was first introduced.
7. The NDSP will cease operation from 30 June 2004 unless alternative resource to those provided by Land & water Australia can be found. LWA has provided the critical mass of funds for ten years now, and is under pressure to redirect its funds towards other under-resourced imperatives.
8. Because of its strengths in regional communication networks, the NDSP remains the best placed institution to coordinate research in a way that connects current knowledge with action, while fostering new generation of knowledge.