Unwooded Fresh Water Lakes of the Southern Wheatbelt of Western Australia, dominated by *Muehlenbeckia horrida* subsp. *abdita* and *Tecticornia verrucosa* across the lake floor and, *Muehlenbeckia horrida* subsp. *abdita* Interim Recovery Plan 2001-2006

by Sheila Hamilton-Brown and John Blyth

Photograph: Val English

2001

INTERIM RECOVERY PLAN NO. 92

DEPARTMENT OF Conservation AND LAND MANAGEMENT
Conserving the nature of WA

INTERIM RECOVERY PLAN NO. 92

UNWOODED FRESH WATER LAKES OF THE SOUTHERN WHEATBELT OF WESTERN AUSTRALIA, DOMINATED BY *MUEHLENBECKIA HORRIDA* SUBSP. *ABDITA* AND *TECTICORNIA VERRUCOSA* ACROSS THE LAKE FLOOR, AND *MUEHLENBECKIA HORRIDA* SUBSP. *ABDITA* INTERIM RECOVERY PLAN 2001-2006

2001-2006

by

Sheila Hamilton-Brown and John Blyth

July 2001

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FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Conservation and Land Management Policy Statements Nos 44 and 50.

IRPs outline the recovery actions that are required to urgently address those threatening processes most affecting the ongoing survival of threatened taxa or ecological communities, and begin the recovery process.

This IRP replaces IRP 48 (Hamilton-Brown and Blyth 1999) and covers the Critically Endangered ecological community 'Unwooded fresh water lakes of the southern Wheatbelt of Western Australia, dominated by *Muehlenbeckia horrida* subspecies *abdita,* and *Tecticornia verrucosa* across the lake floor' and the Critically Endangered flora *Muehlenbeckia horrida* subspecies *abdita*. It will also cover any taxa restricted to the Community that may be declared as threatened in the future.

The Department is committed to ensuring that Critically Endangered ecological communities are conserved through the preparation and implementation of Recovery Plans or Interim Recovery Plans and by ensuring that conservation action commences as soon as possible and always within one year of endorsement of that rank by the Department 's Director of Nature Conservation.

This Interim Recovery Plan will operate from July 2001 and will remain in force until replaced by a full Catchment Recovery Plan.

The provision of funds identified in this Interim Recovery Plan is dependent on budgetary and other constraints affecting the Department, as well as the need to address other priorities.

Information in this IRP was accurate at July 9, 2001.

SUMMARY

Name: **Unwooded fresh water lakes of the southern Wheatbelt of Western Australia, dominated by *Muehlenbeckia horrida* subspecies *abdita,* and *Tecticornia verrucosa* across the lake floor and *Muehlenbeckia horrida* subspecies *abdita.***

Description: The shrub-dominated community's (herein called the 'Lake Bryde' community) habitat is characterised by intermittent fresh water inundation which sometimes holds little water for several consecutive years. The major components of the community (*Muehlenbeckia horrida* subsp. *abdita* and *Tecticornia verrucosa*) and other biota depend on the intermittent inundation by relatively fresh water followed by a longer period of drying out of the lake bed. In addition, the lakes support a fringing open woodland of *Eucalyptus occidentalis* over *Melaleuca strobophylla* dominated scrub. The taxon *Muehlenbeckia horrida* subsp. *abdita* is known only from this ecological community.

Region: Wheatbelt Region

District: Katanning

Shire: Kent

Recovery Team: The Lake Bryde Wetland System has been designated a natural diversity recovery catchment under the State Salinity Strategy and a Catchment Recovery Team has been established under that program.

Current status: The Lake Bryde Community was assessed by the Western Australia Threatened Ecological Communities Scientific Advisory Committee on 1 September 1998 as Critically Endangered and endorsed by the Director of Nature Conservation on 6 November 1988.

Muehlenbeckia horrida subsp. *abdita* was declared as Rare Flora in December 1999 and ranked as Critically Endangered in October 2000 under IUCN Red List Criteria A2c, B1+2c (World Conservation Union 2000).

Habitat requirements: The Threatened Ecological Community and *Muehlenbeckia horrida* subsp. *abdita* are confined to the clay and silt lake beds of lakes with intermittent inundation of fresh water.

Critical habitat: The critical habitat of the Lake Bryde Community and *Muehlenbeckia horrida* subsp. *abdita* comprises the clay and silt lake beds of two episodic freshwater lakes (Lake Bryde and East Lake Bryde); the local catchment for the surface waters that provide the wetland habitat of the community and taxon; and areas of similar habitat i.e. clay and silt depressions within the Lake Bryde Wetland System that are occasionally inundated with fresh water that could potentially be used for future translocation.

IRP Objective(s): To maintain or improve the overall condition of the Threatened Ecological Community and reduce the level of threat to its survival towards downgrading it from Critically Endangered to Endangered.

To abate identified threats and maintain viable *in situ* populations of *Muehlenbeckia horrida* subsp. *abdita* to ensure the long-term preservation of the taxon in the wild.

To preserve the genetic material of *Muehlenbeckia horrida* subsp. *abdita* for restocking existing populations or translocation to more secure sites.

Recovery criteria:
Criterion for success: The continuing existence of the components of the Threatened Ecological Community on the known occurrences.

Criterion for failure: Loss of *Muehlenbeckia horrida* subsp. *abdita* and/or other component species or further modification of the community (i.e. reduction in the dominance of shrub species, increase in weed composition) due to increased salinity or other means.

Summary of Recovery Actions

1. Write a full Recovery Catchment Plan
2. Assess and monitor the condition of the community
3. Obtain and monitor changes in hydrological information
4. Manage water quality and ensure stability in hydrological regimes
5. Explore options for catchment revegetation
6. Obtain biological and ecological information on the major components of the community
7. Preserve genetic diversity of the major components of the community
8. Conduct further surveys
9. Disseminate information
10. Determine the extent of weed invasion, design and implement weed control program
11. Develop and implement a translocation proposal
12. Seek to vest Lake Bryde Nature Reserve in the Conservation Commission of WA

1. BACKGROUND

History, defining characteristics of the threatened ecological community and taxon and their conservation significance

Lake Bryde and East Lake Bryde are two fresh water lakes that are part of the Lake Bryde Wetland System situated at the headwaters of the Lockhart sub-catchment of the Swan Avon System (Giraudo 1995).

Lake Bryde and East Lake Bryde are regionally ecologically significant, particularly because most fresh water lakes in the Wheatbelt are suffering secondary salinisation and excessive inundation as a result of large-scale clearing of their catchments. Clearing of the Kent Shire began in the 1960's and presently, sixty-six percent of the Lake Bryde catchment and fifty percent of the East Lake Bryde catchment are cleared.

Of one hundred and six lakes in nature reserves of the south-west of Western Australia, Lakes Bryde and East Lake Bryde were found to be the only lakes with beds dominated by shrubs (Halse *et al*. 1993). They are, in fact, the only known occurrences of the community 'Unwooded fresh water lakes of the southern Wheatbelt of Western Australia, dominated by *Muehlenbeckia horrida* subsp. *abdita* and *Tecticornia verrucosa* across the lake floor'. *Muehlenbeckia horrida* subsp. *abdita* is known only from the two lakes supporting this community.

The Lake Bryde Wetland System has been nominated as a lake of outstanding ornithological importance (Raines 1995). A survey of the aquatic invertebrates of Lake Bryde has shown that fauna to be highly diverse in relation to other Wheatbelt lakes such as Toolibin Lake (National Parks and Nature Conservation Authority 1999) and probably richer than those on the Swan Coastal Plain (Davis *et al.* 1993). The lakes' ecological uniqueness and human community concern (Lake Bryde is a recreation site as well) have become an impetus for conservation.

Extent and location of occurrences/populations

Lake Bryde is located thirty four km south-west of Newdegate in a reserve for purposes of emergency water supply, recreation and the conservation of flora and fauna, vested in the Minister for Water Resources and managed by the Water Corporation. Thirty two km south-south-west of Newdegate, East Lake Bryde is located in a reserve for the conservation of flora and fauna, vested in the Conservation Commission of Western Australia and managed by the Department of Conservation and Land Management (Table 1).

Table 1: Summary of occurrence information and threats for the Critically Endangered (CR) TEC and the CR Taxon *Muehlenbeckia horrida* subsp. *abdita.*

Occ./Pop. No. & Name	Land Status	Area of lake (ha)	Population size of CR taxon	Condition	Threats
1 - Lake Bryde	Nature Reserve	50 ± 1	2-3 000*	Healthy	Salinity and water-logging/inundation
2 - East Lake Bryde	Class A Nature Reserve	85 ± 5	424+*	Moderate	Salinity, water-logging/inundation and weed invasion

*1996 data

Critical habitat

Critical habitat is habitat identified as being essential to the survival of a listed threatened species or community. Habitat means the biophysical medium or media: (a) occupied (continuously, periodically or occasionally) by an organism or group of organisms; or (b) once occupied (continuously, periodically or occasionally) by an organism, or group of organisms, and into which organisms of that kind have the potential to be reintroduced. (*Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)).

The critical habitat for the Threatened Ecological Community and *Muehlenbeckia horrida* subsp. *abdita* comprises:

- The habitat of occupancy of the two known populations and occurrences.
- Similar habitat within 200 metres of the known populations of *Muehlenbeckia horrida* subsp. *abdita* (these provide potential habitat for natural recruitment).
- The local catchment for the surface waters that provide the wetland habitat of the species.
- Areas of similar habitat i.e. clay and silt depressions within the within the Lake Bryde Wetland System that are occasionally inundated with fresh water that may be used for future translocation.

Biological and ecological characteristics

This Lake Bryde habitat is characterised by intermittent fresh water inundation and sometimes holds little water for several consecutive years. The major components of the community (the shrubs *Tecticornia verrucosa* and *Muehlenbeckia horrida* subsp. *abdita)* and other biota depend on relatively fresh water and regular drying out of the lake bed for survival.

Little is known about the biological and ecological characteristics of the component species: *Tecticornia verrucosa* is generally found on fresh water or slightly saline claypans and lakes (Wilson 1972) and is probably a different variant to those known from coastal flats (P. Wilson, personal communication[1]).

Muehlenbeckia is a small genus of 19 species of which 14 are found in Australia (Wilson 2000). They are commonly known as lignums. Whilst the biology of some of the eastern states *Muehlenbeckia* species are well researched, the biology of *Muehlenbeckia horrida* subsp. *abdita* is poorly known and gathering such information is a priority in this Interim Recovery Plan (IRP). In particular, seed and flowering phenology are

[1] Paul Wilson – Botanist, CALM (Herbarium)

poorly known as only one flowering specimen has been collected at the end of August; on many occasions, the lakes have been inundated during August – September which is presumed to be the flowering season. The breeding system of the plant is unknown although post-disturbance recruitment in other *Muehlenbeckia* species suggests that the genus has a long dormancy of propagules in the soil seed bank (Mallinson *et al.* 1998). No seeds have been collected from the plant, and seed collection is a priority in this IRP.

Like its closest relative *Muehlenbeckia horrida* subsp. *horrida, Muehlenbeckia horrida* subsp. *abdita* is restricted to fresh water and can survive prolonged inundation so long as it dries out within a year or thereabouts (K. Wilson, personal communication[2]).

Hydrology and Water Quality

Both occurrences are situated at the head of a chain of lakes that extend from Lake Magenta Nature Reserve (Breheny 1995). They lie in an asymmetrical basin and are thought to be perched with an impermeable layer of silt and clay.

Lake Bryde fills only when the annual rainfall of the area exceeds 400 mm (Giraudo 1996). Since monitoring began in 1979, it has flooded six times, in 1983, 1988, 1990, 1992, 1993 and 1996. It is not known exactly how often it filled prior to monitoring, but it is considered to have been approximately every four years in the 19th century, and less in the 20th century. As it takes about fifteen months for the surface water in the lake to dry out from full, it is more dry than it is wet (Davies 1996; Giraudo 1995).

Surface water drainage from the alluvial plain that fills Lake Bryde is via a single channel that runs northwards into the lake. The water evaporates rather than leaves the lake via an outflow channel. If the lake fills beyond the maximum depth of two metres, it extends outwards along the inflow channel until it falls below two metres. As a result, no flushing of the lake occurs.

When monitoring of water levels and salinity began in 1979, Lake Bryde had a salt concentration of 0.036 parts per thousand (ppt). The catchment of 45 200 ha is sixty-six percent cleared.

In contrast, much less work has been done and less is known about East Lake Bryde. The catchment of 27 730 ha is fifty percent cleared, with most of the vegetated area in the Lake Magenta Nature Reserve. It has always been known to be fresh and since monitoring began in 1979, there has been no significant change in salinity (J. Lane, personal communication[3]).

For information on the hydrogeology of the Lake Bryde Wetland System, refer to Sinclair Knight Merz (2000).

Historical and current threatening processes

Given the degradation of fresh water lakes throughout much of the Wheatbelt and the significant clearing that has taken place in the catchments of these two lakes since about 1960, there appear to be three major, interacting processes threatening their long term survival. These are increased levels of salinity resulting from input of secondarily saline surface water; increased periods of inundation resulting from increased run-off following clearing of much of the catchment; and finally, the threat of both inundation and salinity increasing massively if regional water tables rise to the surface within the lakes themselves or nearby in their catchments. It is already predicted that, without intervention, ground water levels will intersect both lakes within the next 5-10 years (Sinclair Knight Merz 2000).

- **Salinity:** Monitoring of the water in Lake Bryde began in 1979 and the salt concentration recorded was 0.036 ppt. Although the lake is still essentially fresh, there have been increases in the salinity since 1979

[2] Karen Wilson – Botanist, Royal Botanical Gardens, New South Wales
[3] Jim Lane – Research Scientist, CALM (Busselton)

as a result of increased discharge of saline groundwater in the catchment area (B. Bone, personal communication[4]).

Less is known about changes in the quality of the water in East Lake Bryde. Monitoring has not shown a significant salt concentration (J. Lane, personal communication[3]), yet the vegetation on the lake floor has been noted by the local community to have been in decline for a number of years (A. Ralph, personal communication[5]). This suggests that saline groundwater is nearing the surface of this lake.

Salinity abatement is being tackled via the State Salinity Strategy, with the Lake Bryde Recovery Project managed by the Department Katanning District.

- **Water-logging and inundation:** *Muehlenbeckia horrida* subsp. *abdita* and other components of the lake bed community rely on the lakes drying-out to complete their life-cycles. Since clearing of the catchment 30 years ago, the volume of surface water running into the lakes has increased resulting in more frequent flooding and filling of the lakes (Sinclair Knight Merz 2000).

  Water-logging and inundation is being tackled via the State Salinity Strategy, with the Lake Bryde Recovery Project managed by the Katanning District.

Other threats to the community and plant population include weed invasion and a lack of recruitment.

- **Weeds** are invading both the lakes, particularly on East Lake Bryde. Weeds can have significant impacts on a community through competition with the native species and prevention of regeneration (Hobbs and Mooney 1993). In the case of these lakes, salinity is encouraging the proliferation of herbaceous species that can tolerate saline conditions and water-logging/inundation. Early action on invading species could prevent the build up of a major weed problem.

- A **lack of recruitment** has been observed in the *Muehlenbeckia horrida* subsp. *abdita* at East Lake Bryde (A. Coates, personal communication[6]). There are a number of possible causes including low seed production; high flower, seed and/or seedling predation; and a lack of disturbance events to stimulate germination.

Guide for decision-makers

The previous section provides details of current and possible future threats. Developments in the region of the Lake Bryde Wetland System require assessment and should not be approved unless the proponents can demonstrate that they will have no significant impact on the lakes and the rare flora.

Conservation status

The ecological community 'Unwooded fresh water lakes of the southern Wheatbelt of Western Australia, dominated by *Muehlenbeckia horrida* subsp. *abdita* and *Tecticornia verrucosa* across the lake floor' meets the following criteria for Critically Endangered (CR) ecological communities:

B(i) current distribution is limited and currently subject to known threatening processes that are likely to result in total destruction in the immediate future (within approximately 10 years) if trends continue.

B(ii) current distribution is limited and there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes.

[4] Bruce Bone – District Manager, CALM (Katanning)
[5] Arletta Ralph - Ex- Lake Grace Community Landcare Coordinator, Shire of Lake Grace
[6] Anne Coates - Coordinator, Newdegate Volunteer Flora Group

Muehlenbeckia horrida subsp. *abdita* was declared as Rare Flora in December 1999 and ranked as Critically Endangered (CR) in October 2000. It currently meets World Conservation Union (IUCN) Red List Criteria A2c, B1+2c (World Conservation Union 2000) as there has been an observed population size reduction of 80% over the last ten years and the processes thought to be causing this decline are still occurring.

Strategy for recovery

To design recovery actions for both occurrences; and identify and influence the management of the two catchments, so maintaining natural biological and non-biological attributes of the sites and the current area covered by the community.

To conduct appropriate research into the ecology of the community to develop further understanding about the management actions required to maintain or improve the condition of the community.

2. RECOVERY OBJECTIVES AND CRITERIA

Objective

To maintain or improve the overall condition of the lake bed community of both Lake Bryde and East Lake Bryde and reduce the level of threat to their survival towards downgrading it from Critically Endangered to Endangered.

To abate identified threats and maintain viable *in situ* populations of *Muehlenbeckia horrida* subsp. *abdita* to ensure the long-term preservation of the species in the wild.

To preserve the genetic material of *Muehlenbeckia horrida* subsp. *abdita* for restocking existing populations or translocation to more secure sites.

Criteria for success

- Maintenance or improvement of the vigour and extent of the community, especially *Muehlenbeckia horrida* subsp. *abdita*.
- Reduction of threatening processes as defined in this document, in particular the maintenance of salinity at less than ten parts per thousand.

Criterion for failure

- Continuing increases in salinity of either or both occurrences and significant loss of the number of individuals and populations of *Muehlenbeckia horrida* subsp. *abdita* and other component species or further modification (i.e. reduction in the dominance of shrub species, increase in weed composition) of the community due to increased salinity or other means.

3. RECOVERY ACTIONS

3.1 Existing Recovery Actions

Appropriate land managers have been informed of the importance of the Threatened Ecological Community, and the Declared Rare Flora and their legal obligations.

Staff from the Katanning District are regularly monitoring the populations.

The Lake Bryde wetland system has been designated a natural diversity recovery catchment under the State Salinity Action Strategy, and a Lake Bryde Catchment Recovery Team has been established under that program. Abatement strategies for salinity and water-logging/inundation are being designed under that strategy. The Recovery Team will report annually to the Department's Corporate Executive. Already information regarding the Wetland System has been obtained: Catchment hydrogeological assessment (including modeling the development of shallow saline watertables); Valley Floor Contour Mapping and GIS Flow Characteristic Assessment; and Catchment Crown Reserve Vegetation Survey and Assessment. Other investigations in train include Soil Landscape Unit Assessment; and Catchment Surface Water Management Options (B. Bone, personal communication[4]).

3.2. Additional Recovery Actions

3.2.1 Write a full Recovery Catchment Plan

This IRP constitutes a preliminary step to the production of a full Catchment Recovery Plan, the writing and implementation of which will be overseen by the Lake Bryde Recovery Catchment Team.

Responsibility: Katanning District via the Lake Bryde Recovery Catchment Team (LBRCT)
Estimated cost: LBRCT to determine costs and seek funds
Completion date: Year 2.

3.2.2 Assess and monitor the condition of the community

It is important to assess the current condition of the lake bed community at each of the occurrences. A suitable method would be to estimate percentage cover of the lake bed community using a long linear transect (as the lake bed community is sparse). As well, another line transect should be placed elsewhere on the lake that would show a change in cover up-slope. This procedure, performed annually, would be one of a number of suitable ways to monitor any changes to the community. In addition, annual aerial and land photography from the same position as previous studies (eg. Watkins and McNee 1987) could be used to further monitor changes in the vegetation. All information will be added to the Threatened Ecological Communities (TEC) database as recommended in English and Blyth (1999).

Monitoring of factors such as recruitment, longevity, population stability (expanding or declining), pollination activity and seed production of *Muehlenbeckia horrida* subsp. *abdita* is essential. These factors should be inspected biennially.

Responsibility: Katanning District via the LBRCT
Cost: $2 500 p.a.
Completion date: On-going.

3.2.3 Obtain and monitor changes in hydrological information

This includes determining surface- and ground- water processes affecting the two lakes using information from current equipment (e.g. bore data, depth gauges) and installing new equipment (e.g. groundwater piezometers, gauging stations).

Responsibility: Katanning District via the LBRCT

Estimated cost: Katanning District to determine costs and seek funds
Completion date: On-going.

3.2.4 Manage water quality and ensure stability in hydrological regimes

Design and implement strategies to manage water quality and ensure stability in hydrological regimes. This may include the design and implementation of a groundwater pumping scheme and a surface water diversion scheme, and the disposal of both the pumped groundwater and surface water.

Responsibility: Katanning District and Catchment landowners via the LBRCT
Estimated cost: Katanning District to determine costs and seek funds
Completion date: On-going.

3.2.5 Explore options for catchment revegetation

Liaise with landholders/catchment group to be involved in catchment revegetation and to promote agronomic practices that increase water usage and help in lowering the water table. Lists of suitable species and the various agronomic practices should be available from Agriculture WA and the Land Conservation District Committee.

Responsibility: Katanning District, Community Landcare Coordinator & Agriculture WA via the LBRCT
Estimated cost: Katanning District to determine costs and seek funds
Completion date: On-going.

3.2.6 Obtain biological and ecological information on the major components of the community

Research designed to increase an understanding of the biology of the two key species of the community, particularly *Muehlenbeckia horrida* subsp. *abdita,* will provide a scientific base for management in the wild. Research will include:

1. Study of the soil seed bank dynamics and the role of various factors (disturbance, competition, rainfall and grazing) in recruitment and seedling survival.
2. Seed germination requirements.
3. Quantification of level of seed predation or removal of seed.
4. Determination of reproductive strategies, phenology and seasonal growth.
5. Factors determining level of flower and fruit abortion.
6. Investigation of population genetic structure, levels of genetic diversity and minimum viable population size.
7. Effects of weeds on recruitment and establishment.
8. Response to herbicide treatments.
9. Response to fire.
10. Response to trampling.
11. Response to changes in salinity and periods of inundation, particularly at different stages of their life-cycles.

Responsibility: Science Division and Katanning District
Cost: Katanning District to determine costs and seek funds
Completion date: On-going.

3.2.7 Preserve genetic diversity of the major components of the community

It is necessary to store germplasm as a genetic resource, ready for use in translocations and as an *ex situ* genetic 'blueprint' of the major components of the Threatened Ecological Community, in particular *Muehlenbeckia horrida* subsp. *abdita*. The germplasm stored will include seed and live plants in cultivation.

Care will be taken to minimise an inherent risk of depletion of seed bank reserves. The first aim of germplasm collection will be the preservation of the species in the wild.

If it is not possible to collect adequate quantities of viable seed, other methods of germplasm storage will be investigated, such as living collections grown from cutting material.

Responsibility: Katanning District and Threatened Flora Seed Centre
Cost: $4,500 for year 1; $1,500 for year 3
Completion date: Year 3.

3.2.8 Conduct further surveys

Further surveys supervised by district staff, and with the assistance of the Newdegate Volunteer Flora group, will be conducted for *Muehlenbeckia horrida* subsp. *abdita* during the year. Aerial photography may be used to locate sites where the species may occur or to which it could be introduced if necessary. Publicity methods such as radio interviews and articles on the community as well as actions taken to secure the community's future may also aid in locating further occurrences.

Responsibility: Katanning District
Cost: $2,000 p.a.
Completion date: On-going.

3.2.9 Disseminate information

The importance of biodiversity conservation and the protection of the Lake Bryde Wetland System will be promoted to the public. This will be achieved through an information campaign using the local print media, electronic media and by setting up poster displays at agricultural field days. This is especially important as lakes are highly threatened, and increased awareness may result in the discovery of other occurrences.

An information sheet, which includes a description of the threatened community, declared rare flora, threats and management actions will be produced. Formal links with local naturalist groups and interested individuals will be encouraged.

Responsibility: Katanning District
Cost: $1 000 p.a.
Completion date: On-going.

3.2.10 Determine the extent of weed invasion, design and implement weed control program

Determine the extent of weed invasion on both the lakes with a site visit. If deemed necessary, design and implement a weed control program involving the following steps (adapted from Panetta and Hopkins 1991):

1. Accurately mapping the boundaries of the weed populations.
2. Selection of an appropriate herbicide after determining which weeds are present.
3. Controlling invasive weeds by hand removal and spot spraying when weeds first emerge.

The tolerance of the native plant species to herbicides is unknown and it is recommended that weed control programs are undertaken in conjunction with research (see recovery action 3.2.6).

Responsibility: Katanning District
Cost: Katanning District to calculate and pursue funds
Completion date: On-going.

3.2.11 Develop and implement a translocation proposal

Background information on the translocation of threatened animals and plants in the wild is provided in The Department's Policy Statement No 29 *Translocation of Threatened Flora and Fauna* (Department of Conservation and Land Management 1995). Translocation is considered as desirable for the conservation of a species if populations are in rapid decline. In light of the predictions of Sinclair Knight Merz (2000), it is recommended that restocking existing populations and translocation to more secure sites be investigated, with the latter given priority.

Although translocations are generally undertaken under full Recovery Plans it is possible to develop a translocation proposal, search for suitable translocation sites and start growing plants within the timeframe of this Interim Recovery Plan. All translocation proposals require endorsement by the Director of Nature Conservation.

Responsibility: Katanning District
Cost: Katanning District to calculate and pursue funds
Completion date: Year 3.

3.2.12 Seek to vest Lake Bryde Nature Reserve in the Conservation Commission of Western Australia

Negotiate with the Water Corporation to transfer the vesting of Lake Bryde Nature Reserve to the Conservation Commission of Western Australia, to be managed by the Department of Conservation and Land Management.

Responsibility: Katanning District and Land Administration Section
Estimated cost: $Nil.

4. TERM OF PLAN

This Interim Recovery Plan will operate from July 2001 until replaced by a full Catchment Recovery Plan.

5. ACKNOWLEDGMENTS

The following people have provided assistance and advice in the preparation of this Interim Recovery Plan:

Brett Beecham	Regional Ecologist, Department of Conservation and Land Management (Wheatbelt Region)
Bruce Bone	District Manager, Department of Conservation and Land Management, Katanning District
Emma Bramwell	Assistant Recovery Catchment Officer, Department of Conservation and Land Management, Katanning District
Andrew Brown	Botanist, WATSCU, Department of Conservation and Land Management
Bethea Loudon	Flora Conservation Officer, Department of Conservation and Land Management, Katanning District
John Riley	Rare Flora Technical Officer, Widlife Branch, Department of Conservation and Land Management.

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6. REFERENCES

Breheny, K. (1995). *An assessment of the salinisation of Lake Bryde and East Lake Bryde using diatoms and macro-invertebrates*. Unpublished report to Edith Cowan University.

Department of Conservation and Land Management (1994) *CALM Policy Statement No. 55, Setting Priorities for the Conservation of Western Australia's Threatened Flora and Fauna.* Department of Conservation and Land Management, Perth.

Department of Conservation and Land Management (1995) *CALM Policy Statement No. 29, Translocation of Threatened Flora and Fauna.* Department of Conservation and Land Management, Perth.

Davies, J. and Associates Pty. Ltd. (1996). *Feasibility of Drainage Modifications*. Unpublished report to the Lake Bryde Land Conservation District Committee.

Davis, J. A., Rosich, R. S., Bradley, J.S., Growns, J.E., Schmidt, L.G. and Cheal, F. (1993). Lakes of the Swan Coastal Plain. Volume 6, *Lake classification on the basis of water quality and invertebrate community data*. Water Authority of Western Australia: Leederville.

English, V. and Blyth, J. (1999). Development and application of procedures to identify and conserve threatened ecological communities in the South-west Botanical Province of Western Australia. *Pacific Conservation Biology 5: 124-138.*

Giraudo, M. (1995). *The Hydrology of Bryde*. Unpublished report to Agriculture Western Australia.

Giraudo, M. (1996). *Lake Bryde/East Lake Bryde Management Plan*. Notes on State of Play. Unpublished report for the Lake Bryde Landcare Project.

Halse, S. A., Pearson, G. B. and Patrick, S. (1993). *Vegetation of depth gauge lakes in nature reserves of south-west Western Australia*. Department of Conservation and Land Management, Technical Report No. 30.

Hamilton-Brown, S and Blyth, J. (1999). Unwooded fresh water wetlands dominated by *Muehlenbeckia horrida* subsp. *abdita* and *Tecticornia verrucosa* across the lake floor of the southern Wheatbelt of Western Australia, 1999-2002. *Interim Recovery Plan 48*.

Hobbs, R. J. and Mooney, H. A. (1993). Restoration ecology and invasions. In Saunders, D. A., Hobbs, R. J. and Ehrlich, P. R. (eds.) *Nature Conservation 3: Reconstruction of Fragmented Ecosystems, pp 127-133*, Surrey Beatty and Sons: NSW.

Mallinson, D., Armstrong, B., Baker, K., Bogie, L., Docherty, L., Gilmore, S., Hopkins, E., Indhamusika, S., Jewell, M., Kivshar, V., Mant, J., Mills, H., Neal, J., Paul, J., Macnamara, J., Stadler, F. and Wilkinson, M. (1998). Ecology and conservation status of *Muehlenbeckia tuggeranong* (Polygonaceae) near Canberra. *Cunningham 5(3): 773-778.*

Mattiske Consulting Pty. Ltd. (1999). *Vegetation Survey of the Lakelands Nature Reserve.* Unpublished report prepared for the Department of Conservation & Land Management

National Parks and Nature Conservation Authority (1999). *Lake Bryde Lake Complex Proposed Recovery Catchment.* Unpublished summary sheet of the National Parks and Nature Conservation Authority.

Panetta, F. D. and Hopkins, A. J. M. (1991). Weeds in Corridors: Invasion and Management. In Saunders, D.A. and Hobbs, R.J. (eds.) *Nature Conservation 2: The Role of Corridors*, pp. 341-51, Surrey Beatty & Sons: NSW.

Raines, J. (1995). *Nomination of lakes of outstanding ornithological importance for the Register of National Estate*. Unpublished report to the Register of National Estate.

Sinclair Knight Merz (2000). *Lake Bryde Recovery Catchment. Hydrology of Lake Bryde, Rev 1.* A report prepared for the Department of Conservation and Land Management.

Watkins, D. and McNee, S. (1987). *A survey of lakes in and adjacent to Dunn Rock and Lake Bryde Nature Reserves*. Unpublished report for the Department of Conservation and Land Management.

Wilson, K. (2000). Polygonaceae. In Harden, G. J. (ed.) *Flora of New South Wales. Volume 1.* pp 278-293. UNSW Press: Kensington, N.S.W.

World Conservation Union (2000). *IUCN red list categories* prepared by the IUCN Species Survival Commission, as approved by the 51st meeting of the IUCN Council. Gland, Switzerland.

7. TAXONOMIC DESCRIPTION of *Muehlenbeckia horrida* (Wilson 1996)

Muehlenbeckia horrida: Depauperate erect to divaricate-intricate subshrub 0.3-1.2 m high, suckering to c. 2m diameter. Older stems grey-white and glaucous, with age becoming brown with flaky or corky bark; younger stems pale to reddish, often somewhat glaucous, irregularly striate or verrucose; branchlets sometimes terminally spinescent. Leaves usually densely crowded on short (c. 2mm long) lateral branchlets, eventually deciduous, semi-succulent, rarely glaucous, simple, sessile; blade linear with abaxial groove, 10-55 mm long, 0.7-1.5 mm wide; base truncate; margins rounded, flat to recurved; apex acute. Flowers 3-5 per cluster at stem nodes or in short lateral branchlets. Perianth in fruiting stage much thickened, mostly 4-angled, tough and corky when dry. Stamens 6-8; anthers 0.8-1.5 mm long. Nut trignous, 2-3 mm long, dark brown, shining smooth.
Muehlenbeckia horrida subsp. *abdita:* Plants 0.6-1.2 m high. Main stems spreading to more or less erect but divaricately to intricatley branched; stems not minutely warty. Perianth segments 5, rarely 4 in a few flowers on a plant.

Summary of recovery actions and costs

Recovery Action	Year 1	Year 2	Year 3
1. Write a full Recovery Catchment Plan	*	*	
2. Assess and monitor the condition of the community	$2 500	$2 500	$2 500
3. Obtain and monitor changes in hydrological information	*	*	*
4. Manage water quality and ensure stability in hydrological regimes	*	*	*
5. Explore options for catchment revegetation	*	*	*
6. Obtain biological and ecological information on the major components of the community	*	*	*
7. Preserve genetic diversity of the major components of the community	$4 500	-	$1 500
8. Conduct further surveys	$2 000	$2 000	$2 000
9. Disseminate information	$1 000	$1 000	$1 000
10. Determine the extent of weed invasion, design and implement weed control program	*	*	*
11. Develop and implement a translocation proposal	-	-	*
12. Seek to vest Lake Bryde Nature Reserve in the Conservation Commission of Western Australia	$Nil		

*CALM (Katanning District) via Lake Bryde Recovery Catchment Team to calculate and pursue costs