River Restoration and Management in Australia: A National Framework for Vocational Education and Training and Graduate Studies

A Project of the National Rivers Consortium Land and Water Australia

Blacklow, W. M., Bell, G., Davies, P., Jasper, R. and Pen, L.

Centre of Excellence in Natural Resource Management
Publication 01/01
December 2001

CONTENTS

List of Tables

List of Recommendations

Graduate Studies

List of Appendices

Summary

Many inputs are required to restore and manage the rivers of Australia. A high priority is the commitment of skilled and knowledgable people. Present education and training in river restoration and management is considered inadequate. This project was commissioned by the National Rivers Consortium to survey education and training in river restoration and management and then to propose a framework to develop and implement adult education and University courses to bring about improvements.

The report on the Project develops eighteen recommendations and a business plan to spend about $750000 over the next three years on options to develop a unified national training framework and deliver strategic courses to establish an education program. An option is to appoint an Education Manager to facilitate the efficient and effective establishment of an education program.

Vocational Education and Training in River Restoration and Management (VET): Courses for adult education (VET) are to be competency-based within the National Training Framework. Existing short courses are to be mapped against competencies within the framework and graduates issued with Statements of Attainment. Options are described to develop specialisations in river restoration and management from existing and new competencies within the new Conservation and Land Management Training Package. A range of week-long, on-the-job short courses are described for delivery in three regions in Australia in 2002. These courses will require the customisation of competencies, the development of training resources, and a common trainer to assist regionaly Registered Training Organisations. Participants in the short courses will build the capacity of River Restoration Teams. These strategic, regional short courses are aimed to establish a momentum for education programs. Longer-term options are recommended to develop qualifications in river restoration and management at levels of Certificates and Diplomas within the National Training Framework. The development of resources for 'distance education' is recommended. Scholarships and course-subsidies are suggested to encourage enrolments.

A Graduate Certificate (GC) in River Restoration and Management: A GC is recommended and a framework for its content described. The GC may be the equivalent of a semester of full-time University study or a module (one-third) of a GC in Natural Resource Management or similar course. The GC can be used as credit in studies for a Graduate Diploma or Professional Masters Degree. Options to establish the GC include assistance to a regional University with strengths in distance education or to three regional Universities. Delivery is planned for 2004, although there may be some flexibility in existing courses for delivery in 2003. Graduates with a GC are seen as members of River Restoration Teams. Scholarships and course-subsidies are suggested to encourage enrolments.

SECTION 1

Project Background and Objectives

Education and Training for the Restoration and Management of Australia's Rivers

Australia is the driest populated continent and has the most variable and unpredictable stream flows. Furthermore, increasing intensity of agriculture and population growth have resulted in degradation of riparian zones, diminishing water quality and increasing water diversion (Maher *et al.* 2000). Australia requires a predictable supply of quality water in an inherently unpredictable and degraded environment. Yet, it is now widely recognised in Australia that many river systems and catchments are in state of crisis and a concerted local and National effort is required to manage and restore them.

Rivers and streams are critically important components in the ecology of our landscapes. They are regions of high biodiversity and provide valuable ecological linkages to floodplains and downstream reaches, including terminal wetlands. However, many land-use activities result in the degradation of rivers. Rivers integrate the impacts of many catchment practices on the natural environment (Koehn *et al.* 2001).

Recent National Initiatives (Maher *et al.* 2000) that have recognised the importance of improved river management include:

1990 The National Water Quality Management Strategy
1992 Intergovernmental Agreement on the Environment and the National Strategy for Ecologically Sustainable Development
1993 Formation of ARMCANZ (Agriculture and Resource Management Council of Australia and New Zealand)
1994 Council of Australian Governments recommended reforming Australia's water industry
1995 Interim Cap on further water allocation from the Murray River
1996 State of the Environment reporting
1997 The formation of the National Heritage Trust
1998 The introduction of the Environment and Biodiversity Conservation Bill by the Commonwealth Government

Despite these initiatives, progress with river restoration and management has been slow. It is estimated that currently in Australia about $50 million per annum is spent on river restoration and management (Rutherfurd *et al.* 2000). Unfortunately, much of this activity is *ad hoc* with little sound science and training to underpin the restoration works. This situation can be improved if resources are allocated strategically to research, education and training. The goal is to ensure a high commitment of well-trained people to river restoration and management who are adequately funded and able to apply well-researched practices.

For the purposes of this report the following definitions apply:

River restoration is defined as "aiming to protect and rehabilitate the physical and biotic processes of a river in a way that is conducive to the progression of ecosystems towards their natural state" (Koehn *et al.* 1997).

Rehabilitation aims to change a stream or river to a desired condition, which may not necessarily be the pre-disturbance condition.
River management is a structured, scientifically based process designed to meet and maintain specific objectives over a long period of time.

A systems approach to management assesses the discrepancy between the desired state of a river and its present state, and then applies resources to overcome the discrepancy. Given scarce resources for river restoration and management, it is a matter for policy to consider setting a priority to protect rivers that are in good condition while endeavouring to restore and manage those that are degraded.

In this report we use "restoration and management" for the names of courses and modules, where restore is to "protect and rehabilitate", and manage is "to move from a present state or condition to a desired state or condition". The knowledge, skills and commitment of people are among a set of resources needed to facilitate change. This report is concerned about the efficiency and effectiveness of education and training to develop the human resource to restore and manage the rivers of Australia.

One of the manifestations of concern for the environment in Australia was the initiation of the Landcare movement in early1990s. This movement is organised around the formation of Landcare District Councils (LCDCs). There are about 4500 LCDCs in Australia and each would be concerned with a number of river catchments. For example, the Blackwood Basin Group in the south west of Western Australia embraces 150 catchment groups and 17 LCDCs. It is proposed (Koehn *et al.* 2001) that River Restoration Teams undertake the restoration and management of rivers and their catchments.

The magnitude of the demand for education in river restoration and management can be estimated by considering the needs of Restorations Teams. If each Landcare group has only one River Restoration Team that is active then there would be 4500 Teams that would have variable needs for education and training to enhance their efficiency and effectiveness. It is more likely, however, that only a small proportion of the Landcare groups presently allocates a high priority to river restoration and management. Higher priorities would be given to other conservation and land management problems, particularly those that have a more immediate effect on farm profitability. The adage "you can't be green when you are in the red" applies. The challenge remains, however, to increase the activity and effectiveness of river restoration and management and education and training is seen to be a means to that end.

Presently, the education and training that is available for those who undertake work for the restoration and management of rivers and their catchments is unsatisfactory (Koehn *et al*. 2001). Integra *et al*. (2000) reported that the top priority for action in river restoration and management was to "develop an overarching competency framework – to direct short courses". This action was recommended to achieve "a coherent set of training and education responses rather than the current *ad hoc* and sporadic workshops and training days. This initiative will also impact on "the current lack of quality assurance in the training being provided and the effect this could have on activities undertaken in river management" (Integra *et al*. 2000). It is the challenge of this report to propose methods for improvement in education and train for river restoration and management.

The NRC Project

The National Rivers Consortium (NRC) is an initiative of Land and Water Australia and was formed to facilitate improvements in the condition of Australia's rivers. Fundamental to progress in RRM is the commitment of skilled people operating in Restoration Teams as described in the River Restoration Framework (Koehn *et al.* 2001). It was recognised that effective Restoration Teams require the Building of Capacity through training, education and research (Integra *et al.* 2000).

In May 2001, the National Rivers Consortium called for submissions for a Project (Appendix A1.1) to survey training and education being delivered in Australia for RRM and, having consulted widely, to propose a national framework for two training and education programs:

- A graduate diploma in river management
- A community level course in on-ground river management

The NRC considered that specialised, nationwide education and training in river restoration and management, offered at different levels of required expertise, has the potential to make a substantial contribution to the restoration of rivers and their catchments in Australia.

The Project Team

The NRC accepted a submission from the Centre of Excellence in Natural Resource Management (CENRM) to conduct the NRC Project. The Project began in August 2001 and was completed 31 December 2001. Members of the Team were: Marcus Blacklow (Interim Director CENRM), Peter Davies (The University of Western Australia), Randall Jasper (The University of Western Australia Albany Centre) and Gael Bell (WA Department of Agriculture). Luke Pen (WA Water and Rivers Commission) was an early member of the Team but was unable to comment on the Final Draft of the Report.

Project methods

Providers and users of education and training across Australia were surveyed to assess current activities and suggestions for improvement. Details of the questionnaire used in the telephone-surveys are given in Section two and the Appendices. Given the requirements of the NRC Project, the surveys were directed at the following:

- **Adult Education (VET)**. Training for members of community organisations who generally take the lead on practical and locally based activities as well as long-term management, monitoring and evaluation. For these activities, a reasonable understanding of river science would be required together with a sound knowledge of river restoration methods and issues. The Project Team anticipated that any course at this level would, most probably, be incorporated into the National Training Framework as vocational education and training (VET) and delivered and assessed by Registered Training Organisations (RTOs).

- The **Graduate Certificate (GC)**. The GC would be for those with tertiary qualifications who work in RRM or who wish to do so. It would be a University course and emphasise the science and technology of RRM and the needs of multidisciplinary teams.

The Project Team hypothesised that both the VET and the GC should be within the National Training Framework and take advantage of the existing offerings and systems of delivery. The design and conduct of the surveys was used to test this hypothesis. However, it was recognised that if education and training were part of a unified National System then the courses would need to accommodate the diversity of river systems and allow for local variations in requirements for education and training.

SECTION 2

2. Survey of Existing Courses and Delivery

2.1 Vocational Education & Training (VET)

Introduction

A survey was carried out to assess the VET available in River Restoration and Management (RRM). Further to this it was intended to assess the level of institutional capacity currently available to deliver this training and to provide an analysis of gaps and priority-areas where further capacity might be required.

A previous report commissioned by the NRC (Integra *et al*. 2000) surveyed many providers of training in RRM. This current survey of VET builds upon that report. Integra *et al.* (2000) highlighted the sporadic nature of training in river restoration. They noted "workshops and training days ranging along a spectrum of very general non-accredited courses, through to accredited courses being run by qualified educators". The authors raised their concern with the "lack of quality assurance" and the disparity between the level of the expertise involved in delivering the training.

Information for the current survey was collated from a telephone survey of nationwide RRM providers of training and education (with some differences from those surveyed by Integra *et al*. 2000) and people most likely to participate in this area of training.

Methods

A telephone-survey was conducted and consisted of closed and open-ended questions. The questions were tested initially on several agency-staff and the revised questions were used consistently for all those who were surveyed. For the purposes of making generalisations, the responses were divided into three groups: majority (>70%), equivocal support (30-70%) and a minority (<30%) of respondents.

A total of 25 training and education providers from throughout the Nation were contacted and all participated in the survey. The survey questions were developed with the aims of identifying:

- Providers of RRM training
- Demand and provision for accredited training
- Content, delivery-methods and patterns of the training
- Gaps in the capacity of the providers or the training provided

All participants in the survey were questioned on the basis of their involvement in Adult Education. The respondents are detailed in Appendix 21. They fell into the following categories:

- State Government Agencies (32%)
- TAFE Colleges (16%)
- Universities (12%)
- Environmental Groups (16%)
- Large Community Groups (12%)
- Small Community Groups (8%)

- Local Government (4%)

Results
A summary of the responses to the survey is given in Table 2.1.1.

Table 2.1.1. Responses of providers of VET to the survey questions on River Restoration Management. (A complete table of results is included in Appendix 2.5.)

Survey Question (Appendix 2.2)	Responses to Survey-Questions on RRM (n=25)
Question 2 Course titles	23% delivered courses with a title directly related RRM 19% were involved in some form of monitoring 15% in Hydrology 8% in Land Management/Earthworks 8% in Rural Planning 8% in Cultural studies linked to river systems 4% GIS 12% in Extension Methods 4% in other courses
Question 3 Accreditation	52% of courses were not accredited 36% were from level 1 to Diploma (ref Q9)
Question 4 How often is training delivered?	45% of courses are delivered on demand 21% twice a year 21% three or four times each year
Question 5 Modes of delivery	38% short courses 27% Internal 17% provide flexible delivery 15% external 3% on line.
Question 9 Accreditation details (ref Q3)	45% accredited through TAFE 36% with another RTO or in conjunction with a TAFE College 18% VET
Question 10 Links to National Industry Training Packages	52% not linked to Training Packages 28% linked to various packages and courses 16% waiting for new Conservation and Land Management package.
Question 11 (a) Skills Recognition	50% provided Skills Recognition, Statement of Attainment or formal Certificate
Question 11 (b) Participation	67% provided a Certificate of Participation or Attainment
Question 13 Course deliverers	31% government agency staff 16% industry professionals 13% environmental consultants 11% lecturers from TAFE or universities 8% workplace trainers 5% Landcare officers 5% local government staff

	11% others
Question 14 Target Audience	12% Landcare officers 12% community catchment management groups 10% professionals 10% teachers 10% local government staff 10% environmental consultants 13% state government staff 7% unemployed 16% others
Question 15 Additional courses	95% are interested in providing additional courses in RRM
Question 16 Best method of delivery	50% 'in-the-field' with a 50/50 mix of theory and practice Over 30% regional, face-to-face courses 3% weekend courses A small number thought that mentoring of traineeships was a sound option.
Question 19 Participants' expectations	10% future employment in this area 9% access to other courses 13% professional interest 13% serious amateurs 14% hobbyists 17% land managers (farmers) 9% environmental consultants 15% for other reasons
Question 20 Participants' background	18% environmental management 25% NRM and community support 9% ecosystem restoration 6% land use or town planning 6% education and training
Question 21 Participants' work role	20% Community Support Officers 16% Project Managers 8% Program Managers 10% Research Officers 6% Planners 6% Engineers
Question 22 Participants' employer	28% government agencies 19% local government 16% environmental groups 12% education and training 7% consultants
Question 23 Where is their work focused?	47% local level 38% regional level 9% statewide
Question 24 Value of qualification in	33% minor 20% occasional 3% moderate

workplace	27% substantial 17% critical

Discussion

The results of this survey indicate that VET covers a wide range of topics and is delivered in a variety of ways - with or without certification or possible articulation to other VET. These results agree with the conclusions of Integra *et al.* (2000).

The providers of the training range from TAFE institutions and Universities, to environmental groups and some Government agencies. TAFE institutions, some Government agencies, and the larger environment groups (such as Greenskills) deliver accredited courses. Accreditation is based upon courses or training packages within the National Training Framework. Small environmental groups and community groups generally offer no form of accreditation, certification or acknowledgment of achievement.

The groups accessing or needing this training included volunteers, students, professionals, farmers, Catchment Coordinators, Landcare Officers, and Waterwatch/Ribbons of Blue facilitators. NHT funding has invigorated the demand for RRM courses (Appendix 2.7).

The training is provided in a variety of formats. Some training, especially that provided by TAFE institutions, is provided over a semester or more, while the other training takes place in an afternoon or over some days. The trainers may or may not have qualifications for delivering training. A large percentage of the trainers are agency or industry professionals who are competent or interested in the particular content being delivered.

The survey results indicated that the majority of providers interviewed believed there is a strong demand for courses that cover a broad range of topics associated with RRM. This demand is manifest on several levels and is demonstrated through consistent requests from the groups and individuals mentioned.

There are numerous reasons for training in RRM. Many providers are required to train volunteer groups, others provide training as part of the professional development of members of local and State Government agencies; Waterwatch/Ribbons of Blue Coordinators; other land and water managers.

The survey results indicate that the preferred format for the delivery of RRM training is as short courses of three to five days delivered face-to-face and in the field with a mix of theory and practice (most suggest 50:50). All respondents indicated that the content, delivery and assessment of such courses would need to be flexible enough to enable them to provide a strong local and regional focus.

The results of this survey are supported by the findings of a survey conducted by Integra *et al.* (2000) who concluded that training in RRM continues to be sporadic in terms of the quality and style of the content and delivery. It is supportive of our findings to reproduce here some of key findings of Integra *et al.* (2000):

- "There is an overwhelming demand for education and training
- There are government and non-government training networks that can be built upon

- There are some high quality manuals and guidelines now available that cover some aspects of RRM
- There is willingness at State and Federal levels of Government to assist and be involved in looking at ways to better manage education and training in RRM"

2.2 Graduate Studies

Introduction

Recommendations for any improvements in GDs required the Project Team to be well informed on existing offerings and systems of delivery. As required by the NRC, the Team consulted widely with those who deliver course in RRM and those who could assist the Team with assessment of demands for courses. The Team pursued three objectives:

Summarise existing opportunities for education in RRM. These opportunities could be specific courses in RRM or courses in Natural Resource Management (NRM)
Consult with existing and prospective providers of GDs (Universities) on course delivery
Consult with prospective course participants as to relevance, content and recommended emphasis of a proposed GD

Methods

Summary of existing river management courses

A survey of existing tertiary level courses in at least some facets of river management was carried out by individual approaches to current course coordinators and by a search of University courses on the Internet.

Consultation with Universities

The following institutions were consulted for information about courses on, or related to, river management (specific advice was sought from those who deliver existing short-course including A/Professor Gary Brierley (RiverStyles), A/Professor Ian Rutherfurd (River Restoration Framework), Professor Stuart Bunn (National Riparian Lands Program Workshops):

Curtin University of Technology
The University of Western Australia
The University of Newcastle
Deakin University
The University of Adelaide
RMIT University
Edith Cowan University
University of South Australia
Flinders University of South Australia
The University of Melbourne
Macquarie University
Murdoch University
James Cook University
Griffith University
University of Ballarat
Central Queensland University
The University of Canberra
CRC for Catchment Hydrology
CRC for Freshwater Ecology

Consultation with prospective course participants

A wide-ranging consultation was conducted for prospective participants. This consultation was focused at those with the potential to be involved in RRM, rather than broad-scale NRM. The agencies consulted in the program are detailed in Appendix 2.3. The survey questions are detailed in Appendix 2.4.

Telephone interviews were conducted of professional people involved in some aspect of RRM. In conducting the ‘phone interviews', each of the questions were carefully read out in full, giving the interviewee each of the alternatives to chose from.

Professional people were selected from Local Governments, consultants working within the State, consultants that work within the State and across the Nation, State Government staff from the NRM agencies, small and large community groups. In some cases, obtaining interviews with prospective course participants proved difficult in the short amount of time available. Of the 45 people selected, 31 were available for interview. All were eager to answer the questions and some asked to be kept informed of details of any subsequent courses arising from the questionnaire process.

Results

The results are detailed in Appendix 2.6 and are summarised below.

Summary of existing river management courses
Many Australian Universities offer diploma and certificate courses in environmental management and some in NRM. Most of these are generic course-work degrees aimed at postgraduates (from sciences, agriculture, engineering), environmental professionals, resource managers, and urban and regional planners. However, very few specifically target RRM.

There are no known extensive courses at a Graduate Diploma level on river restoration and management.

Consultation with Universities
The existing short courses provide a broad and generalised skill-set / theoretical and practical basis for management, monitoring and conservation of freshwater and estuarine ecosystems and include practical sessions, excursions and lectures. Typically, both compulsory core subjects and some optional units are included so those courses may be designed to suit individual interests.

Seminars, conferences, workshops and short courses are occasionally offered by Commonwealth-funded CRCs (Cooperative Research Centre for Freshwater Ecology; CRC for Water Quality & Treatment; CRC for Coastal Zone & Waterway Management) and by Research Centres (*eg* Applied Ecology Research Centre Canberra University; Centre for Water Research, UWA). These activities are usually offered in conjunction with Universities, Government agencies and industry. CRCs also provide public and school-based education programs.

The short courses are typically aimed at a "certificate level". These are usually one semester full-time or one to three years part-time (*eg* four hours/week) costing from $500 - $4,000 for Australian students.

The River Styles® Short Course (A/Professor Gary Brierley, Macquarie University) is an example of a successful short course in RRM. This course is a five-day option that was specifically developed to serve as training for postgraduates and river professionals. It has been successfully run three times, once in Northern NSW and twice in Goulburn. Over 90 individuals have participated in the courses to date. An accreditation procedure has been developed as part of this course, ensuring that individuals who complete the requirements are qualified to undertake River Styles® assessments.

Consultation with prospective course participants
The majority of the professionals interviewed worked in the areas of environmental management, ecosystem restoration (Landcare), NRM, and community support. The main job functions were as program and project managers, with planners, policy officers and consultants being significant but lesser areas of work. The main work focus was at a local, regional and to a lesser extent state level.

Of the total group of interviewees, the importance of a GD was rated as minor (21%) or substantial (29%), with none seeing the diploma as critical to their work. However, when broken up into Government employees and private consultants, a large proportion of the former group saw a GD as being of substantial importance (40%), while the majority (56%) of the latter group considered it of moderate importance.

Discussion
Roles in RRM vary substantially among States. There are a range of agencies and organisations involved in restoration activities. Generally, roles and responsibilities of organisations are poorly defined. However, at a recipient level, there is interest for a generic University-based GD in RRM. There was no specific issue that appeared to have an overriding influence which would determine the structure of a subsequent course.

Existing courses
There are no dedicated courses on RRM that would fulfil the requirements of a University GD. Existing courses typically reflect the specific (and sometimes narrow) interest of academics at Universities; they are *ad hoc* in nature and usually limited to sporadic workshops and training days.

There are many NRM courses offered at Universities across Australia at a PostGraduate Diploma level. Appendix 2.9 shows an outline and points awarded to components of a NRM course at UWA.

Delivering a course
The present training providers (Government Agencies, CSIRO, CRCs, Universities, and TAFEs) have the technical knowledge and training skills necessary to deliver components of a GD in RRM. However, there is no one institution offering a 'complete' RRM course as a GD.

Existing training and education providers across Australia could deliver a specific GD in RRM and achieve "capacity building" in Restoration Teams involved in RRM (Koehn *et al.*2001; Integra *et al.* 2000). While encouraging flexibility at the State and regional level, the objective would be to bring consistency in the design of courses, and in the use of manuals and tools. Coordinated and aligned delivery of capacity building efforts in RRM and minimised duplication of training and education resources would bring efficiency and effectiveness to a GD in RRM.

Taking a course
The survey of prospective course participants showed a variation of support for a GD in RRM. Some felt it unlikely to be attractive to professionals involved in some aspect of NRM. In the case of Government agencies, people surveyed generally fell into two groups: those seeing the GD in RRM as having substantial importance to their work and career progress and those who did not. This dichotomy of support reflects career and work specialisation. The majority of

consultants in NRM saw a GD in RRM as being of moderate importance, or less. This rating reflects the broad and more general work of consultants who tender for a wide range of environmental projects.

A GD in RRM would appeal mostly to professionals involved in ecosystem restoration, environmental management, natural resource management, community support, research and education. These categories contribute to the majority of participants of WA's river restoration workshops (Appendix 2.8).

Much of the training in RRM has been *ad hoc* and fragmented and this is reflected in the on-ground works. In this context, there is a great need for a coordinated national-level response.

An overarching competency framework will achieve a coordinated and coherent set of training and education responses rather than the current situation. This initiative will also address the current lack of quality assurance in delivery and assessment. An overarching competency framework will allow existing training and education providers to review their short courses against the competency framework and address any significant gaps.

SECTION 3

3. Proposed Design and Delivery of National Courses in River Restoration and Management

General Recommendations

A Unified Framework

Our surveys (Section 2), and those of others (Koehn *et al.* 2001; Integra *et al.* 2000), showed that education and training in Australia for RRM is fragmented and insufficient to meet the needs for progress in the restoration and management of Australian rivers. Furthermore, most courses lack quality control of design, delivery and assessment. These limitations of current options lessen their appeal to students who desire accreditation for studies completed within a nationally recognised system of education. A national framework for accredited education and training in RRM would overcome these limitations. Furthermore, employers, industries and others who require and support education and training are more likely to do so if the training is part of a national system with in-built controls of quality. A National Framework for training and education exists in Australia (Appendix A3.1) and the current concerns about education and training for RRM would be overcome if it was aligned to the current National Framework. There was general support among those surveyed (Section 2) for the adoption of the National Training Framework for education and training in river restoration and management.

General Recommendation 3.1: As a matter of urgency, the NRC promotes the Unified, National Framework in Australia for education and training in river restoration and management.

Estimated Cost: Specific methods for promotion and estimated costs are given for subsequent recommendations.

Restoration Teams

The management and restoration of rivers in Australia requires a team of people with a range of knowledge and skills. Koehn *et al.* (2001) suggested a River Restoration Team should have the following composition:

Project Manager (Catchment management authority or equivalent)
Scientist/expert representative
- Geomorphologist and hydrologist
- Freshwater ecologist
- Plant (aquatic and riparian) ecologist
- Sociologist/community development worker

Community representative
- Member of cultural group
- Farmer/landholder and industry representative
-

Angler
Government representative
- Relevant State Agency representative
- Local shire representative
- Catchment authority representative
- River operator

Each member of a Restoration Team brings to the task of management and restoration a range of knowledge and skills that are enhanced by formal education and training. Koehn *et al.* (2001) provided an 'A to Z' list of the "Tools" needed by a Restoration Team. The tools include knowledge about the physical, chemical and biological attributes of streams; the skills needed for groups to work together as teams to asses the current state of a stream and to devise methods and plans for restoration; the practical skills required for doing the restoration work.

General Recommendation 3.2: Education and Training in RRM be designed, delivered and assessed to suit the composition of River Restoration Teams (Koehn *et al*. 2001).

Estimated Cost: Specific methods for promotion and estimated costs are given for subsequent recommendations.

VET and Graduate Studies
Courses for the delivery and assessment of the wide range of knowledge and skills require by Restoration Teams include Vocational Education and Training (VET) and more academic courses offered by the VET and University Sectors of education. Our survey (Section 2) of providers and graduates from education and training in RRM showed there was strong support for both VET and University courses.

General Recommendation 3.3: The NRC promotes two types of education and training in river restoration and management within the National Training Framework: (1) competency-based Vocational Education and Training (VET); (2) a Graduate Certificate (GC) within the VET and University sectors of education.

Estimated Cost: Specific methods for promotion and estimated costs are given for subsequent recommendations.

Education Manager
A number of recommendations specific for the design and delivery of qualifications in River Restoration and Management are developed in Sections 3.1 (Vocational Education and Training) and 3.2 (Graduate Studies). If there is to be an early and sustained effort to improve the quality of rivers in Australia through training then there is an urgent need to implement the recommendations of this report in an efficient and effective manner. Given the urgency of the task and the level of investment recommended, we believe that an Education Manager should be appointed to implement the recommendations. We provide a notional Operational and Business Plan to indicate the duties and Estimated Costs of the appointment of an Education Manager

(Section 4). We estimated the cost of management based upon a consultant at $500 per day and the number of days for specified tasks would be about $59500 for management of the VET recommendations and $25500 for management of the recommendations for Graduate Studies. However, compared with this ad hoc approach of consultants to complete specific tasks, the appointment of an Education Manager is likely to be more efficient and effective in implementing the recommendations of this report, and would be easier for the NRC to implement and monitor. There would be better integration of the education and training program if the Manager had responsibility for both the VET and the Graduate Studies. We consider that the Education Manager would need to be full-time for 18 months and then, subject to review, half-time for an additional 18 months. The Manager would need to have experience in education in the VET and University Sectors and experience in natural resource management. For the purposes of estimating the cost of this recommendation, an appointment at the level of a Research Associate in the University Sector for salary plus on-costs would be about $60000 per full-time year. We estimate (Section 4) that the cost of an Education Manager would be about 20% of the Education budget.

General Recommendation 3.4: The NRC appoints an Education Manager to implement the recommendations contained in this report "A National Training Framework for River Restoration and Management in Australia for the VET and University Sectors of Education".

Estimated Cost: $135000

3.1 Proposed Vocational Education and Training: Design and Delivery

The National Framework for VET provides a wide range of skills required by industries and within this range accommodates the interests and responsibilities of people (Appendix A3.1). Within this Framework we describe a number of options for training in River Restoration and Management.

Option 1: River Restoration and Management within the Training Package for Conservation and Land Management.

The Rural Training Council of Australia (RTCA), as an Industry body, is currently managing the development of a new Training Package for Conservation and Land Management (CLM). This package will include some of the competencies from the Agriculture and Horticulture Training Packages, both of which are currently under review. The CLM Training Package will contain Qualifications from Certificate I (AQF 1) to Advanced Diploma (AQF 6). Each Qualification can be formed from a set of competencies that specialise in one of several areas in the conservation and land management "industry". AQF Level 1 Qualifications are for practical work in the field, Level 3 is for higher level operators and Levels 4 - 6 for supervisors and managers. This range of responsibilities would cover those required by River Restoration Teams (Koehn *et al.* 2001) Appendix A3.1 provides details about the National Training Framework (NTF) and the Australian Qualification Framework (AQF).

The current draft (known as the final draft) of the CLM Training Package describes Qualifications that allow specialisations in:

Bush Restoration and Management
Lands, Parks and Wildlife
Weed Management
Vertebrate Pest Management
Indigenous Land Management
Community Coordination and Facilitation
Conservation Earthworks
General Land Management

Many of the new competencies for these Qualifications in the CLM Package, and those that exist in the Training Packages for Agriculture and Horticulture, can be adapted (customised) for courses in RRM but they would not lead to a Qualification in RRM. However, of the proposed courses in the CLM Training Package, those concerned with Bush Restoration and Management, Conservation Earthworks, Community Coordination and Facilitation, and General Land Management would be the most suitable to adapt to the management of vegetation in catchments and riparian zones for RRM.

The customisation of an endorsed CLM Package for RRM will be the responsibility of each State Training Authority and they may need work done on the Package to enable it to be implemented

within their training system. The Authorities may contract a TAFE college or Institute in their State to conduct this work. State-funded delivery of Qualifications within the package can begin after the State Authorities have accepted the Training Package.

Recommendation 3.1.1: The NRC negotiates with the RTCA to enable training in River Restoration and Management to be delivered within the Conservation and Land Management Training Package and to start in 2003.

Estimated Cost: $3500

Customisation of CLM Competencies for RRM
Development of materials to assist delivery and to place some of the training in the context of River Restoration and Management may be funded by State Agencies or by Institutions delivering the material and undertaking the development of materials for commercial reasons. It may be in the interests of the NRC to contract a consultant to develop materials for the package that make it easy for other providers to deliver the training in the desired context. The cost to customise a competency is about $17000. With four competencies in the CLM Package most relevant to RRM, the total cost for customisation of the new CLM competencies would be $68000.

Recommendation 3.1.2: The NRC supports the customisation of competencies of the Conservation and Land Management Training Package and the development of training resources so that training in River Restoration and Management can be offered as a specialisation within the Conservation and Land Management Package early in 2003.

Estimated Cost: $75000

Option 2: Development of a new competency for River Restoration and Management within the Conservation and Land Management Training Package.

We believe that RRM requires specialised Units of Competency that focus on river restoration and management. With the addition of such Units it would be possible to create a new specialisation in River Restoration and Management. The RTCA, as the industry body, will need to be consulted so those Units of Competency in RRM can be added to the CLM Training Package. We have had discussions with the Consultancy working on the CLM Package and anticipate that a Unit of Competency could be added to the CLM Package titled "Plan River Restoration Works". This Unit would enable the development of specialisation in RRM within the CLM Package.

Recommendation 3.1.3: The NRC negotiates with the RTCA to de velop the new Competency of "Plan River Restoration Works" and training resources so that a specialisation in River Restoration and Management can be offered in 2003.

Estimated Cost: $30500

Option 3: Accreditation of existing short courses in river restoration and management.

Our surveys (Section 2) indicated that some workers and supervisors in the area of RRM might not require a formal qualification in RRM. However, they would be interested in obtaining formal recognition of the competencies they may have gained from the short courses they have attended. Within the National Training Framework (Appendix A3.1), an RTO can issue a Statement of Attainment which describes the competencies that a participant has achieved through the attendance of a short course of instruction. Such a Statement of Attainment would satisfy many of the participants who undertake training in this area. A Statement of Attainment has the additional advantage that it can be used as credit towards a recognised qualification. However, the training would need to aligned, through a formal mapping process, with the competencies of a Training Package (Appendix A3.1), for example the CLM Package.

In Australia, there a number of Short Courses on a range of topics related to RRM offered by a variety of providers (Section 2). There would be many benefits to providers, participants and the industry of RRM if these courses became aligned with the National Training Framework. These benefits include recognition of learning by participants, quality-control of design, delivery and assessment of the courses, and a more coordinated and comprehensive system of recognised training for the industry (Appendix A3.1). A first step in this alignment process would be to map the content of the courses to the competencies of Training Packages. Given the state of training for RRM in Australia, we have recommended an evolutionary process for the creation of a specialisation in RRM within the CLM Package. This evolutionary process involves adapting competencies within the CLM Package and the creation of new competencies in RRM for the CLM Package. As part of this evolutionary process we recommend now that the content of existing short courses in topics related to RRM be mapped against competencies of the CLM Training Package. Once mapped, the graduates of the courses could be issued with Statement of Attainment by an RTO (Appendix A3.1). Through a process of Recognition of Current Competencies, these graduates may be able to gain credit towards a Qualification within the National Training Framework.

Recommendation 3.1.4: The NRC encourages the providers of existing short courses concerned with River Restoration and Management to have the content of their courses mapped against existing competencies so that Statements of Attainment within the National Training Framework can be issued to graduates of the short courses.

Estimated Cost: $3500

Option 4: Development of specialisations in River Restoration and Management.

Education and training in RRM presently consists of Short Courses outside of the National Training Framework. As a process of bringing education and training into the National Training Framework, we have made recommendations for the customisation of competencies within existing Training Packages (Recommendation 3.1.2) and the mapping of Short Courses outside of the Framework to competencies within the Framework (Recommendation 3.1.4). We believe, however, that there is need for additional, new competencies in RRM within the CLM Training. These additional competencies would enable a specialisation in RRM within the CLM Training Package. We identify some competencies that should be developed for the specialisation in RRM (Table 3.1.1). This specialisation would consist, therefore, of new competencies and a number of generic competencies within existing Packages (CLM; Agriculture; Horticulture).

Table 3.1.1. Proposed new Elements or Units of Competency to be included in the RRM specialisation of the CLM Package.

Code	Competency	Relevance to River Restoration and Management
NEW	Analyse hydrological data	Required to determine the flow characteristics of a site over time.
NEW	Conduct channel surveys	Determine the carrying capacity of the channel. Assess the channel slope and design of constructed riffles.
NEW	Assess riparian condition	Use the protocol of Pen and Scott (1995) or similar.
NEW	Manage stock	Management of stock in riparian areas; design stock watering points on stream and river channels.
NEW	Assess in-stream habitats	Assessment of in-stream habitats, including pool in-filling, for habitat restoration.
NEW	Re-establishment of large woody debris (LWD).	Developing the techniques to re-establish and maintain LWD in river channels.
NEW	Assess reach condition (especially upstream).	Assessing the likelihood and the barriers to successful restoration.

NEW	Environmental Water Requirements.	An appreciation of this policy area in restoration, particularly below dams and other impoundments.
NEW	Monitoring and evaluation	Critical to obtain key ecological data prior to restoration activities and to assess success.

An estimate of the cost to develop the new competencies and training resources is based upon an estimate of $17000 per competency. Thus, for nine new competencies the total cost would be $153000. While training providers may develop the new competencies and recoup their development costs from course fees, the development of the specialisation in RRM will proceed more rapidly and uniformly if sponsored by the NRC.

Recommendation 3.1.5: The NRC negotiates with the RTCA to have some new competencies developed in River Restoration and Management so that a comprehensive Specialisation in River Restoration and Management can be developed within the CLM Package for delivery in 2003.

Estimated Cost: $35500.

Option 5: Development of Short Courses from existing competencies of Training Packages with the national Training Framework.

Registered Training Organisations are able to adapt and deliver, within their Scope, existing Training Packages (context; underpinning knowledge) to suit variations in the workplace. Hence, some competencies in the Training Packages in Agriculture, Horticulture and Conservation and Land Management could be adapted to suit the workplace of rivers and their catchments and offered as Short Courses. Graduates from these Short Courses would be issued with Statements of Attainment within the National Training Framework. The four suggested Short Courses (Tables 3.1.2 – 3.1.5) would be useful options for stop-gaps in training in RRM prior to the preferred option of developing specialised Units of Competency and Specialisations in River Restoration and Management (Recommendations 3.1.3 and 3.1.5). There are many other existing competencies that could be customised for specialisations in RRM (Appendix A3.2).

Each suggested Short Course would involve one week of fieldwork and may have a theory component. Short Courses could be offered by a number of providers in a variety of contexts suitable for a broad cross-section of clients. Such training can be recognised by a Statement of Attainment if the training is hosted by an RTO, or provided directly by an RTO. It is envisaged that the clients will undertake these Short Courses "on-the-job", that is, while performing relevant work. In order for the training to be assessed and recognised it would be useful if the trainees had a Training Record Book in which the training and their attainments were recorded. This Record would facilitate the later recognition of training if the trainee decided to undertake further training to gain a qualification.

Short Course 1: *Beginning Work in River Restoration and Management*
The trainees would work "on the job and for the job". That is the trainee would receive training while they were carrying out work that needed to be done in the catchment. They would receive training in areas such as basic nursery work, basic conservation work and basic landscape construction (Table 3.1.2). The training would be provided in the context of catchment management and include work on riparian vegetation (such as sedges and rushes), protection of riverbanks, and the reconstruction of stream forms. The units of competency covered in this Short Course are at AQF Level 1. In order to obtain a Qualification at this level another three units of competency need to be attained.

Table 3.1.2. Competencies to be covered in a Short Course 1: Beginning Work in River Restoration and Management.

Code	Competency	Relevance to RRM
RTC1006A	Support nursery work	Preparing plants for riparian restoration is an important component of river management.
RTC1554A	Support landscape construction.	Protection of riverbanks, through armouring and revetment is important to

		maintain geomorphological integrity of the stream and river form.
RTC1501A	Support conservation work.	

Short Course 2: *Further Work in River Restoration and Management*
The trainees would work on the job to receive further training in areas such as erosion and sediment control, planting trees and shrubs and carrying out revegetation (Table 3.1.3). The training would be provided in the context of catchment management and include work on riparian vegetation (such as sedges and rushes), protection of riverbanks, and the reconstruction of stream forms. The units of competency covered in this Short Course are at AQF Level 2. In order to obtain a Qualification at this level another twelve units of competency need to be attained.

Table 3.1.3. Competencies to be covered in a Short Course 2: Further Work in River Restoration and Management.

Code	**Competency**	**Relevance to RRM**
RTC2012A	Plant trees and shrubs.	Required for riparian restoration.
RTC2022A	Carry out revegetation works.	The practicabilities of the above.
RTC2202A	Conduct erosion and sediment control activities.	Land shaping, bank battering, revetment, sediment basins and revegetation are important river restoration/management.

Short Course 3: *Conducting River Restoration and Management*
The trainees would work on the job to receive further training in areas such as implementing a maintenance program, assessing a site for restoration, and sampling and testing water (Table 3.1.4). The training will be provided in the context of catchment management for river and riparian zone restoration and management work, and knowledge of protocols and procedures as devised by Pen and Scott (1995), Rutherfurd *et al*. (1999; 2000) and, in part, by Brierley (1999). The units of competency covered in this Short Course are at AQF Level 3. In order to obtain a Qualification at this level another twelve units of competency need to be attained. This course may have a theory content that may be covered with the provision of written materials in advance of the week of fieldwork. The assessment of theoretical and practical competence may be conducted in the field and by written work.

Table 3.1.4. Competencies to be covered in a Short Course 3: Conducting River Restoration and Management.

Code	Competency	Relevance to RRM
RTC3211A	Implement a maintenance program for an aquatic environment.	Maintain rivers and riparian vegetation
RTC3218A	Undertake a basic site assessment	Assess condition of rivers and catchments
RTC3507A	Undertake sampling and testing of water.	Assessment of water quality and adequacy of sediment control procedures.

Short Course 4: *Managing River Restoration and Management*
The trainees would work on the job to receive further training in areas such as the planning, design and supervision of conservation works for a river. The training will be provided in the context of catchment for river and riparian zone restoration and management work, and knowledge of protocols and procedures as devised by Pen and Scott (1995), Rutherfurd *et al*. (1999; 2000) and Brierley (1999).

The trainees should attain competence in Supervise Natural Area Restoration Works, Plan River Restoration Works (a new competency to be recommended for inclusion in the Conservation and Land Management training package) and Conduct Biological Surveys (Table 3.1.5). These units of competency covered in this Short Course are at AQF Level 4 and 5. In order to obtain a Qualification at Level 4 another ten units of competency, and at Level 5 another eleven units, need to be completed. This course may have a theory content that may be covered with the provision of written materials in advance of the week of fieldwork. The assessment of theoretical and practical competence may be conducted in the field and by written work.

Table 3.1.5. Competencies to be covered in a Short Course 4: Managing River Restoration and Management.

Code	**Competency**	**Relevance to RRM**
RTC4510A	Supervise natural area restoration works.	Restoration and management of rivers, riparian zones and catchments as natural areas.
RTC5522A New Competency within the Conservation and Land Management Training Package	Plan river restoration works	Planning is essential to the success of restoration and management programs.
RTC 5519A	Conduct biological surveys	Part of the monitoring and evaluation process. Required for fish and possibly aquatic macroinvertebrates.

Statements of Attainment from the Short Courses may be used to negotiate credit in the proposed Graduate Certificate in River Restoration and Management (Section 3.2). However, each University would decide whether the work that any one student completes in these Short Courses is accepted as credit for, or entry into, advanced studies in the graduate courses in RRM that they may offer. Successful articulation needs to be planned in advance.

The need is to deliver VET within the National Training Framework in 2002. It is feasible to deliver Option 5 in the second half of 2002 at three locations in Australia. Option 5, however, will require the selected competencies for the four Short Courses to be written in the context of

RRM and the underpinning knowledge and instructional material to be developed in the first half of 2002. Course 4 of Option 5 requires also a new competency to be written; namely "Plan River Restoration Works".

Expressions of interest for the delivery of the Short Courses should be invited from Registered Training Organisations in the three regions selected for delivery in 2002. The RTOs would charge a fee, payable by the student, to cover the costs of delivery. Elsewhere (Recommendations 3.1.8, 3.1.9) we recommend that the NRC, or other sponsors, offer scholarships or fee-subsidies to encourage participation in the pilot short courses to be run in 2002.

There would be merit in selecting an experienced trainer to develop the Courses and for that trainer to assist with the regional deliveries.

An estimate of the cost to customise a competency and develop instructional resources is about $17000 per competency (34 days at $500 per day). Thus, each of the four Short Courses with three competencies would cost $51000 per Course and $204000 for the four Short Courses. These figures seem high and competitive quotes may see them decreased. An option to decrease costs would be to offer the same Short Course in each of the three regions. This lesser number of Short Courses would still constitute a pilot program and the other Courses could be developed at a later time. The four Short Courses are formulated to suit increasing levels of existing skills and responsibilities. Hence, a pilot program of, say, one Short Course offered in the three regions would need to select River Restoration Teams whose members contain common levels of existing skills and training needs.

It is recommended that a Common Provider (the trainer who developed the course specialisations and instructional materials) assist in the delivery of the Short Courses. The cost of this activity is estimated as 15 days at $500 per day, including travel and accommodation, and $250 for incidentals.

Recommendation 3.1.6: The NRC supports an experienced trainer to develop and assist with delivery of Short Courses in River Restoration and Management from existing competencies in the Conservation and Land Management Training Package. Delivery to be by Registered Training Organisations in three selected regions of Australia late in 2002.

Estimated Cost: $73000 to $226000

Distance Education Resources

Adult education courses (VET) need to have substantial external teaching components ("distance education") offered on a part-time basis and with flexible types of delivery. Such design and delivery considerations allow participants to obtain qualifications without undue impact on their employment and income.

The proposed courses, within the National Training Framework, would ensure that the delivery of capacity building for river restoration and management (Integra et al. 2000) by existing providers of training and education which is consistent among providers and is subject to quality controls. While there will need to be flexibility at the State and regional levels, the Framework will bring consistency also in instructional material such as specific manuals and tools.

It is envisaged that the competencies relevant to river restoration and management will be made available in two different ways. Firstly, by community organisations, as RTOs or hosted by RTOs, who would deliver short courses that target river restoration and management only. Secondly, TAFE colleges and institutes, and other large training providers, would be interested in delivering complete qualifications (eg. Certificates in Conservation and Land Management) part of which could include training in river restoration and management. Accelerated uptake by training providers, consistency of training outcomes, and efficiency of the development of training resources would be greatly enhanced by a coordinated, centrally funded effort in the development of training resources. This applies particularly for delivery by distance education.

Recommendation 3.1.7: The NRC supports the development of materials that enable Registered Training Organisations to deliver training in River Restoration and Management within Training Packages in a flexible manner and over distance. These materials should include student and teacher guides and training record books.

Estimated Cost: $38500

Financial support and encouragement to participate in training
The outcome required for VET in River Restoration and Management is quality graduates that make significant and substantial contributions to the River Restoration Teams. Courses that are well designed and promoted should attract students into areas of VET for which there are good prospects of employment, voluntary work, or improvements to private holdings. Prospective students are attracted also to courses where costs of participation are relatively low. To this end, there are two financial options to encourage participation in training:

Option 1*: Scholarships*
Scholarships would assist in attracting students to courses in RRM. The Project Team did not review the availability of scholarships that may be applied to VET courses in RRM but believe that this review should be undertaken and if scholarships are available then their availability should be used in the promotion of the Courses. If there are insufficient scholarships available for VET studies in RRM then the NRC should consider investing in them, or encouraging the investment of other organisations in them. It would be strategic if there were scholarships available to encourage participation in the Short Courses recommended for delivery in three regions in 2002 (Recommendation 3.1.6).

The fees charged for a short course of one week may be $500 and travel and accommodation may be an additional $600. Hence a scholarship of $1000 would decrease participation costs to a low level. Five scholarships for each of the three regional short courses should encourage participation of key people from selected Restoration Teams.

Recommendation 3.1.8: The NRC reviews the availability of scholarships for VET studies in River Restoration and Management. If considered insufficient then consider investing in scholarships to ensure that key people undertake strategic studies to develop the strengths of River Restoration Teams in the three regions of Australia selected for the delivery of Short Courses in 2002.

Estimated Cost: $17500

Option 2: *Course subsidies*

Sponsors may be attracted to provide scholarships that recognise their contributions in the naming of the Scholarship. However, scholarships support the minority of participants. A subsidy to reduce the costs of the courses, and hence fees paid by all participants, may attract more students to participate in courses than the provision of Scholarships. The fees charges for a week-long short course may be $500 and with 15 students per course the total fees would be $7500. Assuming all students were participants in River Restoration Teams, or potentially so, then a $7500 subsidy of fees would remove any impediment to enrolment due to fees. If the subsidy were applied to each of the three regional short courses then the total cost would be $22500.

Recommendation 3.1.9: The NRC reviews the fees to be paid by participants in VET Short Courses in River Restoration and Management. If considered a discouragement to enrolments, then consider course subsidies to ensure that key people undertake strategic studies to develop the strengths of River Restoration Teams in the three regions of Australia selected for the delivery of Short Courses in 2002.

Estimated Cost: $25000

3.2 Proposed Graduate Studies: Design and Delivery

The University Sector

The construction of Graduate Studies in the University Sector of education (Appendix 3.1) can vary among Universities. In general, however, Postgraduate Studies are a continued specialisation of the Bachelor degree. Alternatively, University graduates, or those with equivalent academic status, can undertake Graduate-Studies to develop a new area of interest that differs from their first degree. These Graduate qualifications include:

- Graduate Certificates (GC)
- Graduate Diplomas (GD)
- Professional Masters Degrees (PM)

The equivalent full-time study for a GC is one semester, for the GD it is two semesters, and it is four semesters for the PM. Graduate-studies are flexible in design, delivery and assessment. The three Graduate Qualifications are "articulated" so that the GC can contribute to the GD and the PM. Graduate Studies can be articulated also with qualifications from the VET Sector (Appendix 3.1).

Students in any one GC are likely to come from a range of academic backgrounds, to have completed University studies some years ago and be currently employed. A high proportion of enrollees, therefore, is likely to be part-time students. Consequently, the design and delivery of the GC needs to assist students to build bridges between current knowledge and RRM, to schedule contact time to suit student availability, and to take maximum advantage of the Internet for delivery of interactive material and lectures. It is essential, also, that students spend a high proportion of their time (50%) in the field to be challenged by exercises in resolving problems of river restoration and management. This brief overview of the requirements for graduate studies in RRM shows that Universities will need to make a substantial commitment if their participation in graduate studies in RRM is to be successful.

The content, design and delivery of courses of study in Universities are controlled within each University through a formal process of proposal-development that requires an assessment of resource-requirements and student demand. Quality control of Graduate Studies is achieved through Boards of Study and of Examiners. Any proposal for Graduate Studies in River Restoration and Management would need to be processed through the University system. The probability of success of a proposal for Graduate Studies in RRM would be increased if generic material on content, design, methods of delivery, resources, costs, and student-demand were made available to interested Universities. Universities with existing courses in Natural Resource Management are more likely to add studies in RRM to the qualifications they offer than Universities without graduate courses in environmental subjects. Some Universities have strengths in Distance Education that could be utilised to assist part-time students likely to enroll in RRM.

Our surveys (Section 2) revealed considerable interest in delivering graduate studies in RRM. For example, interest has been expressed by: The University of Western Australia; Edith Cowan University; Griffith University; University of South Australia; University of Melbourne; and the Northern Territory University.

The Graduate Certificate would be offered for both fee-paying students and those eligible for HECS (Higher Education Contribution Scheme) or PELS (postgraduate education loans scheme). Most Universities believe they have staff with the necessary skills to deliver the GC but may require assistance with the development of course materials. Any plans to assist Universities with the development of a GC will need to allow for the times required for change in a University. For example, Universities require typically about 12 months "lead-time" to ensure new courses are listed in Faculty Handbooks and for resources to be prepared (lecture theatres; laboratory facilities; field trips). They need time also to make their courses known and to encourage enrolments.

We believe Graduate Studies provide a national Framework for the development and delivery of courses in River Restoration and Management and have recommended to NRC that they be developed as a matter of policy (see **General Recommendation 3.3**).

Option 1: *Graduate Certificate in River Restoration and Management*
The Graduate Certificate is the introductory graduate course in RRM. It is the equivalent of one semester of full-time study but would need to be flexible in design and delivery to suit the diversity of student backgrounds, their availability for study and the nature of rivers in the landscapes of their regions. For reasons of employment-constraints, most students will be part-time. The design of the proposed GC, therefore, is based upon four stand-alone modules that can be taken independently of each other. When added together the four modules enable the development of knowledge and skills sufficient for the graduate to contribute to the work of Restoration Teams as managers, planners and leaders (Koehn *et al*. 2000).

The four modules for the GC are:

- Geomorphology and Hydrology
- River Ecology
- River Restoration
- Policy and Management

The four major modules are sub-divided into a number of sub-modules (Table 3.2.1). The major modules are delivered in a sequence: the physical setting; stream biota; restoration; and management. In this way, knowledge is gained sequentially building upon previous material.

The total contact-time for a GC is about 240 hours. For a full-time student, and a semester of 13 weeks, this is about 20 hours per week of prescribed work and allows for 20 hours of private study per week. One module, therefore, is 60 hours of contact-time per week for a semester (Table 3.2.2). Experience suggests that a 50:50 split for theory and practice would suit most GC students and the nature of their studies in RRM. Negotiation with students may see a module delivered in the evenings with weekend field trips. A high proportion of students will undertake graduate studies on a part-time basis (usually halftime).

Government Loans are available to students through schemes such as PELS (Postgraduate Education Loans Scheme) and HECS (Higher Education Contribution Scheme). Graduate students usually pay the full fee for Graduate Courses that is about $10000 to $15000 per year of full time study for a science-based course. Universities may charge an infrastructure cost of about one-third of the Course fee. A break-even enrolment may be 15 students.

Entry into graduate studies requires a University degree, or its equivalent, as a prerequisite. People with VET Qualifications, Statements of Attainment and work experience may be considered by Universities for provisional access to graduate studies. Continued studies would depend upon satisfactory progress in course-work.

Recommendation 3.2.1: The NRC supports the development of a framework for a Graduate Certificate in River Restoration Management by a selected University in Australia for delivery in 2003 and makes the framework available to other Universities for delivery in 2004.

Estimated Cost: $19000

Option 2: *River Restoration as a Module in a Graduate Certificate in Natural Resource Management or related Course.*

Universities would be reluctant to initiate graduate courses unless there is a high probability of sustained enrolments over many years. Sustainable options under conditions of uncertainty of enrolments (dependent upon students' perceptions of career prospects) are to develop generic courses with specialised modules that can expand and contract with student demand. Specialised modules would not be offered unless there were sufficient enrolments, or offered in alternative years – or some other frequency. Specialised modules are more likely to be adopted by Universities that have existing courses that can accept new specialised, but related modules. For example, a University may more readily accept a specialised module in River Restoration and management if it has existing Graduate Studies in Natural Resource Management or Environmental Science.

A specialised module of RRM may be one-third of the content of a Graduate Certificate. As for Option 1, the four modules for the RRM specialisation within a Graduate Certificate would be:

- Geomorphology and Hydrology
- River Ecology
- River Restoration
- Policy and Management

The sub-modules would be the same as those shown in Table 3.2.2. However, the allocation of time and points would be one-third of those shown in Table 3.2.2. The remaining two modules to complete a Graduate Certificate in Natural Resource Management (for example) would be a matter of choice among those available at the University. Thus, complementary Modules may be "Resource Economics', "Conservation and Land Management", "Rangeland Management", "Plantation Forestry", "Hydrology and the Management of Salinity", "Conservation of Biodiversity", "Project Management", and so on.

Recommendation 3.2.2: The NRC supports the development of a framework for a module in River Restoration Management suitable for a Graduate Certificate in Natural Resource Management, or similar Certificate. The Module to be developed by a selected University in Australia for delivery in 2003 and the framework made available to other Universities for delivery in 2004.

Estimated Cost: $19000

Table 3.2.1. Four modules of a Graduate Certificate in River Restoration and Management
The content for each Module is developed in Table 3.2.2.

Module	Competency
1. Geomorphology and Hydrology	Broad qualitative and quantitative understanding of the interaction of "water on the landscape". Appendix 1 shows the major issues associated with this module.
2. Stream and River Ecology	An understanding of the flora and fauna of rivers and streams, their interaction with environmental parameters and contemporary ecological models. Appendix 2 shows the major issues associated with this module.
3. River Restoration	An appreciation of cost-effective, scientifically based contemporary practices of restoration and rehabilitation of rivers and streams. Appendix 3 shows the major issues associated with this module.
4. Policy and Management	Knowledge and appreciation of the policy context and relevant water-related (agency) guidelines. Appendix 4 shows the major issues associated with this module.

Table 3.2.2. Modules and sub-modules of a Graduate Certificate in River Restoration and Management
If River Restoration and Management is only a proportion of the Graduate Certificate then the hours and points are reduced proportionately.

Sub-module code	General content	Hours	Points
Geomorphology and hydrology			
1.1	Geomorphology	20	2
1.2	Hydrology	20	2
1.3	Water quality	10	1
1.4	Geomorphological /hydrological interactions	10	1
Stream ecology			
2.1	Living streams	10	1
2.2	Freshwater biota	10	1
2.3	Ecological models	20	2
2.4	Ecological disturbance and monitoring	20	2
River restoration			
3.1	Stream channel analysis	20	2
3.2	Stabilisation techniques	10	1
3.3	Riparian revegetation	10	1
3.4	Ecological water requirements (EWRs)	20	2

Policy and management			
4.1	Restoration planning and existing policy	20	2
4.2	Community involvement	10	1
4.3	Monitoring and evaluation	20	2
4.4	Indigenous issues	10	1
Optional Units (towards Graduate Diploma)			
5.1	Advanced monitoring and evaluation	40	4
5.2	Habitat and hydraulics	40	4
5.3	Advanced stream community ecology	40	4
5.4	Catchment scale restoration planning	40	4
5.5	Restoration: benefit to cost analyses	40	4
5.6	Nutrient cycling	40	4
5.7	Sediment dynamics	40	4
5.8	Regulation of ecological processes by riparian vegetation	40	4
5.9	Habitat fragmentation (barriers to restoration)	40	4
5.10	Restoration of large and floodplain rivers	40	4
5.11	Social impediments to restoration	40	4
5.12	EWRs: bottom up and top down approaches	40	4
Masters Degree			
6.1	Dissertation (full-time)	-	24

Financial support and encouragement to participate in training
The outcome required for Graduate Studies in River Restoration and Management is quality graduates that make significant and substantial contributions to the River Restoration Teams. Courses that are well designed and promoted should attract students into areas of Graduate Studies for which there are good prospects of employment, voluntary work or improvement of private holdings. Prospective students are attracted also to courses that they consider good value for the fees payable. To this end, scholarships and course subsidies would assist in attracting students to courses in RRM.

Option 1: *Scholarships*
The Project Team did not review the availability of scholarships that may be applied to Graduate Studies in RRM but believe that this review should be undertaken and if they are available then their availability should be used in the promotion of the Courses. If there are insufficient scholarships available for Graduate Studies in RRM then the NRC should consider investing in them, or encouraging the investment of other organisations in them. It would be strategic if there were scholarships available to build strength in River Restoration Teams in the three regions selected for the delivery of Short Courses in VET late in 2002 (Recommendation 3.1.6).

Recommendation 3.2.3: The NRC reviews the availability of scholarships for Graduate studies in River Restoration and Management. If found to be insufficient then consider investments in scholarships to ensure that key people undertake strategic studies to develop the strengths of River Restoration Teams in the three regions of Australia in 2003.

Estimated Cost: $17500

Option 2*: Course subsidies to three Universities*

The University Sector of education endeavours to recover the costs of presenting Graduate Courses through the fees paid by students. The level of fees charged by Universities is set at the discretion of the Universities. However, fees may vary from $7500 to $10000 per student for a semester of full time study in science-based graduate courses. It may be possible for a University to decrease course fees if costs for the development and delivery of the courses are decreased through course subsidies. The NRC may encourage enrolments in Graduate Studies in River Restoration and Management through course subsidies. Such subsidies would also accelerate the development and delivery of the Graduate Studies. The University income from a Course of 15 participants and $7500 paid per student would be $112500. A 10% subsidy would be $11250 and, if the subsidy was passed on to the student, a reduction of $750 to the student. If River Restoration and Management was one of three modules in a Certificate in Natural Resource Management then the cost of a 10% subsidy would be $3750 and a decrease of $250 in the fee paid by the student for the module.

If the intent of the NRC initiative in training and education were to develop regional strengths (taking opportunities to the students rather than expecting students to travel to the opportunities) then course subsidies to three regional Universities would be $3750 to $11250 to each University. The subsidies may be considered as once-only subsidies to assist with the establishment of the Module and Certificates, and regional development may be spread over three years. This strategy could be reviewed as progress is made with building the capacity of River Restoration Teams and the subsidies repeated if necessary.

Recommendation 3.2.4: The NRC reviews the fees to be paid by participants in Graduate Studies in River Restoration and Management. If considered a discouragement to enrolments, then consider course subsidies to three Universities to ensure that key people undertake strategic studies to develop the strengths of River Restoration Teams in three regions of Australia in 2003.

Estimated Cost: $13750 to $36250

Option 3*: Course subsidies to a University with strengths in distance education*
An expensive option to achieve regional coverage of Graduate Studies in River Restoration and Management would be to subsidise the development and delivery a Module or Certificate in River Restoration Management for delivery from three Universities (Option 2). A more favourable benefit/cost from a course subsidy may be to subsidise a single University with distance education built-in to the design and delivery of the options. A 10% subsidy would be $11250 and, if the subsidy was passed on to the student, a reduction of $750 to the student. If River Restoration and Management was one of three modules in a Certificate in Natural Resource Management then the cost of a 10% subsidy would be $37500 and a decrease of $250 in the fee paid by the student for the module.

Recommendation 3.2.5: The NRC reviews the fees to be paid by participants in Graduate Studies in River Restoration and Management. If considered a discouragement to enrolments, then consider a course subsidy to a University with strengths in distance education to ensure that key people undertake strategic studies to develop the strengths of River Restoration Teams in three regions of Australia in 2003.

Estimated Cost: $6250 to $13750

Education Manager
The Recommendations for the development and delivery of Vocational Education and Training and Graduate Studies within the National Training Framework require incorporation into an Operational and Business Plan to achieve objectives on time and within budget (Section 4). The estimated total budget is about $590000 to $740000. In General Recommendation 3.4 (re-stated below) we recommended the appointment of an Education Manager and the arguments for such an appointment are given in Section 3.4 of the Report. We recommend that an Education Manager be appointed to implement the Recommendations for VET and Graduate Studies in River Restoration and Management. The duties of the Manager and an Estimate of costs are given in the notional Operational and Business Plan (Section 4).

An option would be to split the tasks of management between a VET Manager and a Graduate Studies Manager. This option may be exercised if the development of VET and Graduate Studies are to proceed as separate programs or if appointees to management are likely to be more effective in one or the other programs, but not both. It is unlikely that splitting the management of the two programs would decrease the costs of management.

General Recommendation 3.4 (restated): The NRC appoints an Education Manager to implement the recommendations contained in this report on "A National Training Framework for River Restoration and Management in Australia for the VET and University Sectors of Education".

Estimated Cost: $135000

Short Courses

There are a number of short courses offered at a range of Universities in Australia that cover aspects of RRM (Appendix 3.4. Typically, these short courses are about one week in duration. However, these courses reflect the expertise of a single practitioner and there has been little attempt to comply with a National framework.

We are proposing a National System of VET and University Graduate Studies of a Graduate Certificate that can contribute to a Graduate Diploma and professional Masters degrees. This can be a sequential process of learning where each level gains credit from previous studies. However, the Short Courses offered in Australia do not fit neatly into this framework. We have suggested (Section 3.1 Recommendation 3.1.4) that these existing Courses be mapped against competencies within the VET Sector so that the graduates can be issued with Statement of Attainment as a basis of negotiating credit towards a qualification. The mapping exercise would bring the Short Courses into the National Framework (Appendix A3.1), encourage efficiencies in the development and use of resources, greater consistency in the quality of design, delivery and assessment of the courses, and national recognition of graduates.

Critics may argue that uniformity of education and training negates diversity and evolution, and has the danger of 'academic creep' that moves away from the vocational needs of the workplace. There is historical evidence to justify both concerns. This is a continuing debate and sponsors and participants need to be able to make their decisions based upon good information. Non-aligned courses may provide good value for money and serve the needs of RRM. They may also be seen as 'bridging courses' to the formalities of the National Framework.

Recommendation 3.1.4 (restated): The NRC encourages the providers of existing short courses concerned with River Restoration and Management to have the content of their courses mapped against existing competencies so that Statements of Attainment within the National Training Framework can be issued to graduates of the short courses.

Estimated Cost: $3500

SECTION 4

4. Operational and Business Plan to Implement Recommended National Courses in River Restoration and Management

The Operational Plan converts the Recommendations from Section 3 into Objectives and defines the main actions needed to achieve the Objectives. Responsibilities for the defined Actions are assigned together with desired Completion Dates. Estimated Costs are taken from Section 3 and estimates of the costs to complete the Actions are added at $500 per day. The structure and Total Costs for Education Programs are given in the last part of this Section. The Programs are a composite of the Objectives. Many other Programs can be devised from a lesser number of Objectives with consequent decreases in costs. An Education Manager is recommended to ensure integration of the many recommendations with the prospects of efficiency and minimal delays in implementation. The cost of an Education Manager could be about 20% of the education program over the first three years of establishing the Education Program.

General Recommendations

General Recommendation 3.1: As a matter of urgency, the NRC promotes the Unified, National Framework in Australia for education and training in river restoration and management.
Estimated Cost: Specific methods for promotion and estimated costs are given for subsequent Objectives.

General Recommendation 3.2: Education and Training in RRM be designed, delivered and assessed to suit the composition of River Restoration Teams (Koehn *et al.* 2001).
Estimated Cost: Specific methods for promotion and estimated costs are given for subsequent Objectives.

General Recommendation 3.3: The NRC promotes two types of education and training in river restoration and management within the National Training Framework: (1) competency-based Vocational Education and Training (VET); (2) a Graduate Certificate (GC) within the VET and University sectors of education.
Estimated Cost: Specific methods for promotion and estimated costs are given for subsequent Objectives.

Objective 3.4: The NRC appoints an Education Manager to implement the recommendations contained in this report on "A National Training Framework for River Restoration and Management in Australia for the VET and University Sectors of Education".
Estimated Cost: $135000

Action	Responsibility	Estimated Cost	Completion Date
Itemise the duties defined for the Education Manager in the Operational and Business Plan of the report on "A National Training Framework for River Restoration and Management in Australia" and negotiate an appointment.	NRC		March 2002
The Education Manager develops an Operational and Business Plan and reports regularly and on request to the NRC.	NRC; Education Manager		April 2002
Authorise payments for the Education Manager against progress with the Operational and Business Plan.	NRC; Education Manager	$135000	February 2005

4.1 Vocational Education and Training

Objective 3.1.1: The NRC negotiates with the RTCA to enable training in River Restoration and Management to be delivered within the Conservation and Land Management Training Package and to start in 2003.
Estimated Cost: $3500

Action	Responsibility	Estimated Cost	Completion Date
Develop the case for urgent action to have training in RRM implemented within the CLM Training Package.	NRC; Education Manager	$2000	March 2002
Present the case for RRM within the CLM Package to the RTCA, as the Industry Body, and negotiate for a successful outcome.	NRC; Education Manager	$1500	April 2002

Objective 3.1.2: The NRC supports the customisation of competencies of the Conservation and Land Management Training Package and the development of training resources so that training in River Restoration and Management can be offered as a specialisation within the Conservation and Land Management Package early in 2003.
Estimated Cost: $75000

Action	Responsibility	Estimated Cost	Completion Date
Develop specifications and obtain quotes to customise and develop training resources for the delivery of RRM within the CLM Package.	NRC; Education Manager	$2000	March 2002
Appoint Consultant and monitor activities to ensure outcomes meet specifications.	NRC; Education Manager	$1500	June 2002
Authorise and arrange payments by NRC to the Consultant for delivery of customisation and training resources.	NRC; Education Manager; Consultant	$68000	December 2002
Promote customised competencies among RTOs.	NRC; Education Manager	$2500	December 2002

Objective 3.1.3: The NRC negotiates with the RTCA to develop the new Competency of "Plan River Restoration Works" and training resources so that a specialisation in River Restoration and Management can be offered in 2003.
Estimated Cost: $24000

Action	Responsibility	Estimated Cost	Completion Date
Develop specifications and obtain quotes to develop the Competency of "Plan River Restoration Works" in the CLM Package and develop training resources.	NRC; Education Manager	$1500	March 2002
Appoint curriculum consultant and monitor activities to ensure outcomes meet specifications.	NRC; Education Manager	$1000	June 2002
Authorise and arrange payments by NRC to the Consultant for development of competencies and training resources.	NRC; Education Manager; Consultant	$20000	December 2002
Promote the new Specialisation in RRM widely among RTOs and Catchment Groups.	NRC; Education Manager	$1500	December 2002

Objective 3.1.4: The NRC assists the providers of existing short courses concerned with River Restoration and Management to have the content of their courses mapped against existing competencies so that Certificates of Attainment within the National Training Framework can be issued to graduates of their short courses.
Estimated Cost: $3500

Action	Responsibility	Estimated Cost	Completion Date
Study the content of short courses in RRM and encourage selected providers to have their courses mapped against competencies in CLM	NRC; Education Manager	$2000	March 2002
Encourage providers of mapped courses to deliver their courses within the National Training Framework, and issue Statements of Attainment under the auspices of RTOs.	NRC; Education Manager	$1000	May 2002
Encourage the providers of the mapped courses to become Registered Providers and to deliver competency-based training in RRM from Training Packages.	NRC; Education Manager	$500	June 2002

Objective 3.1.5: The NRC negotiates with the RTCA to have some new competencies developed in River Restoration and Management so that a comprehensive Specialisation in River Restoration and Management can be developed within the CLM Package for delivery in 2003. **Estimated Cost:** $158500			
Action	**Responsibility**	**Estimated Cost**	**Completion Date**
Develop specifications and obtain quotes for the development of new Competencies and training resources for a specialisation in RRM.	NRC; Education Manager	$2000	March 2002
Appoint Curriculum Consultant(s) and monitor activities to ensure outcomes meet specifications.	NRC; Education Manager	$2000	June 2002
Authorise and arrange payments by NRC to the Consultant(s) for delivery of competencies and training resources.	NRC; Education Manager; Consultant	$153000	February 2002
Promote the new competencies and specialisation in RRM widely among RTOs and Catchment Groups.	NRC; Education Manager	$1500	February 2002

Objective 3.1.6: The NRC supports an experienced trainer to develop and assist with delivery of four Short Courses in River Restoration and Management from existing competencies in the Conservation and Land Management Training Package. Delivery to be by Registered Training Organisations in three selected regions of Australia late in 2002.
Estimated Cost: $73000 to $226000

Action	Responsibility	Estimated Cost	Completion Date
Develop specifications and obtain quotes for the development of four short courses in RRM based upon existing competencies of the Agriculture and Horticulture Training Packages and one new competency.	NRC; Education Manager	$2000	March 2002
Appoint Consultant (Common Provider) and supervise activities to ensure outcomes comply with specifications.	NRC; Education Manager	$1500	March 2002
Authorise and arrange payments by NRC to the Consultant for delivery of course-customisation and training resources.	NRC; Education Manager; Consultant	$51000 to $204000	June 2002
Contact RTOs with Scope to deliver the Short Courses and assess their interest and ability to deliver and assess the Training in the three selected regions late in 2002.	Education Manager	$2000	June 2002
Develop specifications, obtain quotes and select the RTOs for delivery of Short Courses in the three regions with the assistance of the common Provider.	NRC; Education Manager	$2000	June 2002
Ensure the selected RTOs develop a plan for the delivery of the Short Courses, receive the training resources and integrate the common Provider into the plan for delivery and assessment.	NRC; Education Manager	$1000	July 2002
Select three representative regions for delivery of the Courses and promote the Courses among those who could constitute River Restoration Teams.	NRC; Education Manager	$1500	August 2002
Arrange payment for Common Provider including travel and accommodation.	NRC; Education Manager	$10000	
Monitor delivery of the Short courses to ensure they meet specifications and graduates receive Certificates of Attainment.	NRC; Education Manager	$2000	October 2002

Objective 3.1.7: The NRC supports the development of materials that enable Registered Training Providers to deliver training in River Restoration and Management within Training Packages in a flexible manner and over distance. These materials should include student and teacher guides and training record books.
Estimated Cost: $38500

Action	Responsibility	Estimated Cost	Completion Date
Monitor the development of new training resources for Short Courses in RRM and new competencies in RRM to ensure that they are suitable for flexible delivery and distance education.	NRC; Education Manager	$1500	June 2003
Assess the need for flexible delivery and distance education in RRM among Landcare and Catchment Groups.	NRC; Education Manager	$2000	June 2002
Develop specifications and obtain quotes to review delivery procedures and training resources for RRM to ensure they are flexible and suitable for distance education.	NRC; Education Manager	$2000	July 2002
Appoint curriculum consultant and monitor activities to ensure outcomes meet specifications.	NRC; Education Manager	$1000	July 2002
Authorise and arrange payments by NRC to the Consultant for delivery of training resources for distance education.	NRC; Education Manager; Consultant	$30000	December 2003
Promote flexible delivery procedures and distance education resources among RTOs.	NRC; Education Manager	$2000	February 2004

Objective 3.1.8: The NRC reviews the availability of scholarships for VET studies in River Restoration and Management. If considered insufficient then consider investing in scholarships to ensure that key people undertake strategic studies to develop the strengths of River Restoration Teams in the three regions of Australia selected for the delivery of Short Courses in 2002.
Estimated Cost: $17500

Action	Responsibility	Estimated Cost	Completion Date
Review the availability of scholarships for students of VET studies in RRM in Australia.	NRC; Education Manager	$1000	March 2002
Support and encourage investment in scholarships for students in VET studies in RRM for strategic development of River Restoration Teams in selected regions of Australia.	NRC; Education Manager	$1500	June 2002
Promote the availability of scholarships among prospective students, participate in student selection and allocate 15 scholarships (five in three regions) at $1000 per scholarship.	NRC; Education Manager	$15000	September 2002

Objective 3.1.9: The NRC reviews the fees to be paid by participants in VET Short Courses in River Restoration and Management. If considered a discouragement to enrolments, then consider course subsidies to ensure that key people undertake strategic studies to develop the strengths of River Restoration Teams in the three regions of Australia selected for the delivery of Short Courses in 2002.
Estimated Cost: $25000

Action	Responsibility	Estimated Cost	Completion Date
Review the fees for VET studies in RRM in Australia.	NRC; Education Manager	$1000	March 2002
Support and encourage investment in course subsidies for VET studies in RRM for strategic development of River Restoration Teams in three selected regions of Australia. Promote the Courses.	NRC; Education Manager	$1500	June 2002
Negotiate student fees and pay subsidies to three selected RTOs.	NRC; Education Manager	$22500	September 2002

4.2 Graduate Studies

Objective 3.2.1: The NRC supports the development of a framework for a Graduate Certificate in River Restoration Management by a selected University in Australia for delivery in 2003 and makes the framework available to other Universities for delivery in 2004.
Estimated Cost: $19000

Action	Responsibility	Estimated Cost	Completion Date
In consultation with a selected University, develop specifications and obtain quotes for the development of Graduate Certificate in River Restoration and Management.	NRC; Education Manager; University	$3000	March 2002
Appoint Consultant to develop the Framework for Graduate Certificate and supervise activities to ensure outcomes comply with specifications.	NRC; Education Manager; University	$2000	March 2002
Authorise and arrange payments by NRC to the Consultant for delivery of course details and resources.	NRC; Education Manager; University; Consultant	$10000	September 2002
Cooperate with selected University to promote the Graduate Certificate in River Restoration and Management.	Education Manager; University	$2000	September 2002
Monitor delivery of the Graduate Certificate to ensure delivery meets specifications.	NRC; Education Manager	$2000	December 2003

Objective 3.2.2: The NRC supports the development of a framework for a module in River Restoration Management suitable for a Graduate Certificate in Natural Resource Management, or similar Certificate. The Module to be developed by a selected University in Australia for delivery in 2003 and the framework made available to other Universities for delivery in 2004.
Estimated Cost: $19000

Action	Responsibility	Estimated Cost	Completion Date
In consultation with a selected University, develop specifications and obtain quotes for the development of a Module in RRM for Graduate Studies in NRM are related areas.	NRC; Education Manager; University	$3000	March 2002
Appoint Consultant to develop the Framework for the Module and supervise activities to ensure outcomes comply with specifications.	NRC; Education Manager; University	$2000	March 2002
Authorise and arrange payments by NRC to the Consultant for delivery of course details and resources.	NRC; Education Manager; Consultant	$10000	September 2002
Cooperate with selected University to promote the Module in River Restoration and Management.	Education Manager; University	$2000	September 2002
Monitor delivery of the Module to ensure delivery meets specifications.	NRC; Education Manager	$2000	December 2003

Objective 3.2.3: The NRC reviews the availability of scholarships for Graduate studies in River Restoration and Management. If found to be insufficient then consider investments in scholarships to ensure that key people undertake strategic studies to develop the strengths of River Restoration Teams in the three regions of Australia in 2003.
Estimated Cost: $47500

Action	Responsibility	Estimated Cost	Completion Date
Review the availability of scholarships for students of VET studies in RRM in Australia.	NRC; Education Manager	$1000	March 2002
Support and encourage investment in scholarships for students in VET studies in RRM for strategic development of River Restoration Teams in selected regions of Australia.	NRC; Education Manager	$1500	June 2002
Promote the availability of scholarships among prospective students, participate in student selection and allocate nine scholarships (three in three regions) at $5000 per scholarship.	NRC; Education Manager	$45000	September 2002

Objective 3.2.4: The NRC reviews the fees to be paid by participants in Graduate Studies in River Restoration and Management. If considered a discouragement to enrolments, then consider course subsidies to three Universities to ensure that key people undertake strategic studies to develop the strengths of River Restoration Teams in three regions of Australia in 2003.
Estimated Cost: $13750 to $36250

Action	Responsibility	Estimated Cost	Completion Date
Review the fees for Graduate Studies in RRM in Australia.	NRC; Education Manager	$1000	April 2002
Support and encourage investment in course subsidies for Graduate Studies in RRM for strategic development of River Restoration Teams in three selected regions of Australia. Subsidies to three selected universities.	NRC; Education Manager	$1500	June 2002
Negotiate subsidies and fees and arrange for payments. Promote the Courses.	NRC; Education Manager	$11250 or $33750	June 2003

Objective 3.2.5: The NRC reviews the fees to be paid by participants in Graduate Studies in River Restoration and Management. If considered a discouragement to enrolments, then consider a course subsidy to a University with strengths in distance education to ensure that key people undertake strategic studies to develop the strengths of River Restoration Teams in three regions of Australia in 2003.
Estimated Cost: $6250 to $13750

Action	Responsibility	Estimated Cost	Completion Date
Review the fees for Graduate Studies in RRM in Australia.	NRC; Education Manager	$1000	April 2002
Support and encourage investment in course subsidies for Graduate Studies in RRM for strategic development of River Restoration Teams in three selected regions of Australia. Subsidy to a University with strengths in distance education.	NRC; Education Manager	$1500	June 2002
Negotiate subsidies and fees and arrange for payments. Promote the Courses.	NRC; Education Manager	$3750 or $11250	June 2003

4.3. Education Programs: Options and Estimated Costs

Note: These Programs assume the appointment of an Education Manager and hence the Estimated Costs for the Objectives are less than those shown in the detailed tables.

Objective	Estimated Cost	Completion Date
Objective 3.4: NRC appoints an Education Manager	$135000	February 2005
Objective 3.1.1: NRC negotiates with the RTCA to enable training in River Restoration and Management to be delivered within the Conservation and Land Management Training Package and to start in 2003.		April 2002
Objective 3.1.2: NRC supports the customisation of competencies of the Conservation and Land Management Training Package and the development of training resources so that training in River Restoration and Management can be offered as a specialisation within the Conservation and Land Management Package early in 2003.	$70500	December 2002
Objective 3.1.3: NRC negotiates with the RTCA to develop the new Competency of "Plan River Restoration Works" and training resources so that a specialisation in River Restoration and Management can be offered in 2003.	$21500	December 2002
Objective 3.1.4: NRC assists the providers of existing short courses concerned with River Restoration and Management to have the content of their courses mapped against existing competencies so that Certificates of Attainment within the National Training Framework can be issued to graduates of their short courses.	$1500	June 2002
Objective 3.1.5: NRC negotiates with the RTCA to have some new competencies developed in River Restoration and Management so that a comprehensive Specialisation in River Restoration and Management can be developed within the CLM Package for delivery in 2003.	$156000	February 2002
Objective 3.1.6: NRC supports an experienced trainer to develop and assist with delivery of four Short Courses in River Restoration and Management from existing competencies in the Conservation and Land Management Training Package. Delivery to be by Registered Training Organisations in three selected regions of Australia late in 2002.	$64000 **OR** $217000	October 2002

Objective 3.1.7: NRC supports the development of materials that enable Registered Training Providers to deliver training in River Restoration and Management within Training Packages in a flexible manner and over distance. These materials should include student and teacher guides and training record books.	$32000	February 2004
Objective 3.1.8: NRC reviews the availability of scholarships for VET studies in River Restoration and Management. If considered insufficient then consider investing in scholarships to ensure that key people undertake strategic studies to develop the strengths of River Restoration Teams in the three regions of Australia selected for the delivery of Short Courses in 2002.	$15000	September 2002
Objective 3.1.9: NRC reviews the fees to be paid by participants in VET Short Courses in River Restoration and Management. If considered a discouragement to enrolments, then consider course subsidies to ensure that key people undertake strategic studies to develop the strengths of River Restoration Teams in the three regions of Australia selected for the delivery of Short Courses in 2002.	$22500	September 2002
Objective 3.2.1: NRC supports the development of a framework for a Graduate Certificate in River Restoration Management by a selected University in Australia for delivery in 2003 and makes the framework available to other Universities for delivery in 2004. **OR** **Objective 3.2.2:** The NRC supports the development of a framework for a module in River Restoration Management suitable for a Graduate Certificate in Natural Resource Management, or similar Certificate. The Module to be developed by a selected University in Australia for delivery in 2003 and the framework made available to other Universities for delivery in 2004.	$12000	December 2003
Objective 3.2.3: NRC reviews the availability of scholarships for Graduate studies in River Restoration and Management. If found to be insufficient then consider investments in scholarships to ensure that key people undertake strategic studies to develop the strengths of River Restoration Teams in the three regions of Australia in 2003.	$45000	September 2002

Objective 3.2.4: The NRC reviews the fees to be paid by participants in Graduate Studies in River Restoration and Management. If considered a discouragement to enrolments, then consider course subsidies to three Universities to ensure that key people undertake strategic studies to develop the strengths of River Restoration Teams in three regions of Australia in 2003. **OR**	$11250 **OR** $33750 $3750	June 2003

Objective 3.2.5: The NRC reviews the fees to be paid by participants in Graduate Studies in River Restoration and Management. If considered a discouragement to enrolments, then consider a course subsidy to a University with strengths in distance education to ensure that key people undertake strategic studies to develop the strengths of River Restoration Teams in three regions of Australia in 2003.	**OR** $11250	June2003
TOTAL 1 (3.1.6 @ $64000; **3.2.4 OR 3.2.5** @ $11250**)** **TOTAL 2 (3.1.6** @ $217000; **3.2.4 OR 3.2.5** @ $11250**)** **Manager as a Proportion of Total: 18 OR 23%**	$586250 **OR** $739250	

SECTION 5

Acknowledgments

We wish to acknowledge the following:

- The National Rivers Consortium for the initiative to further develop the extent and quality of river restoration and management in Australia through education and training and the financial support of this Project.
- The many individuals who readily collaborated with us to establish in our surveys to establish the current state of education and training in Australia and the desire and capacity to make improvements; some are listed in our report but there were many others.
- Those involved in the development of the Training Package for Conservation and Land Management. In particular:
  - David Greentree, Chair, National Industry Steering Committee, CLM Training
  - Guy Rischmueller, DNR Group P/L, Project Consultants, CLM Training Package Development Project
  - The Rural Training Council of Australia as the Project Manager for CLM Training Package Development Project
  - The Australian National Training Authority for funding the development of the Package. The competency RTC5522A "Plan River Restoration Works" will be included in the final draft of the Package to be sent for National endorsement at the end of January 2002.
- Rebecca Dobbs and Sue Creagh assisted with the survey of graduate courses
- Staff at the Great Southern College of TAFE, WA, for comment on the design and delivery of VET
- Ian Dadour and John Considine for discussions on Graduate Studies in Forensic Science and Viticulture and Oenology

SECTION 6

References

Brierly, G. 1999. River Styles: An integrative biophysical template for river management. In: Rutherford, I. and Bartley, R. (Eds) Proceedings of the Second Australian Stream Management Conference. Vol. 1. Adelaide. pp. 93-99.

Intégra Pty Ltd., ID&A Pty Ltd., Lovett Clarke Consulting (2000). Knowledge Exchange and Capacity Building in River Restoration and Protection. Design of a Program of Activities to meet the Needs of Australia's River Managers. Report to National Rivers Consortium.

Koehn, J. D., Nicol, S. J. and Lucas, A. M. 1997. River restoration through integrated management. Project No. R7001. Report to the Murray-Darling Basin Commission.

Koehn, J.D., Brierley, G.J. Cant, B.L. and Lucas, A.M. 2001. River Restoration Framework. Land & Water Occasional Paper 01/01.

Pen, L. and Scott, M. 1995. Stream foreshore assessment in farming areas. Department of Agriculture, Western Australia.

Rutherfurd, I.D., Jerie, K. and Marsh, N. 2000. A rehabilitation manual for Australian Streams, Land & Water Australia and the CRC for Catchment Hydrology. Melbourne.

SECTION 7

Appendix Section 1

A1.1: National Training and Education Program Scoping

Project Description

Project Reference:	UWA26
Research Organisation:	University of Western Australia
Program:	National Rivers Consortium
Project Title:	National Training and Education Program Scoping Study
Commencement Date:	24/08/2001
Completion Date:	31/12/2001

Objectives

To undertake a scoping study and prepare a report that presents a detailed framework for the development and implementation of two training and education programs as outlined below.

A graduate diploma course in river management

- The aim is to have a graduate diploma available to institutions to adopt for delivery within each State and Territory, probably incorporating distance education. The course will be targeted at the technical level, including people already involved in river management (eg. government agencies, catchment management authorities) or people with tertiary qualifications wishing to move into a career in river management.
-

The graduate diploma in river management course is proposed to include but not be limited to:

- Rivers in their landscape (geomorphic) context
- Rivers and riparian ecology
- River restoration techniques
- *River protection principles, including environmental flows, legislation, identifying high conservation value rivers and reaches*
- River and riparian management, including flows, structures, large woody debris, riparian vegetation
- Social, institutional and legal factors in sound river management

Community based training course

- The aim is to have a practical, field-based, community targeted adult education and training program in on-ground river management and restoration, broadly equivalent to the very successful Streamkeepers program established in British Columbia.

The community level course in on-ground river management is proposed to include but not be limited to:

- Principles of river and riparian management
- Planning river restoration and on-ground works
- Re-establishing riparian revegetation
- Restoring in-stream habitat
- Channel bed and bank stabilisation
- Monitoring and evaluation of outcomes
- Working in groups and teams, leadership and facilitation

Appendix Section 2: Existing Courses: Survey Samples and Questions; Results

A 2.1. Adult Education: Those included in the Survey

STATE GOVERNMENT AGENCIES

	Officer	Position	Agency	Training	Accreditation
1.	Antonietta Torre	Engineer	WRC (WA)	River Restoration Workshops	No
2.	Noel Nannup	Aboriginal Heritage Officer	Dept. Conservation & Land Management WA	Cultural	Yes, through Links to Greenskills
3.	David Greentree	NRM Learning & Development Consultant	Land & Water NSW	Conservation/ Earthworks RR/MR	AQF 5/6
4.	David Cleary	Primary Coordinator (Streamwatch)	Sydney Water NSW	Professional Development	No
5.	Martin Keen	Snr. Land Conservation Officer	Dept. Agriculture WA	Land Management Conservation/ Earthworks	Yes. Diploma Level 3/4/5
6.	Brian Lloyd	SRD Officer	Dept. Agriculture WA	Rural Planning	No
7.	Beryl Newman	Catchment Education Officer	Dept. Land, Water & Conservation. NSW	RR/MR	No
8.	Kristina Fleming	Manager	South Coast Regional Information Centre WA	GIS	No
TAFE COLLEGES					
9.	Lorraine Stivey	Program Manager	South East Metropolitan College of TAFE WA	Adult Education Program	No
10.	Fiona Martin	Program Manager NRM/Environmental Studies	TAFE NSW	Hydrology, Conservation/E arthworks	Cert 1 - 4 Diploma
11.	Neil Binning	Director, Primary Production/NRM	Great Southern TAFE	RR/MR & Land Management	Cert 2,3,4
12.	Kerry Bowe	Program Manager	Southern Metropolitan College of TAFE WA	Adult Education 'Taster' Courses	Skills Recognition/Stat ement of Attainment
UNIVERSITY GROUPS					
13.	Sandra Maynard	Training Officer	University of Western Australia	RR/MR	No
14.	Trevor Pillar	Manager, Communication & Industry Education	Flinders University SA	Hydrology	Cert 2/3/4

15.	Brian Fergusson	Senior Lecturer	Curtain University College of Higher Education WA	Environmental Technology	Cert 4 - Diploma
ENVIRONMENTAL GROUPS					
16.	Greg Duke	Project Officer	Greenskills WA	RR/MR,	Cert 2 - 4
17.	Louis Marchelli	CEO	Kondinan Group WA	Rural Planning	Certificate of Participation
18.	Gaye Chambers	Honorary Executive Officer	Land Management Society WA	Hydrology Rural Planning	No
19.	Alice McLellan	Bushcare Support Officer	Greening Australia WA	RR/MR First Aid	First Aid RTO link
LARGE COMMUNITY GROUPS					
20.	Brendan Kelly	Regional Coordinator	Waterwatch/ Ribbons of Blue WA	RR/MR	No
21.	Janet Date	State Facilitator (Acting)	Waterwatch/ Ribbons of Blue WA	RR/MR	No
22.	Kristina Dwyer	State Facilitator	Waterwatch QLD	RR/MR	No
SMALL COMMUNITY GROUPS					
23.	Bronwyn Ryan	Training & Network Coordinator	Swan Catchment Centre WA	RR/MR	No
24.	Linda Tammin	Catchment Coordinator	Bennett Brook Catchment Group WA	RR/HR	No
LOCAL GOVERNMENT					
25.	Melanie Price	Environmental Officer	City of Albany WA	N/A	N/A

A2.2. Adult Education: Survey Questions

Information on courses - Providers:

1. Do you deliver any courses or components of courses on River & Riparian Management/Restoration?
If Yes, please answer the following:

2. What course titles do you deliver?

3. At what level/s do you deliver? ie Levels 1 – 4, Graduate Diploma?

4. How often do you conduct these courses?

5. What modes of delivery do you offer your clients? ie Distance Ed, External Studies, Internal Studies, Short Courses etc

6. Do you have the capabilities to deliver at a higher level than you currently are?
If yes, please explain the factors, which determine the level that you are delivering at.

7. Do you feel that there is currently a demand for courses covering River & Riparian Management/Restoration?
Please discuss why/why not.

8. Do you feel that there is currently a 'gap' between what is being offered by agencies, government and non-government, groups and institutions and the need for River/Riparian Management/Restoration courses? Please explain.

9. Are your courses accredited?
If so, please state the institution.

10. Which courses, if any, are linked to the National Industry Training Packages?

11. (a) Do you provide Skills Recognition, Statements of Attainment or formal Certification for these courses?
(b) Do you provide any kind of recognition for the courses attended? Eg Statements of Attainment or Certificate of Participation.

12. Is it a requirement for funding to provide participants with either formal recognition or certification?

13. Principally, who delivers your courses?

a) Landcare Officers
b) Workplace Trainers
c) Local government
d) Industry Professionals
e) Government Agency Professionals
f) University Lecturers
g) Environmental consultants

Other, please write

14. Who is your target audience? eg

a) Unemployed persons
b) Professionals
c) Landcare officers
d) Community Catchment Management groups
e) Teachers or lecturers
f) Local government officers
g) Environmental consultants

h) Other

15. Would you be interested in providing additional courses?
in River/Riparian Management/Restoration?

16. What, in your opinion, are the best ways of delivering a course covering River/Riparian Management/Restoration?

17. What do you think would be the cost of development for these courses? (Approx)

18. What would be the cost of delivery? (Approx)

Participants expectations/learning

19. What do you think are your participant's expectations? eg

a) Future employment
b) Access to other courses – university, TAFE etc.
c) Professional interest eg Civil Engineers,
d) Serious amateur
e) Hobbyists
f) Land managers
g) Environmental consultancies
h) Other

20. Which of the following best describes their main work area or area of interest?

Civil Engineering
Drainage Planning and Design
Landuse/Town Planning
Landscape Architecture
Environmental Management
Environmental Regulation
Ecosystem Restoration
Natural Resource Management
(eg Ag, Fisheries, Forestry)
Community Support
Catchment Management
Education/training
Scientific Research
Student
Other, Please specify.

21. What is their main job function?

Program Manager
Project Manager
Research Officer
Community Support Officer
Policy Officer
Planner
Teacher/Trainer
Other, please specify

22. Who is their main employer (or area in which they seek employment)?

Government Agency
Local Government
Environmental Group

Educational/training Inst/Group
Consultancy
Other, please specify

24. Is their work?

Local (eg local Govt. TAFE college)
Regional (eg regional office of an organisation)
State (eg state-based consultancy or State Gov Agency)
National (Comm. Agency or nationwide Consultancy)
International (eg World Wildlife Fund)

23. To what degree would a qualification in River/Riparian Management/Restoration assist in their work?

Minor ☐ eg would do the course mostly for interest, but work area touches on river management
Occasional ☐ eg growing amounts of work touches on rivers and therefore needs to understand issues
Moderate ☐ eg often required to give advice on river management or assess management plans
Substantial ☐ eg majority of work is in the area of waterways management or restoration ecology
Critical ☐ eg work area is more or less solely involved in river management

25. On a scale of 1 – 5 (1 least to 5 most) how would you rank the following subject areas (topics) for inclusion into a RR/MR course?

Catchment and stream hydrology
Stream channel form and geomorphology
Stream channel hydraulics
Erosion Processes
Stream and floodplain ecology
Stream channel analysis
Riparian zone condition assessment
Stream channel restoration
Riparian weed control and revegetation
Floodplain management
Waterways management legislation
Stormwater management
Rural Land Drainage
River Restoration Action planning/decision making
Community consultation and involvement
Indigenous issues, heritage protection, consultation and negotiation
Monitoring and evaluation of restoration projects (outputs)
Ecosystem health monitoring and assessment (outcomes) – including water quality

26. Any further comments/observations?

A 2.3. Graduate Studies: Those included in the Survey

State Government Agencies
- Water and Rivers Commission (WA)
- Water Corporation (WA)
- AgWest (WA)
- Department of Conservation (WA)
- Swan Catchment Centre (WA)
- Department of Fisheries (WA)
- Main Roads Department (WA)
- Queensland Department of Natural Resources (QLD)
- Department of Heritage and Environment (SA)

Small community groups
- State Catchment Group
- "Friends of" Groups
- Integrated Catchment Group
- Land Care District Councils

Federal Government Agencies
- CSIRO Land and Water
- Land and Water Australia
- Environment Australia

National Level Professional Consultants
- Kinhill/Brown & Root
- Lloyd Environmental Consultants
- GHD
- Halpern, Glick & Maunsell
- Streamtec P/L
- Dames and Moore (URS)

State Level Professional Consultants
- Ecoscape
- Syrinx Environmental
- Hydro Smart
- Welker Environmental Consultancy
- Acacia Springs Environmental
- Dames & Moore
- ATA Environmental
- Rural Solutions WA
- Native Environmental Systems
- Green Skills

A2.4. Graduate Studies: Survey Questions

1 Which of the following best describes your main work area or area of interest?

- Civil engineering
- Drainage planning and design
- Landuse/town planning,
- Landscape architecture
- Environmental management
- Environmental regulation
- Ecosystem restoration
- Natural resource management
- Community support
- Education/training
- Scientific research
- Other fields.

What is your main job function?

- Program manager
- Project manager
- Research officer
- Community support
- Policy officer
- Planner
- Teacher/trainer
- Consultant
- Other.

2 To what degree is your work local, regional, state, national and international (ranked on a scale 1 to 5)?

3 To what degree would a graduate diploma in river management assist in your work: minor, occasional, moderate, substantial or critical?

4 On a scale of 1 to 5 how do the following subject areas relate to your area of work or interest?

- Catchment and stream hydrology,
- Stream channel form and geomorphology'
- Stream channel hydraulics,
- Erosion processes,
- Stream and floodplain ecology,
- Stream channel analysis,
- Riparian zone condition assessment,
- Stream channel restoration,
- Riparian weed control and revegetation,
- Floodplain management,
- Waterways management legislation,
- Stormwater management,
- Rural land drainage,
- River restoration action planning and decision making,

- Community consultation and involvement,
- Indigenous issues, heritage protection, consultation and negotiation,
- Monitoring and evaluation of restoration projects (outputs), and
- Ecosystem health monitoring and assessment.

A2.5. Adult Education: Survey Results

Question 1 Do you deliver training?	92% delivered a course or component of a course on RR/NR. 8% did not but were interested in either doing so or attending a course.
Question 2 Course titles **	96% of courses delivered were in some way linked to the area of RR/MR. 23% were delivering courses with a title directly related to this area of study. 19% were involved in some form of monitoring, 15% in Hydrology, 8% in Land Management/Earthworks, 8% in Rural Planning, 8% in Cultural studies linked to river systems, 4% GIS, 12% in Extension Methods and 4% in other courses.
Question 3 Accreditation	52% of courses were not accredited, 36% were level 1 to Diploma, 8% were Certificated through an RTO, 4% linked to Nat. Indus. Training Packages.
Question 4 How often is training delivered?	45% of courses are delivered on demand, 21% on a semester or twice yearly basis, 6% thrice yearly, 15% on a term basis or quarterly, 3% annually and 9% fee for service.
Question 5 Modes of delivery	38% offer short courses, 27% Internal, 17% provide flexible delivery, 15% External and 3% on line.
Question 6 Capabilities	61% have the capabilities to deliver at a higher level, 30% don't and 9% are unsure.
Question 7 (a) Is there a demand	87% feel that there is a demand for courses and 13% are unsure.
Question 7(b) Discuss	Requests for training come from: 38% professionals working in the area, 35% from volunteer groups and 27% through student interest.
Question 8 (a) Is there a gap?	74% believe there is a 'gap' in training, 9% no 'gap', 17% unsure.
Question 8 (b) Discuss	70% believe this gap exists through lack of courses/resources, 20% need for accreditation/validity, 10% more info required on existing courses.
Question 9 (b) With whom?	45% accredited through TAFE, 36% with another RTO or in conjunction with a TAFE College, 18% VET.
Question 10 Links to National Industry Training Packages	52% not linked to N.I.Training Packages, 8% through Conservation Earthworks, 8% Ag/Hort, 4% Bushland Regen/Land Mngmt, 8% Cert in Landcare, 4% unsure and 16% waiting for new CALM package.

Question 11 (a) Skills Recogn	50% provide Skills Reco. Statement of Attain or formal Cert. 50% doesn't.
Question 11 (b) Cert. Of Partic.	67% provide a Certificate of Participation/Attainment, 33% don't provide anything.
Question 12 Accred/fundi ng	73% cert. not a requirement for funding, 27% is.
Question 13 Course deliverers	31% Govt. Agency Profs. deliver training, 16% Industry Profs. 13% Enviro Consults. 11% Lecturers, TAFE, Uni, 8% Workplace Trainers, 5% Landcare Officers, 5% local Government, 11% others.
Question 14 Target Audience	12% Landcare Officers, 12% Comm. Catchment Mngment Groups, 10% Professionals, 10% Teachers, 10% Local Govt. 10% Enviro Consults, 13% State Govt, 7% unemployed, 16% others are targeted for training.
Question 15 Additional courses	95% of people would be interested in providing additional courses in RR/MR while 5% were unsure.
Question 16 Best ways of delivery	50% of people believed that courses should be delivered 'in-the-field' with a 50/50 mix of theory and practice. Over 30% felt that regional, face-to-face courses were highly desirable. 3% would like to see weekend courses, and a small number thought that mentoring/traineeships was a sound option. The majority of respondents thought that short courses were the preferable option.
Question 17 Cost of development	The majority of people (54%) did not know what the cost would be for development of these courses however, all agreed that they would be expensive. Guesstimates ranged from $5,000 to $30,000 with 12% guessing that it would be between $5,000 and $10,000.
Question 18 Cost of delivery	Again 74% of respondents didn't know what the cost of delivery would be. 13% up to $5,000, 4% $10,000 to $20,000 and 4% $20,000 to $30,000.
Question 19 Participant's expectations	Respondents felt that 10% of participants were seeking future employment in this area, 9%, access to other courses, 13% for professional interest, 13% as serious amateurs, 14% hobbyists, 17% land managers (farmers), 9% Enviro Consults and 15% for other reasons.
Question 20 Participants background	18% participants are involved in Enviro. Mngmnt, 25% in NRM and Comm. Support, 9% in Ecosystem Restoration, 6% in Landuse/Town Planning, 6% Education/Training, 4% Drainage Planning/Design, 3% Civil Engineering, 3% Scientific Research, 4% Students and 16% in other areas.
Question 21 Participants work role	20% participants work as Comm. Support Officers, 16% Project Managers, 8% Program Managers, 10% Research Officers, 6% Planners, 6% Engineers, 4% Teacher/Trainers, 4% Policy Officers

	and 27% in other areas.
Question 22 Participant's employer	28% participants employed in Govt Agencies, 19% Local Govt. 16% Enviro Groups, 12% Education/Training, 7% Consultants and 16% in other areas.
Question 23 Where is their work focused	47% work on a local level, 38% on a regional level, 9% statewide, 4% national and 2% international.
Question 24 Value of qualification	33% of people believe that a qualification in this area of training would assist with their work on a minor level, 20% occasional, 3% moderate, 27% substantial and 17% critical.
Question 25 Possible subject areas for course	

** Question 2 elicited a wide range of responses. There were a wide variety of course titles recorded in the survey, however, for ease of analysis these titles were grouped together under the following headings:

- RRM covers those courses dealing with Designing River Control Works, Riparian Assessment, Land Management/Bushland Regeneration, Coastal Rehabilitation, Environmental Technology, Revegetation of Bushland/flora, Ecology, Revegetation Assessment, Riparian Survey, and Restoration.
- Monitoring includes chemical and biological data collection and recording in a wide range of settings.
- Hydrology covers: Diploma of Natural Resource Management, Managing Urban Wetlands, Salt Lake Ecology, ABCs of Groundwater, Creeks etc.
- Land Management: Conservation and Earthworks, Designing River Control Works.
- Rural Planning: Pasture Management, Farm and Property Planning.
- Cultural: courses that relate directly to rivers in the form of Aboriginal Heritage stories and Aboriginal Land Management practices.
- Extension methods: a wide range of topics such as Media Management, Group Facilitation Skills etc.
- GIS: ARC View 3.2, GIS for Managers.
- Adult Short Courses: a wide range of topics not necessarily linked with RRM.

A2.6. Graduates Studies: Survey Results

1. *Which of the following best describes your main work area or area of interest?*	*%*
Civil engineering	3
Drainage planning and design	7
Landuse/town planning,	2
Landscape architecture	1
Environmental management	27
Environmental regulation	2
Ecosystem restoration	17
Natural resource management	15
Community support	10
Education/training	5
Scientific research	2
Other fields	5
2. *What is your main job function?*	
Program manager	27
Project manager	28
Research officer	0
Community support	2
Policy officer	11
Planner	7
Teacher/trainer	0
Consultant	10
Other	6
3. *To what degree is your work local, regional, state, national and international (ranked on a scale 1 to 5)?*	*Scale 1-5*
Local	3.2
Regional	3.1
State	2.4
National	1.5
International	1.1
4. *To what degree would a graduate diploma in river management assist in your work: minor, occasional, moderate, substantial or critical?*	*%*
Government Departments:	
Minor	40
Occasional	20
Moderate	0
Substantial	40
Critical	0
Consultants:	
Minor	22
Occasional	11
Moderate	56
Substantial	11

Critical	0
5. *On a scale of 1 to 5 how do the following subject areas relate to your area of work or interest?*	*Scale 1-5*
Catchment and stream hydrology	4.1
Stream channel form and geomorphology	3.0
Stream channel hydraulics	3.1
Erosion processes	3.4
Stream and floodplain ecology	3.2
Stream channel analysis	2.8
Riparian zone condition assessment	3.1
Stream channel restoration	3.3
Riparian weed control and revegetation	3.2
Floodplain management	3.1
Waterways management legislation	3.1
Stormwater management	3.5
Rural land drainage	3.3
River restoration action planning and decision making	3.5
Community consultation and involvement	3.9
Indigenous issues, heritage protection, consultation and negotiation	3.1
Monitoring and evaluation of restoration projects (outputs)	3.3
Ecosystem health monitoring and assessment	3.7

Question 4:

Comparing the main areas of work with the importance of a graduate diploma showed the following categories:

Minor/occasional:	Landscape architecture
	Drainage planning and design
	Civil engineering
	Other
Occasional/moderate:	Landuse/town planning
	Environmental regulation
Occasional/moderate/substantial	Ecosystem restoration
	Environmental management
	Natural resource management
	Community support
	Scientific research
	Education/training

A2.7. Example of existing short courses concerned with river restoration and management. We recommend (Recommendation 3.1.4) that such courses become part of the National Training Framework through the process of mapping content against competencies within the National Framework.

UWA Summer School Course in RRM (See Appendix 2.8 for an evaluation of this Short Course)

The summer school course offered at the University of Western Australia is based upon the "Newbury Workshops" and was designed to combine both theoretical and practical aspects of RRM. This course is six days and culminates with a detailed restoration plan for a reach of a local degraded river.

The course is a broad overview of the four modules outlined in the Graduate Certificate (Table 3.2.2). The objective of the course is to give students an appreciation of RRM issues and enable successful participants to conduct some small-scale restoration activities (*eg*. riparian replanting). This course has 38 contact hours with a ration of theory to practice of a 1:2. The fee is $360 per student. Details of the UWA Course on "Ecological health and restoration of rivers and streams" are as follows:

River restoration is becoming an increasingly important component of catchment management. More and more people are involved is some form of environmental protection, restoration and rehabilitation of streams and rivers. This involvement is typically at a variety of levels and includes volunteers, farmers, foresters, landcare, rivercare groups and a great number of government institutions. However, it is imperative that good science underpins the practical aspects of successful restoration. To ensure a linkage between the theoretical and practical, The University of Western Australia and the Water and Rivers Commission have developed this course in partnership to train people involved in river management. An emphasis of the course will be the relationship between the physical condition of the catchment and the ecological "health" of associated stream and river ecosystems. Participants will be exposed to biological monitoring of macroinvertebrates and fish, water quality measurement, riparian assessment and determination of river channel morphology. These will provide a context for the practical component of the course.

The course will involve a series of lectures and field and laboratory work; it will culminate with participants writing a river restoration plan for a degraded reach of river.

The course will run over 6 days (Mon-Sat) and has the following contact hours:

Lectures:	12 hours
Labs:	15 hours
Field work:	11 hours

No formal prerequisites are required for the course. However, the objective is to attract professional agency personnel (eg. Water and Rivers Commission), UWA students and land-care coordinators.

The course will be assessed by evaluation of a report and formal presentation of results. The course is available to UWA students for credit (2 points).

River Styles

River Styles® (Brierly 1999) has been proposed as a biophysical template for the management of Australian rivers. This short course is of five days duration and the fee is $2000 per student. The course is about a 50:50 split between theoretical and practical with a strong emphasis on the geomorphological context for RRM. The course has been successfully run three times, once in Northern NSW and twice in Goulburn. Over 90 individuals have participated in the courses to date. An accreditation procedure has been developed as part of this course, ensuring that individuals who complete the requirements are qualified to undertake River Styles® assessments.

A2.8. Evaluation of UWA Summer School RRM Course (L Pen 2001, unpublished)

Course history

In March 1995, Land & Water Australia sponsored a visit to southwest Western Australia by the Canadian river manager, Bob Newbury. He promoted an approach to river restoration that recognised natural stream channel form as the critical aspect in stream management. This approach was embraced by the Water and Rivers Commission. Two officers from the Commission attended his river restoration course in the eastern states in February 1996, with the intention of bringing the course to WA. With financial support by Land & Water Australia the course was presented on the Avon River at Northam in May 1996. Following its success, NHT funding was obtained to present the course, known as the River Restoration Workshop, on at least three occasions over 1998-2001. Such was the demand for the course that it has been presented on eight further occasions, at various sites around the southwest:

Fairbridge (Pinjarra) May 1998
Wellington Mills (near Bunbury) September 1998
Dunsborough (near Busselton) May 1999
Perth Metro (Coastal Plain) October 1999
Geraldton March 2000
Porongorups (near Albany) May 2000
Perth Metro (Hills) October 2000
Harvey (near Bunbury) September 2001

The workshop has always been conducted with the support of the University of Western Australia, strengthening the course's connection to Land & Water Australia's (L&WA) Riparian Lands Program. In February 2001 the course was presented in partnership with the University as an accredited "Special Course" as part of the Summer Course Program (Appendix 2.7). It is hoped that the University Course would appeal to more academic and professional people (see below).

Course synopsis

Course participants are chosen from a list of people who have expressed an interest in the course and who have provided background information on their skills, experience and relevance to river management. The aim is to choose a good mix of people to encourage networking and dialogue and thereby impart a respect for river management from a variety of viewpoints.

The course seeks to provide a basic understanding of river function, both conceptually and mathematically. It covers catchment processes, stream channel geomorphology, hydrology and hydraulics; stream ecology; channel surveying and hydraulic analysis; revegetation and both soft and hard engineering techniques; and Aboriginal heritage protection. The course runs over 5 consecutive days (including evening work), with about 10 hours lecture time, 10 hours classroom activities and 5 hours fieldwork. Introductory site visits are carried out on Day 1 (3 hours) and field based presentations of restoration plans are given on Day 4 (4 hours). There is also a 2 hour forum to discuss river management issues of relevance to the region in which the workshop takes place and 3 hours of talks from local people engaged in river restoration.

Between 20 and 30 participants are broken up into 4 to 5 groups to carry out a river section restoration plan based on the understandings and techniques presented at the workshop. The aim is to have restoration plans that conform with and are reinforced by natural stream channel form. The final plans and presentations form the basis of assessment of the success of the course in imparting concepts and techniques.

Breakdown of participants

A total 223 people have taken part in the river restoration courses present by the Water and Rivers Commission and the University of WA between May 1996 and February 2001. The majority of participants were, at the time of the courses, engaged in some form of natural resource management (NRM) relating to integrated catchment management. About 13% were Rivercare and waterways management officers; 11% were more broadly engaged in water resource management at the catchment level; 14% were volunteers or employed Landcare technicians, mostly pursuing sustainable agriculture; 14% were members of community catchment groups; and 10% employees of community catchment groups, including catchment coordinators, environmental officers and communication officers. Categories making up between 3-6% of participants include, NRM agencies (Agriculture and Conservation), Environmental Groups (eg Conservation Council of WA), Local Government (mainly parks and recreation and environmental officers), Waterwatch Coordinators, Bushcare officers and university students. More minor categories included training centres (eg TAFE colleges), consultants and Town Planning.

The course has failed to attract participants from the following categories:

- Drainage service engineers
- Local Government engineers
- Consultant engineers
- Environmental consultants
- Landscape architects
- Regional and town planning
- Fisheries management
- Infrastructure planning and management (eg roads, railways, etc)

Evaluation form

An evaluation form was used to obtain feedback from participants at the end of each workshop. It covers questions 15 to 25 in the Stakeholder Consultation Document, seeking information on:

- Benefit of group activities
- Suggested changes to workshop format
- Venue and catering
- Further formal education in river management (Q18; at the Sept 2001 workshop only)
- Use of the information and techniques presented in the course
- Other interested fields of endeavour
- Hindrances to making use of information and techniques presented in the course
- Expectations of technical support
- Changes in course content and subject areas
- Keeping in touch

Summary of Comments

Learning of the course's existence

Word of mouth through community groups and in the workplace was the main way people found out about the course. The reputation of the course appears to have assisted in word of mouth promotion over time. Local newspaper advertising, fliers, mail outs and brochures were of lesser value in promoting the course.

Course expectations

Participants had an accurate expectation of what the course was presenting:

- restoration techniques, such as riffle design and construction, revegetation, erosion control and habitat creation;
- action planning;
- understanding catchment and stream hydrology and ecological processes; and
- river assessment and surveying methods.

This suggests that participants were reading the plethora of Commission and L&WA river management literature available. One area not covered in the course, but which some participants expected, was that of river restoration works planning and costing.

Relevance to work area and use of information

Most of the participants were engaged in some degree of extension work, and as such the relevance of the course was mostly 'soft', in that it was considered to improve confidence in awareness raising and the provision of technical advice to community groups, colleagues, schools, local government, etc. Some people considered that the course provided a framework for action planning. A small number were interested in the 'hard' applications and fully intended to use the riffle, erosion control and revegetation techniques in their local waterways (including urban drains), mostly on small creek size systems. There is no doubt that the impetus provided by the NHT Rivercare Program for river management activities had increased considerably the relevance of the course to people involved in catchment management.

Some senior staff of the Water and Rivers Commission has attended the course to gain a broader understanding and perspective of issues relating to community-based river management, ostensively for policy and State program development.

Policy makers in landuse planning and other areas of natural resource management wished to assimilate river restoration principles and concepts into their work areas, to develop 'holistic' approaches, but this was very much a minority intended use of the information presented at the workshop.

Suggested changes to course content and subject areas

Content. While the course places an emphasis on the conceptual understanding of the physical and ecological functioning of rivers, many participants generally wanted more 'hands-on' exercises related to river restoration, for example riffle construction and large woody debris placement. An actual exercise in the construction of a simple riffle was favoured. Similarly, more case studies demonstrating practical landowner experience, successes and failures were suggested.

Subject areas. Nearly all of the participants acknowledged that there is only so much that can be fitted into 5 days, but nevertheless suggested a range of subjects that could be included in the course:

- works planning and river restoration costing (ie equipment needs, site preparation, access, time estimates and timelines, methods and material and cost estimates);
- monitoring and evaluation of rivercare projects;
- practical rehabilitation methods and demonstrations;
- legislation and regulations pertaining to waterways management and water abstraction (riparian rights);
- fire management in riparian corridors;
- flora and fauna management in riparian corridors;

- direct seeding in the riparian zone;
- management of tidal reaches of rivers; and
- groundwater hydrology in relation to riparian zone management;

Some recommendations pertained to general landcare or were beyond the scope of the course:

- community consultation, support and involvement;
- custodial implications and responsibilities;
- catchment management and flood mitigation;
- water sensitive urban design;
- the importance of ecological corridors; and
- local government perspective on natural resource management.

A number of recommendations came together within a subject area, which could be called 'fitting rivercare into farm management'. They covered dealing with traditional land management views, approaches and rural cultures, both in relation to farmers and those agencies and institutions that support farming. This included, for example, the practicalities of livestock management in relation to waterways, with such considerations as access to water, paddock connection and design, fenceline optimisation and neighbour issues; and also farm economics and the burden of managing non-productive riparian corridors.

Appropriateness of course technical level

Most participants found the course quite understandable and to suit their level of technical and academic expertise. A large minority (10-30%) found the course too difficult and fast paced. Many participants had difficulty in the calculations using hand calculators; and so teaching aids, such as step by step workbooks and computer spreadsheets, were recommended to make the mathematical exercises easier. Some people had trouble seeing the relevance of all the 'math' and needed to see the 'real-world' relevance and application. A few participants found the course too easy. The hardest concept to teach, along with the mathematical formulas was that of Manning's equation and within this the concept of hydraulic radius.

As a general observation many, if not most, participants had to brave the maths, rediscover some of the more obscure buttons on their calculators and re-learn how to conduct a level survey. Once this was achieved the course ran relatively smoothly. The lack of technical proficiency among course participants reflects to some extent the sort of people drawn to Landcare.

Course organisation – format and group activities

The majority of participants had no problem with the format of the course, although some would have preferred more time and more field-based activities (see below).

Generally the mix of people of differing backgrounds, perspectives and disciplines was thought to create a less intimidating work environment, enabling participants to develop mutual respect and gain confidence to contribute and thereby share ideas, knowledge and experience. This is generally reflected in the 'hum' of conversation and the exchange of contact details at the end of the workshop.

Virtually all participants considered the group approach essential. It was felt that the groups, consisting of people with differing backgrounds and areas of expertise, mimicked real-world community catchment groups. As such the groups made use of complementary skills and overcame conflicting views to develop competent restoration plans. The field-based group activities therefore had the effect of 'team building', engendering productive collaborative efforts. The team approach was also seen as saving time, enabling greater learning, and to be good for social interaction which made the course more enjoyable.

On the negative side, some participants found that certain individuals dominated the group, while others could easily retreat from making a strong contribution.

Venue and catering

According to the feedback, the venue needs to be well ventilated and lit; seats need to be comfortable. Meals, if provided, should be variable and cater to specific dietary requirements. Catering needs to be environmentally 'aware' ie no non-biodegradable, ozone depleting cups! Presentation rooms need to have the capacity to be darkened to facilitate slide and PowerPoint presentations. Keep the tea and coffee coming during the heavy calculations and restoration planning exercises. Above all, a good venue, ie picturesque views or nestled in a forest, makes up for lousy accommodation.

Who would benefit from the course?

Having just done the course, participants were asked who would benefit from it. The suggestions included:

- community members, although the less active ones would benefit from a shorter more practical 'hands-on' course, of about one day's duration;
- catchment coordinators and community support officers (which are the bread and butter of the course);
- local government officers, such as engineers, rangers, environmental officers;
- drainage management officers;
- regional and town planners;
- developers;
- road planners and managers; and
- natural resource managers.

Hindrances to use of course information and techniques

Three main reasons were given by participants as hindrances to putting into practice what they had learnt at the workshop:

- a lack of resources, including volunteer labour and equipment;
- a lack of interest on the part of land holders, local government and developers, who prefer to stay with traditional practices; and
- institutional and cultural hurdles among land and water managers, who simply do not agree with the general application of river restoration principles (eg drainage service providers).

There were some interesting comments by a small number of participants that are worthy of analysis. A number recognised the need for a government department dedicated to the theory and practice of river restoration from lecture theatre to the ground. At the present time, river restoration in WA is underpinned at State Government level by NHT funding and the technical support of the L&WA's Riparian Lands Program. That is widely appreciated in the 'Rivercare' community. There is a need for a 'cadetship' phase for the initial first attempts at in-channel river restoration where there is a risk of things going wrong. Finally, river restoration activity is hampered by a lack supporting policy and legislation, both at the State and local government level. Participants could see very early that their first task in river restoration would be to convince the authorities of the value and competency of restoration techniques.

Expectations of technical support

Participants were well aware of the fact that they alone could not facilitate river restoration and that their skills would need to fit within a support framework. Some of the suggestions for this

framework included: provision of earth moving equipment and materials by local government, where the economies of scale were better; the provision of technical literature, presentation media and meeting venues by catchment centres; dedicate Rivercare officers to assist in advice and planning for the more demanding aspects of river restoration; engineering support by the principal waterways management agency, especially in design work and for checking plans; and an overall acceptance of the philosophy of river restoration among State Government departments, drainage service providers and local government, such that the work of these bodies complemented rather than hindered or undid the work of Rivercare.

Keeping in touch

The main recommendations were for a WA website and newsletter on river restoration activities and demonstration sites and for refresher or booster courses to keep exponents in rivercare up to date with the current conceptual thinking and techniques.

Major findings of relevance to adult education

- It is essential to get a mix of people, with varying backgrounds, to mimic community-based action planning.
- A mix of participants, with differing backgrounds, provides the opportunity to build multi-skilled groups and thus to make team building a facet of the course.
- The course mainly appeals and appears relevant to natural resource managers, engaged in the management of waterways, water resources, sustainable agriculture and urban and rural community catchment management.
- All of the above categories have been invigorated by NHT funding and it is unlikely that the course demand would have been as strong in its absence.
- The course has failed to draw business, service provider and local government professionals, especially from the engineering field.
- The course's reputation would appear to be its main drawcard.
- The accurate expectations of the participants suggest that the river restoration literature of the Water and Rivers Commission and L&WA be being widely read.
- Most of the participants would use what they learnt from the course in 'soft' extension and planning activities rather than 'hard' in channel works.
- Participants are generally happy with the course content, but a large minority would have preferred a more practical hands-on in-channel course, supported by visits to practical demonstration sites.
- Works planning and cost estimation should be considered as an additional component of the course, probably to facilitate grant applications.
- A component covering watercourse management as a part of 'practical' farm management would appear to be relevant to many of the participants.
- Rote learning and glib acceptance of the physical principles, because they are too hard to comprehend, is not considered acceptable in a balanced understanding of stream processes – physical and biological. The course must present the necessary calculations for understanding stream form and behaviour in parallel with the conceptual understanding. Furthermore, engaging the 'math' is seen as a necessity to gain a respect for the 'particles in motion' aspects of river management.
- While the course should teach the more difficult mathematical aspects, where these are not well understood, it must impart the fundamental concepts underlying our understanding of river processes as a 'bottom line'.

- Careful consideration and planning of catering and the venue are essential to ensure the success of the course.
- River restoration needs to be underpinned by an overall policy and legislative framework, agreed to and supported by drainage service providers, catchment centres, local government and a dedicated government department (eg Water and Rivers Commission).

A2.9. Graduate Diplomas in Science at the University of Western Australia: Agriculture; Horticulture; Natural Resource Management.

These graduate diplomas are available to students who have completed a bachelor's degree in Agriculture, Horticulture or Natural Resource Management at UWA or have been granted equivalent status. In each case, the course consists of units prescribed for the relevant bachelor's degree that have not been passed by the candidate within the previous seven years and total not less than 48 points.

Regulations

To qualify for the diploma, a candidate shall complete units to the value of 48 points which shall consist of units which have not been passed by the candidate in the previous seven years selected from those prescribed for the BSc (NatResMgt).

The course for the diploma shall extend over one year for a full-time candidate and two years for a part-time candidate, but candidates may be permitted to extend candidature over two years as a full-time candidate or three years as a part-time candidate. Candidates who have not completed the course within two full-time years or three part-time years may re-enrol only with the permission of the Faculty.

Course Description

The exploitation or conservation of natural resources (air, energy, fauna, flora, land, minerals and water) typically involves conflicts between competing interests which can only be resolved by management of these natural resources in the public interest. The aim of the course is to complement students' existing disciplinary skills with training in the principles of efficient resource management and the evaluation of policies in the public interest. Students are taught to identify the components of a natural resource management problem and to understand how the various specialist inputs can be integrated as part of a management strategy.

Emphasis in the course is on:

(a) objectives for the management of natural resources and the natural environment in the public interest;
(b) the theory, concepts and principles of efficient resource management; and
(c) a conceptual appreciation of the ways in which elements of natural resource systems interact and an understanding of the likely consequences of manipulating these systems.

The course is intended for persons employed or seeking employment in government departments or agencies responsible for the management of natural resources; or in private corporations involved in the development of natural resources; or seeking employment as private consultants involved in restoration, conservation, development or management of natural resources and the environment.

Details of Study Program

This course is a research degree and as such combines a research topic, resulting in the production of a thesis, with a formal coursework component that introduces students from disparate backgrounds to the content required to facilitate the combination of science with the relevant issues of economics and management. In addition, students are provided with a solid base from which to undertake their individual program of research. Students enrolling on a part-time basis are required to undertake the coursework units in advance or concurrently with the

thesis. Thesis topics are to be determined in consultation with academic staff members and should take account of the interest, qualifications and experience of students. Most of the lecture program deals with the economic aspects of natural resource and environmental management, while the case studies deal mainly with social, political, biological and physical aspects of natural resource management problems. The lecture program must be satisfactorily completed before, or taken concurrently with, the case studies. A student may be required to undertake additional coursework before beginning the degree.

Principles of Systems Ecology
This module provides an introduction to the range and patterns of productivity and plant diversity in Australian as well as other ecosystems and identifies key processes accounting for these patterns. It seeks to develop students' understanding of those processes important for the sustainable management of agricultural ecosystems and for the conservation of the biodiversity of natural ecosystems. Practical work focuses on field experiments and includes aspects of carbon metabolism, plant water relations, growth and allocation patterns.
Lectures: 20 hours
Practical work: 20 hours, mainly as fieldwork

Wildlife Ecology
This module examines the ecology and dynamics of wild populations. Students learn adaptation, natural selection and factors affecting population numbers both by theoretical approaches and by analysing real data sets to examine natural or man-caused fluctuations in natural animal populations.
Lectures: 20 hours
Practical work: 20 hours

Forest Ecology and Management
8 points Full Year.
This unit focuses on the ecological functioning and management of natural and managed forests, plantations, remnants and shelter belts. Emphasis is placed on management of eucalypt forests as well as plantations of eucalypts and other tree species (e.g. for oils and fuels). The application of scientific understanding of tree productivity and environmental constraints (*e.g.* soil, water, salinity) to plantation establishment and silviculture is addressed. Other topics include forest resource assessment, biodiversity, economics of forest industries and forest products, community ecology, effects of fire and logging, and land evaluation for plantations and forest management. There are two compulsory modules: Forest Ecology (in Plant Sciences) and Forestry Management (in Agricultural and Resource Economics). In addition, two modules must be selected from the following optional modules: Soil Biology, Soil Mapping, Landscape-scale Processes, and Agroforestry.

Land and Water Management
8 points Full Year
This unit aims to provide students with an understanding of the principles and practices involved in managing soil and water resources. Management is approached from a systems perspective. Students undertake detailed study from two of the following four modules: measurement and modeling of hydrological field fluxes; land restoration; management of landscape-scale processes; and wetland management. A topic from Soil Science 401 may be substituted for any of the above modules. Additionally, students undertake a case study in which environmental

consequences of the principles of land management and hydrology and their application in the solution of practical problems are emphasised.
Lectures: 39 hours Labs: 39 hours
Field work: up to 15 hours

Natural Resource Management
20 points Full Year
This unit is based on a research project that the student selects in consultation with members of the Faculty academic staff. The project will focus on an issue of relevance to natural resource management and at least one supervisor for each student will be a member of one of the groups (Agricultural and Resource Economics, Animal Science, Plant Sciences, Soil Science and Plant Nutrition) within the Faculty. Students are encouraged to nominate potential projects and then refine these in consultation with staff. Presentation of formal and informal seminars may also be required and students must submit a dissertation that is the basis for assessment.

Natural Resource Management Research Projects
Principles of Resource Economics
[8 points] Semester 2
This unit builds on the material presented in Resource Policy Analysis by exploring a number of key issues in natural resource management in greater depth. Normally, three issues are dealt with in any year and, depending on staff availability, these may include management of mineral and other non-renewable resources; management of forestry, fisheries and other renewable resources; market failure, externalities and public goods; environmental quality management; management of national parks and water resources; and models and techniques for natural resource management.
Lectures: 51 hours
Tutorials: 17 hours

Rangeland Management
8 points Semester 1
This unit is based on a natural resource management approach to rangeland use in Australia with emphasis on Western Australia. Thus focus is on the environmental, economic and social aspects of managing rangelands including legislation and policy matters. The unit specifically examines rangeland management concepts and principles, management processes, management practices and procedures. Emphasis is on rangeland types and the effects and influences of rangeland management on the natural resources that support various uses such as pastoralism, water production, conservation reserves, mining and ecotourism. This includes perspectives of sustainable rangeland use in ecological, economic and social terms. Specific parts of the unit include rangeland ecology such as impacts of fire, the interaction of animals with plants, the study of how grazing of stock and feral animals affects pastures, social issues regarding the National Native Title Act, and conservation outside of national parks.
Lectures/seminars: equivalent to 39 hours
Practical work: 39 hours.

Resource Policy Analysis
This unit focuses on a framework for public policy analysis, utilitarian and other approaches; policy objectives, maximising social welfare, efficiency and equity; individual welfare and consumer choice; resource allocation in competitive and non-competitive markets, equilibrium in

product and factor markets; the invisible hand and sources of market failure, externalities and public goods; evaluation of policy instruments for natural resource management, and cost-benefit analysis.
Lectures: 51 hours Tutorials: 17 hours
Prerequisites: Microeconomics, Prices and Markets 101 and Macroeconomics, Money and Finance.

Systems Ecology
8 points Semester 1
This unit comprises the following combination of systems ecology modules. All students are required to participate in a four-day field excursion.
Principles of Systems Ecology
This module provides an introduction to the range and patterns of productivity and plant diversity in Australian as well as other ecosystems and identifies key processes accounting for these patterns. It seeks to develop students' understanding of those processes important for the sustainable management of agricultural ecosystems and for the conservation of the biodiversity of natural ecosystems. Practical work focuses on field experiments and include aspects of carbon metabolism, plant-water relations, growth and allocation patterns.
Lectures: 20 hours
Practical work: 20 hours, mainly as field work

Natural Systems
This module focuses on developing students' understanding of the functioning of ecosystems, with emphasis on major Australian ecosystems. Students learn to think at different levels of integration, ranging from local to global and from physiological ecology to systems ecology, as this is essential for an understanding of ecosystem functioning and management for sustainability. They are also encouraged to develop their capacity for analytical thinking and for the development of logical arguments with respect to ecology.
Lectures: 20 hours
Practical work: 20 hours, mainly as field work

Appendix Section 3

A 3.1. The Australian National Training Framework and Competency-Based Training

The following information has been abstracted from publications of the Australian National Training Authority (www.anta.gov.au) and the National Training Information Service (www.ntis.gov.au). Comments are added *in italics* to indicate the relevance of the Framework to education and training in River Restoration and Management.

The National Training Framework (NTF) is based upon an agreement between the Commonwealth, State and Territory governments aimed to simplify the vocational education and training system and to reduce the points of regulation. The NTF is made up of two elements:

- The Australian Recognition Framework whereby Registered Training Organisations (RTOs) become the quality assurance mechanism and all qualifications and statements of attainment are mutually recognised among RTOs.
- Training Packages which include competency standards, assessment guidelines and qualifications.
-

The Australian Qualifications Framework (AQF) provides a comprehensive, nationally consistent yet flexible framework for all qualifications in post-compulsory education and training. The Framework was introduced Australia-wide on 1 January 1995. Presently, there are 66 Training Packages for industries in Australia. It is expected that Training Packages will ultimately offer nationally recognised training to more than 80% of the Australian workforce.

These two Frameworks (NTF; AQF) provide for the design, delivery and assessment of education and training based upon recognised best practices. Incorporation of education and training for River Restoration and Management within the Frameworks will overcome the perceived deficiencies in current courses of fragmentation, lack of quality-control in delivery and assessment, and no accreditation towards a comprehensive qualification at a level suited to the needs of a range of students. Compliance with the Frameworks will accommodate short courses evolving to qualifications at various levels of responsibility.

The AQF consists of twelve national qualifications in three sectors of education:

The Secondary Schools Sector
- Senior Secondary Certificate of Education

The Vocational Education and Training Sector
- Certificate I
- Certificate II
- Certificate III
- Certificate IV
- Diploma
- Advanced Diploma

The Higher Education Sector
- Diploma
- Advanced Diploma
- Bachelor Degree
- Graduate Certificate
- Graduate Diploma
- Masters Degree
- Doctoral Degree

There is overlap between Sectors and the Qualifications they offer. Increasingly, vocational education and training is being offered by the Schools Sector (VET in Schools) and may be recognised at the appropriate level of Certificates (I-IV), or as credit towards the Senior Secondary Certificate of Education. Some Certificate Qualifications (I-IV) are issued also in the Higher Education Sector and there is a VET pathway to the Graduate Certificate and Graduate Diploma. A purpose of the AQF is to provide "articulation" within and between Qualifications.

An AQF Statement of Attainment is a record of recognised learning which, although falling-short of a Qualification, may contribute towards a Qualification outcome. The Statement of Attainment may be for a partial completion of a course leading to a Qualification, attainment of competencies within a Training Package, or completion of nationally accredited short course which may accumulate towards a qualification through a "Recognised Prior Learning" process.

Statements of Attainment may be particularly helpful for the progression of existing Short Courses in River Restoration and Management to become part of the NTF.

Although the AQF as represented implies publicly-funded education sectors, competency-based training can be delivered and assessed by individuals or organisations as Registered Providers who are registered through a State Recognition Authority.

Competency Based Training and Training Packages

Competency is a broad concept that describes a person's ability in a range of areas. It covers:
- Task skills (performing individual tasks)
- Task management skills (managing a number of different tasks within the job)
- Contingency management skills (responding to problems, breakdowns and changes in routine)

- Job or role environment skills (dealing with the responsibilities and expectations of the workplace)
-

River Restoration Teams (Koehn et al. (2001) require competency in all of these categories of skills. That is, practical skills required to complete field-work through to the skills required to plan and manage restoration programs by teams of people who contribute individually to the aggregate of skills required by the Restoration Team.

Competency-based Training aims to provide learners with the skills, knowledge and understanding to demonstrate competency against standards, usually nationally endorsed Industry Competency Standards.
Competency Standards are developed by **industrial parties** (based upon the organisation of work) expressed in terms of **workplace outcomes** and regularly reviewed to ensure their continuing relevance to the workplace.
Elements of Competency are the basic building blocks of training and describe an action or outcome that is demonstrable and assessable. The elements of competency describe the lowest logical, identifiable and discrete sub-grouping of actions and knowledge that contributes to and build a unit of competency.
A Unit of Competency is a discrete component within a competency standard. It comprises a title, a short description of its purpose and its constituent elements of competency, together with their associated performance criteria. It will usually include a range of variables and it may include and evidence guide.
A Qualification is formal certification, issued by a relevant approved body, in recognition that a person has achieved competency relevant to identified individual, professional, industry or community needs. A qualification consists of a prescribed number of units of competence.
A Training Package is a flexible set of resources designed to provide guidance on industry training requirements. The endorsed portion of a training package includes national competency standards, assessment guidelines and national qualification levels and titles. A qualification will consist of Core Units and Elective Units.

A 3.2. Thirty eight existing competencies at AQF Levels 3, 4, 5 and 6 that could be customised for specialisation in river restoration and management

Prepared by David Greentree. The customisation would need to be completed by a curriculum consultant and made available to Registered Training Organisations because *ad hoc* customisation by RTOs would be inefficient and unlikely to happen.

Competency	River health	Native vegetation	Water quality	Soil erosion	Salinity	Coastal management
RTC6502A Review management plans and strategies	✓	✓	✓	✓	✓	✓
RTC6505A Map regional issues and stakeholders		✓	✓	✓	✓	✓
RTC6504A Coordinate the development of a regional resources management plan	✓	✓	✓	✓	✓	✓
RTC6902A Monitor projects in a program	✓	✓	✓	✓	✓	✓
RTC5914A Prepare reports	✓	✓	✓	✓	✓	✓
RTC5913A Collect and manage data	✓	✓	✓	✓	✓	✓
RTC5910A Contribute to regional planning process	✓	✓	✓	✓	✓	✓
RTC5908A Prepare estimates, quotes and tenders	✓	✓	✓	✓	✓	✓
RTC5801A Provide specialist advice to clients	✓	✓	✓	✓	✓	✓
RTC5521A Assess and monitor soil quality		✓		✓	✓	✓
RTC5519A Conduct biological surveys	✓	✓	✓	✓	✓	✓
RTC5518A Review assessment for legislative compliance		✓		✓		✓
RTC5504A Develop a management plan for a designated area	✓	✓	✓	✓	✓	✓
RTC5503A Design natural area restoration works	✓	✓	✓	✓		✓
RTC5502A Conduct field research into natural and cultural resources	✓	✓	✓	✓	✓	✓
RTC5501A Assess applications for changes in land use	✓	✓	✓	✓	✓	✓
RTC5206A Manage landscape projects			✓			
RTC5204A Plan conservation earthworks		✓		✓	✓	✓
RTC5203A Plan erosion and sediment control measures	✓	✓	✓	✓	✓	✓

RTC5202A Design control measures and structures	✓	✓	✓	✓	✓	✓
RTC50003A Manage bushland restoration programs		✓		✓	✓	✓
RTC40000 Plan river restoration works	✓		✓	✓		✓
RTC4510A Supervise natural area restoration works	✓	✓	✓	✓	✓	✓
RTC4506A Process request/applications for changes in land use	✓	✓	✓	✓	✓	✓
RTC4504A Monitor biodiversity	✓	✓	✓	✓	✓	✓
RTC4207A Supervise on site implementation of conservation earthworks	✓	✓	✓	✓	✓	✓
RTC4206A Supervise landscape project works		✓			✓	✓
RTC4205A Set out conservation earthworks	✓	✓		✓	✓	✓
RTC4020A Plan the implementation of revegetation works	✓	✓	✓	✓	✓	✓
RTC3505A Maintain natural resource areas	✓	✓		✓	✓	✓
RTC3218A Undertake a basic site assessment	✓	✓	✓	✓	✓	✓
RTC3211A Implement a maintenance program for an aquatic environment	✓	✓	✓			✓
RTC3209A Design and construct conventional fencing	✓	✓	✓	✓	✓	✓
RTC3206A Erect timber structures and features	✓	✓	✓	✓	✓	✓
RTC3205A Construct conservation earthworks		✓	✓	✓	✓	✓
RTC3202A Construct access tracks		✓	✓	✓	✓	✓
RTC3000A Collect and preserve biological samples	✓	✓	✓		✓	✓
RTC3507A Undertake sampling and testing of water	✓	✓	✓	✓	✓	✓

A3.3. Modules for Graduate Studies in River Restoration and Management

The content could be developed for a Graduate Certificate in River Restoration and Management of one semester of full-time equivalent study, or a Module of a Graduate Certificate in Natural Resource Management or similar course.

Module 1: Geomorphology and hydrology

Sub module 1.1: Geomorphology

- Geological and geomorphological setting.
- Channel form.
- Fluvial process within channels.
- Position in catchment.
- Hierarchy of scale processes.

Sub module 1.2: Hydrology

- Climate, rainfall variation – sources of water (*i.e.* frontal systems and cyclones).
- Landscape and water flow - evaporation, groundwater infiltration and movement, run-off coefficients.
- Water and gravity – the potential energy of water.
- Channel flow – stream flow gauging, flood record, flood frequency and probability of exceedance.
- Flood flows - concept of bankfull flow and its probability of exceedence.
- Catchment area *vs* bankfull flow relationships.
- Changing landuse (*e.g.* land-clearing, urbanisation, intensification of agriculture).

Sub module 1.3: Water quality

- Water quality monitoring.
- ANZECC/ARMCANZ guidelines.
- EPA guidelines.
- Nutrient issues.
- Salinity issues.
- Statistical methods.
- Determining flood levels on the basis of flood record and catchment behaviour.
- Determining the capacity of the system to respond to restoration.

Sub module 1.4: Geomorphological/ hydrological interactions

- Channel forms and landscape – details the variety of channel forms in relation to landscape setting.
- Basic channel form – width/depth in relation to catchment, meander form, pool/riffle form, bars, *etc*.
- Floodplain formation.
- Branching structure and stream order.
- The response of fringing vegetation and its influence upon channel form.
- deriving Manning's equation – slope, channel cross-sectional form, bed roughness
- understanding bed sheer and tractive force; and in relation to particle size transport and bed stability.
- understanding critical flows, hydraulic jumps, net conveyance (and Froude Number).

Module 2: Stream ecology

Sub module 2.1: Living streams

- Description of stream habitat – interaction with geology, climate, channel form, position in the catchment, riparian and vegetative response,
- Stream fauna – overview of major groups (*e.g.* macroinvertebrates, fish), life-cycle responses, functional feeding and flow-related faunal groups,
- Stream flora – overview of major groups, submergent, floating attached, emergent, fringing,
- Concept of the riparian zone - drawing on the technical guidelines of Land &Water's National Riparian Lands Program.

Sub module 2.2: Freshwater biota

- Community ecology
- Macroinvertebrate community structure
- Functional feeding groups
- Fish fauna
- Top down control
- Trophic linkages
- Dispersal and recruitment

Sub module 2.3: Ecological models

- Underlying ecological concepts.
- River continuum.
- Flood pulse.
- Riverine productivity model.
- Nutrient spiralling concept
- Limiting nutrients
- Ecological processes

Sub module 2.4: Ecological disturbance and monitoring

- Factors influencing the distribution of biota.
- Water quality (salinity, nutrient enrichment)
- Water flow (volumes, seasonality)
- Water temperature (upper lethal temperature, thermal pollution)
- AusRivAs
- Multi-parameter monitoring (e.g. DIBM)
- Carbon, nutrient sources, cycling and stream metabolism, food webs structure,
- Case studies – *i.e.* northern jarrah forest, Murray-Darling catchment, Lake Eyre Basin.

Module 3: River restoration

Sub module 3.1: Stream channel analyses

- Longitudinal survey of the restoration reach
- Identifying bankfull stage
- Measure channel slope
- Measure representative cross sections
- Existing flow velocity – enable an estimate of Manning's n
- Assess bed composition and bed paving
- Foreshore and habitat assessment using standard survey methods
- Reach channel slope
- Cross sectional areas

- Wetted perimeters
- Channel roughness (Manning's n)
- Strickler correction.
- Hydraulic radius (measure of flow contact with the bed).
- Tractive force at bankfull and floodplain.

Sub module 3.2: Stabilisation techniques

- Causes of stream channel instability in relation to natural form.
- Bed control techniques.
- Flow alignment techniques.
- Bank protection techniques.
- Sourcing material.
- Woody debris placement (*e.g.* anchoring).
- Fishways (barriers, habitat diversity, pool/riffle form).
- Measurement of hydraulic diversity.

Sub module 3.3: Riparian vegetation

- Site planning and prioritisation
- Site preparation and weed control
- On-going management
- Species selection
- Plant establishment
- Monitoring and maintenance

Sub module 3.4: Environmental Water Requirements

- Conceptual basis for environmental flows – channel and habitat maintenance, life cycle support
- Bottom up and top down techniques
- Flow dependent ecosystems
- Holistic methodology – Case Studies
- Requirement *vs* provision
- Monitoring and evaluation

Module 4: Policy and management

Sub module 4.1: Restoration planning/ existing policy

[consistent with NHT and current NAP objectives]

- Purpose and objectives of action planning
- Community and stakeholder consultation and involvement
- Understanding traditional landuse practices and practicalities
- Information collection and evaluation
- Strategic outline – vision, issues, goals, objectives and priorities.
- Working in a multi-skilled team (*e.g.* typical community group)
- Establishing management actions
- Basic works planning
- Knowing relevant existing waterway legislation, regulations and gaining approvals
- Knowing State Government policy and legislative framework
- Introduction to River Restoration Framework and the 12-Step Rehabilitation Procedure (particularly prioritisation and evaluation).

- Appropriate knowledge exchange
- International, Commonwealth, state, regional agendas, strategies, agreements.

Sub module 4.2: Community involvement

- Community and stakeholder consultation and involvement.
- Understanding traditional landuse practices and practicalities.
- Information collection and evaluation.
- Strategic outline at a community level – vision, issues, goals, objectives and priorities (Rutherfurd, Jerie and Marsh 1999).

Sub module 4.3: Monitoring and Evaluation

[All consistent with National Objectives and Targets in Biodiversity Conservation, Salinity and Water Quality]

- Defining and distinguishing monitoring and evaluation
- Evaluating aspects of 'ecological health'
- Aspects of good evaluation
- Measurement science - precision *vs* accuracy
- Stepped procedure to ensure effective M&E
- Water quality (and Waterwatch) monitoring
- AusRivAs model and procedures

Sub module 4.4: Indigenous values

- Understanding archaeological, ethnographic and spiritual values of indigenous people local to the area.
- Knowing the relevant legislation and policy for the protection of indigenous heritage and values.
- Native title considerations
- Consultation with tribal or clan elders
- Opportunities for indigenous support

---------- // ----------