Auction for Landscape Recovery

FINAL REPORT

Photo: Mick Davis, WWF-Australia

Authors: Cheryl Gole, Michael Burton, Kristen J. Williams, Helena Clayton, Daniel P. Faith, Ben White, Andrew Huggett and Chris Margules.

WWF-Australia
Head Office
GPO Box 528
Sydney, NSW, Australia 2001
Tel: +612 9281 5515
Fax: +612 9281 1060
www.wwf.org.au

Perth office
Panda Cottage - Herdsman Lake
Flynn St (cnr. Selby St)
Wembley WA 6913
Tel: +61 8 9387 6444
Fax: +61 8 9387 6180

Published October 2005 by WWF-Australia. Any reproduction in full or in part of this publication must mention the title and credit the above-mentioned publisher as the copyright owner.

First published in 2005.

For copies of this report, please contact Cheryl Gole at WWF-Australia on 08-9387 6444.

World Wide Fund for Nature ABN: 57 001 594 074

Acknowledgements

The Auction for Landscape Recovery is a multi-faceted, multi-disciplinary project that has been made possible through the contributions of a great many people and organisations. A core team of people from a number of partnering organisations contributed considerable time, energy and expertise to the project. The Science Team oversaw key auction design and tender evaluation and site selection issues. Members were Kristen Williams and Andrew Huggett (CSIRO Sustainable Ecosystems), Michael Burton, Ben White and Helena Clayton (University of Western Australia), Cheryl Gole and Chris Curnow (WWF-Australia), Dan Faith (Australian Museum) and Brett Beecham (CALM). The project was managed by Cheryl Gole (WWF-Australia).

We particularly acknowledge the contribution of the NEWROC-based ALR Community Support Officers (CSOs) Teagan Smith, Sam Atkinson and Mathew Field. For assistance with the field-based project, we are grateful to the Northeastern Wheatbelt Regional Organisation of Councils. We thank the Shires of Mount Marshall, Nungarin and Wyalkatchem for hosting the project's CSOs, and the following NEWROC personnel for input and support: Kenn Donohoe, Bill Fensome, Scott McKenzie, Gabrielle Pease, Kevin Trustum, Pauline Guest, Linda Vernon and Niel Mitchell.

At WWF-Australia, Pip Walsh, Jane Madgwick, Richard McLellan, Chris Curnow and Mick Davis provided input and support and Bruce Lugton chaired the Steering Committee. Through the CSIRO partnership, additional assistance was also provided by Blair Parsons, Randal Storey (Queensland Government), Trev Parker, Karen Richardson (Rainforest CRC) and Ted Lefroy. At CALM, Robyn Wilson and Nathan Eaten provided assistance with spatial data analysis.

At the Avon Catchment Council, Merrilyn Temby, Bruce Houston, Rob Edkins, Peter Sullivan, Rochelle Pyle, Diane Robinson and Don Cummins contributed to many aspects of the project. WA Farmers Federation landholders contributed to the project through a focus group early in the project's development and to the steering group. Many NEWROC landholders contributed time to the project both in developing tenders and proposals for on-ground projects but also in responding to surveys. We thank them all. Brett Beecham and Peter White (CALM), Martin Revell and Brendan Oversby (Department of the Environment), Shaun Molloy (Greening Australia WA), Don Cummins (Department of Agriculture WA/Avon Catchment Council), Clive Hawkesley (landholder), Aaron Edmunds (landholder), Barry Richardson (legal consultant) and Cameron Poustie (Conservation Council of WA) contributed to the Management Appraisal Review Group.

Jane Madgwick (WWF-Australia) and Ted Lefroy and Chris Margules (CSIRO Sustainable Ecosystems) were responsible for conceiving the project and the ideas and proposal were developed in collaboration with many others. We acknowledge early input and advice from Ian Oliver (Department of Infrastructure and Natural Resources, NSW), David Parkes (Department of Sustainability and the Environment, Victoria), Di Bentley (Liverpool Plains Management Committee, NSW), Karen Richardson (Rainforest CRC), Simon Ferrier (Department of Environment and Conservation, NSW), Paul Walker (CSIRO Sustainable Ecosystems), Mick Davis (WWF-Australia) and Robert Lambeck (Greening Australia WA). Through Murdoch University, Sue Moore and Richard Hobbs provided a project evaluation and, in particular, contributed an analysis of factors contributing to success or failure.

Mick Davis (WWF-Australia), Lyn Atkins (CSIRO Sustainable Ecosystems), Peter White (CALM), Brendan Oversby (Department of the Environment), Shazad Ghuri (Department of Agriculture WA) and Shaun Molloy (Greening Australia WA) provided in-kind support in assisting with training for the Community Support Officers.

The project has been made possible by funding from the National Action Plan for Salinity and Water Quality (NAP) through the National Market-based Instruments Pilot Program.

To all, our grateful thanks.

Executive Summary

The Auction for Landscape Recovery (ALR) is one of 11 market-based instrument (MBI) pilot projects conducted across Australia from 2003-2005. The joint funding of these projects by the Australian and State Governments within a first round pilot program signals the interest of the National Action Plan on Salinity and Water Quality in seeking new approaches to address natural resource management and environmental problems. The ALR is a multi-partner, multi-disciplinary research project which operationalised an auction-based field trial in the Intensive Land-use Zone of the NEWROC, a highly biodiverse landscape in the northeast wheatbelt of Western Australia that is threatened by salinity and the effects of large-scale clearing for agriculture. It is the first biodiversity/conservation auction trial to have been conducted in Western Australia.

- The auction was devised as a simple sealed bid, price-discriminating auction over two rounds, with $200,000 available to private landholders submitting single, multiple or joint tenders for on-ground works focussing on biodiversity conservation measures.
- Three local Community Support Officers, employed part-time for the project, were responsible for communications with landholders, site assessments, data entry and project development with landholders.
- A total of 55 tenders was received from 38 landholders in Round One and 33 tenders from 21 landholders in Round Two, resulting in a total of 21 separate management contracts for periods of up to three years. Management actions focussed on the fencing of remnants and other biodiversity assets such as naturally saline wetlands and granite outcrops, revegetation and associated fencing, rabbit and fox control and corridor construction. Landholders committed to one nature conservation covenant and 14 Voluntary Management Agreements, the latter for periods of up to 30 years.
- Surveys of landholders in the project region indicated that auction participants were more likely to have experience with Landcare-related activities or previous experience with other incentive schemes. A small number of landholders were new to incentive schemes, suggesting that, in relation to the recruitment of landholders, auctions may have a role that complements that of other incentive schemes such as grants. Factors constraining the uptake of conservation-related activities by landholders were time and financial resources.
- The ALR successfully created a competitive market in which landholders tendered to provide biodiversity conservation services. The auction was two to three times more efficient, in economic terms, than a fixed price scheme.
- The ALR showed that the estimation of efficiency gains from an auction depends on the counterfactual with which the auction is compared. The pilot identified that reasonable alternatives generate different estimates.
- The administrative efficiency of the auction was compared to fixed price schemes. Administrative costs were high, but the high costs appeared to be linked to the one-off status of the project and its research and reporting requirements. Fixed costs appear to be relatively high, but there is no evidence that these are restricted only to auctions, compared to alternative fixed price conservation incentive schemes, and as a pilot scheme, funds for on-ground works was low and relative to total project funds.
- For the tender evaluation process, comprehensive site assessment and tender databases were designed and utilised and an extensive suite of spatial data compiled. A requirement for considerable technical capability in GIS analysis was demonstrated. Some spatial datasets were not available in Western Australia in the appropriate format and scale.

- The ALR tested, for the first time in Australia, two methods of tender evaluation, a Systematic Conservation Planning approach and an Environmental Benefits Index. The project successfully demonstrated that it is possible to operationalise a Systematic Conservation Planning approach within a market-based instrument (auction) setting.
- The project provides a basis for identifying differences between a Systematic Conservation Planning approach and an Environmental Benefits Index. Further review and analysis of the available data is suggested before recommendations can be made regarding use.
- The *TARGET* software was used to implement Systematic Conservation Planning, allowing the comparison of biodiversity values and costs during tender evaluation.
- Probability of persistence and management benefit analysis are critical components of tender evaluation and conservation planning approaches. The accurate and reliable prediction of response to proposed management actions is an area requiring a dedicated research program to provide workable and meaningful methodologies.
- The high levels of diversity, endemism and species turnover in the Western Australian wheatbelt are a challenge to any schema or metric attempting to account for biodiversity at a regional scale.
- The project successfully engaged a number of stakeholders including landholders, a regional NRM body, government and non-government agencies, local government, a landholder organisation and research and tertiary institutions in a multi-disciplinary project. It was also successfully managed by a non-government organisation.

Table of Contents

Appendices

Auction for Landscape Recovery: Final Report

Cheryl Gole[1], Michael Burton[2], Kristen J. Williams[3], Helena Clayton[2], Daniel P. Faith[4], Ben White[2], Andrew Huggett[3] and Chris Margules[3]

[1]WWF-Australia; [2]University of Western Australia; [3]CSIRO Sustainable Ecosystems; [4]Australian Museum

1 Introduction

The Auction for Landscape Recovery is one of 11 market-based instrument (MBI) pilot projects conducted across Australia from 2003-2005. The joint funding of these projects by the Australian and State Governments within a first round pilot program signals the interest of the National Action Plan on Salinity and Water Quality in seeking new approaches to address natural resource management and environmental problems. The current interest in MBIs or market-like mechanisms arises from a concern that reliance on traditional policy approaches alone may be insufficient to achieve required natural resource outcomes. Economists now understand more about the design of markets and information systems required for complex natural resource problems, however there is particular interest in the mechanisms and the range of circumstances under which particular instruments might be applied (NAPSWQ 2002). Auctions are a promising option for facilitating management interventions that are consistent with the economic capabilities of landholders and provide cost-effective landscape-scale environmental outcomes. The national pilot program undertakes to examine the practical application of a range of MBIs, including auctions, and to add to the knowledge base needed to design, apply and evaluate MBIs used to address natural resource management (NRM) and environmental issues. It is anticipated that pilots within the program will shed light on the role of MBIs, their performance relative to alternative policy mechanisms, and difficulties associated with their use. It is likely that they will also assist in knowledge transfer to policy makers and practitioners.

The Auction for Landscape Recovery (ALR) is a conservation auction pilot project within the current MBI pilot program that builds on earlier auction approaches such as the Liverpool Plains trial in NSW (DLWC 2002) and the Victorian BushTender trial (Stoneham *et al*, 2003). The ALR pilot project was designed to test a number of features of auctions as a specific market-based instrument. Objectives of the project have focussed on evaluating the instrument design and its implementation; they do not explicitly address or require reporting on the achievement of environmental or biodiversity outcomes. The auction was designed to be trialed as an incentive mechanism for private landholders to participate in environmental management and applied at the regional scale. The ALR addressed biodiversity conservation issues in a salinised biodiverse landscape, seeking to conserve regionally significant biodiversity assets on private land.

The project has been managed by WWF-Australia and is a partnership between a number of non-government organisations, government agencies, local governments, research institutions, tertiary institutions, community-based organisations and a regional natural resource management authority. Partners for the project, in alphabetical order, are the Australian Museum, Avon Catchment Council, the WA Department of Conservation and Land Management, CSIRO Sustainable Ecosystems, the Department of Agriculture WA, the WA Department of the Environment, Greening Australia WA, the Northeast Wheatbelt Regional Organisation of Councils, Murdoch University, the University of Western Australia, the WA Farmers Federation and WWF-Australia.

The ALR has been conducted as a field trial and research pilot between 2003 and 2005. Operationally, over two rounds in 2004-2005, the ALR was conducted as a simple sealed bid, price discriminating auction. Landholders within the project region were encouraged to submit a bid describing proposed management activities, identifying anticipated environmental outcomes and nominating the remuneration they required to undertake and complete on-ground works.

Tenders were evaluated using a regional metric of biodiversity complementarity within a Systematic Conservation Planning framework. Complementarity is the marginal gain each project provides to increase the protection of biodiverse ecosystems when evaluated against land known currently to exist in protected areas such as nature reserves. Key research objectives for the pilot included a comparison between this approach and an Environmental Benefits Index. Other objectives included research related to landholder perceptions and an analysis of administrative efficiency of the auction approach.

This report evaluates the ALR pilot project against its objectives, summarises results and identifies lessons learned for implementing similar projects elsewhere.

1.1 Pilot Project Region Description

The ALR pilot is located in the northeastern wheatbelt of southwestern Western Australia, in the 'Wheatbelt' planning and management zone of the Avon River Basin (Figure 1.1). Under the national regionalisation process for natural resource management delivery, the Avon River Basin is an NRM region managed by the Avon Catchment Council. The northeastern wheatbelt region is one where seven contiguous local government authorities have formed a Regional Organisation of Councils. Most of this administrative region – the Northeastern Wheatbelt Regional Organisation of Councils (NEWROC) – forms the study region for the ALR. Local governments comprising the NEWROC are the Shires of Koorda, Mount Marshall, Mukinbudin, Nungarin, Trayning, Westonia and Wyalkatchem.

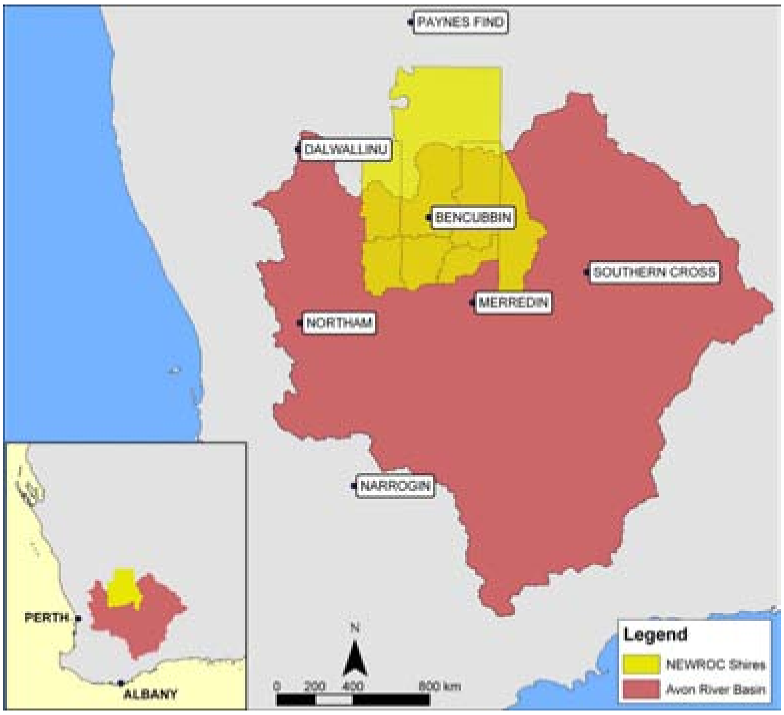


Figure 1.1: Map showing the location of the NEWROC project region in relation to the Avon River Basin in southwestern Western Australia.

The study area, within which tenders were accepted from landholders, was also defined by differentiation between two land-use zones and comprises the Intensive Landuse Zone of the NEWROC. In Western Australia, the Intensive Land-use Zone is defined by the southwest agricultural area. The Extensive Land-use Zone describes the remainder of the state, an area dominated by grazing and mining activities (Shepherd, *et. al*., 2002). To the west and south of the clearing line the Intensive Landuse Zone portion of the NEWROC study region comprises an area of 1,696,722 ha, of which 12.07% is remnant vegetation (Shepherd *et al.*, and see Table 1.1 and Figure 1.2). Just over two thirds (69%) of the NEWROC is contained within the Intensive Land-use Zone with the remaining 31% in the Extensive Land-use Zone (Table 1.1). The study area is located in the semiarid climatic zone of the State east of the 350mm rainfall isohyet, with much of it receiving less than 300mm rainfall annually.

Table 1.1: Vegetation cover in the NEWROC project zone by local government authority, together with areal extent of the Intensive and Extensive Land-use Zones for each of the seven rural shires within the region (after Shepherd *et al*., 2002). [* public land includes salt lakes and saline flats not included in the estimates of total vegetation cover].

Shire	Total area (ha)	Area within Intensive Land-use Zone (ha)	Area within Extensive Land-use Zone (ha)	Vegetation cover within Intensive Land-use Zone	
				(ha)	(%)
Koorda	283,746	266,057	17,685 (6.2%)	21,537	8.1
Mount Marshall	1,019,574	444,185	575,389 (56.4%)	47,071	10.6
Mukinbudin	342,575	278,129	64,446 (18.8%)	39,021	14.0
Nungarin	117,004	117,004	N/A	17,827	15.2
Trayning	164,255	164,255	N/A	13,811	8.4
Westonia	329,601	269,088	60,513 (18.3%)	57,813	21.5
Wyalkatchem	158,004*	158,004	N/A	7814	4.9
Total, NEWROC	2,256,755 ha	1,696,722 ha	718,033 ha (31%)	204,894 ha	12.07%

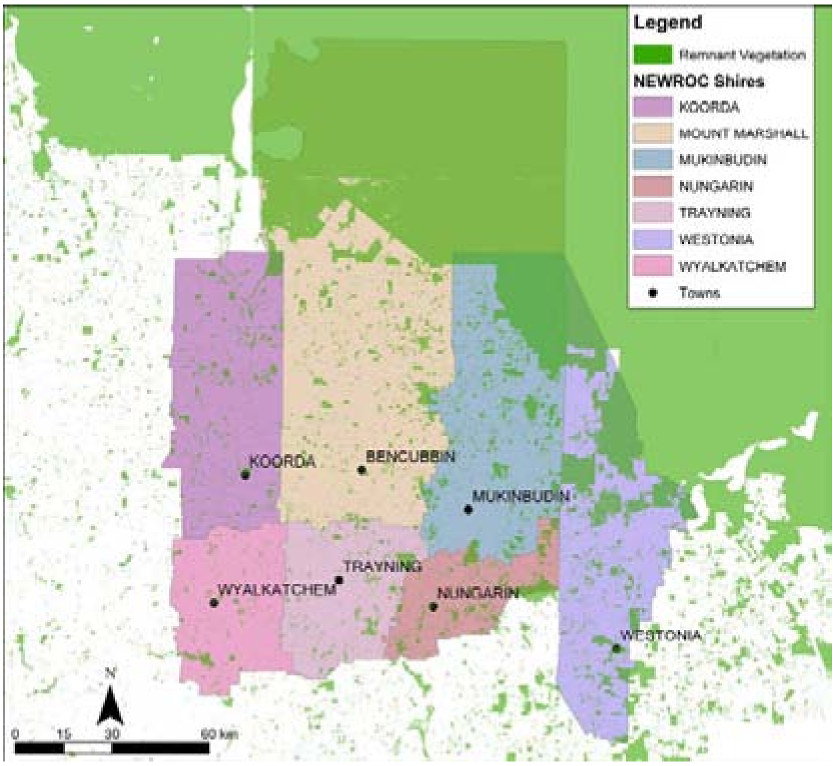


Figure 1.2: Map showing remnant vegetation extent by Local Government Authority in the NEWROC project region.

Under the Interim Biogeographic Regionalisation of Australia (IBRA) three bioregions intersect the NEWROC area: these are the Avon Wheatbelt, Coolgardie and Yalgoo Bioregions or IBRAs (Thackway & Cresswell, 1995). The Intensive Land-use Zone portion of the NEWROC (i.e. the study region) is almost completely covered by the Avon Wheatbelt IBRA. This is a dissected plateau of Tertiary laterite in the Yilgarn Craton. Much of the study area is contained within the eastern sub-IBRA (Avon Wheatbelt 1), an area of ancient, gently undulating plain of low relief and paleo-drainage systems without connecting drainage (May & McKenzie, 2002). The overall condition and trend of the Avon Wheatbelt IBRA is poor with remnant vegetation, wetlands, riparian systems and populations of species and ecosystems at a continental stress class of one (most severe), largely due to the current and predicted extent of dryland salinity (McKenzie *et al*., 2002; Morgan, 2000). Part of the NEWROC area is covered by the Southern Cross sub-IBRA of the Coolgardie IBRA. Salinity problems are beginning to emerge in this sub-region and the continental stress class is two on a scale of one (most severe) to six (McKenzie *et al*., 2002). A small portion of Mt Marshall Shire in the Extensive Landuse Zone (i.e. outside the study area) is contained within the Yalgoo IBRA, an arid zone area with some pastoral land use.

The region is part of the globablly significant Southwest Australia Ecoregion, an area of high value due to exceptionally high terrestrial diversity and a correspondingly high degree of threat (Myers *et. al*., 2000).

Vegetation in the Avon NRM region is characterized by high levels of habitat loss and fragmentation due to clearing for agriculture and degradation due to ongoing threats such as weeds, grazing by livestock, and collection of firewood. Dryland salinity and associated waterlogging and inundation caused by rising water tables are major threats to biodiversity values in the Avon River Basin (Avon Catchment Council, 2004). Vegetation clearing regulations now prohibit all but minimal clearing, however ‘passive’ clearing of native vegetation through ongoing degrading processes such as grazing, weed invasion and the effects of agricultural production (e.g., fertiliser drift) continue to account for vegetation and habitat loss. Local Government Authority areas in the NEWROC vary in remnant vegetation extent from less than 5% in the Shire of Wyalkatchem in the largely cleared central wheatbelt to more than 21% inside the Intensive Land-use Zone in the Shire of Westonia on the eastern margins of the agricultural zone (Table.1.1, Fig. 1.2). The reservation status of vegetation in the CALM conservation estate in the Avon Wheatbelt 1 sub-IBRA is only 8.2%, with Chiddarcooping, Lake Campion and Mollerin Lake the largest nature reserves in the project region. Additional significant biodiversity features in the landscape are naturally saline wetlands and granite outcrops and rocky breakaways and ridges. Dominant vegetation types in the study area include Proteaceous shrublands on residual lateritic uplands and derived sandplains, diverse eucalypt and Jam-York Gum woodlands and samphire shrublands supported by extensive naturally saline wetlands (May & McKenzie, 2002). Most remnant vegetation remains in freehold land tenures.

Within the project region there is a relatively low and declining population: in June 2004 the seven shires of the NEWROC had a population of 3298 (Australian Bureau of Statistics, 2004), with approximately 700 landholders (K. Donohoe, pers. comm.). Land use within the region is largely confined to large farms focusing production on dryland agriculture and grazing with some regional income derived from mining and tourism. The region is one in which landholders work their properties as a farm business. As the area is some distance from the Perth Metropolitan Area or major regional centres, and with limited potential for tourism and ecotourism, few landholders derive most of their income off-farm, and the number of ‘lifestyle’ landholders is negligible. Since clearing regulations have reduced the possibility that landholders might continue to clear native vegetation in anything other than a minimal way, there is some evidence that this is interpreted as an economic cost by at least some landholders and there is a recognised need to consider incentives to landholders for the protection of biodiversity assets (North-East Wheatbelt Working Group, 2004; Davidson *et al*., 2005). It is within this economic context that the ALR provides a mechanism for the uptake of a biodiversity conservation incentive by landholders.

The ALR pilot has been the first conservation auction conducted in the state of Western Australia. The project has thus been conducted within the context of a relatively novel incentive mechanism not only for the project region, but for the State.

1.2 Pilot Objectives

The Auction for Landscape Recovery has been conducted as both an operational project intended to deliver on-ground funding to landholders in the project region, and a field trial with proposed experimental and research outcomes. The stated project objectives for the ALR largely relate to the research components of the pilot. Specific pilot objectives for the ALR are as follows:

- To test two alternative selection methodologies for assessing the relative benefits of individual actions by private landholders against quantitative biodiversity targets;
- To evaluate the minimum information needs for applying an auction approach to delivery of natural resource management at a regional scale;
- To evaluate the relative benefits of a discriminative price auction versus a fixed price scheme and existing Landcare schemes;
- To analyse administrative efficiency of a discriminative price auction versus fixed-price schemes;
- To analyse communication strategies with landholders;
- To identify and define the ‘key success factors’ and ‘key impediments’ for conservation auction schemes in Australia and the factors which are likely to be regionally sensitive; and
- To communicate pilot results.

The outcomes for all project objectives are considered within this report.

1.3 Key Agents

The ALR comprises a field-based trial and research project engaging a number of agents. These include a number of non-government organisations, institutions, government agencies, community organisations and landholders. The lead partner and project manager is WWF-Australia, which is responsible for overall project coordination and management, including the implementation and management of the field-based operational project. The organisation also provides technical expertise in biodiversity conservation together with a facilitation and coordination role for the project’s Science Team.

A technical advisory group or Science Team has overseen the research components of the project. Key partners in the ALR’s Science Team include CSIRO Sustainable Ecosystems, responsible for the identification of project environmental outcomes, the development of a site assessment method and the development and testing of two methods of tender evaluation, the Environmental Benefits Index and the Systematic Conservation Planning framework. The University of Western Australia is responsible for auction design, input to the Science Team and evaluation of the pilot’s economic efficiency. The Department of Conservation and Land Management and Murdoch University also provide technical input to the Science Team.

Avon Catchment Council is a community-based organisation responsible for Western Australia’s largest natural resource management region. Within the ALR, the Avon Catchment Council provides a clearinghouse for tender documents lodged by landholders, draws up and manages contracts with landholders, and manages on-ground funds. It also provides communication expertise and some administrative support such as the provision of meeting facilities in a regional centre. The project's Community Support Officers (CSOs) are employed through the North Eastern Wheatbelt Organisation of Councils (NEWROC). In addition to site assessment and landholder communication responsibilities, CSOs provide a link between project managers, researchers and landholders. Other partners to the pilot provide technical advice and support, and input through the project Steering Group.

The pilot engaged private landholders in on-ground delivery of conservation actions but the private sector was otherwise not involved in the field and research trial.

2 ALR Pilot: Components and Process

The ALR pilot project applied an existing MBI mechanism, a conservation auction, to the problem of biodiversity conservation in a biodiverse salinising landscape in Western Australia. The project comprised a number of key components, each of which is discussed in Section 2 detail below. The pilot performance, in terms of price discovery and resource allocation, and in relation to milestones and objectives, is discussed in Section 3 below. Key components of the ALR are:

- Auction design
- Tender evaluation and site selection
    - Setting regional goals and environmental outcomes for the project
    - Site assessment for on-ground projects
    - Design, management and manipulation of project databases
    - Development/testing of two tender evaluation methodologies: Environmental Benefits Index and Systematic Conservation Planning
    - Tender evaluation
    - Tender selection and contract development
- Project organisation and management.

2.1 Auction Design

The formal component of the ALR auction design has been kept relatively simple: it is a sealed bid, price discriminating auction, along the lines of the Victoria BushTender project (Stoneham *et al*, 2003). In such a structure, landholders submit a tender based on proposed activities and anticipated costs. The advantage of such a mechanism is that it overcomes the asymmetric information problem in which government agencies do not know the accurate costs of achieving the desired outcomes. By establishing an auction, there is competitive pressure on landholders to keep tenders close to their opportunity costs, in order to ensure a greater chance of winning the auction (Moxey *et al*, 1999; Smith, 1995; Latacz-Lohmann & Van der Hamsvoort, 1997; White 2002). Price discrimination implies that it is possible for some landholders to be paid differential rates for the provision of the same service. The implication is that costs can be reduced to the funding agency if that is possible, and greater environmental gains can be achieved (Wu & Babcock, 1996). Feedback from the focus groups conducted in the early phases of the project suggested that auction design needs to be clear and simple from the landholders' perspective, so a relatively simple tender process, which can be communicated as rewarding those who deliver the greatest environmental benefit per dollar funded, is appropriate. Given the relatively small amount of on-ground funds available to the pilot, and the potential difficulty in communicating the concept of standardised output measures, the price discriminating structure was adopted to maximise the level of activity that can be funded.

The project operated on an 'inputs' rather than an 'outcomes' basis; i.e. contracts were phrased in terms of management actions with expected outcomes, and selection of contracts is based on the expected outcomes arising from those actions. However, strict compliance with the contracts will be in terms of on-ground activities rather than the expected gains themselves. The consequences of this structure is that a large element of the risk associated with translating onground actions into outcomes is borne by the funding agency. External risks or a failure in the science that selected the projects that result in the desired outcomes not arising will not impact on the landholder (e.g. the risk associated with unanticipated salinity degrading a site that has been successfully fenced would not lead to penalties for the landholder). This simplifies the tender process, as one does not require the landholder to identify quantifiable outcomes, and also transfers risk from the farmer to the funding bodies, who, with a portfolio of projects, are better able to absorb it.

2.1.1 Development of Landholder Documentation

The communication of environmental outcomes within landholder documentation needs to reflect the scientific criteria identified in a manner that is accessible by landholders. Considerable emphasis was placed on appropriately communicating desirable outcomes so that the project would not suffer from poorly-directed proposals or missing proposals that landholders did not realise would have been acceptable. However, there was a need for some revison of the documentation between Rounds One and Two. In this section a description of the documentation is given with notes on the changes made in Round Two.

Three documents were developed to act as the key communication process between landholders and the project staff. The information flow was bilateral: documents allowed for both key information on the nature of the project to flow from the project to landholders, and they also formed the basis by which landholders communicated their intent for the auction to the project. These documents were the Expression of Interest form, Guidelines for landholders and the Tender Form.

2.1.1.1 Expression of Interest

The Expression of Interest (EOI) form was the first formal point of contact between landholders and the ALR project team (see Appendix 1). This was effectively a formal trip wire to capture the identities of landholders interested in engaging in the tender process. The design of the form required a balance between requiring sufficient information about landholders' intentions, and being quick and simple for landholders to complete and submit, thus encouraging their entry to the process. Ideally, the EOI should provide a basis for initial evaluation of the proposal. It included a brief statement of the proposed benefits from the tender, proposed management actions and the size of the proposed site. This was needed because it was possible the ALR might be overwhelmed with proposals, and, given the imited time and resource, site visits may not be feasible for every respondent. Thus, the EOI document requested a minimum level of information which may potentially be used to prioritise the allocation of CSO time. This prioritisation process was not required, with all landholders submitting EOIs receiving a site visit. An alternative process allowing a more even spread of the workload, would have been to phase the submission of EOIs and Tenders. This would obviously have to be undertaken in a manner that did not discriminate against any landholders i.e. it would be important to allocate the same time from site assessment to tender.

The possible prioritisation of EOIs raises an interesting economic question in terms of auction design. In a world where it is costless to construct and evaluate tenders, a 100% coverage from landholders is preferred as it ensures that any feasible tender will be available for selection. However, in the situation where it is costly to construct and evaluate tenders this is not the case. Non-funded tenders represent an economic cost that ideally would be minimized. Clear communication of desired outcomes of the tender, and a reserve price that can be interpreted in the context of an individual tender before submission would assist in this process. However a tender evaluation process based on a site's complementarity (relative contribution to representation of biodiversity features under conservation mangement in the region) means that it is not possible to identify the value of an individual tender in isolation of all others, and hence the notion of an *ex ante* reserve price. Furthermore, the idea of achieving a 'target' success rate by, in some sense rationing tenders, is not possible *ex ante*, because it requires information on the opportunity costs of landholders, which are unknown to the agency (a fact that underpins the use of the auction mechanism). Trying to restrict the number of tenders runs the risk of undermining the competitive nature of the auction process, requiring a commitment to review all submissions. However, in practice there is the economic problem of optimising the submission of tenders to achieve the best set of ecological outcomes, while recognising that there are trade-offs in terms of comprehensive coverage and transactions costs.

2.1.1.2 Tender Guidelines

The Guidelines document was intended as the primary printed source of information on the project for landholders (Appendix 2). It presented the project's desired environmental outcomes, and emphasised the importance of public benefits, rather than private or production-based benefits. It was also designed to give a basic introduction to the auction concept. It was anticipated that this information would be supplemented by additional support from the CSOs when they made site visits.

Because of the landscape-scale focus of the project, the potential and desirability of joint bids had been recognized at an early stage, and support for these was re-enforced by landholder focus groups. The tender documentation and background information was developed to allow for this possibility. Joint bids may involve proposals from two or more landholders who wish to manage a site that straddles property boundaries, or multiple sites that are geographically close and would benefit from joint management. Management agreements on such sites would require co-ordination between landholders, but individual agreements would be made with individual landholders unless the group were legally incorporated (e.g. a landcare group). Landholders submitting tenders identified with others as a Joint Tender were given the option for their tender to also be treated as a single tender. Although Joint Tenders clearly increase the opportunity for tenders that increase net benefits from a project, they also raise the risk of failure, as there is the possibility of future non-compliance post signing of a management agreement, which would reduce or eliminate the value of the joint project outcomes. This is an issue linked to monitoring and compliance of conservation contracts, and would be worthy of further research.

It was also possible for landholders to submit multiple bids for a single site: i.e. a suite of increasingly complex proposals or a series of sub-projects. In some cases, only one bid could be selected within the evaluation process because of mutual exclusivity associated with the same site over which similar management actions were proposed. In other cases, landholders submitted multiple bids which might be individually funded without replicating management actions at a site, or proposing similar actions on different sites. Such submissions were more numerous in the second round, and often represented components of an integrated plan, sub-divided into smaller bids to increase the opportunity that one or more may be funded. Multiple and joint tenders allowed greater flexibility for the landholder in designing and tendering farm projects.

The wording of the tender Guidelines documentation, in particular in regard to the definition of the environmental values that are being protected, was linked to that of the Avon River Basin NRM strategy, which was under development as the auction was being designed. At the same time it had to reflect the much more detailed environmental data that would provide the basis for the project selection process. A recurring issue was the appropriate way in which to communicate the multiple-benefits aspects of proposals. In Round One this led to significant problems, with a number of tenders focusing solely on surface water management, with little evidence of public benefit. In preliminary landholder surveys conducted after Round One, one of the key messages from these interviews was the landholders' perceptions of the required outcomes from the project, and consideration of multiple benefits. Although the main objective of the project has been landscape-scale benefits for biodiversity protection, the ALR has always emphasised that, in considering tenders, other benefits would also be taken into account: the project wanted to break from single-focus outcomes and allow for additional benefits to be counted in the tender evaluation process. The extent to which this has been successful at a technical level is considered elsewhere in this report.

At the time of the initial design of the Round One tender documentation it was clear that communicating the intention to include multiple benefits was potentially problematic. For example, although we were flagging the possibility of including outcomes for water quality improvement, we did not want to encourage the development of projects that were solely focused on surface water management such as deep drainage. Given the context of the project within the Avon Region, there is also an issue with salinity management and drainage for protecting agricultural productivity. The landholder surveys indicated that landholders' primary land management concern was salinity. It is perhaps not then surprising that some landholders generated projects primarily focused on salinity mitigation with largely on-farm benefits. These demonstrated few or difficult to confirm biodiversity benefits, despite the fact that the documentation emphasised that the projects would be evaluated on the basis of public benefits rather than private benefits.

As a result of this experience the ALR team considered whether the stated outcomes of the auction should be changed for Round Two to increase the emphasis on biodiversity benefits, by more closely defining these as vegetation protection and rehabilitation. This would reduce the scope of the project and technically make the evaluation of tenders simpler. However, it would also significantly change the overall perspective of the second auction round compared to the first and potentially cause confusion in the minds of landholders; especially for those wishing to re-submit valid projects in Round Two. Such a change in emphasis of auction outcomes would also make any comparison of participation between Round One and Round Two problematic. As a result it was decided that the wording of desired outcomes in the Tender Guidelines for the second round should remain unchanged.

The only changes made to the Tender Guidelines for Round Two were minor grammatical updates clarifying the distinction between the ALR project as a whole and the landholder's proposed project. However, CSOs provided additional input and project development advice during site assessment visits, effectively screening projects that did not meet the ALR's objectives.

The other major revision in the tender process was the nature of the data collected through the tender form. It became apparent during the management appraisal review process and tender evaluation process in Round One that the information provided by landholders regarding management actions was often insufficient to make sound judgments on proposed ecological outcomes. It was also a poor basis for a management contract. The core premise of the ALR pilot for achieving biodiversity benefits within a landscape context, but with additional environmental benefits, makes it difficult to deliver a prescriptive list of information to be provided within a tender. In particular the possibility of water management projects, with the inherent problem of assessing the hydrological implications of works, raises difficulties. A requirement for standardised formats for digital farm maps designed by CSOs was implemented in Round Two. These designated proposed works and their relationships to other vegetation in the tendered area. An extended list of guidelines on minimum standards was also introduced, with copies of relevant documentation provided to landholders by CSOs. Given the possible range of management activities that could be undertaken, this minimum standards list was extensive. In completing the tender documentation, landholders were aware that they were expected to meet appropriate standards to achieve the proposed outcomes. The implications for this for evaluation are considered in the following section.

An important component of the tender Guidelines was the communication of the geographic limits of eligibility. Although the initial project proposal and intention was to cover a wider area within the Avon, the restriction of funds for on-ground works to $200 000 meant that eligibility was restricted to the NEWROC region. In part this was to make the logistics of site assessments more feasible, and to ensure that we did not engender substantially more interest and tenders than could be supported with the available funding (see discussion in Section 2.1.1.1).

2.1.1.3 Tender Submission Form

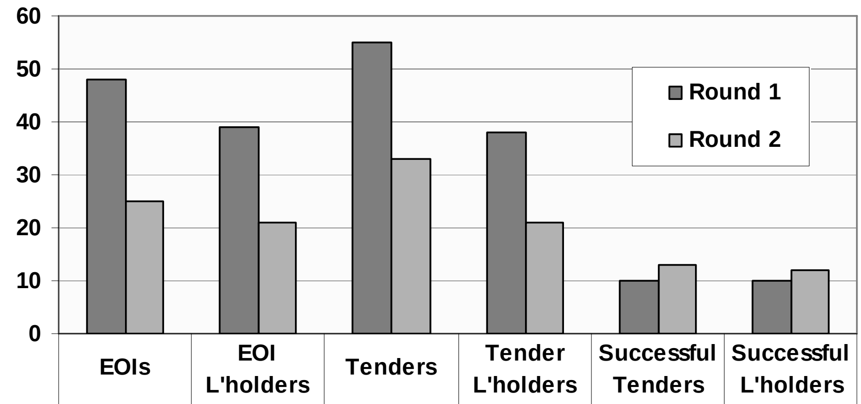
The Tender Submission Form (Appendix 3) captured much of the key information required for the evaluation process including site identification, details of proposed on-ground works and plans for long-term management, and the tender amount. Identifiers for joint or multiple tenders were included. The document was supported by appropriate farm maps, and supplementary information as required by the tender.

2.1.2 Auction Process

The auction was conducted over two rounds. The idea of the ALR project as a novel conservation incentive and funding scheme was advertised widely through local press and radio, through contacts with local Community Landcare officers, and through personal contacts between Community Support Officers (CSOs) and landholders during informal community gatherings. EOI forms, Guidelines and Tender forms were available through the project website hosted by the Avon Catchment Council, and distributed by CSOs. Closing dates were issued for EOIs so that site visits could be arranged: an EOI was a requirement for participation. Site visits by CSOs followed the close of EOIs, allowing some informal feedback to landholders on their proposed projects in terms of physical design, although at all times the CSOs refrained from commenting on the appropriate bid price. In Round Two, CSOs played a greater role, drafting digital farm maps and completing a draft tender; however final signoff remained the landholder's responsibility. Landholders were solely responsible for selection of tendered dollar amounts that they required to undertake the work, and submitting the tender to the Avon Catchment Council. Tender data entry based on the contents of the submitted forms was a more formal role for the CSOs. These data, a key element in the development of the environmental benefit index measures and the site selection process, were entered in the ALR tender evaluation databases (see Sections 2.2.4 & 2.2.5). Following close of tenders, the data were then available for the formal process of tender evaluation.

2.1.2.1 Auction Results

Round One closed at the end of April 2004: a total of 56 bids was received from 38 landholders, some landholders submitting more than one bid. Round Two closed at the end of February 2005 and generated 33 tenders from 29 landholders. Figure 2.1 shows the numbers of landholders, from EOIs to successful tenders for both rounds.



	EOIs	EOI L'holders	Tenders	Tender L'holders	Successful Tenders	Successful L'holders
Round 1	48	39	55	38	10	10
Round 2	25	21	33	21	13	12

Figure 2.1: Summary results for numbers of expressions of interest and tenders Rounds 1 and 2, Auction for Landscape Recovery. In each round, one landholder subsequently withdrew the successful tender. These figures were compiled prior to tender withdrawal.

2.1.3 Probity

Probity was considered to be an important issue within the ALR tender evaluation process and was based on adherance to principles of fairness, equity and objectivity. All relevant ALR team members, including tender evaluation team members, Community Suppport Officers (CSOs), Avon Catchment Council staff and WWF-Australia staff were made aware of ALR probity standards in relation to equity and confidentiality. Probity arrangements and considerations within ALR tender evaluation took the following form:

- Objectivity in the tender evaluation process:
    - The identity of landholders was withheld from members of the tender evaluation team and Management Appraisal Review Group (MARG);
    - MARG: members were asked to declare conflicts of interest, such as the recognition of projects/landholders through information provided. In the single case where a panel member was able to identify a landholder through familiarity with property and project characteristics, the panel member was excluded from comment and voting on the feasibility of management actions for that project;
    - A legal consultant was present at MARG meetings in Rounds 1 and 2 to ensure the objectivity, fairness and equity of the discussion and appraisal process;
    - Tenders ‘masked’ or excluded from selection were excluded for reasons that were fair and transparent. For example, on-ground projects failing to meet requirements for feasibility of works were excluded from selection;
    - Analysis of tenders has been appropriately documented.
- Equity:
    - All landholders within the designated project region (within the seven shires in the intensive landuse zone of the NEWROC) were eligible to participate;
    - All landholders were given the same opportunity for on-ground project development, assistance with tender submission and discussion with field officers (CSOs);
    - Tenders and Expressions of Interest submitted after the advertised submission date were not accepted;
    - Expressions of Interest and Tenders were lodged by mail, email or fax with Avon Catchment Council on or before 30 April 2004 in Round One. In Round Two, because of practical problems experienced with the numbers of

tenders received by fax at the close of the first tender period, submission was limited to mail, with a requirement that submissions were date stamped on or before 31 October 2004;
    - In Round One, the quality and amount of information provided by landholders varied. In Round Two, considerable effort was expended to standardise this information by utilising the CSOs in project proposal writing and production. In addition, in Round Two a digital farm map was produced for each tender;
    - For Tender data entry reasons, submitted tenders were returned to CSOs by Avon Catchment Council, and held in secure conditions.
    - Only CSOs communicated directly with landholders during the tender evaluation period. CSOs were not permitted to participate in the tender evaluation process.
    - Throughout the project, communication with landholders has been limited to the project manager, CSOs and the agency responsible for contract administration (Avon Catchment Council).
- Confidentiality:
    - Landholders' personal details held by CSOs were stored in secured databases. At the close of the CSOs' employment contract period, all databases and other ALR-related materials, including landholders' tender documents, were destroyed or returned to the WWF project manager. At the close of the project period, relevant documents will be transferred to Avon Catchment Council for appropriate secure storage;
    - Landholder identification details were withheld from all tender evaluation team members and MARG panel members. In addition, all printed tender-specific project information provided to the MARG panel was returned to the project manager at the close of each MARG meeting;
    - Following tender evaluation, final site selection, funding and contract negotiation, bid information that links landholders with proposed tenders (cost) has been restricted to the project manager, the CSOs and Avon Catchment Council.
- Transparency and defensibility of the tender evaluation process:
    - The process of tender evaluation and final site selection has been transparent. Outside the MARG feasibility process, which relied on expert panel opinion (see above), the process was heavily data-dependent, with the value of the projects determined by the contribution the site made toward biodiversity conservation targets and value for money. Site selection criteria were identified in advance.
- Consistency of the tender evaluation process:
    - Within rounds all tenders (i.e. the set competing for selection) were treated consistently as a set.

Although only parts of the ALR probity process were formally overseen by a qualified legal consultant, the ALR project team considered that tender evaluation was a fair and equitable process maintaining confidentiality for landholders.

2.1.4 Survey of Landholders

An important part of the evaluation of the ALR was a survey of participants and non-participants in the project region. The objective was to obtain information that could help evaluate the performance of the project from the perception of landholders, in particular identifying those factors that induced landholders to participate in the auction.

The data were collected through telephone and face-to-face interviews with NEWROC landholders. The telephone interviews and some face-to-face interviews were conducted over June and July 2004 and additional face-to-face interviews were conducted in October 2004.

Preliminary interviews in June and July 2004 were conducted to scope the range of issues concerned with participation in the ALR. Five Round One ALR participants agreed to participate in a face-to-face interview and a further 15 Round One participants were asked to take part in a brief telephone interview of 15-20 minutes.

The preliminary interviews provided the basis for a structured questionnaire that was used for detailed face-to-face interviews in October 2004 with ALR participants and non-participants. All ALR participants were asked if they were willing to take part in an interview. Non-participants were randomly selected across the NEWROC shires, with varying population of the seven shires taken into account. A total of 62 farm-based interviews was conducted, with surveys evenly divided between participants and non-participants. Of the 31 ALR participants interviewed, 24 landholders participated in Round One and 13 participated in Round Two. Six Round Two participants had also participated in Round One. The smaller number of Round Two landholders participating in the surveys in part reflects the reduced number of landholders active in Round Two, but also the difficulty experienced in obtaining interviews, and particularly a shorter time period over which Round Two landholders could be contacted, closer to the end of the ALR project.

The ALR pilot was interested in whether an auction mechanism, with a less restrictive funding framework compared to conventional incentive schemes, would be able to extend landholder participation in the case study area. An extension to participation would be an additional benefit from the auction, over and above the normal economic efficiency arguments that are of interest with auction mechanisms. The ALR farm survey included questions exploring the ability of the ALR to attract landholders who had not previously participated in environmental or conservation incentive schemes or Landcare.

In exploring questions regarding participation in other incentive schemes, the ALR Background Report (WWF-Australia, 2004) on previous and existing environmental schemes in the Avon region reviewed the policy context of the ALR. The initial plan was to compile incentive scheme data on NEWROC participation rates for a comparison with participation rates in the ALR. The compilation of a full data set was not possible due to the paucity of information about participation rates in other schemes. However, data collected through the ALR farm survey provided some indicators of participation in other schemes.

The ALR Background Report identified 11 schemes offering opportunities for access to support for on-farm conservation activities. These are presented in Table 2.1 and Figure 2.1 below. The incentive programs listed vary in the support mechanisms provided for on-ground activities, and many draw on a combination of support tools. For example some incentives primarily provide financial assistance (e.g. Envirofunds), while others place an emphasis on the provision of technical assistance (e.g. Land for Wildlife) or legal frameworks (e.g. covenants) to support landholders' conservation efforts. The design of some of the schemes also includes an element of official recognition to reward and encourage land stewardship activities. Table 2.2 provides an aggregated summary of applications and successful applications by landholders to . The results are grouped by ALR participants and non-participants.

Table 2.1: Conservation incentive schemes identified as currently or previously operating in the NEWROC region at the time of the survey, June 2004.

Scheme	**Management Agency**
Current incentives	
Conservation Covenants (3 different schemes)	Department of Conservation and Land Management Department of Agriculture National Trust of Australia
Envirofunds	Department of Environment and Heritage, Commonwealth

Land for Wildlife	Department of Conservation and Land Management
NHT (Bushcare, Landcare, Rivercare)	Department of Environment and Heritage, Commonwealth
Threatened Species Network	WWF-Australia
Woodland Watch	WWF-Australia
Earlier incentives	
ACC Community Grants (funded through NHT)	Avon Catchment Council
Oil Mallee Program	CALM/Oil Mallee Association

Table 2.2: Participation of survey respondents (*n*=62) in other incentive schemes operating in the NEWROC region.

	Number of respondents	
Participation Type	ALR Participants (*n*=31)	ALR Non-participants (*n*=31)
No previous participation	7	13
Submitted an application	24	18
Successful application (of those who submitted an application)	21	14

The number of respondents who have participated in other schemes operating in the study area is shown in Figure 2.2 below.

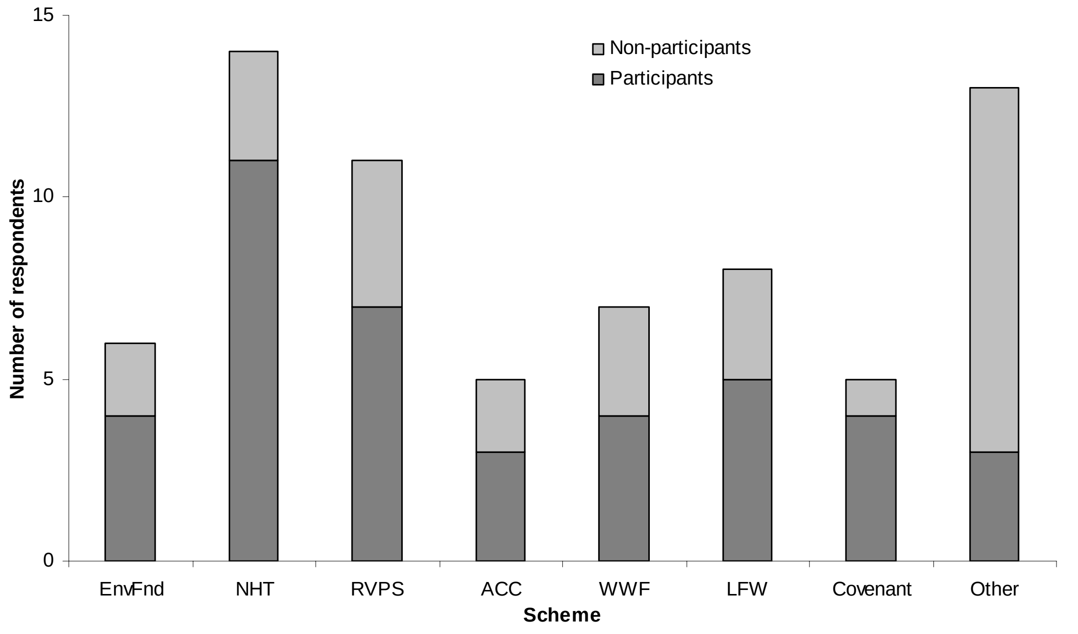


Figure 2.2: The participation of survey respondents in other schemes operating in the NEWROC region. (*n*=42: 24 ALR participants and 18 non-participants). Key: EnvFund=Envirofund; NHT=Natural Heritage Trust; RVPS=Remnant Vegetation Protection Scheme; ACC=Avon Catchment Council Community Grants; WWF=WWF-Australia (Woodland Watch); LFW=Land for Wildlife.

The survey also explored the patterns of participation within Landcare-related activities to determine if the pool of ALR participants was drawn from those within or outside Landcare-related networks. Responses to questions regarding membership in a Landcare or Catchment Group and assistance from a Landcare officer on the farm are summarised in Figure 2.3 below.

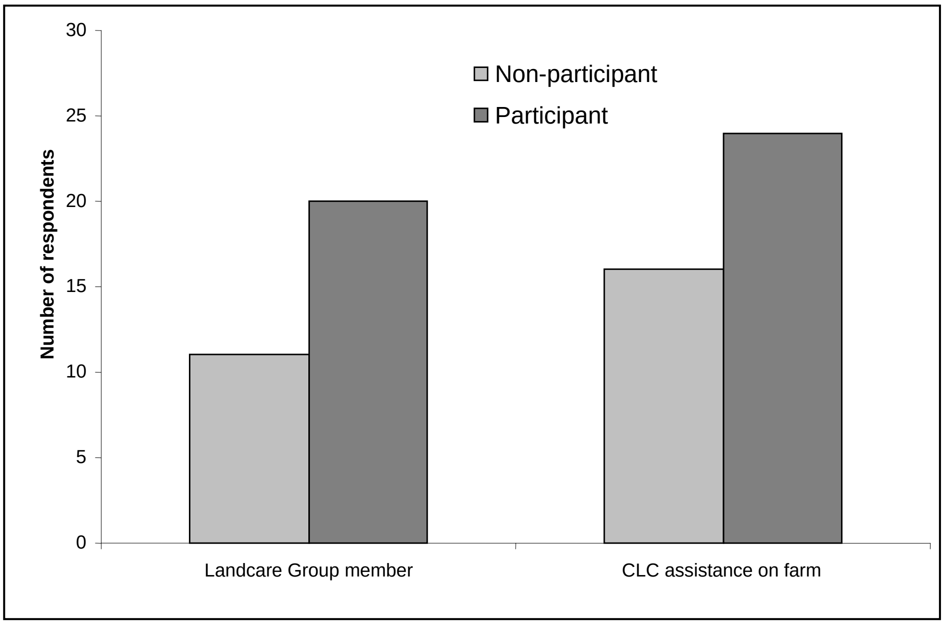


Figure 2.3: Landcare membership and assistance for respondents in the ALR survey (*n*= 62; *n*=31 for both Participants and Non-participants). Key: CLC=Community Landcare Coordinator.

From the results shown in Figure 2.3, it is not possible to conclude whether the ALR has drawn exclusively from a pool of landholders who are 'landcare oriented'. However the results do indicate that ALR participants are more likely to have landcare-related experience on both measures . The statistical significance of landcare activities as a predictor of participation has also been confirmed in the regression analysis presented in Clayton (2005).

A preliminary evaluation of the influence of socio-economic factors (including previous participation in schemes and landcare involvement) on the influence of participation in the ALR has been explored quantitatively using regression analysis. In this analysis, logit estimation was used based on the notion that the propensity for participation varies depending on the influence of explanatory variables (Long 1997). The statistical analysis is discussed in more detail in Clayton (2005).

The questionnaire for the survey was designed, in part, for the purpose of exploring the socio-economic factors thought to be important in explaining the likelihood that a landholder would participate in the auction. The full set of variables included in the survey is outlined in Table 2.3. A subset of this full set was included in the final regression; these are indicated in the Table by an asterisk. The process of eliminating variables from the larger set to be included in the final estimation was based on a commonly used process of iterative estimation steps where insignificant variables are removed, working from general-to-specific.

Table 2.3: Variables measured in the landholder interviews, hypothesised as significant for explaining the participation decision.

Category	Survey Item
Economic factors	Farm size * Farm ownership Cropping yields Off-farm income Farm enterprises

	Resource constraints regarding nature conservation *
Basic demographics	Age Education level
Landcare, experience	Participation and success in environmental schemes * Landcare membership * Assistance from Community Landcare Coordinator*
Attitudes and perceptions	Motivations for nature conservation Responsibilities regarding protecting the environment Financial assistance and willingness to undertake nature conservation * Local values and nature conservation schemes

*Item included as variables in preliminary logit regression model

The results from the estimation of the logit model indicate that, of those included in the survey questionnaire, the significant factors increasing the likelihood of participation in the ALR are:

- the importance of cost and time as constraining factors for on-farm nature conservation activity;
- higher yields of the primary crop (wheat);
- positive attitude toward the role of financial compensation and willingness to undertake nature conservation;
- previous experience in other incentive schemes;
- input by a Landcare officer on the farm; and
- membership in a Landcare group.

The positive correlation between 'landcare experience'[1] and likelihood of participating in the ALR indicates that the ALR has been able to engage the interest of those who have been involved in other ways in conservation activities. This result also reflects positively on the contribution of Landcare for engaging sustained interest from landholders in environmental management.

The regression results regarding 'landcare experience' also suggest that the ALR had attracted, on average, a group of landholders who might normally be expected to participate in environmental schemes, or Landcare-related activities. However, having said this, it is important to reflect on the fact that several (7 of the 31) of the ALR participants interviewed had not previously participated in any other incentive scheme. These landholders provided a range of reasons for their decision to participate in the ALR, including: the availability of money for on-farm work; the simplicity of the application process; an interest in nature conservation; the flexibility of the ALR compared to other incentives; the encouragement of the CSOs; and the possibility of receiving assistance for salinity-related works. Several of these reasons suggest that there were features of the ALR design that are specific to conservation auctions, which attracted participation.

2.1.4.1 Learnings

The use of an *ex post* survey within the NEWROC project region allowed us to gain information on the perspectives of both participating and non-participating landholders. It confirms that one of the key issues in the success of the project has been the support provided by CSOs employed by the ALR. There are important implications for this for similar projects

[1] In the regression analysis the 'landcare experience' was a composite variable based on previous success with applications to other incentive schemes, current membership in a landcare or catchment group, and recent assistance from a landcare officer on the farm.

elsewhere. The relatively high number of participants who had participated in previous incentive schemes may suggest that a degree of human capacity/prior experience is required of participants. The ALR has obviously reached out to a number of landholders who had not previous participated, and an important aspect for consideration is how to best to support those who may be attracted to the open tender process, but do not have the relevant prior experience.

2.2 Tender Evaluation and Site Selection

2.2.1 Introduction

In addition to objectives related to the administrative efficiency of auctions, a key objective of the ALR was to implement a field-based trial in which an auction approach tested two methods of tender evaluation, the Environmental Benefits Index (EBI) and the Systematic Conservation Planning approach (SCP). This involved a number of steps and processes. Following auction design and the design and distribution of landholder documentation (see Section 2.1), regional environmental goals and environmental outcomes were identified for the project and the project region. A site assessment method was chosen and modified and relevant databases designed, managed and manipulated for the purposes of tender evaluation and the subsequent experimental comparisons. An existing EBI was modified for the project and the SCP approach developed to the point where it could be utilised to assess tenders for site selection and funding. Finally, tenders were evaluated and sites selected in the two rounds of funding available to landholders in the study area. The project thus had both operational and research objectives in relation to tender evaluation and site selection. In the sections below, these aspects of the project are described and site selection results discussed.

The process of tender evaluation and site selection was an integral part of auction and project design and involved a number of information flows. The way that the tender evaluation and site selection process linked to auction design and procedures such as the administration of management contracts for landholders is depicted schematically in Figure 2.4 below. The figure is underwritten by the principle of the assessment of value for money in relation to site selection for biodiversity protection and conservation and the ALR budget of $100,000 per tender round.

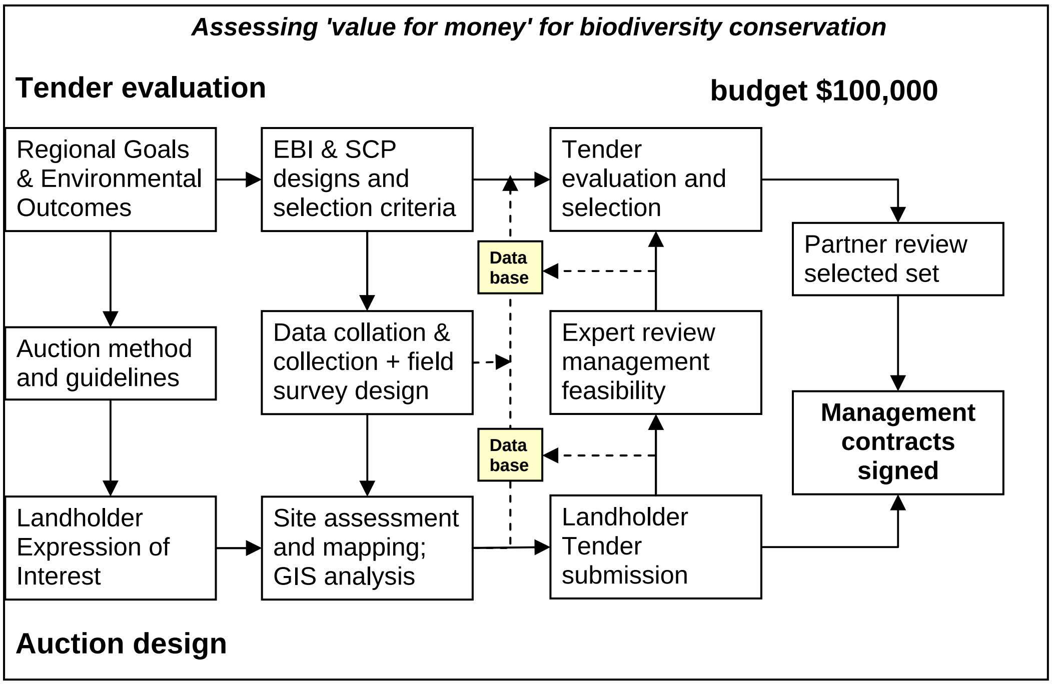


Figure 2.4: The relationship between elements of auction design, ALR project components and information flows associated with tender evaluation and site selection in the Auction for Landscape

Recovery. Key: EBI = Environmental Benefits Index; SCP = Systematic Conservation Planning approach.

2.2.2 Regional Goals and Environmental Outcomes

The ALR environmental goals and outcomes provide the over-arching framework for communicating the objectives of the auction to landholders and the design of selection criteria for tender evaluation and site assessment methods. Environmental goals and outcomes were developed with reference to the then draft version of the Avon NRM region regional strategy, the *Regional Natural Resource Management Strategy for the Avon River Basin* (Avon Catchment Council, 2004) and the monograph *Managing Natural Biodiversity in the Wheatbelt: a Conceptual Framework* (Wallace *et al.*, 2003a).

Outcomes for native biodiversity, water management and soil management were considered most relevant to the ALR. These are listed in Appendix 4 with some measures that can be used to assess the success of achieving, or not achieving, these goals. Climate change was also considered important but such outcomes could not be achieved over the life of management contracts possible for this project. At the time of development, there was no readily available practical means by which we could assess – or communicate to landholders – a quantitative approach to evaluating the benefit or disbenefit of management actions targeting climate change outcomes. A means to do this has since become available through the Australian Greenhouse Office (2005).

For public communication purposes, abbreviated versions of the target environmental outcomes were developed and included in the auction Guidelines, on project websites, in advertising posters and media releases. Abbreviated target environmental outcomes related to the particular focus on biodiversity conservation outcomes, with some focus on benefit for salinity control, waterlogging control and the improvement of water quality. There was particular emphasis on the following:

- the conservation and recovery of threatened species and ecological communities;
- larger, representative landscapes with significant areas of remnant vegetation and wetlands;
- the management of numbers of remnants together, including linkages through the creation of corridors;
- the contribution of the proposed management plan to the landscape/regional outcomes;
- the contribution of management actions to multiple environmental benefits, such as the impact of revegetation on water tables and soil erosion.

2.2.3 Site Assessment

2.2.3.1 Development and Overview

Expressions of Interest submitted by landholders triggered farm visits by the CSOs, the development of proposed on-ground projects by landholders, the identification of defined project site areas, and site assessment/s. The site assessment method for the ALR included the development of a site assessment proforma designed principally to capture information about each proposed on-ground project site in order to score the Environmental Benefits Index (EBI – see Section 2.2.5). Attribute categories for the Index were initially developed from site assessment frameworks used in the then draft version of a prototype toolkit for scoring biodiversity benefits in NSW (Oliver & Parkes, 2003) and the Liverpool Plains (NSW) auction trial (DLWC, 2002). Individual site assessment attributes also had potential application as preferences, masks, filters or condition modifiers (positive or negative) on complementarity or costs as part of the Systematic Conservation Planning procedure (SCP-see Section 2.2.6). The site assessment proforma was developed and then field-tested and further refined. Field testing was conducted by a trained botanist, the project CSOs and WWF-Australia staff; concurrent with training for the CSOs in the recognition of vegetation structure and condition and other site attributes including threatening processes.

Site assessments from field and desktop studies provided the baseline data on site characteristics, habitat structure and condition, landscape context, conservation significance and management profile (threatening processes). Databases were used to store, manage and integrate site assessment information for the tender evaluation process (see Section 2.2.4). In the field, the attributes and categories recorded provided information about the current condition of the site at paddock and property scales. Additional contextual information at catchment and regional scales was obtained using GIS and desktop analysis. A copy of the site assessment proforma is included in Appendix 5. Attribute categories for the Index were not scored in the field; rather, data were collected in raw format and attributes scored later.

Differences in the confidence level or consistency with which site attributes were measured reflects upon the robustness of the EBI to be calculated, and therefore its suitability for comparing sites and tenders in the evaluation stage. Simple estimates of reliability, or confidence were recorded on field proformas by the CSOs in the context of each attribute observed. These estimates of reliability, rather than primarily reflecting on site factors affecting measurement accuracy, tended to be used by CSOs as an indication of observer confidence and the potential need for further training in detection methods. The project responded by focusing attention on these training needs or refinement of the site assessment procedures within CSO skill levels. Confidence ratings from the site assessments were recorded in the database but not specifically used to refine the EBI scoring.

CSOs took digital photographs of each site assessed. This additional field assessment procedure was introduced as a benchmark for comparing the observed variety of habitats at local scales with the biodiversity surrogate, which combined vegetation and regolith mapping for the SCP approach, used to assess habitat complementarity at regional scales (i.e. between sites and within landscape). The site photos were also a valuable resource for the Management Appraisal Review Group, enabling members to compare the appearance of a site within the context of their own field experience and to reflect upon feasibility of proposed management actions.

2.2.3.2 Site Assessment Process

A project site for site assessment by CSOs was identified as an area or location associated with a tender in which management actions are proposed or an area targeted to benefit from proposed management actions. A single farm project can be large and complicated and may involve multiple tenders (including separate or nested project sites). Projects typically comprised one or more sites where works were proposed, associated with which were one or more adjacent sites likely to benefit from the works.

A site for field assessment purposes was thus defined as a geographically distinct area or location over which a) one or more management actions is proposed, or b) an adjacent area or location which is affected (usually intentionally) by the proposed management action. Where one or more management actions was proposed, the site was denoted the '*location of works*'. Where an adjacent area was affected by the proposed management action, the site was denoted the '*immediate area of impact*' of the works. In this latter case, environmental or biodiversity assets were expected to benefit from the works, even though they were not also part of the works' area. For example, consider a proposal to establish a wildlife corridor between two remnants; one with a core area of 10 ha and the other with a core area of 40 ha or more (note: core area of a remnant excludes an edge effect of 30m). The revegetation and management practices associated with the wildlife corridor may be undertaken over three years under best practice. For site assessment and tender evaluation purposes, the wildlife corridor is the '*location of works*' and the two connecting remnants are the '*immediate area of impact*' of the works. In this case, site assessments would be conducted in each of these areas, except where remnants were located on adjoining properties for which no agreement had been entered into between land holders on a joint proposal.

During the development phase of the project through Round One, tender sites were not consistently denoted '*location of works*' or '*immediate area of impact'* of the works. As a result all areas mapped for a tender were treated equally in tender evaluation. In Round Two, greater emphasis was placed on the distinction between site types and sites were denoted either '*location of works*' or '*immediate area of impact'* of the works, without overlap. Even though the '*location of works*' will also benefit, only those peripheral areas not already associated with a specific management action were denoted '*immediate area of impact'* of the works. This distinction enabled separate areas to be identified and delineated in maps and data used in tender evaluation. The scoring of the EBI in Round Two, for example, was able to take the site type into account in the weighting of scores by area in hectares.

Within sites, relatively homogeneous, representative vegetation types were sampled using a standard 50 x 20 m survey area for quantitative data. Sampled areas within sites were termed plots. Qualitative observations within plots were of a more general nature relevant to the extent of the particular vegetation type within the site.

Following site visits, the site assessment process was completed in the office. In Round One, landholders produced hand-drawn farm maps to indicate the nature and location of works. In Round Two, farm maps for landholders' tenders were refined by CSO's and produced using Streets Ahead™ software and output as graphic files showing the '*location of works*' and contextual information such as property boundaries, existing fence lines and associated remnant vegetation. Descriptive notes from site assessment were completed, and data from site assessment proformas entered into the site assessment database.

In Round One, farm maps appended with tenders were generally poor quality. In Round Two, farm maps developed by CSOs were included with tender forms authorized and submitted by relevant landholders. The Round Two digital farm maps improved visualisation of the landholders' intent for the tender area. These maps were used by the Management Appraisal Review Group for review of tender proposals and facilitated cross-checking with the tender coverage dataset for the same areas.

The tender coverage is a GIS vector dataset representing the location and extent of sites for tenders and their attributes submitted in each auction round. The tender coverage was compiled from MapInfo 'shapefiles' generated by the CSOs using Streets Ahead™ software. These shapefiles were first converted to ESRI ArcView™ shapefiles and then compiled into a single coverage by a GIS officer. During this process, unique identifiers and labels enabling linkage to tender, site and plot identifiers in the site assessment and tender databases were incorporated.

The EBI required further surrogate 'landscape context' attributes that capture the spatial context of a tender and site, such as connectivity among remnants, size and proximity, and percentage vegetation cover remaining within landscape neighbourhoods. These factors were used as general indicators of overall biodiversity condition or viability, and were also applicable as surrogates for 'probability of persistence' in SCP approaches.

Spatial analysis of landscape context required an experienced GIS officer. Proposed analyses were not completed in Round One but were revised and implemented in Round Two. Landscape context analyses included the proximity of sites to the nearest significant (>40ha) remnant, perimeter:edge ratios, the proximity of the site to high salinity risk areas, and other attributes.

2.2.4 Databases

The compilation of databases underpinning regional-, landscape- and site-level analyses required streamlined data integration and management procedures. Tender-relevant data were derived from expressions of interest, site assessments and submitted tenders and were recorded and/or collated by Community Support Officers (CSOs). Additional databases were compiled from desk-top spatial analyses and in the construct of EBI attributes. A comprehensive explanation of the suite of databases, fields and codes is available on request.

The site assessment and tender databases were initially designed in MS Excel spreadsheets and then exported to an MS Access relational database designed for the ALR. Each CSO entered the relevant data for their site assessments and tenders in Excel spreadsheet tables. The capacity of the CSOs to work with software, the availability of software, and the lack of financial and other resources to address these issues were significant considerations. In the period leading up to Round One tender evaluation, extreme time restrictions impacted on the ability of the project to always provide comprehensive quality assurance checks on data. These considerations were addressed in Round Two, and are relevant to future projects.

The primary purpose of the site assessment and associated spatial databases was systematic collation and integration of information to support implementation of queries that define criteria and scores for the EBI calculation. A secondary purpose was to support extraction of data for the SCP analysis.

The purpose of the tender database was to collate information from the tender form, incorporate site and plot identifiers that link tenders with the site assessment database, and support implementation of queries to enable integration between databases for the process of tender evaluation.

2.2.4.1 Lessons Learned

A review of data handling, entry, checking and integration across databases was prompted by the identification of problematic issues in Round One. Time frames for tender evaluation were subsequently lengthened in Round Two to enable more time for data entry, data checking and more effective integration across site, tender and landscape context (spatial) databases.

The ALR acquired a comprehensive and extensive suite of spatial data for the evaluation and selection of tenders. This required effective networks with custodian institutions and individuals in government to facilitate rapid and accurate supply of data. In Round One, these networks were not established early enough to ensure data provision and completed analysis for tender evaluation. In Round Two, all data input requirements for spatial analysis to support tender evaluation were achieved. In future studies, the time and skill required to negotiate and acquire spatial data and complete standard but sophisticated spatial analyses should be carefully assessed and advocated early in the project cycle. Many of the spatial analyses undertaken for the ALR have relevance to future conservation planning and NRM projects in the Avon NRM region.

2.2.5 Environmental Benefits Index

For the experimental phase of the ALR, two tender evaluation approaches were being tested: selection of tenders based on a multi-attributed Environmental Benefits Index (EBI), and biodiversity complementarity within a Systematic Conservation Planning (SCP) framework. Operationally however, an integrated approach was developed in order to make the best use of both methods when selecting tenders for funding. For the pilot, sufficient data were collected to allow tenders to be evaluated using the EBI and SCP approaches. This section of the report describes the EBI and its development within the ALR tender evaluation process. The SCP framework is presented in Section 2.2.6.

Site assessment from field and desktop studies provided the baseline data for calculating the EBI. A key motivation for compiling and integrating the site assessment data into relational databases was to support the EBI scoring process with semi-automated queries.

The EBI is an additive scoring system used to value biodiversity and environmental assets and services. The scores for different sites or areas can be compared by ranking, and evaluation occurs when a set of sites is selected according to their rank importance, or in relation to their cost and a budget. The US Department of Agriculture (USDA) pioneered the development of environmental benefit indices through its Conservation Reserve Program in the 1980s. Under this system, an EBI is used to indicate the value of different environmental management practices that landholders might implement (e.g., USDA, 1999, 2003). Components of the index were devised by ecologists to reflect the relative scarcity of ecosystem services and comprised six factors relating to wildlife, water quality, erosion, enduring benefits, air quality, cost, and state or national significance (Feather *et al.*, 1999). In Australia, EBIs have been utilised within the NSW Liverpool Plains project (DLWC, 2002) and the Victorian BushTender project (Parkes *et al.*, 2003), and are currently the favoured application in auction-based incentive schemes.

2.2.5.1 Development of the EBI

The ALR utilised an EBI comprised of a 'native biodiversity benefits index' (NBBI) assessing native biodiversity values, and an 'other Environmental Benefits Index' (OEBI) assessing salt and water management, soil management, and threatening processes such as livestock management, fire regime, weeds and feral animals. These conformed to target environmental goals, outcomes and measures defined for the project and were consistent with regional NRM goals (see Section 2.2.2).

The attribute categories and scores for the NBBI were largely developed from site assessment frameworks used in the Victorian BushTender trial (Parkes *et al.*, 2003) and the then draft prototype toolkit for scoring biodiversity benefits in NSW (Oliver and Parkes, 2003). The OEBI largely derived from the NSW Liverpool Plains auction trial (DLWC, 2002). Other documents sourced for relevant information in developing the EBI attribute categories and scores included the *Regional NRM Strategy for the Avon River Basin* (Avon Catchment Council, 2004), *Biodiversity Asset Survey* (Northern Agricultural Catchment Council, 2003), and the Remnant Vegetation Protection Scheme operated under the Department of Conservation and Land Management (Wallace, 1990).

The 'native biodiversity benefits index' (NBBI) utilises four surrogate measures of biodiversity: vegetation or habitat condition, vegetation or habitat complexity, landscape context, and conservation significance. A formula adapted from Oliver and Parkes (2003) calculates a biodiversity significance score and a land use change impact score and combines these into an overall biodiversity benefits index. The biodiversity significance score combines and weights conservation significance and landscape context, and the land use change impact score estimates the magnitude and direction of change in biodiversity value as a result of land use change. The resulting NBBI is a multiplicative combination of the biodiversity significance score, the land use change impact score and a logarithm to base-ten transformation of area in hectares (representing the extent of land use change resulting from successful implementation of on-ground works proposed in a tender). The 'extent of land use change' factor effectively weights the BBI before it is additively combined with the OEBI.

The OEBI was grouped into two categories – salt, water and soil management benefits, and other environmental benefits or management activities (grazing, fire, weeds and feral animals). The scores from the component attributes were simply summed within each group and then added together to create the OEBI. The OEBI was then weighted by 0.5 as a step in the calculation of the final EBI. The 0.5 weight on the OEBI is consistent with ALR policy which has a primary focus on nature conservation outcomes. The final EBI was calculated as the sum of the NBBI and weighted OEBI.

The detailed design of the EBI used in Round One of the ALR program is presented in Appendix 6 and the revised version used in Round Two is presented in Appendix 7. A list of the attributes grouped by type is given in Appendix 8, and the number of attributes in each group and maximum scores is given in Appendix 9.

Data to drive the EBI came from site- and office-based assessments of land by the CSOs in those areas proposed by landholders, desk-top spatial analysis of biodiversity and land inventory data, and landholder statements of management objectives and activities submitted with each tender. Minor adjustments were needed to adapt scores and indices to the condition and range of vegetation types found within the NEWROC project region, ensure consistency with regional goals, and take into account the capacity and experience of CSOs. Significant changes were implemented between Round One and Round Two, taking into account feedback from the ALR team, CSOs and valid measurement ranges emerging from the site assessment program.

2.2.5.2 Automating EBI Calculations

In Round One, the EBI calculations were conducted manually with significant reliance on expert judgment, resulting in scores that, while credible, lacked transparency and could not be repeated. In Round Two, in order to ensure accuracy, transparency and repeatability, all EBI calculations were conducted on the source data using MS Access tables and queries. Changes or additions that were required to complete an analysis were fully documented and new table fields were defined to capture any further interpretation of the source data. Adjustments to scoring categories were made to align with available field notation and to clarify scoring thresholds. All adjustments were recorded and a revised EBI scorecard was created (Appendix 7). In cases where zero values for a category were not pertinent, null values were recorded. Calculations were implemented at the plot in site or site level, as relevant to the measurement hierarchy developed for site assessment. EBI calculations fully utilised the site assessment database (measurements from field based observations) and the landscape context database (spatial analysis results from GIS desk-top assessments).

2.2.5.3 Round One NBBI Calculation

The formula used to calculate the NBBI in Round One was modified from Oliver and Parkes (2003):

NBBI = {Biodiversity Significance Score (BSS)} × {Land Use Change Impact Score (LUCIS)} × area of land use change (ha)

$$= \{(CS\ t_0 + LC) \times VCO\ t_0 + (VCY\ t_0 / 50)\} \times \{([CS\ t_n - CS\ t_0] + [VCO\ t_n - VCO\ t_0] + [VCY\ t_n - VCY\ t_0]) / 2\} \times ha$$

Where:

$CS\ t_0$ = Current Conservation Significance

$CS\ t_n$ = Potential Conservation Significance

LC = Landscape Context

$VCO\ t_0$ = Current Vegetation/Habitat Condition (before land use change)

$VCO\ t_n$ = Potential Vegetation/Habitat Condition (after land use change – generated by successful implementation of on-ground works proposed in a tender over a specified time period)

$VCY\ t_0$ = Current Vegetation/Habitat Complexity (before land use change)

$VCY\ t_n$ = Potential Vegetation/Habitat Complexity (after land use change – generated by successful implementation of on-ground works proposed in a tender over a specified time period)

ha = Area of land use change resulting from successful implementation of on-ground works proposed in a tender over a specified time period.

The formula for the EBI used in Round One was revised in Round Two with some departures from the original NBBI index originally devised by Oliver and Parkes (2003). The allocation of points to the ‘potential’ category for vegetation/habitat condition and complexity, in particular, proved a challenging exercise and was not included in the Round Two NBBI calculations. The revised index is discussed in the following section.

2.2.5.4 Round Two NBBI Calculation

Several changes and enhancements were introduced in Round Two to improve consistency and repeatability in calculating the NBBI. These changes included 1) addressing the observation scale of site assessment and method of aggregation for individual attribute values and scores, 2) addressing the weighting of attributes within and between attribute groups, 3) calculating scores in the absence of estimates of potential land use change, 4) addressing the area-based weighting of the overall NBBI. Each of these changes are discussed below.

The calculation of the NBBI was complicated by the hierarchy of plots within sites and sites within tenders. Each tender comprised one or more sites and each site comprised one or more plots. Site assessment observations mostly occurred at the plot and site level and occasionally at the tender level. This hierarchy needed to be taken into account in aggregating scores, and to ensure the aggregation is appropriate to the intent of the score in each case. Raw attribute values (site observations or measurements) needed to be aggregated within plots and then sites and finally within tenders. The scale of observation of raw attributes values for the different NBBI attributes is given in Appendix 10.

For example, in the case of the *landscape context* attribute “site is part of a continuous area of native vegetation (area of remnant)”, the proximity of a site to a remnant was investigated at the plot level using GIS and the size of each remnant directly intersecting with a ‘plot’ (a GIS polygon in the tender coverage) was recorded. More than one remnant may intersect with a plot. The maximum size of a remnant for the plot is the objective of this attribute, and so the *maximum* remnant size was used to determine the attribute score for the plot.

The general process was to calculate the NBBI attributes and scores at the lowest level in the hierarchy – plot or site as relevant – and then aggregate to site and then tender. At the site level, plots were aggregated as statistics for average, maximum and minimum values, and these were carried through to the tender level. Each component group of attributes within the NBBI (*viz.* vegetation or habitat condition, vegetation or habitat complexity, landscape context, and conservation significance) were equally weighted by normalizing scores within each group using the maximum *possible* score, before completing the calculation. Thus at the tender level, the final NBBI scores comprised average, maximum and minimum values.

Area was taken into account by weighting the NBBI scores by the base 10 logarithm as applicable to either the *‘location of works’* or ‘*immediate area of impact’* of the works. To avoid inflating the indices by large areas denoted *‘immediate area of impact’* of the works, sites larger than 10ha were treated as 10ha. Conversely, sites for *‘location of works’* smaller than one hectare were treated as 1.1 hectares, to avoid deflating the indices by proportions.

The resulting NBBI calculation for Round Two comprised two components, one based on the *‘location of works’* and the other based on the *‘immediate area of impact’* of the works. The general form of the calculations is:

NBBI = $NBBI_{works} + NBBI_{influence}$

$NBBI_Y$ = {Biodiversity Significance Score (BSS_Y)} × LOG_{10} (area in ha $_Y$)]

Where:

BSS_Y = {[($NormCS_{t0} + NormLC_{t0}$) × ($NormVCO_{t0} + NormVCY_{t0}$)]}

Y = *works* or *influence*

works = *‘location of works’* at a site (as relevant to NBBI). Areas < 1 ha are included as 1.1 ha and areas > 10 ha are included as stated.

influence = *‘immediate area of impact’* of the works at a site (as relevant to NBBI). Areas < 1 ha are included as 1.1 ha, and areas > 10 ha are included as 10ha.

Where:

$NormCS_{t0}$ = Current Conservation Significance, normalized in the range 0-1 (maximum score = 54)

$NormLC_{t0}$ = Current Landscape Context, normalized in the range 0-1 (maximum score = 90)

$NormVCO_{t0}$ = Current Vegetation/Habitat Condition (before land use change), normalized in the range 0-1 (maximum score = 24)

$NormVCY_{t0}$ = Current Vegetation/Habitat Complexity (before land use change), normalized in the range 0-1 (maximum score = 50)

area in ha_{Y} = Area of land use change in hectares attributed to the *'location of works'* or the *'immediate area of impact'* of the works, as relevant to the site.

The $NBBI_{works}$ was calculated where a site was denoted *'location of works'* and 'remnant' (extant native vegetation, native revegetation and natural regeneration). Proposed native revegetation sites on cleared land (cultivated or pasture) were not included because they were not relevant to estimates of current site condition. The biodiversity significance score was calculated for each site, multiplied by the $\log_{10}$ (location of works, site) and then summed across sites within tender, resulting in the $NBBI_{works}$ score for a tender.

The $NBBI_{influence}$ was calculated where a site was denoted *'immediate area of impact'* of the works and 'remnant' (extant native vegetation, native revegetation and natural regeneration). Revegetation sites on cleared land (cultivated or pasture) were not included because they were not relevant to current site condition. The biodiversity significance score is calculated for each site denoted '*immediate area of impact*' of the works and summed across sites within a tender, resulting in the $NBBI_{influence}$ score for a tender.

The final NBBI score is the sum of $NBBI_{influence}$ and $NBBI_{works}$.

2.2.5.5 Round Two OEBI Calculation

As for NBBI, the weighting of attributes within and between attribute groups for the OEBI was addressed by normalizing scores within each group based on the maximum possible score before calculating final indices. Also for consistency with the NBBI, an area weighting was introduced to the OEBI calculation to take into account the area over which land use change is proposed in a tender, treating the site types differently, viz. *'location of works'* or '*immediate area of impact'* of the works.

As for NBBI, the OEBI calculations used information about vegetation and site types collated through the site assessments. Each site or plot was classified as 'remnant' or 'cleared' for the purpose of this analysis, where 'remnant' denoted extant native vegetation, pre-existing native revegetation or natural regeneration sites. Contrasting with the NBBI, the size of projects which propose native revegetation for sites denoted *'location of works'*, but which were currently cleared, were also included in the OEBI calculations.

The resulting OEBI calculation for Round Two comprised two components, one based on the *'location of works'* and the other based on the *'immediate area of impact'* of the works. The general form of the calculations is:

$$OEBI = OEBI_{works} + OEBI_{influence}$$

$OEBI_{Y}$ = [salinity, water and soil management benefits + other environmental benefits and disturbance] × LOG_{10} (area in ha_{Y})]

Where:

Y = *works* or *influence*

works = *'location of works'* at a site (as relevant to NBBI). Areas < 1 ha are included as 1.1 ha and areas > 10 ha are included as stated.

influence = *'immediate area of impact'* of the works at a site (as relevant to NBBI). Areas < 1 ha are included as 1.1 ha, and areas > 10 ha are included as 10ha.

Where:

$NormSW_{t0}$ = Current salinity, water and soil management, normalized in the range 0-1 (maximum score = 52)

$NormOM_{t0}$ = Current other management and disturbances, normalized in the range 0-1 (maximum score = 44)

area in ha_Y = Area of land use change in hectares attributed to the *'location of works'* or the *'immediate area of impact'* of the works, as relevant to the site.

The $OEBI_{works}$ was calculated for a site denoted '*location of works*' and may comprise vegetation types classified as 'remnant' or 'cleared' for the purpose of this analysis. Remnant types include extant native vegetation, pre-existing native revegetation and natural regeneration sites. Proposed revegetation and other sites of works on cleared land (cultivated or pasture) were also included in these calculations. The OEBI score was calculated for each site, multiplied by the $\log_{10}$ (location of works, site) and then summed across sites within tender, to derive the $OEBI_{works}$ score for a tender.

The $OEBI_{influence}$ was calculated where a site was denoted '*immediate area of impact*' of the works, and may be classified as either 'remnant' or 'cleared' for the purpose of this analysis. Remnant includes extant native vegetation, pre-existing native revegetation and natural regeneration sites. Proposed revegetation and other sites of works on cleared land (cultivated or pasture) were also included in these calculations. The calculations for each site were summed across sites within a tender, resulting in the $OEBI_{influence}$ score for a tender.

The final OEBI score is the sum of $OEBI_{influence}$ and $OEBI_{works}$.

2.2.5.6 Round Two EBI Calculation

Variation in OEBI and NBBI scores attributed to plots within sites and sites within tenders were carried through to the final calculation of the EBI, resulting in average, minimum and maximum scores for a tender. The final EBI scores, were simply the sum of the weighted NBBI and OEBI scores:

$EBI = (NBBI_{works}+NBBI_{influence})* w_1 + (OEBI_{works}+OEBI_{influence})* w_2$

$NBBI_{works}+NBBI_{influence}$ = summed NBBI for the two site-types, summed across all sites for each tender.

$OEBI_{works}+OEBI_{influence}$ = summed OEBI for the two site-types, summed across all sites for each tender.

w_1 = 1.0 for R2 tender evaluation, a weight determined by ALR policy and applied to each tender according to the cumulative value of proposed management actions relevant to NBBI

w_2 = 0.5 for R2 tender evaluation, a weight determined by ALR policy and applied to each tender according to the cumulative value of proposed management actions relevant to OEBI

The particular focus of the ALR was on achieving nature conservation benefits at the landscape scale. However, projects that could show additional benefits for salinity control, waterlogging control and improvement of water quality were sought. The weighting of the OEBI with respect to the NBBI reflected this policy. That is, "other environmental benefits" were treated as half as important as nature conservation benefits in the calculation of the final EBI score for each tender, through the 0.5 weight on the OEBI score.

2.2.5.7 Tender Selection using EBI to Calculate Cost-Benefit

The resulting EBI was primarily used as a preference within the overall SCP process in order to identify the set of tenders for funding which also contributed site-level benefits attributed to biodiversity condition and potentially additional environmental benefits. As part of the research component of the ALR project, a parallel 'dummy' tender evaluation process was undertaken, based solely on the EBI. To undertake this, the tender value ($, bid cost) was divided by the EBI, to give a 'cost per unit of benefit' score. The tenders were then ranked according to increasing cost, and the set of tenders that exhausted the budget were identified, taking into account mutually-exclusive tenders. This was equivalent to the process undertaken by the Victorian BushTender scheme (Stoneham *et al.* 2003). The tender set identified was then compared with that generated by the SCP approach. This comparison of approaches addresses the ALR objective: *how best to evaluate landholder tenders to achieve the highest cumulative environmental benefit at the landscape scale, for a given budget.*

2.2.5.8 Results: NBBI, OEBI and EBI calculations

Round One EBI calculations were completed manually and aggregated at the tender level. The rank order of tender by 'cost per unit of benefit' is shown in Figure 2.5. For Round Two, the rank order of tenders by 'cost per unit of benefit' is shown in Figure 2.6.

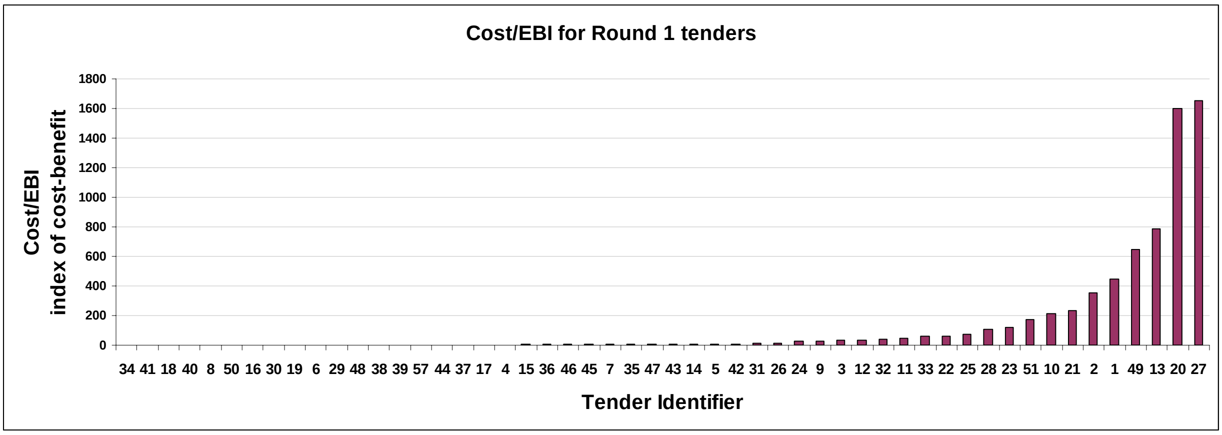


Figure 2.5: Rank order of tenders by 'cost per unit of benefit' based on EBI for ALR Round One.

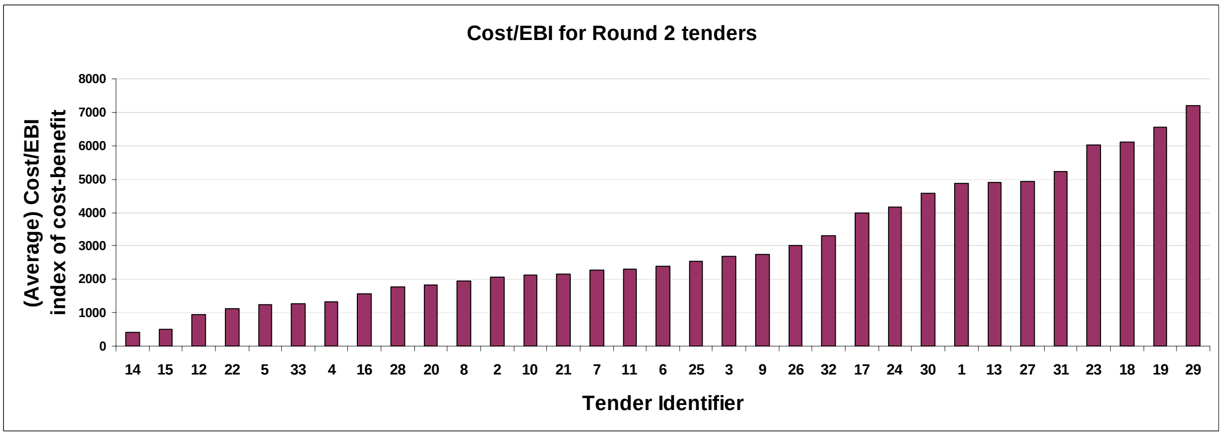


Figure 2.6: Rank order of tenders by 'cost per unit of benefit' based on 'average' EBI for ALR Round Two.

2.2.5.9 Discussion

The difference in the calculation of the EBI between Round One and Round Two meant that the two figures presenting the 'cost per unit benefit' (Figures 2.5 and 2.6) are not comparable numerically, but are comparable with respect to their trends.

In Round One, some scoring difficulties were encountered due to differences between the categories specified by the EBI and the categories observed and recorded through the site assessment procedure. In Round Two these categories were aligned and a revised EBI scoring system was developed (Appendix 7). Other scoring difficulties experienced during Round One related to a lack of data, insufficient data, data of poor quality, and inadequate time to complete the consolidation of data for use in the scoring process. Of particular note, scores for conservation significance attributes were not included. This reduced the total points a tender could expect to score from the NBBI component of the EBI.

In Round Two, allowance for 'null' values in attribute scores prevented the introduction of bias attributed to a lack of information, or where an attribute was inapplicable to a particular site. For example, some vegetation types characteristically do not occur on rocky or stony ground and so scores for rockiness are inapplicable. Also, in Round Two, considering the treatment of conservation significance in the SCP approach, concepts of conservation significance were broadened to include existing State or regional policy for the protection or retention of target vegetation types and catchments. For example, the department of Conservation and Land Management (CALM) undertook an analysis of poorly conserved and potentially threatened vegetation types in the Western Australian wheatbelt (Hopkins, 2000), and promotes conservation management in areas that have some long-term potential for biodiversity maintenance or recovery. 'Potential natural diversity recovery catchments' were designated by experts on the basis of their importance for biodiversity and high level of threat from salinity. The Western Australian Salinity Investment Framework (Department of Environment, 2003) used preliminary results from the recent biological survey of the agricultural area (Harvey and Hopkins, 2000; Hopkins, 2000). Areas were identified because of the presence of representative examples of species (not necessarily yet threatened) that, across their range, are broadly at risk of rising groundwater and associated salinisation. In addition, the Western Australian Salinity Investment Framework (Department of Environment, 2003) delineates landscapes with over 10,000 ha that have 25% or more of their area in natural habitats, that have additional biodiversity assets and are at risk due to rising water tables and associated salinity (Wallace *et al*., 2003b). In order to take these earlier assessments into account, the respective EBI attributes were broadened in scope and redefined as 'site contains remnant vegetation associated with regional biodiversity conservation priority area as identified in State or regional plan or policy' and 'Presence of locally and regionally significant ecological communities (threatened Beard vegetation types) at site'.

The original Native Biodiversity Benefits Index (NBBI) formula comprised two sections, 'Current Points' and 'Potential Points'. The potential points related to an expert estimate of the likely points to accrue from successful implementation of management activities contained in a tender, that is, the land use change that could be reasonably expected to occur over about ten years. The time frame is notional and provides a benchmark for assessing relative change in condition in calculating the land use change impact score (LUCIS, Oliver and Parkes 2003). This score related to vegetation/habitat condition, vegetation/habitat complexity, and conservation significance. The allocation of potential points included an estimate of future benefits likely to accrue from the project as proposed. The expert decision process considered data confidence, practicality (i.e. whether a proposal could actually deliver the type and magnitude of land use change indicated by a points level), and seasonal effects.

In Round One, allocation of points to the 'potential' category for vegetation/habitat condition and complexity proved a challenging exercise, given the need to estimate the likely benefit a given proposed action might have on these attributes after implementation. In several instances this required best estimates based on available data and expert knowledge of on-ground outcomes of standard practice for native vegetation/habitat management. The relative subjectivity of these estimates increased the variation in scores across tenders that proposed such diverse activities as salinity-mitigation through large-scale surface drainage works and site-specific habitat protection programs through local revegetation and fencing projects. In Round Two, the landuse change impact score approach to assessing management benefit (Oliver & Parkes, 2003) was abandoned due to the subjectivity involved and the general lack of a coherent framework for quantitatively estimating the magnitude and trajectory of environmental change for a specific area of land given current condition and proposed management actions (see Section 2.3.2). This pragmatic decision was in part due to inadequate time for the science team to complete reviews of work in progress in other parts of Australia and adapt them for operational use within the ALR. However, completion of spatial data analysis and data management objectives in Round Two enabled accurate calculation of the EBI from observations of current condition derived through site assessments, compared with the difficulties encountered in Round One.

In Round One, experience suggested that allocation of points to OEBI attributes was not accurate. This was due to the absence of suitable data and perceived deficiencies in the collection of site assessment data. The result was either over- or under-estimation of the OEBI scores for specific sites. This problem was overcome in Round Two by more closely aligning site assessment and OEBI scoring procedures and broadening data sourcing to include results from desk top analysis of salinity risk, for example.

2.2.5.10 Learnings

A number of learnings are apparent from the ALR's experience in formulating an EBI for tender evaluation in Western Australia. These include:

- Sufficient time and resources need to be available so that indices can be developed or adapted for local or regional environmental or biodiversity conservation goals;
- Comprehensive testing prior to site assessment and tender evaluation is advisable;
- Requirements for standard but sophisticated spatial analyses of landscape context should not be underestimated;
- Strategies to work within the absence of benchmarking in many regions of Australia need to be considered.

2.2.6 Systematic Conservation Planning and TARGET Software

A key ALR objective has been the comparison of two alternative methods for tender evaluation and selection: the Environmental Benefits Index (EBI) and Systematic Conservation Planning approach (SCP). As the SCP framework has not previously been applied in conservation auctions, the theoretical basis and stages are summarised below.

2.2.6.1 Systematic Conservation Planning

Systematic Conservation Planning is a process or framework for systematically identifying priorities for local conservation management within a regional or landscape context and taking into account the needs of human society. The systematic or stepwise process was first articulated by Margules and Pressey (2000), building on decades of accumulated experience in biodiversity assessment, conservation planning and reserve design. As conservation policy objectives extended beyond reserves to regional sustainability imperatives, the framework likewise evolved or was reiterated with different emphases to address such application requirements (Faith *et al.,* 2003; Margules *et al.,* 2002; Sarkar *et al,*. 2002).

SCP, by definition, is a structured, systematic approach to conservation planning that provides the foundation to ensure regional objectives are met for the representation and persistence of biodiversity, and operates at the scale for which consistent levels of information are available for comparison of sites. Margules and Pressey (2000) defined SCP as a six stage process, noting that the process is not unidirectional, but involves many feedbacks and reasons for revised decisions about priority areas. This was later refined by Sarkar *et al*.(2002) to a 10 stage process as follows:

1. Compilation and assessment of biodiversity data for the region;
2. Identification of biodiversity surrogates for the region;
3. Establishment of conservation targets and goals;
4. Review of existing conservation areas;
5. Prioritisation of new places for potential conservation action;
6. Assessment of the prognosis for biodiversity for each potential targeted place;
7. Refinement of the networks of places targeted for conservation action;
8. Feasibility analysis using multiple criterion synchronisation;
9. Implementation of the conservation plan;
10. Periodic reassessment of the network (and return to stage 1).

It is important to clarify the generic application of SCP as relevant to all forms of biodiversity conservation decision-making that aims to ensure regional representation and persistence of biodiversity. In this sense, Margules and Pressey (2000) frequently replace the term ‘reserve’ with ‘conservation areas’ to reflect the more broadly-based general objective of regional land use planning or management for biodiversity conservation, as distinct from a narrow policy of formal tenure-based protection. The recognition that the appropriate target of conservation is always a local place or network of such places, and that we are unable to conserve all places and must therefore prioritise among a set of potenially equally important places, is a founding principle of the process.

2.2.6.2 Complementarity and Relevance to Conservation Auctions

Because the ALR is concerned with biodiversity protection, tender evaluation can draw on a key principle that promotes efficient use of limited resources in regional biodiversity conservation, that of ‘complementarity’. The complementarity of an area is the marginal gain in biodiversity that it can provide if added to a set of other areas already managed for nature conservation (Vane-Wright *et al.*, 1991; Pressey *et al.*, 1993; Sarkar, 2004). These marginal gains are often compared with alternative land use opportunities (equated with ‘opportunity costs’) when selecting sets of conservation areas (to form part of a conservation area network), in order to achieve regional biodiversity goals at least cost. But as noted by Faith *et al.* (2003; see also Faith, 1997), complementarity may be even more useful for targeting economic instruments, such as conservation contracts, to specific areas. Given bids by landowners, and a budget determining total payments, overall regional biodiversity conservation may be maximised (in combination with other constraints) by comparing each bid amount to the area's current complementarity value. Accepting the bids and developing management contracts for the set of areas identified through the analysis will provide greatest biodiversity benefits at least cost. These complementarity approaches focus on how much an area can contribute to the whole ‘package’, not just on the characteristics of the area on its own. In practice, Faith *et al.* (2003) point out that there may be advantages in replacing this whole-set approach using a computer-based algorithm with a ‘policy-based algorithm’ that evaluates bids over time (as they come in), constantly re-estimating complementarity values of areas and comparing bids to current complementarity values.

2.2.6.3 Defining and Using Biodiversity Surrogates

Surrogates serve as indicators of general biodiversity. No single parameter is capable of capturing all biological features of interest for conservation. The problem of which features to use as biodiversity surrogates is the problem of providing a sufficient measure of biodiversity to prioritise places for conservation management. As noted by Sarkar and Margules (2002), this problem is only partly soluble but whatever solution is obtained, it will have to be used in practice. Theoretical issues of ‘what is to be measured’ (quantification) and practical issues of ‘what data are realistically obtainable’ (estimation) need to be resolved in order to determine choice of surrogate measures for prioritisation.

Sarkar and Margules (2002) discuss the inappropriate use of species richness (the number of species at a place) for place prioritisation, and describe at least five plausible candidates for surrogates that reflect biodiversity composition or diversity of a place. These are:

- Environmental parameter composition;
- Vegetation class or type;
- Species composition;
- Genus or other higher taxon composition;
- Subsets of species composition.

The first two are commonly used simultaneously. Vegetation and environmental datasets have the obvious advantage of being relatively easily accessed, and can be combined either explicitly in a numerical clustering or ordination algorithm, or intuitively to derive ecological classes. However, the empirical question of the relation of these data to species diversity (or other potential true surrogates) is unresolved: it remains a question that is being systematically addressed by various research groups (e.g. Ferrier & Watson, 1997; Ferrier, 2002; Ferrier *et al.*, 2004; Sarkar *et al*., 2005).

Consistent with many similar applications, the choice of estimator surrogate for biodiversity used in the ALR was limited by the availability of suitable data. Species composition or better datasets were not available, limiting the choice to some combination of (1) and (2), above. The best available data in suitable format comprised mapped lithology and vegetation at comparable scales (approx. 1:250,000 or better) for Western Australia.

2.2.6.4 Biodiversity Viability – Probability of Persistence

The notion of viability, persistence or the long-term prognosis for biodiversity is integral to SCP frameworks and reserve or conservation area design (e.g. Margules and Pressey, 2000; Ferrier, 2002; Faith *et al.*, 2003). Conservation areas need to be sufficiently large, well-connected and replicated to provide for the long-term persistence of constituent biodiversity. The problem facing conservation planners is the availability of measures that consistently and reliably account for biodiversity persistence, in the general sense of maintaining viable populations of all biota and of the ecosystem processes that maintain them *in situ*, in the long term. This is an area of developing science.

2.2.6.5 Defining and Choosing Biodiversity Targets

Margules and Pressey (2000) note the need to identify conservation goals for the planning region. Part of this process involves the setting of explicit, quantitative targets for species, vegetation types or other surrogate features chosen to represent biodiversity. Without explicit targets and goals, it would be impossible to assess the success (or failure) of a conservation plan.

2.2.6.6 Place Prioritisation and *TARGET* Software

Sarkar (2004) outlined philosophical and ethical tenets associated with place prioritisation: what is now called ‘place prioritisation’ was called ‘reserve selection’ in the early conservation biology literature. The change in terminology reflects the realisation that designating places as reserves which exclude human habitation is only one of many possible conservation measures that may be implemented (Margules and Pressey 2000).

Software called *TARGET* (Faith and Walker 1996a, 1998, 2002) uses a multi-criteria approach to iteratively compare biodiversity values and costs, and so identify a set of optimal areas based on the rationale that resources for conservation are limited. *TARGET* is a software implementation of the SCP framework, providing for the proper setting of biodiversity in an analysis of costs and benefits that builds on early Australian developments in ‘minimum set’ algorithms (Margules *et al.* 1988; Rebelo and Siegfried 1992; Pressey *et al.* 1993; see also Kirkpatrick 1983).

The data and policy setting associated with selection of tenders in the ALR is ideally suited to an analysis of costs and benefits using appropriate software such as *TARGET*. The software uses information on the biodiversity attributes (species, environment, vegetation types, etc) contained in different geographic areas (polygons, grid cells, properties, etc) to search for sets of areas that represent the biodiversity of the region. The sets may be required to satisfy one or more constraints and/or have minimum cost. Constraints are limited to one at any one time, as *TARGET* does not evaluate true multi-criteria analysis. *TARGET* may evaluate scenarios – for example, the biodiversity gains/losses if an area is added to/deleted from a set of protected areas. The search algorithm selects a set of places in order to balance representation of biodiversity attributes with total cost of the set. Representation of biodiversity attributes is measured by having some kind of nominated target for the representation of each attribute. In the simplest case we may want 10% of the total number of times an attribute occurs in the region to be the level of representation in the set.

TARGET addresses trade-offs, defined in any given analysis by some nominated weight assigned to the costs. The software algorithms are based on iteratively updating complementarity values (as places are ‘selected’) and comparing these values to weighted costs. A place is selected for addition to the set of places if and only if its current complementarity value (contribution to representation targets for biodiversity attributes) exceeds its weighted cost. No additional places are selected if this rule cannot be met. The set is usually initiated in *TARGET* with a partial set of given places – such as existing or nominated conservation areas.

As areas are added to a set, the complementarity value of any area in the current set can go down – some of its attributes may now be contributed by other areas in the set, so its loss-if-deleted value is lower. So, a second critical aspect of *TARGET* algorithms is that areas are removed from the set if their complementarity value now does not exceed the corresponding weighted cost. Thus, the *TARGET* analysis proceeds by iteratively adding and deleting areas until no further places can be added (within budget for costs or within targets for attributes). Variations on the basic algorithm allow the user to interactively impose additions and deletions and ask the software for the single best place to add or delete from a set.

An important special case for *TARGET* analyses is the setting of targets for attributes derived from some nominated overall probability of persistence. Selecting a area can be seen as increasing the probability of persistence for member attributes in that area from some lower base value (say 0.30) to a higher nominated value (say 0.80). A set of area combines together to determine the overall probability of persistence of attributes. The complement of the probability of persistence is the probability of (local) extinction. Of interest is the overall regional probability that an attribute will go extinct everywhere – this is the product of probabilities for individual areas – assuming independence. (It is possible to incorporate spatial or temporal dependencies between areas through external analyses of eological function, connectivity and landscape context, and from site estimates of habitat condition for example: interpreted in terms of probabilities of persistence for an attribute in an area for use in conservation planning tools.)

For these probabilities-based algorithms, the areas not selected for the set still provide some (nominated) baseline probability of persistence (Faith and Walker 1996b; Faith *et al*. 2001c). The probability assigned to a selected area may be lower or higher if membership of the set implies not formal protection, but some partial protection from sympathetic management

(Faith and Walker 1996b). Similarly, probability of persistence for an area may be lowered if subsequent analysis and ground truthing demonstrates that habitat quality (condition) is less than that for comparable, intact sites. As for basic *TARGET* analyses, complementarity values incorporating probability of persistence are iteratively compared to costs.

Through the *TARGET* software, the SCP utilises data in several groups:

- A biodiversity surrogate based on pre-European and current extent of vegetation or habitat types;
- A condition modifier for biodiversity persistence based on probability estimates ;
- Cost modifiers based on opportunity costs and threatening processes;
- Preference or attractiveness modifiers relevant to conservation goals and policies, such as spatial and point data for presence of declared threatened species, threatened ecological communities and significant wetlands;
- Feasibility modifiers or masks based on potential impact (benefit and outcomes) of proposed environmental management, and overall feasibility of on-ground works; and
- Other masks or filters representing constraints on land allocation related to socio-economic factors and pre-existing land use, and in the case of ALR: eligible properties within NEWROC for submitting a tender.

A comprehensive outline of *TARGET* software structure and function is presented in Appendix 11.

2.2.6.7 SCP Application for the ALR Pilot: Methods

As an overview of *TARGET* analyses for this project, the biodiversity surrogate information is summarised as the list and amount in hectares of vegetation by regolith attributes found in each tender location, and so used for dynamic calculations of complementarity values. Some tender locations may be excluded (masked) from analysis based on information about the feasibility of proposed management or other factors, as determined by the Management Appraisal Review Group or the project team. Some areas will have other gains, including presence of threatened species and high EBI scores, and *TARGET* treats these areas as deserving preference, based on a 'look-here-first' algorithm. The term 'preference' has been used interchangeably with 'attractiveness throughout this report. Lastly, bid costs as determined by land holders are used by *TARGET* in a trade-offs framework to find the set of areas - among all possible good sets - that offers maximum biodiversity and other gains within a given budget (i.e. $100,000 per ALR Round).

Nominated places for the SCP analysis were the tender areas from ALR Rounds 1 and 2. The biodiversity content and protection levels (as formal CALM nature reserves) of non-tender areas in the NEWROC project region were taken into account in calculating complementarity, but were masked from selection.

The areas identified in the tenders included known amounts of extant remnant vegetation, pre-existing native revegetation, natural regeneration and proposed projects that included native revegetation on currently cleared land, and remaining areas of cleared land. The location and extent of tender areas derived from the compiled GIS coverage which defined places as '*location of works*' or '*immediate area of impact'* of the works. In Round One, the '*location of works*' or '*immediate area of impact'* of the works were not consistently distinguished and so all areas were treated equally as the tender 'place' for the purpose of evaluation. In Round Two these areas were consistently distinguished and could be treated differently during tender evaluation.

Stage 1: Measure and map biodiversity

Three levels of biodiversity information are applicable to biodiversity conservation planning in the ALR project region:

- Biodiversity surrogates based on landform and vegetation heterogeneity;
- Locations of targeted species, communities and landscapes; and
- On-site evaluation of biodiversity: including observations of vegetation structural type, dominant species and floristic richness; and proximity to areas of high conservation value.

The wheatbelt region of southern Western Australia is characterised by high diversity, endemism and species turnover (Burgman, 1988, Hopper *et al.,* 1996, Wallace *et al.*, 2003a). The challenge for any Systematic Conservation Planning schema applied to this region is the ability to adequately represent biodiversity features at a scale that is comparable to the scale of species turnover. Burgman (1988), for example, found that conservation reserves were needed every 15 kilometres to comprehensively sample plant species diversity in the eastern half of the Roe Botanical District.

The choice of surrogate for the ALR was limited to the availability of spatial datasets for vegetation and regolith types. Pre-European vegetation for WA was compiled from various sources at 1:250,000 by Hopkins *et al.* (2001), based on the classification of J S Beard. The regolith classification for WA was compiled from 1:100,000 to 1:250,000 series geological maps by Geological Survey of Western Australia (ND) and simplified to nine subdivisions. These datasets were combined and used as the pre-European surrogate for assessing biodiversity representation. Supplementary data for locations of target species, communities and landscapes were included as preferences in the selection process. These additional biodiversity conservation features are outlined in Appendix 12.

Systematic biological survey data that would have enabled considerations related to turnover in species composition to be taken into account, were not available to the ALR. In addition, surrogates for estimating biodiversity persistence based on site assessment surveys by CSOs were not fully developed for this application, and were not included in the analysis of tenders, except through the EBI in the manner of preferences.

Stage 2: Setting Conservation Targets for the Project Region

Quantitative conservation targets and goals were required for the project region relevant to the total extent of areas ultimately to be managed for nature conservation values or landscape sustainability. These included targets for representation of each surrogate attribute type (combination of vegetation by lithology); establishing a minimum size of viable habitat (e.g. core area of 40ha); setting design criteria for connectivity (length, width and composition of revegetation corridors); and precise goals for biodiversity criteria other than the representation surrogate. Each of these is considered below:

- Targets for representation of vegetation by lithology types (biodiversity surrogate) were based on regional goals for retention of vegetation cover within whole landscapes to ensure notional maintenance of ecological processes such as climate, soil and hydrology, and retention of viable populations of native species in their normal habitats. A native vegetation cover threshold of 30-50% is recognised as a threshold below which biodiversity decline is evident and local populations of species are at risk of extinction, with 10% vegetation cover being a threshold below which extinctions are rapidly occurring (e.g. McIntyre and Hobbs, 1999, 2000, and discussion in Beecham, 2003). While substantial clearing has occured in the Western Australian Wheatbelt, some representative landscapes of approximately 25% remnant vegetation are extant in NEWROC (Beecham, 2003). Furthermore, the national objectives and targets for biodiversity conservation identifies 30% as a regional goal for retention of native habitats (Environment Australia, 2001a). Conservatively, therefore, the ALR used a regional sustainability goal of 30% for retention of native vegetation cover to define representation targets based on the pre-European extent of biodiversity surrogate types in Western Australia (Faith and Williams, unpublished data). The pre-European biodiversity surrogate was combined with the remnant vegetation coverage to define the location and extent of remnant types. Due to extensive clearing in the West Australian Wheatbelt, this regional goal is unattainable and merely reflects the importance of all remaining areas of habitat able to sustain viable populations and the need to restore areas to improve the quality of habitat to ensure extant populations remain viable.

- Minimal size of viable habitat: focal species work in Western Australia (Parsons *et al.*, 2003; Lambeck, 1997) suggests 40ha as a notional minimal size for effective habitat. Effective habitat was subsequently defined as remnant vegetation within an internal buffer of 30m from the remnant/cleared boundary, based on minimum corridor width recommendations by Frost *et al.* (1999).
- Design criteria for connectivity required spatially explicit criteria such as size, shape, dispersion, isolation distance, time since isolation, habitat structure and composition and analysis of the relative value of potential linkages. Parsons *et al*. (2003) developed a lanscape conservation plan based on the requirements of sedentary bush birds. Spatially explicit models and tools exist but require experimental data, skilled spatial analysts and sufficient time/resources to fully develop the application. These skills/models were not available to the ALR.

Goals for criteria other than the biodiversity surrogate required the use of several datasets for features/biodiversity assets that were included as preferences in the analysis rather than specifically defined targets. They were:

- Threatened or priority flora and fauna;
- Threatened or priority ecological communities;
- Mapping indicators of species assemblages associated with significant habitat types (granite/other rock assemblages, naturally saline and clay pan habitats);
- Significant wetlands and surface hydrology mapping;
- Poorly conserved and potentially threatened Beard vegetation types (based on criteria: comprehensive, adequate and representative and salinity risk);
- Potential natural diversity recovery catchments (priority landscapes threatened with salinity); and
- Representative (target) landscapes.

Stage 3: Review of Existing Conservation Areas

Protected area tenure has often been used as an indicator of effective conservation management, and consequently the level of protection ensuring persistence of biodiversity. Unless information states otherwise, biodiversity types in protected areas managed for nature conservation values were considered to have the highest probability of persistence. For the ALR, the SCP analysis used protection levels based on existing CALM-managed lands. The location of nature conservation covenants represents areas where partial biodiversity protection might be taken into account, but this information was not available to the ALR.

Within NEWROC there is approximately 37,000ha remnant vegetation within 49 nature conservation reserves, of which Karroun Hill Nature Reserve, Walyahmoning Nature Reserve, and Lake Campion Nature Reserve are the most extensive. Most land is privately owned. Many of the CALM Nature Reserves in the wheatbelt are small areas opportunistically captured into the conservation area network. Although the persistence of biodiversity in many of the smaller areas is doubtful, especially where secondary salinisation is evident, the SCP analysis assumed all biodiversity in CALM managed lands was viable in the long-term. An analysis of the extent to which conservation targets are met by the existing set of conservation areas was undertaken using the pre-European biodiversity surrogate for

Western Australia. As a consequence the target for some biodiversity types in NEWROC was reduced.

In Round Two, areas selected for voluntary management contracts in Round One were included in the initial selected set, and the Round Two analysis sought to select areas which best complemented the existing set.

Calculation of Ecosystems Targets for NEWROC

The area-based percentage targets for the ALR biodiversity conservation surrogate (notionally comprising many ecosystem types) were derived from calculations based on the biogeographic theory of the species-area relationship. The rationale of this approach is that we must make minimal assumptions and acknowledge that for these ecosystem types we do not know relative species richness and do not know how much different ecosystem types overlap in their species. Under these, not uncommon, real-world conditions it makes sense to conservatively assume that each type is equally species rich. Further, we can focus on strategies that would pick up a maximum number of the species endemic to each ecosystem type – we simply assume that, given equal richness, the types will also offer equal numbers of endemics – this leads us to maximise the number of species sampled for each type. This is where the species area curves play a major role. An ecosystem type that is limited in extent (small-area type) has a steeper species-area curve than a large-area type – and when we calculate some proportion of species that we want sampled (the ‘species goal’; say 50%) it turns out that the curve dictates that the smaller-area type will deserve to have a greater proportion of its total extent sampled. For example, a 50% species goal is 50,000 species, assuming a maximum richness of 100,000 species within an ecosystem. This species goal is the parameter that was varied in determining the area-based targets for each ecosystem type. Indeed every ecosystem type gets a different percentage-of-area in this way, reflecting its different total area. The analysis is thus individually based on the area-extent of each ecosystem type.

Thus, we assumed that each ecosystem type (vegetation by lithology combination) has the same chance of contributing endemic species, and that each type has equal species richness, and that the log-log relationship for the species-area curve is a reasonable empirical approximation to a straight line.

The number of species (whole of biodiversity) was assumed to be 100,000 within each type, with an intercept for the species area curve in each case of 1000 species – this is more or less an assumption about how many species might exist in a single small plot. Again, this means that small total-area ecosystem types should have a higher proportion of area-representation.

Note that the sum of the area amounts for each ecosystem type adds up to some total for the study region. If the species goal is 50%, this total area might be say 8% of the study region. But we may wish to adjust the species goal (e.g. the 50% value) to make this overall regional coverage summed across the areas targeted for each ecosystem type to come out at, say, 30% of total area, This is termed the “regional goal”. The new species goal for representing ecosystems up to a total area of 30% of Western Australia turns out to be 74.4%, for this example.

Several such regional goals of, say, 10%, 20%, 30%, etc can be evaluated to generate ecosystem targets for the conservation scenarios of interest. These regional goals are percentages of the total area of the NEWROC study region (intensive and extensive land use zones).

In order to calculate the area-based percentage targets for Western Australian ecosystems types, the proportion of species to be represented (species goal) was varied until the summed total area across all habitat types in the NEWROC equalled the regional goal of 30%.

Taking into account the contributions to protection of some of these ecosystem types throughout Western Australia, the summed pre-European extent of ecosystem targets in the

NEWROC account for 22.8% of the area[2]. Adjusted for current levels of protection these areas were used as the ecosystem targets for the biodiversity surrogate in the *TARGET* analysis of Round Two tenders in the Auction for Landscape Recovery pilot.

Note: Detailed results of the analysis of area-based targets for the biodiversity surrogate occurrences in NEWROC are available from the authors on request.

Stage 4: Tool for Selecting Additional Conservation Areas

The *TARGET* software provided a structured framework for selecting conservation priority areas. Tables of data and information were sequentially utilised in the following groups:

- Biodiversity surrogate features – the distribution and extent of different types of biodiversity (*combinations* of vegetation and lithology types for Western Australia).
- Areas for selection – locations of tender areas available for selection were defined through ALR Round One and Two submissions and site assessments, and were included in the analysis along with lumped areas for all other locations within NEWROC.
- Target parameters – the conservation planning goals and percentage targets for biodiversity representation were defined in accordance with the empirical theory of species-area relationships, adjusted by existing levels of protection.
- Condition modifiers – condition scores affect the expected probability of (biodiversity) persistence and influence or modify the complementarity value. Here, condition modifiers are primarily defined in *TARGET* by parameters relating to probability of persistence. An important issue arising for candidate areas in the ALR is how 'condition' modifiers, which were compiled through the site assessment process and are specific to individual candidate areas, were to be used in tender evaluation. This is an area of developing science integral to SCP, and while analyses were scoped, these could not be completed within the operational timeframe of the project.
- Opportunity cost – the dollar value of the bid nominated by the landholder was considered the opportunity cost of conservation associated with each tender. These are the costs weighted against complementarity values in the *TARGET* trade-off analysis. Complementarity values are iteratively updated as places are selected, and selection continues until the budget is spent.
- Attractiveness modifiers – these are attribute scores that influence or reduce cost in the multi-criteria analysis. Features such as threatened species or adjacency to existing protected areas have negative effects on cost (representing additional benefits in selecting the area). These modifiers were incorporated in *TARGET* using the preferences approach - all else being equal, attractiveness modifiers are a positive preference. A conservative approach to weighting of preferences was implemented. Once a preference threshold is established and similar features aggregated, preference attributes were weighted either 1 or 0.
- Avoidance modifiers – these are attribute scores that influence or increase cost in the multi-criteria analysis. Threatening processes such as salinity hazard may be equated with opportunity costs (increasing the cost to conservation planners of selecting the area). Often these modifiers were treated in *TARGET* via the preferences approach, as areas to be avoided or, all else being equal, a negative preference. Conservation priority areas such as potential recovery catchments (Department of Environment,

---

[2] Note: Detailed results of the analysis of area-based targets for the biodiversity surrogate occurrences in NEWROC are available from the authors on request.

2003) enabled these to be treated as positive preferences in the SCP analysis, aggregated with the attractiveness modifiers, above.

- Feasibility (masks or filters) – feasibility scores act as a mask or threshold or constraint for the availability of the area to be included in the analysis. Constraints related to land allocation rules and the goals of the conservation planning process in which only the tender areas were available for selection; all other areas were included in the analysis but masked from selection. An additional constraint on selection of tender areas was the feasibility of proposals for on ground management: infeasible projects were masked from analysis. If additional criteria arise, they can be peer-reviewed, made explicit, and appropriately included in the analysis in one of the above categories.

The *TARGET* analysis acknowledged that there exists a multitude of equally possible and logical solutions. Of the possible solutions, the 'preferences method' aimed to find a solution that also satisfied the subsidiary criteria. To achieve this solution, some iterative analysis was required to determine appropriate thresholds for preferences and the weighting on cost. The objective was to look for alternative sets that met the main criteria (complementarity) and look for additional sets that approximated the same solution for the subsidiary criteria. Preferences enabled these alternative solutions to be explored.

Several input tables and files were needed to run the *TARGET* analysis, based on the groupings of data described above. These files and tables are outlined in Appendix 11.

Stage 5: Prioritize new places for potential conservation action

The objective of prioritisation was to select those tenders that contributed most to the biodiversity targets and conservation goals for the given budget ($100,000), while taking into account the feasibility and relative benefit of management actions. This restricted the selection to only those areas nominated in a tender and all areas within a tender were treated as a single unit. The limited budget for selection of sites (tenders) and the regional sustainability goal of 30% for retention of vegetation cover in the landscape relative to the extent of clearing meant that the prioritisation process measured the trend toward achievement of targets, rather than the achievement of targets *per se*.

TARGET scenarios

Several target scenarios were developed and tested in each round. The first scenario was described as a benchmarking scenario in which all tenders were included in a preliminary analysis, irrespective of feasibility, preferences, mutual exclusivity and budget. This provided a reference point for the maximum potential gain in biodiversity irrespective of tender feasibility and other constraints. The relative complementarity contribution among tenders, given that already committed in existing reserves, provides a basis for feedback on biodiversity value without identifying cost of management. Subsequent scenarios provide additional information on cost-benefit of tenders relevant to landholder feedback.

The second scenario tested the best among the feasible set of tenders, incorporating masks on tenders with management actions considered infeasible or doubtful according to the process established for the Management Appraisal Review Group.

Some (multiple) tenders submitted by the same landholder were complementary across adjacent areas of land and were not mutually exclusive, while others were mutually exclusive. Initial reviews of tenders identified the best among mutually-exclusive sets of tenders derived from joint or multiple tenders. Some tenders, however, were equivalent in current biodiversity values and only differed by their proposed management. In such cases, decisions about which tender to choose required critical review of management actions proposed in each tender. An expert decision process, utilising expertise within the ALR team, identified cost-benefit among competing tenders, or validated selected sets identified through a *TARGET* scenario.

For joint tenders, a 'dummy' tender was created to encompass the combination of works and costs of the associated tenders. The joint 'dummy' tender was subsequently treated as mutually exclusive with the source tenders. Joint tenders were an ALR mechanism to encourage collaboration between landholders who share an interest in an asset. For tender evaluation purposes, however, a 'dummy' tender could apply to landholders who might share an interest in an area of remnant bushland across property boundaries, or a landholder who submitted multiple bids with complementary 'location of works'. The determination of joint tenders required detailed review of the spatial location and nature of proposed works, as these were not necessarily explicit in tender submissions.

Although landholders were asked to indicate if their tender were mutually exclusive, it was often the case that this question was not consistently or correctly answered. The respondents' answers were therefore reviewed along with all tenders to assess where management actions might occur across mutually exclusive locations or be complementary.

2.2.6.8 SCP Application for the ALR Pilot: Results

The extent of vegetation across different tenures in the NEWROC study area, compared with the amounts available in the Round Two tenders, is shown in Table 2.4. There is at least 41% of pre-European native vegetation remaining in the NEWROC, largely occurring in the extensive land use zone to the north. For the purpose of analysis, the study area included the amount of vegetation in the Extensive Land Use zone, to account for complementarity among biodiversity features between zones. Eligible tenders were only accepted from the intensive land use zone.

Table 2.4: Vegetation extent by tenures in the NEWROC study area, including amount of native vegetation in Round Two tenders by site type (Area of Works = '*location of works*'; Area of Influence = '*immediate area of impact*' of the works)

		Area in Hectares					
		Broad Land Classification					Grand Total
Vegetation status	Site Type	CALM reserve	Other Crown reserves	Other freehold	Unallocated crown land	Unmanaged reserves	
Cleared or non-woody	Other non-tender	20757	7394	1837189	32724	16612	1914676
	Area of influence	4	93	370	355	8	831
	Area of works		19	8448	0	8	8475
Cleared Total		20762	7506	1846007	33079	16629	1923982
Remnant, woody	Other non-tender	374278	20405	563948	329098	18667	1306395
	Area of influence	4	249	1165	2259	51	3727
	Area of works		3	1449	0	0	1452
Vegetation Total		374281	20656	566561	331357	18718	1311574
Grand Total		395043	28162	2412568	364437	35346	3235556

ALR Round One

The biodiversity surrogate (vegetation by lithology combinations) used in the Round One SCP application was only available for the NEWROC study area. A baseline representation target of 10% for the extent of each biodiversity surrogate type was used. The Round One budget for funded projects was $100,000.

Two sets of tenders were considered mutually exclusive in Round One. These had management actions in common over part of the same location or offered a series of increasingly comprehensive management actions for the same location.

Several sets of tenders were determined to have complementary management over part of the same locations. For example, two tenders were associated with the same sites, one aiming to control salinity and water logging, and the second to fence and revegetate remnants. In Round One, each of these potential joint tenders with overlapping locations were included as separate tenders in the *TARGET* scenarios. The creation of a 'dummy' tender which properly combines the complementary contribution of such paired proposals was introduced in Round Two.

Revegetation projects required special consideration with respect to their contribution to regional biodiversity (potential recovered biodiversity complementarity value). In Round One, a *TARGET* revegetation scenario was created which treated project areas for native revegetation as equivalent in value to remnant of the same type. This scenario assumed the future success of proposed management actions for native revegetation. Complementarity was not recovered from sites that proposed to establish oil mallee plantation, for example. Such projects potentially contribute salinity, soil and water logging management benefits; values for which were incorporated through preference for high Environmental Benefits Index.

For each of these native revegetation sites, additional parameters for isolation (distance in metres from existing remnants with >40 ha core area), size of revegetation project (area in hectares) and minimum width (in metres) of revegetation area (or core area using 30m edge buffer) were defined. These parameters were incorporated as preferences in the *TARGET* 'revegetation' scenario.

TARGET was used to evaluate two different scenarios – one based on remnant (and regenerating) vegetation associated with each tender and one that also included native revegetation projects. The final analyses focused on the feasible set of tenders defined through Management Appraisal Review Group, with consideration given to high EBI score. Other scenarios were conducted to evaluate the sensitivity of the *TARGET* analysis to preferences, including with or without the EBI scores or with a 'greedy' weighting on the EBI scores. For each set of analyses, we used current protected areas to initiate the analysis and constructed estimated trade-offs curves through successive *TARGET* runs, varying the weights assigned to costs.

The results for Round One are presented in Table 2.5 and Figure 2.7 as six *TARGET* scenarios of biodiversity/cost trade-off curves. Each scenario is based on a different analysis of the tenders. Trade-off curves are created by varying the weights assigned to the costs. The point at which a trade-off curve exceeds the budget of $100,000 is shown by points to the right of the vertical line. The object of the *TARGET* analysis is to minimise 'distance from biodiversity target' while minimising cost or not exceeding the budget.

Table 2.5: Results of *TARGET* scenarios for Round One Tender Evaluation, by scenario 'series' shown in Figure 2.7.

Scenario	*TARGET* Code	$AUD cost	Complementarity (distance from biodiversity target, D)	OEBI & NBBI scores		Number of tenders selected	Series in Figure 2.7
Remnant vegetation, all 56 tenders, no preferences, no feasibility constraints, no EBI weight	9	99433	589219	170.9	67,396	10	6
	10	106453	587579				6

Scenario	*TARGET* Code	$AUD cost	Complementarity (distance from biodiversity target, D)	OEBI & NBBI scores		Number of tenders selected	Series in Figure 2.7
Remnant vegetation, feasible set 56 tenders, preferences included, no feasibility constraints, no EBI weight	11	67833	609256				2
	17	82233	602697				2
	18	87233	601399				2
	24	94253	599759				2
	27	96253	599306	137	55,192	8	2
	26	126253	592478				2
	25	128253	592025				2
Remnant vegetation, *feasible set of 32 tenders*, preferences included, no EBI weight	31	73093	617778				1
	32	78093	616411				1
	33	83093	615113				1
	34	90113	613473				1
	35	97613	611788	174.9	40,835	10	1
EBI driven – ‘greedy’ EBI weight	28	104,570	663774				3
Remnant and revegetation, all 56 tenders, no preferences, no feasibility constraints, no EBI weight	40	48110	627869				4
	41	55310	615873				4
	42	77693	588099				4
	43	92033	571996				4
	44	99053	565896	201.9	56,419	12	4
Remnant and revegetation, *feasible set of 32 tenders*, preferences included, no EBI weight	45	63693	613786				5
	46	65693	611663				5
	48	78258	601739				5
	50	88673	596532				5
	51	99673	596516	199.4	31,684	13	5
	49	103073	590054			13	5
Other revegetation scenarios with weight on EBI	19			EBI threshold, does not improve solution ~$73,000, could not find $100,000 solutions - $126,000 jump)			

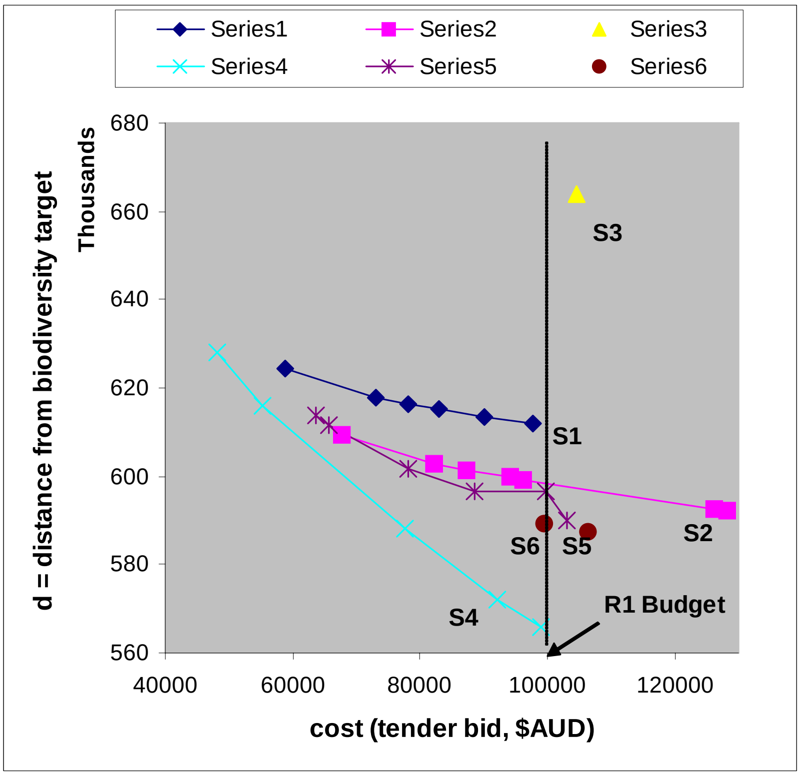


Figure 2.7: Round One tender evaluation. Biodiversity/cost trade-off curves for five *TARGET* scenarios and a budget of $100,000. The selected scenario was series 5 (> $100,000 cost, minus three infeasible tenders). Descriptions for each series are given in Table 2.5

There were three alternative trade-off analyses: one was driven by the complementarity values of remnant vegetation (series 6, 2, 1 in Figure 2.7), one driven by the EBI (series 3 in Figure 2.7) and the other incorporating revegetation projects along with remnant vegetation in the calculation of complementarity (series 4, 5 in Figure 2.7). Within the remnant and remnant plus revegetation alternatives, benchmarking scenarios (series 6 and 4, respectively) were used to demonstrate the potential cost/benefit that could be achieved if all tenders were considered feasible and in the absence of weighting due to preferences.

ALR Round Two

The Western Australian extent of the biodiversity surrogate (vegetation by lithology combinations) was used in the Round Two SCP analysis to calculate the percentage targets for each surrogate attribute taking existing protection into account for a regional goal of 30% vegetation cover. The NEWROC extent was subsequently used as the context for analysis of biodiversity complementarity.

Nine tenders selected from Round One that proceeded to conservation management contracts were incorporated in the Round Two analysis as areas already committed to conservation and contributing complementarity. One tender selected for Round One funding was not included as it did not lead to a management contract.

The budget for Round Two was $108,887. This comprised the original budget of $100,000 plus $8,887 unexpended funds from Round One.

Prior to evaluation, the Management Appraisal Review Group, an independent reference group comprising scientists, land managers and landholders assessed the feasibility of proposed works. Three tenders were subsequently masked from all *TARGET* scenarios except the benchmarking scenario which included all tenders irrespective of feasibility. Outstanding questions remained about the benefit of proposed works for several other tenders. These were considered feasible but questionable and subject to further review if selected.

The steps in the *TARGET* scenarios were: 1) include all tenders in benchmark analyses, 2) mask infeasible tenders in subsequent analyses, 3) review questionable tenders if selected; 4) iterate analysis to search for best tenders and review selected set until all questions about tenders are satisfied and costs are within budget.

Six pairs of tenders were determined to be mutually exclusive. In the *TARGET* scenarios, the possibility that tenders with complementary works that share one or more locations (either '*location of works*' or '*immediate area of impact'* of the works) could both be selected was tested. A 'dummy' tender was created for such pairs of tenders with complementary works, to avoid replicating complementarity values of shared locations. The combined tenders were consistent with landholders' intent in configuring and submitting individual tenders. If one of the tenders combined to form a dummy tender is infeasible or masked for particular reasons in a *TARGET* scenario, then the dummy tender is also treated as infeasible or masked.

A pragmatic approach to dealing with pairs of mutually exclusive tenders was devised that explores scenarios of pair-wise combinatorial possibilities, if mutually exclusive tenders are selected, as follows:

- Include the mutually exclusive tenders in the initial scenario and determine whether any have been selected in the final set.
- If one or sets of mutually exclusive tenders are included in a selected set, carry out iterative analyses where one is removed (constrained by applying a mask to that tender in subsequent scenarios) and the evaluation is rerun, and the best tender is selected.
- Test for best tenders until no mutually exclusive cases are included in the final selected set.

A more comprehensive and complete assessment of the site level outcomes with respect to future condition of the land and native habitats given current condition and particular management actions over a specified time frame was identified as fundamental to tender evaluation. However, it was not possible to implement this strategy for Round Two. This remains a research question. A pragmatic approach to updating the information in tenders, was identified:

- Identify cleared areas within tenders that appear as 'cleared' areas based on vegetation extent mapped for the intensive land use zone (woody type), but were identified as extant vegetation based on field assessment and aerial photography. Label these areas as 'remnant' for the purpose of contributing biodiversity complementarity (representation) in the *TARGET* scenarios.
- Identify areas of extant native revegetation and natural regeneration based on field assessment (annotated in site assessment database) and label these areas as 'remnant' for the purpose of contributing biodiversity complementarity (representation) in the *TARGET* scenarios.

In contrast to Round One, a revegetation scenario in which proposed areas of revegetation (currently cleared) were tested for their potential complementarity contributions was not conducted. Instead, Round Two ensured adjacent remnants likely to benefit from the management plan—'*immediate area of impact'* of works—were incorporated into areas identified for the tender and a qualitative assessment of likely short- and long-term management benefit (environmental outcomes) attributed to the works was conducted.

Some questions remained with respect to tenders associated with high salinity risk or small and isolated remnants (e.g. less than 40 ha and greater than 1 km from nearest remnant of more than 40 ha). Some attributes of landscape context were developed through the site assessment process with potential application in the context of *probability of persistence*. However, direct estimates of *probability of persistence* with respect to current condition of remnants or potential condition following successful undertaking of management actions proposed in a tender, were not adequately developed to enable implementation in the Round Two *TARGET* analysis. These questions were addressed within the project team through the process of management benefit analysis (Section 2.3.2).

The results of the benchmarking ('add-best') scenario including each tender is shown in Figures 2.8 and 2.9. Nine tenders selected from Round One were included (committed) at the start of the scenario. Mutually exclusive tenders were included even though they replicate biodiversity. The dummy tenders were excluded from this scenario.

Figures 2.8 and 2.9 present the results from one *TARGET* scenario. Figure 2.8 shows the stepwise addition of each 'best' tender to the selected set until a stopping condition is met. In this case, the stopping condition was the availability of locations for selection that reduce the distance to the biodiversity target. The order in which locations were selected and added to the set are listed with the title of the figure as the 'members'. All locations available for selection were included. Although this scenario is presented as a trade-off curve, costs did not contribute to the selection order as the weight on costs; the '*b*-weight' parameter shown in title of Figure 2.8 was set to zero. Because of the need to take into account mutually exclusive tenders, some attribute areas were slightly inflated. The effect on distance to target is negligible because of the relatively small areas involved compared to the size of the NEWROC study area.

Figure 2.9 supplements Figure 2.8 by showing the 'scree plot' for the reduction in distance to biodiversity target as additional members (tenders) are added to the selected set. Both plots arise from the same *TARGET* scenario.

Table 2.6 presents the summed attribute values relevant to the benchmarking scenario. These exceed the maximum values possible because mutually exclusive tenders were included.

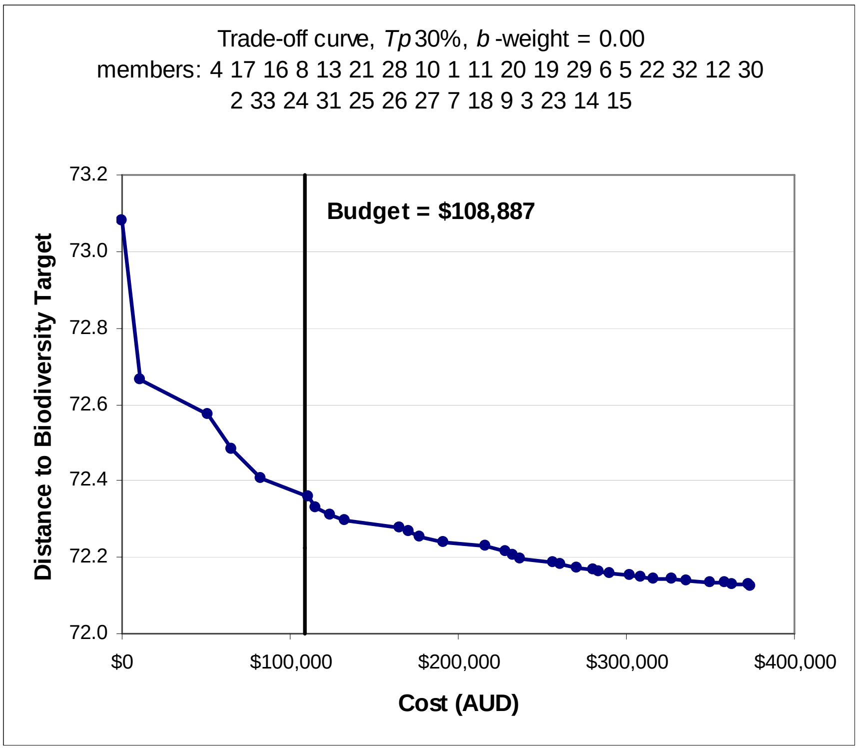


Figure 2.8: Trade-off curve for successively selected tenders based on 'add-best' scenario using nil weight on cost, b = 0.0. Nine tenders selected from Round One were included (committed) at the start of the scenario. Mutually exclusive tenders were included even though they replicate biodiversity. Dummy tenders were excluded.

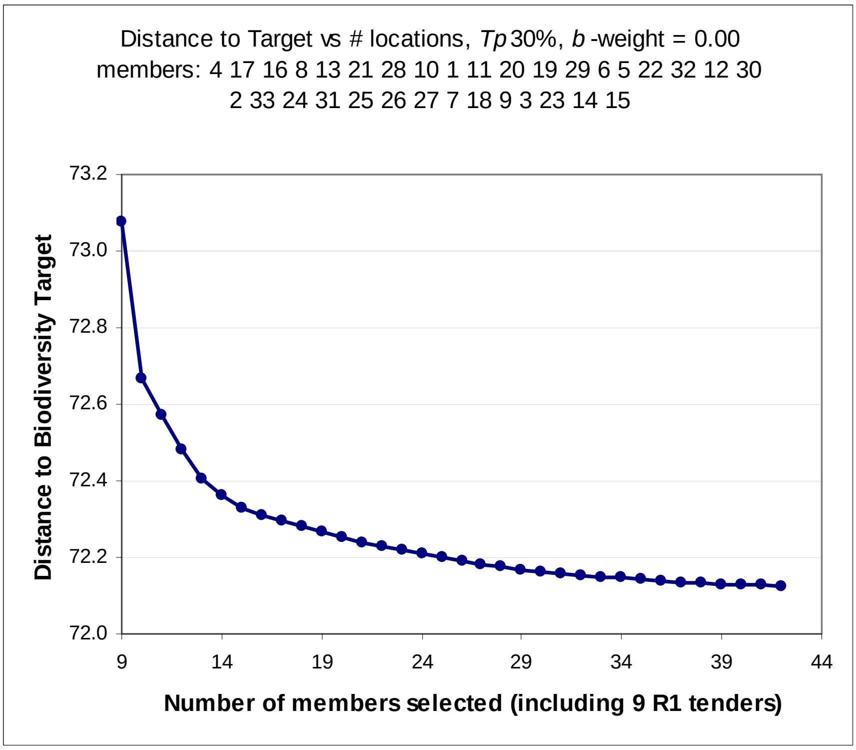


Figure 2.9: Distance to target versus number of locations for successively selected tenders based on 'add-best' scenario using nil weight on cost, b = 0.0. Nine tenders selected from Round One were included (committed) at the start of the scenario. Mutually exclusive tenders were included even though they replicate biodiversity. Dummy tenders were excluded.

Table 2.6: Attribute summary for locations on select list for Scenarios 1a and 1b: Tenders 1-33 (cost = $374,142). MASK: 34 35 36 37 38 854 (dummy tenders).

	Biodiversity Conservation Features	Values	Environmental Benefit Index	Values	Management Benefit Scores	Values
1	Total number of tenders adjacent to CALM nature reserve	1	Total area in Hectares	14068.6 81	Sum of management benefit scores	133
2	Total number of tenders associated with granite or rock outcrops in reasonable condition	6	Total area attributed to '*immediate area of impact'* of the works (hectares)	4672.45	Sum of confidence scores relevant to management benefit	39.833
3	Total number of tenders associated with threatened fauna or declared flora	8	Total area attributed to '*location of works*' (hectares)	9510.57	Sum of total number of activities with management benefit	133
4	Total number of tenders associated with threatened vegetation association	4	Total area used in the calculation of the NBBI score	5412.47	Sum of 10 years management benefit scores	42
5	Total number of tenders associated	21	Total area used in the calculation of the OEBI	11209.4 72	Sum of confidence scores relevant to 10 years	48

	Biodiversity Conservation Features	Values	Environmental Benefit Index	Values	Management Benefit Scores	Values
	with 'at risk' vegetation association		score		management benefit	
6	Total number of tenders associated with a target (representative) landscape	6	Sum of Average NBBI score	89.67	Sum of total number of activities with 10-years management benefit	45
7	Total number of tenders associated with a potential recovery catchment	9	Sum of minimum NBBI score	77.4		
8	Total number of tenders with remnant > 40 ha (core habitat) in reasonable proximity	12	Sum of maximum NBBI score	104.69		
9	Total number of tenders with wetland feature in reasonable condition	14	Sum of average OEBI score	73.69		
10	Total number of tenders in this set	33	Sum of minimum OEBI score	73.6		
11	Total number of tenders interested in conservation covenant	2	Sum of maximum OEBI score	76.11		
12	Total number of tenders interested in voluntary management agreements	22	Sum of average EBI score	126.55		
13	Total number of biodiversity conservation features included	138	Sum of minimum EBI score	114.15		
14	Total costs for selected set of tenders	374142	Sum of maximum EBI score	144.62		

The final analysis of tenders required that decisions be made about the best choice among mutually exclusive tenders. Iterative analyses incorporated professional judgment in the final evaluation of preferred tenders, where appropriate. Selection among mutually exclusive tenders, in particular, required close scrutiny. Preferred tenders were identified to facilitate decision points in the final *TARGET* analysis.

Decision criteria and final TARGET solutions for Round Two

The decision criteria used for the final *TARGET* scenarios proceeded as follows:

- Mask infeasible and data deficient tenders in all scenarios.
- R1 tenders included as committed set in all scenarios.

- Identify the point at which location 854 enters the analysis and then masked in subsequent scenarios. Dummy duplicate tender 17 with real cost estimates (location 854) is included as a test for cost-benefit.
- Initially iterate through one decision point at a time.
- If both of a mutually exclusive pair of tenders is selected under budget, retain the preferred tender and mask the other. If no specific preference exists among mutually exclusive tenders, split the *TARGET* scenarios and proceed through each as separate analyses.
- If both of a complementary pair of tenders sharing a location are selected, replace with their dummy tender which combines cost-benefit values of the subsidiary tenders. If the combined tender is not selected, split the *TARGET* scenarios and proceed through each as separate analyses while iteratively testing for the solution in which both tenders might be included; in which case the split scenarios coalesce.
- Consult with the evaluation team about validity of decision criteria at each step. The project team subsequently identified dubious tenders in which relatively large '*immediate area of impact'* of the works appeared to cause selection bias, and requested test masking of either or both. Split *TARGET* scenarios evaluated these cases.
- During iterations, check for a better solution associated with a next best tender just over-budget.
- As solution approaches budget, successively mask over-budget tenders until an alternative tender is achieved under budget, or no further tenders are available for selection.
- Iterate solutions or restart *TARGET* scenarios to ensure all criteria have been appropriately considered..
- Report final solutions for critical review by evaluation committee. Compile *TARGET* diagnostics, present results in tables and figures. If changes are required or a tender is excluded, restart the analysis.

Subsequent to the analysis, one of the tenders in the final set was withdrawn by the landholder. As this tender was selected in every final solution, the scenario steps were rerun. Marginal choice between two approximately equal, under-budget solutions occurred around the alternative inclusion of two tenders. The decision as to which solution is 'best' required comparative review of site condition from field assessments and proposed farm management.

The *TARGET* scenario decision trees used for the full set of tenders and the subsequent set of tenders before and after the selected tender was withdrawn are shown in Figures 2.10 and 2.11. The relative position in terms of cost-benefit of the final solution for each scenario is presented in Figure 2.12. The funded solution is shown as a triangle, other solutions are shown as filled circles. The later selection steps in these runs are compared in Figure 2.13. The funded scenario is approximately half-way between the other scenarios. The trade-off curve and 'distance to target' versus number of locations for successively selected tenders for the funded solution are presented in Figure 2.14a and 2.14b. The attribute summary for the funded solution is presented in Table 2.7

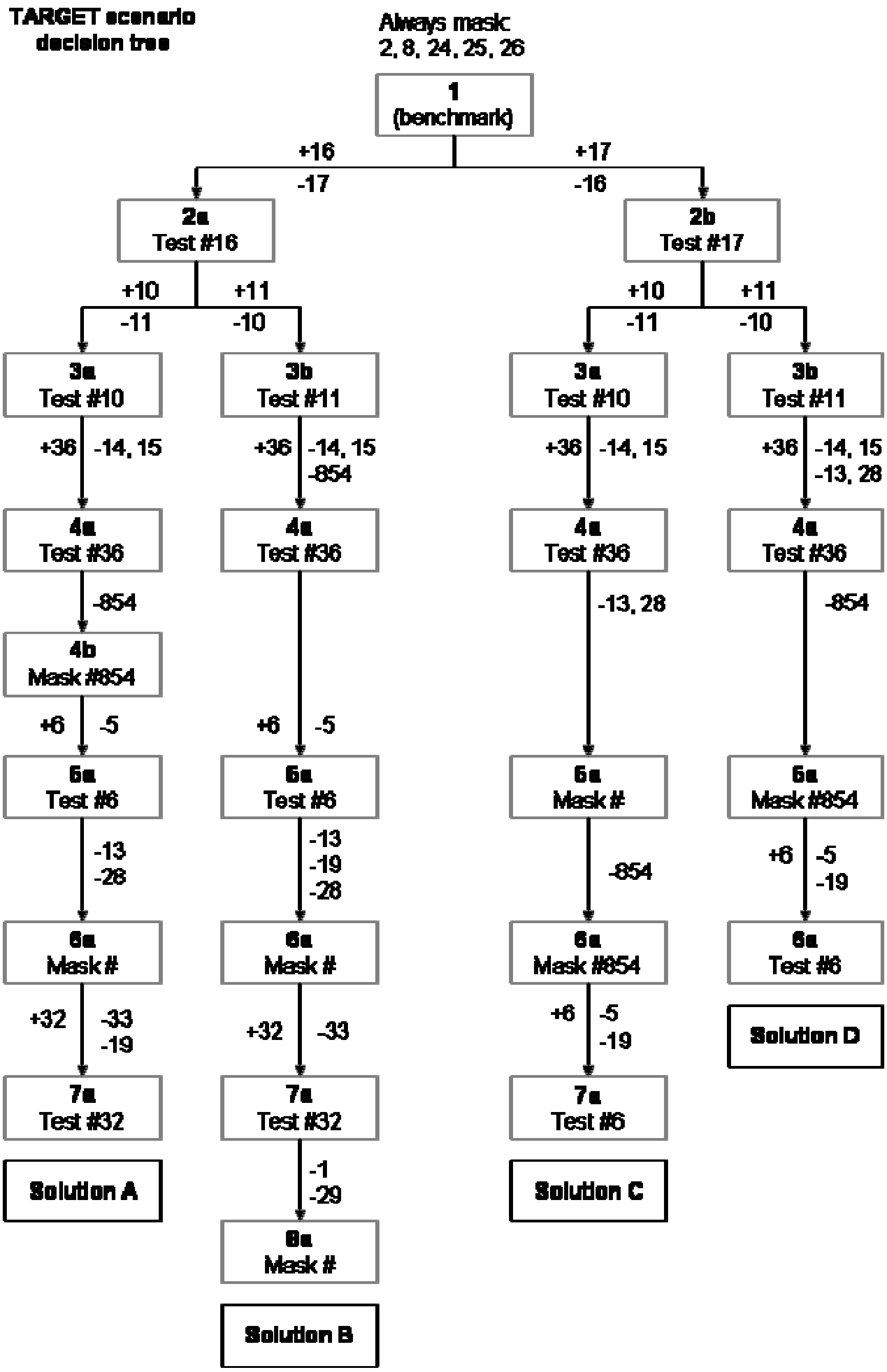


Figure 2.10: *TARGET* scenario decision tree used to evaluate the full set of tenders.

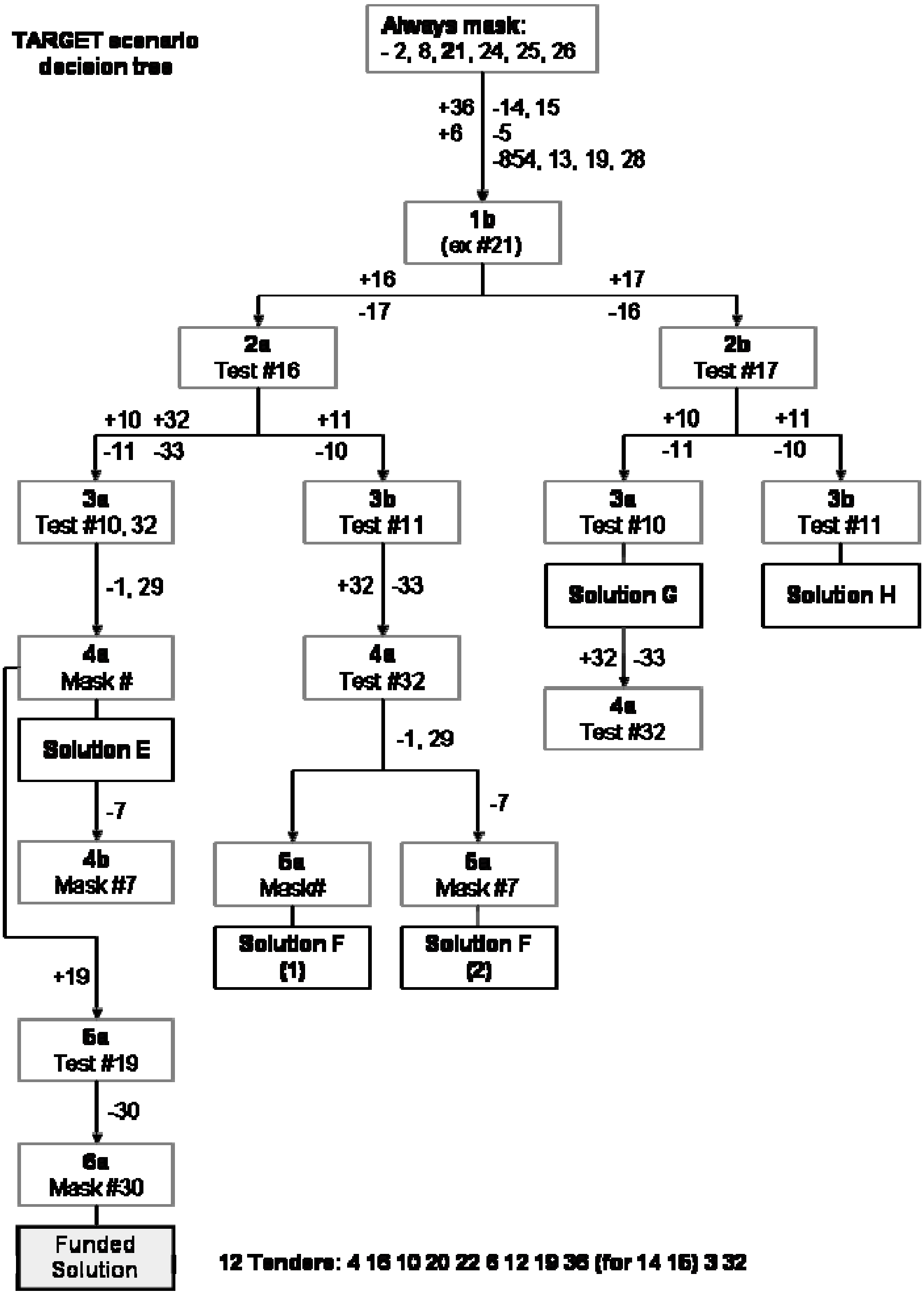


Figure 2.11: *TARGET* scenario decision tree used to evaluate the set of tenders following withdrawal of tender 21 by the landholder after selection.

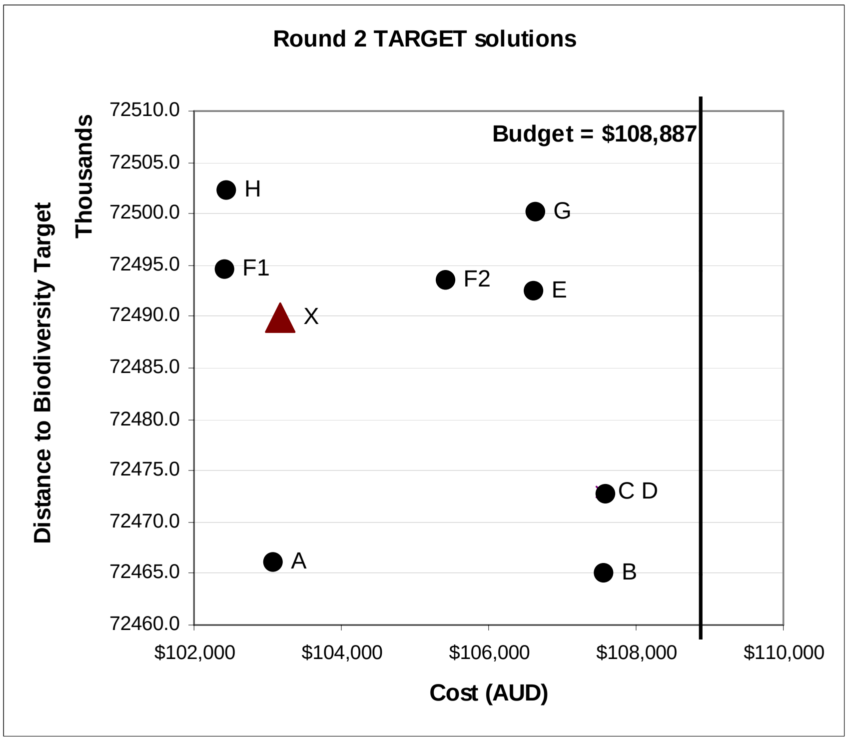


Figure 2.12: The relative position in terms of cost-benefit of the final solution for each *TARGET* scenario. The funded scenario is shown as a triangle. The Y-axis values are scaled for convenience.

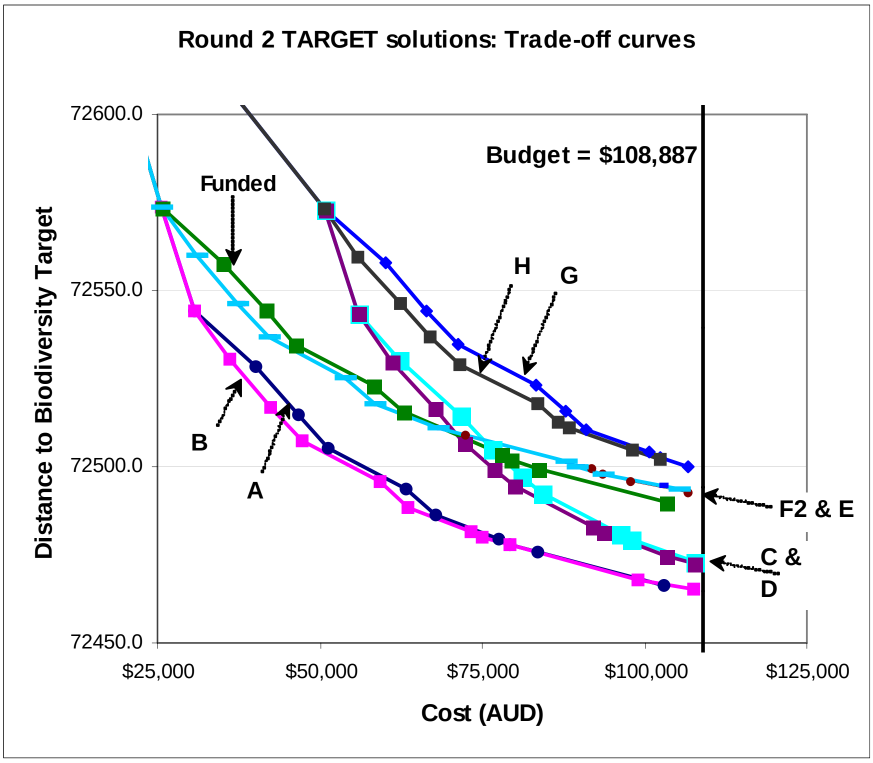


Figure 2.13: *TARGET* runs for each solution. The Y-axis values are scaled for convenience. The full trajectory of the funded solution is shown in 2.14.

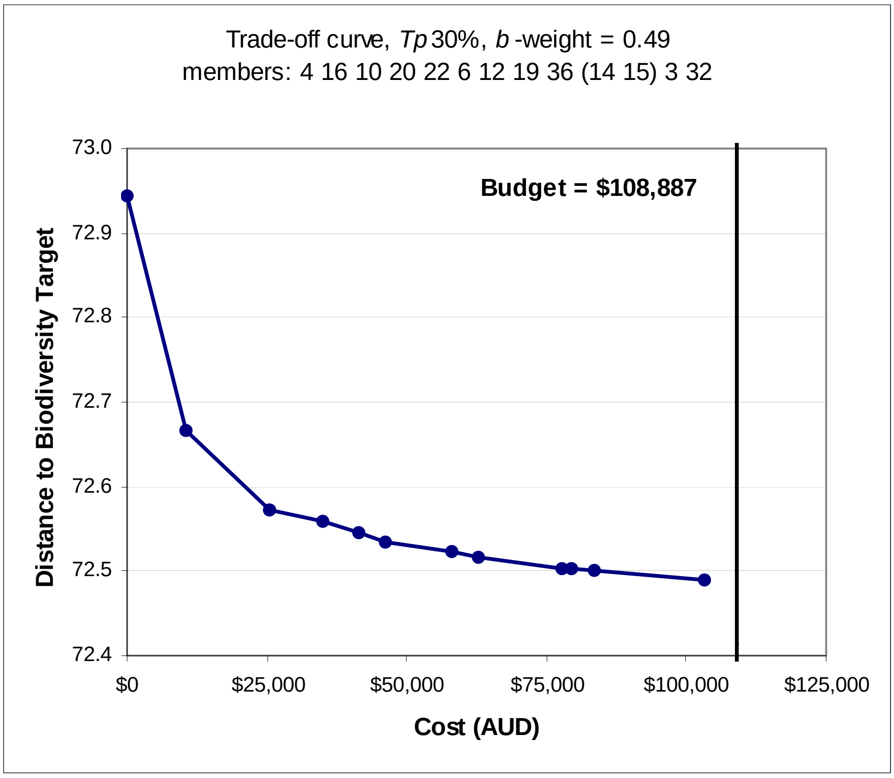


Figure 2.14a: Trade-off curve for successively selected tenders based for the funded solution using weight on cost, *b* = 0.49. Tenders 3, 4, 6, 10, 12, 14, 15, 16, 19, 22, 32 (cost = $103,175).

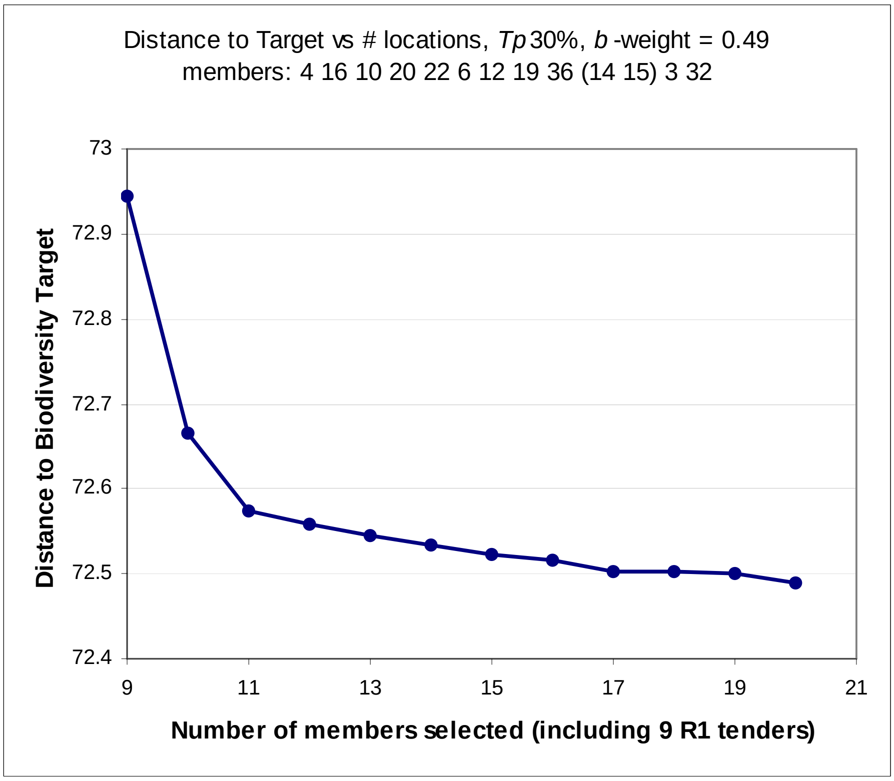


Figure 2.14b: Distance to target versus number of locations for successively selected tenders for the funded solution using weight on cost, *b* = 0.49. Tenders 3, 4, 6, 10, 12, 14, 15, 16, 19, 22, 32 (cost = $103,175).

Table 2.7: Attribute summary for locations on the select list for the *Funded Solution*: Tenders 3, 4, 6, 10, 12, 14, 15, 16, 19, 22, 32 (cost = $103,175).

	Biodiversity Conservation Features	Values	Environmental Benefits Index	Values	Management Benefit Scores	Values
1	Total number of tenders adjacent to CALM nature reserve	0	Total area in Hectares	4615.979	Sum of management benefit scores	54
2	Total number of tenders associated with granite or rock outcrops in reasonable condition	2	Total area attributed to '*immediate area of impact'* of the works (hectares)	2879.93	Sum of confidence scores relevant to management benefit	12.833
3	Total number of tenders associated with threatened fauna or declared flora	2	Total area attributed to '*location of works*' (hectares)	1850.39	Sum of total number of activities with management benefit	54
4	Total number of tenders associated with threatened vegetation association	1	Total area used in the calculation of the NBBI score	2026.26	Sum of 10 years management benefit scores	17
5	Total number of tenders associated with 'at risk' vegetation association	8	Total area used in the calculation of the OEBI score	1968.69	Sum of confidence scores relevant to 10 years management benefit	15.333
6	Total number of tenders associated with a target (representative) landscape	1	Sum of Average NBBI score	38	Sum of total number of activities with 10-years management benefit	20
7	Total number of tenders associated with a potential recovery catchment	4	Sum of minimum NBBI score	34.3		
8	Total number of tenders with remnant > 40 ha (core habitat) in reasonable proximity	5	Sum of maximum NBBI score	43.71		
9	Total number of tenders with wetland feature in reasonable condition	5	Sum of average OEBI score	27.82		
10	Total number of tenders in this set	12	Sum of minimum OEBI score	27.8		

	Biodiversity Conservation Features	Values	Environmental Benefits Index	Values	Management Benefit Scores	Values
11	Total number of tenders interested in conservation covenant	1	Sum of maximum OEBI score	30.17		
12	Total number of tenders interested in voluntary management agreements	8	Sum of average EBI score	51.92		
13	Total number of biodiversity conservation features included	49	Sum of minimum EBI score	48.18		
14	Total costs for selected set of tenders	103175	Sum of maximum EBI score	60.68		

2.2.6.9 Systematic Conservation Planning: Learnings from an Operational Trial

The ALR pilot is the first time a Systematic Conservation Planning (SCP) approach has been operationalised in a conservation auction trial. A number of learnings, described in more detail above, are summarised here:

- The SCP framework identifies the need to take into account the relative condition or viability of biodiversity, using quantitative estimates equated with ‘probability of persistence’. An application of ‘probability of persistence’ in an auction requires an estimate of current condition based on ground-truthing, and an estimate of future condition, considering current condition and proposed management. This is conceptually equivalent to the Land Use Change Impact Score (LUCIS) described by Oliver and Parkes (2003). Site assessments procedures were also intended for estimating probability of persistence in SCP frameworks. However, operational constraints of the project did not allow full development and testing of the process for tender evaluation. How this site assessment information relates to condition modifiers for biodiversity persistence in the context of complementarity for tender evaluation is a key consideration that has not been fully addressed through this pilot and needs further study.
- In the absence of ‘probability of persistence’ estimates, the ALR team utilized expert judgment to screen tenders considered infeasible and estimated future benefit of proposed management actions. These processes are described in Section 2.3.2.
- Conservation planning tools such as *TARGET* software continue to be developed and improved to address the operational needs of conservation planning and management, through applications such as the ALR pilot. Software enhancements were identified, for example, related to alternative ways in which ‘probability of persistence’ can be incorporated in the analysis. Research involvement in pilot projects such as ALR is critical to ongoing development within the discipline.
- A key issue arising was the identification and combination of different factors that could form ‘preferences’. It is clear that multiple preference factors can be combined by producing a composite mask variable. In future work, a multi-criteria analysis process with *TARGET* could utilise the individual EBI attributes of the NBBI and/or OEBI which define preferred weights, without aggregating or using the area

component which is already taken into account in the calculation of biodiversity complementarity. Such an application is not new: *TARGET* has previously been dynamically interfaced with multi-criteria analysis tools (e.g. Faith *et al* 1996).

- In ALR Round Two the preference approach was further tested to ensure better search of ‘solution space’, but the relatively few locations (tenders) available for selection meant that improvement due to preferences was marginal.
- The *TARGET* software has considerable flexibility in the way tests can be conducted and contrasted. For example, *it* includes a strategy in which a place judged to be attractive (for whatever reason) can be ‘imposed’ on the solution – *TARGET* then is constrained to include this place and search for complementary places to form a complete set. This result can be contrasted with results based on no imposed places and/or alternative constraints. While systematic testing of alternative solutions was conducted in Round Two, the manual mode of iteration limited the number of tests that could be conducted. The need to enhance batch functionality taking into account a set budget has been identified and funded through the Rainforest CRC in Queensland. Several minor software ‘bugs’ are also being addressed.
- In Round One, in order to carry out the *TARGET* analysis within the restricted operational timeframe, an arbitrary decision was made to reduce the scope of the biodiversity surrogate to NEWROC. In Round Two, a complete spatial analysis of the biodiversity surrogate (vegetation by regolith) throughout Western Australia was achieved. This analysis, combined with refinements to the percentage targets approach for conservation planning (Faith and Williams, in prep.) improved the outcomes for tender evaluation.

2.3 Tender Evaluation: an Overview

Tender Evaluation combined data, people and tools in the process of choosing tenders to be funded by the ALR. Landholders submitted their tenders by the due date and resulting tender information was databased and integrated with site assessment and GIS information. Extracts of the linked databases were subsequently prepared for review and analysis as part of the process of tender evaluation.

An expert panel, the Management Appraisal Review Group (see Section 2.3.1) was convened to review the feasibility of projects submitted by landholders. Proposed projects required expert assessment to ensure they could achieve stated outcomes. Projects needed to achieve minimum standards for environmental works, and some works such as earthworks for ground water management require permits under legislation. Projects that do not present sufficient information to enable feasibility to be assessed, and many that were considered infeasible or doubtful, were ultimately excluded from evaluation.

The operational undertaking of tender evaluation was conducted using *TARGET* software, which selected projects based on their complementarity gains in regional biodiversity, incorporating projects with high EBI and other preferences using a ‘look-here-first’ strategy. A second review panel was convened within the project team to critique the results of the *TARGET* analysis, test for errors in the site assessment data and iterate the selection procedure according to alternative choices based on estimated management benefit of projects. Successful projects were selected within a notional pilot budget of $200,000 over two auction rounds. Savings from the Round One budget were added to the Round Two budget and management contracts were prepared.

The tender selection process was explicitly competitive. In selecting tenders to maximise the biodiversity benefits within the limited budget, those landholders who submitted a more competitive tender in terms of cost had a greater chance of being selected. Indeed, within the Guidelines distributed to landholders this was made clear: “*The tender will be assessed solely on the level of benefits generated in relation to the overall size of the amount of money that* *you request"*. The *TARGET* software ensures that this is the case through its process of searching for combinations of projects that are within budget and maximise complementarity gains.

2.3.1 Management Feasibility Review Process

The management feasibility review process was initiated to review the feasibility of management actions proposed by landholders in tenders. The implementation of this rapid appraisal process recognised the need for additional expertise for the tender evaluation team, which did not comprise expertise able to judge the feasibility of all proposed works in tenders. The appraisal was not tender evaluation; rather, it provided information to inform the tender evaluation process.

In both Rounds One and Two of the auction, management actions described in de-identified tenders were appraised by a panel of experts, the Management Appraisal Review Group (MARG). Information related to proposed bids (i.e., costs) was not relevant to this process and this information was withheld. The group was comprised of an experienced landholder and other experts with experience with and knowledge of on-ground management in relevant fields such as biodiversity conservation, revegetation, streamline management and riparian vegetation, and hydrology. Each MARG meeting was comprised of voting members of the panel, a non-voting chair who presented each tendered project, a recorder, a legal consultant to ensure probity, and ALR team observers who were interested in the process from a research perspective, but refrained from comment and voting.

Members were required to declare conflicts of interest. The group met after the completion of tender data entry, and prior to tender evaluation in each round. The proposed on-ground works for each tender were judged feasible, infeasible or data deficient (i.e. insufficient data was available to make a feasibility appraisal reasonable). Feasibility was interpreted as the ability of proposed management actions to meet landholders' proposed objectives and ALR outcomes; there was no attempt to determine the value of on-ground projects.

Prior to the MARG meeting, relevant tender data were extracted from the databases, formatted into documents suitable for rapid scrutiny, and made available in printed form to each panel member. Data included the following:

- Stated objectives;
- Stated proposed outcomes;
- Project area (in hectares);
- Project duration, together with start and completion dates;
- Listed proposed activities, together with relevant site numbers, detailed description of works, stated activity outcomes and propsed long-term management;
- Plant species list, where relevant, for proposed revegetation by planting or direct seeding.
- In Round Two, in addition to printed material provided to panel members, the following information was available in digital format for each tender and screened for panel members:
    - Standardised farm map for each tender, clearly delineating project areas and relevant features such as remnant vegetation, creeklines, proposed and existing fences and proposed revegetation areas (see example, Figure 2.15). Relevant maps were automatically screened as each tender was discussed;
    - Area of influence map, showing landscape context for each tender and clearly delineating areas of proposed works and influence. These were screened as required;

- o Plot photographs. These were screened as required.

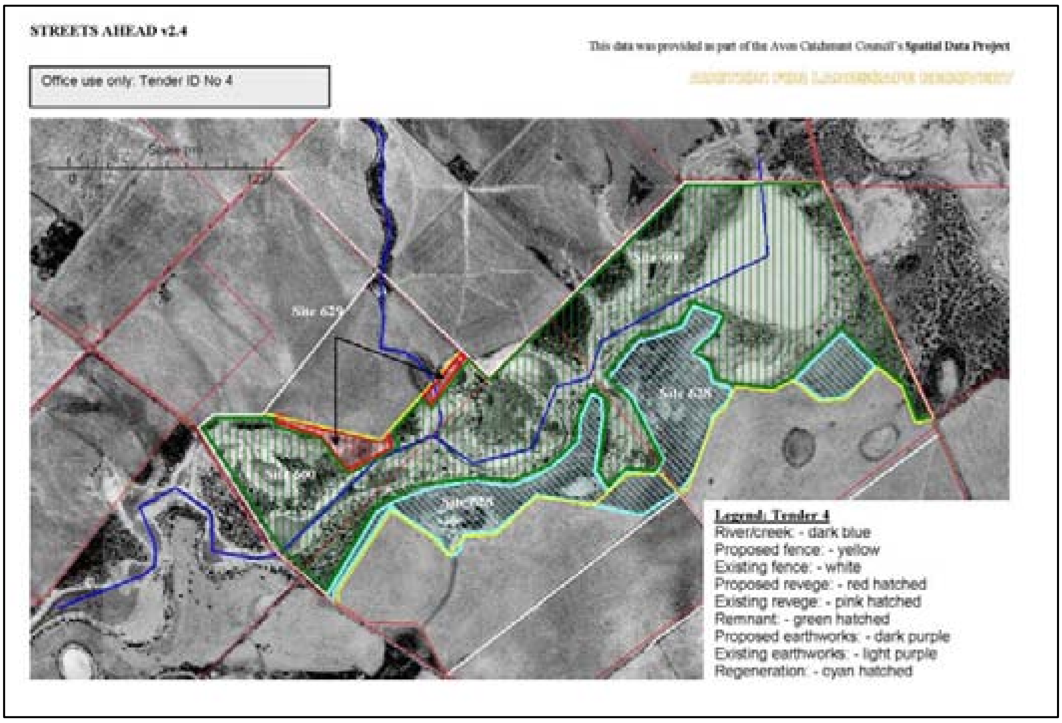


Figure 2.15: Example digital farm map produced by CSOs for each tender and utilised within the ALR management appraisal process.

The Round One MARG meeting identified several difficulties that required resolution prior to Round Two appraisals. Difficulties related to the extremely tight timetable and scanty descriptions of management proposals provided by landholders in tenders, and on which basis the MARG required appropriate information for appraisal decisions. In Round Two, considerable assistance was provided to landholders by the CSOs, who drafted the management proposals and returned them to landholders for their review and agreement. Round Two allowed for more realistic timeframes for relevant data collation and document production for the meeting. In addition, tender document preparation by the CSOs and landholders had included the production of digital farm and project maps for each tender and these were made available to the MARG. One of the recommendations of this project is that many landholders require considerable assistance to complete project management plans and this is a task best suited to extension staff such as the ALR's CSOs.

2.3.2 Management Benefit Analysis

Management benefit—the benefit accrued to biodiversity through agreed on-ground works—was in Round One estimated through calculation of the Land Use Change Impact Score (Oliver & Parkes 2003). In Round Two, management benefit was determined through an analysis of current condition, and a broad assessment of the likelihood that a given management action would provide benefit in a fixed period (c.10 years).

Within the ALR, any management action by a landholder that proposed biodiversity benefit was acceptable within a tender, provided it was legal. In Round One, in addition to fencing and revegetation activities, etc., actions proposed by landholders included earthworks to realign creeklines, divert surface water flow or mitigate salinity. The ALR lacked the resources to adequately quantify and assess benefit of such diverse environmental activities and only on-ground projects more narrowly focussed on direct biodiversity enhancement mechanisms were funded. In Round Two, landholders tendered a more homogeneous group of projects largely focussing on fencing, revegetation, corridor construction and weed and feral animal control.

The impact of land use change is estimated as the differences between current and potential *Vegetation Condition* and current and potential *Conservation Significance*. Oliver and Parkes (2003) intended that the land use change impact score (LUCIS) would provide a measure of the change in biodiversity value against a baseline condition score. A prediction of the rate and amount of change is required in order to adequately calculate the magnitude of change. This problem is effectively equivalent to that of ‘probability of persistence’, a term defined within the conservation planning literature.

For the ALR, in Round One, professional judgment was used to estimate the LUCIS. Some difficulties were encountered with this procedure. These difficulties related to the allocation of points to the ‘potential’ category for vegetation/habitat condition and complexity, given the need to estimate the likely benefit that a proposed action might have on these attributes after the successful implementation of the action. In Round Two, analysis of the degree of subjectivity in this process caused some re-evaluation of the exercise, and a decision was made to utilise current condition, along with a broad form of management benefit analysis that did not commit to scoring specific management actions in relation to potential condition on sites. This was achieved by estimating the probability that a given action would have some demonstrated benefit in the long-term (defined as 10 years).

For the latter management benefit analysis, actions protecting or enhancing remnant vegetation were weighted over regeneration or revegetation. All actions were given a score of 3 if the action related to remnants, 2 if they related to regeneration, 1 if they related to revegetation, and zero if no benefit was likely to result. For example, the protection of very long narrow strips of vegetation by fencing, but in the absence of other protective measures such as weed control or buffering, would score zero, as there is a likelihood of long-term degradation through edge effects and a net loss to biodiversity value. These scores were based on expert opinion. While this method allowed some estimation of the likelihood that benefit would accrue following the implementation of particular management actions, it was insensitive to the differences between proposed works in different tenders.

The ALR experience in attempting to assess the benefit from proposed management activities highlights two problems. One relates to the requirement that prediction of potential condition or conservation significance from proposed actions be undertaken by highly skilled people with extensive experience in the responses of relevant ecosystems to different management regimes. This presupposes the availability of suitably skilled and experienced staff. The other is that the accurate and reliable prediction of response to various management actions is an area of developing science. Various experimental studies have been undertaken in the wheatbelt and other regions in recent times, but not reviewed and integrated to assess utility in providing general principles to advise ALR or similar incentive schemes.

The development of this scence requires that available knowledge be pooled and used to parameterise spatial planning decision models and evaluate knowledge gaps. For example, in a report that provided a broad assessment of biodiversity benefits attributed to vegetation rehabilitation and enhancement activities, Freudenberger and Harvey (2003) provided case study assessments of 44 projects around Australia that demonstrated, or had the potential to demonstrate, the biodiversity benefit of vegetation enhancements. They concluded that while some data are available to support the hypothesis that enhancement activities have benefit for biodiversity, much research remains to be done.

2.3.2.1 Learnings

Whether termed LUCIS or ‘probability of persistence’ or ‘management benefit estimation’ the development of a new metric, or the extensive and apropriate adaptation of an existing metric, to score the benefit of proposed land use change was beyond the scope and resources of the ALR. We experienced difficulty in moving from an inputs-based assessment process based on the assumption that inputs will have benefit for biodiversity to a defensible predictive and probabilitistic assessment of outcomes from given inputs.

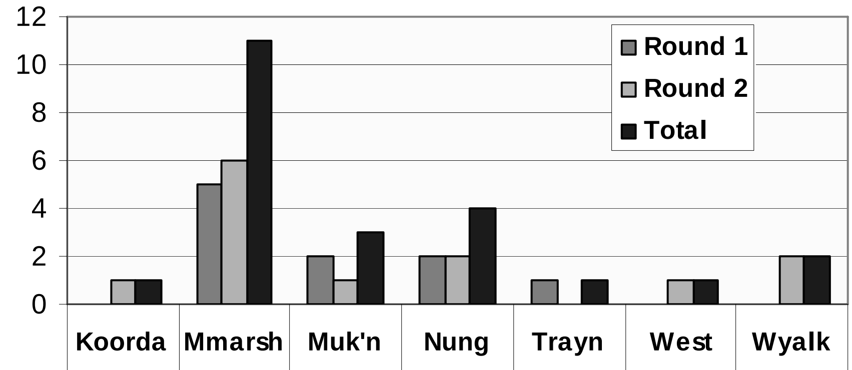
Another issue requiring more consideration in the future is that of the benefit of proposed works for threatened or declining fauna. The ALR identified two issues here that were problematic. The first is related to fox baiting proposals, usually by groups of landholders, where the question of *'location of works'* and *'immediate area of impact'* of the works is critical. Furthermore, standard site assessment metrics are unsuitable. The second relates to the use by fauna of corridors. In fragmented landscapes such as those of the Western Australian wheatbelt, corridors are often proposed as a way of reducing the isolation of remnants. They are thus in theory a means of improving a landscape context score in any metric involving a score-based index. Corridors are also generally well-understood by landholders and there is a high degree of acceptance of their use in landscape and conservation planning. It is been suggested within the ALR team however, that corridor construction might be more effective if targeted at defined species known (or expected) to utilise corridors. This presupposes the existence or development of a suitable metric to assess the benefit for targeted taxa of corridor construction proposals. A critical evaluation of current concepts of corridor design, their applicability and effective benefits for biodiversity and landscape recovery in the Western Australian wheatbelt is needed to address these concerns.

2.4 Site selection: Results

A total of $200,000 was available for two rounds of funding for tenders submitted under the ALR auction process. Early in the project, a decision was made to allocate $100,000 for each round, although it was acknowledged that it was unlikely that the costs of selected tenders would provide an even total for those figures. This was the case. In Round One, $93,130 was allocated for 10 tenders. One landholder subsequently withdrew. In Round Two, available funds meant that $108,323 was allocated for 13 tenders, with one subsequent withdrawal. Withdrawals by landholders after selection were due to private reasons (e.g. sale of property) and not dissatisfaction with the process or a change of mind in relation to their project design.

2.4.1 Geographic Distribution of Successful Tenders

Successful tenders were located in each of the seven shires of the NEWROC, although numbers of successful tenders in some Local Government Authority (LGA) areas differed significantly (Figure 2.16). Successful tenders in most LGAs totalled 1 or 2 over the project as a whole. This may partly reflect past patterns of vegetation clearing and thus the availability of high quality biodiversity assets, particularly in relation to size of remnants (for locations of LGAs within NEWROC and remnant vegetation patterns, see Figure 1.2). For example, the Shire of Wyalkatchem, with less than 5% remnant vegetation extant, had one successful tender. However, other LGAs with higher percentages of vegetation had similar numbers of successful tenders and it is likely that other factors are at work here. The Shire of Westonia, with 21% remnant vegetation extant was similarly successful (one tender), whereas the Shire of Mt Marshall (10% remnant vegetation) had 11 successful tenders across the two rounds.



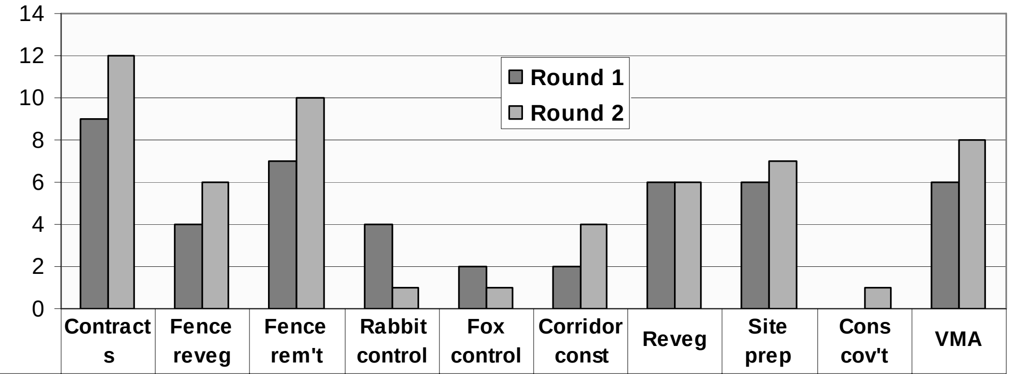
	Koorda	Mmarsh	Muk'n	Nung	Trayn	West	Wyalk
Round 1	0	5	2	2	1	0	0
Round 2	1	6	1	2	0	1	2
Total	1	11	3	4	1	1	2

Figure 2.16: Numbers of successful tenders by Local Government Authority (LGA) in the NEWROC project region for the ALR. Key to LGA names: Koorda = Shire of Koorda; Mmarsh = Mt Marshall; Muk'n = Mukinbudin; Nung = Nungarin; Trayn = Trayning; West = Westonia; Wyalk = Wyalkatchem.

It seems possible that at least some of the difference in these figures relates to differences in the location of biodiversity or program extension staff. At the time that the ALR was running the auction, the Shire of Mt Marshall was particularly well serviced by extension staff, with an ALR Community Support Officer, a WWF-Australia Woodland Watch officer, and a Community Landcare Coordinator all based in the small rural town of Bencubbin. These figures appear to support results from the ALR landholder survey (see Section 2.1.4 above) suggesting that landholders react very positively to the assistance and support of local field staff. This may have relevance for the planning and implementation of future conservation incentives programs, regardless of their mechanism as it suggests that support staff may be cost-effective.

2.4.2 Summary Site Selection Results: Management Actions

The number of successful tenders proceeding to signed contract and thus leading to assumed compliance and implementation of on-ground works was 9 in Round One and 12 in Round Two (Figure 2.17). Management actions included the fencing of remnants (including naturally saline wetlands and other landforms including granite outcrops and rocky ridges), fencing revegetation, feral animal control, corridor construction, site preparation (including weed control and ripping prior to revegetation or direct seeding), revegetation works (including planting and direct seeding), and the institution of nature conservation covenants and voluntary management agreements. The completion of management actions, including the signing of covenants and voluntary management agreements, is the basis of agreed milestones and milestone payments for contracts with landholders (see Section 3.1.2). While a very low number of landholders (one) agreed to legally binding nature conservation covenants, a relatively high number (14 of 21) agreed to sign Voluntary Management Agreements for periods ranging from 10 to 30 years with one of the two agencies able to administer long term agreements. These were Land for Wildlife (WA Department of Conservation and Land Management) and Woodland Watch (WWF-Australia). These figures represent a significant long-term commitment by landholders to biodiversity conservation on private land.



	Contracts	Fence reveg	Fence rem't	Rabbit control	Fox control	Corridor const	Reveg	Site prep	Cons cov't	VMA
Round 1	9	4	7	4	2	2	6	6	0	6
Round 2	12	6	10	1	1	4	6	7	1	8

Figure 2.17: Summary, key content of management contracts with landholders for selected tenders in Rounds 1 & 2, Auction for Landscape Recovery. Data relate to management activities in projects that proceeded to landholder contract negotiation and implementation. Key: VMA=Voluntary Management Agreement.

In the two rounds of the ALR auction, a number of regionally significant biodiversity assets were selected utilising a regional metric of biodiversity complementarity within an integrated Systematic Conservation Planning and Environmental Benefits Index framework. Assets to be protected by a suite of management actions for the successful tenders in the two rounds of the ALR auction are as follows:

- Remnant bushland;
- Naturally saline wetlands;
- Listed threatened species;
- Declining species vulnerable to fox predation; and
- Granite outcrops and rocky ridges.

3 ALR Pilot Performance

3.1 Overall Performance

3.1.1 Price Discovery

An important rationalisation for the use of the auction mechanism is that it helps to reveal the true opportunity cost of a landholder providing an environmental service, and this is one of the key reasons for interest in the mechansim as an MBI. This benefit has two aspects to it: firstly it allows landholders with costs lower than those funded through fixed price schemes to be recompensed at a discriminatory rate, allowing budgetary savings to be made. However, and perhaps more importantly, it allows landholders with high opportunity costs but highly valuable environmental services to enter into the market, as long as the benefits from the tenders is sufficiently high. Under conventional fixed price schemes, landholders who require payments above the set levels will be excluded from the market, even though the benefits they deliver will result in a desirable high benefit to cost ratio. A key objective of the ALR was to identify the extent to which the opportunity costs of environmental service provision vary across landholders. Without this variation the primary justification for the auction as a process of price discovery no longer holds true.

Evaluating price discovery in the Systematic Conservation Planning (SCP) framework utilised for ALR tender evaluation (see Section 2.2.6) is problematic, because it is not possible to identify a unique value of the 'benefits' of an individual tender in isolation of all other tenders: the value is conditional upon the selected set of tenders. Therefore, it is not possible to 'rank' individual projects in terms of a cost/benefit ratio independently. However, such an action is possible if one utilizes an Environmental Benefits Index (EBI) framework. In this report, in order to investigate the relative costs of the tenders provided, we utilise the cost/EBI measure.

In the graphs below (Figures 3.1, 3.2) we show the variation in cost/EBI score in the two tendering rounds of the ALR. The horizontal axis shows the increase in EBI that is available as each higher cost project is included. Note that the EBI scoring differs between the two rounds, so the absolute values of the axes differ. Although the EBI metric is not the primary driver in the final selection of projects (see Section 2.4) thesefigures reveal the relatively large distribution of opportunity costs per EBI exposed through the auction process.

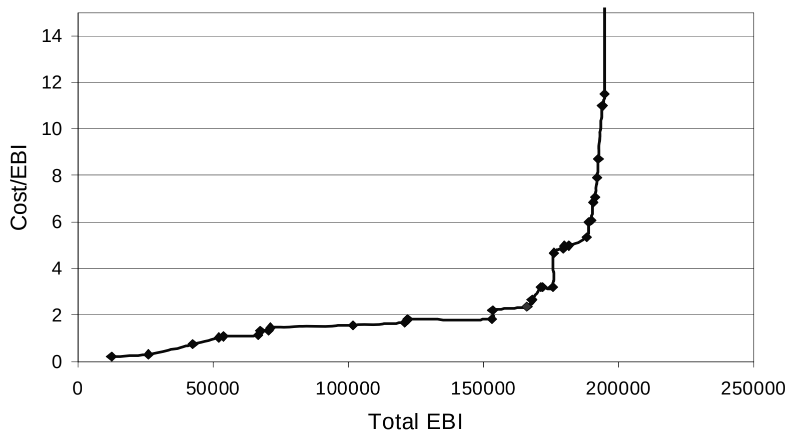


Figure 3.1: Implicit 'supply curve' of environmental benefits: total available benefit as implicit price per EBI rises. Round One tenders, Auction for Landscape Recovery.

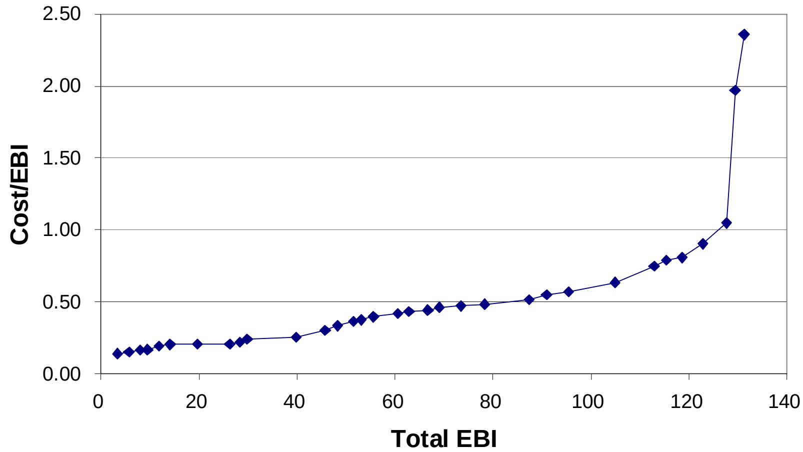


Figure 3.2: Implicit 'supply curve' of environmental benefits: total available benefit as implicit price per EBI rises. Round Two tenders, Auction for Landscape Recovery. (Note that EBI scoring changed between Round One and Round Two).

The ALR also sought to determine whether the auction had been successful in attracting landholders who would not normally participate in conservation incentive schemes. From the regression analysis on participation based on the landholder survey data collected for the ALR, there is some indication that resource constraints may have a positive (rather than negative) influence on the likelihood of participation in the project with the implication that the open-ended nature of the funding opportunity offered by the ALR tender process may have attracted a particular group of landholders. However, the sample size is small to draw definitive conclusions. Further investigation, however, is needed before making firm conclusions about the extent to which the market-based nature of the ALR attracts landholders with higher resource constraints.

The effect of 'landcare experience' is of particular interest with regard to participation. The results (see Section 2.1.4) indicate that those landholders with more exposure to Landcare are more likely to participate, compared to those with limited experience of Landcare. It is a positive result that the ALR has engaged the interest of those who have been involved, in other ways, in conservation activities. The results also provide support for the contribution of Landcare, including the placement of local Landcare officers, in engaging sustained interest from landholders in environmental management.

Hence, there is evidence that the ALR has attracted the 'usual suspects'. However the auction did also attract a number (7 of the 31) of landholders who had not previously participated in other schemes, although three of seven landholders have had involvement in landcare-related activities. These landholders offered a number of reasons for participating. These include: the availability of money for on-farm work; the simplicity of the application process; an interest in nature conservation; the flexibility of the ALR compared to other schemes; the encouragement of the CSO; and the possibility of receiving assistance for salinity-related works (even if this last possibility was largely unfulfilled in the selection of tenders, due to the difficulty in evaluating the impact and area of influence of water management practices proposed). The range of these motivations suggests that there is not a single homogenous pool of untapped landholders that can be easily targeted. However, an auction may provide a complement to other schemes in broadening the range of participants.

3.1.2 Resource Allocation

A key component of the ALR was to identify the subset of tenders which, when funded, achieved the greatest environmental benefit for the budget available to the project. The selection mechanism is predicated upon the marginal environmental contribution being considered in conjunction with the costs of the tender. Implementing this component clearly involves complementary activities undertaken elsewhere in the project by project partners responsible for the development of tender evaluation methods. This particularly concerns the definition and quantification of environmental outcomes, and obtaining appropriate site information to allow an evaluation of proposed changes in environmental services that will arise from the proposal. The proposed mechanism explicitly looks at the full set of tenders, and identifies that subset of tenders which will achieve the greatest environmental benefit for the given budget. This is based not only on the characteristics of the site itself, but how it fits into the overall structure of the biodiversity within the project area, and the region as a whole. As such, the *TARGET* implementation, in conjunction with the identification of the opportunity cost of implementation through the auction process leads to a very strong mechanism for achieving optimal allocation of budgetary resources for the best set of possible environmental outcomes.

3.2 Project Milestones

Twenty eight milestones, with relevant Key Performance Indicators, were set for the ALR pilot project. The project got underway slowly following some initial difficulties in recruiting appropriate staff in the region, but has met all milestones, although some milestones were completed late due to time and resource difficulties. Milestones related to the establishment of auction design and tender evaluation methods, the training of community support officers, design of documentation for landholders, completion of auction component requirements, the analysis and review after Round One of some project components such as auction design and tender evaluation, analysis of the content of landholder management contracts, and reporting requirements such as Quarterly, Background and Interim Reports. The completion and submission of this Final Report completes the milestone requirements for the pilot.

3.3 Project Objectives

Within the initial proposal document and Deed of Grant with the relevant funding agency, seven (7) objectives were set for the Auction for Landscape Recovery (ALR) pilot project. These project objectives have been framed within a number of objectives for the national market-based instrument (MBI) program. The national MBI program objectives and ALR objectives are included in Table 3.1 below.

Table 3.1: Stated objectives for the Auction for Landscape Recovery pilot project together with relevant objectives for the national market-based instrument program.

National MBI Program objective type	ALR objective number	ALR objective	Relevant Section in this report
Overcoming knowledge gaps	1	To test two selection methodologies for assessing the relative benefits of individual actions by landholders against quantitative biodiversity targets	3.4
	2	To evaluate the minimum information needs for applying an auction approach to delivery of NRM at a regional scale	3.5
More efficient natural resource management	3	To evaluate the relative benefits of a discriminative price auction versus a fixed price scheme and existing Landcare schemes	3.6
	4	To analyse the administrative efficiency of a discriminative price auction versus fixed price schemes	3.7
Overcoming particular impediments to the further development of MBIs	5	To analyse communication strategies with landholders	3.8
Transferability of MBI findings	6	To analyse and define the key success factors and key impediments for conservation auction schemes in Australia and the factors thought to be regionally sensitive	3.9
	7	Communicating pilot results	3.10

As distinct from the operational undertaking of the pilot action, these ALR objectives refer to research components of the project together with requirements related to communication. Each of the objectives and the capacity of the ALR to meet, or not meet, each objective, is discussed below.

3.4 Objective 1: Testing Two Methods of Tender Evaluation

3.4.1 Introduction

The ALR project developed two alternative mechanisms for allocating available funding resources to the competing tenders. The Environmental Benefits Index (EBI) required site-specific assessment of the benefits that are to be achieved relative to the cost of the tender. Benefits were calculated for the site itself, and were independent of other tenders that might be included in the portfolio (see Section 2.2.5). The Systematic Conservation Planning (SCP) approach utilised some of the same site assessment data but evaluated the benefits associated with the tender within the context of the full portfolio of tenders selected: thus the marginal contribution to the overall outcome derived from a specific tender might change as the set of tenders selected altered (see Section 2.2.6). Both approaches were based on the principle of competitive allocation of funding resources: it is the definition of ecological benefits which changed between them.

A key research goal of the ALR pilot is a comparison of the relative biodiversity conservation benefits that stem from selection of tenders resulting from these two selection methodologies. Also of interest is the extent to which the two methodologies select actions that provide multiple environmental benefits. A secondary goal relates to the marginal value of datasets in determining the environmental outcomes from the selection process (Objective 2, Table 3.1).

While this comparison process is central to the research being addressed, it was also necessary to proceed within a timetable for funding of on-ground works, and to use a transparent process for selecting among competing tenders. Operationally and pragmatically, the tender selection process was based on the SCP methodology incorporating the EBI as a weighted preference. An integrated approach was developed in order to make the best use of both methods when selecting tenders. At no time was there any intention to make the actual selection process contingent on alternative forms of analysis, as that would introduce a degree of uncertainty and arbitrariness into the on-ground implementation of the project which we wished to avoid.

An argument for complementarity to be extended as a policy-based instrument to guide environmental investment over time was earlier presented in Faith *et al.* (2003). The ALR pilot subsequently introduced the concept of biodiversity complementarity within a Systematic Conservation Planning framework as a metric to facilitate selection of tenders submitted by landholders. Tender selection by earlier auctions (e.g. Parkes *et al.* 2003) utilised a scoring and ranking system—such as the Habitat Hectares approach—of which the ALR Environmental Benefits Index is a derivative. The SCP approach offers quite a different policy-based metric to that of an index of environmental benefit, while retaining consistency with concepts for valuing biodiversity relative to amounts of biodiversity (e.g., area in hectares). Complementarity approaches focus on how much a site can contribute to the whole ‘package’ of available biodiversity types in a region, not just on the characteristics of the site on its own. The two approaches fundamentally differ in their definition of ecological benefits.

Resolving the question of which is best necessitated a comparison of the two approaches. Given that the index approach requires intensive collection of field-based data, the secondary question of comparison arose to determine how different levels of information affect the selection process.

At the time of this pilot, there existed no other worked examples in Australia of how a complementarity-based biodiversity metric might be implemented in an ‘on-ground’ Auction setting. Therefore, the research and development approach adopted by the project team was explicitly based on a ‘learn-as-we-go’ philosophy.

3.4.2 Conceptual bases of EBI and SCP in valuing biodiversity

There is a fundamental difference between EBI and SCP. The EBI approach is fundamentally a site-based scoring and weighting system that assumes each site is independent of the other. An EBI may include site-based attributes as indicators of regional context, such as species or ecosystem conservation significance incorporating concepts of representation, viability and levels of protection. However, no matter how sophisticated the underpinning indices, an EBI by definition scores each site without context: the selection of a site is independent of other selections and therefore cannot take complementarity into account.

By comparison, the SCP approach is fundamentally focused on measures that iteratively take into account the relative contribution a place or site makes to an existing set, in the context of the whole landscape (complementarity). This approach is not simply the sum of individual site values, but is a context-dependent relative measure of the marginal gain a place contributes to regional biodiversity (pattern and process). Complementarity encompasses the notion of overall biodiversity representation incorporating viability and habitat condition, although most applications focus on representation without explicit condition or viability measures because the latter are rarely available for whole landscapes. Reliable estimates of viability (interpreted for conservation planning in terms of ‘probability of persistence’) require sophisticated models of biodiversity viability or surrogate metrics of habitat condition based on spatial configuration of remnants (e.g. see discussion in Ferrier 2002; Faith *et al.* 2003).

Consistent with ALR environmental outcome objectives, both tender evaluation methods (EBI and SCP) are intentionally weighted toward biodiversity conservation. Other environmental benefits are accrued only if biodiversity values are first achieved. Both methods require an external process utilising expert judgment to define the feasibility of management actions and therefore the likelihood that biodiversity values will be maintained or enhanced.

In the SCP approach, probability of persistence concepts enable estimates of current and future condition of biodiversity to be included in the analysis. Future biodiversity condition (forecasting) depends on the feasibility and effectiveness of particular land use or management regimes, given a particular context and time frame. Ideally, complementarity calculations for SCP would include probability of persistence. However, this requires that we know or can reliably estimate the relative contribution to biodiversity viability of each management action, or the cumulative effects of a management regime, over a specified timeframe. A key research question is: *how do we equate particular management actions for a particular site with biodiversity viability over a specified timeframe*?

Within the EBI, a land use (or management regime) change impact score (LUCIS) was used to estimate the future condition of each attribute which is a component of the native biodiversity benefits (NBBI). As for probability of persistence, this process also requires the reliable estimation of the effectiveness of particular management actions given a particular context (current condition) and time frame. The EBI also uses surrogate ‘landscape context’ attributes to describe relative connectivity among remnants such as distance to core habitat and percentage vegetation cover remaining within different landscape neighbourhoods. These are used as indicators of overall biodiversity viability and are relevant to both the EBI and SCP frameworks.

This discussion demonstrates that while the input attributes to EBI and SCP approaches are based on the same overall concepts in ecology and evolution, the complementarity of different types of biodiversity which arises from the discipline of conservation biology is fundamentally not addressed in EBI.

3.4.3 Comparison of EBI and SCP in valuing biodiversity

An effective comparison of EBI and SCP in valuing biodiversity requires fully worked examples of both evaluation metrics. The ALR pilot developed these two approaches to evaluation of tenders in Round One and Round Two, but for operational purposes, developed an integrated approach. The approach used to select tenders based on the EBI in Round One is presented in Hajkowicz *et al.* (2005). Hajkowicz *et al*. explore the use of several decision rules for solving the optimisation problem in selecting tenders that maximise their aggregate benefits whilst not exceeding the budget.

In Round Two, tender evaluation based on the EBI was conducted using a simple ranked cost-benefit ratio: cost in dollars per unit benefit of EBI for each tender. We extend this analysis by presenting the tenders ranked from lowest to highest cost per unit EBI and identify those which are selected within budget, taking into account mutually exclusive tenders. Where necessary, decision rules were used, similar to those in selecting tenders for funding (see Section 2.2.6.8). The SCP selected set was then compared with the EBI selected set by ranking tenders along the same gradient of cost per unit EBI, even though selection was based on complementarity among multiple biodiversity attributes. As a comparative test, the EBI index was included as an attribute for tenders in the *TARGET* software. A *TARGET* scenario was used to select the best tenders based on the cost trade-off with EBI.

As a corollary test, Round Two tender evaluation based on the SCP was compared with the EBI results by analysing the EBI-selected set as the ‘available set’ in a *TARGET* scenario.

This enabled the complementarity contributions of the EBI selected set to be compared with those from the SCP selected set. The small number of tenders and potential area contribution to biodiversity conservation was a recognized limitation in developing these scenarios. However, there exist possibilities for further research based around use of the ALR data and spatial information collated for this project, for which time and resources precluded undertaking and reporting comprehensive analyses for this report.

3.4.4 Results: SCP and EBI comparisons

Figure 3.3 shows the general relationship between (average) EBI and total ‘raw complementarities’ for the 33 Round Two tenders, before complementarity itself is taken into account in the analysis of cost-benefit. Table 3.2 compares ‘raw complementarity’ with the component indices for biodiversity and other environmental benefits. The size of the site in hectares is included in the calculation of EBI and complementarity. In weighting the EBI, area is $\log_{10}$ transformed. The comparisons in Figure 3.3 and Table 3.2 are based on $\log_{10}$ transformed complementarity values. Complementarity is calculated as the sum of the areas of representative biodiversity types available from the selected set (tenders) and required to trend toward a regional goal of 30% retained vegetation cover (see Section 2.2.6.7).

It is interesting to note the best regression relationship (r^2 = 74%) between ‘raw complementarity’ and EBI components was with minimum scores for the native biodiversity benefits index (NBBI). This correlation could simply be a function of the same area amounts contributed by tenders in the NBBI as for complementarity. Many attributes of site assessment record information about the structure and composition of habitat types which have analogies in the vegetation class and regolith type combinations that constitute the biodiversity surrogate, and these may also contribute to the correlation. Indicators of habitat condition from site assessments may be further aggregated with biodiversity type to provide indicators of amounts of biodiversity remaining at a site; as external repeated disturbances and threatening processes contribute to declining populations and local extinctions. Such estimates are usually interpreted in terms of ‘probability of persistence’ and are used to proportionally reduce the amount of biodiversity a site contributes to the region as a whole. The full analysis of these site facets of biodiversity complementarity were not completed through the ALR due to time and resource constraints, and so their impact could not be demonstrated in tender evaluation (see Section 2.3.2).

As expected, scores for Other Environmental Benefits (OEBI) have little relationship to complementarity (r^2 = 37%). This is expected because the site assessment data on which the OEBI is based records distinct information about farm management such as grazing and the extent of threatening processes such as feral animals, weed incursions, other evidence of disturbance, salinity outbreaks and fire regimes. This information, which reflects on threatening processes (in the case of feral animals, weeds and salinity outbreaks) or opportunity costs (in the case of farm management regimes for grazing and fire) has no analogy in the current structure of the biodiversity surrogate for complementarity, which currently does not include ‘probability of persistence’. In many cases, the OEBI is scored for cleared land over which revegetation may be proposed and incorporates the size of the proposal through the area in hectares ($\log_{10}$ transformed). Current areas of cleared land were not included in the calculation of complementarity. To do so requires proper consideration of probability of persistence.

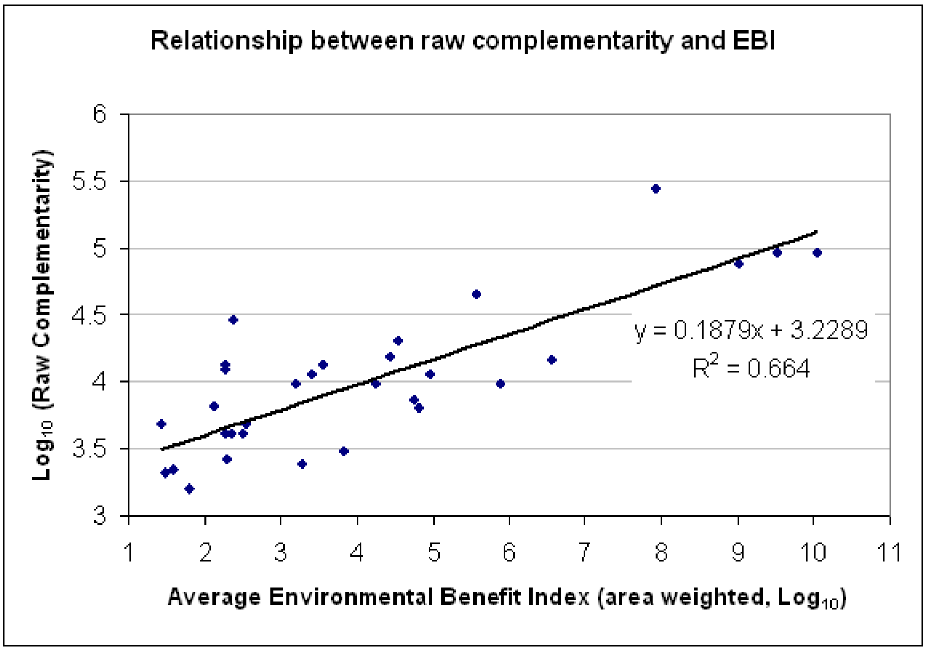


Figure 3.3: Example relationship between EBI and total 'raw complementarities' ($\log_{10}$ transformed) for Round Two tenders.

Table 3.2: Linear relationships (y = ax + b) between 'raw complementarity' ($\log_{10}$ transformed) and component indices of biodiversity and environmental benefits for Round Two tenders.

Index	Parameter *a* (slope)	Parameter b (intercept)	R^2
Average EBI	0.1879	3.2289	0.6640
Maximum EBI	0.1650	3.2396	0.6205
Minimum EBI	0.2061	3.2498	0.6841
Average NBBI	0.2504	3.2671	0.7076
Maximum NBBI	0.2101	3.2786	0.6417
Minimum NBBI	0.2817	3.3051	0.7360
Average OEBI	0.2634	3.3733	0.3727
Maximum OEBI	0.2637	3.3720	0.3731
Minimum OEBI	0.2632	3.3747	0.3722

Figure 3.4 presents the EBI 'benchmark' and selection scenarios for Round Two. The first scenario shows the cumulative cost versus EBI for all tenders. The second scenario shows the cost versus EBI for the feasible set of tenders and the preferred tenders among the mutually exclusive subsets. Considering infeasible and mutually exclusive tenders, the total EBI potentially contributed by Round Two tenders is 92.86 points for a total cost of $273,550. The third scenario is the EBI selected set within budget. One tender (21) withdrawn from Round Two by the landholder following selection was included in the first two scenarios.

The resulting EBI selected set comprised 13 tenders for a total cost of $105,872. This compares with the SCP selected set (funded scenario) which comprised 12 tenders for a total cost of $103,175. Table 3.3 compares the cost, EBI and the gain in complementarity for the two selected sets. Most tenders are in common between the two selection methods. As expected, the EBI selected set has marginally higher total EBI than the SCP selected set (Figure 3.5), and conversely, the SCP selected set demonstrates higher marginal gain in biodiversity complementarity (Figure 3.6).

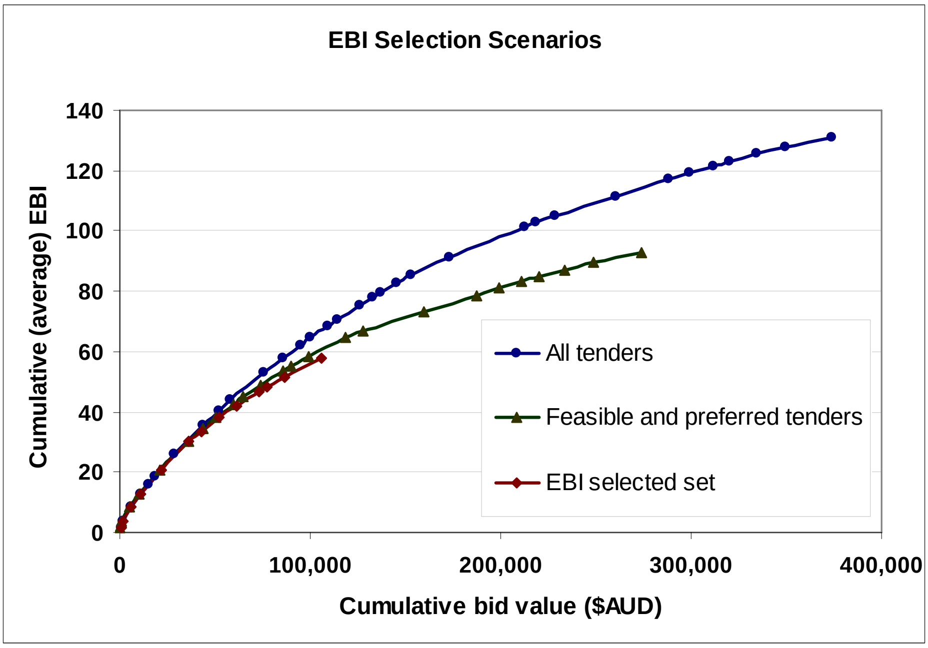


Figure 3.4: EBI selection scenarios for Round Two tenders showing cumulative cost and total EBI. Preferred tenders refer to previous decisions made to select one tender from mutually exclusive subsets.

Table 3.3: General comparison between SCP (funded) set and EBI selected set for ALR Round Two, using the same decision criteria for infeasible and mutually exclusive tenders.

SCP selected set (funded solution)				EBI selected set (scenario)			
Tender identifier	Cost ($AUD)	Average EBI	Biodiversity Complementarity	Tender identifier	Cost ($AUD)	Average EBI	Biodiversity Complementarity
3	4250	1.5854	2244	3	4250	1.5854	2244
4	10615	7.9153	277400	4	10615	7.9153	277400
6	11932	4.9639	11431	6	11932	4.9639	11431
				7	8697	3.8340	3093
				9	9000	3.2779	2465
10	9450	4.4447	15640	10	9450	4.4447	15640
12	4543	4.7543	7474	12	4543	4.7543	7474
14	760	1.7923	1587	14	760	1.7923	1587
15	910	1.7923	As for 14	15	910	1.7923	As for 14
16	15000	9.5028	92577	16	15000	9.5028	92577
19	15000	2.2850	12301				
20	6500	3.5602	13361	20	6500	3.5602	13361
22	4700	4.2443	9778	22	4700	4.2443	9778
32	19515	5.8885	9713	32	19515	5.8885	9713
Total	103175	52.7290	453506	Total	105872	57.5560	446763

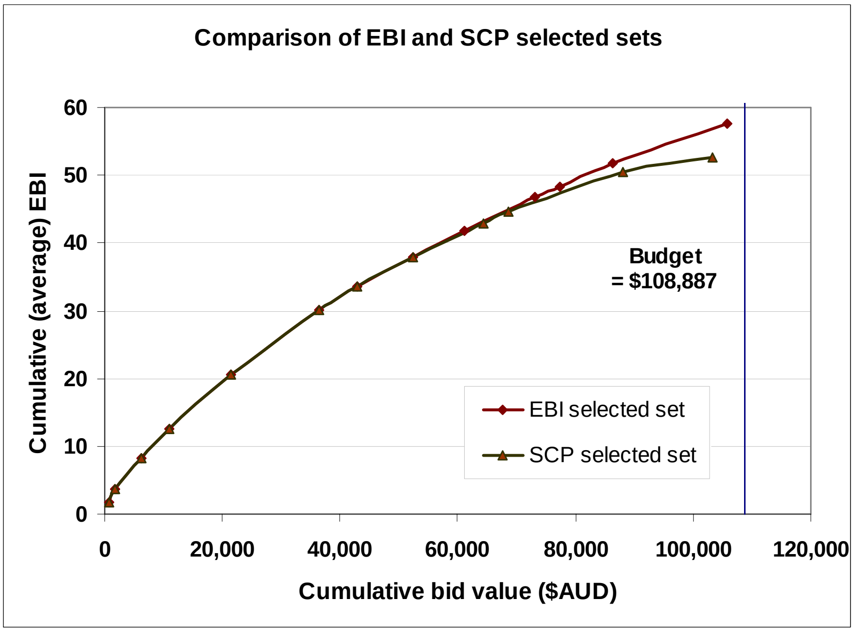


Figure 3.5: Comparison of EBI and SCP selected sets for cumulative cost and total EBI (see Table 3.3).

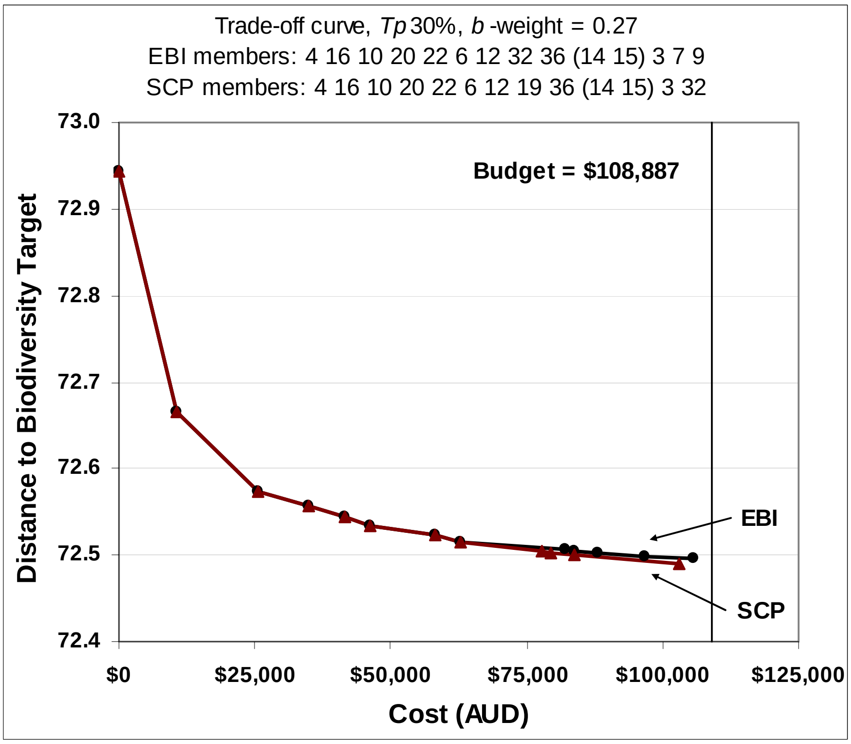


Figure 3.6: Comparison of EBI and SCP selected sets for cumulative cost and distance to biodiversity target (complementarity) (see Table 3.3).

The small number of tenders available for selection relative to the budget, combined with a notional regional goal for landscape-level retention or restoration of vegetation cover of 30%, and proportionally few areas in public land managed for nature conservation, results in comparable solutions between the EBI and SCP in this context. In order to evaluate differences in selection, the tenders available for selection were restricted to the feasible and preferred set, taking into account mutually exclusive tenders, and the budget was arbitrarily increased to $210,000 allowing more tenders to be selected within budget. The available set for experimental comparison of EBI and SCP comprises 22 feasible or preferred tenders for a total bid value of $269,162.

Figures 3.7 and 3.8 present the results of an experimental comparison between the EBI and SCP selection methodologies. The EBI selected set was derived using the ranked cost-benefit method for selection of tenders and cumulative cost within a budget of $210,000. The SCP selected set was derived using the trade-off between biodiversity complementarity and cost within a budget of $210,000. In Figure 3.7, the EBI and SCP selected sets are compared within the context of the SCP method and in Figure 3.8 they are compared in the context of the EBI selection method. In Figure 3.7, the total complementarity contribution of the SCP-selected set is 570494 units ($209,989) and for the EBI-selected set is 558013 units ($201,155). In Figure 3.8, the total aggregate EBI is 76.58 units for the EBI selected set and 78.96 units for the SCP selected set. This scenario confirms the previous analysis (Table 3.3 and Figure 3.6) and demonstrates a small marginal difference between the two selection methodologies, all else being equal with respect to the regional context of the study, the data and decision logic constraining the choice of available tenders to include or mask in an analysis. In a larger scale application an SCP approach with validation of biodiversity persistence from site assessments is expected to consistently outperform EBI approaches because complementarity is able to take into account changing priorities as areas contributing to conservation management are added to the funded set.

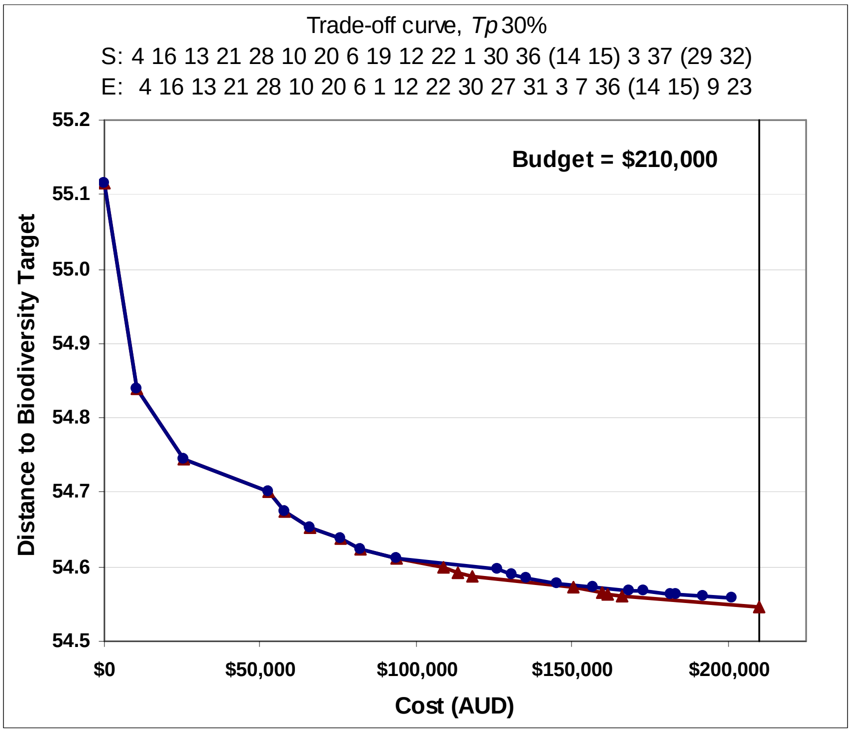


Figure 3.7: Comparison of EBI and SCP selected sets for cumulative cost and distance to biodiversity target (complementarity) based on a regional goal of 30% vegetation cover. The weight on cost, for the SCP scenario is parameter *b* = 0.358 and for the EBI scenario is parameter *b* = 0.20. The EBI curve (blue circles) largely coincides and is marginally above the SCP curve (red triangles) as both trend toward the budget of $210,000.

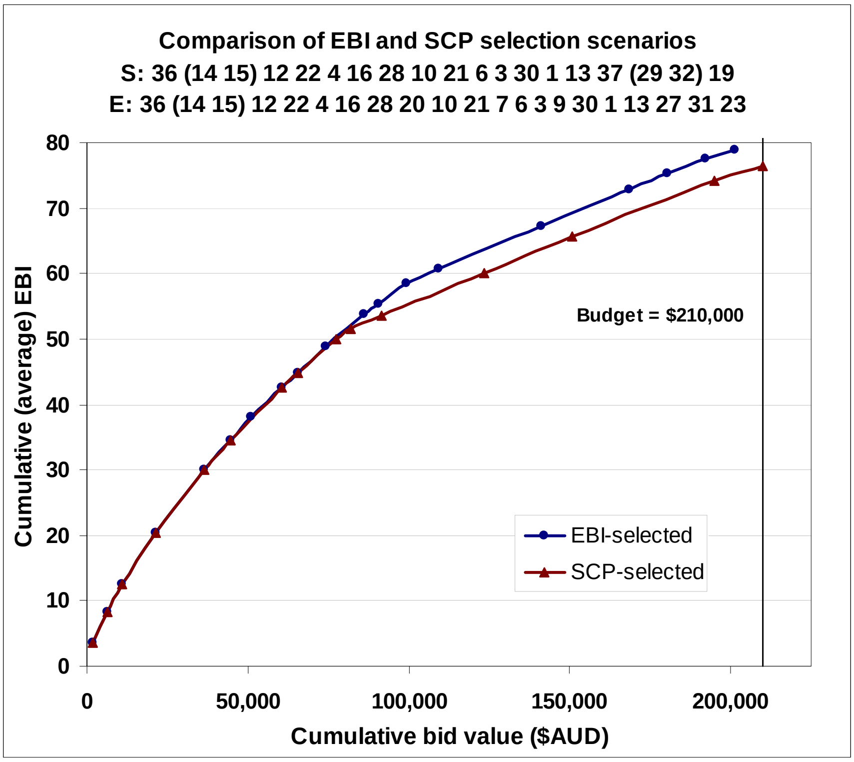


Figure 3.8: Comparison of EBI and SCP selected sets for cumulative cost and total (average) EBI. The EBI curve largely coincides and is marginally above the SCP curve as both trend toward the budget of $210,000.

3.4.5 Discussion: Comparison of EBI and SCP

Systematic Conservation Planning uses dynamic complementarity values. When SCP selects a set of localities, it avoids selecting an attribute more times than necessary (as indicated by the target for the attribute). In other words, because localities overlap generally in their attributes, SCP's dynamic complementarity ensures that what initially was "in demand" is recognized as "in excess". This is fundamental to the cost-effectiveness and efficiency that is the corner-stone of SCP approaches. Only when dynamic complementarity is used can selection/priority-setting properly shift resources to other attributes (and not continue to be distracted by possibly-identical localities that all looked good at the start).

It is possible to have selection exercises where either the targets are so large, or the overlap among localities so small, that initial complementarity values for localities do not change dynamically in the course of building up a set of selected localities meeting targets. In addition, an EBI may coincidentally, or by design, reflect or correlate with initial complementarity values. That special case suggests that the EBI scores could be used to mimic the SCP selection (i.e., no penalty in ignoring dynamic complementarity occurs).

We can relate that scenario to the ALR pilot. In our pilot, some analyses adopted a very high target for attributes (partly a consequence of defining attributes at a course scale, partly a consequence of taking on an attribute-representation obligation within the exercise that might better be spread out over many such exercises; see below); so, more or less all occurrences of all attributes were needed to satisfy targets – and initial complementarity values did not change as selection proceeded. Also, EBI correlated fairly well with these values, partly because of the "native" factor in the EBI. From a single analysis of that kind, one might be tempted to conclude that EBI=SCP. However, a single analysis does not indicate general lessons about differences. Our pilot results suggest there is a need to assess how often we might expect to see very large targets, coarse-scale attribute definitions and small numbers of sites.

The ALR pilot presents an ideal opportunity to contrast SCP and EBI. We can argue that, even in a case where there is correlation between initial complementarity values and EBI scores, that SCP has clear advantages over EBI. We note that our biodiversity attributes data for this study reveals an important general phenomenon – localities overlapped significantly in their member attributes. Indeed, the top 5 or so localities for EBI typically had attributes that appeared 2 or 3 times in that set of 5. We can show the implications of this overlap phenomenon here by distilling the example down to a simple scenario, shown below in Table 3.4.

Table 3.4: Example scenario comparing the Environmental Benefits Index and Systematic Conservation Planning.

Site number	EBI	Initial complementarity	Attributes data version I	Attributes data version II
1	10	5	a b c d e	a b c d e
2	9	4	f g h I	a b c d
3	8	3	j k l	a b c
4	7	2	m n	c d
5	6	1	o	e
6	6	1	p	f
7	6	1	q	g
8	6	1	r	h

There are 8 localities shown in Table 3.4. Here, EBI correlates perfectly with initial complementarity. Assume targets are such that one representation of each attribute is needed. In our theoretical scenario here, all localities cost the same as one unit and we have a budget of 4 units.

We can imagine these initial complementarity values arising in two different ways and illustrated by attributes data 'versions' I and II in Table 3.4. Under version I, localities have no overlap. Selecting the top 4 EBI localities also captures the best set of 4 localities for representation. If the actual data were the more realistic version II, after we selected site/locality number 1, the new dynamic complementarity of sites 2, 3 and 4 goes to 0. Proceeding in this way, SCP would select sites 1, 5, 6, and 7 for a total representation of 8 attributes. What would happen if we used EBI? EBI would still select sites 1, 2, 3 and 4 – for a total attribute representation of only 5.

We conclude that the overlap among high EBI localities in this study reveals a weakness of EBI-based selection. Only when initial complementarity values remain constant (as areas are selected) can EBI appear efficient. On the other hand, SCP works very well given its use of dynamic complementarity, and also covers the case where initial complementarity values happen not to change. Therefore SCP acts as the sensible general basis for analyses – even if we "know" that complementarity values are likely not to change, the SCP approach is more sensible in that it allows explicit trade-offs between biodiversity and other factors – in the EBI scoring approaches, there is no clarity of this kind.

Future work will have to focus on determining how often we may expect to have coarse-scale attributes, large targets and small numbers of sites. This also put a premium on future work which better establishes one of the principles introduced in this study, that of equitability. In this context, equitability means that any one small sub-region would not be expected to achieve the larger universe of biodiversity goals. Consequently, targets for the small region are lower, and attributes "in demand" will more often become "in excess" as localities are selected. That realism will go hand-in-hand with the efficiencies offered by SCP approaches.

3.4.5.1 Learnings: EBI and SCP

SCP has previously been utilised for reserve selection, but it has relevance beyond this. Indeed, it may be most valuable when it is used to integrate decisions over a range of biodiversity conservation strategies. In this way, gains made by one strategy can be taken into account by another, so increasing overall cost-effectiveness. SCP does involve geographic "scale" issues: for example, the localities might be so fine-scale that they appear homogeneous in terms of the biodiversity surrogate information. In part, SCP finds applicability even at the fine scale when complementarity values indicate, not just gains in representation, but also gains in persistence. This latter case may be the one that is most relevant to many auction-type applications. The scale of application will depend on the scale at which data are able to define or infer biological heterogeneity - that is, the variability in biodiversity trending toward applicability at the species and subtaxa, or to genetic levels, see for example, Section 3.5.1.2.

SCP should be tested further in the auction context. One reason is that methods for integrating practical persistence measures need to be investigated. Another is that the scale of biodiversity surrogates as compared to scale of localities/"properties" needs to be explored further – how often will it be the case that sustainability targets are so high that all properties are required for landscape recovery? Related to this is the need to further investigate appropriate target setting, especially regarding the need for equitability – not expecting one component sub-region, or set of candidate properties, to achieve the biodiversity targets for the broader region.

A question that has been raised is: if a complementarity-based approach to tender evaluation and incentive schemes is not immediately applicable (i.e. available 'off the shelf') what is required to make it useable? Is it useable by stakeholders other than State agencies or researchers? Conversely, how could practitioners identify the circumstances under which an appropriately designed EBI is likely to be reliable?

It should be possible to identify cases where an EBI approach, with initial complementarity values recorded, could avoid running into the updating problem. Such an approach (on those restricted occasions) at least would treat biodiversity representation reasonably well – however, it would still suffer from the "confounding" effect of all scoring approaches – where apples and oranges are added together. Clearly, a multi-criteria analysis approach has advantages in allowing some control of different variables/factors.

Another question that has been asked is: under what circumstances could an EBI approach, with initial complementarity values recorded, avoid running into the updating problem? The user would require an estimate of their targets for the accepted biodiversity attributes forming their surrogates information. Then, simple scenario analyses could explore whether selecting many similar tenders (projects) would exceed the target (for corresponding attributes) or in fact not exceed it.

The ALR was funded as an MBI pilot and remains the only conservation auction in Australia to date to have trialed a non-EBI metric for tender evaluation and realistically develop an integrated approach that makes the best use of remotely sensed data combined with field verification of site condition and current management or threats to biodiversity and landscape integrity.

A range of experimental approaches were devised for comprehensive and comparative testing of EBI and SCP approaches utilizing the ALR data. However, resource and time constraints prevented the completion of these analyses. While emerging trends are reported here, a more complete analysis of the available data is recommended.

3.5 Objective 2: Evaluating Minimum Information Needs

Consistent with ALR objectives, the evaluation of minimum information needs for selecting tenders that deliver NRM at a regional scale aims to compare conservation benefits arising from the use of three levels of information: 1) a minimum dataset comprising biodiversity surrogates based on landform and vegetation heterogeneity; 2) the minimum data set plus locations of threatened species, communities and target landscapes; and 3) plus on-site assessment. This comparison provides some insight into outcomes for the application of tender selection processes in situations where less biophysical information exists.

The marginal value of datasets is assessed separately for the EBI and SCP evaluation methods, which utilise different sets of data. The EBI approach does not utilise information in category 1), a biodiversity surrogate based on landform and vegetation heterogeneity. The SCP approach, however, is flexibly able to utilise information across all categories, and is explicitly designed to make the best use of available data, with the *proviso* that theories in ecology and conservation support the manner in which data are incorporated in the analysis. The SCP approach assumes that as finer scale data become available within a region the scale and the precision of analysis is increasingly improved. The SCP approach is designed to address marginal gains in biodiversity and is therefore more applicable to this analysis of marginal datasets values required to achieve regional conservation targets.

We propose three SCP scenarios to compare the marginal gain in conservation benefit from selection processes based on 1) a minimum dataset, 2) the minimum dataset plus additional information about biodiversity conservation priorities, 3) datasets utilised in 2) plus site assessment information.

The minimum dataset is the biodiversity surrogate, in this case derived as a combination of vegetation by regolith. The biodiversity surrogate is the basis for iteratively calculating site complementarities.

The second level of information is to include locations of threatened species, communities and target landscapes in addition to the biodiversity surrogate. Systematic information about the distribution of species' assemblages, and identification of threatened species and communities from integrated surveys recently completed for the region, were not available to the ALR, and therefore could not be used as an attribute for representation of biodiversity in this comparison. Therefore, available locality records and information relevant to existing conservation policies on threatened species, communities and target landscapes were aggregated and used as preferences in *TARGET* scenarios.

The third level of information is on-site assessments. Observation of vegetation structure, composition and condition were recorded for representative sites by the CSOs. Rather than the aggregated attributes and scores of the biodiversity benefits index, component indices for vegetation condition, complexity, conservation significance and landscape context, are assessed for their marginal value.

As for the comparison between EBI and SCP, above, the regional target for landscape recovery of 30% was used in conjunction with extant vegetation in Crown land estate being arbitrarily 'committed' to protection. A second scenario is proposed in which the regional target is lowered to 10%, again in conjunction with extant vegetation in Crown land estate being arbitrarily 'committed' to protection.

Also, taking into account the relatively small set, all tenders were utilized in the analysis ignoring those deemed infeasible but taking into account preferences for mutually exclusive tenders. Dummy tenders, which aggregated tenders that shared a site with complementary works, were ignored in this analysis. In developing each scenario, the weight for cost trade-offs were iteratively determined to be the value which allows a set of tenders to be included under budget.

An initial benchmarking scenario is conducted for the first analysis using the biodiversity surrogate only. Biodiversity conservation preferences were then tested where three or more criteria are associated with a tender. The effect of imposed or committed solutions are assessed, and compared using the distance to biodiversity target, and the total scores of native biodiversity benefits index (NBBI).

Finally the component scores of the NBBI (not weighted by area) were included as attributes along with the biodiversity surrogate associated with tender locations in a TARGET scenario. The results are compared using the distance to biodiversity target, and the total NBBI for the set. The relative gains in other environmental benefits are compared using the total scores of other Environmental Benefits Index (OEBI) for the set. The OEBI provides an indication of the extent to which the different datasets provide multiple environmental benefits.

The SCP approach originally intended utilizing information about habitat condition from site assessment data in the calculation of probability of persistence. A disaggregated site index defining relative condition could be used as a modifier on complementarity. The NBBI component indices *vegetation or habitat condition* (VCO) and *vegetation or habitat complexity* (VCY) are potential modifiers on complementarity. These NBBI component scores (not weighted by area) were separately calculated for each site or plot within a tender. Adjustments to ‘effective area’ of biodiversity contribution from each tender site were calculated and a revised LOC file created for subsequent TARGET scenarios. The differences in selection of tenders within budget were compared with previous scenarios in which expert judgment was used to assign preferences resulting in a set of funded tenders. The marginal gain contribution determines whether including condition modifiers from site assessments facilitates decisions and expert judgment required during tender evaluation.

3.5.1.1 Results: Minimum Information Needs

Approaches to testing minimum information needs were devised but not fully implemented due to resource and time constraints. Aspects of ecological science and conservation theory underpinning the comparison is outlined in the discussion below, and emerging trends are considered in the context of learnings (Section 3.5.1.3).

3.5.1.2 Discussion: Minimum Information Needs

Two hierarchical schemes are available for the classification of biological entities. One is a spatial, or generalized, ecological hierarchy starting with molecules and macro-molecules, then cell organelles, cells, individuals, populations and metapopulations, communities, ecosystems, and ultimately to the biosphere. The second is a taxonomic hierarchy from alleles to loci, linkage groups, genotypes, subspecies, species, genera, families, orders, classes, phyla, and kingdoms. Both hierarchies reflect evolutionary history and are constrained by evolutionary mechanisms. Classes at all levels in each hierarchy are heterogeneous in that all members of each class can be distinguished from one another. Therefore, the complete description of a class requires the inclusion of all members. The variety of viable biological configurations at all hierarchical levels is extremely large, currently unknown and probably immeasurable.

Described in this way, it is clear that biodiversity is extremely complex and impossible to estimate or quantify in the field. The concept of biodiversity must be operationalised through the use of ‘surrogates,’ features of the landscape such as the presence of species or other taxa, habitat type, *etc*., that can *in principle* be quantified and assessed in the field. Even when we identify or choose biodiversity surrogates, we often do not have an accurate estimate of spatial distribution (a map). Because assessing conservation value is a matter of comparison, comparing areas in a planning region with one another, the choice of surrogate is constrained by the requirement for spatial consistency in level of detail across the entire planning region. The data have to be both quantifiable and obtainable.

Environmental variables such as climate, rock type and terrain are usually available at a consistent level of detail across regions. Vegetation types or assemblages have often been mapped in regions. Some combination of these two kinds of surrogates will often meet the requirements of quantifiability and obtainability. There is considerable debate in the literature about the efficacy of biodiversity surrogates, but it is absolutely necessary to obtain some measure across entire regions in order to set goals and estimate levels of achievement of those goals. Species at risk, rare or unusual assemblages and landscape features can be added, but some measure, consistent across the planning region, has to underpin planning decisions across the region.

3.5.1.3 Learnings: Minimum Information Needs

Within the ALR, the experimental approaches to testing minimum information needs were devised but not fully implemented due to resource and time constraints. The ALR pilot required, and achieved, successful implementation of the operational field phase of the project. A more complete analysis of the available data is recommended before objective conclusions can be made with respect to minimum information needs. While the ALR data have been compiled and experimental designs have been established, only the emerging trends are reported here.

- A regional NRM approach to defining conservation goals, targets and strategies is needed, within which framework individual on-ground projects may be identified, assessed and selected.
- Considering that conservation decision-making at all levels requires data that are both quantifiable and obtainable, the principle of biodiversity surrogates is generally applicable. Broad-scale environmental data (e.g. 1:250,000) are generally readily available and should be utilized as a component of the conservation decision hierarchy in a manner that is relevant to the scale and accuracy of the data. Complementarity provides the proper framework for using such biodiversity surrogate data.
- Considering the operational requirements of the ALR to ensure the best projects were funded and the actions of funded projects feasible, site assessment information is essential and should target critical elements of vegetation/land condition, threatening processes, current management practices and the range of feasible management relevant to the context. In this respect, site assessments should target requirements for ground truthing to facilitate decision-making about choice of project, all else being equal.
- Methodologies to properly account for quantifiable variation and comparison of biodiversity persistence most urgently need to be developed using existing knowledge and spatial analysis tools and applied as an element of dynamic conservation decision-hierarchies.

3.6 Objective 3: Comparing the Auction and Fixed Price Schemes

3.6.1 Introduction

The current interest in auctions for conservation contracts is based on the assumption that a price-discriminating auction is more efficient than alternative fixed-price contracts (Stoneham *et al.* 2003). The relative efficiency of the auction depends upon the fixed-price contract representing a realistic counterfactual for the auction. Stoneham *et al* (2003), propose a counterfactual paying a fixed amount per unit of environmental benefit. An alternative is to pay fixed payments per unit of conservation inputs such as kilometers of fencing and the area of revegetation. This approach is already widely used in Western Australia (DOE, 2004), the EU and US as a basis for conservation payments (Huylenbroeck and Whitby, 1999). It is important to note that what is being compared are the actual costs incurred under the auction and a counterfactual that attempts to generate either the input cost of achieving the same environmental outputs (or environmental outputs that could be achieved with the same costs). The counterfactual has to rely upon assumptions about how landholders would respond if faced with an alternative policy implementation.

One of the key objectives of the ALR has been to compare the efficiency of the price discriminating auction and alternative fixed price schemes. Sealed-bid conservation auctions exploit variations in producers' compliance costs to price discriminate. Depending upon the level of competition perceived by producers, the auction may deliver a given level of biodiversity conservation at a lower cost than a fixed-price contract. The size of the cost efficiency gain depends critically upon the specification of the fixed-price contract and assumptions about the rent component of the bid. For the ALR, Burton and White (2005) report a comparison of alternate fixed-price contracts to measure auction efficiency using tender data from the two rounds. This shows that efficiency measures depend upon the fixed-price benchmark selected, results vary between the two rounds in the same auction scheme and there is some evidence of some bids including a significant rent. A summary of those results is presented here.

3.6.2 Results

The starting point for the analysis is a representation of the price discriminating auction. The regulator receives tenders from producers with varying levels of environmental benefit, bids and conservation inputs. For a continuum of very small producers tendering for small projects the problem of selecting bids is summarized by Figure 3.9, where bids ranked by environmental benefit per dollar are plotted against the cumulative environmental benefit. Given a budget constraint, the total cumulative environmental benefit is *J** and the total cost of the auction, the area under the 'supply curve' S, is given by 0abJ*. If the auction is compared to a fixed-price scheme where a fixed-amount *g** is paid per unit of environmental benefit. The total cost of the fixed payment is 0g*bJ* and the area *ag*b* gives the efficiency gain from the auction.

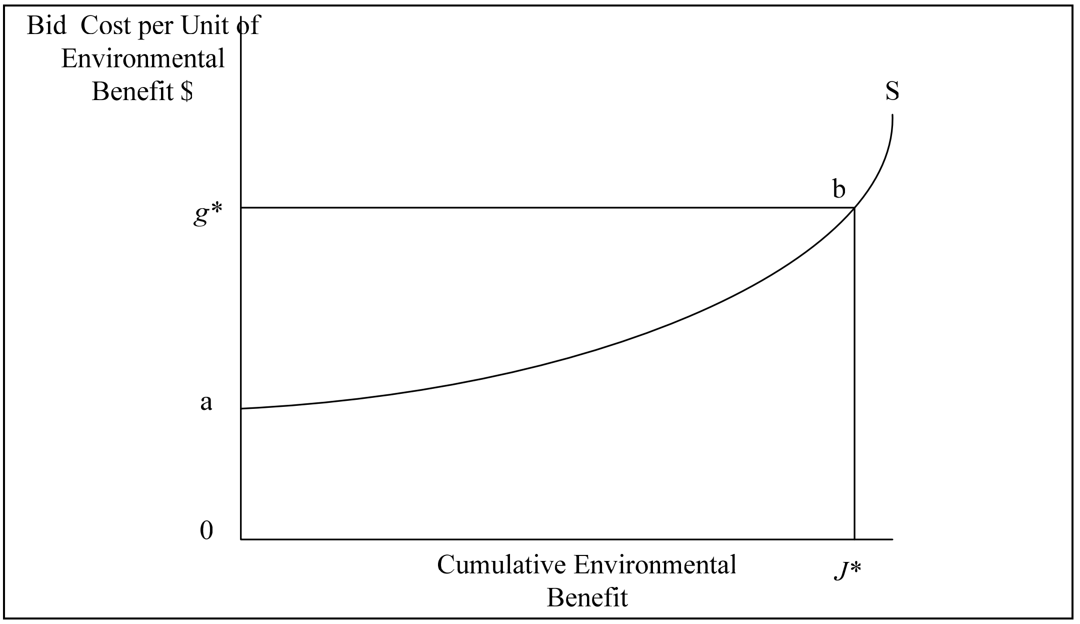


Figure 3.9: A theoretical supply curve for environmental benefits.

The theoretical model represented in Figure 3.9 is for a continuum of small producers and projects; the reality is that projects can be large relative to the budget, therefore the optimal selection is a knapsack problem (Martello and Toth, 1990). That is, projects are selected until the optimal total environmental benefit is achieved that is within the budget. The knapsack problem arises because the choice of tenders is binary and their total cost must be less than the budget constraint.

Once the successful tenders have been selected, a conservation incentive scheme can be implemented by any contract which pays the successful landholders in the auction at least the same amount as their bid; in other words the bid is used to form an individual rationality constraint. There are a number of possible price-discriminating and fixed-price contracts which can be considered:

- Contract 1 is the auction itself where successful tenderers are paid their bid in return for management inputs.
- Contract 2 is where a fixed-price per unit of environmental benefit is paid for the selected tenders (Stoneham *et al,* 2003).
- Contract 3 sees a fixed-price per unit of environmental input applied to the actual tenders – these payments ensure compliance by being greater than or equal to the bid. If the administrator of the project is restricted to fixed price contracts, there is no guarantee that the optimal set of tenders selected from the price-discriminating auction will be optimal under this framework. In other words, the administrator would make an alternative choice of successful bids if they were restricted to fixed output or input price contracts (see contract 5 below).
- Contract 4 is where the regulator makes an optimal selection of successful bids and pays a fixed-price per unit of environmental benefit.
- Contract 5 is where the project administrator selects bids on the basis of fixed prices for environmental inputs.
- Contract 6 assesses the gains from a partial price discrimination based on a fixed-price for conservation inputs where the regulator divides the successful bids into two groups with different payment rates.
- Contract 7 and 8 environmental benefit and environmental input based schemes account for the possibility that bids include an element of rent. Details on how these counterfactual contracts are implemented are given in White and Burton (2005).

It is important to note that the management inputs proposed by most ALR landholders were a combination of revegetation with native species, fencing to exclude stock, weed control, feral animal control and a range of drainage works intended to reduce salinity. Here we focus exclusively on the group of tenders proposing revegetation, fencing and feral control in order to achieve some degree of homogeneity in the tenders, reducing the sample to 27 in Round 1 and 32 in Round 2. Thus, for the purposes of the analysis we exclude some tenders, including some which may well have been selected in the tender evaluation and site selection process.

The results from the analysis of program costs when employing different forms of fixed price contracts are reported in Table 3.5, below.

Table 3.5: Comparison of program costs when employing different forms of fixed price contracts.

					Transfer payments $:			
Contract	**Round**	**Total Cost $**	**EBI**	**Cost as per cent of Contract 1**	**EBI**	**Fence km**	**Revegetation ha**	**Feral control ha**
1. Landholders paid bids to maximize environmental benefit subject to budget constraint.	1	99462	58540	100	**-**			
	2	98878	60854	100	-			
2. Fixed	1	313368	58540	315	5.353	-	-	-

payment per unit of environmental benefit	2	163129	60854	165	2.680	-	-	-
3. Fixed payments per unit of inputs	1	206197	58540	207	-	3659.87	266.;66	0
	2	183672	60854	186	-	1888.89	874.87	0.453
4. Optimal fixed payment per unit of environmental benefit	1	313368	58540	315	5.353	-	-	-
	2	142207	61584	144	2.309			
5. Optimal fixed payments per unit of inputs	1	206197	58540	207	-	3659.87	266.;66	0
	2	143327	60965	145	-	2329.41	198.71	0.88
6. Two-tier input pricing	1 tier 1 1 tier 2	148370	58566	149	-	3911.53 2212.92	37.88 266.67	0 0
	2 tier 1 2 tier 2	135348	60956	137	-	2207.09 1513.94	376.86 1.50	0.88 40.69
7. Efficient frontier fixed-payment per unit of environmental benefit..	1	282494	58540	284	4.826			
	2	69892	61323	71	1.139			
8. Efficient frontier fixed-payments per unit of inputs	1	86016	58540	86		2009.52	52.08	0
	2	85159	61160	86		1195.29	123.52	0.238

Table 1: footnote: Contract 1 is the outcome from a price discriminating auction.

EBI is the aggregate EBI obtained under each contract.

Cost as per cent of Contract 1 reveals the budegt efficiency gain from Contract 1

3.6.3 Discussion

The first conclusion from this analysis is that the data drawn from the ALR pilot auction scheme report a significant increase in efficiency over an output-based and an input-based uniform price scheme of between 315 and 207% respectively in Round One and 165% and 186% in Round Two. Although not as large a gain as reported for the BushTender project of 700%, this may reflect the pilot nature of the ALR, and the relatively small level of funding for on ground works, such that the project operates in a zone where the marginal cost of purchasing benefits is not rising steeply.

A further, more speculative analysis, attempts to adjust bids to identify and eliminate the rent component on the basis that a farm taking part in a fixed -price scheme, may earn rent, but will not be able to use a bid to extract rent from the agency undertaking the auction. The problem with analyzing this issue is that the compliance costs are not observed and therefore have to be inferred from actions and the bid. If the bid cost is simply adjusted to a bid frontier Corrected Ordinary Least Squares (COLS: Winsten, 1957) this assumes that all firms can reasonably be expected to derive the same level of private benefit as the firms on the frontier. With the COLS frontier the percent gains from the auction fall for both the uniform-price schemes to 284% for the output-based scheme and to 86% for the input-based scheme in Round One and 71% and 86% in Round Two.

The choice of a counterfactual fixed-price scheme to measure auction efficiency should be guided largely by what is a pragmatic alternative. In Western Australia an input-based incentive is widely applied in conservation incentive schemes but a scheme where payments are linked to actual realised environmental outcomes has, to our knowledge, never been considered. Designing tiered contracts where different producer groups are paid different rates increases efficiency but may not be acceptable to the farming community. Finally the rent component of bids is of interest in that fixed price schemes are less vulnerable than auctions to rent-seeking. Given the straightforward nature of the actions proposed by landholders in the ALR, there is evidence either of significant rent-seeking or variations in the opportunity cost of labour. It may be the case that, if incentives are run at a larger scale, with more understanding of the competitive nature of the bidding process, this rent-seeking behaviour will be reduced, but that is an empirical question that will depend on the nature of any future MBI schemes.

3.7 Objective 4: Analysing Administrative Efficiency

3.7.1 Introduction

The purpose of this objective was to provide insight into the administrative costs of the ALR, and, where possible, to identify costs specifically associated with running an auction. In undertaking this, a number of factors have to be borne in mind. Firstly, with any conservation scheme, there are a number of fixed costs that will not vary as the size of the budget/area protected changes. As such, small pilot schemes such as the ALR will look inefficient, but that is only because of the budget limits imposed upon them. Secondly, the ALR was both a research project and an on-ground implementation project. Under normal conditions the research component (including the communication and dissemination to the MBI pilot program management process) would not have been undertaken. Separating out these different elements of costs is difficult and imprecise but important if one wants to identify the costs associated with the on-ground project, which are the relevant component for any agency that may wish to implement something similar. However, an attempt has been made to do that here.

The total funds available to the ALR were $495,000, of which $200,000 were available for on-ground work. These values are the budget available from the MBI pilot program, and do not reflect in-kind contributions made by partners.

The focus of efficiency assessment for conservation auctions has been almost entirely on the benefits from reductions in transfer payments when compared with fixed price schemes. This analysis is valid and measures an important component of the overall efficiency of an auction mechanism but it is only a partial measure. Administrative costs are defined broadly here to include all costs which are not transfers to landholders for on-ground works. This includes fixed and variable operational costs, research costs and reporting costs. Administrative costs can account for 30-80% of the total cost of an agri-environmental Scheme (Falconer & Whitby, 1999). In the case of the ALR, the estimate of administrative costs including all research and operational costs is around $500,000 and with an expenditure on transfer payments to landholders of around $200,000 administrative costs account for 70% of the total cost of the project. Superficially, this would appear to be a very large proportion of the total project cost, however it is not out of line with the small number of other estimates cited above from Australia and Europe. Inevitably, a pilot project budgeted to only spend $200,000 on on-ground work is going to have administrative costs as a high proportion of total expenditure.

Administrative costs arise in agri-environmental schemes to overcome a deficiency of information between the agency that is undertaking the scheme (in this case the ALR team and then subsequently Avon Catchment Council) and the agents (Landholders). In terms of the ALR, administrative costs were incurred during four stages: Scheme design, Implementation, Tender Selection and Evaluation. What is apparent (Huylenbroeck and Whitby, 1999) is that these stages are common to most agri-environmental schemes and therefore the issue to address is whether there is anything specific about an auction scheme which will increase or reduce administrative costs. There is also a strong possibility that a pilot project with a temporary ‘bureaucracy’ and obligations to produce research and reports on the project will have a relatively low administrative efficiency. In previous studies administrative costs have been extracted *ex post* from large bureaucracies and may be prone to under-estimate. Here the estimate of administrative costs aims to include all in-kind contributions, in addition to those included in the original budget.

3.7.2 Administrative Costs for the ALR

3.7.2.1 Overview

Table 3.6 reports a summary of the estimated costs borne by each project partner. In some cases these costs are financial costs that can be directly attributable, in others (such as staff costs) these are inferred from the time commitment of partners. However, these costs are no less real: they are borne through the project partners co-funding of the project. The final column (Budget) gives the actual financial budget associated with each partner. The costs reflect different types of activities of the partners. WWF were responsible for project coordination and providing training and guidance to the Community Support Officers. NEWROC employed the CSOs and Avon Catchment Council provided legal and administrative support for the contracting process. These partners dealt directly with landholders and had the key operational role in implementing the auction. CSIRO and CALM were responsible for tender evaluation and establishing the database required for tender selection. UWA had an operational role in terms of auction design, the design of documentation for landholders and input into the tender selection process. CALM, landholders, the Department of the Environment, Greening Australia WA and the Department of Agriculture participated in the management appraisal process assessing the feasibility of proposed management actions. Murdoch University produced a project overview. Greening Australia provided input to the project steering group. Landholders and the WA Farmers Federation provided input through landholder focus groups. A number of agencies and NGOs contributed to CSO training.

The overheads and wages for the CSOs are based on actual payments while all other partners returned estimates of staff costs. Overheads referred to in the calculations include both partner-specific multipliers based on staff costs as well as any specific operational costs.

Table 3.6: Estimated total cost to project partners in the Auction for Landscape Recovery pilot project.

Partner	Overheads	Notional staff costs	CSO wages	Total by partner	Allocated budget
NEWROC (Community Support Officers)	19013		98112	117125	135000
WWF	25255	74700		99955	48000
Landholders	54	540		594	
University of Western Australia	90860	40860		131720	50000
CSIRO and Australian Museum	78109	101837		179946	27000
Murdoch University	2469	24690		27159	15000
Department of Conservation and Land Management	783	7829		8612	5000
Avon Catchment Council	339	3385		3724	15000
NEWROC (Administrative costs)	7028	6000		13028	
Dept of Agriculture WA and Department of the	213	2132		2345	

Environment					
Greening Australia WA	49	488		536	
Total	224172	262461	98112	584744	295000

The contribution by some partners was significantly in excess of the budget. In particular, WWF contributed 100% over budget and CSIRO 656% over budget. This is important as the administrative costs of a large scale project should be taken into consideration, even if some of the costs are similarly 'hidden' within agency budgets.

The following sections disaggregate partners' costs by activity and into research/operational components.

3.7.2.2 Community Support Officers

The largest element of variable operational costs of running the auction was accounted for by the employment of Community Support Officers by NEWROC and expenditures associated with establishing the auction. These expenditures are summarised in Table 3.7. The costs are summarised per tender and per landholder (over the two rounds 57 landholders submitted 89 tenders, with some landholders submitting multiple tenders).

Table 3.7: Cost breakdown for Community Support Officers, Auction for Landscape Recovery pilot project.

Cost Category	Total	Cost per tender	Cost per landholder
Salary	98112	1102	1721
Training	996	11	17
Equipment	546	6	10
Travel and accommodation	15528	174	272
ALR project promotion	1943	22	34
Total costs	$117125	$1316	$2055

The ability of the CSOs to deliver services efficiently (in terms of time) was greatly reduced by workload fluctuations due to deadlines for expressions of interest and tenders. A full scale project would have been able to eliminate these bottle necks and increase the number of tenders evaluated. Travel and accommodation costs reflect the remoteness of the NEWROC shires and long distances between farms and towns. A very small proportion of these costs, if any, were specific to the scheme being administered as an auction. The CSOs were largely responsible for site assessments and assembling/producing site-specific data.

3.7.2.3 CSIRO Tender Evaluation

The CSIRO activities included the design and collation of all relevant data, spatial data analysis skills and the operationalisation of the tender evaluation process and communicate of this to the rest of the tender evaluation team. These activities represented a mixture of research and variable operational costs which are difficult to separate. In terms of in-kind contribution, CSIRO made the largest contribution over budget and this reflected the complexity of the tasks involved in establishing the database and the need for staff with a range of skills to be involved.

Table 3.8: Disaggregation of CSIRO staff costs by activities, and distribution to Operational and Research components of the ALR. Note that this decomposition of costs is for the labour component only.

	Estimated Staff Costs			
Activity	**Total cost**	**Operational Cost %**	**Research $**	**Operational $**
Establish environmental outcomes	728	100	0	728
Develop suitable site assessment method	2170	50	1085	1085
Design and manage site assessment and tender databases	16610	100	0	16610
Develop biodiversity surrogates and conservation targets from relevant biophysical data	21540	100	0	21540
Develop two alternative methods of tender evaluation (EBI & SCP)	11390	50	5695	5695
Evaluate tenders and select successful tenders	23230	100	0	23230
Analyse minimum information needs for delivery of auction approach at regional scale	1750		1750	0
Provide relevant information for evaluation of project relative to other incentive schemes	88		88	0
Provide relevant component/s of site assessment training for CSOs	3070	100	0	3070
Coordinate data entry by CSOs	2100	100	0	2100
Compare tender evaluation methods (EBI & SCP)	960		960	0
Provide comprehensive and relevant reports on above	10150		10150	0
Website access for reports	0	50	0	0
Participate in Science Team	4300	50	2150	2150
Participate in steering committee	3750	50	1875	1875
Total ($)				78083

2.4 Summary Operational Costs

The contribution of ALR partners in terms of operational costs amounts to a total cost of $3607 per tender (Table 3.9). The variable costs are an estimate of costs which vary directly with the number of tenders processed; fixed costs are those which do not vary directly with tenders. Thus, if the size of the on-ground works budget were to have been increased, we estimate that the fixed costs of $163,381 would not change, but be spread across the larger number of tenders, and hence the proportion of operational administrative costs would fall significantly as a proportion of the project cost.

Table 3.9: Operational cost for project partners in the Auction for Landscape Recovery pilot.

Partner	Overheads $	Staff costs	Total $	Variable costs	Fixed costs
NEWROC (Community Support Officers)	18252	94445	112697	112697	0
WWF	14943	46611	61554		61554
Landholders	54	540	594		594
University of Western Australia	14301	14301	28602		28602
CSIRO and Australian Museum	39054	50918	89972	44986	44986
CALM	728	7284	8012		8012
Avon Catchment Council	339	3385	3724		3724
NEWROC	7028	6000	13028		13028
Department of Agriculture and Department of the Environment	213	2132	2345		2345
Greening Australia WA	49	488	536		536
Total costs ($)			321064	157683	163381
Total costs per tender ($)			3607	1771	1835

3.7.2.4 Research Costs

In the context of this project, research costs are those incurred by undertaking activities relating to the nature of the pilot project. The major contributors include University of Western Australia, CSIRO , WWF and Murdoch University. The operation of a technical advisory group (the ALR Science Team) and reporting obligations for the MBI pilot program added significantly to research costs.

Table 3.10: Research costs of the Auction for Landscape Recovery pilot MBI project.

	Research Costs		
	Overheads	Staff costs	total
NEWROC (Community Support Officers)	760	3668	4428
WWF	10312	28089	38401
University of WA	76559	26559	103118
CSIRO and Australian Museum	39054	50918	89972
Murdoch University	2469	24690	27159
CALM	55	545	600
Total ($)			263678

3.7.3 Conclusions

It is a characteristic of agri-environmental schemes that they incur significant administrative costs relative to transfer payments. These administrative costs tend to be particularly high during the initial years of a project, and the opportunity cost of these funds is in terms of additional on-ground expenditure. There is no evidence from this analysis that significant costs were incurred by running an auction rather than a fixed price or a negotiated scheme.

It should be noted that the administrative costs described here are only those associated with establishing the project, and the initial funding of the tenders. It should be anticipated that further costs will be incurred in terms of monitoring and enforcing compliance. However, these costs could be greatly reduced by putting in place penalties for breach of contract by landholders. Such penalties have not, to date, formed part of agri-environmental schemes in Australia.

The analysis of the full costs of administering the ALR is made difficult by two factors: firstly, much of the cost has been provided as unfunded in-kind support, and as such it is difficult to capture all of these contributions. Secondly, the ALR is unusual when compared with other conservation incentive schemes in that it includes both research and implementation components. Again, separating these two is a difficult and imprecise activity. Nonetheless, it is not clear that there are additional costs associated with the auction process itself, although the high information needs and complexity of the SCP may have increased the costs of this form of tender evaluation mechanism. Perhaps the most significant learning from this evaluation is the relatively high ‘fixed’ cost component of such a scheme, and the associated implication that any program needs to operate at a sufficiently large scale that these fixed costs can be efficiently distributed across a number of tenders or funding applications.

3.8 Objective 5: Analysing Communication Strategies with Landholders

3.8.1 Promoting the ALR

Responses from the ALR landholder survey indicate that the three most effective means of communications to landholders was through local newsletters, the Community Landcare Coordinators, or the ALR Community Support Officers (CSOs). These results suggest that avenues for locally-based information dissemination for NRM proved to be an effective means for promoting the ALR. The high number of randomly selected non-participant survey respondents who had heard about the ALR (19 of the 31) also indicates that there was effective use of media and other means for informing landholders in the study area about the ALR project. There was no evidence that landholders utilised the available website for accessing information and tender documents.

In relation to publicising the ALR, it is important to comment on the confusion caused by the utilisation of the word ‘auction’ in the context of a conservation funding scheme. The CSOs reported that many landholders found the word a frustrating technical term that they did not find related, intuitively, to what they were required to do in order to participate. The problem arose because ‘auction’ is a term that is, by the general public, commonly connected with land and house sales. Difficulties with the use of the term were also reflected in discussions with three of the ALR participants who took part in the landholder survey.

3.8.2 Community Support Officers Role

The feedback from landholders in the survey indicates that the placement of CSOs in the study area was a very positive and important element of the project’s auction design. The CSOs assisted in both attracting participants and supporting landholders through the tender submission process. The feedback from some landholders indicates that the CSOs have also had a role in terms of engendering enthusiasm and providing inspiration to participants. There was also very positive feedback from survey respondents relating to the visit from the CSO to their farm for the purpose of undertaking a site assessment. The comments from landholders indicate that the positive response is related to having personal contact with the ALR project team, and liking the fact that the CSO had seen what they were trying to achieve through their project. These results have important implications for the naming and communication of similar mechanisms in the future.

3.8.3 Communicating Economic Aspects of the ALR Design

The dissatisfaction that some landholders had with the use of 'auction' apart from a dislike of the technical use of the word, is perhaps also related to the feeling that the ALR was similar, conceptually and practically, to conventional grant-based schemes – i.e. the ALR was offering financial assistance for on-farm activities and the ALR was making a minor technical distinction in its emphasis on the use of the word 'Auction'. In the preliminary telephone interviews with Round One participants, landholders were specifically asked about ways in which they found the ALR different to other environmental schemes. The responses from 12 of the 14 landholders who answered this question indicates that they did not see the ALR as very different, other than being a simpler process with fewer information requirements. This mirrored feedback from the landholder Focus Group meeting held outside the project region, but in the nearby regional town of Northam in 2003. There was consensus among landholders in the Focus Group that the ALR was no different from a basic grants-based incentive. This may reflect a degree of sophistication among landholders, in recognising that all of the aspects of the ALR could be mimicked within any grant-based scheme, apart from the process of setting the tender value, or it could be a lack of understanding of the key competitive, information-revealing, role of the tender value process.

There has been, however, some feedback from landholders that suggests that there may have been some advantages in attempting to communicate a conceptual distinction, by name at least, between the ALR and conventional devolved-grant schemes. In the structured interviews in the farm survey there were several (9 of the 31) of the ALR participants who explicitly mentioned that they were interested in participating in the ALR because it took a different approach. The differences that these landholders identified related to either the flexibility of the auction or the competitive evaluation of the projects landholders submitted. For example there were several (7 of the 31) respondents who returned specific comments about the encouraging aspects of being able to budget their own project; one landholder indicated that they had participated because the ALR was the first scheme that allowed them to include labour costs.

Other landholders experienced difficulty in working with the flexible design of the ALR. Some landholders, primarily Round One participants, raised concerns regarding the need for more specific guidelines on the kinds of on-ground works being sought in the ALR. These issues are reflective of the difficulties the ALR project team had in Round One in being able to clearly define how the multiple benefits would be assessed in the tender evaluation process. This difficulty presented challenges for the communication with landholders.

There were significant learnings from the ALR project team in regards to communicating guidance to landholders and improvements were implemented from Round One to Round Two. The challenges that were experienced highlight the importance of being able to clearly articulate what the 'market signal' is – that is what the project wants to buy – so that the bidders are able to submit a valuable project. Some further discussion of the issues concerned with communication of the target outcomes is continued in the section below, where some of the issues regarding the implementation of the ALR in a salinity-affected landscape are highlighted.

3.8.4 Communicating ALR Target Environmental Outcomes

Auctions for biodiversity conservation, by design, attempt to establish a market-like setting in which to buy and sell biodiversity goods and services. The feedback from landholders and the bidding behaviour across the two rounds discussed in this section provide some insights into the challenges of establishing a market setting in which there is clear communication (or signaling) of market incentives for biodiversity conservation.

The ALR was designed as a biodiversity conservation auction with multiple environmental targets because of the known salinity and water quality problems in the study area, and the known links between these processes and the degradation of biodiversity assets. Apart from the technical challenges of defining and measuring the multiple benefits in the tender evaluation process, the project team was also aware of the challenges of communicating the multiple benefits targets to landholders. The communication challenges related primarily to the need to avoid misunderstandings about the projects' overarching objective of achieving landscape-scale biodiversity benefits.

There were also challenges in communicating what is meant by 'biodiversity conservation' on the ground. The ALR team decided to use the term 'nature conservation' rather than 'biodiversity conservation' in communications with landholders because of prior experience that 'biodiversity' was not a term widely understood by landholders. In the landholder survey a question was not included to specifically solicit details of how landholders define 'nature conservation'. However, there is anecdotal evidence from the survey that many of the interview respondents held a fairly broad definition of nature conservation. In the interviews it was clear that nature conservation defined by the landholders includes activities with strict biodiversity outcomes as well as activities related more directly to land conservation such as soil conservation, surface water management, planting trees for wind breaks, fox baiting for stock protection, and salinity mitigation. On the other hand the definition of 'nature conservation' applied by the ALR tender evaluation was strictly confined to evaluating activities with potential biodiversity conservation outcomes.

In the landholder survey the ALR participants were asked to rate the importance of the ALR's target outcomes for their local area. The majority of respondents felt the ALR environmental targets were of substantial importance to their local area. This is a promising result, and not necessarily an unexpected one given that these were responses from landholders who had voluntarily chosen to participate in the project.

In contrast, regarding the most disappointing aspects of participating in the ALR, there were issues raised by some of the Round One participants with reference to the target environmental outcomes in the ALR and salinity management priorities. There has been a clear message from the interviews that the primary land management concern of many of the landholders, both ALR participants and non-participants, is salinity. A substantial amount of the landholder-directed discussion during interviews centred on the subject of salinity, and the technical and political dimensions of engineering solutions to the problem. It is perhaps not surprising that a large proportion (almost 30%) of the tenders submitted in Round One proposed engineering interventions (drainage or groundwater pumping) largely for surface water control or salinity mitigation purposes. Many of these projects had largely on-farm benefits and difficult to confirm biodiversity benefits (WWF-Australia 2004). It seemed obvious from the tenders submitted in Round One that there were some misunderstanding from landholders about the target outcomes of the ALR.

Some of the responses by landholders on the subject of nature conservation and salinity are highlighted below. These provide insight into the challenges, from a landholder perspective, posed from the salinity setting of a biodiversity conservation scheme such as the ALR.

There was some general disappointment raised about the scope of the projects that were successfully funded in Round One. For example one landholder commented:

> *"The scope was limited, no value was given to engineering solutions but they are the beginning of recovery from salinity and long-term nature conservation"*

Another comment from an ALR participant expands upon this issue:

> *"We were given suggestions on how to change our application for Round Two to be more likely to be successful but it doesn't work in the long-term [referring to trees], we know that, and it is frustrating to see funds going in that direction. We have learnt what not to do. Priorities are: start with land and deal with salinity. By fixing the soil [saline soil] then the environment will in turn be protected…"*

And a straight-forward comment from another participant:

> *"Are we on different planets? …there are many more things [referring to salinity] than stock affecting our remnants…"*

In response to the lack of clarity in relation to project outcomes in Round One, the ALR team considered changing the stated outcomes of the ALR in Round Two to a single outcome target of biodiversity conservation. For reasons of consistency, this change was not instituted. There was, however, a significant change in emphasis on on-ground project development discussions by the CSOs with landholders. In the second round the CSOs were clear in their communication with landholders that projects that did not have a biodiversity conservation focus were unlikely to be considered suitable. As a result the Round Two projects submitted by landholders were significantly more homogeneous than those in Round One, with the majority of Round Two projects focusing on works to protect or enhance biodiversity such as fencing, regeneration, re-vegetation, or feral animal control.

Once the biodiversity conservation target was more clearly communicated to landholders, a small number (4) of landholders who had participated in Round One said that they realised that the ALR objectives had limited relevance to the project they were prepared to enter as a tender. Hence, the decision from these Round One participants not to participate again was perhaps on the basis of a more realistic expectation of whether the project would be funded.

3.9 Objective 6: Identifying Key Success Factors and Impediments

A number of key success factors and impediments have been identified within the operations of the ALR pilot project and are listed below. Many are likely to be relevant to the implementation of similar projects elsewhere.

3.9.1 Key Success Factors

A number of factors were considered by the ALR project team to be important to the success of individual components of the project. They are:

- The availability of appropriate computer software and the ability of the software to capture economic trade-offs.
- The ecological and economic models worked well together, largely because the representation of the ecological management task within the *TARGET* software is operationalising a constrained optimisation problem.
- The availability of spatial data to set conservation targets.
- The availability of a person with insights into the mechanisms and the technical skills and ability to integrate data and communicate the process to a diverse range of people in the team (not having a person or people with similar skills/abilities would be a key impediment).
- The development of an enthusiastic and committed multidisciplinary project team who understood each others' role and frequently contributed more time and resources to the project, in order to support the interdependency between roles, than the actual budget provided for.
- An effective mix of practical and academic disciplines to run and analyse the pilot project.
- Availability of resources to be able to employ community support officers and having these field staff locally based.
- Using an expert reference group to facilitate decision-making. To a large extent they replaced a formal analysis of future management benefit of project outcomes.
- Use of a price-discriminating auction enabled the ALR to establish a competitive market for biodiversity conservation services.

- Two bidding rounds. Originally conceived as part of auction design, the two rounds enabled key learnings from Round One to be instituted in Round Two. The pilot was much stronger, with more reliable results, because of this.

3.9.2 Key Impediments

A number of factors were considered by the ALR project team to be impediments to the success of individual components of the project. They are:

- The relatively short project timeframe impacted on many aspects of the project, and in particular, the constraints imposed by the agricultural calendar, and thus, availability of landholders once key farming events such as seeding or harvest started, made management of the project timelines difficult.
- The ALR budget was restricted to $495,000 in total, with $200,000 available for on-ground works. Four field/managerial staff were employed by the pilot. The budget constrained many aspects of the project, including the actual operation of the tender process and ability to fund projects with meaningful environmental outcomes. The project relied, critically, on significant in-kind contributions and this did not always provide the necessary resources or input at key times. It also caused strain with a key partner at a critical time.
- The methodology behind the EBI is complex and requires a large amount of assessment at different scales, which can only be carried out by experienced/knowledgeable individuals, and/or in conjunction with an expert panel.
- The inability to develop or use effective estimates of future management benefit of tendered projects and threat/risk analysis. Methods already used in other projects are of questionable value, especially when transferred to a new environment. A dedicated research program is required to develop this area and provide workable and meaningful methodologies. Reliable scientific information on the nature of the relationships between land use change and ecosystem impacts is critical for the functioning of environmental markets (Whitten *et al*. 2003).
- The SCP process is challenging to communicate, given its conceptual and computational complexity: both process and the means by which tenders are evaluated and selected are difficult to communicate to many stakeholders.
- While we identified as a success factor the availability of spatial data as allowing the development of a set of ecosystem types against which targets could be set, there were also significant limitations relating to using such data for this purpose. This is a particular issue in the extremely diverse Southwest Australia ecoregion and one that confounds the application of simple mapping, selection and prioritisation processes. Access to biological survey data would have facilitated evaluation of the ecosystem types and their use as a surrogate for biodiversity in the region.
- Appropriate spatial data were not available ‘off the shelf’ or from a central location in Western Australia for use at a regional scale of analysis, meaning that it was relatively time consuming to convert/interpret available data for regional use for a pilot program. Such time commitments are often under-estimated.
- The plan to include multiple environmental benefits in the ALR was probably poorly considered. Unrealistic project goals and a failure to early recognise funding and other limitations contributed to difficulties in this regard. Complex environmental benefits metrics were unlikely to be developed within the lifetime of a time-limited field and research trial. Although a multiple benefits auction has recently been developed in Victoria under the MBI pilot program, it was fully resourced and is only now being field tested. Appropriate metrics for assessing multiple environmental benefits of proposed management actions by landholders are not available ‘off the shelf’ and could not be developed and tested within the life of this pilot. In addition,

there is some suggestion (D. Pannell, pers.comm.) that single outcome projects may be more appropriate in the salinising landscapes of the Western Australian wheatbelt, where management actions to effectively mitigate salinity may not necessarily coincide with actions to conserve biodiversity.

- The limited budget for on-ground funding ($100,000 in each of two rounds), restricted the scope and scale of the auction to biodiversity conservation-focused actions within the NEWROC area of the Avon Catchment Council NRM region. As a result projects of significant size that could make an impact on broader issues (e.g. salinity) were not feasible. The degree to which a small on-ground funds budget constrained the development of innovative and/or extensive on-ground projects by landholders for biodiversity conservation is unknown.

3.9.3 Conservation Auction Schemes and Questions of Regional Significance

Within ALR reporting requirements, this objective is also concerned with the identification and definition of key success factors and impediments as they relate to conservation auction schemes in Australia and the factors thought to be regionally significant. Although this information is relevant to the implementation of MBIs elsewhere, particularly auctions, it was not possible within the resources and the timeframes of the project to undertake an appropriately detailed analysis of this issue. Here, we offer a simple comparative analysis of three conservation auctions: the Auction for Landscape Recovery pilot, the Victorian BushTender project and the NSW Liverpool Plains project. Questions of success or failure as they relate to pilot design and other factors are covered in Section 4.

All three projects were based on voluntary tenders with rural landholders (Table 3.11). They all focussed on biodiversity, although the Liverpool Plains project was more broadly focused on environmental benefits. The ALR had the smallest budget allocated for on-ground works and consequently small scale projects were developed and the smallest number of contracts signed. Site-based assessment is a feature of all three auctions, although the ALR remains the only auction to have tested a Systematic Conservation Planning metric utilising regional complementarity.

Table 3.11: Summary of project details for Auction for Landscape Recovery (WA), Liverpool Plains Tender (NSW) and BushTender (Victoria)

Feature and details	**ALR**	**LP**	**BT**
Project details			
Biodiversity conservation focus	√	--	√
On-ground funds	$200,000	$735,000	$400,000
Areal extent (no. of Local Govt Authorities/catchments)	7 LGAs	1	2
Auction type			
First price, sealed bid, price minimisation and discrimination, no reserve price	√	√	√
Number of rounds	2	2 (3?)	1
Input-based tenders (where inputs include fencing, revegetation etc)	√	√	√
Site-based assessments of tenders integral to evaluation	√	√	√
Regional complementarity assessment capability in tender evaluation method	√	X	X
Contract type			
Individual management agreements with progress payments	√	√	√
Number of contracts signed	22	35	73
Area under contract (ha)	?	7,000	3,160
Length to be fenced (km)	?	230	?

Sources: Stoneham *et al*. (2003), Clayton (2005), White & Burton (2005), and unpublished quarterly activity reports by the Auction for Landscape Recovery to the Commonwealth.

Table 3.12 provides some comparison between the three auction approaches in terms of information requirements, landholder engagement, quantity and quality of bids, and quantity and quality of management interventions proposed by landholders.

Table 3.12. Summary of information requirements, landholder engagement, quantity (and quality) of bids and quantity (and quality) of proposed management interventions. Key: ALR = Auction for Landscape Recovery; LP = Liverpool Plains, BT = BushTender.

Feature and detail	**ALR**	**LP**	**BT**
Auction information requirements			
Single-price tender (no requirement for detailed costing of actions)	√	√	√
Relied on calculating an environmental (biodiversity) score for each tender to identify the 'best' tenders	X	√	√
Regional conservation priority of tender part of evaluation	√	√	?
Regional/landscape contribution of tenders *as a set* underpinned tender selection	√	X	X
Scarcity of vegetation (i.e. conservation value) included in the environmental index	?	√	√
Amount of biodiversity improvement/benefits possible through tender included in environmental index	X	√	√
Other environmental benefits (e.g. salinity management) included in environmental index	√	√	X
Land use change impact score part of environmental index	√ (in Round One)	√	X
Landscape-level threats (e.g. salinity) included in scoring	X	?	X
Expert panel provided advice on the practicality of tenders/finalisation of scoring	√	√	√
Landholder engagement			
Those submitting tenders who had not previously participated in agri-environmental schemes (%)	23% (*n*=31)	?	18% not Landcare members
Biodiversity information revealed to landholders	No	No	No
Habitat services information revealed to landholders	N/A	N/A	Yes
Feedback to landholders on lack of tender success	√	√	?
New landholders between rounds?	15 out of 24 (in Round Two)	?	?

* Each calculation is based on different assumptions: ALR figure based on a comparison with fixed payment per unit of input scheme (White and Burton 2005; these authors also explore other efficiency estimates); LP figure based on estimates of costs for similar works given in their Regional Investment Strategy (WWF-Australia, 2004); BT figure based on a fixed price scheme where it is assumed to pay the marginal price determined from the auction (Stoneham et al. 2003).

[1] Calculated as the percentage of contracts within which this action is proposed.

[2] Calculated as the percentage of sites where this action is proposed.

[3] Calculated as the percentage of the total area under contract where this action is proposed.

Sources: Stoneham *et al*. (2003), Clayton (2005), White & Burton (2005), WWF-Australia(2004), Anon. (n.d.), together with unpublished quarterly activity reports from the Auction for Landscape Recovery to the Commonwealth.

No detailed comparative analysis is possible from this information. The tables above provide some sense of the key similarities and differences between the three conservation auctions.

3.10 Objective 7: Communicating Pilot Results

One of the ALR's objectives relates to the requirement to transfer information about progress and findings of the pilot to stakeholders locally, regionally, nationally and internationally. The ALR project team has undertaken to meet this objective through a variety of means. Table 3.13 summarises the type and number of communications such as workshop and seminar presentations, poster and conference papers and papers submitted to refereed journals. Only communications complete or underway (e.g., abstracts accepted) are included here.

Table 3.13: Types of communications undertaken by Auction for Landscape Recovery project partners in communicating pilot progress and results to September 2005. Communications listed are those that have been completed, or for which abstracts have been accepted or papers submitted/are in review.

Type of communication	Examples	Number
Workshop or seminar presentation	MBI Round Tables, Biodiversity Indicators Workshop, regional NRM group meetings/seminars, landcare professionals workshop, Biodiversity Auction Practitioners Workshop, National Conservation Incentives Forum	14
Invited speaker	NHT Advisory Committee Conference dinner	1
Poster paper	Salinity Solutions Conference, National Conservation Incentives Forum; Ecological Society of Australia Meeting 2005	2
Conference paper	AARES Conference, Salinity Pre-conference Workshop, 11th International Symposium on Society and Resource Management	6
Refereed journal paper	Australian Journal of Agriculture and Resource Economics	2

4 Factors Contributing to Project Success or Failure

4.1 Mechanism Design

Two aspects of the design of the market-based instrument adopted by the Auction for Landscape Recovery were important factors in the project's success. These were the utilisation of a price-discriminating auction and the use of two bidding rounds instead of one.

The key attribute of mechanism design leading to the success of the ALR project is the use of a price-discriminating auction. This allowed us to develop a competitive market in the provision of biodiversity conservation services within the NEWROC project region. The competitive market enabled us to maximise the level of biodiversity outcomes, and also increase the total number of successful tenders. The distribution of costs revealed in Section 3.1.1 suggests that if a fixed price scheme had been used then we would have been able to fund significantly less activity on ground. Although the primary purpose of the ALR pilot was to field test a number of concepts rather than act as a conservation scheme in its own right, the ability to engage with more landholders will have ensured that the scheme it self will have had a higher profile in the region.

At an early stage in the auction design it was decided to operate with two rounds of tenders. The initial intention was to allow for landholders, who were likely to be be unfamiliar with the concept of an auction, to 'test the water' with Round One and then fully engage in Round Two. As such it was, in part, a risk management strategy on the part of the project management team. However, of more importance *ex post* was the ability of the project team to adaptively modify many aspects of the administration of the second round auction, and in that sense this part of auction design was a major contributor to the success of the project. One countervailing negative impact was the implication for the project timetable. Running two rounds in the limited time period of the pilot, combined with the limits imposed by the agricultural year led to periods when extremly tight deadlines were imposed on ALR project management activities Running a single round would have allowed more development and testing of materials and methods prior to the implementation of the field project. Alternatively, the project timeline could have been usefully extended by 12 months, thus allowing for more flexible project management around key events of the farming calendar.

4.2 Measurement of Outcomes

The metrics employed by the ALR for tender evaluation have been reported in detail above (see Sections 2.2.5 for Environmental Benefits Index; 2.2.6 for Systematic Conservation Planning and 3.4 for a comparison of the two methods). As a tender evaluation metric, the EBI has previously been utilised within BushTender (Stoneham *et al.*, 2003) and is currently being adapted and utilised within a number of other conservation auctions, eg Plains Tender (Victoria), River Tender (Victoria) and Bush Returns (Victoria). The ALR successfully integrated two tender evaluation metrics, SCP approach and EBI for the first time within a conservation auction. It was the first time an SCP approach had been operationalised in this way. Although work remains to be done, utilisation of a novel integration of two metrics is one of the successes of the ALR pilot.

4.3 Project Planning and Management

This is considered under Section 3.9 above, success factors and impediments for the ALR.

4.4 Engaging Agents

The ALR pilot has effectively engaged a wide range of stakeholders/agents. This section considers some agents engaged by the project together with the implications of this engagement for the implementation of similar projects elsewhere. Here, we consider a number of key agents:

The ALR was efficiently managed by a non-government organisation (WWF-Australia). The NGO provided significant in-kind contributions to the project but gained considerable experience in managing a multi-faceted, multi-disciplinary MBI project. There was some evidence that there was an advantage in the project being managed by a non-government agency, in particular with the level of acceptance by landholders.

Avon Catchment Council administers one of Australia's largest NRM regions. Within the ALR, its main roles were the provision of a 'clearing house' for the lodgment and administration of legal documents such as Expressions of Interest and Tenders submitted by landholders and landholder contract design and administration. The clearing house worked well, showing that a community based NRM group can deal with this effectively. Contract design and administration by an NRM group proved less certain within the ALR. Landholder contracts were developed at a time when the Avon's regional NRM strategy and investment plan was being developed and the organisation was reluctant to commit to contracts lasting longer than three years. This is at least partly due to uncertainties of funding, even in the context of recent NAP funding. Thus, the Avon Catchment Council was unsure as to whether it would be in a position to monitor and administer contracts of longer duration. There was also some uncertainty related to the ability and authority of a community-based organisation to enforce compliance if this issue arose.

A tertiary institution, the University of Western Australia, designed the auction approach for the ALR and provided expertise in economics. This expertise is critical to the development of well-designed auctions. There is considerable anecdotal evidence from interactions with other stakeholders and groups in the course of our pilot that, in WA at least, the importance of appropriate auction design (with its underlying economic principles) is poorly understood. It is important that future projects engage economists as consultants or include them as partners in the project. As auctions are showing some signs of shifting into the mainstream as conservation incentives, it is important that core design issues are well understood. This has implications for capacity building in relation to managing/implementing auctions through inexperienced community groups and government agencies.

The pilot engaged a number of agents for technical expertise, particularly in relation to tender evaluation methodologies and data/spatial data management and manipulation. Key stakeholders here included CSIRO Sustainable Ecosystems and the Australian Museum. As the methodology adopted for tender evaluation for this pilot is not available 'off the shelf', any project implemented elsewhere would require technical expertise similar to that utilised by CSIRO.

The NEWROC played two major roles - the administrative support for the project field staff and the provision of general support for the incentive in the project region. The group of local governments had not previously hosted staff for a project of this kind. It had considerable community support, and the local government group gained knowledge, expertise and experience, and have indicated a willingness to engage in similar programs again. Elsewhere, this role could be filled by local governments or groups of local governments, NRM groups (CMAs), government agencies or large community-based organisations.

As the targets of any conservation incentive or market-like mechanism such as the ALR, landholders are a key agent. Given the funds available for on-ground works, the geographical area for implementation of the ALR was restricted to a relatively small area within the Avon River Basin, but there was sufficient interest for both rounds of the auction to be significantly oversubscribed. One of the key factors that emerged from the landholder survey was the provision of local support in the form of the CSOs. There was also evidence that, if repeated, landholders would wish to participate again in the auction, suggesting that they accepted the mechanism as a means for delivering conservation funding.

5 Potential Applications

Auctions are now a recognised incentive mechanism to address problems of biodiversity conservation. This pilot has, for the first time in Australia, addressed the question of applying an integrated approach to tender evaluation through the integrated use of complementarity in a Systematic Conservation Planning (SCP) framework and an Environmental Benefits Index (EBI). The use of EBI is well-established, but a method operationalising a metric utilising complementarity is novel. Complementarity has uses in natural resource management, in any situation where prioritisation of places for conservation is needed, and where prioritisation requires trade-offs at the landscape or regional level.

Making clear and unambiguous recommendations regarding the utilisation of either tender evaluation method tested in our pilot would be premature. The EBI targeted field-based methods of site selection and focused on site condition and the appropriateness of site actions, neither of which can be accessed by regional remote sensing methods. SCP utilises complementarity in a way that cannot be undertaken within an EBI, however site assessments, conducted primarily to support the EBI, have an important 'ground-truthing' role.

There is a question related to the necessity of utilising complementarity in highly cleared landscapes of high biodiversity value with high species turnover such as the WA wheatbelt, where most if not all remnants are of value, though resources for conservation management and environmental amelioration works are limited. Complementarity-based approaches such as the SCP have value wherever limited resources require prioritisation among biodiversity assets available for protection. The regional analyses of biodiversity information, such as those undertaken to support the ALR pilot, should be undertaken within the general context of NRM frameworks, as an explicit policy expression of regional goals and targets articulated within regional NRM plans. In this respect, SCP frameworks for NRM planning are flexible and adaptable as a metric and approach consistently underpinning a wide range of incentive mechanisms.

6 Skills Required for Implementation

In terms of expertise and skills development, specific lessons learned from the ALR pilot project have been included in other sections of this report. Generally, they relate not so much to the development of novel expertise and skills, so much as learnings regarding expertise and skills required to develop and implement a similar project elsewhere.

6.1 Technical Skills

In implementing an integrated tender evaluation method and operationalising the Systematic Conservation Planning (SCP) approach, the ALR pilot has identified a need for high level GIS and spatial data analysis skills, particularly ESRI ArcInfo™ and ArcGIS™ expertise. The costs and availability of technical expertise in GIS software needs to be fully factored into projects utilising the SCP approach or the ALR integrated tender evaluation methods in future trials or operational projects.

The development of appropriate data storage and management protocols was time-consuming and required relational database skill and expertise. Database development and/or management skills have been identified as a requirement in similar projects. In addition, information flows linked to database design, data collection and collation, and data management require timely and careful forward planning.

6.2 Organisational Skills

In terms of organisational skills, the Auction for Landscape Recovery pilot project required the skills and experience necessary for a complex, multi-faceted, multi-disciplinary research project. While some of these tasks required high level project management and communication skills, none of them is particularly novel to the market-based instrument mechanism tested here.

7 Institutional Changes Required for Implementation

The national MBI pilot program seeks to identify legislation or rules that would need to be changed before MBIs could be applied more widely. These may be relevant to State or Commonwealth legislation, local government bylaws, institutional settings in the economy, or other impediments to implementation.

The ALR pilot did not test possible institutional impediments to implementation. As the multiple benefits intent of the project was shifted to a more focused concern with biodiversity conservation, we did not need to examine possible questions of duty of care or obligations related to, for example, soil conservation or surface water management. Nor were we implementing the pilot in a part of WA where significant declared weeds are impediments to natural vegetation management. In a differently focused project, or one located in a different geographic area, these might be issues.

Another possible impediment, though not tested by the pilot, relates to positive obligations for management contracts. Although the ALR did not seek to implement a program where contracts with landholders were bound to the land title for the duration of the management contract (cf. nature conservation covenants which bind to the title in perpetuity), the lack of ability to do this in Western Australia might affect the ability of land managers and planners in this State to always enforce compliance. This might be an issue where longer contracts were being sought for larger, more complex projects.

The wheatbelt population in Western Australia is relatively small and continuing to decline (see Section 1 above). There is some anecdotal evidence from our pilot that small numbers of farm properties change hands while project funds are being expended on the property. Currently, State agencies lack the legislative power to enforce the completion of management actions where properties change owners.

8 Conclusion: Future Directions

The Auction for Landscape Recovery (ALR) is a national market-based instrument pilot that has operationalised an auction-based field trial in the NEWROC, a highly biodiverse landscape in the northeast wheatbelt of Western Australia that is threatened by salinity and the effects of large-scale clearing for agriculture. Within the auction approach, the pilot has trialed two methods of competitive tender evaluation, tested the administrative efficiency of the auction compared to fixed price schemes and undertaken landholder surveys to investigate a number of aspects of auction design and communication strategies. The ALR successfully engaged landholders in a competitive market, and effectively managed a complex, multi-faceted project with a multi-disciplinary team comprised of landholders, non-government staff, government agency staff, economists, ecologists and other scientists. A number of successes and impediments to success have been identified in this report. In addition, across the various components of this project, a number of learnings and gaps in knowledge have been identified that are relevant to future projects utilising similar approaches elsewhere, and also point the way forward to future research needs. These are summarised here.

Systematic Conservation Planning and Relevance to Conservation Auctions

- **Complementarity can be operationalised with alternative definitions of opportunity costs of management.**
    - As the ALR is concerned with biodiversity protection, it can draw on the principle of ‘complementarity’, a key principle that promotes the efficient use of limited resources in regional biodiversity conservation. The complementarity of an area is the marginal gain in biodiversity that it can provide if added to a set of other areas already managed for nature conservation. These marginal gains are often compared with alternative land use opportunities (equated with ‘opportunity costs’) when selecting sets of conservation areas (to form part of a conservation area network), in order to achieve regional biodiversity goals at least cost. However, complementarity may be even more useful for targeting economic instruments, such as conservation contracts, to specific areas. Given bids by landowners, and a budget determining total payments, overall regional biodiversity conservation may be maximised (in combination with other constraints) by comparing each bid amount to the area's current complementarity value.
- **Further research is needed to clarify the relative utility of Systematic Conservation Planning and Environmental Benefits Index in conservation auctions**.
    - At the time of this pilot, there existed no other worked examples in Australia of how a complementarity-based biodiversity metric might be implemented in an ‘on-ground’ auction setting. The comparisons of Systematic Conservation Planning and Environmental Benefits Index presented in this report provide a firm basis for communicating trends in differences and highlighting the potential gains from using complementarity as a component of frameworks to assess biodiversity benefits. However, a more comprehensive review and comparative analysis are recommended.
- **There are residual questions for Systematic Conservation Planning and conservation auctions.**
    - Systematic Conservation Planning should be tested further in the auction context. One reason is that methods for integrating practical persistence measures need to be fully investigated. Further, the scale of biodiversity surrogates compared to the scale of proposed on-ground projects needs to be

explored– how often will it be the case that sustainability targets are so high that all available projects are required for landscape recovery?

- Related to this is the need to further investigate appropriate target setting, particularly regarding the need for equitability – i.e., not expecting one sub-region, or set of candidate projects, to achieve the biodiversity targets for the broader region.
- Evaluating price discovery within the Systematic Conservation Planning framework is problematic because it is not possible to identify a unique value of the ‘benefits’ of an individual tender in isolation from all other tenders: the value is conditional upon the selected set of tenders. This problem with evaluation does not restrict the use of Systematic Conservation Planning, it simply makes it more difficult to characterise *ex post* the benefit per unit cost for each tender. There is also an issue of how to set reserve prices for biodiversity within a complementarity context, so that one can identify when tenders become uncompetitive.

Metrics

- **Environmental Benefit Index metrics may not be spatially transferable.**
    - Sufficient time and resources need to be available so that locally/regionally-relevant metrics such as the Environmental Benefits Index can be developed for or adapted to local or regional environmental or biodiversity conservation goals and local or regional situations. Testing prior to site assessment and tender evaluation is advisable. Strategies to work within the absence of benchmarking in many regions of Australia need to be considered.
- **Complex multiple benefits auctions may not be feasible in the short-term.**
    - It is unlikely that complex environmental metrics can be developed within the lifetime of time- and resource-limited field and research trials. Appropriate metrics are not available ‘off the shelf’ and may not be appropriate outside the region in which they are developed.
    - Single outcome projects (eg biodiversity conservation outcome) may be more appropriate in regions such as the salinising landscapes of the Western Australian wheatbelt, where effective management actions to mitigate salinity may not necessarily coincide, in location or scale, with actions to conserve biodiversity. Research into multiple-outcome management is necessary before projects like the ALR can realistically adopt multiple benefits approaches to complex environmental problems.
- **Methods for linking management actions to biological persistence are required.**
    - The problem facing conservation planners is the availability of measures that consistently and reliably account for biodiversity persistence, in the general sense of maintaining viable populations of all biota and of the ecosystem processes that maintain them *in situ* in the long term. The accurate and reliable prediction of response to proposed management actions is a area requiring a dedicated research program to develop workable and meaningful methodologies. The relationship between site assessment information and condition modifiers for biodiversity persistence in the context of complementarity for tender evaluation has not been fully addressed by this pilot and requires further study. The availability of datasets and capacity among ALR project team members is an asset for future work in this area.
    - The notion of viability, persistence or long-term prognosis for biodiversity is integral to Systematic Conservation Planning frameworks conservation area

design, including conservation areas identified on private land. These concepts are also articulated in the EBI through the landuse change impact score (LUCIS). Given current condition and particular management actions over a specified time frame, a more comprehensive and complete assessment of site level outcomes with respect to future condition of the land and native habitats has been identified as fundamental to tender evaluation.

- **There is a feedback loop between development of decision support tools and on-ground work.**
    - Conservation planning tools such as *TARGET* software are under continuous development, addressing the operational needs of conservation planning and management identified through applications such as this ALR market-based instrument pilot project. Software enhancements were identified, for example, that related to alternative ways in which 'probability of persistence' can be incorporated in the analysis. Research involvement in pilot projects such as the ALR is critical to ongoing development within the discipline and thus wider application within market-based biodiversity conservation mechanisms. The data and policy setting associated with selection of tenders in the ALR was ideally suited to an analysis of costs and benefits using conservation planning software such as *TARGET*.
- **Assessment of the benefit of proposed works for fauna requires development within metrics such as the Environmental Benefits Index.**
    - The assessment of the benefit of proposed on-ground works for threatened and declining fauna needs more consideration, as standard site assessment metrics are unsuitable. The ALR identified two issues here that were problematic. The first is related to fox baiting proposals, usually by groups of landholders, where the question of *'location of works'* and *'immediate area of impact'* of the works is critical.
    - The second issue identified by the ALR relates to the use by fauna of corridors. Future research work could focus on the development of a suitable metric to assess the benefit for targeted taxa of corridor construction proposals, and to critically evaluate current concepts of corridor design, applicability and effectiveness for biodiversity and landscape recovery in the Western Australian wheatbelt.

Scale Issues

- **Measures are needed of biodiversity at the appropriate scale.**
    - The wheatbelt region of southern Western Australia is characterised by high levels of diversity, endemism and species turnover. The challenge for any evaluation schema or metric applied to this region, whether it is explicit or not, is the ability to adequately account for biodiversity at a scale that is comparable to the scale of species turnover. Novel methods to account for such turnover in biodiversity are currently being developed and require access to comprehensive lists of biodiversity from integrated ecological surveys that can be used to determine compositional differences in species between sites and used to calibrate compositional differences in a suite of environmental predictors. Such data were not available to the ALR for development and testing in the context of biodiversity surrogates for the SCP approach. The application is feasible and worthy of future research.

Spatial Data Acquisition and Use

- **Technical skills in GIS are a requirement for future projects of this kind.**
  - In integrating a Systematic Conservation Planning framework with an Environmental Benefits Index, there is a requirement for considerable technical capability in GIS analysis, particularly ESRI workstation ArcInfo™ expertise. The costs and availability of technical expertise in ArcInfo™ needs to be fully factored into plans for future projects of this kind.
- **Spatial data sets may be a limiting factor.**
  - Some datasets were not available in Western Australia in the appropriate format or scale. The cross-agency utilisation of CALM and CSIRO spatial data design and management capabilities helped mitigate the impact of this issue on the quality of data delivery, however access to appropriately experienced technical staff would be important to the success of future projects utilising spatial data to this extent.

Efficiency Assessment

- **The full economic costs of alternative conservation incentive schemes need to be evaluated.**
  - The size of the transaction costs may vary for different market-based instruments. Although this study did not find any reason to infer that the auction generated higher transaction costs than a scheme with a similar level of technical evaluation, it has highlighted the difficulty in identifying the full costs of such schemes, especially when administration costs are embedded in core agency budgets.
- **The determination of economic benefits from an auction depends on the benchmark used.**
  - One of the main advantages of the price discriminating auction design is that it can deliver efficiencies in administrative costs; this has been confirmed in the current study. However, the size of these efficiencies depends on the counterfactual with which the auction is compared. The ALR pilot has identified that reasonable alternatives generate quite different estimates, and this should be borne in mind when assessing the relative efficiency of different market-based instruments.

Management Contract Issues

- **Joint tenders offer both increased benefits and risks.**
  - The risks associated with Joint Tenders in increasing the risk of default by a component landholder may offset the ecological benefits of integrated proposals. This is an issue that is linked to monitoring and compliance of conservation contracts, and would be worthy of further research.
- **Long-term management contracts may pose compliance problems.**
  - The use of longer-term contracts (5-10 years) was not tested by the ALR pilot, where contracts were limited to 3 years. Within Western Australia, positive obligation legislation, allowing for management contracts to be bound to the land title for the duration of the contract, is not available. Longer-term on-ground projects are vulnerable if land titles change hands.
  - Optimal contract length was not tested by our pilot as a part of auction design, but is worthy of further research.

Conclusion

As part of the national market-based instrument pilot program, the Auction for Landscape Recovery operationalised an auction for the first time in Western Australia. It tested two methods of tender evaluation, the Systematic Conservation Planning approach and Environmental Benefits Index and considered the minimum information needs required for applying an auction approach to the delivery of biodiversity conservation outcomes at a regional scale. The project evaluated the relative benefits of a discriminative price auction versus a fixed price scheme and analysed the administrative efficiency of discriminative auction. As a part of project evaluation, the pilot also undertook surveys of landholders within the project region. A number of findings relevant to future research requirements have been detailed within this report.

9 References

Agriculture WA and Conservation and Land Management (2002). *Vegetation Theme Metadata – Vegetation extent Western Australia*. Department of Agriculture Western Australia, Perth.

Anon. (n.d.). [Online] URL: http://www.deh.gov.au/land/publications/incentives-vic/section.1.html

Australian Bureau of Statistics (2004). Population for local government areas. [Online] URL: http://www.abs.gov.au/

Australian Greenhouse Office (2005). National carbon accounting toolbox, Version 1.0. [Online] URL: http://www.greenhouse.gov.au/ncas/

Avon Catchment Council (2004). *Regional Natural Resource Management Strategy for the Avon River Basin*. Avon Catchment Council, Northam.

Barton, D.N., Faith, D., Rusch, G., Gjershaug, J.L., Castro, M., Vega, M., and Vega, E. (2003). *Spatial prioritization of environmental service payments for biodiversity protection: Decision-making models for evaluating cost-effectiveness of conservation priorities using alternative biodiversity indicators*. Report SNR 4746/2003. Oslo: Norwegian Institute for Water Research. [Online] URL: www.inbio.ac.cr/ecomapas/bioindicadores/paginas_es/Bioindicators.pdf

Beecham, B. (2003). Target Landscapes: An approach to ranking landscapes for biodiversity conservation in the wheatbelt. Appendix 3. In K.J. Wallace, B.C. Beecham and B.H. Bone, *Managing Natural Biodiversity in the Wheatbelt: A conceptual framework.* Department of Conservation and Land Management, Western Australia.

Burgman M.A. (1988). Spatial analysis of vegetation patterns in southern Western Australia: implications for reserve design. *Australian Journal of Ecology* 13:415-429.

Clayton, H. (2005). Market incentives for biodiversity conservation in a saline-effected landscape: farmer response and feedback. Conference paper: 49th Annual Conference of the Australian Agricultural and Resource Economics Society, Coffs Harbour, NSW.

Davidson, A., Elliston, L., Kokic, P. and Lawson, K. (2005). Native vegetation: cost of preservation in Australia. *Australian Commodities* 12(3): 543-548.

Department of Environment (2003). *Salinity Investment Framework Interim Report – Phase I*. Report No. SLUI 32. WA Department of Environment,.Perth.

DLWC (2002). *Liverpool Plains Auction Trial*, Department of Land and Water Conservation, Sydney.

Environment Australia (2001a) *National Objectives and Targets for Biodiversity Conservation 2001–2005*. Commonwealth of Australia, Canberra.

Environment Australia (2001b). *A Directory of Important Wetlands in Australia*, Third Edition. Environment Australia, Canberra. [Online]. URL: http://www.deh.gov.au/water/wetlands/database/index.html.

Faith, D. P. (1995). *Biodiversity and regional sustainability analysis*. CSIRO, Canberra.

Faith, D. P. (1997). Biodiversity assessment and opportunity costs. In: *Investing in Biodiversity*, ed. anon., pp. 87-103. OECD, Paris.

Faith, D. P. (2001a). Cost-effective biodiversity planning. *Science* 293 [Online] URL: http://www.sciencemag.org/cgi/eletters/293/5538/2207

Faith, D. P. (2001b). Overlap of Species richness and development-opportunity does not imply conflict. *Science* 293 [Online] URL: http://www.sciencemag.org/cgi/eletters/293/5535/1591#354

Faith, D. P. (2002). Those complementarity analyses do not reveal extent of conservation conflict in Africa. *Science* [Online]. URL: http://www.sciencemag.org/cgi/eletters/293/5535/1591#381.

Faith, D. P. and Walker, P. A. (1995). DIVERSITY: a software package for sampling phylogenetic and environmental diversity. Reference and user's guide. v. 2.1., CSIRO Division of Wildlife and Ecology. Canberra.

Faith, D.P. and Walker, P.A. (1996a). DIVERSITY – TD. In: *BioRap, rapid assessment of biodiversity. Volume 3. Tools for Assessing Biodiversity Priority Areas*. Ed. Faith, D.P. and Nicholls, A.O., pp. 63-74. The Australian BioRap Consortium, Canberra.

Faith, D.P. and Walker, P.A. (1996b). Integrating conservation and development: incorporating vulnerability into biodiversity assessment of areas. *Biodiversity and Conservation* 5: 431-446.

Faith, D. P. and Walker, P. A. (1996b). Environmental diversity: on the best-possible use of surrogate data for assessing the relative biodiversity of sets of areas. *Biodiversity and Conservation* 5: 399-415.

Faith, D. P. and Walker, P. A. (1996c). How do indicator groups provide information about the relative biodiversity of different sets of areas? On hotspots, complementarity and pattern-based approaches. *Biodiversity Letters* 3: 18-25.

Faith, D. P. and Walker, P. A. (1996d). Integrating conservation and development: effective trade-offs between biodiversity and cost in the selection of protected areas. *Biodiversity and Conservation* 5: 417-429.

Faith, D. P. and Walker, P. A. (1996e). Integrating conservation and development: incorporating vulnerability into biodiversity-assessment of areas. *Biodiversity and Conservation* 5: 431-446.

Faith, D. P. and Walker, P. A. (1997). Regional sustainability and protected areas: biodiversity protection as part of regional integration of conservation and production. In: *National parks and protected areas: selection, delimitation, and management,*. Pigram, N. and Sundell, R.C., eds., pp. 297-314. University of New England Press.

Faith, D. P. and Walker, P. A. (1998). *TARGET: Software for the analysis of priority protected areas representing biodiversity. User's Guide*. Draft. CSIRO, Canberra.

Faith, D. P. and Walker, P. A. (2002). The role of trade-offs in biodiversity conservation planning: linking local management, regional planning and global conservation efforts. *J. Bioscience s* 27(Suppl. 2):393-407.

Faith, D.P., and Williams, K.J. (2005). A new way to set biodiversity targets for conservation planning based on the species-areas relationship. In prep.

Faith, D. P., Walker, P. A., Ive, J. R. and Belbin, L. (1994). Integrating conservation and forestry production: effective trade-offs between biodiversity and production in regional land-use assessment. In: *Conserving biological diversity in temperate forest ecosystems - towards sustainable management* pp. 74-75.

Faith, D. P., Walker, P. A., Ive, J. and Belbin, L. (1996). Integrating conservation and forestry production: exploring trade-offs between biodiversity and production in regional land-use assessment. *Forest Ecology and Management* 85: 251-260.

Faith, D. P., Margules, C. R. and Walker, P. A. (2001a). A biodiversity conservation plan for Papua New Guinea based on biodiversity trade-offs analysis *Pacific Conservation Biology* 6(4): 304-324.

Faith, D. P., Margules, C. R., Walker, P. A., Stein, J. and Natera, G. (2001b). Practical application of biodiversity surrogates and percentage targets for conservation in Papua New Guinea. *Pacific Conservation Biology* 6(4): 289-303.

Faith, D. P., Nix, H. A., Margules, C. R., Hutchinson, M. F., Walker, P.A., West, J., Stein, J., Kesteven, J. L., Allison, A. and Natera, G. (2001c). The BioRap Biodiversity Assessment and Planning Study for Papua New Guinea. *Pacific Conservation Biology* 6 (4): 279-289.

Faith, D. P., Walker, P. A. and Margules, C. R. (2001d). Some future prospects for systematic biodiversity planning in Papua New Guinea – and for biodiversity planning in general. *Pacific Conservation Biology* 6(4): 325-343.

Faith, D. P., Carter, G., Cassis, G., Ferrier, S., Wilkie, L. (2003). Complementarity, biodiversity viability analysis, and policy-based algorithms for conservation. *Environmental Science and Policy* 6: 311–328.

Falconer, K. and Whitby, M. (1999). The invisible costs of scheme implementation and administration. In: *Countryside Stewardship: Farmers, Policies and Markets,* Van Huylenbroeck, G. and Whitby, M., eds., pp. 67-88. Pergamon, Amsterdam.

Feather P., Hellerstein D. and Hansen L. (1999). *Economic Valuation of Environmental Benefits and the Targeting of Conservation Programs: The Case of the CRP*. Agricultural Economic Report No. 778. Resource Economics Division, Economic Research Service, U.S. Department of Agriculture, Washington, DC.

Ferrier, S. (2002). Mapping spatial pattern in biodiversity for regional conservation planning: where to from here? *Systematic Biology* 51:331–363.

Ferrier, S. and Watson, G. 1997. *An Evaluation of the Effectiveness of Environmental Surrogates and Modelling Techniques in Predicting the Distribution of Biological Diversity*. Armidale: Environment Australia. [Online]. URL: http://www.deh.gov.au/biodiversity/publications/technical/surrogates/index.html

Ferrier, S., Powell, G., Richardson, K., Manion, G., Overton, J., Allnutt T., Cameron S., Mantle, K., Burgess, N., Faith, D., Lamoreux, J., Kier, G., Hijmans, R., Funk, V., Cassis G., Fisher, B., Flemmons, P., Lees, D., Lovett, J., and Rompaey R. (2004). Mapping more of terrestrial biodiversity for global conservation assessment. *Bioscience* 51:1101-1109.

Freudenberger, D. and Harvey, J. (2003). *Assessing the benefits of vegetation enhancement for biodiversity: a draft framework.* A report for Environment Australia and the Biodiversity Benefits Task Group. Environment Australia, Canberra.

Frost, F., Lambeck, R., Dymond, W., Rowley, T., and Gowdie, T. (1999). *Living Landscapes – Final Report.* Greening Australia Western Australia and Alcoa, Perth.

Hajkowicz, S, Higgins, A., Williams, K., Faith, D. and Burton, M.P. (2005). Optimisation and the selection of conservation contracts. Unpublished manuscript. CSIRO Sustainable Ecosystems, Brisbane.

Harvey, J.M. and Hopkins, A.J.M. (2000). *Poorly Conserved and Potentially Threatened Vegetation Types in the Western Australian Wheatbelt. II Sub-associations: Project no N722, National Reserves System Cooperative Program, Environment Australia: First Report*. Department of Conservation and Land Management, Perth.

Hopkins, A.J.M. (2000). *Poorly Conserved and Potentially Threatened Vegetation Types in the Western Australian Wheatbelt. I, Associations: Project no N722, National Reserves System Cooperative Program, Environment Australia: First Report*. Department of Conservation and Land Management, Perth.

Hopkins, A.J.M., Beeston, G.R., Harvey, J.M. and Lemin, H. (2001). *A Database on the Vegetation of Western Australia, Stage 1*. Technical Report No 251. Department of Agriculture, Perth.

Hopkins, A.J.M., Coker, J., Beeston, G.R., Bowan, P. and Harvey, J.M. (1996). *Conservation status of vegetation types throughout Western Australia: final report, May 1996: Australian Nature Conservation Agency, National Reserves Systems Co-operative Program: project no. N703.* Department of Conservation and Land Management, Perth.

Hopper, S.D., Harvey, M.S., Chappill, J.A., Main, A.R. and Main, B.Y. (1996).The Western Australian biota as Gondwanan heritage – a review. In *Gondwanan Heritage*, eds S.D. Hopper, S.D., Chappill, J.A., Harvey, M.A and George, A.S., eds., pp. 1-46. Surrey Beatty and Sons, Chipping Norton, New South Wales.

Kirkpatrick, J. B. 1983. An iterative method for establishing priorities for the selection of nature reserves: an example from Tasmania. *Biological Conservation* 25: 127 -134.

Kirkpatrick, S., Gelatt, Jr., C. D., and Vecchi, M. P. 1983. Optimization by simulated annealing. *Science* 220: 671-220.

Lambeck, R.J. (1997). Focal species: a multi-species umbrella for nature conservation. *Conservation Biology* 11: 849-856.

Latacz-Lohmann, U. and van der Hamsvoort, C.P.C.M. (1997). Auctioning conservation contracts: a theoretical analysis and an application. *American Journal of Agricultural Economics* 79: 407-418.

Long, J.S. (1997). Regression models for categorical and limited dependent variables. Sage, Thousand Oaks.

Margules, C. R. and Pressey, R. L. (2000). Systematic conservation planning. *Nature* 405: 242-253.

Margules C.R., Nicholls A.O. and Pressey R.L. (1988). Selecting networks of reserves to maximise biological diversity. *Biological Conservation* 43: 63-76

Margules, C., Readhead, T., Faith, D. P. and Hutchinson, M. (1995). *Guidelines for using the BioRap methodology and tools*. CSIRO, Canberra.

Margules, C.R., Pressey, R. L. and Williams, P. H. (2002). Representing biodiversity: data and procedures for identifying priority areas for conservation. *Journal of Bioscience* 27 (4) (suppl. 2): 309–326.

May, J.E. and McKenzie, N.L., eds. (2002). *A Biodiversity Audit of Western Australia's 53 Biogeographic Subregions in 2002.* Department of Conservation and Land Management, Perth.

McIntyre S. and Hobbs R.J. (1999). A framework for conceptualizing human impacts on landscapes and its relevance to management and research models. *Conservation Biology* 13: 1282–1292.

McIntyre S. and Hobbs R.J. (2000). Human impacts on landscapes: matrix condition and management priorities. In *Nature Conservation 5: Nature Conservation in Production Environments: Managing the Matrix,* Craig, J.L., Mitchell, N. and Saunders, D.A., eds., pp. 301-307. Surrey Beatty and Sons, Chipping Norton, New South Wales.

McKenzie, N.L., May, N.E. and McKenna, S. (2002). Bioregional summary of the 2002 biodiversity audit for Western Australia. Department of Conservation and Land Management, Perth.

McNeely, J., Faith, D.P., Albers *et al.* Biodiversity responses. In *The Millennium Ecosystem Assessment*. In review.

Morgan, G. (2000). *Landscape health in Australia: a rapid assessment of the relative condition of Australia's bioregions and subregions*. Environment Australia and National Land and Water Resources Audit, Canberra.

Moxey, A.P., White, B. and Ozanne, A. (1999). Efficient contract design for agri-environmental policy. *Journal of Agricultural Economics* 50: 187-202.

Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B., and Kents, J. (2000). Biodiversity hotspots for conservation priorities*.* *Nature* 403: 853-858.

NAPSWQ (2002). *Investigating new approaches: a review of natural resource management pilots and programs in Australia that use market-based instruments*. NAPSWQ, Canberra.

North East Wheatbelt Working Group (2004). *Draft scoping paper: planning and natural resource management issues in the north-east wheatbelt, Western Australia*. Report by the North-East Wheatbelt Regional Organisation of Councils and Natural Resource Management Committee, an advisory committee of the Western Australian Planning Commission.

Northern Agriculture Catchment Council (2003). *Biodiversity Asset Survey*. Northern Agriculture Catchment Council, Perenjori, Western Australia.

Oliver, I. and Parkes, D. (2003). *A Prototype Toolkit for Predicting the Biodiversity Benefits of Land use Change*. Version 5.1. NSW Department of Infrastructure, Planning and Natural Resources, Parramatta, NSW.

Parkes D., Newell, G, and Cheal D. (2003). Assessing the quality of native vegetation: the Habitat Hectares approach. *Ecological Management and Restoration* 4 (suppl.): S29-S38.

Parsons, B., Huggett, A.J., Atkins, L. and Ingram, JA. (2003). *Bringing Back the Birds: Landscape Planning for Nature Conservation in Wallatin Creek Catchment.* Technical report to Wallatin Wildlife and Landcare Inc. and Greening Australia (WA). CSIRO Sustainable Ecosystems, Perth.

Pressey, R L., Humphries, C J., Margules, C.R., Vane- Wright, R. I. Williams, P.H. (1993). Beyond opportunism: key principles or systematic reserve selection. *Trends in Ecology and Evolution* 8: 124-8.

Rebelo, A. and Siegfried, W. (1992). Where should nature reserves be located in the Cape Floristic Region, South Africa? Models for the spatial configuration of a reserve network aimed at maximizing the protection of floral diversity. *Conservation Biology* 6: 243-252.

Sarkar, S. and Margules, C. R. 2002. Operationalizing biodiversity for conservation planning. *Journal of Biosciences* 27(S2): 299 -308.

Sarkar, S. (2004). Conservation Biology. In Zalta, E. N. Ed. *The Stanford Encyclopedia of Philosophy*. Summer 2004 Edition. [Online]. URL: http://plato.stanford.edu/entries/conservation-biology/

Sarkar, S., Aggarwal, A., Garson, J., Margules, C., and Zeidler, J. (2002). Place prioritization for biodiversity content. *Journal of Biosciences* 27: 339 – 346. [Online]. URL: http://plato.stanford.edu/entries/conservation-biology/

Sarkar, S., Justus, J., Fuller, T., Kelley, C., Garson, J., and Mayfield, M. (2005). Effectiveness of environmental surrogates for the selection of conservation area networks. *Conservation Biology* 19: 815 - 825.

Shepherd, D.P., Beeston, G.R. and Hopkins, A.J.M. (2002). *Native vegetation in Australia: extent, type and status*. Resource Management Technical Report 249. Department of Agriculture, Perth.

Smith, R.B.W. (1995). The Conservation reserve program as a least-cost land retirement mechanism. *American Journal of Agricultural Economics* 77: 93-105.

Stoneham, G., Chaudhri, V. and Strappazon, L. (2003). Auctions for conservation contracts: an empirical examination of Victoria's BushTender trial. *Australian Journal of Agricultural and Resource Economics* 47: 477-500.

Thackway, R. and Cresswell, I., eds. (1995). *An Interim Biogeographic Regionalisation for Australia: A Framework for Setting Priorities in the National Reserves System Cooperative Program*. Version 4.0. Australian Nature Conservation Agency, Canberra.

USDA (1999). *Fact Sheet: CRP Signup 20: Environmental Benefits Index*. Farm Service Agency, US Department of Agriculture.

USDA (2003). *Fact Sheet: CRP Signup 26: Environmental Benefits Index*. Farm Service Agency, US Department of Agriculture.

Van Huylenbroeck, G. and Whitby,M., eds. (1999). *Countryside Stewardship: Farmers, Policies and Markets*. Pergamon, Amsterdam.

Vane-Wright, R. l., Humphries, C. J. and Williams, P. H. (1991). What to protect? Systematics and the agony of choice. *Biological Conservation* 55: 235-254.

Walker, P. A. and Faith, D. P. (1995) DIVERSITY-PD: Procedures for conservation evaluation based on phylogenetic diversity. *Biodiversity Letters* 2: 51-58.

Wallace, K.J. (1990). A remnant vegetation protection scheme for private farmland in Western Australia. In *5th Australian Soil Conservation Conference: Community Action, Landcare in the 90s*. Retention and replacement of vegetation workshop: field tour notes, pp 40-77. Standing Committee on Soil Conservation and Western Australian, Department of Agriculture, Perth.

Wallace, K.J., Beecham, B.C. and Bone, B.H. (2003a). *Managing natural diversity in the Western Australian wheatbelt: a conceptual framework*. Department of Conservation and Land Management, Perth.

Wallace, K.J., Carr, B., Hillier, M. and Nicholson, C. (2003b). Identification and ranking of important biodiversity assets — South West Agricultural Region. Salinity Investment Framework. In: *Salinity Investment Framework Interim Report – Phase I*, Appendix 2, pp. 60-90. Department of Environment, Salinity and Land Use Impacts Series No. SLUI 32.

White, B. and Burton, M.P. (2005). Measuring the efficiency of conservation auctions. Contributed Paper 49th Annual Conference of the Australian Agricultural and Resource Economics Society, Coffs Harbour, NSW.

White, B. (2002). Designing voluntary agri-environmental policy with hidden information and hidden action: a note. *Journal of Agricultural Economics* 53(3): 678-680.

Whitten, S., van Bueren, M. and Collins, D. (2003). An overview of market-based instruments and environmental policy in Australia. Conference Paper 6th Annual Australian Agricultural and Resource Economics Society National Symposium Market-Based Tool for Environmental Management, Canberra, ACT.

Winsten, C.B. (1957). Discussion on Mr. Farrell's paper. *Journal of the Royal Statistical Society* Series A, General 120(3): 282-84.

Wu, J-J. and Babcock, B. A. (1996). Contract design for the purchase of environmental goods from agriculture. *American Journal of Agricultural Economics* 78: 935-44.

WWF-Australia (2004). *Land Management Tenders on the Liverpool Plains*. Draft. Unpublished report. WWF-Australia.

Auction for Landscape Recovery

WWF

action Salinity & Water AUSTRALIA

A partnership project between Australian Museum, Avon Catchment Council, CALM, CSIRO Sustainable Ecosystems, Department of Agriculture, Department of the Environment, Greening Australia WA, North East Wheatbelt Regional Organisation of Councils, Murdoch University, University of Western Australia, WA Farmers Federation and WWF Australia.
The project is supported by the State and Commonwealth through the National Action Plan for Salinity and Water Quality (NAP).

Expression of Interest Form

ROUND TWO

The Auction for Landscape Recovery is a voluntary land and nature conservation program for landholders operating as a pilot project in the North East WA wheatbelt. It is a partnership project between landholders and a number of organisations, research institutions and local governments in the NE Wheatbelt Regional Organisation of Councils (NEWROC). The 7 shires of the NEWROC are Koorda, Mt Marshall, Mukinbudin, Nungarin, Trayning, Westonia and Wyalkatchem.

The objective of the scheme is to achieve significant environmental benefits at the landscape scale. If you wish to submit a tender, then your project should demonstrate benefits for nature conservation, but if multiple benefits, including salinity control and/or water quality are being proposed, this will increase your chance of selection and funding. If you are interested in submitting a tender for the auction please return this form by **31st August 2004.** The form is an expression of interest only and does not bind you in any way. Once you have submitted it you will be contacted by a Community Support Officer, who will guide you through the rest of the bid process.

In this form we ask for some basic information about the nature conservation and land management actions you are considering for your bid. This is only to assist us in managing the bid process, and you are free to alter these if you submit a full bid (tender). The Expression of Interest is a formal requirement for entry into the Auction; however submission of this form places no obligation on landholders or the Avon Catchment Council and Auction project partners.

CLOSING DATE: 31st AUGUST 2004

Expression of Interest must be post marked on or before 31 August 2004

1. Contact Details

Full Name	
Business/ Farm Name	
Postal Address	Phone
	Fax
Farm/ Property Address	Mobile
	E-mail
Shire:	

2. Proposed Project

The objective of the scheme is to achieve significant environmental benefits in the region. What benefits for nature conservation, and any additional benefits, including salinity control and/or improvement of water quality, will be achieved?

Please provide a brief summary of the management actions you are considering.
Size of proposed project site/s (in hectares or acres)

Please submit your completed form by mail.

(Forms must be postmarked on or before 31 August 2004)

Details are provided below.

Auction for Landscape Recovery

Mailing Address:

Auction for Landscape Recovery
Avon Catchment Council
PO Box 311
NORTHAM WA 6401

For more information contact your nearest Community Support Officer:

Teagan Smith	**Matthew Field**	**Sam Atkinson**
(Wyalkatchem)	**(Nungarin)**	**(Bencubbin)**
9681 1166	**9046 5121**	**9685 1202**
Mob: 0418 926 848	**Mob: 0427 191 278**	**Mob: 0429 611 127**

Auction for Landscape Recovery

A partnership project between Australian Museum, Avon Catchment Council, CALM, CSIRO Sustainable Ecosystems, Department of Agriculture, Department of the Environment, Greening Australia WA, North East Wheatbelt Regional Organisation of Councils, Murdoch University, University of Western Australia, WA Farmers Federation and WWF Australia.
The project is supported by the State and Commonwealth through the National Action Plan for Salinity and Water Quality (NAP).

Tender Guidelines, Round 2

These guidelines provide background information on the Auction for Landscape Recovery **(ALR)** project. They also outline the types of tenders that you might consider submitting, list the environmental outcomes that the ALR project is trying to achieve, and provide details on how it will be run.

1 What we are trying to achieve

The Auction for Landscape Recovery is a voluntary land and nature conservation program for landholders operating as a pilot project in the north east WA wheatbelt. It is a partnership between landholders and a number of organisations, research institutions and local governments in the NE Wheatbelt Regional Organisation of Councils (NEWROC). The seven shires of NEWROC are Koorda, Mt Marshall, Mukinbudin, Nungarin, Trayning, Westonia and Wyalkatchem. The program is funded by the National Action Plan for Salinity and Water Quality.

The auction will bring together scientific research and landholder expertise to bring about improved on-farm natural resource management (NRM) actions. The participation of landholders in this auction will involve formal agreements between the landholder and the Avon Catchment Council.

2 About the Auction for Landscape Recovery Project

The Auction:

- Allows landholders to tender for funding to protect and enhance nature conservation, and also improve water quality, control rising water tables and associated dryland salinity;
- Enables landholders to nominate the management activities they are willing to undertake to protect natural and environmental assets on their land and nominate how much money they will require to do that work;
- Allows for tenders to be evaluated on the basis of 'value for money' for nature conservation and other environmental outcomes in the region. ***Proposed projects with the highest long-term biodiversity conservation value in the landscape and that also address other ALR outcomes are most likely to be selected and funded;***
- Recognises that on-farm conservation and environmental work has benefits to the whole community;
- Requires that successful landholders sign a management contract to undertake the agreed management activities on their nominated site(s);
- Will operate over two rounds between November 2003 and late 2004;
- Represents a partnership of landholders, local governments, non-government organisations and government agencies.

3 Why an auction?

- In most previous funding programs, the funding agencies have required landowners to contribute a set amount to the costs of on-ground works. This may make it difficult for some landowners to take part in the schemes.
- In an auction, the landowner decides how much funding they need to undertake the work. As part of the auction, landowners will identify the management and ecological restoration practices they are willing to undertake, and then nominate the payment required to do that work.
- There will be no set rates of payments for particular types of work, and no requirement that landowners make “in-kind” contributions.
- The tenders from landowners will be compared with each other in terms of the environmental benefits delivered: only the most competitive, in terms of value for money, will be successful.

4 The target environmental outcomes

The target environmental outcomes of the Auction for Landscape Recovery are consistent with the goals of the Avon Regional NRM Strategy, and will have a particular focus on achieving nature conservation benefits at the landscape scale. However, projects that can show additional benefits for salinity control, waterlogging control and improvement of water quality will be particularly welcomed.

The Avon River Basin NRM Strategy recognises that all remnants of natural vegetation and wetlands, whether in public reserves or on private land, are valued, and that it is management of these within a landscape context that brings greatest benefits. When evaluating tenders, the Auction for Landscape Recovery team will be looking for the proposals that contribute the most to achieving the environmental outcomes, given the amount of funding requested. In particular, the ALR will focus on:

- Conservation and recovery of threatened species, populations and ecological communities of native flora and fauna and their habitat. In some cases individual species of plants or animals have become very rare, and examples of whole communities of plants are very restricted. Protecting these small pockets of biodiversity from threats or minimising the influence of these threats is critical if we are to hope to retain these species and communities in the landscape over time.

- Although it is vital to protect threatened species once they have become rare, it is better to try and protect larger, representative landscapes where there are significant areas of remnant vegetation and wetlands, so that individual species or communities do not become threatened.

- It is often the case that managing several remnants together will deliver greater benefits than dealing with each individually. Linking remnants through the creation of corridors of vegetation can often increase the ecological value of the remnants as a whole.

5 Multiple Benefits

It is possible that some management actions will bring about multiple environmental benefits across a number of areas. For example, revegetation to create wildlife corridors may also have a local impact on water tables, soil erosion and salinity risk, and at the same time protect infrastructure such as roads. Although the primary focus of the Auction for Landscape Recovery is on biodiversity benefits, if a proposal can show benefits across a number of other areas, this will be taken into account when evaluating the tenders. It is important that landholders realistically try to identify the scale of these additional benefits, and in particular identify the public benefits, as opposed to improving on-farm productivity. Innovative ideas for achieving multiple benefits are encouraged.

6 Eligibility Requirements

- Entry is restricted to landholders in the following NEWROC shires: Koorda, Mt Marshall (south of the clearing line), Mukinbudin, Nungarin, Trayning, Westonia (west of the clearing line) and Wyalkatchem;
- It is also a requirement that you are not currently receiving other sources of public funds for the management actions you offer into the auction;
- Landholders who have a successful tender and choose to enter into a management contract with the ALR will not be eligible to receive other sources of public funding for those management actions identified in the agreement over the period of the agreement.

7 Guidelines for developing a tender

- The ALR will employ a number of Community Support Officers (CSOs) who will assist you in the preparation of your tender.
- Community Support Officers will provide technical evaluation of the site that you are proposing to work on, and advice on the management practices that might enhance them.
- You must clearly identify the size and location of land over which your management actions will be undertaken, and the timing of those actions.
- It is a requirement of funding a project that the management actions meet certain minimum standards that will be discussed with you by the CSOs. A list of relevant documents providing information on minimum standards is provided in section 16, and most will be available from the CSOs.
- If the proposal involves water management, then there may be a legal requirement for a Notice of Intent to Drain or Pump Water (NOI) to be lodged. If there is an existing NOI for the project, this should be declared in the tender. If appropriate selected tenders will require an NOI before any funding is released.
- You must provide a list of proposed management actions and identify the likely benefits arising from these actions. You should also identify the location and size of the areas where benefits are expected to arise.
- Community Support Officers are not able to provide advice on the amount of money you will nominate for your final tender. You need to decide this final sum.

8 Issues to consider when constructing your tender

- **Joint tenders**

In recognition that landscape features can extend beyond individual farm boundaries, joint submissions from groups of landholders are encouraged. For example, if there are a number of areas of remnant vegetation on different farms, then a joint tender to link these remnants could be made. In evaluating the benefit from the tender, the whole work would be considered. Management contracts would be signed with each individual farmer taking part in the joint project. If your application is part of a joint tender, complete the relevant section on the Tender Application Form. If submitting a joint tender, each landowner completes a separate application for their part of the project: the group coordinator will fill out an additional combined application.

- **Multiple tenders**

Multiple tenders, multiple sites

It is possible that you might have several quite different projects that you would like considered. You could either include these in a single tender, or split them into multiple tenders, in which case some may be successful, and some may not. It is probably only sensible to submit multiple tenders if each involves a substantial amount of funding. If you submit multiple tenders, each corresponding to a different site or project activity, it is possible that more than one will be awarded.

Multiple tenders, same site

It is also possible that you could develop alternative projects involving the same area of land. Thus you may be able to identify a simple project to protect an asset, which you are prepared to do for a low cost. Alternatively, you may identify a much higher level of management on the land requiring a higher level of payment. By submitting both tenders, the ALR team will identify the option that gives the most cost effective outcomes. In this case only one of the two options would be selected.

- **The amount that you tender**

In making the tender you do not have to specify how the money will be spent: you do not have to give a detailed costing for the management actions that you are proposing. The tender will be assessed solely on the level of benefits generated in relation to the overall size of the amount of money that you request. However, when you make an assessment of the amount of the tender that you request you might want to consider the following:

- The cost of materials;
- The cost of your time, if you undertake the work;
- The cost of a contractor, if you employ one;
- Any profit forgone, e.g. if your proposal means that you have to use land for your project that is currently in agricultural production;
- Any **on-farm production benefits** that may accrue to you as a result of the management e.g. from shelter belts, or lowering water tables. These on-farm benefits are not part of the ALR project objectives, but they may mean that you can reduce your tender amount, and hence improve the chance of obtaining funding.

9 The selection process

Your tender will be ranked against the other tenders on the basis of the *'value for money'*. The rank of each tender will be assessed objectively using an assessment of the environmental benefits being delivered and the price of your tender.

Your tender will be evaluated against the following:

Acceptability	- Does your proposed project generate environmental outcomes consistent with the target environmental outcomes of the Auction?
Feasibility	- Are the objectives of your project tangible and achievable?
Multiple Benefits	- Does your proposed project have multiple benefits? In evaluating the tenders, all relevant benefits (consistent with the project objectives) from your proposed management will be considered.
Long-term benefits	- Does your project provide long-term benefits for conservation and the environment?

10 Confidentiality

Details about all of the projects that are funded will be made publicly available, in terms of the location and type of management practice. However, details of the amount tendered will not be revealed in a way that they can be linked to individual landholders.

11 Management contracts

If you are successful in your tender, a Contract for management of the project for a fixed term will be prepared and signed by you and the Avon Catchment Council. The Tender Form, these Guidelines and a Project Milestones and Payments Schedule will form the Schedules to the Contract. There is no legally binding commitment by either side until the Contract is signed. It will set out what management actions have to be undertaken, the standard to which they should be carried out, the milestones for reporting and the schedule of payments. Typically there will be an initial payment, with subsequent payments as actions (milestones) are completed. These will differ according to each project. However, it is anticipated that all on-ground works will be completed within the first 2 years.

12 Reporting obligations

As part of the Contract, you are required to provide brief reports of work completed and other relevant measures of progress. Payments will be connected to reporting and completion of actions (milestones) outlined in the Agreement and failure to comply with the conditions of the Agreement may result in funding being withdrawn. Any remittances already paid may need to be returned in full to the Avon Catchment Council.

13 What happens at the end of the fixed-term agreement?

At the end of the contract period, the landowner’s management obligations will cease, and farmers can manage their land in whatever way seems appropriate to them at that point in time. If you have entered into a third-party Voluntary Management Agreement or Nature Conservation Covenant, then the terms of those agreements will apply.

14 Legal obligations

The fixed-term management agreements will be contracts under common law. Parties to these agreements will be the Avon Catchment Council and the landholder managing the site. Lessees will be eligible to sign a management agreement as long as they have the written authority of the owner of the site and the proposed management actions are not already the responsibility of the lessee under the existing lease arrangement.

15 Long term management agreements

You may wish to enter into longer term management commitments i.e. through a third-party Voluntary Management Agreement or Nature Conservation Covenant. These are negotiated through third parties such as WWF Australia, CALM or the National Trust, and information on these is available from the Community Support Officers. Voluntary Management Agreements are management agreements entered into voluntarily and supported by the relevant management assistance program. Covenants are legal contracts under Common Law, which outline commitments and responsibilities in relation to the long-term management of the site. Covenants are bound to the title of the land and ensure long-term benefits from the project.

Covenants require minimum bushland conservation values; thus not all remnant vegetation would be accepted for covenanting.

It is likely that the tender selection process will favour those projects that include a Conservation Covenant or to a lesser extent a Voluntary Management Agreement, even if the tender amount is higher. If you are interested in the possibility of entering into one of these agreements as part of the tender, you should raise this with the Community Support Officer when they conduct the site visit.

16 Minimum Standards Checklist for Implementation of Tendered Management Action

It is a requirement of funding a project that the management actions meet certain minimum standards e.g. the type of plants used in revegetation schemes, widths of wildlife corridors, site preparation etc. In the following table the documents that outline these standards are listed. You should ensure that, for all activities that you are proposing, you are familiar with the accepted minimum standards, discussed with you by your CSO. Printed material on acceptable standards for all major management activities is available on request from your CSO. The list of available books and documents is given below for your information.

MANAGEMENT ACTION	ACCEPTED BEST PRACTICE REFERENCE [SOURCE]
REMNANT VEGETATION MANAGEMENT	
Remnant Vegetation Management	• Eucalypt Woodlands: A Guide to Management [Dept of Agriculture miscellaneous publication 17/00]
REVEGETATION AND WEED CONTROL	
Species Selection for Revegetation	• Consult with your Community Support Officer and/or the Extension Officer from the management assistance program you are working with
Species Selection for Revegetation	• Revegetation Guide to the Central Wheatbelt [Lefroy *et al*, 1991]
Species Selection for Revegetation	• Seedling Quality: Making Informed Choices [Mullan, G. and White, P, CALM 2002]
Site Preparation for Revegetation	• Revegetation Site-preparation in the WA Wheatbelt [Mullan, G. and White, P, CALM 2002]
Site Preparation for Revegetation	• Weed Control for Successful Revegetation [Farmnote 47/1998]
Site Preparation for Revegetation	• Revegetation Post Planting Weed Control Table [http://agspsrv34.agric.wa.gov.au/progserv/natural/trees/Tech/weedtabl.htm]

MANAGEMENT ACTION	ACCEPTED BEST PRACTICE REFERENCE [SOURCE]
Biodiversity Corridors	• Western Wildlife 2/1 • Western Wildlife 3/1
Revegetation for Creekline Restoration	• Riparian Zone Revegetation in the Avon Catchment [Water notes 24, Oct 2001]
Revegetation to Buffer [Protect] Remnants	• Vegetation Buffer Zones [Farmnote 38/2000]
FERAL SPECIES CONTROL	
Fox Baiting	• Fox Baiting [Farmnote 61/2003]
1080 Use	• Guide to the Safe Use of 1080 Poison [Farmnote 32/2003]
Fox or Rabbit Shooting	• Guidelines for Landcare Community Programs to Control Foxes, Feral Cats and Rabbits [M. Paton, Senior Veterinary Officer, WA Dept of Agriculture]
Rabbit Baiting	• Landholder Use of 1080 One Shot Oat Rabbit Bait [Farmnote 88/2001]
SURFACE WATER CONTROL	
Surface water control	• Surface Water Management for Dryland Agriculture Kit #1 [Department of Agriculture, 2004]
Drainage	• Drainage and Regulation in Dryland Agriculture Kit #2 [Department of Agriculture, 2004]
Drainage	• Sub-Surface Drainage & Surface Water Management for Salinity Control [Farmnote 52/2003]

For more information contact your nearest Community Support Officer:

Teagan Smith
(Wyalkatchem)
9681 1166
Mob: 0418 926 848

Matthew Field
(Nungarin)
9046 5121
Mob:0427 191 278

Sam Atkinson
(Bencubbin)
9685 1202
Mob: 0429 611 127

Auction for Landscape Recovery

A partnership project between Australian Museum, Avon Catchment Council, CALM, CSIRO Sustainable Ecosystems, Department of Agriculture, Department of the Environment, Greening Australia WA, North East Wheatbelt Regional Organisation of Councils, Murdoch University, University of Western Australia, WA Farmers Federation and WWF Australia.
The project is supported by the State and Commonwealth through the National Action Plan for Salinity and Water Quality (NAP).

TENDER FORM

ROUND 2

CLOSING DATE: 31 OCTOBER, 2004

Date of Submission

For more information contact your nearest Community Support Officer:

Teagan Smith
(Wyalkatchem)
9681 1166
Mob: 0418 926 848

Matthew Field
(Nungarin)
9046 5121
Mob:0427 191 278

Sam Atkinson
(Bencubbin)
9685 1202
Mob: 0429 611 127

1. CONTACT DETAILS:

Full name of tenderer/s **Title (Mr/Mrs/Ms/Miss) of tenderer/s** **Business Name:**	
Postal Address	**Phone**
	Fax
	Mobile
	e-mail

2. PROPERTY DETAILS:

Property name and address (if different from postal address)
Shire:

3. JOINT TENDER (*see section 8 of the Guidelines*)

Is your tender part of a group submission? YES / NO

If YES,
In addition to being considered as part of the joint tender, do you wish your tender to be considered for funding as an independent tender as well?

YES / NO

Contact details of your group coordinator (if applicable):

Name of group coordinator:	
Address:	**Phone**
	Fax
	Mobile
	e-mail

4. DETAILS OF YOUR PROPOSED PROJECT

Project Duration (month/year)	**Start:**	
	Finish:	

Please give a short outline of the overall objectives of the proposed project (*see sections 4 & 5 of the Guidelines*)

Long Term Management Commitments (Optional) (*see section 15 of the Guidelines*)

I am / am not prepared to commit to a Voluntary Management Agreement for the relevant site/s for a period of _____ years. That agreement will be negotiated between me and the appropriate third party during the term of the proposed project.

I am / am not prepared to commit to a legal Nature Conservation Covenant for the relevant site/s. The Covenant will be negotiated between me and the appropriate third party during the term of the proposed project.

Provide details of your land management proposal in the table(s) below.
Please include:
- Duration of proposed project
- Site/s location and land area (with reference to a map of your farm);
- Details of your proposed land management actions
- Plans for the long-term management of your proposed project.

If more than 4 activities are proposed contact your CSO for additional sheets.

Activity 1 **Description of proposed on-ground works and plans for long-term management**	
On-ground works (*see section 7 of the Guidelines*)	
Site numbers	
	Start date for activity 1: Year Month Finish date for activity 1: Year Month
Contribution of activity to proposed project outcome	
Proposed long-term management	

Activity 2 **Description of proposed on-ground works and plans for long-term management**	
On-ground works (*see section 7 of the Guidelines*)	
Site numbers	
	Start date for activity 2: Year Month Finish date for activity 2: Year Month
Contribution of activity to proposed project outcome	
Proposed long-term management	

Activity 3 **Description of proposed on-ground works and plans for long-term management**	
On-ground works (*see section 7 of the Guidelines*)	
Site numbers	
	Start date for activity 3: Year Month Finish date for activity 3: Year Month
Contribution of activity to proposed project outcome	
Proposed long-term management	

Activity 4 ***(if more than 4 activities contact your CSO for additional sheets)*** **Description of proposed on-ground works and plans for long-term management**	
On-ground works (*see section 7 of the Guidelines*)	
Site numbers	
	Start date for activity 4: Year Month Finish date for activity 4: Year Month
Contribution of activity to proposed project outcome	
Proposed long-term management	

Farm Map of Proposed Works

Legend:

Existing fence

Proposed fence

Road/track

Creek/drainage line

Building

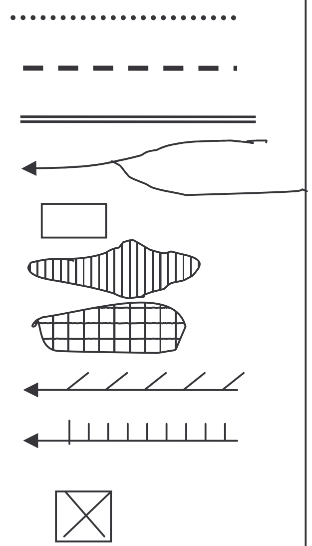
Existing vegetation

Proposed revegetation

Existing drain/bank

Proposed drain/bank

Dam



5. YOUR TENDER (*see section 8 of the Guidelines*)
Please enter the amount of your tender in the box below. Your tender will remain confidential between you and the Auction for Landscape Recovery team.

Tender $

Declaration

I declare that the information provided on this form is complete and correct to the best of my knowledge. I understand that submission of this tender does not guarantee funding and that the Auction for Landscape Recovery team reserves the right to select tenders based on the criteria specified in the guideline documentation. Submission of this form places no obligation on me.

If awarded the tender, I agree that the work will be undertaken to minimum standards discussed with me by the Community Support Officers, and included in the description of works that forms a part of this Tender submission.

Signature of tenderer/s	**Date**

6. YOUR TIME
We recognise that your time is valuable and as part of the pilot we want to record the amount of time you have provided in completing your tender application. We would also like to record any financial costs that you may have incurred in putting together your application. Provision of this information is voluntary and it will not be considered in the tender selection process.

Your time (hours): (include your time to write your proposal and the time you provided during the field visits of the project Community Support Officers)	**Financial Cost $:** (eg. for consulting services, information collation, income foregone as a result of dedicating time to this tender application etc).

Before lodging your tender:

- **Check that you have answered all questions**
- **Make a copy of the application for your records**
- **Securely fasten all pages together**
- **Enclose a map of your farm indicating proposed activity sites**

Tenders may not be faxed or emailed. Please post your tender to:

Auction for Landscape Recovery
Avon Catchment Council
PO Box 311
NORTHAM WA 6401

Closing Date: Your tender must be postmarked on or before 31 October 2004 to be considered in the current round.

FOR Office USE ONLY

Is this tender part of a group tender? YES/NO

If YES, record Tender ID numbers for all Tenders in group tender:

....

....

....

....

....

....

....

Confirmed with Group Coordinator? YES/NO

Is this tender one of a set of mutually exclusive (multiple) tenders over the same land?

YES/NO

If YES, record other Tender ID numbers

....

....

....

....

Auction for Landscape Recovery

ENVIRONMENTAL OUTCOMES

Group	Environmental Goal	Outcomes	Measures
		BIODIVERSITY CONSERVATION	
1.1 Native Biodiversity 1. Long-term (50-years)	1.1 To conserve and recover rare, threatened and other significant species, populations and ecological communities of native flora and fauna and their habitat within the study area	1.1.1 Retain the existing complement of rare, threatened and regionally significant indigenous plant and animal species, populations and ecological communities in the study area	• Reduction in species, populations and communities remaining on the WA threatened species list
		1.1.2 Improve the conservation status of threatened plant and animal species, populations and ecological communities (including fungi, cryptogams and invertebrates)	• Increase in size and number of populations of threatened species; • Species prevented from becoming extinct in the area; • Increased representativeness of locally, regionally, State and nationally-significant species within existing reserve system and covenanted lands
		1.1.3 Recover threatened species, populations and ecological communities in the study area	• Increase in the size and improvement in breeding status of these species in the area; • Reduction in number of these species remaining on WA threatened species list
		1.1.4 Protect and improve the quality, quantity, connectivity and spatial arrangement of habitat of rare, threatened and other significant species, populations and ecological communities in the study area	• Increased habitat patch (i.e. woodland, shrubland, heathland, wetland) size, improved condition (floristically and structurally), • Maintenance and enlargement of existing connective native vegetation to link adjoining significant patches and remnants; • Prevention of loss of area, condition and connectivity of key habitat of threatened species, populations and communities

Group	Environmental Goal	Outcomes	Measures
		BIODIVERSITY CONSERVATION	
1.2 Native Biodiversity 2 (short=5 yrs, medium=20 yrs, long-term)	1.2 To conserve all existing taxa of native species in their natural or near-natural habitats, regardless of their rarity or conservation status, and protect and improve the quality, quantity and spatial configuration of their habitat	1.2.1 Protect all existing taxa of native species within their natural or near-natural habitats	• Retention of native species within the study area; increased level of species diversity following implementation of conservation actions; • High level of genetic diversity in the study area
		1.2.2 Protect and improve the amount and condition of remnants and key habitat patches in the study area	• Increased remnant area and habitat patch size, • Improved structural complexity and floristic diversity, • Reduced amount of edge, • Presence and quality of key habitat components (fallen woody debris, organic litter cover, shrub layer, hollow-bearing trees, foliage density), • Reduced weed levels, • Reduced grazing pressure, and • Appropriate fire management practices implemented
		1.2.3 Maintain and enhance the existing spatial configuration of remnants and patches in the study area to improve ecosystem function and maintain ecological processes	• Reduced isolation distance between key remnants and patches, especially for isolation-sensitive fauna and flora; • Increased amount of native vegetation planted to connect key remnants, patches and ecological neighbourhoods; • Enhancement of remnant shape to facilitate fauna dispersal/movement between remnants, • Increased number of linkages used by native fauna to move through their home ranges in the landscape, and • Increased area-perimeter ratio.
1.3 Native Biodiversity 3 (short-long-term)	1.3 To manage the impact of threats and threatening processes on all native flora and fauna and their habitats in the study area	1.3.1 Identify all threats and threatening processes likely to adversely impact on the maintenance and improvement of biodiversity values in the study area	• reduced level of threats from habitat loss, modification and fragmentation, loss of genetic diversity, inappropriate fire regimes, weed incursion and spread, fertiliser drift, feral plant and animal invasion, livestock grazing, and rubbish disposal; • Dampening of threatening processes expressed at patch, remnant, sub-catchment, catchment and regional scales, especially reduction of predation and competition by feral animals and plants and adoption of appropriate firing cycles

Group	Environmental Goal	Outcomes	Measures
		1.3.2 Implement appropriate management strategies and actions to minimise the adverse impact of threats and threatening processes on native biodiversity of the study area	
		1.3.3 Integration of these strategies and actions with catchment and regional scale landscape management plans and programs.	
1.4 Native Biodiversity 4 (medium-long-term):	1.4 To conserve and where possible enhance wetland ecosystems in the study area, including naturally saline systems	1.4.1 Protection of existing wetlands (saline and non-saline) and maintenance of key ecological functions and processes consistent with Australian Ramsar Management Principles and other relevant international conservation treaties (e.g., JAMBA, CAMBA for intercontinental migratory wading birds)	• Reduced level of threats to wetland ecosystems especially from drainage and infilling, burning, grazing, weed incursion and salt damage (non-natural); increase in number of privately owned wetlands included in conservation reserve or covenanting systems; • Development of a ranking system for allocating conservation action priority to management of existing wetlands across all tenures
		1.4.2 Improved understanding and knowledge of wetland ecological functions and values in agricultural landscapes	• heightened community awareness of wetland biodiversity values and • Increased willingness to implement conservation actions to protect wetland ecosystems.
1.5 Native Biodiversity 5 (short, medium and long-term)	1.5 To develop and implement landscale-scale management strategies and actions which conserve and, where possible, restore the range of the study area's natural biological diversity	1.5.1 Conservation of viable representative samples of the study area's natural biological and physical diversity	• Increased number of samples of vegetation associations, faunal populations and communities, topographical units and features (e.g. granite outcrop and breakaway habitats) added to conservation reserve (private and public) system in study area
		1.5.2 Design and implementation of revegetation programs that target biodiversity conservation and recovery in the immediate landscape and across the region	• Number of biodiversity-specific revegetation programs implemented in study area and monitoring of the performance of these efforts to achieve their goals; • Areal contribution of these programs to providing alternative or replacement habitat, especially for area and isolation-sensitive native fauna (i.e. 'corridors', foraging habitat, breeding resource, etc.)

Group	Environmental Goal	Outcomes	Measures
WATER MANAGEMENT			
2.1 Water Management	2.1 To manage the quality and flow of surface and ground water (including salt) to ensure positive environmental benefits for humans and native species in the study area	2.1.1 Reduced landscape salinity risk to biodiversity and agricultural production values – criteria for measurement/assessment: position in landscape re salt risk, waterlogging, hydrogeological factors, scale of intervention, likely timescale of benefit, site assessment – examples of management actions: revegetation, saltland perennial pasture, tree alley/strip farming, deep drainage, etc	
		2.1.2 Identification of salt-affected areas and areas likely to be affected by salinity over the next 5-10 years	
		2.1.3 Identification of salt-affected and waterlogging-prone areas and areas at risk of primary and secondary salinisation over next 5-10 years; improved knowledge and understanding of salinity mitigation actions available for implementation in the region	
		2.1.4 Improved quality of surface and ground water flows through best practice management of on-farm activities (fertiliser application, low tillage to maintain soil structure, perennial pasture coverage to filter overland flows, minimised drawdown of local and regional water tables, infilling of gravel pits used as rubbish dumps, etc)	

SOIL MANAGEMENT			
3.1 Soil Management	3.1 To conserve and enhance the soil and topographical landscapes of the study area, especially for sustainable agricultural production	3.1.1 Reduced risk of soil erosion, stream sedimentation, loss of vegetation and lowered biodiversity values through improved on and off-farm land management practices	
		3.1.2 Raised awareness of, and commitment to, local and regional scale conservation of soil resources and vegetation cover (perennial non-woody/woody, ephemeral)	
		3.1.3 Improved protection and representation of significant topographical units across the study areas, especially natural erosional features (breakaways), specific geological features (granite outcrops, lateritic rises, etc), in reserves and under covenanting systems	

Auction for Landscape Recovery

Name of CSO: ______________________________

Date and time of assessment:______________________________

Site Location: ______________________________

Property owner :______________________________

Contact details:

Phone:______________________________

Fax:______________________________

Address:______________________________

Email:______________________________

____

Property conditions at time of assessment (e.g. drought cycle, above average rainfall):

____

____

Size of remnant in hectares (GIS)	Size of Site	Type of Tender	EOI Number	Site ID Number
		Single Multiple Joint		

Check List

- ✓ Landholders EOI
- ✓ Streets ahead map (with scale)
- ✓ Extra site assessment forms
- ✓ Additional biodiversity characteristics sections
- ✓ Several tender documents
- ✓ Information on management options
- ✓ DBH tape
- ✓ First aid kit
- ✓ Digital Camera (spare batteries)

TIME SPENT

Time spent:		
In discussion with landholders (project information, project planning	On actual site assessment	Data Entry
______________ ______________ ______________		

GIS INFORMATION

Attribute Type	Data collection	Confidence
Major vegetation types present; size/ percentage. Estimate area (in hectares) of habitat patch within remnant (field estimate needed as determination may not be possible using GIS data or aerial photo interpretation)	*Identified by*: GIS / Field Estimate *Major Vegetation Types*: Type:______________ Size/ percentage:__________ Type:______________ Size/ percentage:__________ Type:______________ Size/ percentage:__________ Type:______________ Size/ percentage:__________	Veg types *Not* ☐ *Moderate* ☐ *Confident* ☐ If field estimate then do confidence rating
Proximity of remnant to nearest native vegetation remnant of significant size, ie. core area (of >40 ha) Edge width for core habitat area >40 ha = 60 metres	Derived from a database of distances in kilometers between the nearest edge of each vegetation remnant and the nearest edge of all other vegetation remnants and size as area in hectares of the vegetation remnants. Quantitative estimate using GIS Size:__________ Direction:________ *Notes – any additional observations:* ______________ ______________ ______________ ______________	
Remnant area divided by perimeter length, representing reduction of habitat value due to edge effects	Derived from a database of area, perimeter and area: perimeter ratio for each remnant vegetation in the study area. Quantitative estimate using GIS <20 ha: ______ >20 ha: ______	
Aerial extent of water logging, from database and hydrological maps	Areal extent of waterlogging Size:__________	

BIODIVERSITY CHARACTERISTICS

Attribute Type	Data collection	Confidence
Number of strata – tree, mallee, shrub, herbs and cryptogams. Records observable strata and sub-strata, and picks up levels of complexity that may not be implied in recorded height/cover of main strata, e.g. list apparent layers: emergent tree (1), mallee (1), shrub (2), herb (1)	*Layers present(count all strata even if <5% cover):* Trees | Mallee | Shrubs | Herbs (non woody plants) | Cryptogams *Notes –observations* __________	*Layers* Not Moderate Confident
Vegetation structural type – distinguish between distinctively different woodlands (wandoo, salmon gum), mallee forms, shrubland, chenopod and cleared land. Note: chenopod shrubland includes samphire. Mimimum assessable unit >10% or >1 ha whichever is larger Note that pasture = not cultivated in recent history (>20yr) not just in pasture phase of rotation. Mosaic = standard plot contains more than one veg. type	*Descriptive vegetation type:* Woodland (W) | Mallee (M) | Shrubland/ Heathland (S) | Chenopod shrubland (C) Cleared – pasture (CP) | Cleared – cultivated (CC) | Other (eg. mosaic) (O) Plot ID Number | Photo Taken VT- *Notes –observations/ Description* __________	*Veg. Type* Not Moderate Confident
Height estimate of first stratum (name strata type, applicable to tree, mallee, shrub, heathland, etc) – height defined as the top of the lowest to the top of the highest in the stratum, range in metres, e.g. tree, 12-14m. Foliage cover of first stratum– estimate in category of %Projective Foliage Cover	*Strata type:* __________ N/A *Height in metres, (range or single value):* __________ *% Projective Foliage Cover* 5-10% | 10-30% | 30-50% | 50-70% | >70% *Description: eg., Acacia shrubland, mixed shrubland.* __________	*Height* Not Moderate Confident *%PFC* Not Moderate Confident

<table>
<tr>
<td>Presence/absence of emergents over first stratum. Isolated emergent trees/mallees may project from the canopy of some communities, generally making up <5% foliage projected cover, e.g. 2 trees, 20-25m height, per 50x20m plot.</td>
<td colspan="5">Emergents: present / absent

If present, estimate number of trees within a standard plot; height in meters:

Number: ____________________

Height in metres, (range or single value): _______________

Notes – any additional observation
____
____
____
____
____
____</td>
<td>Emergents
Not
Moderate
Confident</td>
</tr>
<tr>
<td rowspan="3">Height estimate of second stratum (note strata type) – height defined as the top of the lowest to the top of the highest in the stratum, range in metres, e.g. mallee, 5-8m

Foliage cover of second stratum– estimate in category of %Projective Foliage Cover</td>
<td colspan="5">Strata type: _____________________________________ N/A

Height in metres, (range or single value)::___________________

% Projective Foliage Cover</td>
<td>Height
Not
Moderate
Confident</td>
</tr>
<tr>
<td>5-10%</td><td>10-30%</td><td>30-50%</td><td>50-70%</td><td>>70%</td>
<td rowspan="2">%PFC
Not
Moderate
Confident</td>
</tr>
<tr>
<td colspan="5">Description: eg., Acacia shrubland, mixed shrubland.
____
____
____
____
____
____</td>
</tr>
<tr>
<td rowspan="3">Height estimate of third stratum (name strata type) – height defined as the top of the lowest to the top of the highest in the stratum, range in metres, e.g. shrub, 2-3m

Foliage cover of third stratum (name strata type) – estimate in category of %Projective Foliage</td>
<td colspan="5">Strata type: _____________________________________ N/A

Height in metres, (range or single value): ____________________

% Projective Foliage Cover</td>
<td>Height
Not
Moderate
Confident</td>
</tr>
<tr>
<td>5-10%</td><td>10-30%</td><td>30-50%</td><td>50-70%</td><td>>70%</td>
<td rowspan="2">%PFC
Not
Moderate
Confident</td>
</tr>
<tr>
<td colspan="5">Description: eg., Acacia shrubland, mixed shrubland
____
____
____
____
____
____
____</td>
</tr>
</table>

<table>
<tr><td rowspan="5">Foliage cover of herb (non-woody plants including dead annuals) stratum (name strata/s type if known) – estimate in category of %Projective Foliage Cover, e.g. herbs, 25%</td><td colspan="6">% Projective Foliage Cover N/A</td><td colspan="2">%PFC</td></tr>
<tr><td><2%</td><td>2-10%</td><td>10-30%</td><td>30-50%</td><td>50-70%</td><td>>70%</td><td>Not</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>Moderate</td><td></td></tr>
<tr><td colspan="6" rowspan="2">Description (If known):
____
____
____
____
______________________________</td><td>Confident</td><td></td></tr>
<tr><td colspan="2"></td></tr>
<tr><td rowspan="5">Projective cover, of intact cryptogam layer, excluding exposed rock.</td><td colspan="6">% Cover:</td><td colspan="2">% Cover</td></tr>
<tr><td><5%</td><td>5-10%</td><td>10-30%</td><td>30-50%</td><td>50-70%</td><td>>70%</td><td>Not</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>Moderate</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>Confident</td><td></td></tr>
<tr><td colspan="6"></td><td colspan="2"></td></tr>
<tr><td rowspan="5">Floristic composition (native species only): counting number of species of trees, mallees and shrubs present in 50 x 20m plot.</td><td colspan="6">Number of species (tree, mallee, shrubs) in a 50 x20m standard plot (do not assign a range) N/A</td><td colspan="2">Species present</td></tr>
<tr><td colspan="2">Trees</td><td colspan="2">Mallees</td><td colspan="2">Shrubs</td><td>Not</td><td></td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td>Moderate</td><td></td></tr>
<tr><td colspan="6" rowspan="2">Notes – observation
____
____
____
____
______________________________</td><td>Confident</td><td></td></tr>
<tr><td colspan="2"></td></tr>
<tr><td rowspan="7">Presence of rocks (>10cm diameter) and/or boulders on ground (habitat for reptiles, insects, mammals and frogs)

Outcrop: (5 x10m minimum)</td><td colspan="6">Rocks and outcrops:</td><td colspan="2">Cover</td></tr>
<tr><td colspan="2">Rocks present</td><td colspan="2">Outcrops present</td><td colspan="2">No rocks or outcrops present</td><td>Not</td><td></td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td>Moderate</td><td></td></tr>
<tr><td colspan="6">Rocks/outcrops present, % site:</td><td>Confident</td><td></td></tr>
<tr><td><5%</td><td>5-15%</td><td colspan="2">15-30%</td><td colspan="2">>30%</td><td colspan="2" rowspan="3"></td></tr>
<tr><td></td><td></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="6"></td></tr>
</table>

<table>
<tr>
<td>Large tree as >30cm DBH; large mallee as >15cm (DBH = diameter at breast height measured over bark 1.3m above ground level).

Counted over standard plot 50 x 20m</td>
<td>Number of living/dead 'large' trees/mallee: N/A
<table>
<tr><td>Large standing dead trees</td><td>Large living trees</td><td>Large standing dead mallees</td><td>Large living mallees</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>
Notes – observation</td>
<td>Number
<table>
<tr><td>Not</td><td></td></tr>
<tr><td>Moderate</td><td></td></tr>
<tr><td>Confident</td><td></td></tr>
</table></td>
</tr>
<tr>
<td>Presence/absence and structural complexity of litter layers (significant litter >5% ground covered by leaf, bark, branches, and/or logs)

Branches <10cm diameter; Logs >10cm diameter.

Rubbish, eg. Metal sheets, tin cans etc.</td>
<td>Foliage: present / absent N/A
Bark: present / absent
Branches: present / absent
Logs: present / absent
Other (includes rubbish): present / absent

Describe other if applicable</td>
<td>Presence/ absence
<table>
<tr><td>Not</td><td></td></tr>
<tr><td>Moderate</td><td></td></tr>
<tr><td>Confident</td><td></td></tr>
</table></td>
</tr>
<tr>
<td>Ground cover of combined litter (significant litter >5% ground covered by leaf, bark, and/ or branches <10cm diameter) – estimate in category of %Projective litter Cover e.g. 15-30% (litter of leaves and bark generally less than 2cm thick, except around the base of trees where 20-30cm thick)</td>
<td>%Projective Litter Cover: N/A
<table>
<tr><td><5%</td><td>5-15%</td><td>15-30%</td><td>30-50%</td><td>50-70%</td><td>>70%</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
Litter depth (range): ___________________

Notes – observations including distribution of litter</td>
<td>%PFC
<table>
<tr><td>Not</td><td></td></tr>
<tr><td>Moderate</td><td></td></tr>
<tr><td>Confident</td><td></td></tr>
</table></td>
</tr>
<tr>
<td>Presence of fallen logs and branches or other coarse woody debris (shelter/habitat for reptiles, insects, mammals and frogs)</td>
<td>Fallen logs /branches N/A

Present / Absent

% Area with coarse woody debris:
<table>
<tr><td>0</td><td><5%</td><td>5-15%</td><td>>15%</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table></td>
<td>Fallen Logs
<table>
<tr><td>Not</td><td></td></tr>
<tr><td>Moderate</td><td></td></tr>
<tr><td>Confident</td><td></td></tr>
</table></td>
</tr>
</table>

<table>
<tr><td rowspan="4">Evidence of recruitment (ie. Plants that haven't yet set seed) of woody perennial native species (where assessable, noting that evidence of recruitment can be difficult to find in some communities, eg. salmon gum)</td><td colspan="4">% Site containing recruitment stands or areas with seedlings: N/A

Presence / Absence</td><td colspan="2">Recruitment
Not
Moderate</td></tr>
<tr><td><5%</td><td>5-15%</td><td>15-30%</td><td>>30%</td><td colspan="2"></td></tr>
<tr><td></td><td></td><td></td><td></td><td>Confident</td><td></td></tr>
<tr><td colspan="4">Notes – observation
______
______
______
______
______
______</td><td colspan="2"></td></tr>
<tr><td>Number of trees/mallee with visible hollows (>3 cm diameter per 50x20m plot min. height above ground of these trees/mallee =1.5m) – visually assessed) Hollows include hollows, spouts and stags</td><td colspan="5">Number of trees/mallees with visible hollows: N/A

Number: ______

Notes – observation
______
______
______
______
______
_</td><td colspan="2">Hollows
Not
Moderate
Confident</td></tr>
<tr><td rowspan="4">Evidence of plant health problems (crown dieback, epicormic shoots, insect damage). The health of some isolated trees or small patches of remnant vegetation may also be affected by mistletoe infestations. Record the rationale used to assign canopy health score. 50 x 20 plot.</td><td colspan="5">% of plants with significant health problems: N/A</td><td colspan="2">Health issues
Not</td></tr>
<tr><td><5%</td><td>5-15%</td><td>15-30%</td><td>30-50%</td><td>>70%</td><td>Moderate</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>Confident</td><td></td></tr>
<tr><td colspan="5">Describe symptom / cause if known (Do separately for trees/mallees and shrubs):
______
______
______
______
______
______
______</td><td colspan="2"></td></tr>
</table>

Characteristics of cleared sites/paddocks, record number and distribution (ie. clumped, located along narrow strips such as fencelines, creeks or as potential corridors linking two remnants on the site, single paddock trees, not present) of scattered farm trees, number/presence/site distribution of cleared rocky outcrops (granite, laterite,etc), presence and site distribution of small area of shrubland <1ha.

Characteristics of cleared sites/paddocks: N/A

Site Distribution of trees mallee and shrubs:

	Absent	Scattered	clumped	Located along narrow strips	Single paddock tree
Trees					
Mallee					
Shrubs					

If present number of individuals :

	Trees	Mallee	Shrubs
Number			

Note – observations:

Cleared areas	
Not	
Moderate	
Confident	

Additional features not described elsewhere, may include the existence of dams, contours, wells, etc. Also any other observations worth noting.

Additional Features not described elsewhere:

LANDSCAPE CONTEXT

<table>
<tr><td rowspan="8">Condition of adjacent native vegetation remnants. Site is located within 10m of an existing remnant. Estimate overall condition of the remnant that the site is proximal to.</td><td colspan="3">Adjacent remnants:

present / absent

Condition:</td><td colspan="2">Condition</td></tr>
<tr><td>Adjacent Remnant</td><td>Direction</td><td>Condition</td><td>Not</td><td></td></tr>
<tr><td>1</td><td></td><td>Pristine / Excellent / Very good / Good / Poor</td><td>Moderate</td><td></td></tr>
<tr><td>2</td><td></td><td>Pristine / Excellent / Very good / Good / Poor</td><td>Confident</td><td></td></tr>
<tr><td>3</td><td></td><td>Pristine / Excellent / Very good / Good / Poor</td><td colspan="2"></td></tr>
<tr><td>4</td><td></td><td>Pristine / Excellent / Very good / Good / Poor</td><td colspan="2"></td></tr>
<tr><td>5</td><td></td><td>Pristine / Excellent / Very good / Good / Poor</td><td colspan="2"></td></tr>
<tr><td colspan="3">Notes – any additional observation:</td><td colspan="2"></td></tr>
<tr><td rowspan="4">If site includes a riparian or wetland zone, condition of the riparian or wetland zone (F). A drainage line or any intermittent or permanent watercourse or wetland shown on a topographical map of scale 1:50,000 or better.

Riparian zone: high water mark plus 20m on either side. Is associated with rivers/streams/ wetlands</td><td colspan="5">Riparian /wetland zone:

Present / Absent

Condition of riparian / wetland zone:</td><td colspan="2">Condition
Not
Moderate</td></tr>
<tr><td>Pristine</td><td>Excellent</td><td>Very Good</td><td>Good</td><td>Poor</td><td>Confident</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td colspan="5">Description:</td><td colspan="2"></td></tr>
</table>

Observed and/or previously recorded presence of locally and regionally significant flora and fauna species, populations and ecological communities (farmer knowledge) at site. Ask landholder if they have bird/plant/etc list and if they are willing to give you a copy.	*Previously surveyed:* Yes / No / Unknown *If yes, by whom*: ______________________________ *If 'yes', significant flora or fauna species or communities:* Present / Absent *List regionally/ locally significant species or ecological communities present:* ____ ____ ____ ____ ____ ____ ____ ____	

MANAGEMENT PROFILE

Salinity outbreak, observations of evidence of salinity outbreak or landholder comments Proximity of salt outbreak to drainage line (as identified on 1:50 000 map), ask landholder for information, direction, distance. Distances derived by reference to database of drainage lines and known wetland areas. Or observed in the field using topographic mapping or aerial photos, estimate distances. Ask farmer for information.	*Salinity:* Primary salinity / Secondary salinity / Unknown *Notes – observations (vegetation decline, salt crystals, scald, changed soil surface structure):* ____ ____ ____ ____ ____ ____ ____ *Proximity of salt outbreak to drainage line*: Distance: ______________m Direction: _____________ Size: _________________ *Notes – any additional comments made by farmers:* ____ ____ ____ ____ ____ ____ ____ ____	*Salinity*	
		Not	
		Moderate	
		Confident	

Time since salt outbreak first detected and action (if any) taken – can include fencing out, planting of salt tolerant species, deep drainage to redirect sub-surface salt away from cropping zones. (Landholder discussions)	*Time (yrs) since salt outbreak first detected:* Time detected: ______________________ *Description of management actions undertaken and its location*: ____ ____ ____ ____ ____ ____ *Note any other relevant information*: ____ ____ ____ ____ ____ ____	
History of waterlogging (Landholder discussions and existing hydrological maps (if available)	*Notes from discussions with landholder and any other relevant observations:* ____ ____ ____ ____ ____ ____ ____	
Severity and areal extent of soil erosion associated with the site. Erosion: incision of soil surface and translocation of sediment.	*Soil Erosion:* Present / Absent *Extent of soil erosion across whole remnant:* <5% | 5-15% | >15% Note any other relevant information: ____ ____ ____ ____ ____ ____ ____	*Soil erosion* Not [ ] Moderate [ ] Confident [ ]

Grazing intensity and access to remnants (note: historical grazing = site grazed > 10 yrs ago; grazed recently = in the past 10 years) Landholder discussions/EOI form responses	*Notes from discussions with landholder* *a) Current or Recent grazing:* Set Stocked | Rotationally Grazed | Strategically Grazed *b) Never or historically grazed.* Time since exclusion (stock fenced out of remnant): _____yrs______ mths Notes – additional information ____________________ ____________________ ____________________ ____________________ ____________________ ____________________	
Fire regime - intensity and frequency (F/O – via landholder discussions and EOI/bid form responses)	*Notes from discussions with landholder:* Site not burnt in past 10+ years | Site burnt in the past 10 years *If in past 10yrs, number of years since fire*: ____________________ *Number of fires in last 10yrs:* ____________________ *Fires deliberate or accidental:* ____________________ *Notes from discussions with landholder and any other relevant observations:* ____________________ ____________________ ____________________ ____________________ ____________________	
Weed plants present on site, weeds may be patchy with high occurrence around rabbit warrens etc.	*Weeds within remnant:* Obviously weedy throughout | Patchily weedy throughout | Weedy around edges | Not or very slightly weedy *Distance (metres) from remnant edge (survey for weed incursions up to 100m):* _____________ m *Notes – weeds present:* ____________________ ____________________ ____________________ ____________________ ____________________ ____________________	*Weeds* Not Moderate Confident

Evidence of feral animals (ie. rabbit, cat, fox, pig, goat) into native vegetation remnants and distance from remnant edge in proximity to the site. Presence of feral animals (ie. rabbit, cat, fox, pig, goat) on site (detected by presence of scats, diggings or direct observation)

Feral animals:

Evidence of feral animals / No evidence of feral animals

Evidence of feral animals present:

	Fox	Cat	Rabbit	Pig	Goat	Other
Tracks						
Scats						
Diggings						
Warrens						
Observed						
Other						

Describe 'other'. Comment on severity of impact:

Feral Animals	
Not	
Moderate	
Confident	

Other observed disturbances, such as gravel /sand mining, rubbish dumping, firewood collection, drains etc.

Disturbance:

Gravel/sand mining	Rubbish dumping	Firewood collection	Drains	Other
	recent past		in site from site into site	

Describe other and/or severity of disturbance:

Other Disturbance	
Not	
Moderate	
Confident	

ALR Environmental Benefits Index Scorecard, Round One

The scorecard notation "nas" = not assessable (usually due to lack of data, insufficient data or poor data quality).

BID ID NUMBER: ____________________

1. Native Biodiversity Benefits Index (NBBI)

Vegetation/habitat Condition (VCO)

BID ID NUMBER:	Current points (VCO t_0)	Potential points (VCO t_n)
1. Evidence of recruitment		
No recruitment	0	0
<15% of site with recruitment stands	1	1
15-30% of site with recruitment stands	2	2
>30% recruitment evident	4	4
2. Number of large standing dead trees present		
None	0	0
All large trees dead	1	1
>50% dead	2	2
<50% dead	4	4
3. Number of trees with visible hollows (>3cm diam per 50x20m plot)		
Nil	0	0
1-2 trees	2	2
3-5 trees	4	4
>5 trees	6	6

BID ID NUMBER:	Current points (VCO t_0)	Potential points (VCO t_n)
4. Evidence of tree health problems, eg. dieback, insect damage, etc		
All or most trees (>70% canopy) showing health problems	0	0
Several trees with health problems (50-70% canopy)	1	1
Few trees affected by dieback, etc (<50% canopy)	3	3
No trees affected by dieback	4	4
5. Intact or interconnecting shrubland/heathland canopy offering nesting and foraging habitat for fauna		
No shrub cover	0	0
Shrub cover <20%	2	2
Shrub cover 20-40%	4	4
Shrub cover > 40%	6	6

VCO total	Total Current points (VCO t_0)	Total potential points (VCO t_n)
out of max possible of 24 points		

Vegetation/habitat Complexity (VCY)

BID ID NUMBER:	Current points (VCY t_0)	Potential points (VCY t_n)
1. Degree of woodland structural complexity (number of strata present and % projective foliage cover)		
No layers present	0	0
One layer present but <30% foliage cover per layer	1	1
Two layers present & >30% foliage cover per layer	3	3
3 or more layers present but <30% foliage cover per layer	6	6
2. Degree of shrubland structural complexity (number of strata present and % projective foliage cover)		
No layers present	0	0
One layer present but <30% foliage cover per layer (no missing layers =5)	1	1
2-3 layers present & >30% cover per layer (no missing layers=7)	3	3
>3 layers present but <30% cover per layer	6	6
>3 layers present & >30% cover	10	10
3. Percentage projective foliage cover of herb stratum (estimated)		
<2%	0	0
2-10%	1	1
10-30%	2	2
30-50%	3	3
50-70%	4	4
>70%	5	5
4. Presence of a leaf/bark/other plant material litter layer		
No litter layer present	0	0
Litter layer present	3	3
5. Floristic composition: number of commonly occurring native tree and shrub species present		
0-2 species present	1	1
3-5 species present	3	3
>6 species present	5	5

BID ID NUMBER:	Current points (VCY t_0)	Potential points (VCY t_n)
6. Percentage projective foliage cover of intact cryptogam layer		
<2%	0	0
2-10%	1	1
10-30%	2	2
30-50%	3	3
50-70%	4	4
>70%	5	5
7. Presence of fallen logs and branches or other coarse woody debris		
Nil	0	0
<15% of site covered by fallen logs/debris	1	1
15-30% of site covered	2	2
> 30% of site covered	4	4
8. Presence of rocks (>10cm diam) and/or boulders on the ground		
No rocks	0	0
<15% site covered by rocks	1	1
15-30% rocks	2	2
>30% rocks	4	4
9. Estimated height of vegetation strata present (shrub, heathland)		
0-1 m (shrub, heath)	1	1
1-2 m (shrub, heath)	2	2
2-3 m (shrub, heath)	3	3
10. Estimated height of vegetation strata present (tree, mallee)		
2 m (tree, mallee)	1	1
2-3 m (tree, mallee)	2	2
>3 m (tree, mallee)	3	3

VCY total	Total Current points (VCY t_0)	Total potential points (VCY t_n)
out of max possible of 48 points		

Landscape Context (LC)

BID ID NUMBER:	LC Points	Feasibility (MARG)
1. Site is part of a continuous area of native vegetation (area of remnant)		
<2 ha	1	
≥2 to ≤5	2	
>5 to ≤10	4	
>10 to ≤20	6	
>20 to ≤40	8	
>40 to ≤80	10	
>80	13	
2. Site is part of a habitat patch, where assessable (size of habitat patch)		
<1 ha	1	
≥1-2	2	
≥3-5	3	
≥6-8	4	
≥9-12	6	
≥13-20	8	
>21	11	
3. Proximity of site to nearest native vegetation remnant of significant size, ie. core area (of >40 ha)		
> 5 km	0	
≥3-5	2	
≥1-3	5	
<1	8	
contiguous	10	
4. Condition of adjacent remnant		
No adjacent remnant	0	
In poor condition	2	
In moderate condition	4	
In good condition	6	
5. Site connects two or more remnants. Site is part of a remnant that connects two or more native vegetation remnants		
No existing connection (>1 km between remnants)	0	
Potential exists for connection (<1 km between remnants)	2	
Site and remnants already connected or <60 m apart	5	

BID ID NUMBER:	LC Points	Feasibility (MARG)
6. Remnant area divided by perimeter length, representing reduction of habitat value due to edge effects		
Area (A) to perimeter (P) ratio <20	0	
A:P ratio >20	6	
7. Neighbourhood characteristics of existing native vegetation		
80% native vegetation occurs within 100m radius of site	5	
40% of native vegetation within 1km of site	3	
40% of native vegetation within 5km of site	1	
8. Does site include a riparian or wetland zone and what is their condition?		
Nil present	0	
Riparian/wetland zone in poor condition	1	
Riparian/wetland zone in moderate condition	3	
Riparian/wetland zone in good condition	5	

LC total	Total LC points
out of max possible of 60 points	

Conservation Significance (CS)

BID ID NUMBER:	Current points (CS t_0)	Potential points (CS t_n)
1. Observed and/or previously recorded presence of threatened flora and fauna species, populations and ecological communities at site		
Nil present	0	0
1-2 present	3	3
3-5 present	6	6
6-10 present	9	9
>11 present	12	12
2. Observed and/or previously recorded presence of locally and regionally significant flora and fauna species, populations and ecological communities at site		
Nil present	0	0
1-2 present	2	2
3-5 present	4	4
6-10 present	6	6
>11 present	9	9

BID ID NUMBER:	Current points (CS t_0)	Potential points (CS t_n)
3. Location of previous biodiversity survey effort and method (target, non-target)		
No previous surveys in or near site	0	0
1 previous survey in/near site	1	1
>2 previous surveys in/near site	3	3
4. Regional biodiversity conservation priority zone as identified in a regional plan, e.g. site is part of a regional wildlife linkage or corridor proposed by CALM		
Low priority ascribed	3	3
Moderate priority	6	6
High priority	10	10

CS Total	Total Current points (CS t_0)	Total potential points (CS t_n)
out of max possible of 34 points		

Calculation of NBBI

The Formula (modified from Oliver and Parkes 2003)

NBBI = Biodiversity Significance Score (BSS) x Land Use Change Impact Score (LUCIS) x area of land use change (ha)

= *(CS t_0 + LC) VCO t_0 + VCY t_0 / 50 (the Biodiversity Significance Score) x ([CS t_n - CS t_0] + [VCO t_n - VCO t_0] + [VCY t_n – VCY t_0]) / 2 (the Land Use Change Impact Score) x ha*

Where:

CS t_0 = Current Conservation Significance
CS t_n = Potential Conservation Significance
LC = Landscape Context
VCO t_0 = Current Vegetation/Habitat Condition (before land use change)
VCO t_n= Potential Vegetation/Habitat Condition (after land use change generated by successful implementation of a tender and a specified time period)
VCY t_0 = Current Vegetation/Habitat Complexity (before land use change)
VCY t_n = Potential Vegetation/Habitat Complexity (after land use change generated by successful implementation of on-ground works contained in a tender and a specified time period)
ha = Area of land use change resulting from successful implementation of on-ground works contained in a tender.

BBS score	LUCIS score	Area of land use change (ha)	NBBI outcome

2. Other Environmental Benefits Index (OEBI)

Salt, water and soil management

BID ID NUMBER:	points
1. Is the site associated with a salinity occurrence (discharge area, salt outbreak)? What is the severity of the occurrence? Is the site within a natural saline wetland?	
No salt outbreaks or discharge areas present	10
Salt outbreaks occur in local landscape: severity rating of S1	7
Salt outbreaks occur in local landscape: severity rating of S2	5
Salt outbreaks occur in local landscape: severity rating of S3	3
Salt outbreaks at site: severity rating of S1	2
Salt outbreaks at site: severity rating of S2	1
Salt outbreaks at site: severity rating of S3	0
Site occurs in naturally saline wetland	Weighting factor: subtract 2 points
2. Size of salt outbreak (ha)	
<0.5	2
0.6-1	1
>1	0.5

BID ID NUMBER:	points
3. Proximity of salt outbreak to drainage line (m)	
>1000	5
<1000	4
<500	3
<200	2
riparian	1
4. Time since salt outbreak was first detected and action (if any) taken	
Undetected, no action taken	1
Detected in last year, some action taken	3
Detected 2+ years ago, action taken	5
5. Areal extent/history of waterlogging	
Most of site affected by seasonal waterlogging	0.5
50% of site affected by seasonal waterlogging	1
10-50% of site prone to seasonal waterlogging	3
<10% of site affected by waterlogging	5
6. Severity and areal extent of soil erosion associated with the site	
Minimal (<25% of site)	8
Slight (25-50% of site)	6
Moderate (51-75% of site)	4
Severe (>75% of site)	2

Salt, water and soil mgt total	Total points
out of max possible of 35 points	

Other management activities

BID ID NUMBER:	points
1. Livestock grazing intensity and access to remnant native vegetation and water	
Set stocked	1
Rotationally grazed	3
Strategically grazed	5
Never or historically grazed, livestock fenced out of remnants, and access to water exists	7
2. Fire management regime – intensity and frequency	
Site not burnt in past 20+ years	8
Site hazard reduction burnt every 10+ years	4
Site wild-fired or deliberately burnt every 2-3 years	0
3. Floristic composition of weeds present at site	
>10 weed species present	0
5-10 weed species present	1
1-5 weed species present	2
No weed species present	4
4. Incursion distance (m) of weeds into native vegetation remnants up to 100m from remnant edge and in proximity to site (eg. 25m from site)	
Weeds occur 100m into remnant	0
Weeds occur 50-100m into remnant	1
Weeds occur 20-50m into remnant	2
Weeds occur 10-20m into remnant	4
Weeds do not occur beyond 10m into remnant	5

5. Presence of weeds in native vegetation remnants as % projective foliage cover within 100m of remnant edge	
Weeds present as > 70% projective foliage cover	0
50-70%	1
30-50%	2
15-30%	3
10-15%	4
5-10%	5
<5%	6
0	7
6. Incursion distance (m) of feral animals (ie. rabbit, cat, dog, goat, fox, pig, horse, etc) up to 100m into native vegetation remnants	
Feral animals occur 100m into remnant	0
Occur 50-100m into remnant	1
Occur 20-50m into remnant	2
Occur 10-20m into remnant	4
Feral animals do not occur beyond 10m into remnant	5
7. Presence of feral animals on site, detected by presence of diggings, scats or direct observation	

BID ID NUMBER:	points
<10% feral animal invasion/presence	8
10-50% feral animal invasion/presence	4
>50% feral animal invasion/presence	0

Other management activities total	**Total points**
out of max possible of 44 points	

<u>Calculation of the OEBI</u>

OEBI = salinity benefits (SB) + water management (WM) benefits + soil management (SM) benefits + other environmental benefits or management activities (grazing, fire, pest plants and feral animals) /2

SB & WM score	SM score	Other environmental benefits (management activities) score	OEBI outcome (includes /2)

3. Calculation of the overall EBI

EBI = Native Biodiversity Benefits Index (NBBI) + Other Environmental Benefits Index (OEBI)/value of bid ($)

NBBI	OEBI	Value of bid ($)	EBI outcome

ALR Environmental Benefits Index Scorecard, Round Two

BID ID NUMBER: ____________________

1. Native Biodiversity Benefits Index (NBBI)

Vegetation/habitat Condition (VCO)

BID ID NUMBER:	Current points (VCO t_0)	Potential points (VCO t_n)
1. Evidence of recruitment		
Not applicable/ not assessable (e.g. cleared land)	Null	Null
No recruitment (i.e., none observed)	0	0
<5% of site with recruitment stands	1	1
5-15% of site with recruitment stands	2	2
15-30% of site with recruitment stands	3	3
>30% recruitment evident	4	4
2. Number of large standing dead trees (or mallees) present		
Not assessable (e.g. cleared land), or none observed – no large trees or mallee present	Null	Null
None (large trees or mallee present, but none dead)	0	0
All large trees and/or mallees dead	1	1
>50% of all large trees and/or mallees dead	2	2
<50% of all large trees and/or mallees dead	4	4
3. Number of trees (or mallees) with visible hollows (>3cm diam per 50x20m plot)		
Not assessable	Null	Null
Nil (none visible)	0	0
1-2 trees or mallees	2	2
3-5 trees or mallees	4	4
>5 trees or mallees	6	6

BID ID NUMBER:	Current points (VCO t_0)	Potential points (VCO t_n)
4. Evidence of tree health problems, eg. dieback, insect damage, etc		
Not assessable	Null	Null
>15% of plants showing health problems	0	0
5-15% of plants showing health problems	1	1
<5% of plants showing health problems	3	3
No trees, mallees, shrubs etc affected by dieback	4	4
5. Intact or interconnecting shrubland/heathland canopy offering nesting and foraging habitat for fauna		
Not assessable (e.g. vegetation types that do not normally have shrub/heath stratum)	Null	Null
No shrub cover (including NA, cleared areas and sites where no shrub strata recorded)	0	0
Shrub cover <5%	1	1
Shrub cover 5-10%	2	2
Shrub cover 10-30%	3	3
Shrub cover 30-50%	4	4
Shrub cover >50% (site assessment classes 50-70% or >70%)	6	6

VCO total	Total Current points (VCO t_0)	Total potential points (VCO t_n)
out of max possible of 24 points		

Vegetation/habitat Complexity (VCY)

BID ID NUMBER:	Current points (VCY t_0)	Potential points (VCY t_n)
1. Degree of woodland structural complexity (number of strata present and % projective foliage cover)		
Not assessable	Null	Null
No layers present	0	0
One layer present but <30% foliage cover per layer	1	1
Two layers present but <30% foliage cover per layer	2	2
Two layers present & >30% foliage cover per layer	3	3
3 or more layers present but <30% foliage cover per layer	6	6
3 or more layers present & >30% foliage cover per layer	8	8
2. Degree of shrubland structural complexity (number of strata present and % projective foliage cover)		
Not assessable	Null	Null
No layers present	0	0
One layer present but <30% foliage cover per layer (no missing layers =5)	1	1
One layer present & >30% foliage cover per layer	2	2
2-3 layers present but <30% cover per layer	2	2
2-3 layers present & >30% cover per layer (no missing layers=7)	3	3
>3 layers present but <30% cover per layer	6	6
>3 layers present & >30% cover	10	10

BID ID NUMBER:	Current points (VCY t_0)	Potential points (VCY t_n)
3. Percentage projective foliage cover of herb stratum (estimated)		
Not assessable	Null	Null
No layers present (none, cleared)	0	0
<2%	0	0
2-10%	1	1
10-30%	2	2
30-50%	3	3
50-70%	4	4
>70%	5	5
4. Presence of a leaf/bark/other plant material litter layer		
Not assessable	Null	Null
No litter layer present	0	0
Litter layer present	3	3
5. Floristic composition: number of commonly occurring native tree and shrub species present		
Not assessable	Null	Null
0-2 species present	1	1
3-5 species present	3	3
≥6 species present	5	5
6. Percentage projective foliage cover of intact cryptogam layer		
Not assessable	Null	Null
No layers present (none, cleared)	0	0
<2%	0	0
2-10%	1	1
10-30%	2	2
30-50%	3	3
50-70%	4	4
>70%	5	5
7. Presence of fallen logs and branches or other coarse woody debris		
Not assessable	Null	Null
Nil (absence of logs/woody debris)	0	0
<5% of site covered by fallen logs/debris	1	1
5-15% of site covered by logs/woody debris	2	2
>15% of site covered by logs/woody debris	4	4

BID ID NUMBER:	Current points (VCY t_0)	Potential points (VCY t_n)
8. Presence of rocks (>10cm diam) and/or boulders on the ground		
Not assessable	Null	Null
No rocks	0	0
<5% site covered by rocks	1	1
5-15% site covered by rocks	2	2
15-30% site covered by rocks	3	3
>30% site covered by rocks	4	4
9. Estimated height of vegetation strata present (tree, mallee)		
Not assessable (shrubland, heathland, sedgeland)	Null	Null
No trees or shrub layers present (ie cleared)	0	0
Strata height ≤ 2 m (tree, mallee)	1	1
Strata height >2 to ≤3 m (tree, mallee)	2	2
Strata height >3 m (tree, mallee)	3	3

BID ID NUMBER:	Current points (VCY t_0)	Potential points (VCY t_n)
10. Estimated height of vegetation strata present (shrub, heathland, sedgleland)		
Not assessable (mallee, woodland)	Null	Null
No trees or shrub layers present (ie cleared)	0	0
Strata height ≤1 m (shrub, heath, sedge)	1	1
Strata height >1 to ≤2 m (shrub, heath, sedge)	2	2
Strata height >2 m (shrub, heath, sedge)	3	3

VCY total	Total Current points (VCY t_0)	Total potential points (VCY t_n)
out of max possible of 50 points		

Landscape Context (LC)

BID ID NUMBER:	LC Points	Feasibility (MARG)
1. GIS-based: Site is part of a continuous area of native vegetation (area of remnant)		
Not assessable	Null	Null
No remnant present (Site not part of a remnant)	0	0
Remnant <2 ha	1	1
Remnant ≥2 - <5 ha	2	2
Remnant ≥5 to <10 ha	4	4
Remnant ≥10 to <20 ha	6	6
Remnant ≥20 to <40 ha	8	8
Remnant ≥40 to <80 ha	10	10
Remnant ≥80 ha	13	13
2. Site is part of a habitat patch, where assessable (size of habitat patch)		
Not assessable	Null	Null
Site is not part of a habitat patch (ie cleared land)	0	0
Patch <1 ha	1	1
Patch ≥1 to <2 ha	2	2
Patch ≥2 to <5 ha	3	3
Patch ≥5 to <8 ha	4	4
Patch ≥8 to <12 ha	6	6
Patch ≥12 to <20 ha	8	8
Patch ≥20 ha	11	11
3. GIS-based: Proximity of site to nearest native vegetation remnant of significant size, ie. core area (of >40 ha)		
Not assessable	Null	Null
> 5000 metres	0	0
≥3000 to ≤5000 m	2	2
≥1000 to <3000 m	5	5
≥250 to <1000 m	8	8
>50 to <250 metres	9	9
Contiguous, connected (≤ 50 m)	10	10
4. Condition of adjacent remnant		
Not assessable	Null	Null
No adjacent remnant	0	0
In poor condition	2	2
In good condition	4	4
In very good condition	5	5
In excellent condition	6	6
In pristine condition	7	7

BID ID NUMBER:	LC Points	Feasibility (MARG)
5. GIS-based: Remnant area divided by perimeter length, representing reduction of habitat value due to edge effects		
No remnants present	0	0
Area (A) to perimeter (P) ratio >=1 and <10	1	1
Area (A) to perimeter (P) ratio >=10 and <20	2	2
Area (A) to perimeter (P) ratio >=20 and <40	3	3
Area (A) to perimeter (P) ratio >=40 and <100	4	4
Area (A) to perimeter (P) ratio >=100 and < 200	5	5
Area (A) to perimeter (P) ratio >=200 and < 500	6	6
Area (A) to perimeter (P) ratio >=500	7	7
6. GIS based: Proportion of existing native vegetation within 5000m neighbourhoods of site centre-points		
Not assessable	Null	Null
≤5% native vegetation in 5km	0	0
>5 to ≤10% native vegetation in 5km	1	1
>10 to ≤15% native vegetation in 5km	2	2
>15 to ≤20% native vegetation in 5km	3	3
>20 to ≤30% native vegetation in 5km	4	4
>30 to ≤40% native vegetation in 5km	5	5
>40 to ≤50% native vegetation in 5km	6	6
>50 to ≤60% native vegetation in 5km	7	7
>60 to ≤70% native vegetation in 5km	8	8
>70 to ≤80% native vegetation in 5km	9	9
≥80% native vegetation in 5km	10	10

BID ID NUMBER:	LC Points	Feasibility (MARG)
7. GIS based: Proportion of existing native vegetation within 1000m neighbourhoods of site centre-points		
Not assessable	Null	Null
≤5% native vegetation in 1km	0	0
>5 to ≤10% native vegetation in 1km	1	1
>10 to ≤15% native vegetation in 1km	2	2
>15 to ≤20% native vegetation in 1km	3	3
>20 to ≤30% native vegetation in 1km	4	4
>30 to ≤40% native vegetation in 1km	5	5
>40 to ≤50% native vegetation in 1km	6	6
>50 to ≤60% native vegetation in 1km	7	7
>60 to ≤70% native vegetation in 1km	8	8
>70 to ≤80% native vegetation in 1km	9	9
≥80% native vegetation in 1km	10	10
8. GIS-based: Proportion of existing native vegetation within sites		
Not assessable	Null	Null
≤5% native vegetation in site	0	0
>5 to ≤10% native vegetation in site	1	1
>10 to ≤15% native vegetation in site	2	2
>15 to ≤20% native vegetation win site	3	3
>20 to ≤30% native vegetation in site	4	4
>30 to ≤40% native vegetation in site	5	5
>40 to ≤50% native vegetation in site	6	6
>50 to ≤60% native vegetation in site	7	7
>60 to ≤70% native vegetation in site	8	8
>70 to ≤80% native vegetation in site	9	9
≥80% native vegetation in site	10	10

BID ID NUMBER:	LC Points	Feasibility (MARG)
9. Does site include a riparian or wetland zone and what is their condition?		
Not assessable	Null	Null
Nil present	0	0
Riparian/wetland zone in poor condition	1	1
Riparian/wetland zone in good condition	3	3
Riparian/wetland zone in very good condition	5	5
In excellent condition	6	6
In pristine condition	7	7
10. GIS-based: Does site include a riparian or wetland zone that is associated with high salinity risk?		
Not assessable (No wetland or riparian feature; naturally saline feature – Beard SL code)	Null	Null
Riparian or wetland feature associated with salinity risk (Moderate)	1	1
Riparian or wetland feature associated with salinity risk (High)	3	3
Riparian or wetland feature *not* associated with salinity risk	5	5

LC total	Total LC points	
out of max possible of 90 points		

Conservation Significance (CS)

Conservation Significance (CS)

BID ID NUMBER:	Current points (CS t_0)	Potential points (CS t_n)
1. Observed and/or previously recorded presence of threatened flora and fauna species, populations and ecological communities at site		
Not assessable	Null	Null
Nil present (none observed)	Null	Null
1-2 present	3	3
3-5 present	6	6
6-10 present	9	9
>11 present	12	12
2. Site and GIS-based: Observed and/or previously recorded presence of locally and regionally significant flora and fauna species, populations (including 'declining' birds)		
Not assessable	Null	Null
Nil present (none observed)	Null	Null
1-2 present	2	2
3-5 present	4	4
6-10 present	6	6
>11 present	9	9
3. GIS-based: Presence of locally and regionally significant ecological communities (threatened Beard vegetation types) at site		
Nil present (no pre-European extent)	Null	Null
None extant (of pre-European extent)	0	0
Extant distance < 100m	4	4
Extant distance = 0	9	9
4. Location of previous biodiversity survey effort and method (target, non-target)		
Not assessable	Null	Null
Unknown if previous surveys	Null	Null
No previous surveys in or near site (none known)	0	0
1 previous survey in/near site (surveys known / method?)	1	1
>2 previous surveys in/near site (surveys known / method?)	3	3

Conservation Significance (CS)

BID ID NUMBER:	Current points (CS t_0)	Potential points (CS t_n)
5. GIS-based: Site contains remnant vegetation associated with regional biodiversity conservation priority area as identified in State or regional plan or policy		
Not assessable	Null	Null
No remnant vegetation	0	0
Low priority ascribed (all other areas of remnant)	3	3
Moderate priority (remnant in target landscapes, all remnant in or adjacent to other reserves – unmanaged reserves, unallocated crown land, other crown land)	6	6
High priority (remnant in potential recovery catchments of first tier, all CLW reserved lands)	10	10
6. Site and GIS-based: Presence of granite outcrops and condition: granite outcrops are likely to harbour unique flora / fauna assemblages		
Not assessable (no granite outcrops present or adjacent)	Null	Null
Granite outcrops present or adjacent but cleared for cultivation or pasture	1	1
Granite outcrops present or adjacent and in (probable) but poor condition/disturbed	3	3
Granite outcrops present or adjacent and in (probable) good condition	5	5
Granite outcrops present or adjacent and in (probable) very good or excellent condition	7	7

Conservation Significance (CS)

BID ID NUMBER:	Current points (CS t_0)	Potential points (CS t_n)
7. Presence of naturally saline wetlands and condition: naturally saline wetlands are likely to harbour unique flora / fauna assemblages		
Not assessable (no naturally saline wetlands)	Null	Null
Naturally saline wetlands (within or adjacent to site) but no remnant vegetation (cleared)	0	0
Naturally saline wetlands (within or adjacent to site) but poor condition/disturbed	1	1
Naturally saline wetlands (within or adjacent to site), disturbed but in good condition	3	3
Naturally saline wetlands (within or adjacent to site) in very good condition	5	5
Naturally saline wetlands (within or adjacent to site) in pristine condition	7	7

Conservation Significance (CS)

BID ID NUMBER:	Current points (CS t_0)	Potential points (CS t_n)
CS Total	**Total Current points (CS t_0)**	**Total potential points (CS t_n)**
out of max possible of 54 points		

Calculation of the NBBI

The NBBI calculation for Round 2 comprised two components, one based on the *'location of works'* and the other based on the *'immediate area of impact'* of the works.

NBBI = $NBBI_{works} + NBBI_{influence}$

$NBBI_Y$ = {Biodiversity Significance Score (BSS_Y)} × LOG_{10} (area in ha_Y)]

BSS_Y = {[($NormCS_{t0} + NormLC_{t0}$) × ($NormVCO_{t0} + NormVCY_{t0}$)]}

Y = *works* or *influence*

works = *'location of works'* at a site (as relevant to NBBI). Areas < 1 ha are included as 1.1 ha and areas > 10 ha are included as stated.

influence = *'immediate area of impact'* of the works at a site (as relevant to NBBI). Areas < 1 ha are included as 1.1 ha, and areas > 10 ha are included as 10ha.

Where:

$NormCS_{t0}$ = Current Conservation Significance, normalized in the range 0-1 (maximum score = 54)

$NormLC_{t0}$ = Current Landscape Context, normalized in the range 0-1 (maximum score = 90)

$NormVCO_{t0}$ = Current Vegetation/Habitat Condition (before land use change), normalized in the range 0-1 (maximum score = 24)

$NormVCY_{t0}$ = Current Vegetation/Habitat Complexity (before land use change), normalized in the range 0-1 (maximum score = 50)

area in ha_Y = Area of land use change in hectares attributed to the 'location of works' or the *'immediate area of impact'* of the works, as relevant to the site.

BBS score	Area of land use change (ha)	NBBI outcome
Minimum Maximum Average	Remnant only, excluding cleared land even if proposed for revegetation activity	Minimum Maximum Average

2. Other Environmental Benefits Index (OEBI)

Salt, water and soil management

BID ID NUMBER:	points
1. Is the site associated with a salinity occurrence (discharge area, salt outbreak)? What is the severity of the occurrence? Is the site within a natural saline wetland?	
Not assessed (ie, site occurs in naturally saline wetland)	Null
No salt outbreaks or discharge areas evident	10
Salt outbreaks occur in local landscape (site proximity ≥100m): severity rating of S1	7
Salt outbreaks occur in local landscape (site proximity ≥100m): severity rating of S2	5
Salt outbreaks occur in local landscape (site proximity ≥100m): severity rating of S3	3
Salt outbreaks at site (site proximity <100m): severity rating of S1	2
Salt outbreaks at site (site proximity <100m): severity rating of S2	1
Salt outbreaks at site (site proximity <100m): severity rating of S3	0
2. GIS-based: Mapped Salinity Risk: Is the site associated with a salinity occurrence (discharge area, salt outbreak)? What is the severity of the occurrence? Is the site within a natural saline wetland?	
Not assessed (ie, naturally saline wetland – Beards SL code)	Null
LOW salinity risk (RISK2000)	10
Moderate salinity risk (RISK2000)	5
HIGH salinity risk (RISK2000)	0
3. Size of salt outbreak (ha)	
Not assessed (ie, naturally saline wetland)	Null
No salt outbreaks or discharge areas evident	Null
Salt outbreak occurs but size unknown	2
<0.5 ha	2
0.6-1 ha	1
>1 ha	0

BID ID NUMBER:	points
4. Proximity of salt outbreak to drainage line (m)	
Not assessed (No salt outbreaks or discharge areas evident; existence of salt outbreak not known; or naturally saline wetland)	Null
Proximity of salt outbreak to drainage line >1000	5
Proximity of salt outbreak to drainage line <1000	4
Proximity of salt outbreak to drainage line <500	3
Salt outbreaks or discharge areas not close to riparian, but distance not known	3
Proximity of salt outbreak to drainage line <200	2
Riparian and salt outbreak	1
5. GIS-based: Proximity of High salinity risk area (RISK2000) to wetland or drainage feature (m)	
Not assessed (naturally saline wetland; area of moderate salinity risk)	Null
high salinity risk site further than 1000m from riparian	5
high salinity risk site within 1000m of riparian	4
high salinity risk site within 500m of riparian	3
high salinity risk site within 200m of riparian	2
high salinity risk site proximal to riparian	1
6. Time since salt outbreak was first detected and action (if any) taken	
Not assessed (No salt outbreaks or discharge areas evident; existence of salt outbreak not known)	Null
Undetected, no action taken	1
Detected in last year, some action taken	3
Detected 2+ years ago, action taken (including naturally saline systems)	5

BID ID NUMBER:	points
7. Areal extent/history of waterlogging	
Not assessed (No waterlogging areas evident)	Null
>75% site affected by seasonal waterlogging	0
50-75% of site affected by seasonal waterlogging	1
10-50% of site prone to seasonal waterlogging	3
<10% of site affected by waterlogging	5

BID ID NUMBER:	points
8. Severity and areal extent of soil erosion associated with the site	
Not assessed (unknown)	Null
No soil erosion areas evident)	10
Minimal (<5% evidence of soil erosion at site)	8
Slight (5-15% evidence of soil erosion at site)	6
Moderate (>15-30% evidence of soil erosion at site)	4
Severe (>30% evidence of soil erosion at site)	2

Salt, water and soil mgt total	Total points
out of max possible of 52 points	

Other management activities

BID ID NUMBER:	points
1. Livestock grazing intensity and access to remnant native vegetation and water	
Not assessed (unknown)	Null
Set stocked	1
Rotationally grazed	3
Strategically grazed	5
Never or historically grazed	7
2. Fire management regime – intensity and frequency	
Not assessed (unknown)	Null
Site not burnt in past 10+ years	8
Site hazard reduction burnt in the past 10 years	4
Site subject to wild-fire or deliberately burnt every 2-3 years	0
3. Extent and distribution of weeds within remnant	
Not assessed (unknown)	Null
Obviously weedy throughout	0
Patchily weedy throughout	1
Weedy around edges	2
Not or very slightly weedy	4
4. Incursion distance (m) of weeds into native vegetation remnants up to 100m from remnant edge and in proximity to site (eg. 25m from site)	
Not assessed (unknown)	Null
Weeds occur 100m into remnant (or obviously weedy throughout)	0
Weeds occur 50-100m into remnant (or patchily weedy throughout)	1
Weeds occur 20-50m into remnant	2
Weeds occur 10-20m into remnant	4
Weeds do not occur beyond 10m into remnant	5
5. Presence of feral animals on site, detected	

BID ID NUMBER:	points
by presence of diggings, scats or direct observation	
Not assessed (unknown)	Null
Feral animals absent (no evidence of presence detected)	10
feral animals present, old or minor evidence and impact is minimal	8
feral animals present, clear evidence of several types	4
feral animals present, clear evidence of infestation, fox and/or rabbit represented	0
6. Other observed disturbances, such as gravel /sand mining, rubbish dumping, firewood collection, drains etc.	
Not assessed (unknown)	Null
No significant disturbance (no evidence of disturbance detected)	10
disturbance minor and impact is minimal	8
disturbance significant and impact is apparent, including regrowth after clearing	4
disturbance has had a major impact, or the site has been converted to pasture or cultivated)	0

Other management activities total	Total points
out of max possible of 44 points	

Calculation of the OEBI

The OEBI calculation for Round 2 comprised two components, one based on the *'location of works'* and the other based on the *'immediate area of impact'* of the works.

$OEBI = OEBI_{works} + OEBI_{influence}$

$OEBI_{Y}$ = [salinity, water and soil management benefits + other environmental benefits and disturbance] × LOG_{10} (area in ha_{Y})]

Where:

Y = *works* or *influence*

works = *'location of works'* at a site (as relevant to NBBI). Areas < 1 ha are included as 1.1 ha and areas > 10 ha are included as stated.

influence = *'immediate area of impact'* of the works at a site (as relevant to NBBI). Areas < 1 ha are included as 1.1 ha, and areas > 10 ha are included as 10ha.

Where:

$NormSW_{t0}$ = Current salinity, water and soil management, normalized in the range 0-1 (maximum score = 52)

$NormOM_{t0}$ = Current other management and disturbances, normalized in the range 0-1 (maximum score = 44)

area in ha_{Y} = Area of land use change in hectares attributed to the *'location of works'* or the *'immediate area of impact'* of the works, as relevant to the site.

SW score	OM score	Area of land use change (ha)	OEBI outcome
Minimum Maximum Average	Minimum Maximum Average	Area of land use change in hectares attributed to the 'location of works' or the 'immediate area of impact' of the works, as relevant to the site.	Minimum Maximum Average

Calculation of the overall EBI for each tender

$EBI = (NBBI_{works}+NBBI_{influence})* w_1 + (OEBI_{works}+OEBI_{influence})* w_2$

Variation in scores attributed to plots within sites are carried through to the final scores as the average, minimum and maximum values.

$NBBI_{works}+NBBI_{influence}$ = summed NBBI for the two site-types, summed across all sites for each tender.

$OEBI_{works}+OEBI_{influence}$ = summed OEBI for the two site-types, summed across all sites for each tender.

w_1 = 1.0 for R2 tender evaluation, a weight determined by ALR policy and applied to each tender according to the cumulative value of proposed management actions relevant to NBBI

w_2 = 0.5 for R2 tender evaluation, a weight determined by ALR policy and applied to each tender according to the cumulative value of proposed management actions relevant to OEBI

NBBI	OEBI	EBI outcome
Weight = 1.0	Weight = 0.5	

The cost-benefit of each tender was calculated as the ratio of the tender cost ($) nominated by the landholder and the EBI score, to give a 'cost per unit of benefit' score. The tenders were then ranked according to increasing cost per unit of benefit, and the set of tenders that exhausted the budget were identified, taking into account mutually-exclusive tenders.

EBI	$ value of bid	Benefit per unit cost

Environmental Benefits Index Attributes Grouped by Type

Table shows the Environmental Benefits Index attributes by type for the Auction for Landscape Recovery. Maximum scores are shown for each attribute for Rounds One and Two.

Index	Attribute Group	Round1		Round 2	
		Attribute	Max score	Attribute	Max score
NBBI	Vegetation or habitat condition	1. Evidence of recruitment	4	1. Evidence of recruitment	4
		2. Number of large standing dead trees present	4	2. Number of large standing dead trees (or mallees) present	4
		3. Number of trees with visible hollows (>3cm diam per 50x20m plot)	6	3. Number of trees (or mallees) with visible hollows (>3cm dia. per 50x20m plot)	6
		4. Evidence of tree health problems, eg. dieback, insect damage, etc	4	4. Evidence of tree health problems, e.g. dieback, insect damage, etc	4
		5. Intact or interconnecting shrubland/heathland canopy offering nesting and foraging habitat for fauna	6	5. Intact or interconnecting shrubland/heathland canopy offering nesting and foraging habitat for fauna	6
	Vegetation or habitat complexity	1. Degree of woodland structural complexity (number of strata present and % projective foliage cover)	6	1. Degree of woodland structural complexity (number of strata present and % projective foliage cover)	8
		2. Degree of shrubland structural complexity (number of strata present and % projective foliage cover)	10	2. Degree of shrubland structural complexity (number of strata present and % projective foliage cover)	10
		3. Percentage projective foliage cover of herb stratum (estimated)	5	3. Percentage projective foliage cover of herb stratum (estimated)	5
		4. Presence of a leaf/bark/other plant material litter layer	3	4. Presence of a leaf/bark/other plant material litter layer	3
		5. Floristic composition: number of commonly occurring native tree and shrub species present	5	5. Floristic composition: number of commonly occurring native tree and shrub species present	5
		6. Percentage projective foliage cover of intact cryptogam layer	5	6. Percentage projective foliage cover of intact cryptogam layer	5
		7. Presence of fallen logs and branches or other coarse woody debris	4	7. Presence of fallen logs and branches or other coarse woody debris	4
		8. Presence of rocks (>10cm diam) and/or boulders on the ground	4	8. Presence of rocks (>10cm dia.) and/or boulders on the ground	4
		9. Estimated height of vegetation strata present (shrub, heathland)	3	9. Estimated height of vegetation strata present (tree, mallee)	3
		10. Estimated height of vegetation strata present (tree, mallee)	3	10. Estimated height of vegetation strata present (shrub, heathland, sedgeland)	3
	Landscape context	1. Site is part of a continuous area of native vegetation (area of remnant)	13	1. GIS-based: Site is part of a continuous area of native vegetation (area of remnant)	13
		2. Site is part of a habitat patch, where assessable (size of habitat patch)	11	2. Site is part of a habitat patch, where assessable (size of habitat patch)	11
		3. Proximity of site to nearest native vegetation remnant of significant size, ie. core area (of >40 ha)	10	3. GIS-based: Proximity of site to nearest native vegetation remnant of significant size, ie. core area (of >40 ha)	10
		4. Condition of adjacent remnant	6	4. Condition of adjacent remnant	7
		5. Site connects two or more remnants. Site is part of a remnant that connects two or more native vegetation remnants	5	5. GIS-based: Remnant area divided by perimeter length, representing reduction of habitat value due to edge effects	7
		6. Remnant area divided by perimeter length, representing reduction of habitat value due to edge effects	6	6. GIS based: Proportion of existing native vegetation within 5000m neighbourhoods of site centre-points	10

Index	Attribute Group	Round1 Attribute	Round1 Max score	Round 2 Attribute	Round 2 Max score
		7. Neighbourhood characteristics of existing native vegetation	5	7. GIS based: Proportion of existing native vegetation within 1000m neighbourhoods of site centre-points	10
		8. Does site include a riparian or wetland zone and what is their condition?	5	8. GIS-based: Proportion of existing native vegetation within sites	10
				9. Does site include a riparian or wetland zone and what is their condition?	7
				10. GIS-based: Does site include a riparian or wetland zone that is associated with high salinity risk?	5
	Conservation significance	1. Observed and/or previously recorded presence of threatened flora and fauna species, populations and ecological communities at site	12	1. Observed and/or previously recorded presence of threatened flora and fauna species, populations and ecological communities at site	12
		2. Observed and/or previously recorded presence of locally and regionally significant flora and fauna species, populations and ecological communities at site	9	2. Site and GIS-based: Observed and/or previously recorded presence of locally and regionally significant flora and fauna species, populations (including 'declining' birds)	9
		3. Location of previous biodiversity survey effort and method (target, non-target)	3	3. GIS-based: Presence of locally and regionally significant ecological communities (threatened Beard vegetation types) at site	9
		4. Regional biodiversity conservation priority zone as identified in a regional plan, e.g. site is part of a regional wildlife linkage or corridor proposed by CALM	10	4. Location of previous biodiversity survey effort and method (target, non-target)	3
				5. GIS-based: Site contains remnant vegetation associated with regional biodiversity conservation priority area as identified in State or regional plan or policy	10
				6. Site and GIS-based: Presence of granite outcrops and condition: granite outcrops are likely to harbour unique flora / fauna assemblages	7
				7. Presence of naturally saline wetlands and condition: naturally saline wetlands are likely to harbour unique flora / fauna assemblages	7
	Area in hectares of land use change		n/a	1. Location of works	n/a
			n/a	2. Immediate area of impact of the works	n/a
OEBI	Salt, water and soil management benefits	1. Is the site associated with a salinity occurrence (discharge area, salt outbreak)? What is the severity of the occurrence? Is the site within a natural saline wetland?	10	1. Is the site associated with a salinity occurrence (discharge area, salt outbreak)? What is the severity of the occurrence? Is the site within a natural saline wetland?	10
		2. Size of salt outbreak (ha)	2	2. GIS-based: Mapped Salinity Risk: Is the site associated with a salinity occurrence (discharge area, salt outbreak)? What is the severity of the occurrence? Is the site within a natural saline wetland?	10
		3. Proximity of salt outbreak to drainage line (m)	5	3. Size of salt outbreak (ha)	2

Index	Attribute Group	Round1		Round 2	
		Attribute	Max score	Attribute	Max score
		4. Time since salt outbreak was first detected and action (if any) taken	5	4. Proximity of salt outbreak to drainage line (m)	5
		5. Areal extent/history of waterlogging	5	5. GIS-based: Proximity of High salinity risk area (RISK2000) to wetland or drainage feature (m)	5
		6. Severity and areal extent of soil erosion associated with the site	8	6. Time since salt outbreak was first detected and action (if any) taken	5
				7. Areal extent/history of waterlogging	5
				8. Severity and areal extent of soil erosion associated with the site	10
	Other environmental benefits (grazing, fire, weeds and feral animals)	1. Livestock grazing intensity and access to remnant native vegetation and water	7	1. Livestock grazing intensity and access to remnant native vegetation and water	7
		2. Fire management regime – intensity and frequency	8	2. Fire management regime – intensity and frequency	8
		3. Floristic composition of weeds present at site	4	3. Extent and distribution of weeds within remnant	4
		4. Incursion distance (m) of weeds into native vegetation remnants up to 100m from remnant edge and in proximity to site (eg. 25m from site)	5	4. Incursion distance (m) of weeds into native vegetation remnants up to 100m from remnant edge and in proximity to site (eg. 25m from site)	5
		5. Presence of weeds in native vegetation remnants as % projective foliage cover within 100m of remnant edge	7	5. Presence of feral animals on site, detected by presence of diggings, scats or direct observation	10
		6. Incursion distance (m) of feral animals (i.e. rabbit, cat, dog, goat, fox, pig, horse, etc) up to 100m into native vegetation remnants	5	6. Other observed disturbances, such as gravel /sand mining, rubbish dumping, firewood collection, drains etc.	10
		7. Presence of feral animals on site, detected by presence of diggings, scats or direct observation	8		

Environmental Benefits Index: Summary of Attributes by Score

Table: Summary of attributes by groups and maximum scores used in the EBI for Round 1 and Round 2 of the ALR.

Index	Attribute Group	Round1		Round 2	
		Number of Attributes	Maximum score	Number of Attributes	Maximum score
NBBI	Vegetation or habitat condition	5	24	5	24
	Vegetation or habitat complexity	10	48	10	50
	Landscape context	8	60	10	90
	Conservation significance	4	34	7	54
	Area in hectares of land use change	1	n/a	2	n/a
OEBI	Salt, water and soil management benefits	6	35	8	52
	Other environmental benefits (grazing, fire, weeds and feral animals)	7	44	6	44

Scale of Observation of Raw Attributes for NBBI

Table: The scale of observation of raw attributes values for the different Native Biodiversity Benefits Index (NBBI) attributes of the Environmental Benefits Index, Auction for Landscape Recovery.

Attribute Group	Round 2 NBBI Attribute	Observation scale
Vegetation or habitat condition	1. Evidence of recruitment	Plot
	2. Number of large standing dead trees (or mallees) present	Plot
	3. Number of trees (or mallees) with visible hollows (>3cm diam per 50x20m plot)	Plot
	4. Evidence of tree health problems, eg. dieback, insect damage, etc	Plot
	5. Intact or interconnecting shrubland/heathland canopy offering nesting and foraging habitat for fauna	Plot
Vegetation or habitat complexity	1. Degree of woodland structural complexity (number of strata present and % projective foliage cover)	Plot
	2. Degree of shrubland structural complexity (number of strata present and % projective foliage cover)	Plot
	3. Percentage projective foliage cover of herb stratum (estimated)	Plot
	4. Presence of a leaf/bark/other plant material litter layer	Plot
	5. Floristic composition: number of commonly occurring native tree and shrub species present	Plot
	6. Percentage projective foliage cover of intact cryptogam layer	Plot
	7. Presence of fallen logs and branches or other coarse woody debris	Plot
	8. Presence of rocks (>10cm diam) and/or boulders on the ground	Plot
	9. Estimated height of vegetation strata present (tree, mallee)	Plot
	10. Estimated height of vegetation strata present (shrub, heathland, sedgleland)	Plot
Landscape context	1. GIS-based: Site is part of a continuous area of native vegetation (area of remnant)	Plot
	2. Site is part of a habitat patch, where assessable (size of habitat patch)	Plot
	3. GIS-based: Proximity of site to nearest native vegetation remnant of significant size, ie. core area (of >40 ha)	Plot
	4. Condition of adjacent remnant	Site
	5. GIS-based: Remnant area divided by perimeter length, representing reduction of habitat value due to edge effects	Plot
	6. GIS based: Proportion of existing native vegetation within 5000m neighbourhoods of site centre-points	Plot
	7. GIS based: Proportion of existing native vegetation within 1000m neighbourhoods of site centre-points	Plot
	8. GIS-based: Proportion of existing native vegetation within sites	Plot
	9. Does site include a riparian or wetland zone and what is their condition?	Site
	10. GIS-based: Does site include a riparian or wetland zone that is associated with high salinity risk?	Plot
Conservation significance	1. Observed and/or previously recorded presence of threatened flora and fauna species, populations and ecological communities at site	Site/Plot
	2. Site and GIS-based: Observed and/or previously recorded presence of locally and regionally significant flora and fauna species, populations (including ‘declining’ birds)	Site
	3. GIS-based: Presence of locally and regionally significant ecological communities (threatened Beard vegetation types) at site	Plot
	4. Location of previous biodiversity survey effort and method (target, non-target)	Site
	5. GIS-based: Site contains remnant vegetation associated with regional biodiversity conservation priority area as identified in State or regional plan or policy	Plot
	6. Site and GIS-based: Presence of granite outcrops and condition: granite outcrops are likely to harbour unique flora / fauna assemblages	Plot
	7. Presence of naturally saline wetlands and condition: naturally saline wetlands are likely to harbour unique flora / fauna assemblages	Plot

TARGET SOFTWARE – DEVELOPMENT HISTORY

This appendix reproduces parts of, and expands upon Faith and Walker (1998): *TARGET: software for the analysis of priority protected areas representing biodiversity.*

Purpose

TARGET is a computer-based conservation planning tool for the analysis of priority conservation areas representing biodiversity. *TARGET* was developed to address the question: *what is the minimum set of areas that will represent some target amount of biodiversity?.* Given a set of protected areas, *TARGET* further addresses the questions:

- Which are the best areas to add to this set to increase biodiversity representation?
- Which area would be the worst to lose, in terms of biodiversity representation?
- Which area would be the 'best' to lose, in terms of smallest loss in biodiversity representation?
- What is the potential contribution of any given area to biodiversity representation?
- How does the exclusion of some areas from consideration as priority areas affect the answers to the above questions?
- If there are costs (of protection) associated with the areas, what set of protected areas provides a good trade-off between costs and biodiversity benefits?
- If some areas offer some partial degree of protection (or have some degree of 'vulnerability'), what is the answer to the above questions taking this into account?

TARGET can use any definition of 'areas' described by environment and/or biotic attributes. These attributes (for biodiversity representation) may optionally have recorded 'amounts' for each area.

Previous ideas or approaches on which it builds

TARGET development began in 1996 (it was formerly known as DIVERSITY-TD). It builds on the trade-offs methods developed in DIVERSITY-ED, and the probability of persistence methods developed in DIVERSITY-XD (Faith and Walker, 1994, 1995, 1996a, 1996b, 1996c, 1996d), with applications described in Faith *et al.* (1994, 1996) and Faith and Walker (1997). While using variable costs and linking to multi-criteria analysis, *TARGET* also can be seen as building on early Australian developments in 'minimum set' algorithms (Margules *et al.* 1988; Rebelo and Siegfried 1992; Pressey *et al.* 1993; see also Kirkpatrick 1983) that were based explicitly on the rationale that conservation resources are limited. TARGET also builds on ideas and debates about regional sustainability in Faith (1995), and Faith and Walker (1996b).

Reasons for development

The motivation for *TARGET* arose from problems raised in the course of the Comprehensive Regional Assessments process in Australia – issues relating to setting of targets, surrogates for biodiversity, and whether or not trade-offs are incorporated at the level of priority setting (*TARGET* is based on the idea that they must be). *TARGET* also has served as a platform for exploring probability of persistence approaches, as a response to the perceived need to avoid the "all or nothing" view of protection and optionally allocate land uses that provide "partial protection" in addition to other ecosystem services (Faith and Walker1996c). The more recent development of *TARGET* has responded to the reality that few "whole" sets of areas from computer-based methods are ever implemented, so that the practical focus should be on scenarios and outputting of dynamic complementarity values for decision support and links to economic instruments (Faith *et al.* 2003a, 2003b).

Applications

A major application of *TARGET* was the World Bank funded "BioRap" study for Papua New Guinea (Faith 2001a, 2001b; Faith et al. 2001a, 2001b, 2001c, 2001d; Faith and Walker 2002). Other applications are ongoing within Australia and overseas (e.g. Faith *et al.* 2003a; Barton *et al.* 2003; McNeely *et al.* in review).

Key capabilities

Key capabilities that make *TARGET* software distinctive are the algorithm for trade-offs and implementation of probability of persistence. The algorithm for trade-offs; based on variable weights; avoids weaknesses of simple benefit/cost ratio approaches (Faith 2002). Implementation of probability of persistence allows for allocation of land uses to areas that provide "partial protection". *TARGET* provides for the proper setting of biodiversity targets in a trade-offs setting.

Key limitations

A constraint of *TARGET* software is that visualization of some outputs is limited. Some newer changes are not fully described in the current manual, and some idiosyncrasies or bugs while not affecting function may confuse the novice user. However, *TARGET* is about to undergo rapid changes, including enhancing its use for targeting economic instruments in regional biodiversity planning (Faith *et al.* 2003a).

Introduction to *TARGET* software (Faith and Walker 1998)

The *TARGET* analysis focuses on regional biodiversity “targets” or conservation planning goals.

It is common practise in conservation planning to set regional goals for biodiversity protection in a formal network of reserves, or for sustainable management of biodiversity across whole landscapes. For example, a broad 10% target for the extent of each biome in formal protection was adopted by many countries (Caracas Action Plan, Convention on Biological Diversity). A common interpretation of this guideline is that 10% of each recognised “type” within a given biome (eg. the “forests” biome) should be represented in the protected area system. The nomination of a number of “types” in a region raises practical problems. If few types are recognised, relatively little land and few areas may be needed to achieve 10% representation. If many types are nominated, many areas may be needed to achieve 10% representation. This dependency will occur unless the areas always can be sub-divided so as to allocate fractional portions to protection, and there are no existing protected areas to be added-to in order to meet the percent target.

TARGET provides a partial solution to this problem by allowing both the degree of variation within recognised types (expressed using the finer-resolution “attributes”; see below) and the “opportunity costs” associated with protecting the different types to influence the degree of representation. There is less emphasis on *a priori* targets and more emphasis on maximising the amount of variation that is managed for conservation, while minimising costs. Indicative targets may be nominated for the biodiversity types in a region, but achieving the target for a given type depends on its heterogeneity and the weighting given to any “forgone opportunities” (= opportunity costs or just “costs”) implied by protecting those areas.

TARGET provides one strategy for applying 10% (or similar) targets so that they can more effectively be used as comparative performance indicators among countries or regions. A benchmark analysis may be carried out to determine how much heterogeneity (how many attributes) could be sampled (perhaps to some pre-defined viability level) under an assumption that any 10% (or similar) target for the region can be selected. This level of heterogeneity becomes the new ‘effective’ biodiversity target, and subsequent analyses ask how this target can be reached in the face of real constraints (such as existing disturbed areas or an existing reserve system) and costs (such as competing logging opportunities).

TARGET typically searches for a set of candidate areas that achieve nominated target levels of representation of all the attributes, but with a minimum opportunity cost. These “opportunity costs” of biodiversity protection often will correspond to estimates of the suitability of areas for other competing land uses, or as in the case of ALR, the direct remuneration costs required by landholders in order to retire the land from production or actively manage it for conservation. Alternatively, the “cost” of all areas can be set equal to a constant value, and *TARGET* then will search for the minimum number of areas which forms a set that meets the representation target for all attributes.

When costs are taken into account, the relative “importance” or weight given to these costs, relative to biodiversity representation, will influence the outcome of the allocation procedure. An area is justified for protection (or selected for conservation action) if and only if its “complementarity” value (its marginal contribution to overall biodiversity representation) exceeds its weighted cost. This marginal contribution of a given area simply reflects how much additional contribution it makes to the overall regional achievement of the targets.

When costs are given high weight, some initial biodiversity targets are not reached. A particular forest type, for example, may have a lower level of representation (not all attributes within that type are represented) because protection of that type generally implies higher opportunity costs. Forest types that are more heterogeneous (have a greater number of different attributes describing variation within the type) may justify greater representation, particularly in the presence of competing land use demands.

In addition to costs, the other factor that properly should influence the amount of area needed for protection within a given forest type is the degree to which areas of that type are likely to persist in the absence of formal protection. Quite extensive forest types may require a relatively small percentage of their total area in formal protection, because the extent of coverage helps ensure overall regional persistence of that type. Each “attribute” in a given area may have some assumed degree of persistence in the absence of any new land-use allocation for the area, and some different degree of persistence if the area is allocated to a particular land use (e.g. formal protection or sympathetic management).

TARGET uses a simple strategy in which partial protection in the absence of action/re-allocation can be taken into account through modification of targets, and there is some further partial-protection or persistence value assignable for each attribute if the given area is allocated to protection. The usual quantitative values in the input data files, associated with each attribute in each area, are interpreted as indicating the degree of persistence of the attribute (e.g. persistence of a particular species) if that area were allocated to protection. The total regional degree of persistence for a given attribute is then the sum of that attribute’s individual persistence values in the set of protected areas. When the values are log transforms of probabilities of persistence, then summing these values provides a (log transform) of the overall regional probability of persistence of the attribute (e.g. a species). The associated regional target for the attribute may be a 99% probability of persistence.

A note on algorithm

TARGET processes geo-referenced data and links these to spatial mapping software. The first step in using *TARGET* involves setting a target level for representation for all biodiversity attributes (which may vary for each attribute). For any given area, the software calculates the number of so-far-under-represented attributes that the area could contribute to the list of protected areas. This indicates how well the area complements the existing ones in the context of the target. We call this a complementarity-based biodiversity value. *TARGET* iteratively adds and deletes areas from a list of nominated committed areas (the “select list”), usually the existing protected areas, so as to approach the nominated target levels of representation.

Normally, the area that is next added to the set is the one that has the greatest complementarity-based biodiversity value – it is the area that adds the most biodiversity to the set. When cost trade-offs are used, *TARGET* attempts to balance this contribution against the specified costs of protection. The area which is added to the "select list", at any stage, is the one which has the greatest difference between complementarity and (weighted) cost.

The user can take advantage of *TARGET* capabilities to extend and modify the simple search provided by the basic algorithm. One approach can use alternative random starts, read in using an ".sel" file. Another approach can begin with a high weighting on costs, such that targets are not met, and the reading in of this partial result into a subsequent analysis with lower weight on costs. This strategy can be applied iteratively until the target is met. Similar iterative approaches might initially mask out some areas, giving preference to others until later iterations.

Data required for *TARGET*

Input to *TARGET* comprises:

- a list of environmental and/or biotic attributes, each with a sequence number;
- a list of geographic areas, each containing a set of attributes found in the area, with some quantitative value associated with each; and
- a nominated degree of representation (a target) for each attribute.

Menu functions in *TARGET*

- find a location which adds most to the target on a select list
- find a location on the select list which if removed from the list would make a minimal impact on the target
- estimate the contribution of a location to the protected set of locations
- nominate a set of locations as mandatory members of the select list
- evaluate the cost/benefit of the biodiversity contribution of locations
- report the set of locations on the select list
- report the amount of area of each attribute on the select list
- summarise the results by aggregate attributes
- map the results

TARGET input files

- environment file (*.env format)
- location file (*.loc format)
- attribute file (*.att format) – optional
- select list file (*.sel format) - optional
- targets file (*.targ format) – optional
- persistence file (*.per) - optional
- map base for TARGET-POLYVIEW (*.pol format) – optional

The environmental attribute file (*.env format) for *TARGET* is a free-format numerical list of unique identifiers for all of the biodiversity surrogate features to be used in the area-based analysis of complementarity. The number list must be sequential. The unique identifier for environmental attributes (biodiversity surrogate features) should relate to original attribute labels/codes or habitat descriptions as relevant.

The location file (*.loc format) for place units in *TARGET* is a free-format numerical list of the unique identifiers for the location, the attributes within the location and the amount of each attribute (e.g., in hectares). The information presented in the *.LOC file defines the spatial structure of the conservation planning question, the data on which basis the complementarity analysis is conducted. The unique identifiers in the location file should relate back to polygons or clusters of polygons within a spatial coverage. A Fortran tool (*ARC2TARG*) has been developed to semi-automate the conversion of a GIS attribute flat-table into that required for the location file (*.loc format). The location file is usually derived from the GIS intersection between the biodiversity surrogate and the place units for prioritisation analysis.

The select list file (*.sel format) is a free format numerical list of location identifiers (represented in *.LOC file) that are places committed to selection in a *TARGET* scenario. The number list must be sequential. The select list may be protected areas, or other areas for which conservation policy determines they are committed to selection, or they may be included in a scenario for testing. The select list requires decisions about choice of place units to be committed to selection to be made.

The targets file (*.TARG) is a free-format numerical list of attribute identifiers and their percentage targets. Targets must be given in percentages (0-100), with respect to the area or amount of each environmental attribute (biodiversity features). The targets file drives the analysis of complementarity and biodiversity priority-setting. This is an optional file, used where variation in targets is required for priority setting.

The persistence file (*.per) is a free format numerical list of attribute identifiers and their probability of persistence values (0-1). Probability of persistence (biodiversity viability) is estimated for each biodiversity attribute from a prior analysis of landscape context and ecosystem health and function. Probability of persistence scores are assigned to attributes rather than localities. Individual species viability such as population viability analysis is commonly estimated for the biodiversity feature - species. Persistence levels for biodiversity in general, however, are usually recorded by site or locality with consideration given to landscape context. For the more general analysis, the site scores for persistence need to be equated with attribute scores for the persistence file in a *TARGET* analysis. For landscape context, this analysis requires a spatially explicit definition of remnants and their configuration in fragmented landscapes, followed by an analysis of relative connectivity given regional goals for maintaining or enhancing biodiversity composition. If the condition of biodiversity can be estimated for a location, the amount of pre-European contribution attributed to biodiversity can be proportionally reduced. The difference in condition between the current and pre-European extent of biodiversity provides an estimate of current persistence for each biodiversity attribute. Probability of persistence levels at 1.0 may be unattainable for many biodiversity types. The use of probability of persistence scores assigned to attributes rather than localities, without the ability to dynamically updating persistence as new areas are included in conservation area network requires further consideration.

The attributes file (*.ATT) is a free-format list of locations by one or many attributes and their quantities. Although the file formats are the same, attribute files have four fundamental uses in the *TARGET* analysis: 1) masking to exclude locations from analysis; 2) defining opportunity costs for locations; 3) defining preferences for locations; 4) defining attribute values for preferences or other features (other than environmental attribute for biodiversity surrogate) for summary reporting on the results of a scenario.

The attribute file (*.ATT) for masking is a free-format list of locations and up to ten different attribute types with values that identify locations to be excluded from an analysis. The attribute values are given as 0 or 1, where a value of 0 masks a location from analysis. For conservation planning purposes, areas which are already committed to other land uses—such as intensive agriculture, urban, peri-urban—may be permanently masked from a *TARGET* scenario, but still contribute to the overall analysis of complementarity (in the sense of pre-European amounts of biodiversity). Although a limit of ten different attributes in a list for any one file exists, there is no limit on the number of different attribute files that can be created and sequentially tested in a series of *TARGET* scenarios.

The attribute file (*.ATT) for opportunity costs is a free-format list of locations and up to ten different attribute types with values that can be any number according to the amount, a quantity or an index, used to represent the opportunity costs. The opportunity costs are the costs associated with the pace unit being included in the selected set. This requires that an analysis of opportunity costs (such as alternate land uses) associated with each locality has been conducted and is available to the *TARGET* scenario. Although a limit of ten different attributes in a list for any one file exists, there is no limit on the number of different attribute files that can be created and sequentially tested in a series of *TARGET* scenarios.

The attribute file (*.ATT) for preferences is a free-format list of locations and up to ten different attribute types with values that identify locations to be excluded from an analysis. The attribute values are given as 0 or 1, where a value of 1 indicates a masking-*in* preference exists for the location (a value of 0 masks the location from analysis). Although similar to the process of masking, specific *TARGET* scenarios are conducted to identify preferred locations, for which – all else being equal – such locations are selected over another place with equivalent biodiversity complementarity. For simplicity, and typically in the absence of good reason for introducing complexity, these features were defined as either present or absent within a tender area. Preferences operate by a 'look here first' approach that masks-in the candidate set for a given analysis as the only candidates for the purpose of looking-there-first. The 'weighting' toward preferences depends on how many sites are to be selected under the analysis scenario, while this mask is turned on. The list of sites selected as preferences may then be used in a select list to initialise the analysis, or depending on the weighting of importance, committed to selection. Although a limit of ten different attributes in a list for any one file exists, there is no limit on the number of different attribute files that can be created and sequentially tested in a series of *TARGET* scenarios.

The attribute file (*.ATT) for locality reporting is a free-format list of locations and many different attribute types with values that can be any number according to the amount, a quantity or an index, used to quantify the attribute. The attribute values may be associated with actual values of preferences from which the weighting as 0 or 1 was derived, or could be the attribute values for opportunity costs or any other peripheral attribute or feature that is of interest for summary reporting on the outcomes of a scenario through the 'export' function (output file: *sumloc.txt*). The locality report sums the quantities in the attribute file for the set of selected areas in a *TARGET* scenario. Attribute quantities that cannot be sensibly summed should not be used. The limit of 10 attributes does not apply to attribute files for locality reporting: more than ten attributes can be listed and successfully reported. There is no limit on the number of different attribute files that can be created and sequentially used as summary reports for a *TARGET* scenario.

TARGET output files

- Log file (Target2000.log)
- Target export file (Target-export.txt)
- Attribute export file (Attribute-export.txt)
- Set export file (Set-xpt.txt)
- Cost solution output file (costsoln.txt)
- Summary of locations report file (sumloc.txt)
- Richness variable file (rich.var)

- Richness legend file (rich.leg)
- Reserve set locations file (resv.var)
- Reserve set legend file (resv.leg)
- Cost variable file (cost.var)
- Cost legend file (cost.leg)
- Contribution to biodiversity complementarity file (biod.var)
- Contribution to biodiversity legend file (biod.leg)
- Residual biodiversity complementarity file (bio.var)
- Residual biodiversity legend file (bio.leg)

The log file (Target2000.log) is a complete record of commands, inputs and outputs of a *TARGET* run. The log file enables the conduct of the scenario to be checked as sometimes the software does not pick up the correct column identified for masking a set of locations in an ATT file, for example, even though the header for that column was correctly specified in the windows control box.

The target export file (Target-export.txt) is a list of locations by 'Costs' (if applicable), 'Complementarity value in set' (the complementarity value of locations in the selected set), 'Member of the selected set' =0/1 (selected = 1), 'Number of attributes for location'=integer (the number of different biodiversity surrogate attributes listed for a location), 'Complementarity value to set'=number (complementarity value of locations not included in the selected set). There are some software code limitations/bugs which mean some of the numbers in the columns exceed the space available and are printed to file as ********. Alternative outputs which allow more space for character fields can be used to complete the tables, by manually rebuilding in MS Excel.

The attribute export file (Attribute-export.txt) is primarily a list of the complementarity inputs and results for the environmental attributes (biodiversity surrogate features). The file starts with a list of locations on the select list (the locations selected during a TARGET scenario), clarifies which were 'committed' to protection and then summarises results of the analysis in terms of complementarity. For each attribute identifier in rows, the following columns are given: 'On list' = 1 or 0 (=1 if the attribute is on the select list), 'No. repl' = integer (number of times an attribute is replicated, present across more than one place unit), 'Dist to Target' = number (distance to target after completion of the run), 'Target set' = number (distance to target as determined by the TARG file, or a constant %target for the analysis), 'Target on list' = number (actual complementarity recovered for each attribute based from the locations on the select list). The end of the file gives a global summary on the performance of the *TARGET* run: 'Current distance from target' = number, 'Number of attributes fully represented' = integer, 'Number of attributes partly represented' = integer, 'Number of attributes not represented' = integer, 'Attribute furthest from target' = integer, 'Maximum distance from target' = number, 'Cost constrained processing with b = ' = the specified weight on the cost. From about line 100 and greater there is a row of integers repeating the number series 0, 1, 2...9. There is no explanation for this, except it may have been used as a counter during debugging at some stage and not removed.

The set export file (Set-xpt.txt) is the standard summary report on complementarity achievement for the set of locations resulting from the *TARGET* scenario. This is a list of place units (Location identifier) with columns for 'Location contribution' (to complementarity) and 'Location contribution %' (the percentage contribution to complementarity). The file is presented in the same format as an ATT file. The location identifiers are listed in the order in which they were stepwise included in the scenario run. 'Location contribution %' (the percentage contribution to complementarity) does not write, it is always 0.00000000. This is an outstanding bug in *TARGET*. However, the actual contribution can be read from the ‘biod.var’ output file, the total target for complementarity can be read from ‘Target2000.log’ log file and the percentage location contribution to complementarity can be reproduced in MS Excel.

The cost solution output file (costsoln.txt) is the cost solution arising from the steps in the selection of locations resulting from a scenario run. The output file comprises three columns and no header. The first column is the 'Members in select list' =integer, and is the number of sites on the select list at that step of the run. The second column is the 'Distance to Target' =number, and is the current distance to target (for complementarity to be achieved) at that step of the run. The third column is the 'Cost' =number, and is the current cumulative cost (based on the cost attribute used in the trade-off analysis) of the selected set at that step of the run. This output file can be used to create standard graphics to present the results of a scenario run. These graphics are: 1) trade-off curve - Yaxis='Distance to Target' and Xaxis='Cost', and 2) distance to target versus number of locations - Yaxis='Distance to Target' and Xaxis='Members in select list'. It would be useful to have a header included with this export file.

Summary of locations report file (sumloc.txt) sums the attribute values for the selected set of locations resulting from a *TARGET* scenario based on the values for attributes by locations given in an ATT file set up for location reporting. A comprehensive header is presented which defines the attribute number for each attribute given in the ATT file based on the header label for the attribute given in that file. The file defines the locations by identifier that are used in the summary output. The output processing is to simply sum the attribute values for the list of locations and presents the results in a two-way table. This is very useful for reporting on outcomes of a scenario run including attributes which may have been used in the analysis and others which are of interest, though not specific drivers of an analysis.

The richness variable and legend files (rich.var; rich.leg) are used for mapping the richness of attributes in a *TARGET* analysis. The variable file, rich.var, lists 'location identifier', 'map class' and the variable 'attribute richness' (of the biodiversity surrogate used in complementarity) for all locations. The map class defines the categories and colours used with the corresponding legend file, rich.leg, for mapping. The legend numbers represent standard mapping colours, pre-defined. A simple mapping program, Polyview, applies these files to polygons with the same locality identifiers and maps richness. Polyview mapping software interfaces with *TARGET* software.

The reserve set location variable and legend files (resv.var; resv.leg) are used for mapping reserve set locations resulting from a *TARGET* scenario. The variable file, resv.var, lists 'location identifier', 'map class' and the variable for 'reserve set locations', which includes those locations committed to selection and those additional sites selected for the scenario run. The map class defines the categories and colours used with the corresponding legend file, resv.leg. For all locations, the treatment of a location in a scenario run is annotated in several ways: Selected for protection, Selected then rejected, Not selected, Excluded from protection, Committed to protection. The map class defines the categories and colours used with the corresponding legend file, resv.leg, for mapping. The legend numbers represent standard mapping colours, pre-defined. Polyview, applies these files to polygons with the same locality identifiers and maps reserve set locations.

The cost variable and legend files (cost.var, cost.leg) are used for mapping costs for the reserve set locations resulting from a *TARGET* scenario. This output file lists 'location identifier', 'map class' and the variable 'costs', for those locations on the select list for a scenario run. The map class defines the categories and colours used with the corresponding legend file, cost.leg, for mapping. The legend numbers represent standard mapping colours, pre-defined. Polyview, applies these files to polygons with the same locality identifiers and maps costs.

The contribution to biodiversity complementarity variable and legend files (biod.var, biod.leg) are used for mapping contribution to biodiversity complementarity for the reserve set locations resulting from a *TARGET* scenario. This output file lists 'location identifier', 'map class' and the variable 'Contribution', which is the contribution to biodiversity complementarity for those locations on the select list for a scenario run. The map class defines the categories and colours used with the corresponding legend file, biod.leg, for mapping. The legend numbers represent standard mapping colours, pre-defined. Polyview, applies these files to polygons with the same locality identifiers and maps contribution to biodiversity complementarity.

The residual biodiversity complementarity variable and legend files (bio.var, bio.leg) are used for mapping residual biodiversity complementarity for the unselected set locations available for selection, resulting from a *TARGET* scenario. This output file lists 'location identifier', 'map class' and the variable 'Contribution', which is the potential (residual) contribution to biodiversity complementarity for those locations not included on the select list for a scenario run (but which were available for selection, not masked). The map class defines the categories and colours used with the corresponding legend file, bio.leg, for mapping. The legend numbers represent standard mapping colours, pre-defined. A simple mapping program, polyview, applies these files to polygons with the same locality identifiers and maps residual biodiversity complementarity. Polyview mapping software interfaces with *TARGET*.

Improved *TARGET software* (Faith and Walker 2003)

The ALR application of TARGET takes advantage of significant improvements in the software, developed during the course of projects in the Douglas Shire, Queensland (funded through the Rainforest CRC and Australian Museum). A notable improvement in *TARGET* was the implementation of probabilities of persistence calculations. Each attribute can have a nominated overall regional probability of persistence, an estimated persistence in any area under the “status quo” (no change in protection/management) and a nominated probability of persistence as a consequence of “selection” by *TARGET* as part of a set of places that receive protection/new management. This capability combines effectively with *TARGET*'s capabilities allowing filters, preferences, masks, and trade-offs with opportunity costs.

An important novel issue arising for candidate areas in the Auction for Landscape Recovery is how ‘condition’ modifiers, which are specific to individual candidate areas, are used in the selection process through the setting of targets and probability of persistence.

TARGET software allows the user to nominate three kinds of probabilities at the outset of an analysis:

- the overall regional target for each attribute;
- the assumed probability of persistence of the attribute (in any area in which it occurs) in the absence of selection for protection; and
- the assumed probability of persistence of the attribute if the area in which it occurs is selected.

These probability values can be the same in the simplest case for all attributes. Alternatively the user may define a ‘per’ file which, when read into *TARGET*, assigns different values for the three variables for each attribute. Lastly, following the approach used in Costa Rica (Barton *et al.* 2003), the network of given protected areas can be treated as a single "polygon" within which all the attributes are well-protected (in some sense), and the regional target is then altered for just those attributes that we regarded as well-protected. These approaches provide the flexibility needed for the *TARGET* analysis of regional, local and site based attributes of biodiversity representation, persistence, cost-trade-offs and other masks and modifiers.

Conservation Significance Datasets Available and Applicable to the ALR Project Region (NEWROC)

This appendix presents the review of conservation significance datasets available and applicable to the ALR project region, the NEWROC.

Threatened or Priority Flora and Fauna

Threatened fauna or declared rare flora in Western Australia are those listed under schedules of the *Wildlife Conservation Act 1950* and its Regulations, administered through the Department of Conservation and Land Management (CALM). The current list of threatened fauna is given under *Wildlife Conservation (Specially Protected Fauna) Notice 2003* (Minister for the Environment 2003a), and declared rare flora are listed under *Wildlife Conservation (Rare Flora) Notice 2003*. Different conservation codes apply to threatened fauna or declared flora under *Wildlife Conservation Act 1950*.

CALM also prepares priority lists of flora and fauna including taxa: a) that have recently been removed from the lists (declared flora or threatened fauna); or b) that have a restricted distribution, are uncommon or are declining in range and/or abundance, but which do not meet the criteria for listing (as declared flora or threatened fauna); or c) for which there is insufficient information for the Committee to make an assessment of their status. Methods used to decide priorities for conservation action for threatened species are described in CALM Policy Statement No. 50 *Setting priorities for the conservation of Western Australia's threatened flora and fauna*.

The conservation codes for threatened fauna, declared flora and CALM priority lists of flora and fauna intentionally represent different levels of importance, and therefore priority in conservation planning and management. For application in the Systematic Conservation Planning framework the importance order needs to be taken into account. Table A details the proposed importance order that would be used to assign "attractiveness" in the TARGET analysis. The identity of species is not important in the initial assessment of biodiversity values, but becomes significant when considering management actions.

Table A: Proposed importance order of conservation codes for threatened fauna, declared flora and priority lists of flora and fauna.

Conservation code	Description	Proposed importance order for conservation planning
R and/or T: - Declared Rare Flora – Extant Taxa (Schedule 1, *Wildlife Conservation Act 1950*)	Flora taxa that are threatened with extinction	1
X: Declared Rare Flora - Presumed Extinct Taxa (Schedule 1, *Wildlife Conservation Act 1950*)	Flora taxa that are presumed extinct	1
Schedule 1 - Fauna that is rare or is likely to become extinct in the wild (*Wildlife Conservation Act 1950*)	Fauna taxa that are threatened with extinction	1
Schedule 2 - Fauna presumed to be extinct in the wild (*Wildlife Conservation Act 1950*)	Fauna taxa that are presumed extinct	1
Schedule 3 - Birds protected under an international agreement (*Wildlife Conservation Act 1950*)	Migratory birds	1
Schedule 4 - Other specially protected fauna (*Wildlife Conservation Act 1950*)	Fauna taxa of commercial interest likely to be taken	1

Conservation code	Description	Proposed importance order for conservation planning
1: Priority One - Poorly known Taxa	First order management priority	2
2: Priority Two - Poorly Known Taxa	Second order management priority	2
3: Priority Three - Poorly Known Taxa	Third order management priority	2
4: Priority Four - Rare Taxa[†]	Fourth order management priority	2

Locations of declared threatened fauna, declared rare flora and CALM priority taxa within the NEWROC project region were provided by CALM. Locations of declared flora and priority taxa were extracted from the DEFL database (version 29/05/2003). Location of declared and priority fauna taxa were extracted from the ‘threatened fauna file’ (version 27/06/2003). Table B lists the number of declared and priority flora and fauna taxa and their conservation status category known from NEWROC. Of the 183 locations of significant flora, 157 are declared rare with a proposed highest importance ranking for conservation planning, and 26 locations correspond to priority listed flora. Of the 32 locations of significant fauna, 28 are declared threatened with a proposed highest importance ranking for conservation planning, and 4 locations correspond to priority listed fauna.

Table B: Number of locations and conservation status of declared and priority flora and fauna taxa with occurrences in NEWROC.

Status	IUCN Criteria	Flora	Fauna
Declared	Not assigned	-	5
Declared	Critically Endangered	33	-
Declared	Endangered	67	-
Declared	Vulnerable	57	21
Declared	Presumed Extinct	-	-
Migratory birds		n/a	-
Specially protected fauna		n/a	2
1: Priority One		17	3
2: Priority Two		3	-
3: Priority Three		1	-
4: Priority Four		5	1
TOTAL		183	32

Other species may also have relevance to the analysis of biodiversity priority areas. For example, scientific criteria which are commonly associated with species or their populations include (after Wallace *et al.* 2003b):

- Representative samples of native plants and animals (including common species);
- Plants/animals at the limits of their natural range;
- Uncommon genetic variants;
- Unusual living assemblages;
- ‘Ancient’ species;
- Living natural assemblages that have high levels of biodiversity and/or endemism;
- A living assemblage that represents a local ecotype.

Where lists of such species and their locations are available, along with scientific justification, it is possible for these to be reviewed for use within an SCP analysis.

Threatened or Priority Ecological Communities

CALM has been identifying and informally listing threatened ecological communities (TEC) for the last ten years. At 30 June 2001, 94 ecological communities had been entered into the TEC Database. Of these, 19 have been endorsed by the Director of Nature Conservation as Critically Endangered, 11 as Endangered, 19 as Vulnerable and two as Presumed Totally Destroyed. The remainder are either awaiting endorsement as threatened or are allocated to one of five priority lists. Possible threatened ecological communities that do not meet survey criteria are added to Priority Ecological Community Lists under Priorities 1, 2 and 3. Ecological Communities that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. Priority 4 ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

Recognised community types are based on floristic classifications from systematic surveys. A standard dataset is available as a series of buffered points or polygons for known areas. Although the systematic surveys were complete for the WA wheatbelt, lists of threatened ecological communities and their locations in NEWROC were not available at the time of the ALR tender evaluation.

Species Indicators of Significant Ecological Communities

Several ecological communities within the wheatbelt are recognised as significant for their specific assemblage of plant and animal species. Of particular interest are the assemblages associated with granite and other rock outcrops and with naturally saline and clay pan habitats. Granite and other rock outcrops are an important surrogate for endemic species, some of which may not be known to science. These habitats are not well delineated by mapping and are considered important in the context of biodiversity in the Avon NRM region. Existing mapping of granite and other rock outcrops based on 1:25,000 orthophotos, with line work and attributes applicable at +/- 25m scale, were compiled by CALM but were not available for the NEWROC study area. While this mapping includes larger areas of granite, it does not delineate every outcrop and not all granite and other rock outcrops are equally significant.

The most significant granite and other rock outcrops are set high in the landscape above the Tertiary peneplain; representing habitat for relictual taxa. Post-Tertiary weathered granite is not considered as significant. Because of the presence of unusual flora and fauna, granite rock outcrops have been preferentially surveyed by CALM. Locations of granite rock endemics or specialists, especially plants and freshwater invertebrates, are well represented in species databases and provide a suitable basis for flagging the presence of these significant assemblages throughout NEWROC. While it was suggested that locations of these indicator species could be used to identify significant areas, such locality data were not available to the ALR. Instead, the less sensitive indicator of rock outcrop from Beard vegetation types and from the soil landscape subsystem mapping were used for the SCP analysis. Beard pre-European vegetation mapping broadly delineates bare areas which may be associated with these habitats. In addition, these areas are generally not delineated as remnant habitat in the (woody perennial) vegetation extent mapping for Western Australia (Agriculture WA and CALM 2002), and extant habitat within tender areas identified through site assessments need to be included in the SCP analysis.

Significant Wetlands

The third edition of the Directory of Important Wetlands in Australia (Environment Australia 2001b) describes 120 nationally important wetlands and wetland systems in Western Australia. Most of Western Australia's nationally important wetlands occur in existing or proposed conservation reserves managed by CALM. Some nationally important wetlands occur on private property or pastoral lease or lands for other. Ramsar sites are by definition also nationally important wetlands.

Criteria for particular wetlands in NEWROC provided the basis for assigning 'attractiveness'; depending upon a review of the available rankings, a corresponding level can be used in TARGET analyses.

Poorly Conserved and Potentially Threatened Beard Vegetation Types

As a precursor to an inventory of Threatened Ecological Communities in Western Australia, CALM undertook an analysis of poorly conserved and potentially threatened vegetation types in the Western Australian wheatbelt (Hopkins 2000; Harvey and Hopkins 2000). The project built on earlier work developing a digital vegetation map database and assessing the levels of representation of each vegetation type in the conservation reserve system (Hopkins *et al.* 1996; Agriculture WA and CALM 2002; Hopkins *et al.* 2001). The study area was the 12 major soil-landscape zones within the South West Agricultural Region where salinity is considered to be a major problem. The project drew on data sets of native vegetation extent, the conservation estate, and soils with evidence of salinisation, to identify vegetation types that were poorly represented in the conservation reserve system (as at October 2000; after Hopkins 2000).

The principle of combining vegetation association and soil-landscape datasets described by Hopkins and others is consistent with a biodiversity surrogate for representation analysis in Systematic Conservation Planning. The poorly conserved and potentially threatened Beard vegetation types were included as biodiversity preferences in the SCP- TARGET analysis. The NEWROC occurrences of five priority vegetation associations were used.

Potential Natural Diversity Recovery Catchments

The Western Australian Salinity Investment Framework (Department of Environment 2003) describes the process and methods used to define natural and potential recovery catchments. Natural diversity recovery catchments and landscapes are those areas already selected by CALM policy on the basis of their importance for biodiversity and high level of threat from salinity. There are currently no such areas in NEWROC.

Potential natural diversity recovery catchments have been proposed by experts on the basis of their importance for biodiversity and high level of threat from salinity. Their analysis used preliminary results from the recent biological survey of the agricultural area (Keighery and Lyons 2001; Keighery 2002). Areas are identified because of the presence of representative examples of species (not necessarily threatened yet) that, across their range, are broadly at risk of rising groundwater and associated salinisation. The approach uses indicator species that represent the assemblage of species, and is not specific to individual taxa. A more detailed analysis of the available data is work-in-progress (Department of Environment 2003).

Potential recovery catchments are delineated over broad areas that could be used as pointers within which more tangible boundaries can be defined. For example, naturally saline areas and claypans (e.g. Lake Campion in the ALR project region, the NEWROC) comprise distinct assemblages of species, many of which form a component of potential recovery catchments. More specific map boundaries that represent these assemblages of species could be defined from the extent of wetlands/drainage channels (specific habitat) or the broader sub-catchment (zone of influence) within the potential recovery catchments. Datasets which capture these and other hydrology features are available through the WA Department of Environment and an extract relevant to NEWROC was provided for use within the ALR.

For the purpose of defining preferences to these features for the SCP-TARGET analysis, areas of remnant vegetation and the linear feature categories for claypan, wetland and watercourse within the "Lake Campion" potential natural diversity recovery catchment were used.

Representative (Target) Landscapes

In addition to potential natural diversity recovery catchments, the Western Australian Salinity Investment Framework (Department of Environment 2003) delineates landscapes with over 10,000 ha that have 25% or more of their area in natural habitats, that have additional biodiversity assets and are at risk due to rising water tables and associated salinity (Wallace *et al.* 2003b). This approach utilised the baseline work of Beecham (2003) in which the 25% natural habitat within a notional landscape is used as an indicator of viable habitat.

Landscapes over 10,000 ha that have 25% or more of their area in natural habitats were ranked according to (a) amount of native vegetation remaining within their boundaries; (b) counts of rare/threatened species and threatened ecological communities and; (c) measures of wetland importance (DOIW, after Environment Australia 2001). The current importance of each landscape was determined as a numeric count.

Representative (viable) landscapes were derived and rated in relation to their biodiversity importance and their level of threat from salinity (described in Wallace *et al.* 2003b). This information was further subdivided into three groups, termed tiers:

- Tier 1: those representative landscapes ranked highest (rank 1) for biodiversity importance that are also highly threatened by salinity;
- Tier 2: those representative landscapes ranked either second (rank 2) for biodiversity importance, or moderately threatened by salinity, or both; and
- Tier 3: those representative landscapes ranked either third (rank 3) for biodiversity importance or with a low salinity threat, or both.

These tiers were designed for allocating funds to prioritised assets of public value (Department of Environment 2003). Wallace *et al.* (2003) emphasise that while the criteria and methods used provide a valuable starting point for priority setting, they are inadequate in the longer term.

In lieu of a more comprehensive assessment of regional biodiversity probability of persistence, the available analysis of representative (target) landscapes was used to as a preference feature in the SCP- TARGET analysis, where also associated with of remnant vegetation. Although a rank is implied by the three Tiers, all areas were treated as equal in the sense of preference. Within the NEWROC there are seven Tier 2 areas and seven Tier 3 areas.