Invasive Animals Cooperative Research Centre

Economic Analysis of the National Wild Dog Facilitator Project

P. Chudleigh, S. Simpson and J. Lai

Invasive Animals CRC

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"Together, create and apply solutions"

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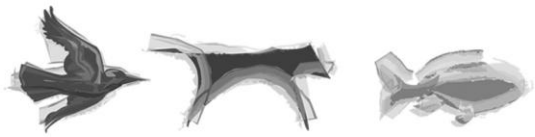
Peter Chudleigh, Sarah Simpson and Jessica Lai



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Executive Summary

The Invasive Animals Cooperative Research Centre (IA CRC), together with a number of partners, has been funding a project to facilitate the strategic management of wild dogs in Australia. The first phase of the project was funded from August 2006 to October 2009 (extended to June 2010). The second phase of the project was then funded from June 2010 and is due to end in June 2012.

Wild dogs are defined as wild-living dogs which include dingoes, feral dogs and their hybrids. Wild dogs are declared as invasive pests requiring control on private lands in most states of Australia, however dingoes are protected as native wildlife when in a conservation area. Wild dogs have traditionally been managed in sheep farming areas due to their impact on sheep, but have been less managed in cattle farming areas due to a perceived lower impact. In addition, dogs are increasingly becoming a problem in urban and peri-urban areas.

The economic costs associated with wild dogs are particularly evident in cattle, sheep and goat industries, and include the production loss of livestock through predation, injury and disease transmission. Furthermore, the management of wild dogs, such as control measures, poses significant costs to landholders and government.

Wild dogs impact on the environment both directly and indirectly. The predation of native wildlife and other invasive animals is a direct environmental impact. Also, wild dog control efforts such as baiting have an indirect impact on the environment by affecting non-target native species.

The social impact of wild dogs is extensive and ranges from the psychological impacts experienced by landholders to the loss of community cohesion due to conflicts surrounding wild dogs. In addition, wild dogs pose a physical threat to humans.

The facilitator model that this project has adopted is proving to be effective in limiting the impact of wild dogs. The purpose of this economic analysis is to demonstrate the value of such a facilitated approach. The facilitator project recognises that producers and the wider community working cooperatively is required to effectively manage wild dogs and their impacts. Prior to the project, guidelines for the coordinated and strategic management of wild dogs had been developed, but there had been only a limited number of successful examples of the application of the approach.

As wild dogs are highly mobile, the nil-tenure approach extended by the national wild dog facilitator (NWDF) promotes that property boundaries should be ignored so that management can focus on the distribution of dog activity, dog impacts and features of the total environment. Such an approach requires cooperation among landholders and other stakeholders who often have varying objectives, capabilities and resources. Formal agreements are also often required between stakeholders and an independent and credible facilitator is of value in helping to broker these agreements.

A national facilitator can also be of value in supporting and complementing the skills of regional coordinators and local pest control authorities as plans are implemented, and can help coordinate activities across management groups and shires. A national facilitator can contribute to improved extension and flow of information between regions and states, and also assist with extension of technical

information (eg training for trapping, laying baits, monitoring of dog activity etc). Having a national view also allows the facilitator to compare and contrast alternative models for wild dog management in a wide range of environments and so extend successful models.

The national wild dog facilitator has been active in most states and territories in Australia. The major outcome that has emanated from the activities and outputs of the NWDF project has been an increased public awareness of the wild dog issue, a changing of attitudes of stakeholders with respect to wild dog management and an increase in the participation of landholders in wild dog management. This change has been associated with an appreciation of the nil-tenure approach. The change has been achieved through the facilitator engaging with all stakeholders, listening to their concerns and developing strategies for encouraging all stakeholders within a community to work together to manage the problem.

The field days and planning meetings with communities, as well as meetings with the state and statutory bodies engaged in wild dog management have been the activities used to achieve the coordination, communication and facilitation manifest in the program. Through these meetings, individuals and communities are provided with examples of successful wild dog management plans and the best practice methodology that was employed to make them work. National coordination has benefited from the activities of the National Wild Dog Management Advisory Group.

Breaking down state and local boundaries is also a key component of the success of the management plans, and presentations of examples and case studies by the NWDF has allowed newly developing groups to see how this can work.

The ability of the NWDF to provide continuous communication allows messages to be reinforced in a way that would not occur without the NWDF. This allows momentum to be maintained in activities. Repeated visits by the NWDF have actually developed the capacity of the stakeholders themselves to drive coordinated management within the community. The NWDF also assists with negotiating the development of wild dog management plans across adjoining regions and shires ensuring better coverage. Frequent contact has also allowed the facilitator to identify issues and facilitate them being addressed at an early stage.

Once an agreement has been reached, the facilitator is of value in assisting in the transfer of information and actions from formal agreements to on-ground control.

There are a number of examples of where the involvement of the NWDF has directly or indirectly led to increased (or redirected) funding for wild dog management, or changes in policy and these are presented in the report.

The approach to the economic impact analysis within this report is firstly to identify and describe the overall impact of wild dogs in Australia. This includes reference to past studies undertaken to quantify the economic impact of wild dogs on Australian farming (including wool, lamb and sheepmeat, goat and beef industries). Following this description of the overall impact of wild dogs, an attempt is made to value the impact that the NWDF project has had (and is having) in reducing the impacts of wild dogs in Australia. This involves making assumptions with respect to what would have happened with respect to wild dog management in the absence of the NWDF (the without scenario).

Examples of where the activities of the NWDF have made a difference with respect to the way wild dogs are managed are noted. Assumptions are made on how this will have reduced the impact of wild dogs in Australia (the with scenario).

Specific assumptions refer to:

- the proportion of sheep/goats and cattle in each state on which wild dogs were creating significant losses as of 2006/07
- the proportion of sheep/goats and cattle being significantly impacted on by wild dogs in the regions where the NWDF has operated, or will operate by June 2012
- the reduction of impact of wild dogs in the regions where the NWDF has operated/will operate (with and without the NWDF project) and the extent of this impact over time
- the proportion of the impact reduction that could be attributed to the NWDF project

The analysis has shown that for the investment in the project from July 2006 to June 2012, there is an expected return (benefit cost ratio) of 5.1 to 1 when benefits are measured over 15 years from the first year of investment (at a 5% discount rate). If the benefits are considered over a 30 year timeframe, then the benefit-cost ratio increases to 8.0 to 1. A break-even analysis showed that the NWDF would only need to reduce the wild dog impact by 4.9% over 15 years in the areas where the project is active in order for the investment to break-even. Benefits valued were restricted to economic benefits; environmental and social benefits were not valued.

The success of the NWDF project in the regions where it has been active (and will be active up until 2012), and feedback from those who have been involved with the project, indicates that there is merit in continuing the project beyond 2012, and extending the activities of the NWDF into other regions. This may well include a greater focus on cattle areas.

An economic analysis was carried out on the expected returns to an assumed investment in the project from July 2012 to June 2016 (4 years). The analysis found that the expected return was 8.6 to 1 when benefits are measured over 15 years from the first year of investment (at a 5% discount rate). If the benefits are considered over a 30 year timeframe, then the benefit-cost ratio increases to 11.3 to 1. A break-even analysis showed that the NWDF would only need to reduce the wild dog impact by 2.9% over 15 years in the areas where the project is active in order for the investment to break-even.

1. Introduction

The Invasive Animals Cooperative Research Centre (IA CRC) has been funding a project to facilitate the strategic management of wild dogs in Australia. The first phase of the project was funded from August 2006 to October 2009 (extended to June 2010). The second phase of the project was then funded from June 2010 and is due to end in June 2012.

In addition to the funding from the IA CRC, additional funding has come from Australian Wool Innovation, the Australian Pest Animal Management Program and the Bureau of Rural Sciences (now Australian Bureau of Agricultural Resource Economics and Sciences (ABARES)). Also, a number of government agencies provided in-kind support to the project including:

- Queensland Department of Natural Resources, Mines and Water (now Queensland Department of Environment and Resource Management)
- Queensland Environmental Protection Agency (now Queensland Department of Environment and Resource Management)
- NSW Department of Primary Industries
- NSW Department of Environment and Conservation (now NSW Department of Environment, Climate Change and Water)
- Victorian Department of Sustainability and Environment
- SA Department of Water, Land and Biodiversity Conservation (now SA Department of Environment and Natural Resources)
- WA Department of Agriculture and Food

Wild dogs are defined as wild-living dogs which include dingoes, feral dogs and their hybrids (National Land & Water Resources Audit and Invasive Animals Cooperative Research Centre 2008). The dingo is a native Asian dog brought to Australia about 4000 years ago; feral dogs are domesticated dogs living in a wild state. Also of concern are free-roaming dogs that are domesticated dogs allowed to roam away from their owner's property and that may behave like wild dogs. Hybrids are progeny of dingoes crossed with other wild dogs. Wild dogs are declared as invasive pests requiring control on private lands in most states of Australia, however dingoes are protected as native wildlife when in a conservation area. Wild dogs have traditionally been managed in sheep farming areas due to their impact on sheep, but have been less managed in cattle farming areas due to a perceived lower impact. In addition, dogs are increasingly becoming a problem in urban and peri-urban areas.

The economic costs associated with wild dogs are particularly evident in cattle, sheep and goat industries, and include the production loss of livestock through predation, injury and disease transmission. Furthermore, the management of wild dogs, such as control measures, poses significant costs to landholders and government. It has been estimated that it costs Australia $10 million per year to maintain the wild dog barrier fence (McLeod 2004).

Wild dogs impact on the environment both directly and indirectly. The predation of native wildlife and other invasive animals is a direct environmental impact. Also, wild dog control efforts such as baiting have an indirect impact on the environment by affecting non-target native species.

The social impact of wild dogs is extensive and ranges from the psychological impacts experienced by landholders to the loss of community cohesion due to conflicts surrounding wild dogs. In addition, wild dogs pose a physical threat to humans.

The facilitator model that this project has adopted is proving to be effective in limiting the impact of wild dogs. The purpose of this assessment is to demonstrate the value of such a facilitated approach. This information will be an important input into future decisions made regarding the ongoing funding of such a model for wild dog management following the June 2012 end date of both the project and the IA CRC. Demonstrating such benefits may be also of value when government and industry are making future decisions regarding the development of 'facilitator' projects that target other invasive animal species.

2. Rationale for the project investment

The facilitator project recognises that producers and the wider community working cooperatively is required to effectively manage wild dogs and their impacts. Prior to the project, guidelines for the coordinated and strategic management of wild dogs had been developed, but there had been only a limited number of successful examples of the application of the approach. This coordinated and strategic management approach is also known as the nil-tenure management approach. This approach was first developed and applied in the Brindabella/Wee Jasper area of New South Wales from 2001 to 2004. The nil-tenure management approach was nationally endorsed in 2005. Consequently, some wild dog management groups were formed through state and local governments, but in some cases the groups were incomplete or agreements between stakeholders were not reached.

In Queensland, there had been a Queensland Wild Dog Strategy released in 2005. One of the key recommendations of this Strategy was the establishment of a State-wide Dog Committee. In 2007, when the National Wild Dog Facilitator (NWDF) was employed as part of this IA CRC project, that Committee had not yet been established and the strategy had not been implemented. Responsibility for managing wild dogs in Queensland rested largely with local governments.

In other states, there were various other activities being undertaken with respect to the management of wild dogs, and the responsibility for management rested with various levels of government and organisations (eg pest boards) in the different states. The levels of strategic and coordinated management varied greatly and were largely inconsistent.

In some regions, there has historically been a strong culture of landholders looking after their own properties and flocks/herds, with less appreciation of the externalities associated with lack of control on individual holdings, reservoirs of reinfestation, and the benefits of acting in a coordinated manner in time as well as spatially to gain more effective local control.

It was determined at a meeting between the partners of the IA CRC, together with Australian Wool Innovation (AWI) and Meat & Livestock Australia (MLA), that the funding of a national facilitator for wild dogs would be an appropriate approach to assist local groups in their strategic and cooperative management of wild dogs, using the nil-tenure approach. The approach of using a national facilitator had already been successful with respect to weed management.

As wild dogs are highly mobile, the nil-tenure approach promotes that property boundaries should be ignored so that management can focus on the distribution of dog activity, dog impacts and features of the total environment. Such an approach requires cooperation among landholders and other stakeholders who often have varying objectives, capabilities and resources. Formal agreements are also often required between stakeholders (eg Memorandums of Understanding (MOUs)) and a facilitator is of value in helping to broker these agreements.

A national facilitator can also be of value in supporting and complementing the skills of regional coordinators and local pest control authorities as plans are implemented, and can help coordinate activities across management groups and shires. A national facilitator can contribute to improved extension and flow of information between regions and states, and also assist with extension of technical information (eg training for trapping, laying baits, monitoring of dog activity etc). Having a national view also allows the facilitator to compare and contrast

alternative models for wild dog management in a wide range of environments and so extend successful models.

It was also determined that social research into barriers to management and values and views towards pest animals was required, and a national facilitator could act as a conduit between researchers and landholders.

3. Description of the project

Objective

The primary objective of the first phase of the project (2006 to 2010) was to promote a nationally consistent strategic approach to wild dog management, resulting in the development of cooperative wild dog management plans utilising all forms of control at local, regional and state government scales to effectively manage the impacts of wild dogs. Improved wild dog control was to be achieved through the following:

- increasing the awareness of wild dogs and their impacts nationally
- increasing the awareness of strategic management of wild dogs, based on a nil-tenure approach
- facilitating the development and implementation of management plans consistent with this approach with local management groups from around the country
- fostering the development of regional agreements (eg MOUs) for wild dog management between key stakeholders
- documenting case studies for wild dog management
- promoting wild dog adaptive management programs
- implementing training programs for the control of wild dogs
- promoting the uptake of IA CRC-developed baits and delivery mechanisms, where appropriate
- participating in processes to revise the strategic approach to wild dog management where appropriate.

The objectives and intentions of the second phase of the project (2010 to 2012) were:

- facilitate wild dog management plans with state government staff, producers and natural resource management (NRM) groups from six wild dog affected locations throughout Australia for each year of the project
- build on the successes of phase one of the project while looking to establish additional local wild dog committees and regional planning groups in other states as required or invited
- provide the template and guidelines by which to conduct the nil-tenure planning processes and build the capacity of local officers to continue developing and reviewing the development of wild dog management plans at the local community level
- transfer knowledge to the newly appointed wild dog coordinator who will take on the facilitator role for the Queensland region inside the wild dog barrier fence including the adoption of the nil-tenure approach
- work with groups in NSW where progress had stalled and review the associated overriding regional plans where necessary
- assist the establishment of local community wild dog working groups in South Australia and build the capacity of the South Australia Arid Lands (SAAL) NRM Board to conduct effective nil-tenure planning processes and on ground management programs
- support the development of cooperative wild dog management plans in various regions of Western Australia that were suffering wild dog impacts as a result of increasing wild dog numbers in the pastoral zone
- contribute to the Victorian Department of Primary Industries' ongoing process of reviewing its wild dog management programs and operational guidelines

Budget for project (inputs)

Estimates of the total investment in the project are provided in Table 1.

Table 1: Estimate of investment in the National Wild Dog Facilitator project (nominal $ terms)

Year ending June	IA CRC (cash)	AWI (cash)	Australian Pest Animal Management Program (cash)	In-kind commitments[a]	Total investment
2007	111 000			104 000	215 000
2008	32 000			109 000	141 000
2009	159 000	76 000		109 000	344 000
2010	0	76 000	71 000	94 000	241 000
2011	0	100 000	72 000	89 000	261 000
2012	74 000		50 000	89 000	213 000
Total	376 000	252 000	193 000	594 000	1 415 000

[a] in-kind commitments from Queensland Department of Environment and Resource Management; NSW Department of Primary Industries; NSW Department of Environment, Climate Change and Water; Victorian Department of Sustainability and Environment; SA Department of Environment and Natural Resources; WA Department of Agriculture and Food; IA CRC

Project methods and activities

The National Wild Dog Management Advisory Group (NWDMAG) was established in December 2008. The group comprises representatives from across the country and provides direction for the NWDF project. The NWDMAG is made up of industry representatives from Wool Producers Australia, Cattle Council of Australia, National Farmers Federation (NFF), Bureau of Rural Sciences (BRS), various state industry representatives and the NWDF. The group also includes government representatives from primary industry and environmental state departments from Queensland, New South Wales, Australian Capital Territory, Victoria, South Australia and Western Australia. The management group meets twice a year.

The function of the NWDMAG is to:

- provide leadership and coordination for the management of wild dogs across Australia
- promote the goals and objectives of the Australian Pest Animal Strategy
- act as the steering group that provides direction and assistance to the NWDF in implementing the project objectives
- raise the profile of wild dog management across the country and highlight the importance of integrated and strategic management of wild dogs on a regional and local scale
- highlight priority areas for wild dog management and research (including dingo conservation) and endorse initiatives that meet the aims of the NWDMAG
- provide a forum whereby stakeholders and government agencies can raise wild dog management issues that they consider to be of national concern for the group to progress to the relevant organisation
- promote the development of communication networks between wild dog management groups, managers and researchers within and across states in order to extend information rapidly

The establishment of the NWDMAG was part of the NWDF project. It evolved from the National Wild Dog Facilitator Steering Committee that was brought together to oversee the implementation of the NWDF project. The operational costs of the meetings are funded by the NWDF project, however the costs of the individual participants are funded by their employer (eg state agencies) or through support from organisations such as AgForce Queensland or AWI. At this stage it is unclear in what form the NWDMAG might continue after the completion of the NWDF project (eg could be disbanded, or could become a statutory body under the Vertebrate Pests Committee (VPC)).

The NWDF works at local, regional, state and federal levels with government agencies, landholder groups, NRM groups and non-government organisations (NGOs) across the country. The first phase of the project was initially largely focused in Queensland, but emphasis has since shifted nation-wide.

The majority of the facilitator's work is communicating with stakeholders in wild dog management through a variety of means in order to facilitate a strategic and coordinated approach to wild dog management. The communication may take the form of telephone calls, emails, contributions to various media outlets, face-to-face meetings, and presentations at, or facilitation of, a range of stakeholder meetings (including with communities, NGOs, landholders and government agencies).

As part of the nil-tenure approach, the first step towards the development of a regional plan is for information on wild dog activity, behaviour, stock attacks, movement corridors and breeding sites to be identified by landholders and the community. This information is then mapped at a landscape level with an overlay of current control practices to identify whether the areas of concern with regard to wild dogs are actually being treated with some form of control. These maps can be used to demonstrate how every landholder has a role and how their own management impacts on neighbours. Local area management plans are usually developed after these maps are completed, with significant cooperation and strategic planning required in their development.

The NWDF project does not itself fund the development and activities of the management plans, but rather funds the involvement of the national facilitator in establishing, developing and implementing these plans. The funding and support for developing the individual plans comes from a range of sources depending on where the responsibility for wild dog management rests in individual states (eg state government, land boards, local government).

Each management plan developed with the aid of the NWDF requires a program of monitoring for wild dog activity, usually using sand plots, stock losses, prey abundance, control effort and expenditure. The monitoring is usually undertaken in nil-treatment areas as well as areas under active management.

Ideally, the management strategies within a plan are deliberately varied in order to be able to make stronger inferences about responses to management, however this may not be practical in all situations and may compromise engagement of stakeholders. However, if this approach is adopted, it provides an opportunity for the facilitator to assess competing models for wild dog management, and dog responses to that management, thus encouraging adaptive management.

4. Outputs

General outputs

The key outputs from the project to date are:

- The project established the NWDMAG. The NWDMAG has developed a number of position statements on national wild dog management issues that support the work and approach of the NWDF.
- Presentations on the project were made at a number of conferences including the Vertebrate Pest Conference in Darwin 2008 and the Queensland Pest Symposium in Cairns 2009.
- There were a wide range and a number of media articles referring to the project in the years 2007 to 2010, appearing in paper (news and magazines), radio, TV and the internet. There were eight articles in 2007, 24 articles in 2008, 49 articles in 2009 and 36 articles in 2010. The spike in media articles in 2009 was largely due to the establishment of the NWDMAG in December 2008.
- There was a total of ten predator control field days held throughout Queensland, with over 1300 landholders attending the field days (attendance at each ranged from 45 to 110). In addition, there have been four field days held in Victoria and seven in Western Australia. The field days aimed to provide landholders with a range of wild dog management options and to build their skill level in wild dog control techniques. Field days also informed landholders about the latest Queensland wild dog research results and the importance of integrated wild dog management across the landscape as promoted by the nil-tenure approach. The field days have been funded by a range of organisations including AWI, state governments, Caring for our Country and AgForce Queensland, however the NWDF was heavily involved in their organisation and facilitation.
- The NWDF successfully applied to BRS for a $68 000 grant to develop a best practice manual for the use of guardian dogs to protect livestock. The need for such a manual had been identified at the predator control field days. The manual was released nationally at the NFF Conference in September 2010. Out of 1000 hard copies printed, 800 had been distributed as at January 2011, with significant interest from overseas as well as in Australia.
- Funds were secured from BRS to develop an instructional DVD on how to trap introduced predators using leg hold traps. The DVD is due for release in February 2011 (value of grant was $58 000).
- From 2007 to 2010 the NWDF attended at least 40 state agency and local government meetings to promote the project and provide updates on wild dog management tools and research (13 in Queensland, six in Victoria, one in ACT, four in WA, two in SA, two in Tasmania and 12 nationally)
- From 2007 to 2010 the NWDF attended 82 community meetings, planning workshops and field days. The majority of these were in Queensland, especially early in the project. However as the project has progressed, there has been greater involvement in other states. Table 2 shows the number of people attending community meetings, planning workshops and field days by state, and by year.

Table 2: NWDF and stakeholder attendance at community meetings, planning workshops and field days

Year	Number of meetings	Number of people attending	Distribution of people attending by state/territory						
			Qld	NSW	Vic	SA	ACT	WA	National
2007	8	245	83	150	12	-	-	-	-
2008	23	615	558	25	-	20	12	-	-
2009	26	930	820	-	30	65	-	15	-
2010	25	936	153	30	156	-	-	105	364
Total	82	2,726	1,614	205	198	85	12	120	364

Interaction with AgForce Queensland

The NWDF has been significantly involved in efforts by AgForce Queensland to improve the management of wild dogs in Queensland. AgForce Queensland sought advice from the NWDF on how to move forward with wild dog management on a state level. Subsequently the AgForce Queensland President made several presentations to the state government resulting in a review of the Queensland Wild Dog Strategy. The NWDF was an integral part of the communication and consultation process for the review. As part of the outcomes of the review of the strategy, an MOU for wild dog management inside the wild dog barrier fence was established. In addition, the review resulted in the establishment of the Queensland Wild Dog Advisory Committee, and the appointment of a Queensland wild dog coordinator inside the wild dog barrier fence. This position facilitates wild dog management programs established by the NWDF, and also initiates new planning programs. The Queensland government has adopted the national approach to wild dog management based on the nil-tenure approach.

The NWDF was also heavily involved in the development and implementation by AgForce Queensland of its Blueprint for the Bush project entitled *Raising the Awareness of Strategic Coordinated Wild Dog Control*. This project was jointly funded by AgForce Queensland and the Queensland State Government and the outputs of the project include:

- funding and organisation of the predator control field days
- engagement of a social scientist to conduct a study looking at the attitudes of producers towards wild dog management and the development of survey questions to conduct a producer survey
- completion of a producer survey to analyse the impacts of wild dogs on producers and the reasons why some producers do not become involved in wild dog control
- survey of saleyard managers and meat processors to assess the cost of wild dog bites on the cattle industry

As a result of these surveys, a report was produced by AgForce Queensland on the impact of wild dogs in Queensland. The NWDF was heavily involved in the report, however the development of the report was funded by AgForce Queensland and not the IA CRC. Key findings of the report related to attitudes and motivations of producers for involvement and non-involvement. Some of the conclusions from the study were:

- Wild dogs cost Queensland producers in excess of $67 million a year through predation, disease and control.
- Producers believe that in order to overcome wild dog impacts they have to work cooperatively with neighbours and the wider community, and the development of wild dog management plans has the capacity to achieve this objective.

- Research on wild dog ecology was vital in order to develop effective control programs.
- Additional control technologies in addition to 1080 poison baiting were imperative in order to achieve greater participation.

Queensland

The NWDF assisted the development of numerous wild dog management plans for the following councils:

- Blackall-Tambo Regional Council
- Flinders Shire Council
- Murweh Shire Council
- Balonne Shire Council
- Moreton Bay Regional Council (specifically Mount Mee)

Furthermore, a coordinated regional wild dog management program has been developed among the shires in western Queensland with the help of the NWDF.

There have been planning workshops in Winton and Longreach where local or state government officers have taken control of the process. There was also a series of workshops in the Southern Downs but that process has since stalled. Assistance was also provided to the Traprock Wool Group Association.

A four day trapper training course for landholders was held in Longreach in April 2009.

Since the inception of the wild dog management plans in western Queensland, the participation of landholders in the control of wild dogs has significantly increased.

South Australia

The NWDF assisted the development of wild dog management plans for the North Flinders region which is part of a larger wild dog management initiative known as the Biteback program. This program intends to establish wild dog management plans for the North East, Marree, Kingoonya and Gawler Ranges with the help of the NWDF. Furthermore, the NWDF assisted in obtaining funds from SA Sheep Industry Fund for the Biteback program.

New South Wales/Australian Capital Territory

Since 2008 there has been ongoing activity in north west NSW including working towards coordinating the control of wild dogs in Bourke Shire (NSW) and Paroo Shire (Qld). Progress stalled due to the lack of support from the NSW Western Catchment Management Authority, however there is currently renewed interest and support for a program in the area and a dialogue is underway between a number of stakeholders. There has also recently been activity by the NWDF in northern NSW, namely around Tenterfield.

With the assistance of the NWDF, the Shannons Flat wild dog management plan was developed (involved working with Namadgi National Park in the Australian Capital Territory).

Victoria

In 2008/09 the NWFD worked closely with the Victorian Department of Primary Industries and Victorian Farmers Federation representatives on the Victorian Dingo Working Group to provide advice and information on the management of wild dogs and dingoes in other states. There was some conflict in this group regarding the

listing of the dingo as a threatened species and the impacts this would have on wild dog management for Victorian farmers.

Work in Victoria with the development of community based cooperative wild dog management plans commenced in 2010/11. The plans that the project helped develop to date include those for:

- Burrowye-Walwa Community (wild dog management plan)
- Tambo Valley (Tambo Junction, Ensay, Swifts Creek, Omeo, Benambra)

Tasmania

In 2008/09 the NWFD was invited to a planning session with the Pyengana Catchment Management Group with respect to the nil-tenure approach, and whether it was appropriate for the management of browsing macropods. Wild dogs are not a significant problem in Tasmania partly due to the non-existent dingo population.

Western Australia

The NWDF assisted the development of numerous wild dog management plans for the following regions and organisations:

- Carnarvon Zone Control Authority
- Shark Bay Shire
- Murchison Shire
- Mt Magnet Shire
- Yalgoo Shire
- Northern Mallee Declared Species Group/Esperance Shire

In addition, workshops were held at Leinster and Kalgoorlie in February 2011, and there is also some planned activity in the Pilbara region.

Northern Territory

To date, there has been no activity by the NWDF in the Northern Territory. This is largely because dingoes are a protected species on both public and private land and exemption permits are required to control wild dogs. In addition, there are no sheep in the Northern Territory however there are some wild dog impacts on cattle and wildlife.

5. Usage

The major outcome that has emanated from the activities and outputs of the NWDF project has been a changing of attitudes of stakeholders with respect to wild dog management and an increase in the participation of landholders in wild dog management. This change has been associated with an appreciation of the nil-tenure approach. The change has been achieved through the facilitator engaging with all stakeholders, listening to their concerns and developing strategies for encouraging all stakeholders within a community to work together to manage the problem.

The field days and planning meetings with communities, as well as meetings with the state and statutory bodies engaged in wild dog management have been the activities used to achieve the coordination, communication and facilitation manifest in the program. Through these meetings, individuals and communities are provided with examples of successful wild dog management plans and the best practice methodology that was employed to make them work.

Breaking down state and local boundaries is also a key component of the success of the management plans, and presentations of examples and case studies by the NWDF has allowed newly developing groups to see how this can work.

The support provided by the NWDF (and therefore the level of impact attributable to the NWDF) varies depending on the longevity of the stakeholders involvement with wild dog management involved in the process. For example, where wild dogs have been an issue for generations of landholders, there is often not as much support needed as where wild dogs have more recently emerged as a problem. Where stakeholders are naive to the process of developing a coordinated, strategic plan, a facilitator is important to build the understanding and capacity of those stakeholders in order that the strategic approach can be successfully implemented. The capacity of stakeholders refers not just to landholders, but also government stakeholders.

The ability of the NWDF to provide continuous communication allows messages to be reinforced in a way that would not occur without the NWDF. This allows momentum to be maintained in activities. Repeated visits by the NWDF have actually developed the capacity of the stakeholders themselves to drive coordinated management within the community. The NWDF also assists with negotiating the development of wild dog management plans across adjoining regions and shires ensuring better coverage. Frequent contact has also allowed the facilitator to identify issues and facilitate them being addressed at an early stage.

Once an agreement has been reached, the facilitator is of value in assisting in the transfer of information and actions from MOUs to on-ground control. The NWDF also complements the skills of regional coordinators and local pest control authorities as management plans and control programs are developed and implemented.

There has been significantly increased public and industry awareness of the wild dog issue as a result of this project. This increased awareness has contributed to significant changes in attitudes to management. It also contributed to raising the interest of state farming bodies and increasing their involvement, as well as that of AWI and MLA.

There are a number of examples of where the involvement of the NWDF has directly or indirectly led to increased (or redirected) funding for wild dog management, or changes in policy. Examples include:

- In 2010 the Western Australia State Government announced their commitment of $8.82 million over the next five years to the upgrading and erection of dog fences, an increased number of wild dog trappers and improved wild dog management programs across the state. The NWDF assisted these changes by facilitating the formation of strong working relationships and collaborative working arrangements.
- The strategic approach of the NWDF to the management of wild dogs has been formally recognised and adopted by the Queensland Government.
- The strategic approach of the NWDF to the management of wild dogs has been adopted by the SAAL Board as the way forward for wild dog management inside the dog fence in South Australia.
- As a result of the direct lobbying of Minister Bourke by Brent Finlay (Chairman of NWDMAG) and the NWDF on behalf of the NWDMAG, wild dogs were listed under the Caring for our Country program. Subsequently, the Victorian DPI successfully obtained $20 000 from Caring for our Country for wild dog management. The NWDF assisted in securing these funds because the Victorian DPI utilised the success of previous field days and planning workshops facilitated by the NWDF to strengthen their application. In addition, the NWDF wrote a letter of endorsement and assisted the project officer with the development of the application.
- In 2008/09 the Murweh Wild Dog Advisory Group successfully lobbied the Murweh Shire Council to commit $600 000 over three years to wild dog management in the shire. A provision of the Council's funding was that the nil-tenure approach was to be adopted. The NWDF's involvement in Murweh Shire through attending committee meetings, facilitating field days and planning workshops and the promotion and knowledge of the nil-tenure approach was a determinant of the council providing these funds.
- In 2008, dingoes and its hybrids were listed as a threatened species under the Victorian *Flora and Fauna Guarantee Act 1988* and consequently they are protected across the entire state of Victoria. The Dingo Working Group was established to determine how the listing of the dingo as a threatened species might have an impact on the management of wild dogs for the protection of livestock. The NWDF worked closely with the Victorian DPI and Victorian Farmers Federation (VFF) representatives on the working group to provide information on the impact of wild dogs and their management. This knowledge was critical in providing a comprehensive rebuttal to the claims put forward by the representatives of dingo conservation groups. For example the dingo advocates wanted to abolish the buffer zone concept whereby wild dogs are proactively managed on public land prior to the private/public interface where wild dogs impact on livestock. The NWDF was instrumental to the development of the strong case for the management of wild dogs and as a result such claims were unsuccessful.

To date, 800 hard copies of the Best Practice Manual for the use of Livestock Guardian Dogs have been distributed throughout Australia and overseas. The manual has been provided to NRM groups across Australia and key industry groups including Australian Wool Innovation, National Farmers Federation, Meat and Livestock Australia, AgForce Queensland, WA Farmers Federation, NSW Farmers Federation, SA Farmers Federation and Victorian Farmers Federation, just to name a few. The uptake of the manual by landholders and producers has also been quite substantial. In addition, the electronic version of the manual is publicly accessible on the internet. The manual has been commended for numerous aspects including its comprehensiveness and usefulness, presentation and interesting case studies. Livestock producers, conservation agencies and wildlife management groups from

Canada, South America, Africa and Europe have praised the manual's attention to detail. Furthermore, a European dog breeding association sought permission to translate sections of the manual to publish in their newsletter.

The surveys that were carried out as part of the AgForce Queensland project have been used by the NWDF to aid in identifying key reasons for Queensland landholders' participation and non-participation in baiting, as well as information on impacts of wild dogs, and attitudes to wild dogs. This information has also been of value to a number of other stakeholders including those in Western Australia. There is an intention to repeat the survey on a national scale, which is possible as the survey was intentionally designed to be a national survey and is not Queensland specific in its questions. This survey together with the experience of the NWDF has identified a number of reasons for non-participation in baiting including seasonal conditions; a shift in production from sheep to cattle; a changing demographic of rural landholders; buy-out of family properties by large companies that can absorb the cost of limited dog predation; and concerns about available control techniques (ie baiting).

The NWDF has contributed to specific regions and people in a number of different ways. A number of examples are provided below that demonstrate the involvement of the NWDF and how the management of wild dogs in those areas has improved as a result.

Queensland – Murweh Shire

The Murweh Shire lies in the semi-arid zone of the Great Artesian Basin and includes the towns of Augathella, Charleville, Cooladdi and Morven. Wild dogs heavily infested the area connecting the towns of Augathella, Charleville and Morven (often referred to as the triangle) and as a result numerous landholders had gone out of sheep.

Prior to the NWDF, there were several wild dog syndicates operating within the shire, however landholder participates rates were low and the lack of a wider coordination meant the individual syndicates were largely ineffective.

The NWDF held several meetings with landholders and wild dog syndicate groups in the Murweh Shire to discuss and promote the nil-tenure approach. With the assistance of the NWDF, the Murweh Shire Wild Dog Management Plan was developed based on the nil-tenure approach. In addition, the NWDF's knowledge and skills in mapping wild dog movements and identifying particular 'hot spots' was fundamental to the management plan.

Furthermore, the NWDF played a significant role in increasing landholders' participation in the coordinated effort to control wild dogs, particularly those landholders who were not exposed to the severity of the wild dog impacts. The NWDF achieved this change by individually talking to landholders and highlighting the wild dog problem and the effectiveness of a cooperative approach to wild dog management. Also, the independence from different landholder groups and government agencies has allowed the NWDF to have a significant impact in facilitating change in the wider south west Queensland area (P Lucas, Chair, Paroo Wild Dog Management Advisory Committee, personal communication, 2011).

In conjunction with the Murweh wild dog management plan, a trapping syndicate was established, the cost of trappers was subsidised and ground baiting is now synchronised across the shire. The NWDF was instrumental in achieving these changes which have resulted in a more effective management of wild dogs in the Murweh Shire. The continuation of the NWDF's involvement in the region is

identified as necessary to the ongoing success of the coordinated effort to control wild dogs (D Volz, AgForce Queensland, personal communication, 2011). Further there are a number of other regions in Queensland that are now looking for assistance regarding coordination and change (P Lucas, Chair, Paroo Wild Dog Management Advisory Committee, personal communication, 2011).

Western Australia – Murchison Shire

Murchison Shire is in the mulga region of northern Western Australia and the primary land use is mining and sheep and cattle grazing. Wild dogs have been identified to impact on cattle, sheep and goats in the shire.

Prior to the NWDF, a coordinated effort to manage wild dogs existed within the Murchison Shire and the neighbouring shires of Shark Bay, Meekatharra, Yalgoo, Cue and Upper Gascoyne. There was one baiting rack in Murchison Shire and landholders were baiting three times per year. This meant that for some landholders a round trip to the baiting rack involved travelling 630 kilometres. As a result, the number of landholders that were participating in ground baiting significantly dropped and the coordinated effort became largely ineffective.

The NWDF held several meetings in Murchison Shire and in neighbouring shires to discuss the nil-tenure approach, share information and techniques being utilised in other states and address the existing barriers to the effective control of wild dogs. It was identified that multiple baiting racks in accessible locations were critical in increasing landholder participation rates. With the assistance of the NWDF, the Murchison Shire wild dog management plan was developed and the coordination among the neighbouring shires with regards to wild dog control has been rejuvenated. Furthermore, three baiting racks have been established in locations within the Murchison Shire which has meant that the maximum round trip a landholder needs to travel to a baiting rack is 75 kilometres.

The NWDF was fundamental in stimulating the participation of landholders in the renewed coordinated effort to control wild dogs. In doing so, the NWDF emphasised the seriousness of wild dog impacts by presenting the tracking map of a wild dog wearing a GPS collar. This demonstrated the extensive distance covered by the travelling dog which made many landholders realise the need for a coordinated effort. Furthermore, the NWDF was particularly influential to landholders who were not actively controlling wild dogs on their properties or who generally did not believe wild dogs were a problem because the NWDF held a neutral and credible position (M Halleen, Murchison Shire, personal communication, 2011).

Furthermore, it is recognised that there are other wild dog affected areas in Western Australia that do not have a coordinated wild dog management plan, especially in cattle affected areas. Therefore the role of the NWDF is imperative in assisting these areas in the future (M Halleen, Murchison Shire, personal communication, 2011). In addition, the continuity of the NWDF is essential to the collaboration between states on wild dog management which would otherwise cease to exist (B Davies, formerly Chairman of the National Wild Dog Facilitator Steering Group, personal communication, 2011).

Victoria – North East and East Gippsland

Public land including state forests and national parks covers 87% of East Gippsland and 54% of North East Victoria. The vast amount of public land provides a haven for wild dogs that then travel to adjoining private land to prey on livestock. Wild dogs mainly attack sheep, however the maiming of cattle inflicted by wild dogs is also evident in both regions.

In 2002 the Victorian Department of Primary Industries (DPI) established two wild dog management groups which were based in North East Victoria and Gippsland. Both management groups applied the nil-tenure approach however there was a lack of coordination and cooperation between the landholders and the DPI staff.

The NWDF was crucial in influencing landholders to take ownership of the wild dog problem and essentially in getting involved in the coordinated effort to control wild dogs. The NWDF was particularly effective in achieving this change in participation for two reasons. Firstly, the NWDF proved knowledgeable in wild dog management by sharing new information from other states including different control techniques. Second, the NWDF's independence from government agencies enabled the NWDF to talk with landholders from a neutral position which was well received by the landholders (A Wernert, Victorian Department of Primary Industries, personal communication, 2011).

Furthermore, the NWDF has provided necessary support to the Victorian DPI staff to overcome concerns regarding operational changes. For instance, greater emphasis is being placed on baiting as opposed to trapping that had increased partly in response to animal welfare concerns. Consequently, dog trappers in particular felt threatened by these operational changes. The NWDF has been instrumental in changing the attitudes of the staff and building their capacity in other wild dog management practices (V Kingston, Victorian Department of Primary Industries, personal communication, 2011).

In addition, the NWDF has accelerated the wild dog management programs run by the Victorian DPI because of the cooperation and coordination that now exists between the Victorian DPI and landholders. It is also recognised that the continuity of the NWDF is vital to the future management of wild dogs in both regions. That is, the NWDF has allowed both regions to access national information with regards to wild dog management which has been beneficial to the efficiency of their own programs (A Wernert, Victorian Department of Primary Industries, personal communication, 2011).

South Australia – North Flinders

The North Flinders region of South Australia is bounded by the dog fence to the north and east, however wild dogs are heavily impacting on sheep graziers south of the dog fence. As a result, the North Flinders District NRM Group initiated the Biteback program, a three-year program to coordinate wild dog control among landholders. The program comprises local area plans that will cover all SA Arid Lands NRM districts in the sheep pastoral zone including North Flinders, Marree, Kingoonya, Gawler Ranges and North East districts.

The NWDF assisted the North Flinders District NRM Group to obtain funding from the SA Sheep Industry Fund for the Biteback program by facilitating the cooperation between key stakeholders and publicly supporting the proposal that was submitted.

In addition, the NWDF has been instrumental to the development of the local area plans. These plans have drawn from the NWDF's knowledge of wild dogs and best practice information and techniques from other states. Furthermore, the NWDF provided support and mentored a Biteback project officer and as a result the capacity built has allowed the project officer to effectively communicate to landholders.

The NWDF's involvement at local area planning workshops was critical in stimulating the participation of landholders in the coordinated effort to control wild

dogs. Consequently the NWDF is viewed as crucial to the future success of wild dog management in the districts (L Nutt, North Flinders District NRM Group, personal communication, 2011). It is also reassuring for the landholders to gain a national perspective on the wild dog problem.

Since the implementation of local area plans, it is estimated that the participation rate of landholders has increased from approximately 30% to 90% in North Flinders (L Nutt, North Flinders District NRM Group, personal communication, 2011). In particular, the cattle producers south of the dog fence were previously not as proactive as sheep producers in terms of wild dog control, however this has changed and cattle producers are getting more actively involved.

Due to the coordination of wild dog management and its greater effectiveness, it is believed that landholders are spending less time controlling wild dogs on their properties (L Nutt, North Flinders District NRM Group, personal communication, 2011).

New South Wales/Australian Capital Territory – Shannons Flat

Shannons Flat is located in New South Wales and neighbours Namadgi National Park of the Australian Capital Territory. Despite its relatively low carrying capacity, the Shannons Flat area is primarily used for sheep grazing. Furthermore, the landscape of Namadgi National Park provides a suitable habitat for wild dogs.

Prior to the involvement of the NWDF, ACT Parks was ground baiting three times per year in Namadgi National Park, however wild dogs were increasingly becoming a problem to surrounding landholders. It was reported that several properties were driven out of their sheep grazing enterprises because the impact of wild dogs on their livestock became unsustainable. In addition, the management of Namadgi National Park had unsuccessfully attempted to achieve a coordinated wild dog management plan since 2004.

The NWDF played a crucial role in facilitating several controversial meetings between the landholders and government agencies. This eventually resulted in an agreement and the Shannons Flat, Bredbo and Michelago wild dog management plan was developed. This plan involves the coordinated effort of ACT Parks (Namadgi National Park), Livestock Health and Pest Authorities (LHPA) and landholders.

Namadgi National Park now undertakes ground baiting monthly and has appointed a contract trapper in addition to a full time trapper. Many landholders have also given permission for the LHPA to ground bait properties that border the national park. As a result of this coordinated effort, there have been no reports of dog attacks in the past 18 months (N Webb, ACT Parks and Conservation Service, personal communication, 2011).

The NWDF was instrumental in facilitating these changes which have also resulted in additional resources being allocated to wild dog management in the region. Furthermore, the NWDF has provided ongoing support to the staff at Namadgi National Park and it is strongly believed that the continuity of the NWDF is critical to continue driving the coordinated effort (N Webb, ACT Parks and Conservation Service, personal communication, 2011).

6. Approach to economic impact analysis

The approach to the economic impact analysis is firstly to identify and describe the overall impact of wild dogs in Australia. This includes reference to past studies undertaken to quantify the economic impact of wild dogs on Australian farming (including wool, lamb and sheepmeat, goat and beef industries). The impact of wild dogs on the environment (eg biodiversity) and society (eg trauma) is also described.

Following this description of the overall impact of wild dogs, an attempt is made to value the impact that the NWDF project has had (and is having) in reducing the impacts of wild dogs in Australia. This involves making assumptions with respect to what would have happened with respect to wild dog management in the absence of the NWDF (the without scenario).

Examples of where the activities of the NWDF have made a difference with respect to the way wild dogs are managed are noted. Assumptions are made on how this will have reduced the impact of wild dogs in Australia (the with scenario).

Specific assumptions refer to:

- the proportion of sheep/goats and cattle in each state on which wild dogs were creating significant losses as of 2006/07
- the proportion of sheep/goats and cattle being significantly impacted on by wild dogs in the regions where the NWDF has operated, or will operate by June 2012
- the reduction of impact of wild dogs in the regions where the NWDF has operated /will operate (with and without the NWDF project) and the extent of this impact over time
- the proportion of the impact reduction that could be attributed to the NWDF project

In addition, assumptions are made with respect to the likely impact on wild dogs if the NWDF role does (with) and does not (without) continue beyond the current planned life of the project (June 2012).

The investment costs in the program from 2006/07 to 2011/12 were sourced from project contract documents and were presented in Table 1. For potential future investment costs, an assumption was made that to achieve the assumed benefits under a NWDF continuation scenario, the funding would continue for the four years from 2012/13 to 2015/16 at the same average rate as it has for the previous six years.

7. Review of previous economic impact studies

Table 3 presents a summary of the economic impact of wild dogs in Australia as estimated by a number of previous studies undertaken. The table shows that the estimates of economic impact range from $48.5 million to $66.3 million Australia wide, to $67 million for Queensland only. The differences in the values estimated by each study relate to differences in methods and inclusions of different impact types. None of the estimates include environmental or social impacts. There are also some differences in the assumptions used with respect to the extent of impact of wild dogs on lamb, wool and cattle enterprises.

Table 3: Results of relevant studies on the cost impacts of wild dogs

Author	**Estimate ($ terms in year of analysis)**	**Estimate converted to 2009/10 $ terms**	**Comment**
McLeod R (2004)	$66.3 million	$78.80 Million	Losses of sheep and calves; management costs; maintenance of dog fence; and research costs.
Gong W, Sinden J, Braysher M and Jones R (2009)	$48.5 million	$49.98 Million	Losses in beef, lamb and wool industries, measured in terms of changes in economic surplus.
Hewitt L (2009)	$67 million	$69.04 million	Costs associated with wild dogs in the Qld grazing industry only. Losses of calves; product loss due to dog-bitten cattle (saleyards); product loss due to dog-bitten cattle (processors); calf loss from *Neospora caninum* abortions; cattle loss due to hydatids; wild dog management costs for cattle producers; sheep/goat losses and attacks; wild dog management costs for sheep/goat producers; costs of Local Government; costs of wild dog barrier fence contributed from Local and State Governments; and costs of Qld State Government.
Lightfoot C (2011)	$13.2 million	$13.2 million	Opportunity cost of wild dogs to livestock production in Victoria, including average losses of dry sheep equivalents and the opportunity cost of labour.
Fitzgerald G and Wilkinson R (2009)	$40 000 to $80 000	$41 220 to $82 440	Losses of sheep in the Upper Hunter region

8. Review of environmental and social impacts of wild dogs

In addition to economic impacts, wild dogs also impact on the environment, and on individuals and the community. A summary of such impacts is provided below. These impacts have not been quantified or valued.

Environmental impacts

The environmental impacts of wild dogs include:

- Predation of wild dogs may have an impact on the survival of remnant populations of endangered fauna. For example, predation by wild dogs is a threat to 36 species listed in the *NSW Threatened Species Conservation Act 1995* (Coutts-Smith et al 2007).
- Non-target poisoning linked to the control of wild dogs is thought to be a threat to several species of small mammals. For example, spotted-tailed quolls are particularly at risk from wild dog baiting.
- There are some who argue that wild dogs may play a constructive ecological role by controlling the population of other pest species, including foxes, feral cats, feral pigs, wild goats, rabbits and rodents.
- Wild dogs may regulate the population of certain native fauna. For example kangaroos and emus, where the numbers in specific regions are often excessive.

Social impacts

The social impacts of wild dogs include:

- Wild dogs pose a physical threat to humans. In the year ending December 2007, the Hunter Rural Lands Protection Board recorded three dog attacks on people, although the nature of these attacks in unclear (Fitzgerald and Wilkinson 2009).
- The loss of farm income due to wild dogs reduces the material quality of life for the farming household, disrupts the plans of landholders by restricting their options and impacts the rest of the community in the form of reduced spending (Fitzgerald and Wilkinson 2009).
- Wild dogs are a source of community conflict and disharmony. For instance, conflicts arise from the non-involvement of landholders in community-based wild dog control efforts; and the contrasting opinions around wild dogs and the mechanisms to control them (eg 1080 baiting is viewed by some as inhumane). As a result, the reduction in community cohesion and sense of belonging can reduce family and personal wellbeing (Fitzgerald and Wilkinson 2009).
- There are several psychological impacts associated with wild dogs. For instance, landholders may feel upset, frustrated and/or angry due to loss of stock from wild dog attacks. Landholders may also suffer from stress related to the management and financial costs of wild dogs. In addition, there is a sense of insecurity and uncertainty that landholders experience when wild dogs are present in the environment (Fitzgerald and Wilkinson 2009).
- Wild dogs vector rabies, and therefore, have the potential to have public health impacts (McLeod 2004).

9. Impact of wild dogs without the NWDF project

It is assumed that without the NWDF project, activity to control wild dogs would have continued in the same manner as it had in previous decades. As described earlier, there had already been some effort towards the adoption of a nil-tenure approach in selected regions, and this may have continued to develop. However the adoption of this approach would not have been on the same geographic scale, and the effectiveness of its implementation may have been limited. It is also recognised that there may have been other sporadic attempts at intensive or improved wild dog management in some areas over time. On the other hand, costs may have increased as the wild dog incidence may have grown along with control costs. However, for the purposes of this analysis it is assumed that on average the status quo would have been maintained. It is therefore assumed that:

- The economic, environmental and social impacts of wild dogs in Australia would have been maintained at the same levels of the past.
- The average level of expenditure on wild dog management (eg local government programs, dog fence maintenance) would also have continued at the same level.

For the purposes of this analysis only the economic impact of the NWDF project is estimated. No doubt there have also been environmental and social benefits but these have not been valued. The economic impact is based on the estimates of the value of impact made by the previous studies identified earlier. The Queensland based Hewitt study (2009) is used as the basis for estimating national impact. This is because it is more recent than the McLeod study (2004), and because it is more detailed in its coverage of impact than both the Gong (2009) and McLeod (2004) studies.

Table 4 provides a breakdown of the values attributed to the different impacts that make up the total estimated impact of $67 million for Queensland. The social costs, opportunity losses associated with lost or damaged stock and the costs of in-kind contributions of producers toward wild dog management were not encapsulated by the study, and it is expected that these factors would have a substantial upwards impact on the total economic cost of wild dogs.

Table 4: Major economic costs associated with wild dogs in the Queensland grazing industry (Source: Hewitt, 2009)

Cost Category		**Cost 08/09**
Cattle Producers	Calf livestock losses	$22 840 000
	Product loss due to dog-bitten cattle (saleyards)	$1 036 914
	Product loss due to dog-bitten cattle (processors)	$1 031 441
	Neospora caninum	$3 143 536
	Hydatids	$2 057 685
	Wild dog management costs	$11 460 498
Sheep/Goat Producers	Sheep/goat livestock losses and attacks	$16 950 000
	Wild dog management costs	$2 248 642
Local Government	Included bounties and management program	$2 623 543
Wild Dog Barrier Fence	Contributed from Local and State governments	$1 870 316
Queensland State Government	Department of Employment, Economic Development and Innovation Queensland Parks and Wildlife	$1 754 000
TOTAL COST		**$67 016 575**

As the Hewitt study estimates only the impact for Queensland, an estimate has to be made of how this value can be extrapolated to all of Australia. The process for making this estimate is explained in Section 10 below when presenting the assumptions relating to the impact of the NWDF.

10. Impact of wild dogs with the NWDF project

As described earlier and demonstrated through a number of case studies, the NWDF has been active in a number of regions and has had a significant influence in improving the participation rate by landholders and associated management of wild dogs across those regions. As this activity is still ongoing, there is more limited evidence with respect to this changed management resulting in a reduction in wild dog numbers, and a subsequent reduction in economic impact on sheep and cattle producers. However, there is enough research and anecdotal evidence to be confident that some benefits have already been captured and that more will eventuate over the medium to long-term.

The improved wild dog management associated with the NWDF is assumed to lead to a reduced impact on cattle producers and sheep/goat producers with respect to product loss and disease impacts. It is not assumed that there will be any reduction in control costs to either producers or to other authorities (local governments, state governments etc). The activities of the NWDF may have resulted in the reduction of such costs in some instances due to efficiencies in planning and spending. However in other cases there is likely to have been a maintenance of, or an increase in, management and control costs. For this reason, it is assumed that on average, control, management and maintenance costs are unchanged as a result of the NWDF.

The impact of the NWDF on sheep and cattle production is estimated on a state basis. This is to allow for differences between states with respect to how closely dog abundance aligns with sheep and cattle presence, and the different level of activity of the NWDF to date in each state.

Table 5 shows the assumptions used to calculate the impact of the NWDF on the sheep/goat industry (includes meat and wool production). The sheep numbers for each state were sourced from ABARES (2010). The proportion of the sheep population in each state significantly affected by wild dogs was estimated by crudely overlaying a wild dog abundance map (National Land & Water Resources Audit and Invasive Animals Cooperative Research Centre 2008) with an Australian Bureau of Statistics (ABS) sheep and lamb distribution map. It should be noted that the figures in Table 5 are estimates only. The number of sheep potentially affected by wild dogs in each state was then calculated by multiplying the sheep numbers by the proportion of the sheep population most likely affected.

The calculations estimated that there was a total of 5.05 million sheep potentially affected by wild dogs, and that 35.6% (1.8 million) of these sheep were in Queensland. This relativity was used to convert the value of the impact of wild dogs in Queensland estimated by Hewitt ($17 million for sheep and goat production losses as shown in Table 4) to a national value of impact of $47.2 million. The relative values for each state were then calculated based on the proportion of total sheep potentially affected in each state. This resulted in an estimate of the potentially reducible loss due to better wild dog control for each state. While the value is based on losses to sheep and goat producers, only sheep numbers have been used in estimating the distribution of the national estimate.

The coverage of the wild dog affected sheep where the NWDF has had an impact was estimated for each state (as a percentage). It should be noted that this is a proportion of the wild dog affected sheep, not a proportion of the total sheep population in each state. It should also be noted that this proportion refers to that

area assumed to be impacted by the NWDF by June 2012 when the current phase of the program is complete. As stated earlier these estimates of impacts are crude estimates, based on overlaying the regions of activity on the wild dog abundance, sheep numbers and activity of the NWDF.

The estimated total loss by the sheep industry in each state was then multiplied by the proportion of sheep in that state where management was assumed to be influenced by the NWDF. This allowed the potential loss addressed by the NWDF to be calculated. An estimate was then made of the reduction in wild dog impact where the NWDF has been active. This is estimated as 25%. It is noted however that in reality this number is likely to be highly variable for different regions.

It is also recognised that the NWDF was just one factor that has contributed to the likely reduction in impact in these regions. It is therefore assumed that 40% of this 25% reduction in impact can be attributed to the NWDF, with the remainder of the impact attributable to other activities and organisations active in those regions. Much of the impact that can be attributed to the NWDF is through being a catalyst for change, increasing the participation rate and for extending information about best practice in wild dog management.

Multiplying the potential loss addressed by the NWDF by these two factors results in an estimate of the annual benefit attributed to the NWDF for sheep producers in each state.

Table 5 summarises the assumptions for the sheep industry.

Table 5: Sheep numbers and relationship to wild dog incidence and impacts

Jurisdiction	Sheep numbers in 2010 (million)	Proportion of sheep population affected by wild dogs (%)	Number of sheep - potentially affected (million)	Estimate of potentially reducible loss due to better wild dog control ($ million)	Coverage of State by NWDF and where impact has most likely occurred (%)	Potential loss addressed by NWDF ($ m per annum)	Estimate of impact reduction (%)	Attribution of impact reduction to NWDF (%)	Annual gain attributed NWDF ($ m per annum)
NSW	23.9	2.5	0.60	5.6	10	0.6	25	40	0.06
VIC	14.4	5	0.72	6.8	85	5.8	25	40	0.58
QLD	3.6	50	1.8	17.0	50	8.5	25	40	0.85
SA	9.1	5	0.46	4.3	20	0.9	25	40	0.09
WA	14.7	10	1.47	13.8	20	2.8	25	40	0.28
TAS	2.0	0	0	0	0	0	0	0	0.00
ACT/NT	0.05	5	0	0.02	25	0.01	25	40	0.00
TOTAL	67.7		5.05	47.5		18.43			1.84

The impact of the NWDF on beef producers was estimated using the same method as used for sheep. The base assumption of the value of impact of wild dogs on Queensland beef producers was $29 million (cattle/calve losses and disease impacts) and $37.7 million nationally. The total impact on sheep, goats and cattle is therefore estimated at $85.2 million.

Table 6 summarises the assumptions used for estimating the benefits to the beef industry. The estimates of coverage of the NWDF in cattle affected areas in each state are lower than for sheep, except for Victoria.

Table 6: Beef cattle numbers and relationship to wild dog incidence and impacts

Jurisdiction	Cattle numbers in 2010 (million) (a)	Proportion of cattle population affected by wild dogs (%) (b)	Number of cattle potentially affected (million) (a) x (b)	Estimate of potentially reducible loss due to better wild dog control ($ million)	Coverage of wild dog areas by NWDF and where impact has most likely occurred (%)	Potential loss addressed by NWDF ($ m per annum)	Estimate of impact reduction (%)	Attribution of impact reduction to NWDF (%)	Annual gain attributed NWDF ($ m per annum)
NSW	5.5	10	0.6	1.7	5	0.1	25	40	0.01
VIC	3.7	5	0.2	0.6	85	0.5	25	40	0.05
QLD	11.5	80	9.2	29.0	30	8.7	25	40	0.87
SA	1.1	10	0.1	0.4	10	0.03	25	40	0.00
WA	2.4	25	0.6	1.9	10	0.2	25	40	0.02
TAS	0.6	0	0	0	0	0	0	0	0.00
ACT/NT	1.9	70	1.3	4.2	5	0.2	25	40	0.02
TOTAL	26.7		11.98	37.7		9.7			0.97

As there is some uncertainty with respect to the assumptions concerning the impact of the NWDF activity on actual reductions in wild dog numbers and impact, a 50% probability of achieving the assumed benefits is placed on the benefits to both the sheep and cattle industries.

For the activity up until 2012, it is assumed that the first year of benefits from the program will be in the year ending June 2010, which is the fourth year of the program. It is assumed that benefits will then rise linearly over seven years, until the maximum benefit is reached in 2015/16. It is assumed that as other factors will influence ongoing wild dog management and impacts, that this maximum benefit is only obtained for one year, and that the benefit attributable to the NWDF then declines to 50% of the maximum over the next four years. The benefits then continue at this lower rate. The reason for the assumed decline is that some of the gains captured will be eroded over time due to participation rates potentially declining in the absence of the NWDF.

With respect to environmental and social impacts, any reduction in impact due to the NWDF is likely to be in the same order of magnitude as for the economic impact. It is recognised however that there may be some 'tipping point' with respect to a critical threshold in impact reduction required before some environmental and social improvements become apparent.

Table 7 summarises the general assumptions used in the analysis.

Table 7: Summary of assumptions

Variable	Assumption	Source
Potential loss addressed by NWDF for sheep/goat producers	See Table 5	NLWRA and IA CRC (2008) ABS (2008) Hewitt (2009) Agtrans estimates
Potential loss addressed by NWDF for beef producers	See Table 6	NLWRA and IA CRC (2008) ABS (2008) Hewitt (2009) Agtrans estimates
Estimate of wild dog impact reduction where NWDF has been active (for sheep and beef)	25%	Agtrans estimate based on discussions with stakeholders
Attribution of impact reduction to NWDF (for sheep and beef)	40%	Agtrans estimate
Probability of achieving assumed impact	50%	Agtrans estimate
First year of benefits	2009/10	Agtrans estimate
Year of maximum benefits	2015/16	Agtrans estimate
Year benefits cease	2019/20	Agtrans estimate

As noted earlier, the extent of impact assumed above relates to the activities of the NWDF up until the completion of the current phase of the project in 2012. Assumptions regarding any future benefits from any potential extension of the project beyond that date are provided in Section 11.

Results - base analysis

The period of analysis was for 30 years after the first year of investment (2006/07) but results were reported also for a 15 year period. The results are expressed in 2009/10 dollar terms and all benefits and costs are discounted to the year 2009/10. A discount rate of 5% was used as the base.

The results for the cost-benefit analysis are reported in Table 8.

Table 8: Results of cost-benefit analysis for investment in the NWDF project (Discount rate 5%)

Investment criteria	15 year time horizon for benefits	30 year time horizon for benefits
Present Value of Benefits ($m)	7.64	11.91
Present Value of Costs ($m)	1.49	1.49
Net Present Value ($m)	6.15	10.42
Benefit–Cost Ratio	5.1	8.0
Internal Rate of Return (%)	41	41

Results – sensitivity analysis

Principal assumptions that drive the benefits from the investment are the estimate of the impact reduction due to the NWDF, and the attribution of that impact

reduction to the NWDF. Each of these assumptions is tested through sensitivity analyses. Results for the sensitivity analyses are for the 15 years planning horizon, and, unless otherwise stated, use the base discount rate of 5%. A sensitivity analysis was also carried out on the discount rate itself.

Table 9 shows that while the investment criteria are quite sensitive to the discount rate, even at the higher discount rate of 10%, the investment proves attractive in economic terms.

Table 9: Sensitivity of investment criteria to discount rate (15 year time horizon)

Investment criteria	**Discount rate**		
	0%	**5%**	**10%**
Present value of benefits ($m)	10.20	7.64	5.91
Present Value of Costs ($m)	1.45	1.49	1.54
Net Present Value ($m)	8.75	6.15	4.38
Benefit Cost Ratio	7.0	5.1	3.9

Table 10 shows the sensitivity of the investment criteria to the assumption on the estimate of the impact reduction as a result of the NWDF's involvement. The results show that even if the economic impact of wild dogs is only reduced by 10% as a result of the NWDFs activities, then the investment still more than breaks even, with a benefit cost ratio of 2.1 to 1 over 15 years. A break-even analysis showed that the NWDF would only need to reduce the wild dog impact by 4.9% over 15 years in the areas where the project is active in order for the investment to break-even.

Table 10: Sensitivity of investment criteria to estimate of impact reduction as a result of NWDF involvement (15 year benefit period, 5% discount rate)

Investment criteria	**Estimate of impact reduction as a result of NWDF involvement**		
	10%	**25% (base)**	**50%**
Present Value of Benefits ($m)	3.06	7.64	15.29
Present Value of Costs ($m)	1.49	1.49	1.49
Net Present Value ($m)	1.57	6.15	13.80
Benefit Cost Ratio	2.1	5.1	10.3
Internal Rate of Return (%)	18	41	64

Table 11 shows the sensitivity of the investment criteria to the assumption on the attribution of the impact reduction to the NWDF project.

Table 11: Sensitivity of investment criteria to attribution of impact to NWDF project

Investment criteria	Attribution of impact to NWDF involvement		
	20%	40% (base)	75%
Present Value of Benefits ($m)	3.82	7.64	14.33
Present Value of Costs ($m)	1.49	1.49	1.49
Net Present Value ($m)	2.33	6.15	12.84
Benefit Cost Ratio	2.6	5.1	9.6
Internal Rate of Return (%)	23	41	61

11. Future investment in the NWDF project

The current phase of the NWDF project ends in June 2012. An estimate is made here of the costs and benefits if the NWDF project were to continue beyond 2012. If the work continued, it is likely that the focus would be on continuing similar work (extension and communication of the nil-tenure approach and new control techniques) in more regions than has been addressed through the investment to 2012. This would include an extension of effort into areas of greater beef production as opposed to areas with sheep production that have largely been the focus to date. For example, in New South Wales, the emphasis would be on the dog affected areas in Eastern NSW, which are also cattle production areas. Many sheep and cattle regions in NSW are currently in need of a national facilitator (B Moore, National Wild Dog Management Advisory Group, personal communication, 2011). Further, all personnel associated with wild dog control contacted as part of this analysis held the view that benefits already captured would degrade over time if the NWDF position was curtailed post 2012. The project would also seek to move into areas of central and northern Australia to focus on wild dog management in cattle production settings.

In addition to targeting new areas, the NWDF would most likely also continue work where appropriate in regions already impacted during the first and second phase. Continued activity in these regions is assumed to contribute to greater longevity of the impacts already assumed captured in these regions, beyond that which would occur if the NWDF activity ceases in 2012. If activity ceases in 2012, it is assumed that benefits in these regions reaches a maximum in 2015/16, and that this maximum is maintained for only one year before declining to 50% of the maximum impact by 2019/20. If the funding for the NWDF continues beyond 2012 for a four year period, it is assumed that the maximum benefit will be maintained for an additional four years (total of five years - years ended June 2016 to June 2020) and that the decline to 50% of the maximum will commence after this time (at the same rate).

The benefits from any future investment in the NWDF position following 2012 are assumed to be of the same order as for the investment prior to 2012, with respect to the estimate of baseline impact, impact reduction and the attribution of impact reduction to the NWDF. However, there will be additional coverage of wild dog areas by the NWDF where the impact will occur. Tables 12 (sheep) and 13 (cattle) present the assumptions regarding this additional coverage by state. Note that once again this coverage relates to the proportion of the wild dog affected sheep or cattle, not a proportion of the total number in each state. Also, these proportions are in addition to (not an increase in) those presented earlier in Tables 5 and 6.

Table 12: Sheep numbers and relationship to wild dog incidence and impact for investment from 2012/13 to 2015/16

Jurisdiction	Sheep numbers in 2010 (million)	Proportion of sheep population affected by wild dogs (%)	Number of sheep - potentially affected (million)	Estimate of potentially reducible loss due to better wild dog control ($ million)	Coverage of State by NWDF and where impact has most likely occurred (%)	Potential loss addressed by NWDF ($ m per annum)	Estimate of impact reduction (%)	Attribution of impact reduction to NWDF (%)	Annual Gain attributed NWDF ($ m per annum)
NSW	23.9	2.5	0.60	5.6	30	1.7	25	40	0.17
VIC	14.4	5	0.72	6.8	10	0.7	25	40	0.07
QLD	3.6	50	1.8	17.0	25	4.2	25	40	0.42
SA	9.1	5	0.46	4.3	20	0.9	25	40	0.09
WA	14.7	10	1.47	13.8	20	2.8	25	40	0.28
TAS	2.0	0	0	0	0	0	0	0	0
ACT/NT	0.05	5	0	0	10	0	25	40	0
TOTAL	67.7		5.05	47.5		10.2			1.02

Table 13: Beef cattle numbers and relationship to wild dog incidence and impact for investment from 2012/13 to 2015/16

Jurisdiction	Cattle numbers in 2010 (million)	Proportion of cattle population affected by wild dogs (%)	Number of cattle potentially affected (million)	Estimate of potentially reducible loss due to better wild dog control ($ million)	Coverage of wild dog areas by NWDF and where impact has most likely occurred (%)	Potential loss addressed by NWDF ($ m per annum)	Estimate of impact reduction (%)	Attribution of impact reduction to NWDF (%)	Annual Gain attributed NWDF ($ m per annum)
NSW	5.5	10	0.55	1.7	45	0.8	25	40	0.08
VIC	3.7	5	0.19	0.6	10	0.1	25	40	0.01
QLD	11.5	80	9.2	29.0	40	11.6	25	40	1.16
SA	1.1	10	0.11	0.34	20	0.1	25	40	0.01
WA	2.4	25	0.60	1.9	20	0.4	25	40	0.04
TAS	0.6	0	0	0	0	0	0	0	0
ACT/NT	1.9	70	1.3	4.2	0	0	25	40	0
TOTAL	26.7		11.98	37.7		12.9			1.29

Table 14 presents the anticipated costs in the NWDF if funded beyond 2012. This is based on the average total costs (in 2009/10 $ terms) over the first six years of the project from 2006/07 to 2011/12. The proportion of contributions from potential individual funders is not specified.

Table 14: Assumed total investment in NWDF position (Years ending June 2013 to 2016)

Year	Investment ($)
2012/13	241 977
2013/14	241 977
2014/15	241 977
2015/16	241 977
Total	967 908

It should be noted that as this continuing phase of the project has not yet been funded and commenced, the probability of the assumed impact occurring is 40%, which is slightly less than for that of the pre-2012 funding. Furthermore, this 40% probability of success only applies to the benefits in new areas of NWDF activity, and not to the benefits flowing from the increased longevity of benefits in areas of existing NWDF activity.

Results – analysis of investment in NWDF post 2012

Table 15 presents the results for the analysis of any potential investment in the NWDF project from 2012/13 to 2015/16. As with the base analysis, the period of analysis was for 30 years after the first year of investment (2012/13) but results were reported also for a 15 year period. The results are expressed in 2009/10 dollar terms and all benefits and costs are discounted to the year 2009/10. A discount rate of 5% was used as the base.

The results for the cost-benefit analysis are reported in Table 15.

Table 15: Results of cost-benefit analysis for investment in the NWDF project from 2012/13 to 2015/16
(Discount rate 5%)

Investment criteria	15 year time horizon for benefits	30 year time horizon for benefits
Present Value of Benefits ($m)	6.71	8.80
Present Value of Costs ($m)	0.78	0.78
Net Present Value ($m)	5.93	8.02
Benefit–Cost Ratio	8.6	11.3
Internal Rate of Return (%)	139	139

The reason the investment criteria are somewhat higher than for the pre-2012 investment is that the continuation of the NWDF is assumed to maintain some of the benefits already captured as well as extending benefits to new areas.

Sensitivity analysis - investment in NWDF post 2012

Principal assumptions that drive the benefits from the investment are the estimate of the impact reduction due to the NWDF, and the attribution of that impact reduction to the NWDF. Each of these assumptions is tested through sensitivity analyses. Results for the sensitivity analyses are for the 15 years planning horizon, and, unless otherwise stated, use the base discount rate of 5%. A sensitivity analysis was also carried out on the discount rate itself.

Table 16 shows that while the investment criteria are quite sensitive to the discount rate, even at the higher discount rate of 10%, the investment proves attractive in economic terms.

Table 16: Sensitivity of investment criteria to discount rate
(15 year time horizon)

Investment criteria	Discount rate		
	0%	5%	10%
Present Value of Benefits ($m)	10.90	6.71	4.32
Present Value of Costs ($m)	0.97	0.78	0.63
Net Present Value ($m)	9.93	5.93	3.68
Benefit Cost Ratio	11.3	8.6	6.8

Table 17 shows the sensitivity of the investment criteria to the assumption on the estimate of the impact reduction as a result of the NWDF's involvement. The results

show that even if the economic impact of wild dogs is only reduced by 10% as a result of the NWDFs activities, then the investment still more than breaks even, with a benefit cost ratio of 2.7 to 1 over 15 years. A break-even analysis showed that the NWDF would only need to reduce the wild dog impact by 2.9% over 15 years in the areas where the project is active in order for the investment to break-even.

Table 17: Sensitivity of investment criteria to estimate of impact reduction due to NWDF involvement

Investment criteria	**Estimate of impact reduction as a result of the NWDF involvement**		
	10%	**25% (base)**	**50%**
Present Value of Benefits ($m)	2.68	6.71	13.41
Present Value of Costs ($m)	0.78	0.78	0.78
Net Present Value ($m)	1.90	5.93	12.63
Benefit Cost Ratio	3.4	8.6	17.2
Internal Rate of Return (%)	43	139	>500

Table 18 shows the sensitivity of the investment criteria to the assumption on the attribution of the impact reduction to the NWDF project.

Table 18: Sensitivity of investment criteria to attribution of impact to the NWDF project

Investment criteria	**Attribution of impact to NWDF involvement**		
	20%	**40% (base)**	**75%**
Present Value of Benefits ($m)	3.35	6.71	12.57
Present Value of Costs ($m)	0.78	0.78	0.78
Net Present Value ($m)	2.57	5.93	11.79
Benefit Cost Ratio	4.3	8.6	16.2
Internal Rate of Return (%)	55	139	>500

12. Conclusion

The investment in the NWDF project has contributed significantly to increases in participation rates in wild dog management, and changes in attitudes to wild dog management techniques, in a number of regions throughout Australia. The NWDF was also a key catalyst in a number of changes in policy, and increases in funding, with respect to wild dog management in a number of jurisdictions. The independence from landholder groups and government agencies and the credibility and experience offered by the incumbent NWDF have been instrumental in facilitating change through adoption of new practices and policies.

To date, there has been more limited evidence with respect to the impact of this increased participation and change in practice/policy in terms of reduced wild dog numbers, and reduced economic impacts of wild dogs. However, anecdotal evidence would suggest that there will clearly be an impact in this regard, and that impact is already evident in some regions.

An economic analysis was carried out in order to value the impact of the NWDF project. This analysis has shown that for the investment in the project from July 2006 to June 2012, there is an expected return of 5.1 to 1 when benefits are measured over 15 years from the first year of investment (at a 5% discount rate). If the benefits are considered over a 30 year timeframe, then the benefit-cost ratio increases to 8.0 to 1.

The success of the NWDF project in the regions where it has been active (and will be active up until 2012), and feedback from those who have been involved with the project, indicates that there is merit in continuing the project beyond 2012, and extending the activities of the NWDF into other regions. This may well include a greater focus on cattle areas.

An economic analysis was carried out on the expected returns to an assumed investment in the project from July 2012 to June 2016 (4 years). The analysis found that the expected return was 8.6 to 1 when benefits are measured over 15 years from the first year of investment (at a 5% discount rate). If the benefits are considered over a 30 year timeframe, then the benefit-cost ratio increases to 11.3 to 1.

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14. Acknowledgments

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