



SURVEY OF STREAM FORESHORES IN THE
SCOTSDALE BROOK CATCHMENT
DENMARK, W A



WATER RESOURCE MANAGEMENT SERIES

WATER AND RIVERS COMMISSION REPORT WRT 19
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SCOTSDALE BROOK CATCHMENT
DENMARK, WA

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Report for
Wilson Inlet Management Authority

by
APACE Green Skills

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Acknowledgments

APACE Green Skills would like to acknowledge the support of landholders and farm managers in the Scotsdale Brook catchment, without whose cooperation the survey would not have been possible. The Shire of Denmark provided support for the survey.

Three studies provided the foundation on which the current report was based. The first, by Dr Luke Pen, surveyed the condition of the Kalgan River foreshore (Pen, 1994), the second surveyed the condition of the Hay and Denmark River foreshores (APACE Green Skills and Dr Luke Pen, 1995) and the third surveyed the condition of foreshores in the Little River catchment (APACE Green Skills, 1996). These surveys were undertaken on behalf of the Albany Waterways and Wilson Inlet Management Authorities, which are now both part of the Water and Rivers Commission.

The on-ground survey work for the project was carried out by Alex Syme, Robyn Glenister and David Oldmeadow, in conjunction with local landholders. Mr Syme also carried out the farmer liaison and preparation of tables for the report. Photographs were taken by Alex Syme, Robyn Glenister and Basil Schur. Mr Schur supervised the overall project for APACE Green Skills, and edited and prepared the final report. Other APACE Green Skills staff who as-

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Kim Greenham of Watershed Digital Mapping entered remnant vegetation and the survey data onto Geographic Information System (GIS) and produced all the maps for the project. Mike Taylor, Agriculture Protection (Agriculture WA) provided information on measures to control weeds. A special thanks goes to the staff of Agriculture WA for ongoing support, including Bruce Radys and Dave Weaver.

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HOW TO USE THIS REPORT:

- 1** **Read the report** (the Summary and Sections 1 through to 6), in particular those parts relating to your area/s of interest.
- 2** **Use the Map Index** (Map 1.2 on page 4) to find your approximate property location on the detailed map sheets – these are maps M6 through A4.
The detailed maps are in Chapter 7.
- 3** **Find the map containing your property.** (This will require searching for your Location or Lot number, using local landmarks).
Each sub-section map has a table beneath it, which gives management and rehabilitation advice to landholders.
- 4** Use the detailed legend key on the edge of each map to understand the map referring to your property.
- 5** Use the table and the map index to determine what recommendations have been made for your property.

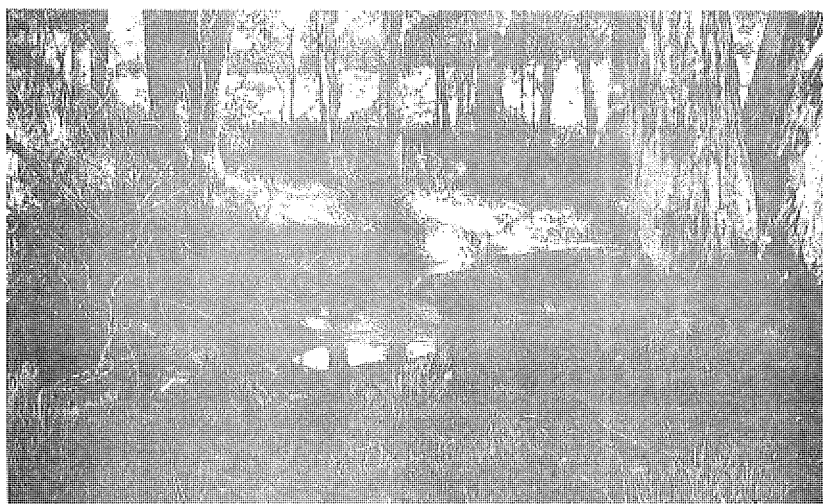




Typical landscape view over the Scotsdale Brook catchment, showing grazing land, remnant karri forest and predominantly cleared valley floor.



*Scotsdale Brook foreshore, showing scarcity of understorey under Peppermint (*Agonis flexuosa*) trees, and erosion along the banks.*



Southern tributary of Scotsdale Brook, adjacent to karri forest remnant. B3 Grade foreshore at this point.



Summary

The Wilson Inlet, on the south coast of Western Australia and adjacent to the township of Denmark, is a regionally significant estuary. The catchment area of the Inlet covers 2363 square kilometres, comprising mainly farmland and Crown land.

The Denmark and Hay Rivers are the two major tributaries of Wilson Inlet with the Sleeman River, Cuppup Creek and Little River being smaller but significant tributaries. The Scotsdale Brook is one of the main tributaries of the Denmark river.

The large quantities of nutrients and sediment that each year discharge into Wilson Inlet come principally from the Sleeman, Little, Hay and Denmark Rivers, and the Cuppup Drain and their tributaries. Currently the Inlet is considered to be eutrophic and under environmental stress. Agricultural land use and resulting nutrient input from farming in the catchment has resulted in the Inlet acting as a sink for nutrient run-off. Unlike most other Australia estuaries the eutrophication is not reflected in frequent algal blooms but in the appearance and rapid growth of *Ruppia* seagrass. The unstable condition of estuary would not require a large amount of added nutrients to disturb the acting balance between *Ruppia* seagrass, algal epiphytes, seasonal phytoplankton levels and the levels of nutrients already retained in the Inlet, creating potentially toxic algal blooms.

Research has highlighted the importance of streamline fringing vegetation in attenuating nutrient and sediment loss from agricultural areas into waterways. There is an increasing call from the local rural community for the rivers and other watercourses of the catchment to be fenced. This would protect these large natural bio-filters and prevent erosion of the riverbanks, which occurs when the protective fringing vegetation is lost through livestock grazing and trampling.

The Scotsdale Brook catchment area covers 6620 hectares. As at 1996 about 3900 ha (59 %) is cleared, about 2343 ha (35 %) under remnant vegetation, 325 ha (5%) under plantations, 3.1 ha under orchards (<0.1%) and 51 hectares (0.8%) under vines. The length of the main brook is 20.1 km. The total length of watercourses in the catchment is 108.7 km, including 18.8 km of northern tributaries, and 67.8 km of southern tributaries.

To assist with the process of catchment repair, the Wilson Inlet Management Authority commissioned APACE Green Skills to carry out a survey to assess the condition of selected foreshores of the Scotsdale Brook catchment. The survey commenced in May 1997 and concluded in July 1997.

This work graded the condition of sections of foreshore bank into three categories: (A) pristine to slightly disturbed, (B) degraded, (C) erosion prone to eroded, and (D) eroding ditch or weed infested drain; on the basis of weed infestation, soil exposure and erosion. The extent of watercourse fencing and revegetation, and the general quality of the fringing vegetation were also assessed.

Foreshore condition and fencing status were assessed in detail along with fencing and rehabilitation needs and other information and the results were then collated.

In total, 68 kilometres of the Scotsdale Brook and its tributaries were surveyed. Of this, about 24% of the riparian zone was A grade, 26% B grade, 26% C grade and 24% D grade. Overall, 62 ha of valley embankment and foreshore requires revegetation to stabilise the banks, and maintain both aquatic and terrestrial corridors.

Of the total of 106 km of watercourses in the Scotsdale Brook catchment, it was estimated that about 16% of the riparian zone was A grade, 20% B grade, 32% C grade and 31% D grade.

In surveyed areas where farmland adjoined the Scotsdale Brook and its tributaries, approximately 41 km of existing watercourse fencing is in place. Only 37% of surveyed foreshores were already fenced. A further 69 km of fencing is recommended in this report. 53% of the required fencing along the 20km of Scotsdale Brook is in place.

The Scotsdale Brook catchment's waterways have many points of erosion and subsidence with the majors sections of degradation in its southern tributaries. Deposits of coarse sediments were observed frequently in the brook bed. Fencing has been placed along some of these sections, but in many cases at an insufficient distance from the waterway to provide an effective buffer.

To protect riverine fringing vegetation and thereby maintain its bio-filtering and erosion control functions, fencelines need to be located above the river valley and, in the case of steep valley embankments, well above it. In some sections of eroding watercourse or dam spillways, soft-engineering approaches (eg construction of pool and riffle systems) are required. Notwithstanding the above, some sections of the brook and tributaries are very scenic and contained foreshores of a high quality.

The findings and recommendations of the survey are designed to provide advice and encouragement to landholders and managers to carry out measures which protect and restore brook and stream foreshore condition. Farmers who wish to receive support for fencing rivers, streams or drains on their properties may apply for assistance from the Wilson Inlet Management Authority and the Shire of Denmark under fencing subsidy and foreshore repair programs currently in place for the Wilson Inlet catchment.

The Scotsdale Brook catchment is intensively used for town water resources, small farms and residential development. In addition to protection, revegetation and weed management of the fringing vegetation of waterways it is recommended that all landusers:

- increase the use perennial grasses, shrubs and trees;
- avoid clearing of remnant native vegetation;



- obtain environmental management advice and approvals prior to constructing dams or any other structures affecting watercourses;
- investigate alternate stock crossing structures, where problems are occurring;
- assist with construction of pools and riffles and dam overflow structures in certain sections of the catchment (such has been recommended by MacKenzie (1996) for sections of the Little River); and
- be encouraged to form and participate in a Scotsdale Brook catchment group, with the aim of formulating a management plan.

Because important species of native fish are still likely to occur in the Scotsdale Brook catchment (including Night fish *Bostockia porosa*, pouched lamprey *Geotria australis*, possibly Galaxid minnows and Marron (*Cherax tenuimanus*)), it is recommended that a management plan be developed with landholders to

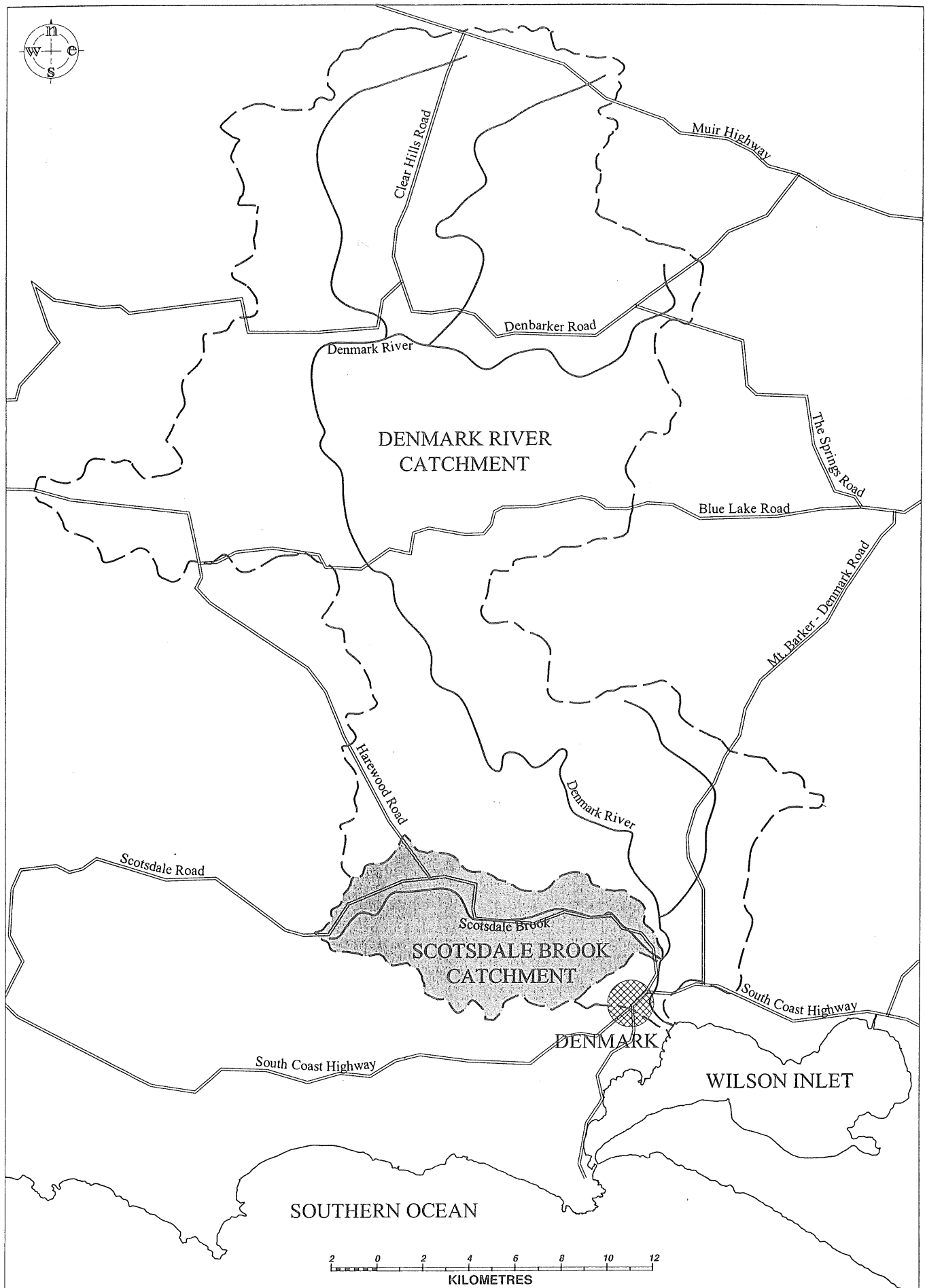
protect native fish and crayfish from introduced fish and crayfish.

Those landholders with farming enterprises in the catchment are encouraged by Agriculture Western Australia to minimise nutrient loss to waterways by:

- regular soil testing and use of appropriate fertiliser recommendations;
- the maintenance of adequate ground cover through stock management;
- the diversification into alternative enterprises on low nutrient retentive sites; and
- the integration of all these measures through whole farm and integrated catchment planning.

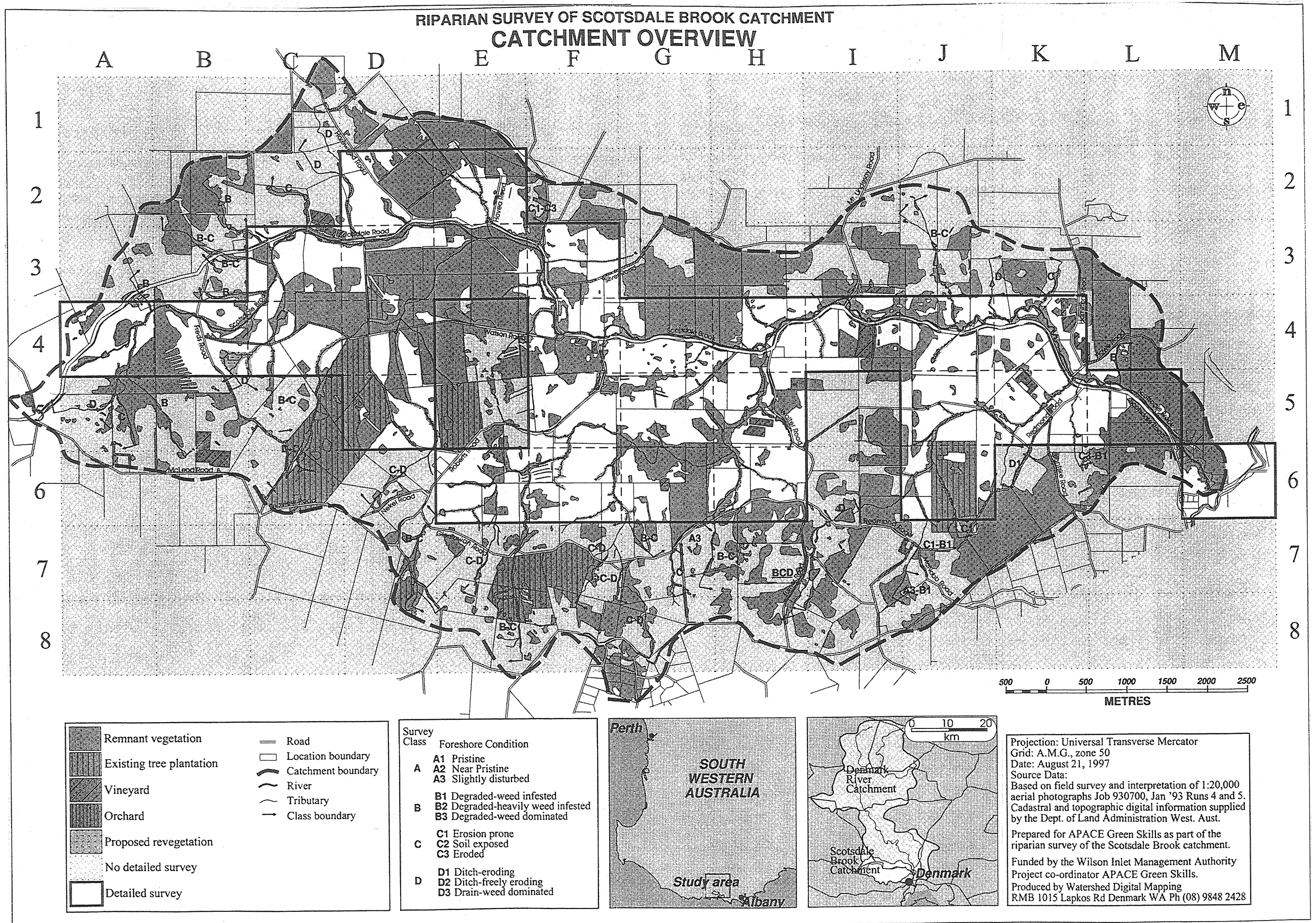
This report is part of an approach whereby Government agencies and community landcare groups cooperate with all landusers to assist in protecting the health of a much valued south coast estuary and its associated waterways.



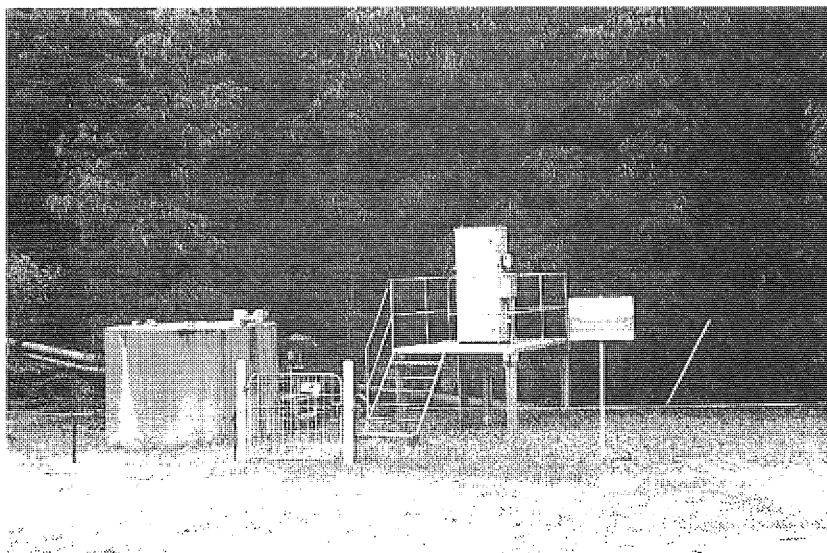


Map 1.1 **Location Map for the Scotsdale Brook Catchment**

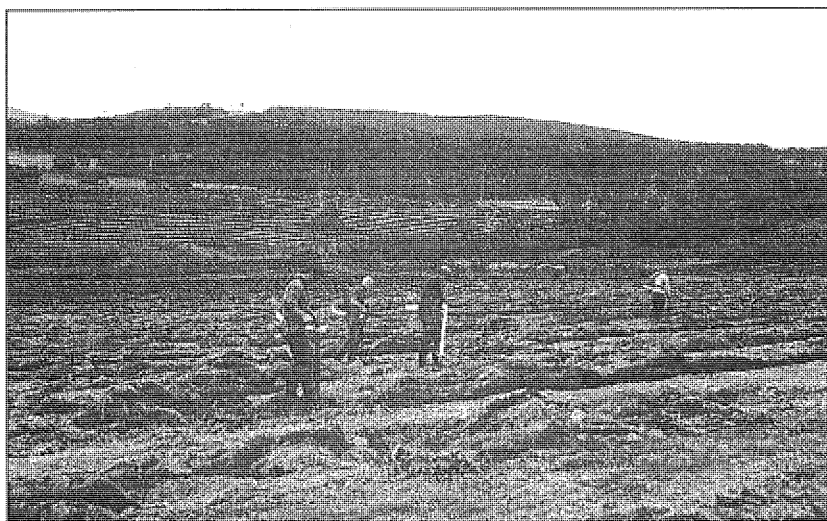




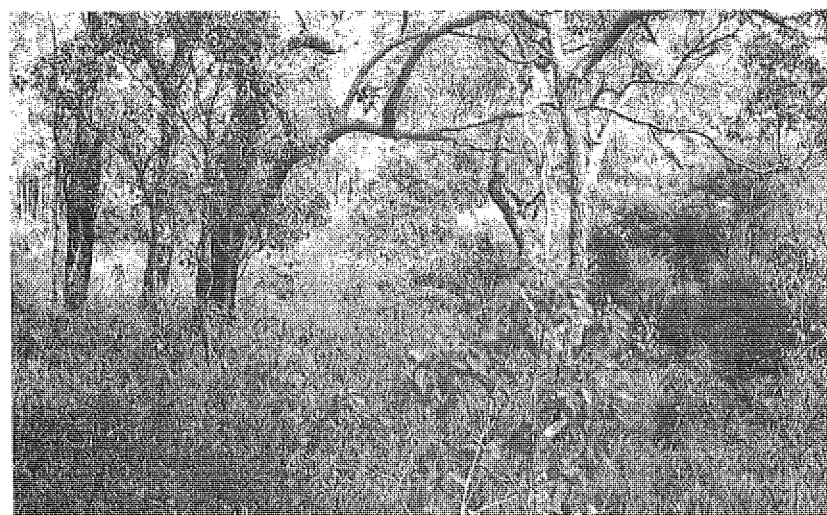
Map 1.2 Base Map and Map Sheet Index for selected tributaries in the Scotsdale Brook Catchment



Scotsdale Pumping Station. The catchment provides an important water resource that has formed part of Denmark's water supply.



Tree planting for Blue Gum plantations in the Scotsdale Catchment, July 1997. Significant areas of farming land are being converted to plantations. Where stock is not removed completely, watercourses still need to be fenced from grazing.



High quality vegetation growing over a tributary of the Scotsdale Brook. At Grade. In their original state many of the watercourses are completely covered by native vegetation.

1. Introduction

1.1 Aims of the study

The aims of the survey were as follows:

1. Survey the condition of selected tributaries in the Scotsdale Brook Catchment and its fringing vegetation using the system outlined in Section 3.2;
2. Map points of serious erosion;
3. Map the extent of fencing along the river and tributaries;
4. Provide a general description of the fringing vegetation and landscape;
5. Assess the health of vegetation along the river and tributaries; and
6. Provide a preliminary series of recommendations for rehabilitation work along the foreshores of the brook and its tributaries. These recommendations were designed to provide encouragement and advice to landholders and agency managers for future riparian repair work.
7. To provide a 'snapshot' of foreshore conditions for selected important tributaries, so that resources for waterway management can be appropriately allocated.

1.2 Study area

The study area consists of the land along the Scotsdale Brook and its tributaries, between where they commence in the catchment and the point at which Scotsdale Brook empties into the Denmark river (see Map 1.2 - Scotsdale Brook catchment index map). The area includes the channel embankments, the floodways and floodplains of the brook and its tributaries, the valley embankments of the river and tributaries which rise immediately above them and the land use adjacent to the Brook and its tributaries (see Fig. 2.1 for an explanation of the terms used to describe river valley form).

1.3 Study background

The Wilson Inlet, on the south coast of Western Australia and adjacent to the township of Denmark, is a regionally significant estuary. Currently, it is threatened with eutrophication, due mainly to excessive nutrient input from agricultural areas in the catchment. The catchment area of the Inlet covers 2363 square kilometres mainly comprising farmland and Crown land.

Studies over the past decade reveal that Wilson Inlet is showing signs of eutrophication. Symptoms include the excessive accumulation of plant material (including of epiphytes) and organic ooze.

Studies carried out by Agriculture Western Australia's Wilson Inlet Catchment Project in 1994 estimated that the total phosphorus load entering the Inlet was approximately 24 tonnes. The Hay River was estimated to contribute 4 tonnes, the Sleeman River 7.4 tonnes and the Cuppup Creek 8.3 tonnes. Because of similarities of the Denmark and Hay River

catchments, Agriculture Western Australia assigned a phosphorus load of 4 tonnes for the Denmark River but did not measure a nutrient load for the Scotsdale Brook or the lower Denmark river catchment. More than 70% of the phosphorus load was estimated to be in particulate form, that is, it is attached to soil particles.

Monitoring results up to 1996 indicate that the Sleeman River and Cuppup Drain appear to be the major sources of sediment and phosphorus in non-high run-off years (Tipping, 1997). However major rain events could still see a major contribution of sediment and phosphate coming from the Denmark and Hay catchments. High sediment loads were observed being discharged from the Scotsdale into the Denmark River during medium rainfall event in August 1997.

In an effort to control nutrient loss to rivers entering Wilson Inlet, a catchment management strategy is being developed, involving the urban and rural community and government agencies. In the general area of the Wilson Inlet catchment, three Land Conservation District Committees (LCDCs) work at a local level to arrest land degradation and reduce nutrient loss. In order to coordinate catchment management work by the LCDCs within the catchment, the Wilson Inlet Catchment Committee (WICC) was formed.

This work has been supported by the South Coast Estuaries Project (SCEP) of Agriculture Western Australia, which investigated and promoted sustainable agricultural systems. In addition, there are a number of other Denmark based conservation organisations which are working towards catchment repair. As the primary source of nutrients entering the Inlet comes from broad acre agriculture, recommendations have been developed that primarily focus on farmers in the catchment area.

Actions recommended by SCEP, that landholders can take to minimise nutrient loss to waterways include:

- regular soil testing to determine fertiliser needs;
- increasing the use and acceptance of the appropriate fertiliser recommendations;
- changing fertiliser application and timing;
- increasing use of deep-rooted plants, perennial grasses, shrubs and trees;
- protecting and rehabilitating stream line vegetation to provide filtering of runoff water;
- reducing drainage and promoting on-farm water use;
- increasing water infiltration and soil water storage;
- using soil amendments such as lime;
- protecting wetland areas from stock;
- minimising clearing of remnant bush;
- maintaining adequate ground cover by better stock management;
- using farm planning as a tool for land management;
- diversifying into alternative enterprises where the nutrient retention capacity of soils is low; and
- promoting sound effluent management for intensive animal industries (Prout, 1995).



SCEP's research has shown that nutrient loss from the catchment reaches maximum levels during high intensity rainfall events during which runoff causes widespread erosion in the catchment (SCEP, 1991). Eroded soil from these events is usually richer in nutrients than the original field soil and large quantities can be washed into Wilson Inlet.

Current scientific research has emphasised the need for placement and maintenance of vegetative strips along streams and rivers. Such fringing vegetation acts to prevent erosion, filter out suspended solids during flood events and assimilate nutrients carried in runoff (Weaver *et al.*, 1994; SCEP, 1991; Weaver and Prout, 1993).

In the Wilson Inlet catchment, there has been a watercourse fencing and regeneration program coordinated by the Denmark Environment Centre since 1989. This has been financially supported by landholders, the Shire of Denmark, the Save The Bush Program of the Australian Nature Conservation Agency, and the Wilson Inlet Management Authority. The program involves landholders applying for grants for watercourse fencing. Between 1989 and June 1995, \$52,600 of fencing subsidy grants had been allocated to farmers. This supported 135 km of fencing on 75 watercourse and river fencing projects on 45 farms within the Wilson Inlet catchment area (Denmark Environment Centre, 1995). In 1996, \$25,768 of funds were provided through WIMA and the Shire of Denmark for fencing 28 km of watercourse fencing on 13 properties (Syme, 1997).

The important values of this catchment have been highlighted in the Denmark Rural Strategy Review (Shire of Denmark, 1997). This strategy identifies the area "as containing some of the best horticultural quality soils in the Shire. Currently the dominant land use in this area is grazing with some intensive agricultural and horticultural activities. There is also increasing pressure for Special Rural subdivision and tourist developments adjacent to the Scotsdale Road. The average lot size is around 40 hectares. The predominant management issues are protection of landscape, rural character, creeklines, eutrophication, over-clearing, water quality and potential salinity, retention of remnant vegetation, fire risk, and protection of prime horticultural land."

The Shire primary policy objective for this catchment area is to conserve the area to support horticulture on capable land and in such a manner that it will not further exacerbate problems identified in the above management issues. The Shire has indicated that it would not support rezoning proposals for Special Rural purposes. The Council's stated goal is to encourage the preparation of an integrated catchment management plan for the catchment in order to address potential management issues and land use conflict. It also encourages the creation of a foreshore protection reserve along the Scotsdale Brook and where appropriate, encourages fencing and revegetation (Shire of Denmark, 1997; 24 - 25)

In recognition of the value of foreshore vegetation in the catchment, APACE Green Skills, received funding from the Wilson Inlet Management Authority to undertake a survey of the condition of selected

foreshores of the Scotsdale Brook and its tributaries. This report contains the results of that survey.

1.4 Description of the region

The Scotsdale Brook River catchment drains about 1.5% of the catchment of Wilson Inlet which is situated on the south coast of south-west Western Australia. The catchment stretches west of Denmark (Map 1.1).

The Wilson Inlet catchment covers an area of about 2363 km². The major waterways of the catchment are the Hay, Denmark, Sleeman and Little Rivers, and the Cuppup and Lake Sadie drains. The Scotsdale Brook is one of the main tributaries of the Denmark river. The Scotsdale Brook catchment area covers 6620 hectares. Of this area about 3900 ha (59 %) is cleared, about 2343 ha (35 %) under remnant vegetation, 325 ha (5%) under plantations, 3.1 ha under orchards (<0.1%) and 50.7 hectares (0.8%) under vines (based on 1996 aerial photography). The length of the main brook itself is 20.1 km. The total length of watercourses in the catchment is 108.7km, including 18.8 km of northern tributaries, and 67.8 km of southern tributaries.

The climate of the catchment is temperate and mild, with a long term historic rainfall average of 1100 mm mostly confined to winter and early spring with evaporation of 1200 mm (Collins and Fowlie, 1981). As with virtually all south-west rivers, the Scotsdale Brook catchment exhibits a discharge pattern which reflects the seasonal rainfall: strong flows over the winter/spring period and moderate to negligible flows over the summer/autumn period. (DPUD, 1991). Although total annual rainfall has decreased, the volume and speed of runoff has increased because of removal of native vegetation (MacKenzie, 1996).

The natural vegetation of the Scotsdale Brook catchment is predominantly forest with a great range of forms and diversity of species. Some areas carry thickets of Peppermint scrub and heath with reed swamps in low lying areas. Karri forest occurs in the hilly country, usually on loamy soils derived from granite outcrops or along the incised valleys. Jarrah forest formations dominate over much of the area. Within the area there are broad swampy drainage lines which currently or used to carry Paperbark, Bullich, Blackbutt or Banksia woodlands and reed swamps, with sandy flats subject to seasonal inundation bearing low woodland of Jarrah, Marri, or Blackbutt (Collins and Fowlie, 1981). The distribution of remnant vegetation in the catchment is shown on Fig 1.2.

The Scotsdale Brook catchment has seen major modifications. Historically it has been affected by clearing for agriculture, logging, road and rail construction (MacKenzie, 1996). Most of the remnant vegetation on farms is unfenced and subject to damage from livestock grazing and trampling.



1.5. Value of fringing vegetation in catchment management

1.5.1 Stream bank stabilisation and soil conservation

The soils of the natural stream valley support a varied flora of trees, shrubs, sedges and herbs. In turn, the vegetation supports the stream bank and protects it from erosion and subsidence. The vegetation does this in a number of ways. Firstly, fringing vegetation increases stream bank roughness which acts to dissipate the energy of running water, with the effect of reducing the erosive capacity of the stream flow (Troeh *et al.*, 1980). Secondly, roots and rhizomes bind and reinforce the soil of the embankments. The large roots of trees anchor the embankment in place and the smaller roots and rhizomes of shrubs, sedges and grasses hold the soil firmly in place at the surface of the ground between the large tree roots. In fact, the soil-root matrix can add ten times extra cohesion to that of an unvegetated embankment (Thorne, 1990).

The roots and rhizomes also act to loosen and break up the soil, with the result that a well vegetated bank enables rapid infiltration of rain water (Thorne, 1990; Riding and Carter, 1992). Together with the extraction of the water by the plants themselves, greater hydrological conductivity causes the bank to be drier than a similar unvegetated bank. In wet weather, this means that the vegetated embankment is less likely to become saturated with water, and thus is less prone to mass failure, such as subsidence and toppling caused by the added bulk weight of the water (Thorne, 1990).

Lastly, riparian vegetation is highly resilient, exhibiting quick regeneration and recolonisation following the effects of severe floods. In this way, the vegetation helps stabilise the river system against the effects of severe erosion and sedimentation (De Bano and Schmidt, 1990; Wissmar and Swanson, 1990).

1.5.2 Sediment and nutrient retention

Research being carried out in Europe, North America and New Zealand increasingly highlights the important function that riparian zone vegetation has in filtering out sediment and nutrients carried in flowing waters. Work on vegetated buffer strips along waterways or between waterways and agricultural land has shown that vegetation of many forms, including grasslands, sedgelands, woodlands and forests, can filter out and retain substantial amounts of sediment and nutrients (Peterjohn and Correll, 1984; Cooper *et al.*, 1987; Dillaha *et al.*, 1988, 1989; Heede, 1988; Knauer and Mander, 1989; Margette *et al.*, 1989). Dissolved nutrients, especially nitrate, are readily taken up and assimilated by plants (Yates and Sheridan, 1983; Peterjohn and Correll, 1984; Howard-Williams and Downes, 1984; Howard-Williams *et al.*, 1986; Pinay *et al.*, 1990).

By reducing stream flow, riparian vegetation promotes sediment deposition (Thorne, 1990). Sand can be deposited even when water is fast moving and silt will

settle out where vegetation causes a marked reduction in flow. However, near-still water, such as that caught in densely vegetated floodplains, is required for the deposition of the very fine clay fractions (Troeh *et al.*, 1980). Over time, substantial stream bank and floodplain accretion can occur in certain areas as a result of sediment deposition, and this can alter hydrological processes (Thorne, 1990). The removal of suspended sediment by vegetation is especially important, as water carrying sediment has a greater momentum and is more abrasive than clean water, and thus has an enhanced capacity to cause erosion (Troeh, 1980).

Many of the nutrients trapped in the vegetation of waterways or in buffer strips are assimilated by the vegetation (Odum, 1990). Generally, the longer the water is held by the vegetation, the greater the uptake of nutrients (Howard-Williams *et al.*, 1986). Of course, the nutrients are eventually released back into the water column when plant material decays, but much of this will once again be assimilated. In this way the riparian system retards the rate of transfer of nutrient particles downstream, in a process known as nutrient spiralling (Pieczynska, 1990; Pinay *et al.*, 1990).

Nitrogen can be removed from riparian systems completely. This occurs via the biochemical process of denitrification, which causes nitrate to be converted to gaseous nitrogen. This process can be the major form of nitrogen removal in certain riparian zones and during particular environmental conditions such as those which occur during and after flooding (Jacobs and Gilliam, 1985; Pinay *et al.*, 1990).

1.5.3 Ecological values

Streamline vegetation not only has natural resource value in its own right, but it also provides a range of habitats for a large variety of plants and animals, particularly species which are restricted to moist or aquatic environments or species which are restricted to particular rivers or streams. For example, it is likely that the Scotsdale Brook and its tributaries provide one of the few breeding environments for the Pouched Lamprey (*Geotria australis*). Furthermore, as stream systems are linear in form and cover large distances, their vegetation helps to create ecological corridors. These natural corridors, along with unnatural ones, such as the vegetated strips along road and rail reserves, enable plant and animal species to move between larger patches of remnant habitat (Hussey *et al.*, 1989).

1.5.4 Recreational and landscape values

Foreshore areas alongside waterways in the Scotsdale Brook Catchment have important water-resource, recreational and landscape protection values. This is especially the case where such waterways are close to population centres, or sites frequently visited by tourists. In particular, foreshore areas along the Scotsdale Road have very high value for recreation and landscape amenity. The high recreational value and landscape values of the Scotsdale Brook foreshore has been recognised and a walkway through the Harewood State Forest. In the future it is expected that a range of further recreational developments will take place in the area surveyed in this report.



1.6 Use of this Report

This report provides a survey of the condition of selected tributaries in the Scotsdale Brook Catchment and its fringing vegetation. The series of recommendations for rehabilitation work along the foreshores of the Brook and its tributaries is intended for use by landholders and waterway management agencies. These recommendations were designed to provide encouragement and advice to landholders and agency managers for future riparian repair work.

The report also aims to provide a 'snapshot' of foreshore conditions for selected important tributaries, so that overall resources for catchment management can be appropriately allocated. The survey aims to provide suitable documentation to support applications for regional resources, as well as providing a means for prioritising fencing and other rehabilitation allocations.



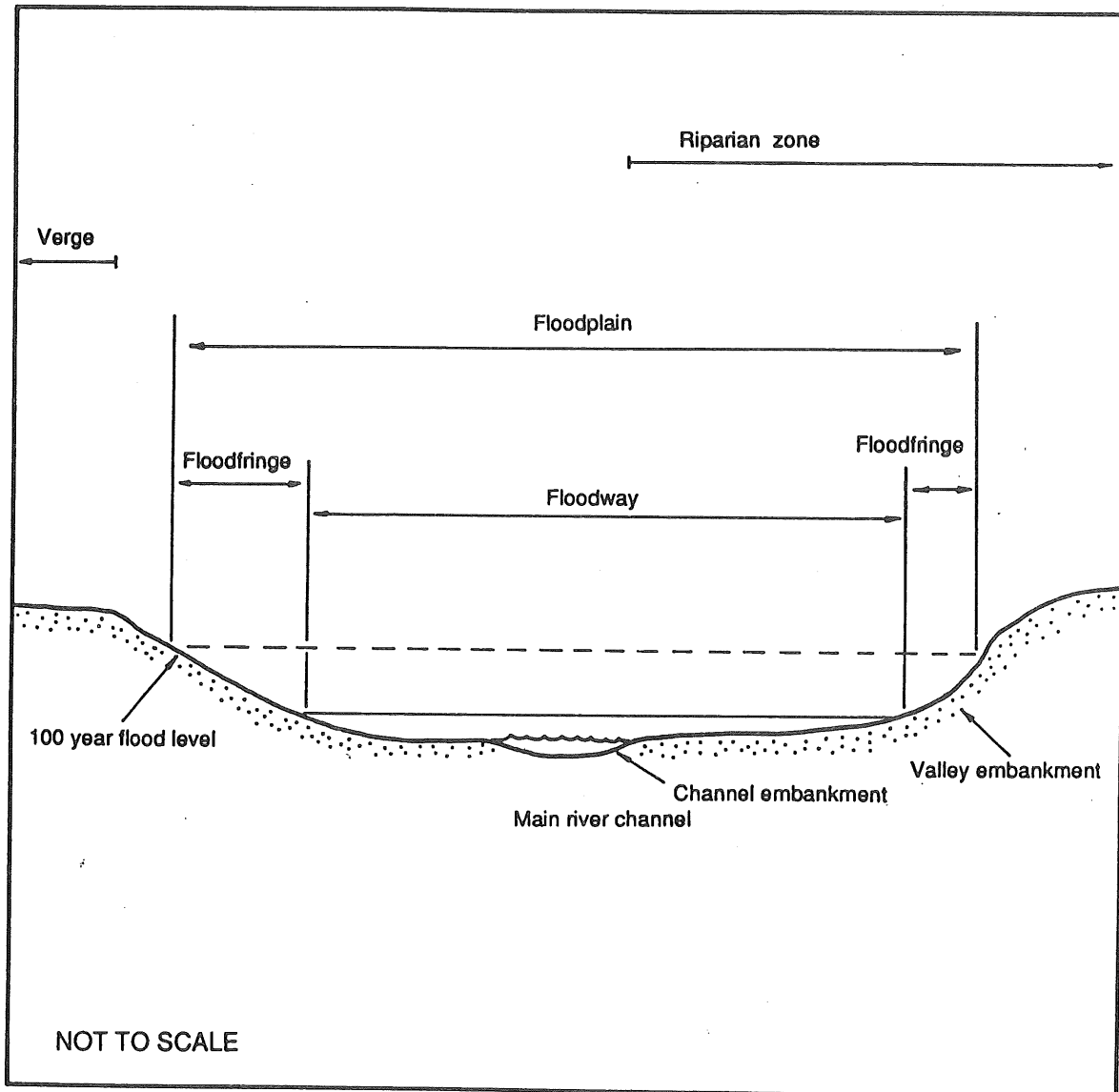


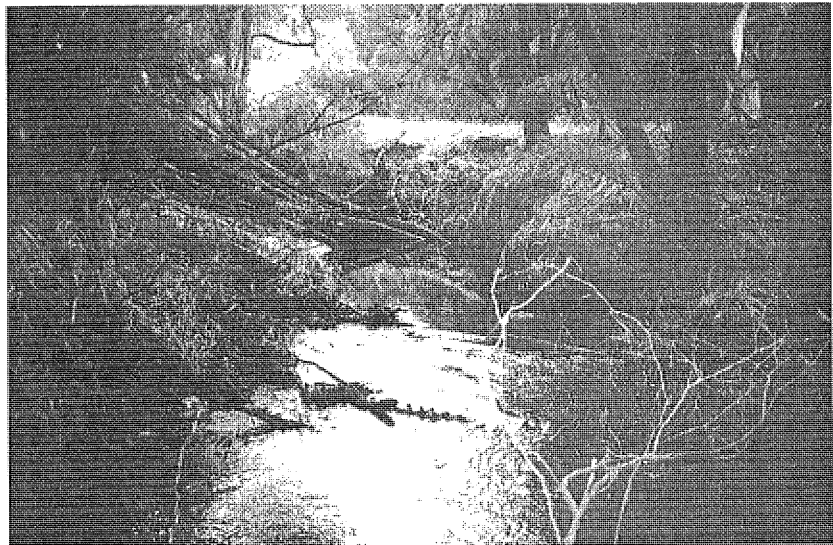
Figure 2.1 - Terms used to describe river valley form.



*Erosion and subsidence
along the Scotsdale
Brook. Blackberry is
visible in the
foreground.*



*Erosion and collapse of
banks and trees into the
Scotsdale Brook.*



*Erosion and woody
snags along the
Scotsdale Brook. It is
recommended that such
logs not be removed, as
they provide aquatic
habitat.*



2. River Valley Form and the Process of River Degradation

2.1 River form

2.1.1 Cross sectional form

Figure 2.1 illustrates typical river valley form in south-west Western Australia and the nomenclature used to describe it.

A typical south-west river consists of a floodway which resides in a valley. Within the floodway, water generally flows along a central channel, which will wander from one side of the floodway to the other as water moves downstream. Sometimes there are two channels: a primary one, which always carries water, and a higher secondary one, which will carry water in times of flood. It is during these large floods, when the broad channel or floodway of the river is full of water, that the river establishes and maintains its form, including the pools and riffles (see below).

When the floodway is contained within a shallow or steep valley, the embankments on each side will contain the water from even the most severe flooding and, therefore, the extent of the extra flood fringe is minor. Conversely, when there is no obvious valley form, the floodplain (ie. floodway plus flood fringe) may extend over a very wide area.

Fringing vegetation seldom occupies the main channel but where water movement is very slow, due to the frictional effects of floodplain vegetation or stream debris, some aquatic species are able to take root. On the other hand, the channel embankment and the floodway support dense vegetation, which may extend over a broad floodplain or up the river valley embankments. Floodplain and river valley embankments can support their own distinctive plant communities, which are often more open than those of the floodway.

2.1.2 Channels, riffles and deep pools

The typical south-west river can be divided into three distinct zones, length-wise. These are the long narrow channels which meander along the floodplain, broad shallow riffle zones and deep broad pools. A typical central channel is often no more than a few metres across, while the floodway can be 5 to 20 metres broad. Sometimes, the riffle zones consist of open areas where shallow water passes over stones, while in other areas it can be densely vegetated, with shallow water passing between clumps of sedges and tree stems. For example, it is not uncommon for the river floodway to support a completely closed canopy of paperbark trees, where, in the absence of an understorey, the water passes freely between the tree stems.

Deep pools are dotted along the length of rivers and are formed as a result of the movement of water (Marsh and Dozier, 1981). In south-western Australia these pools are as long as 50 to 500 metres or more and are typically 20 to 50 metres across and from 3 to 9 metres

deep. Ecologically, they are integral to the south-western Australian river ecosystem, nearly always retaining water over the hot dry summer/autumn months when the channel and riffle zones dry up, thus providing refuge habitat in times of drought for many aquatic animals, including birds, turtles, water rats, fish, crayfish, shrimp and mussels.

2.2 River valley degradation: from river to drain

Previous work by Pen (1994) indicates that there is a pattern of degradation which can be used to describe the state of rivers in south-western Western Australia (see Fig. 3.1).

2.2.1 The healthy river valley

In a healthy river valley, native vegetation is dominant. Not only does it provide habitat for a huge range of animals, but it also supports the substratum that sustains it (Thorne, 1990). The large root systems of trees, which may extend as far as 50 metres, become interlaced and tangled to form a mesh or matrix of roots to a depth of two to three metres or more. This matrix of roots and soil, where trees become tied to each other and support each other, is found right along each side of the river and holds the river valley embankments securely in place. The smaller root systems of shrubs and rhizomes of sedges and the tiny root and rhizome systems of herbs, grasses and small sedges hold the soil firmly in place between the large tree roots and, most importantly, form dense masses of roots and rhizomes along the actual river channel.

In this way, the most powerful floods and heaviest rainfall cannot dislodge the soil of the river valley for virtually the entire length of the river. Only rarely does the action of water gain the upper hand and erosion occur. This usually happens at power bends along the river and would appear, in most cases, to be quickly arrested by the growth of abundant vegetation.

Dense vegetation also serves to retard the rate of flow of floodwaters and to filter out or cause the settling of suspended particles (Thorne, 1990). This action is enhanced by fallen branches which trap leaf litter and cause the formation of obstructions which dam the floodwaters, further reducing their velocity and capacity to erode and carry sediment. In a totally vegetated catchment, floodwaters are held back by the frictional and damming effects of fringing vegetation along hundreds if not thousands of kilometres of streamline and much of the energy required to erode and to carry sediment has been dissipated by the time the waters have reached the estuary.

2.2.2 The degrading river valley

The earliest stage of degradation is the occasional presence of weeds. In near pristine vegetation, weeds are probably brought in by the wind or animals. This



type of degradation is merely floristic and poses no threat to the integrity of the river valley, as the native vegetation remains dominant. However, where there are points of physical disturbance, such as along walking and vehicular tracks or where feral pigs or rabbits have turned over the soil, localised exposures of soil and infestations of weeds may occur. In this situation, there is a small risk of severe water erosion.

Typically, severe degradation does not begin until livestock regularly enter the river valley to graze. Here they trample the native vegetation, eat out the more palatable species, trample the soil and bring in weed seed. This serves to encourage the establishment of weeds and to discourage the regeneration of native species. The longer the river valley is subject to livestock and the heavier the stocking levels, the quicker the native vegetation is replaced by weeds. The rate of weed invasion is accelerated by an increase in the frequency of fires, which favours species with short life cycles, which are mostly introduced grasses, over species with long life cycles, which are mostly native (Hussey and Wallace, 1993).

Eventually, the native understorey species are replaced entirely by weeds and the native trees begin to die out as the level of regeneration can no longer keep pace with mortality.

2.2.3 The eroding river valley

With continued livestock grazing and trampling and frequent fires, the deep root systems of native shrubs, sedges, grasses and herbs, which once had a firm hold on the soil between the large tree roots, are largely replaced by the shallow root systems of introduced annual grasses and other weeds. These new species do not bind the surface soil as well as the former native species, especially over the late summer/autumn period when most have senesced, and are quite easily dislodged by livestock trampling and surface water flow. Under these conditions, the river valley is prone to severe erosion.

If the thin protection afforded by annual weeds is lost, the soil between the large roots of trees and tall shrubs is easily washed away. On the valley embankment,

surface flow from adjacent pastured areas or high flood waters can dig long furrows, exposing tree roots and undermining trees and tall shrubs. Lower down, huge bites can be taken out of the river channel embankment and the valley embankment can be undermined, causing further sections to be undercut beneath the root zone and to collapse into the river. Where this occurs, the remaining part of the embankment can be held in place by tree roots until further undercut, but if trees are not present to support the embankment, parts of the embankment can subside into the river. This would appear to occur in very wet weather where unsupported valley embankments become sodden (Thorne, 1990).

At first, only the most prone areas will exhibit severe erosion, but gradually more and more areas will become eroded, until the river resembles a ditch. Not only will the river valley become increasingly prone to erosion as a result of loss of supporting native fringing vegetation, but as it does so the river can become smoother in parts, and the energy which was once dissipated by the vegetation will become available to erode and to carry sediment. There is also less vegetation to intercept the sediment, and thus prevent it from being washed downstream and ultimately into the estuary.

Ironically, coarse sediment lost from the stream banks can build up in places in the stream bed, which becomes wider and shallower as the material of the eroded embankments fills the floodway. In this situation, high bed sediment loads can have two effects: increased bed roughness can retard stream flow and cause upstream flooding; or conversely, large sediment accumulations can deflect flow into the adjacent stream bank or even onto adjacent land, causing further erosion (Schmidt and De Bano, 1990; Thorne, 1990).

The progressive degradation of riparian vegetation has a compounding effect on the waterway, as the reservoir of sediment and nutrients filtered out and assimilated by downstream vegetation over many years begins to be released. This factor could be responsible for the sudden discharge of large quantities of sediment and nutrients into estuaries when parts of this reservoir of material are dislodged by severe floods.



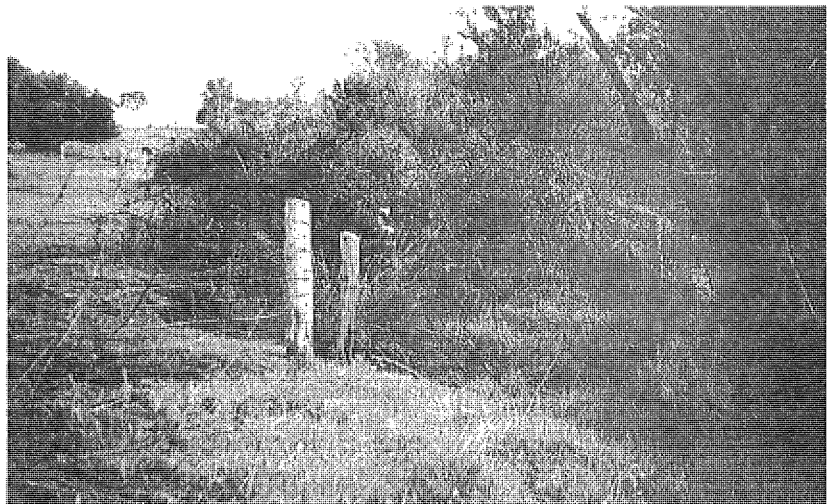
Tea Tree covered watercourse in the catchment. This is a C1 grade site because of the very narrow width of the natural vegetation riparian belt beside the watercourse.



Drain (D1 grade) through farm paddock, with Arum lily, a weed species, growing nearby.



Blackberry growing beside a waterway in the catchment. This is a major weed species and requires a carefully planned catchment approach for its control.



3. Materials and Methods

3.1 Vegetation description

Colour aerial photographs at 1:20,000 scale were obtained from the Waters and Rivers Commission for the study area. Base maps for use in the field were initially produced by Watershed Digital Mapping at 1:10,000 scale. Watershed Digital Mapping also digitised the remnant vegetation for the catchment based on the most recent available colour aerial photographs, and draft vegetation maps were checked and corrected following ground surveys. These sketch maps were drawn to convey information on property boundaries, river foreshore boundaries, the distribution of vegetation, occurrence of weed, the river and the land form.

These sketch maps were then taken into the field and annotated with relevant information on landscape, plant communities, weed infestations, foreshore condition, points of severe erosion and fencing status.

The surveys of the selected tributaries in the Scotsdale Brook Catchment took place over a eight week period between May and July 1997.

3.2 River foreshore condition assessment

3.2.1 System of assessment

The condition of a section of watercourse foreshore or riparian zone was assessed using a simple system developed by Pen (1994) from observations of river system degradation throughout the south-west of Western Australia. The methods, grades and system of assessment have been summarised in Pen and Scott (1995). The system consists of a number of stages or grades - A, B, C and D - beginning at pristine and running through to completely degraded, following the general process of degradation outlined in Section 2.2. Each grade has three sub-levels which are easy to recognise.

This system is described below.

A-Grade foreshore

A1. Pristine

The river embankments and/or channel are entirely vegetated with native species and there is no evidence of human presence, including livestock damage (Fig 3.1A). This category, if it exists at all, would be found only in the middle of large conservation reserves where the impact of human activities has been negligible.

A2. Near pristine

Native vegetation dominates but introduced weeds are occasionally present in the understorey, though not to the extent that they displace native species. Otherwise, there is no human impact. A river valley in this condition is about as good as can be found today (Fig. 3.1A).

A3. Slightly disturbed

Here, there are areas of localised human disturbance where the soil may be exposed and weed density is relatively heavy, such as along walking or vehicle tracks (Fig. 3.1A). Otherwise, native plants dominate and would quickly recolonise disturbed areas should human activity decline.

B-Grade foreshore

B1. Degraded - weed infested

In this stage, weeds have become a significant component of the understorey vegetation (Fig. 3.1B). Although native species remain dominant, a few have probably been replaced or are being replaced by weeds.

B2. Degraded - heavily weed infested

In the understorey, weeds are about as abundant as native species (Fig. 3.1B). The regeneration of some tree and large shrub species may have declined.

B3. Degraded - weed dominated

Weeds dominate the understorey, but many native species remain. Some tree and large shrub species may have declined or have disappeared (Fig. 3.1B).

C-Grade foreshore

C1. Erosion prone

While trees remain, possibly with some large shrubs or grass trees, the understorey consists entirely of weeds, mainly annual grasses (Fig. 3.1C). Most of the trees will be of only a few resilient or long-lived species and their regeneration will be mostly negligible. In this state, where the soil is supported by short-lived weeds, a small increase in physical disturbance will expose the soil and render the river valley vulnerable to serious erosion.



C2. Soil exposed

Here, the annual grasses and weeds have been removed through heavy livestock damage and grazing, or as a result of recreational activities. Low level soil erosion has begun, by the action of either wind or water.

C3. Eroded

Soil is being washed away between tree roots, trees are being undermined and unsupported embankments are subsiding into the river valley.

D-Grade foreshore

D1. Ditch - eroding

Fringing vegetation no longer acts to control erosion. Some trees and shrubs remain and act to retard erosion in certain spots, but all are doomed to be undermined eventually.

D2. Ditch - freely eroding

No significant fringing vegetation remains and erosion is completely out of control (Fig. 3.1D). Undermined and subsided embankments are common, as are large sediment plumes along the river channel.

D3. Drain - weed dominated

The highly eroded river valley has been fenced off, enabling the colonisation of perennial weeds (Fig. 3.1D). The river has become a simple drain, similar, if not identical, to the typical major urban drain.

3.2.2 Application in the field

A section of foreshore would be recognised for assessment on the basis of general homogeneity. For example, a section of foreshore which was fenced off was assessed separately from an adjacent section which was not fenced off and subject to grazing. The floodway, and up to 25 metres up the valley embankment, were assessed together. The opposite

banks of the river were assessed together and the maps show similar class boundaries for the right and left banks of the river.

The banks of the tributaries were graded, and other relevant management information was collected, such as access for stock, presence of weeds, fencing in place, sites of severe erosion, and areas requiring revegetation.



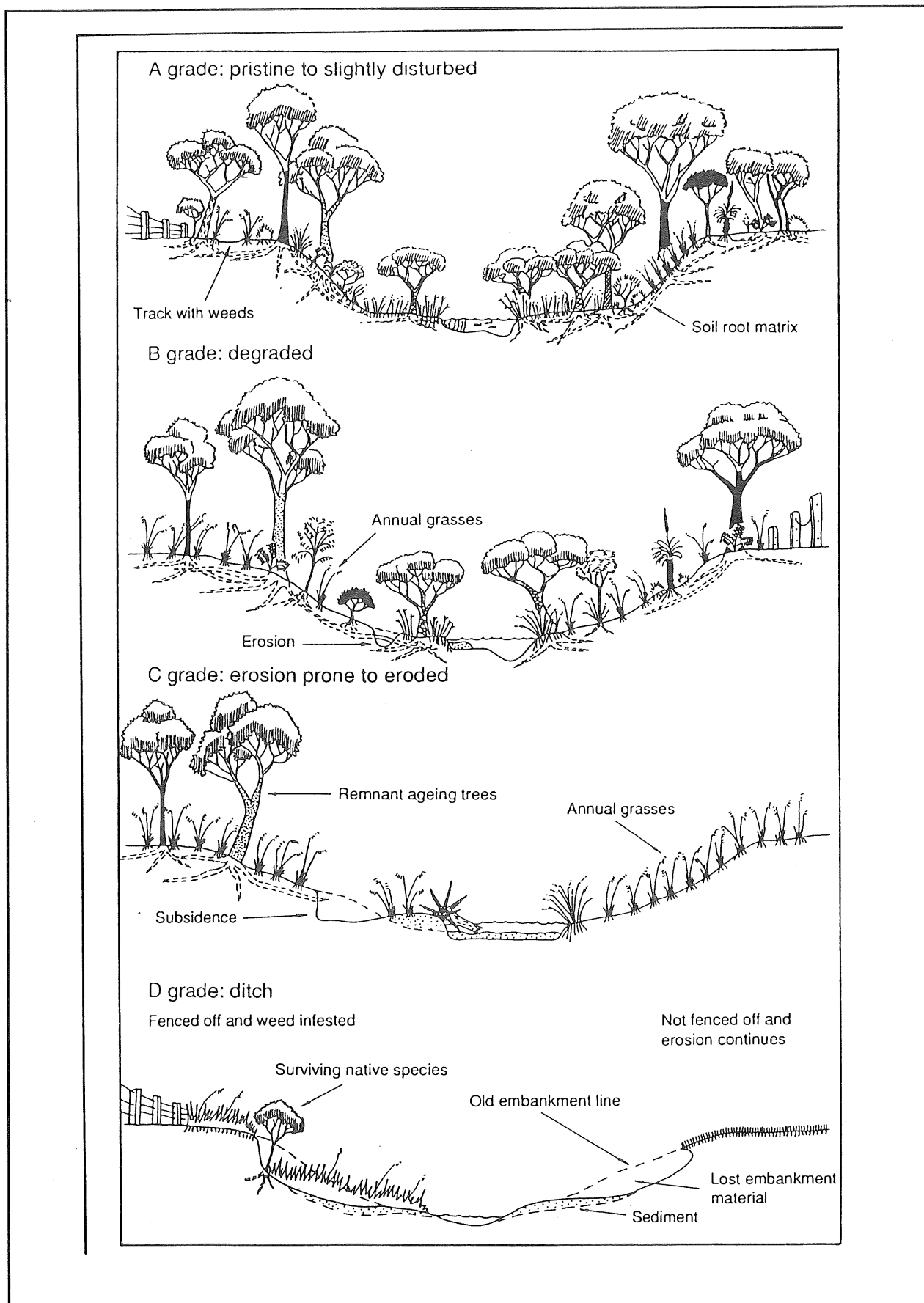
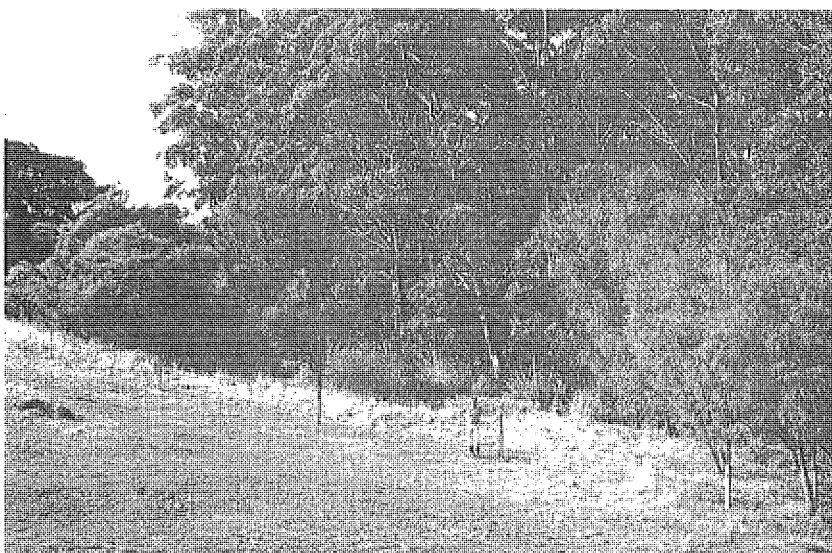


Figure 3.1 - River foreshore condition divided into four stages or grades following the general process of river valley degradation, from pristine river (A) to ditch (D).



This landcare fence was constructed in 1994 beside the Scotsdale Brook to prevent stock grazing. It was funded through the Shire of Denmark's watercourse fencing scheme.



Tree and shrub planting in progress along the Little River in 1996, with ripping, mounding, weed control and planting with a wide range of local species.



Fencing and 3-year-old revegetation, with karri and understorey species along the Little River near Denmark. Such revegetation projects help reduce sediment and nutrient loss to Wilson Inlet.

4. General Condition of the Foreshores of Selected Waterways in the Scotsdale Catchment

Table 4.1 provides details of the length of the streams surveyed in this project, the length of surveyed rives and tributaries adjoined to farmland, riparian condition, current fencing on farms, recommended fencing and recommended revegetation on farms in the study area.

A total of 67.7 km of the Brook and selected tributaries were surveyed amounting to 64 % of the catchment's watercourses. A relatively small length of watercourse of some of the surveyed sections falls within public land and has Class A condition foreshores.

The overall on farm watercourse length surveyed was 65.3 km. This represents 96% of the length of watercourses in the surveyed area.

Of the 67.7 km kilometres of the Scotsdale Brook and its tributaries that were surveyed, about 24% of the riparian zone was A grade, 26% B grade, 26% C grade and 24% D grade. Overall, 62 ha of river valley embankment and foreshore requires revegetation to

stabilise the banks, and maintain both aquatic and terrestrial corridors.

Of the total of 106 km of watercourses in the Scotsdale Brook catchment, it was estimated that about 16% of the riparian zone was A grade, 20% B grade, 23% C grade and 31% D grade.

In surveyed areas where farmland adjoined the Scotsdale Brook and its tributaries, approximately 41 km of existing watercourse fencing is in place. Only 37% of surveyed foreshores were already fenced. A further 69 km of fencing is recommended in this report. 53% of the required fencing along the 20km of Scotsdale Brook is in place.

Detailed information for surveyed sections of the northern and southern tributaries is provided in Table 4.1

Detailed descriptions of required fencing, vegetation rehabilitation and weed control are provided with maps and tables in Chapter 7.



6.4.2 Specific recommendations for control

The following specific recommendations are provided to assist with control of problem weeds. Additional advice from Agriculture Western Australia can be obtained when embarking on weed control programs.

More specific advice on the rehabilitation of cleared areas is beyond the scope of this report and may be obtained from publications such as 'Managing your Bushland' (Hussey and Wallace, 1996) and Bush Regeneration (Buchanan, 1989).

Once waterways are fenced off from stock, weed management problems can arise relatively quickly, particularly if there is insufficient cover of native vegetation on the foreshore. It is vital that landholders who are fencing off waterways from stock, monitor protected areas and plan appropriate means for controlling problem weeds.

Watsonia - Treat by spraying with Round-up Bi-active 360g/l (1 part per 100 of water) or with 2,2-DPA (Dalapon) at 20kg per ha (1kg per 100lt of water spot spray). before flower spike emergence. Dalapon is considered less environmentally damaging than Roundup. Although this formula is designed to be used in wetlands, great care should be exercised to prevent spray drift, which may damage nearby native plants. Isolated plants may be removed by hand. Flower stalks bearing aerial corms or seeds should be cut and bagged and removed from the site. Protect cleanest areas as a priority, and plan the order and priority for tackling larger infestations. Replanting with native plants is important if insufficient occur on site.

Blackberry - Blackberry control is most effective if undertaken during the summer months between early December and late March. When using the herbicide Round-up Bi-active or Metsulfuron methyl" (Ally, Brushoff) it is important that no significant rain falls within at least 2 hours of completion of the spraying and that the entire plant is thoroughly wet with the herbicide mixture. Both herbicides are leaf absorbed so any mixture that reaches the ground would be wasted, so spraying should not be overdone.

The action of Brushoff/Ally on Blackberry can be extremely slow, and may not become obvious until the following Spring (September).

Either "Metsulfuron methyl" (Ally, Brushoff) should be applied at a rate of 10g per 100lt of water. As it is a wettable powder it ideally requires premixing before adding into the spray tank. It is also an advantage to continuously agitate the mixture during use. Add a wetting agent such as "Pulse" at 1 part per 400 mixture.

Or Roundup Bi-active 360g/L (1 part per 80 parts of water) should be applied with 1 part "Pulse Penetrant" to 400 parts of mixture.

Small infestations in environmentally sensitive areas can be treated by neatly cutting every cane (within 5cm of the ground) and immediately (within 5 minutes) painting every stump with pure Round-up.

Where blackberry is removed by grubbing, all root material must be removed.

Regrowth might occur one or two seasons after any one of the above controls, and follow-up monitoring is thus required.

Protect cleanest areas as a priority, and plan the order and priority for tackling larger infestations. Replanting with native plants important if insufficient local plants occur on site.

Arum Lily - Treat by spraying with Roundup Bi-active 360g/l (1 part per 100 of water). Best results if treated between June and October. Monitor for regrowth

Bridal Creeper - Spray with the herbicide "Metsulfuron methyl" (Ally, Brushoff) at a rate of 10g per 100lt of water. Add a wetting agent such as "Pulse" at 1 part per 400 mixture. Protect cleanest areas as a priority, and plan the order and priority for tackling larger infestations. Replanting with native plants important if insufficient local plants occur on site.

6.4.3 Planting along the river valley

Areas of exposed river embankment need to be planted to control erosion. Actual sites of erosion cannot be planted until they are stabilised, as plantings would easily be washed away in the first winter. However, plantings can be carried out just upstream, on cleared non-eroded embankments, to retard flow rates and encourage sedimentation in the former erosion sites, which, in turn, will create sites which can be planted or will be recolonised naturally by plants.

Vegetation rehabilitation requirements along the selected tributaries are given in the tables and maps in Chapter 7.

6.4.4 Minor useful work

There is much useful work that can be done to accelerate regeneration of native riparian vegetation in those B grade areas of the rivers which have recently been fenced off. Tree and shrub seedlings can be protected from rabbit grazing by placing wire cages or old tyres around them, until the plants are large enough to fend for themselves. The cages or tyres can then be moved to other young plants. On a larger scale, small areas can be surrounded by enclosures to reduce grazing by rabbits and small marsupials. This method has produced spectacular results on Rottneest Island where Quokka grazing is a major problem. Clearing or spraying weeds around young plants will encourage growth.

The ground can be prepared below trees and tall shrubs to encourage seed germination and early growth can be encouraged by spraying weeds and by scarifying (shallow ripping) the soil. Deep ripping is not recommended within 20m of trees as it could damage root systems essential for the stability of the embankment and the trees themselves. Scarification has been observed by the authors to produce good results along the Brunswick and Collie rivers. It



should not be done in areas subject to swift flood waters, as severe washouts may result.

Even though these suggested activities are on a small scale, taken across the whole river over many years, they will make a significant contribution to river rehabilitation.

6.5 Stock crossings and watering points

Where properties cross waterways, or where farmers own or manage both sides of streams, livestock crossings are required. The heavy livestock trampling associated with crossings often exposes the soil and initiates serious water erosion. However, simple river crossings, if located and managed properly, need not present an erosion hazard to the river banks. For example, a crossing point could be located just downstream of dense riparian vegetation, where flow rates, even during floods, are minimal, or it could be located in a stony area where erosion is not possible.

In areas where the soil is not cohesive and easily washed away, stones can be placed along the track to dissipate energy and buffer the soil against livestock trampling. At the embankments, where the soil is

often worn down by livestock, large stones or logs can be placed over small ones to form revetments. Crossing points should be fenced off when not in use, to prevent livestock access to the river valley.

Since crossings run up and down the river, embankments they are prone to erosion by water running off the paddocks and channelling down the tracks. To prevent this, tracks leading down to crossing points should not be aligned with the natural drainage lines of the adjacent paddocks.

6.6 Plant species for rehabilitation

Long term general rehabilitation of parts of the fringing vegetation of the Scotsdale Brook tributaries will be necessary to maintain the habitat, bio-filter and ecological corridor functions of the rivers, to combat erosion and preserve the riverine landscape of the region. Lists of native plant species likely to be suitable for the Scotsdale Brook and its tributaries are given in Appendix 1. This Appendix presents information gained from a botanical survey carried out by Mark Parre for the Scotsdale Brook survey.



7. Detailed Description of the Condition and Rehabilitation Needs of Selected Waterways in the Scotsdale Brook Catchment

The selected streams have been divided into 29 maps. Figure 1.2 shows the map index for the various tributaries of the Scotsdale Brook Catchment. For each map, a corresponding table has been developed, recording the foreshore condition along with fencing, revegetation needs and erosion and weed control needs.

Please note the following:

To allow ease of reading from one map to the next, each map has been printed with a legend. The data and information in the table opposite each map refers only to the area indicated, and there are no overlaps between maps.

Information provided in these forms and maps is intended only as suggested recommendations to

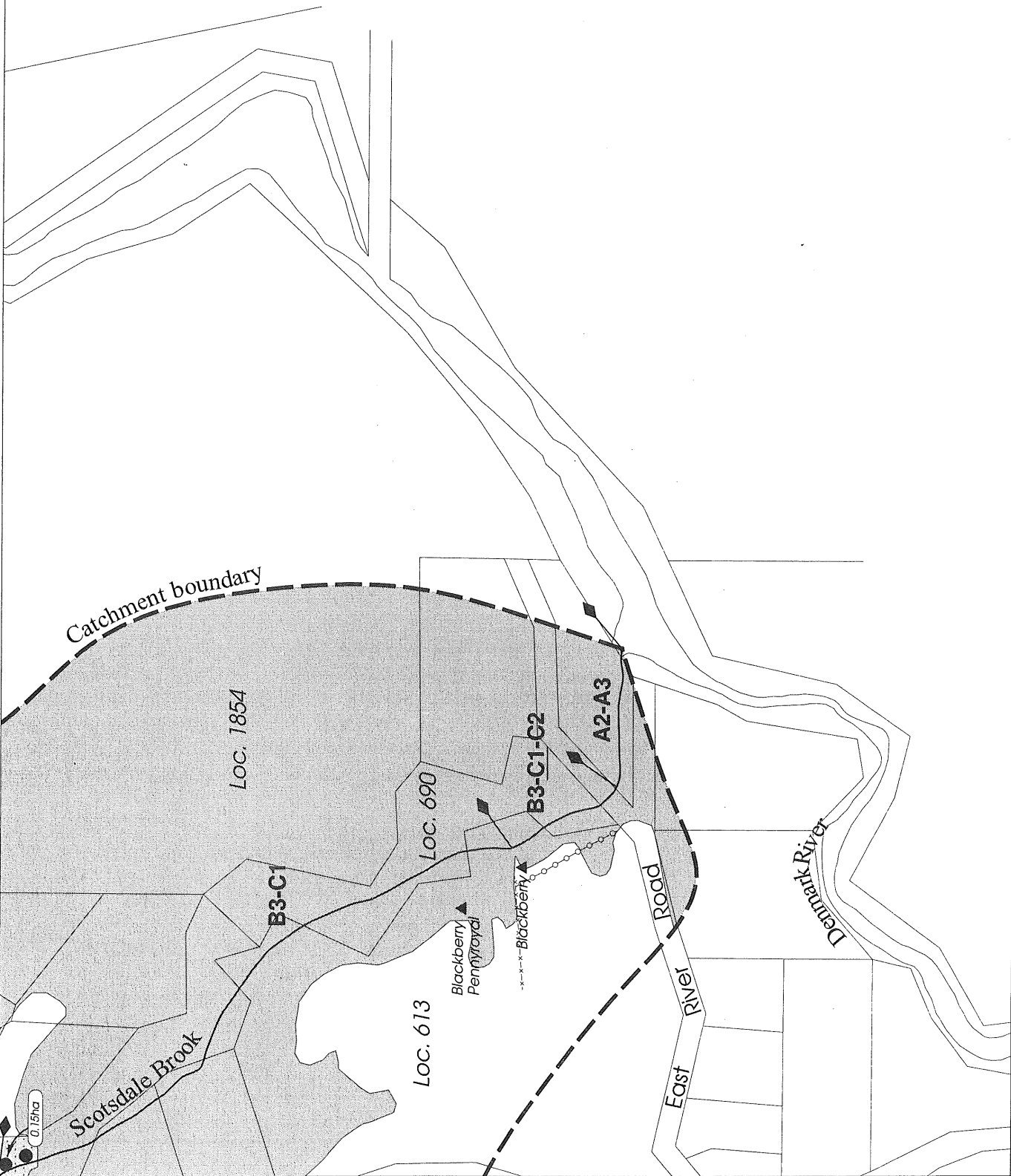
landholders, catchment groups and agencies. As land use is changing in the catchment, all recommended fencing is made on the assumption that livestock are being or will be grazed in the area. Clearly, this is not always the case, and thus when interpreting the maps and recommendations, landholders need to take into account management and land use practices they have in place for their properties. Landholders (either as part of catchment groups or as individuals) are encouraged to apply for fencing and other possible assistance from the Wilson Inlet Management Authority, if they are willing to assist with waterways improvement.

Landholders noting any mistake or modification required of any of these maps are encouraged to advise the Wilson Inlet Management Authority.





M6



Survey Class	Foreshore Condition
A	A1 Pristine
A	A2 Near Pristine
A	A3 Slightly disturbed
B	B1 Degraded-weed infested
B	B2 Degraded-heavy weed infested
B	B3 Degraded-weed dominated
C	C1 Erosion prone
C	C2 Soil exposed
C	C3 Eroded
D	D1 Ditch-eroding
D	D2 Ditch-freely eroding
D	D3 Drain-weed dominated

Example foreshore condition:-
River foreshore condition
A1-A2 mainly A2 with some A1

	Remnant vegetation
	Existing tree plantation
	Vineyard
	Orchard
	Recommended area needing rehabilitation/ revegetation plus approximate area
	Road
	Location boundary
	Catchment boundary
	River
	Tributary
	Foreshore class boundary
	Relevant existing fence at time of survey
	Recommended fencing
	Point of severe erosion or subsidence
	Watercourse crossing point and species
	Watsonia
	Map sheet number

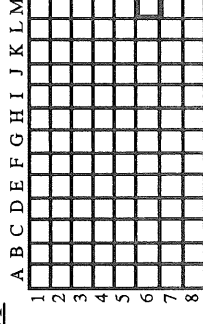


0 50 100 150
METRES
Scale 1:5,000

Projection: Universal Transverse Mercator
Grid: A.M.C., zone 50
Date: August 18, 1997
Source Data:
Based on field survey and interpretation of 1:20,000
aerial photographs Job #60851, Jan 97 Runs 13 to 17
Cadastral and topographic digital information supplied
by the Dept. of Land Administration West. Aust.
Prepared for APACE Green Skills as part of the
riparian survey of the Scotsdale Brook catchment.
Funded by the Wilson Inlet Management Authority
Project co-ordinator APACE Green Skills.
Produced by Watershed Digital Mapping
RMB 1015 Lapkos Rd Denmark WA Ph (098) 482428

SCOTSDALE BROOK SURVEY- Map M6 (See Map 1.2 pg.4 for general location)

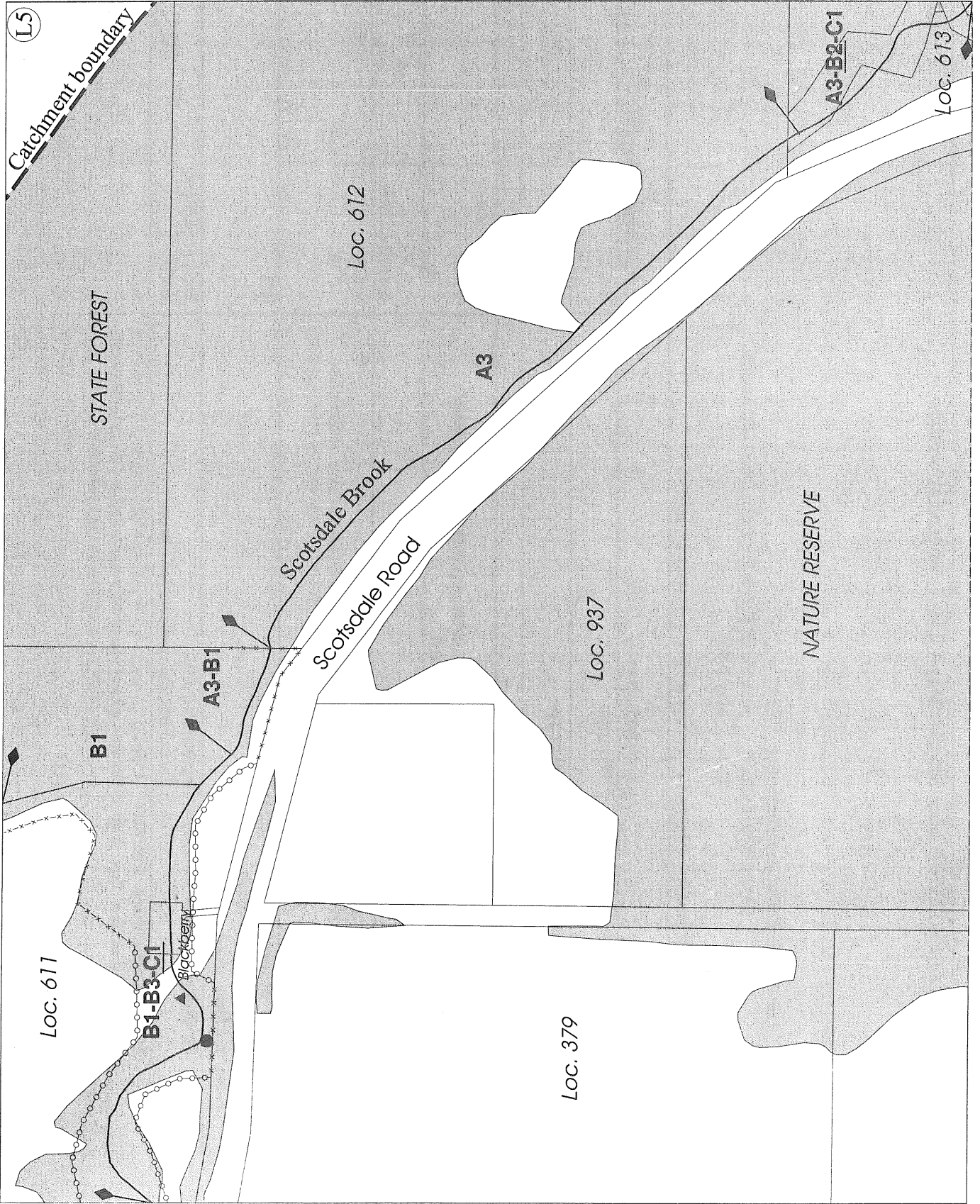
MAP KEY



Loc. Numbers of Adjacent Properties: 613
 Survey Project Officer: Alex Syme; Robyn Glenister; David Oldmeadow.
 Date: May 1997

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Scotsdale Brook	Tributaries/Tributary
Length of watercourse Fencing In Place	106 metres	N/A
Length of watercourse Fencing Recommended	109 metres	N/A
Number of severe erosion sites	1	N/A
Advice on remedial measures required for these sites	Recommendation: Revegetate extensive clearing associated with newly constructed crossing.	Recommendation: N/A
Approximate area along watercourse requiring revegetation	Area (Ha.): 0.2	Area (Ha.): N/A
Advice on Revegetation Species and Preparation	Hand Plant Adjacent vegetation is <i>Agonis juniperina</i> , <i>E. diversicolor</i> <i>Eucalyptus calophylla</i> . (Select further species from Appendix 1)	N/A
Number of other sites requiring rehabilitation work (ie Serious weed infestations)	2	N/A
Advice on Rehabilitation of these sites	Recommendation: Control Blackberry and garden escapes	Recommendation: N/A
Other Management Related Information for this map	Occasional severe undercutting with slumping. The problem lies with greatly increased water volumes during flood events caused by vegetation removal in the catchment.	N/A



L5

Catchment boundary

STATE FOREST

B1

B1-B3-C1

Blackberry

A3-B1

Scotsdale Brook

Scotsdale Road

Loc. 612

A3

Loc. 379

Loc. 937

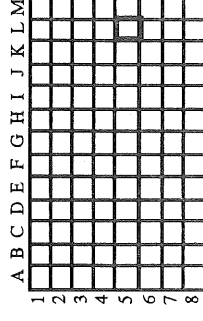
NATURE RESERVE

A3-B2-C1

Loc. 613

SCOTSDALE BROOK SURVEY- Map L5 (See Map 1.2 pg.4 for general location)

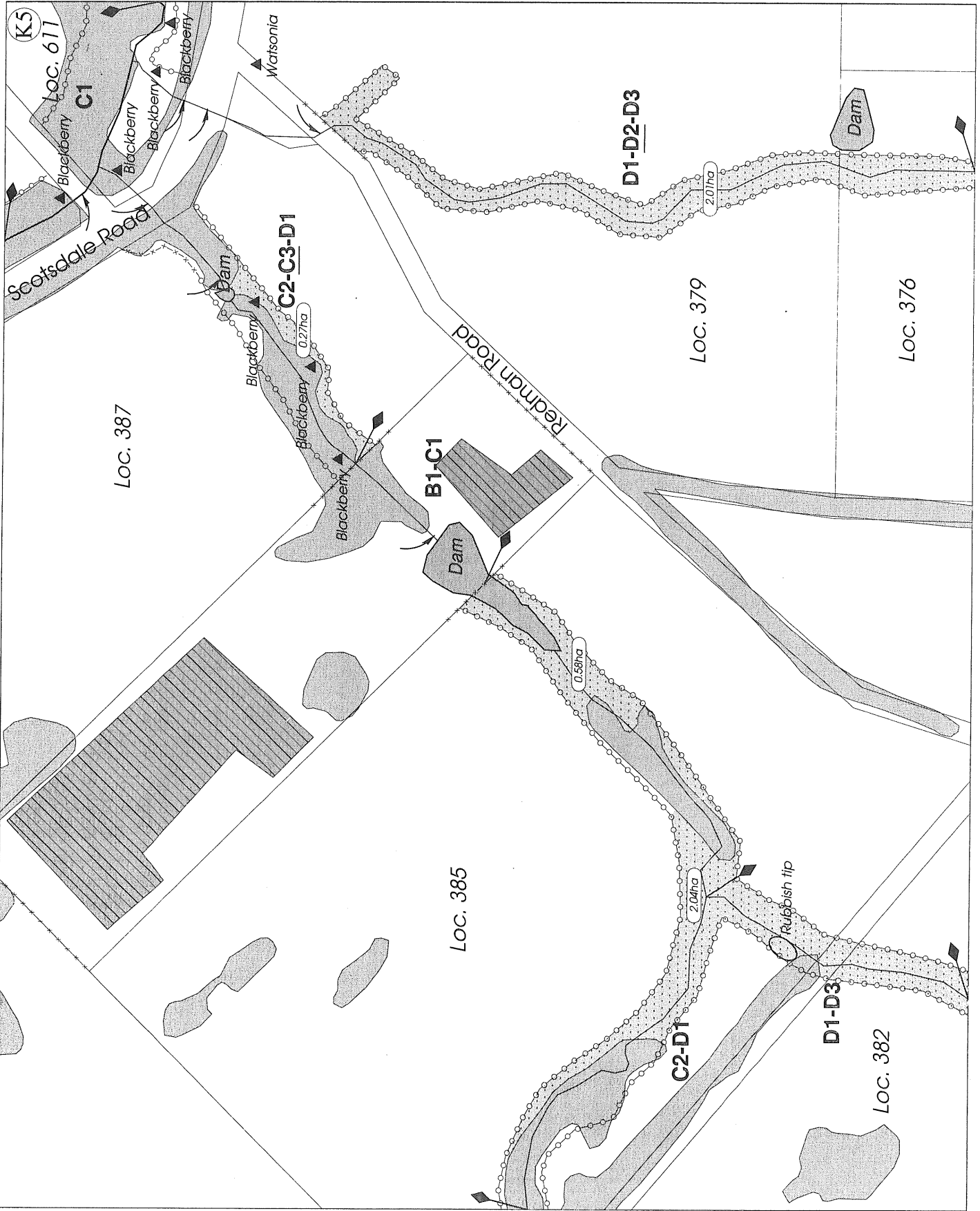
MAP KEY



Loc. Numbers of Adjacent Properties: 611, 612, 613.
 Survey Project Officer: Alex Syme; Robyn Glenister; David Oldmeadow.
 Date: May 1997

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Scotsdale Brook	Tributaries/Tributary
Length of watercourse Fencing In Place	366 metres	160 metres
Length of watercourse Fencing Recommended	702 metres	Nil
Number of severe erosion sites	1	Nil
Advice on remedial measures required for these sites	Recommendation: Fence, control weeds and allow to naturally revegetate.	Recommendation: N/A
Approximate area along watercourse requiring revegetation	Area (Ha.): Nil	Area (Ha.): Nil
Advice on Revegetation Species and Preparation	N/A	N/A
Number of other sites requiring rehabilitation work (ie Serious weed infestations)	Nil	Nil
Advice on Rehabilitation of these sites	Recommendation: N/A	Recommendation: N/A
Other Management Related Information for this map	Occasional severe undercutting with slumping. The problem lies with greatly increased water volumes during flood events caused by vegetation removal in the catchment.	Nil



Survey Class	Foreshore Condition
A	A1 Pristine
	A2 Near Pristine
	A3 Slightly disturbed
B	B1 Degraded-weed infested
	B2 Degraded-heavily weed infested
	B3 Degraded-weed dominated
C	C1 Erosion prone
	C2 Soil exposed
	C3 Eroded
D	D1 Ditch-eroding
	D2 Ditch-freely eroding
	D3 Drain-weed dominated

Example foreshore condition:-
River foreshore condition mainly A2 with some A1

	Remnant vegetation
	Existing tree plantation
	Vineyard
	Orchard
	Recommended area needing rehabilitation/revegetation plus approximate area

3.45ha

	Road
	Location boundary
	Catchment boundary
	River
	Tributary
	Foreshore class boundary
	Relevant existing fence at time of survey
	Recommended fencing or subsidence
	Point of severe erosion
	Watercourse crossing point and species
	Watsonia
	E6

Map sheet number

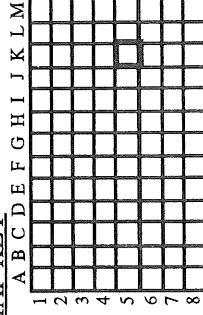


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METRES
Scale 1:5,000

Projection: Universal Transverse Mercator
Grid: A.M.G., zone 50
Date: August 18, 1997
Source Data:
Based on field survey and interpretation of 1:20,000 aerial photographs Job 960851, Jan 97 Runs 13 to 17
Cadastral and topographic digital information supplied by the Dept. of Land Administration West. Aust.
Prepared for APACE Green Skills as part of the riparian survey of the Scotsdale Brook catchment.
Funded by the Wilson Inlet Management Authority
Project co-ordinator APACE Green Skills
Produced by Watershed Digital Mapping
RMB 1015 Lapkos Rd Denmark WA PI (089) 482428

SCOTSDALE BROOK SURVEY- Map K5 (See Map 1.2 pg.4 for general location)

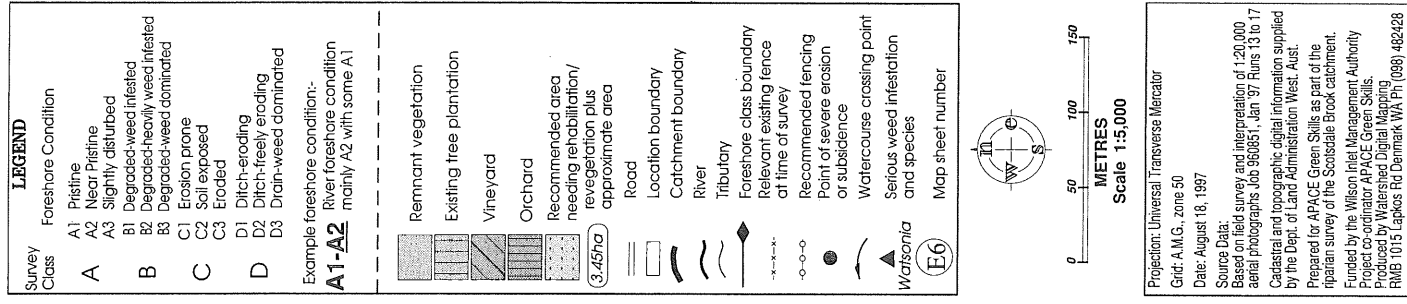
MAP KEY



Loc. Numbers of Adjacent Properties: 386,387,385,382,379,609,611.
 Survey Project Officer: Alex Syme; Robyn Glenister; David Oldmeadow.
 Date: May 1997

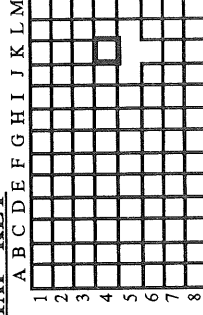
MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Scotsdale Brook	Tributaries/Tributary
Length of watercourse Fencing In Place	Nil	671 metres
Length of watercourse Fencing Recommended	290 metres	3961 metres
Number of severe erosion sites	Nil	5
Advice on remedial measures required for these sites	Recommendation: N/A	Recommendation: Fence and revegetate
Approximate area along watercourse requiring revegetation	Area (Ha.): Nil	Area (Ha.): 4.92
Advice on Revegetation Species and Preparation	N/A	Hand plant Adjacent vegetation is <i>Agonis juniperina</i> , <i>E. diversicolor</i> <i>Eucalyptus calophylla</i> and species suitable for a wetland area. (Select further species from Appendix 1)
Number of other sites requiring rehabilitation work (ie Serious weed infestations)	Numerous Blackberry infestations	Numerous Blackberry infestations
Advice on Rehabilitation of these sites	Recommendation: Carefully treat Blackberry and monitor results	Recommendation: Carefully treat Blackberry and monitor results
Other Management Related Information for this map	Occasional severe undercutting with slumping. The problem lies with greatly increased water volumes during flood events caused by vegetation removal in the catchment.	Where no fencing is recommended in the absence of an existing fence, the recommendation is conditional upon present management of the land continuing.



SCOTSDALE BROOK SURVEY - Map K4 (See Map 1.2 pg. 4 for general location)

MAP KEY

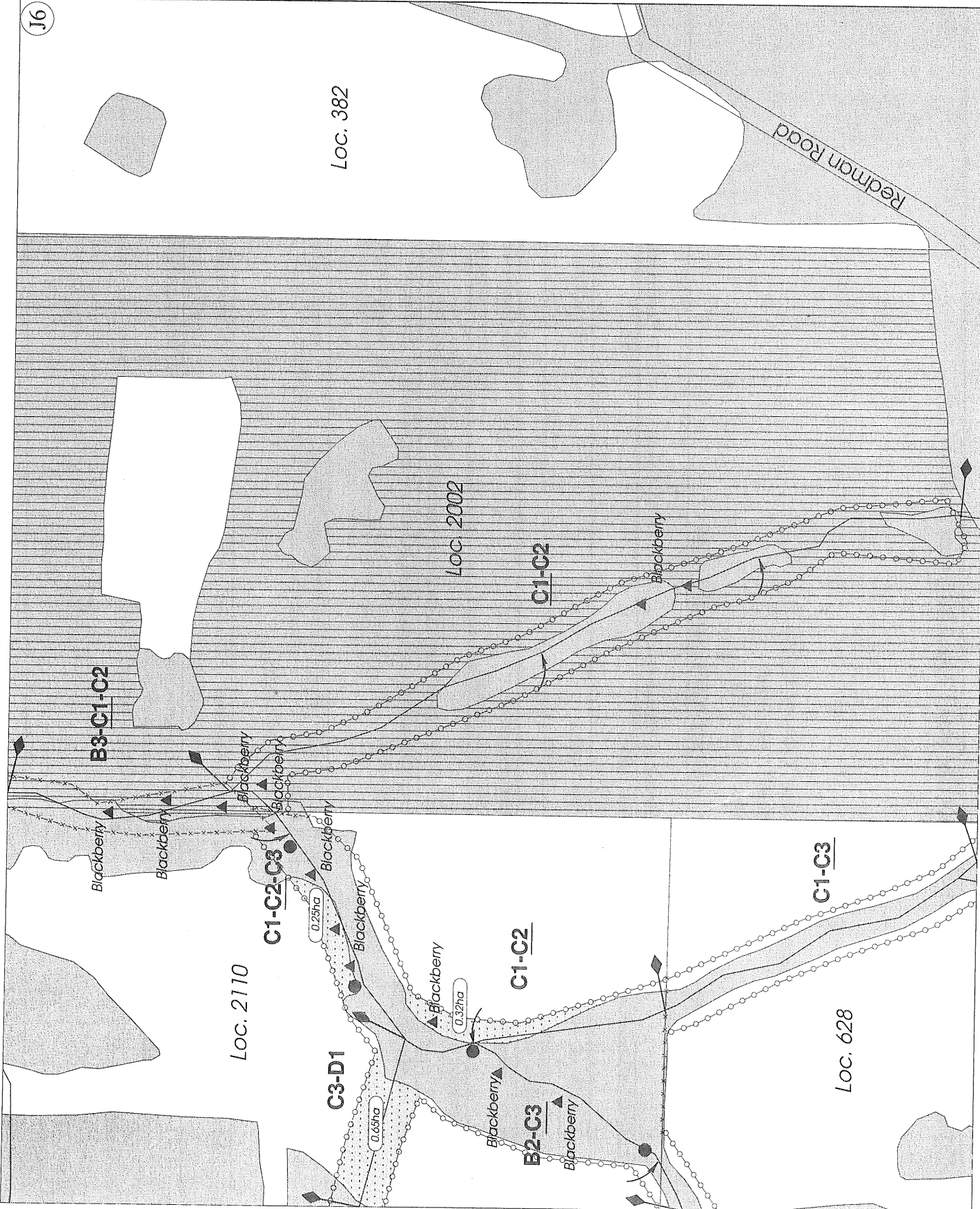


Loc. Numbers of Adjacent Properties: 609,608,705,704.
 Survey Project Officer: Alex Syme.
 Date: June 1997

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Scotsdale Brook	Tributaries/Tributary
Length of watercourse Fencing In Place	1662 metres	Nil
Length of watercourse Fencing Recommended	1942 metres	380 metres
Number of severe erosion sites	7	5
Advice on remedial measures required for these sites	Recommendation: Fence and revegetate	Recommendation: Fence and revegetate drains (former creek)
Approximate area along watercourse requiring revegetation	Area (Ha.): 0.48 and patches under peppermints	Area (Ha.): 0.54
Advice on Revegetation Species and Preparation	Hand plant seedlings and direct seed understory species under peppermints	Hand plant Adjacent vegetation is <i>Agonis juniperina</i> , <i>E. diversicolor</i> <i>Eucalyptus calophylla</i> and species suitable for a wetland area. (Select further species from Appendix 1)
Number of other sites requiring rehabilitation work (ie Serious weed infestations)	Numerous Blackberry, Bridal Creeper and Watsonia infestations Several garden escapes	Numerous Blackberry infestations
Advice on Rehabilitation of these sites	Recommendation: Treat weed infestations	Recommendation: Carefully treat Blackberry and monitor results
Other Management Related Information for this map	Occasional severe undercutting with slumping. Most of the problem lies with greatly increased water volumes during flood events caused by vegetation removal in the catchment.	Drains in urgent need of attention.

J6



Survey Class	LEGEND	Foreshore Condition
A		A1 Pristine
A		A2 Near Pristine
B		B1 Slightly disturbed
B		B2 Degraded-weed infested
B		B3 Degraded-heavy weed infested
C		C1 Erosion prone
C		C2 Soil exposed
C		C3 Eroded
D		D1 Ditch-eroding
D		D2 Ditch-freely eroding
D		D3 Drain-weed dominated

Example foreshore condition:
A1-A2 River foreshore condition mainly A2 with some A1

	Remnant vegetation
	Existing tree plantation
	Vineyard
	Orchard
	Recommended area needing rehabilitation/ revegetation plus approximate area
	Road
	Location boundary
	Catchment boundary
	River
	Tributary
	Foreshore class boundary
	Relevant existing fence at time of survey
	Recommended fencing
	Point of severe erosion or subsidence
	Watercourse crossing point
	Serious weed infestation and species
	Watsonia
	Map sheet number

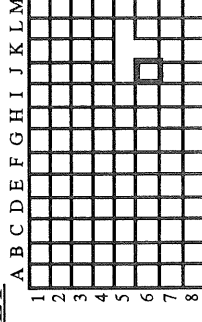


0 50 100 150
 METRES
 Scale 1:5,000

Projection: Universal Transverse Mercator
 Grid: A.M.G., zone 50
 Date: August 18, 1997
 Source Data:
 Based on field survey and interpretation of 1:20,000
 aerial photographs Job 960851, Jan '97 Runs 13 to 17
 Cadastral and topographic digital information supplied
 by the Dept. of Land Administration West. Aust.
 Prepared for APACE Green Skills as part of the
 riparian survey of the Stoddart Brook catchment.
 Funded by the Wilson Inlet Management Authority
 Project co-ordinator APACE Green Skills.
 Produced by Watershed Digital Mapping
 RMBS 1015 Lapkos Rd Denmark WA Ph (089) 462428

SCOTSDALE BROOK SURVEY- Map J6 (See Map 1.2 pg. 4 for general location)

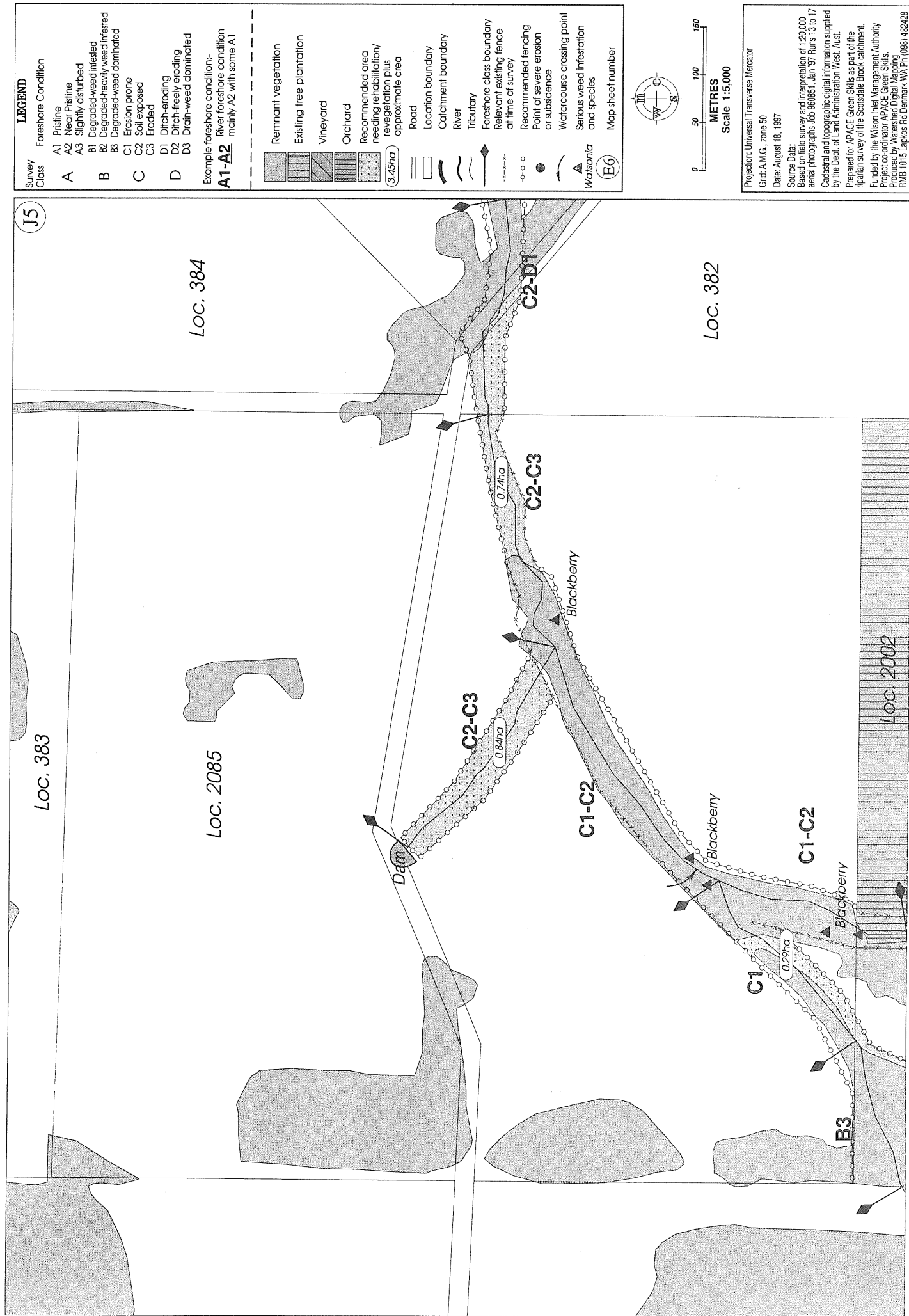
MAP KEY



Loc. Numbers of Adjacent Properties: 2002, 2110,628.
 Survey Project Officer: Robyn Glenister.
 Date: June 1997

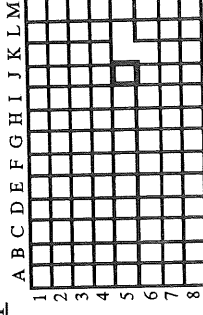
MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Scotsdale Brook	Tributaries/Tributary
Length of watercourse Fencing In Place	N/A	771 metres
Length of watercourse Fencing Recommended	N/A	3556 metres
Number of severe erosion sites	N/A	4
Advice on remedial measures required for these sites	Recommendation: N/A	Recommendation: Fence, revegetate and construct stock crossing points.
Approximate area along watercourse requiring revegetation	Area (Ha.): N/A	Area (Ha.): 1.56
Advice on Revegetation Species and Preparation	N/A	Hand plant Adjacent vegetation is <i>Agonis juniperina</i> , <i>E. diversicolor</i> <i>Eucalyptus calophylla</i> . (Select further species from Appendix 1)
Number of other sites requiring rehabilitation work (ie Serious weed infestations)	N/A	Numerous Blackberry infestations
Advice on Rehabilitation of these sites	Recommendation: N/A	Recommendation: Carefully treat Blackberry and monitor results
Other Management Related Information for this map	N/A	Fencing along watercourse in new plantation is needed before grazing begins under plantation trees.



SCOTSDALE BROOK SURVEY- Map J5 (See Map 1.2 pg.4 for general location)

MAP KEY



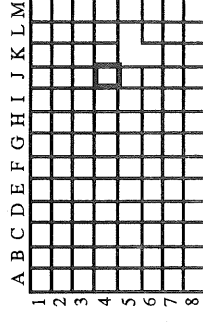
Loc. Numbers of Adjacent Properties: 2085, 382, 385, 2002, 2110.
 Survey Project Officer: Robyn Glenister.
 Date: June 1997

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Scotsdale Brook	Tributaries/Tributary
Length of watercourse Fencing In Place	N/A	779 metres
Length of watercourse Fencing Recommended	N/A	2252 metres
Number of severe erosion sites	N/A	Nil
Advice on remedial measures required for these sites	Recommendation: N/A	Recommendation: N/A
Approximate area along watercourse requiring revegetation	Area (Ha.): N/A	Area (Ha.): 1.89
Advice on Revegetation Species and Preparation	N/A	Hand plant Adjacent vegetation is <i>Agonis juniperina</i> , <i>E. diversicolor</i> <i>Eucalyptus calophylla</i> , <i>Eucalyptus patens</i> . (Select further species from Appendix 1)
Number of other sites requiring rehabilitation work (ie Serious weed infestations)	N/A	Numerous Blackberry infestations
Advice on Rehabilitation of these sites	Recommendation: N/A	Recommendation: Carefully treat Blackberry and monitor results
Other Management Related Information for this map	N/A	Nil

SCOTSDALE BROOK SURVEY - Map J4 (See Map 1.2 pg.4 for general location)

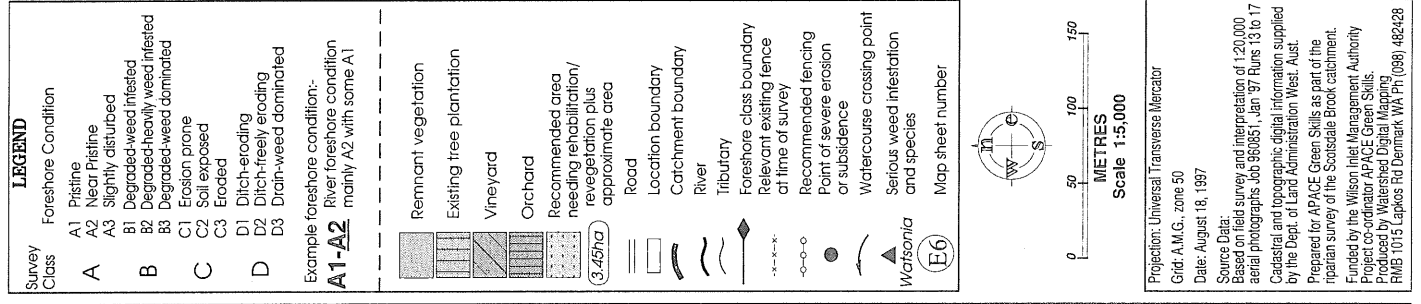
MAP KEY



Loc. Numbers of Adjacent Properties: 704, 391, 392, 393, 383.
 Survey Project Officer: Alex Syme; Kaylene Parker.
 Date: June 1997

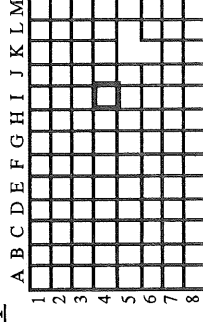
MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Scotsdale Brook	Tributaries/Tributary
Length of watercourse Fencing In Place	968 metres	1031 metres
Length of watercourse Fencing Recommended	2256 metres	510 metres
Number of severe erosion sites	2	Nil
Advice on remedial measures required for these sites	Recommendation: Fence, control weeds and revegetate	Recommendation: N/A
Approximate area along watercourse requiring revegetation	Area (Ha.): 0.47 and patches under peppermints	Area (Ha.): 2.87
Advice on Revegetation Species and Preparation	Hand plant seedlings and direct seed understorey species where peppermints are dominant	Hand plant Adjacent vegetation is <i>Agonis juniperina</i> , <i>E. diversicolor</i> <i>Eucalyptus calophylla</i> . (Select further species from Appendix 1)
Number of other sites requiring rehabilitation work (ie Serious weed infestations)	Numerous Blackberry, Bridal Creeper and Watsonia infestations Several garden escapes	Numerous Blackberry, Bridal Creeper, Arum Lily and Watsonia infestations Many garden escapes
Advice on Rehabilitation of these sites	Recommendation: Treat weed infestations and monitor results	Recommendation: Treat weed infestations
Other Management Related Information for this map	Occasional severe undercutting with slumping. Most of the problem lies with greatly increased water volumes during flood events caused by vegetation removal in the catchment.	Weed infestations on southern tributary are so severe and wayward so disturbed that mechanical removal of weeds is probably the best option initially.



SCOTSDALE BROOK SURVEY- Map I4 (See Map 1.2 pg.4 for general location)

MAP KEY



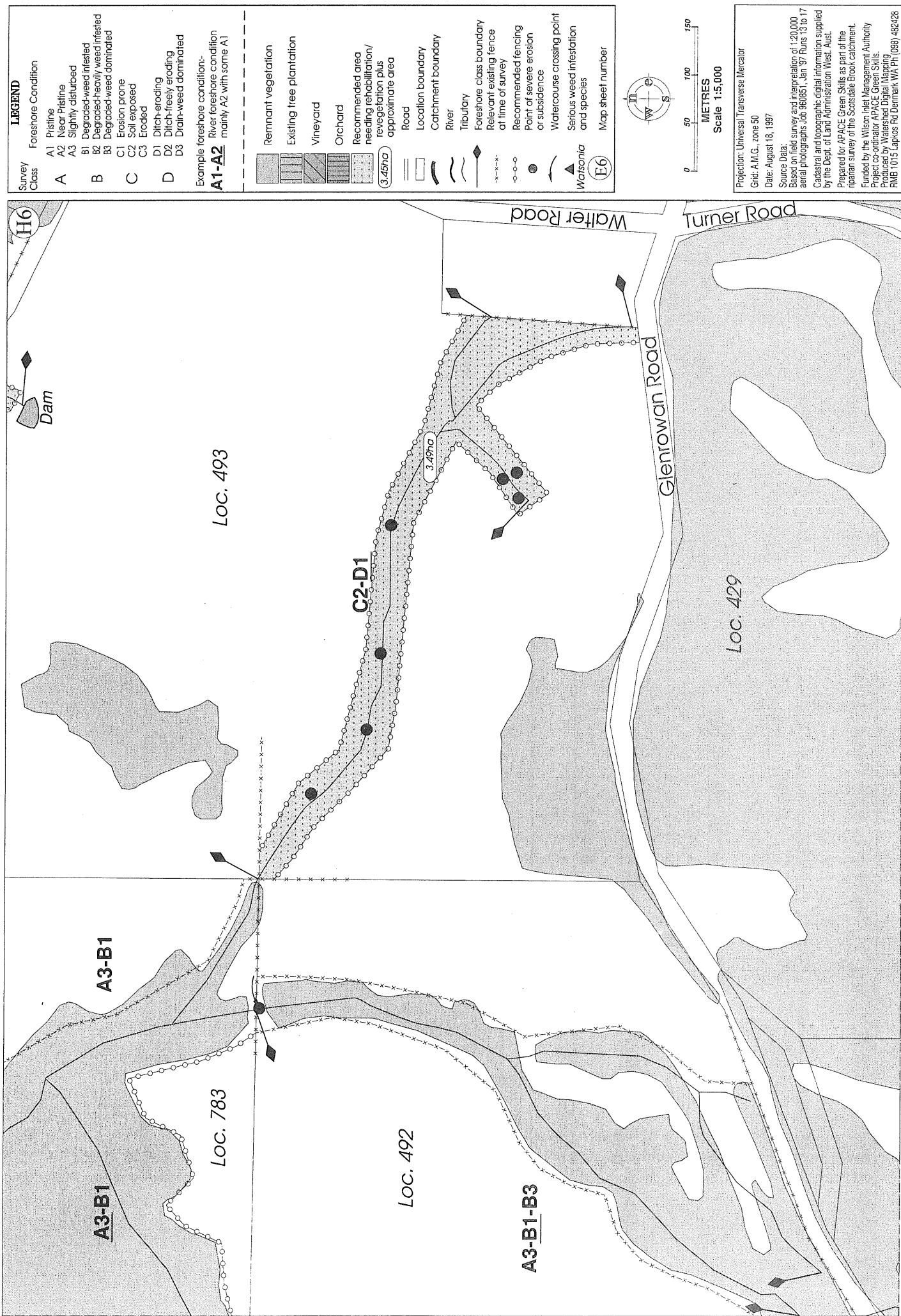
Loc. Numbers of Adjacent Properties: 2110, 510, 393, 511, 509.

Survey Project Officer: Alex Syme.

Date: June 1997

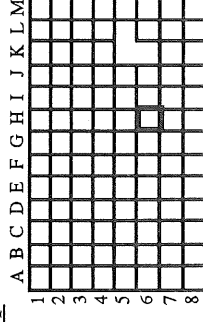
MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Scotsdale Brook	Tributaries/Tributary
Length of watercourse Fencing In Place	994 metres	1000 metres
Length of watercourse Fencing Recommended	1410 metres	1240 metres
Number of severe erosion sites	8	1
Advice on remedial measures required for these sites	Recommendation: Exclude stock	Recommendation: Exclude cattle from firebreak.
Approximate area along watercourse/s requiring revegetation	Area (Ha.): Nil	Area (Ha.): 2.76
Advice on Revegetation Species and Preparation	N/A	Hand plant Adjacent vegetation is <i>Agonis juniperina</i> , <i>E. diversicolor</i> <i>Eucalyptus calophylla</i> , <i>Eucalyptus patens</i> . (Select further species from Appendix 1)
Number of other sites requiring rehabilitation work (ie Serious weed infestations)	Numerous Blackberry and Watsonia infestations	Numerous Blackberry infestations
Advice on Rehabilitation of these sites	Recommendation: Carefully treat Blackberry and Watsonia and monitor results	Recommendation: Carefully treat Blackberry and monitor results
Other Management Related Information for this map	Occasional severe undercutting with slumping. The problem lies with greatly increased water volumes during flood events caused by vegetation removal in the catchment.	Nil



SCOTSDALE BROOK SURVEY- Map H6 (See Map 1.2 pg.4 for general location)

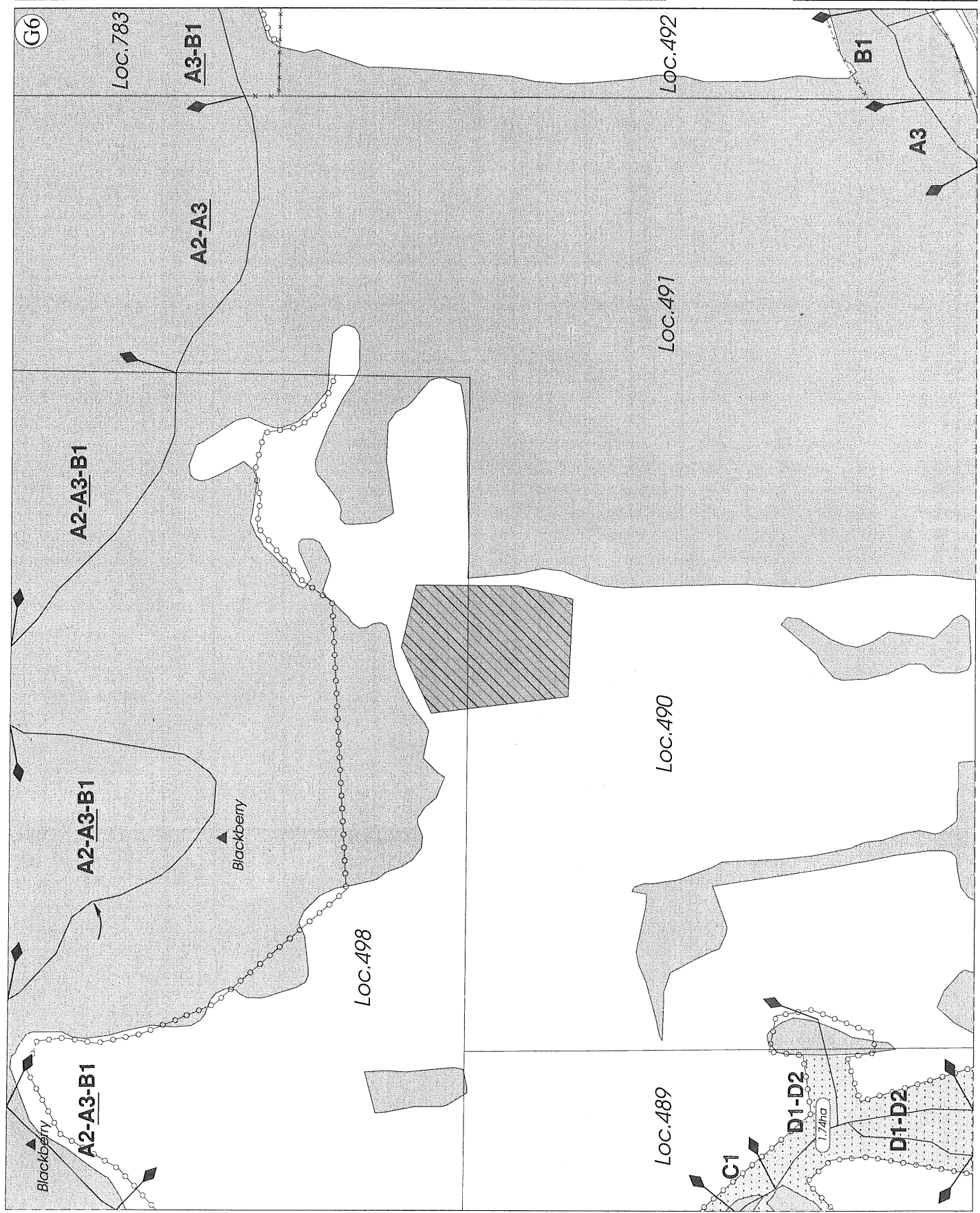
MAP KEY



Loc. Numbers of Adjacent Properties: 783,492,493.
Survey Project Officer: Alex Syme.
Date: May 1997

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Scotsdale Brook	Tributaries/Tributary
Length of watercourse Fencing In Place	N/A	2616 metres
Length of watercourse Fencing Recommended	N/A	2079 metres
Number of severe erosion sites	N/A	9
Advice on remedial measures required for these sites	Recommendation: N/A	Recommendation: Fence and revegetate. Construct controlled stock crossings.
Approximate area along watercourse/s requiring revegetation	Area (Ha.): N/A	Area (Ha.): 3.49
Advice on Revegetation Species and Preparation	N/A	Hand plant Adjacent vegetation is <i>Agonis juniperina</i> , <i>Eucalyptus diversicolor</i> , <i>Eucalyptus calophylla</i> , <i>Eucalyptus patens</i> . (Select further species from Appendix 1)
Number of other sites requiring rehabilitation work (ie Serious weed infestations)	N/A	Nil
Advice on Rehabilitation of these sites	Recommendation: N/A	Recommendation: N/A
Other Management Related Information for this map	N/A	The stream in need of revegetation has been severely degraded by the high volumes of run off coming from the now disused gravel pits to the south of Glenrowan Road. Successful rehabilitation of these pits is urgently required.



LEGEND

Survey Class

Foreshore Condition

- A P1stine
- A2 Near P1stine
- A3 Slightly disturbed
- B1 Degraded weed infested
- B2 Degraded heavily weed infested
- B3 Degraded-weed dominated
- C1 Erosion prone
- C2 Soil exposed
- C3 Eroded
- D1 Ditch-eroding
- D2 Ditch-freely eroding
- D3 Drain-weed dominated

Example foreshore condition:-

River foreshore condition

A1-A2 mainly A2 with some A1

- Remnant vegetation
- Existing tree plantation
- Vineyard
- Orchard
- Recommended area needing rehabilitation/ revegetation plus approximate area
- Road
- Catchment boundary
- River
- Tributary
- Foreshore class boundary
- Relevant existing fence at time of survey
- Recommended fencing
- Point of severe erosion or subsidence
- Watersonia
- Map sheet number

(3.45ha)

(1.74ha)

(E6)

Scale 1:5,000

Projection: Universal Transverse Mercator

Grid: A.M.G., zone 50

Date: August 18, 1997

Source Data:

Based on field survey and interpretation of 1:20,000

aerial photographs Job 960851, Jan. 97 Runs 13 to 17

Cadastral and topographic digital information supplied

by the Dept. of Land Administration West. Aust.

Prepared for APACE Green Skills as part of the

riparian survey of the Scalesdale Brook catchment

Funded by the Wilson Inlet Management Authority

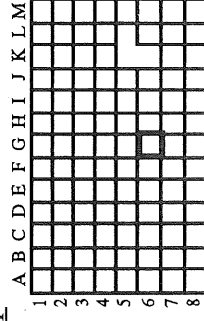
Project co-ordinator APACE Green Skills

Produced by Watershed Digital Mapping

RMB 1015 Lakpos Rd Denmark WA Ph (08) 482428

SCOTSDALE BROOK SURVEY- Map G6 (See Map 1.2 pg.4 for general location)

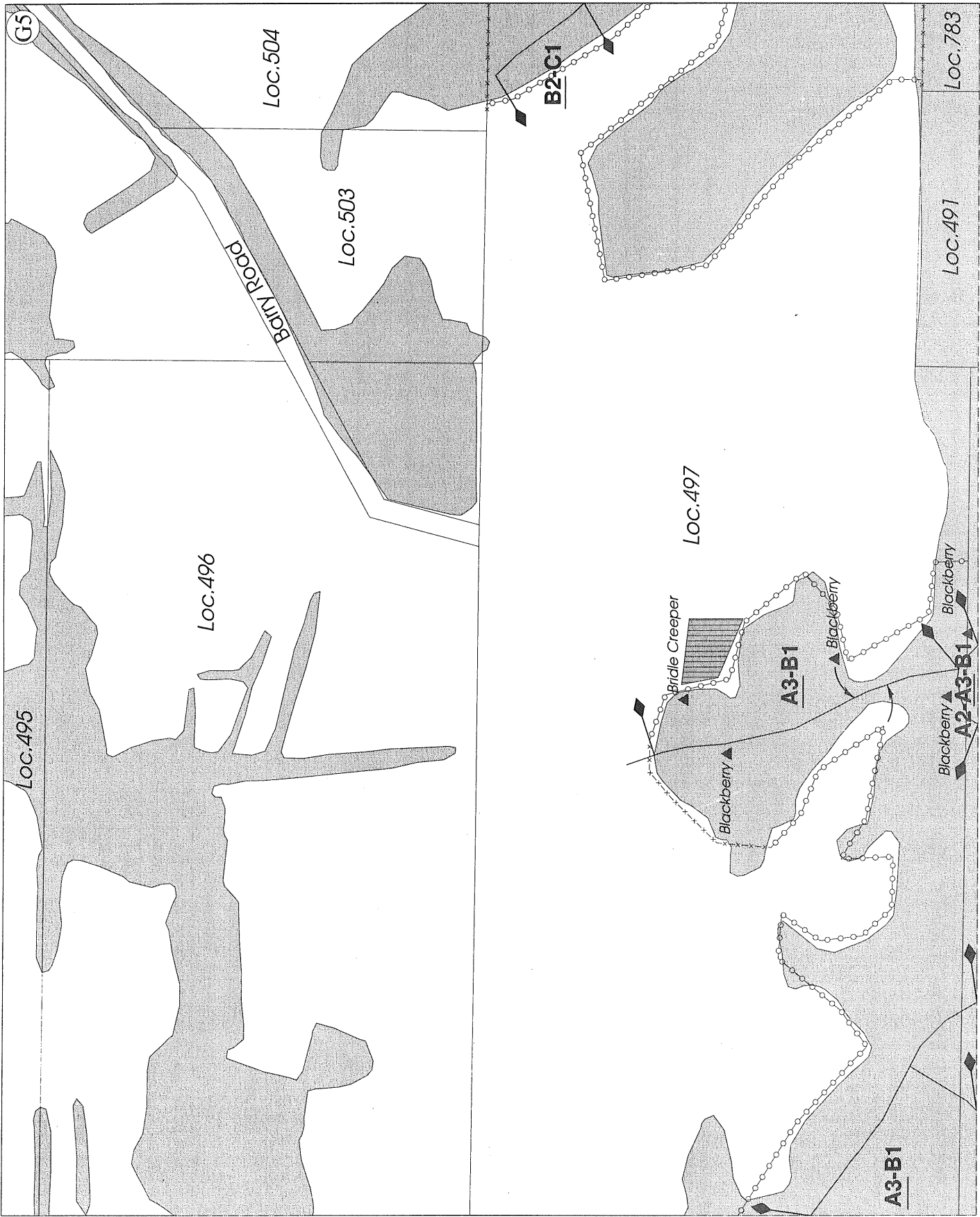
MAP KEY



Loc. Numbers of Adjacent Properties: 498,489,490,491,492,783.
 Survey Project Officer: Robyn Glenister; Alex Syme
 Date: June/July 1997

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Scotsdale Brook	Tributaries/Tributary
Length of watercourse Fencing In Place	N/A	212 metres
Length of watercourse Fencing Recommended	N/A	1956 metres
Number of severe erosion sites	N/A	Nil
Advice on remedial measures required for these sites	N/A	N/A
Approximate area along watercourse/s requiring revegetation	Area (Ha.): N/A	Area (Ha.): 1.74
Advice on Revegetation Species and Preparation	N/A	Hand plant Adjacent vegetation is <i>Agonis juniperina</i> , <i>E. diversicolor</i> , <i>Eucalyptus calophylla</i> , <i>Metaleuca raphiophylla</i> , <i>Agonis hypericifolia</i> . (Select further species from Appendix 1)
Number of other sites requiring rehabilitation work (ie Serious weed infestations)	N/A	Blackberry infestations
Advice on Rehabilitation of these sites	N/A	Recommendation: Carefully treat Blackberry and monitor results
Other Management Related Information for this map	N/A	If no alternative water supply for stock is available, then constructed watering points on streams that minimise bank erosion are desirable.



Survey Class	LEGEND
A	Foreshore Condition
A1	Pristine
A2	Near Pristine
A3	Slightly disturbed
B	Degraded-weed infested
B1	Degraded-heavily weed infested
B2	Degraded-weed dominated
B3	Degraded-weed dominated
C	Erosion prone
C1	Soil exposed
C2	Eroded
C3	Eroded
D	Ditch-eroding
D1	Ditch-free eroding
D2	Ditch-free eroding
D3	Drain-weed dominated
D4	Drain-weed dominated
D5	Drain-weed dominated
D6	Drain-weed dominated
D7	Drain-weed dominated
D8	Drain-weed dominated
D9	Drain-weed dominated
D10	Drain-weed dominated
D11	Drain-weed dominated
D12	Drain-weed dominated
D13	Drain-weed dominated
D14	Drain-weed dominated
D15	Drain-weed dominated
D16	Drain-weed dominated
D17	Drain-weed dominated
D18	Drain-weed dominated
D19	Drain-weed dominated
D20	Drain-weed dominated
D21	Drain-weed dominated
D22	Drain-weed dominated
D23	Drain-weed dominated
D24	Drain-weed dominated
D25	Drain-weed dominated
D26	Drain-weed dominated
D27	Drain-weed dominated
D28	Drain-weed dominated
D29	Drain-weed dominated
D30	Drain-weed dominated
D31	Drain-weed dominated
D32	Drain-weed dominated
D33	Drain-weed dominated
D34	Drain-weed dominated
D35	Drain-weed dominated
D36	Drain-weed dominated
D37	Drain-weed dominated
D38	Drain-weed dominated
D39	Drain-weed dominated
D40	Drain-weed dominated
D41	Drain-weed dominated
D42	Drain-weed dominated
D43	Drain-weed dominated
D44	Drain-weed dominated
D45	Drain-weed dominated
D46	Drain-weed dominated
D47	Drain-weed dominated
D48	Drain-weed dominated
D49	Drain-weed dominated
D50	Drain-weed dominated
D51	Drain-weed dominated
D52	Drain-weed dominated
D53	Drain-weed dominated
D54	Drain-weed dominated
D55	Drain-weed dominated
D56	Drain-weed dominated
D57	Drain-weed dominated
D58	Drain-weed dominated
D59	Drain-weed dominated
D60	Drain-weed dominated
D61	Drain-weed dominated
D62	Drain-weed dominated
D63	Drain-weed dominated
D64	Drain-weed dominated
D65	Drain-weed dominated
D66	Drain-weed dominated
D67	Drain-weed dominated
D68	Drain-weed dominated
D69	Drain-weed dominated
D70	Drain-weed dominated
D71	Drain-weed dominated
D72	Drain-weed dominated
D73	Drain-weed dominated
D74	Drain-weed dominated
D75	Drain-weed dominated
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D77	Drain-weed dominated
D78	Drain-weed dominated
D79	Drain-weed dominated
D80	Drain-weed dominated
D81	Drain-weed dominated
D82	Drain-weed dominated
D83	Drain-weed dominated
D84	Drain-weed dominated
D85	Drain-weed dominated
D86	Drain-weed dominated
D87	Drain-weed dominated
D88	Drain-weed dominated
D89	Drain-weed dominated
D90	Drain-weed dominated
D91	Drain-weed dominated
D92	Drain-weed dominated
D93	Drain-weed dominated
D94	Drain-weed dominated
D95	Drain-weed dominated
D96	Drain-weed dominated
D97	Drain-weed dominated
D98	Drain-weed dominated
D99	Drain-weed dominated
D100	Drain-weed dominated

Example foreshore condition:
River foreshore condition
A1-A2 mainly A2 with some A1

Remnant vegetation
Existing tree plantation
Vineyard
Orchard
Recommended area
needing rehabilitation/
revegetation plus
approximate area
(3.45ha)

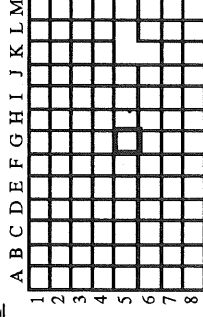
Road
Location boundary
Catchment boundary
River
Tributary
Foreshore class boundary
Relevant existing fence
at time of survey
Recommended fencing
Point of severe erosion
or subsidence
Watercourse crossing point
and species
Watsonia
Map sheet number
(E6)

Projection: Universal Transverse Mercator
Grid: A.M.G., zone 50
Date: August 18, 1997
Source Data:
Based on field survey and interpretation of 1:20,000
aerial photographs Job 960851, Jan 97 Runs 13 to 17
Cadastral and topographic digital information supplied
by the Dept. of Land Administration West. Aust.
Prepared for APACE Green Skills as part of the
riparian survey of the Scottsdale Brook catchment.
Funded by the Wilson Inlet Management Authority
Project co-ordinator: APACE Green Skills.
Prepared by: Wilson Inlet Management Authority
RMB 1015 Capra Rd Denmark WA Ph (098) 482428

0 50 100 150
METRES
Scale 1:5,000

SCOTSDALE BROOK SURVEY- Map G5 (See Map 1.2 pg.4 for general location)

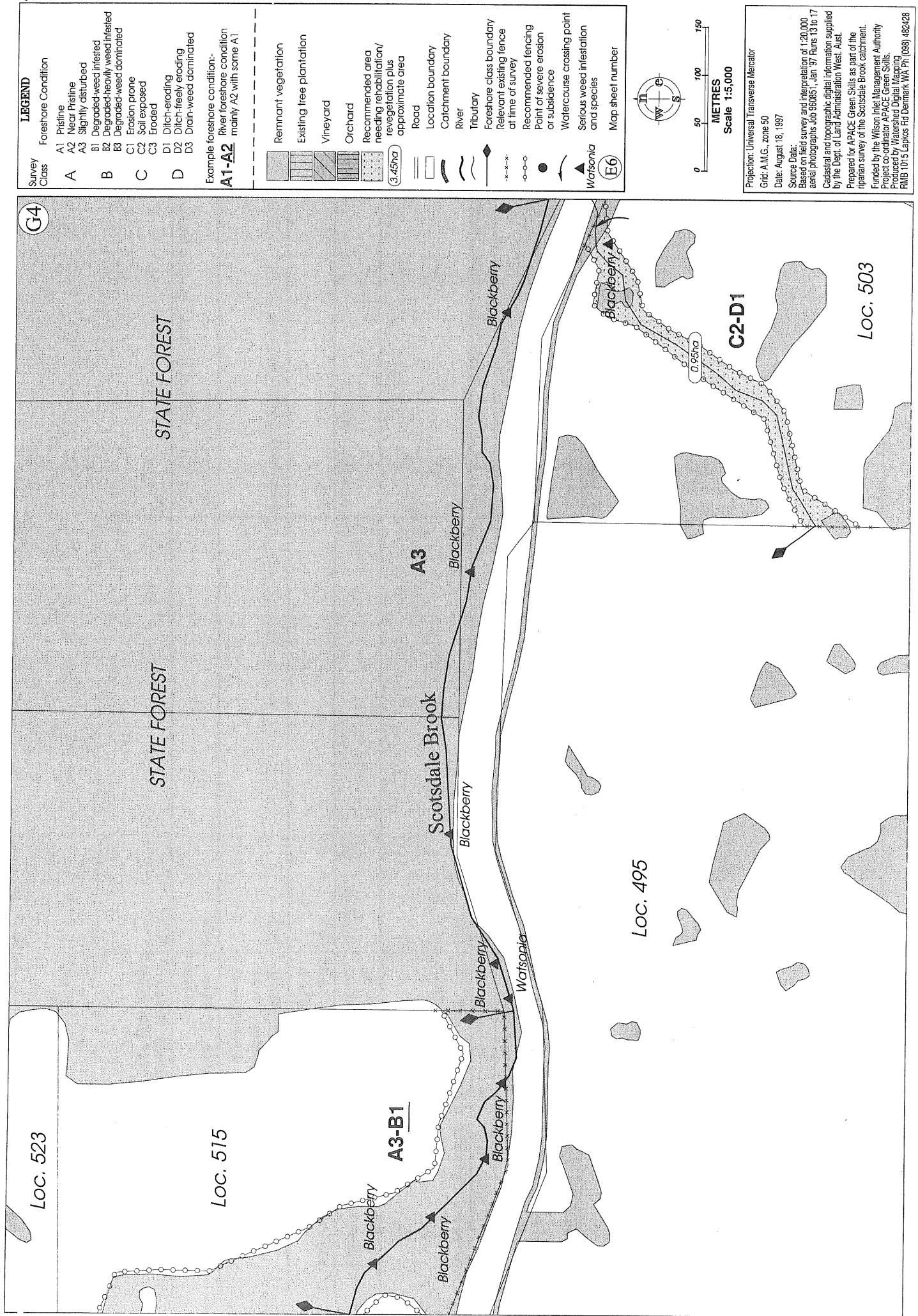
MAP KEY



Loc. Numbers of Adjacent Properties: 497
 Survey Project Officer: Robyn Glenister; Alex Syme.
 Date: June/July 1997

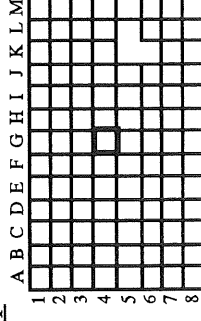
MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Scotsdale Brook	Tributaries/Tributary
Length of watercourse Fencing In Place	N/A	368 metres
Length of watercourse Fencing Recommended	N/A	2298 metres
Number of severe erosion sites	N/A	Nil
Advice on remedial measures required for these sites	N/A	N/A
Approximate area along watercourse/s requiring revegetation	Area (Ha.): N/A	Area (Ha.): Nil
Advice on Revegetation Species and Preparation	N/A	N/A
Number of other sites requiring rehabilitation work (ie Serious weed infestations)	N/A	Blackberry infestations
Advice on Rehabilitation of these sites	N/A	Recommendation: Carefully treat Blackberry and monitor results
Other Management Related Information for this map	N/A	Nil



SCOTSDALE BROOK SURVEY- Map G4 (See Map 1.2 pg.4 for general location)

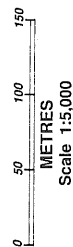
MAP KEY



Loc. Numbers of Adjacent Properties: 503,513,522,514,515.
Survey Project Officer: Alex Syme; Robyn Glenister.
Date: May 1997

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Scotsdale Brook	Tributaries/Tributary
Length of watercourse Fencing In Place	556 metres	Nil
Length of watercourse Fencing Recommended	593 metres	926 metres
Number of severe erosion sites	Nil	Nil
Advice on remedial measures required for these sites	Recommendation: N/A	Recommendation: N/A
Approximate area along watercourse/s requiring revegetation	Area (Ha.): Nil	Area (Ha.): 0.95
Advice on Revegetation Species and Preparation	N/A	Hand plant Adjacent vegetation is <i>Agonis juniperina</i> , <i>E. diversicolor</i> <i>Eucalyptus calophylla</i> . (Select further species from Appendix 1)
Number of other sites requiring rehabilitation work (ie Serious weed infestations)	Numerous Blackberry infestations	Blackberry infestations
Advice on Rehabilitation of these sites	Recommendation: Control Blackberry	Recommendation: Control Blackberry
Other Management Related Information for this map	Nil	Nil



Projection: Universal Transverse Mercator

Grid: A.M.G., zone 50

Date: August 18, 1997

Source Data:

Cadastral and topographic digital information supplied by the Dept. of Land Administration West. Aust.

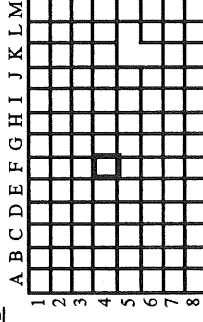
Prepared for APACE Green Skills as part of the riparian survey of the Scotsdale Brook catchment.

Funded by the Wilson Inlet Management Authority
Project co-ordinator APACE Green Skills

Project co-ordinator APAGE Green Skills.
Produced by Watershed Digital Mapping
RMB 1015 Lapkos Rd Denmark WA Ph (098) 482428

SCOTSDALE BROOK SURVEY- Map F4 (See Map 1.2 pg.4 for general location)

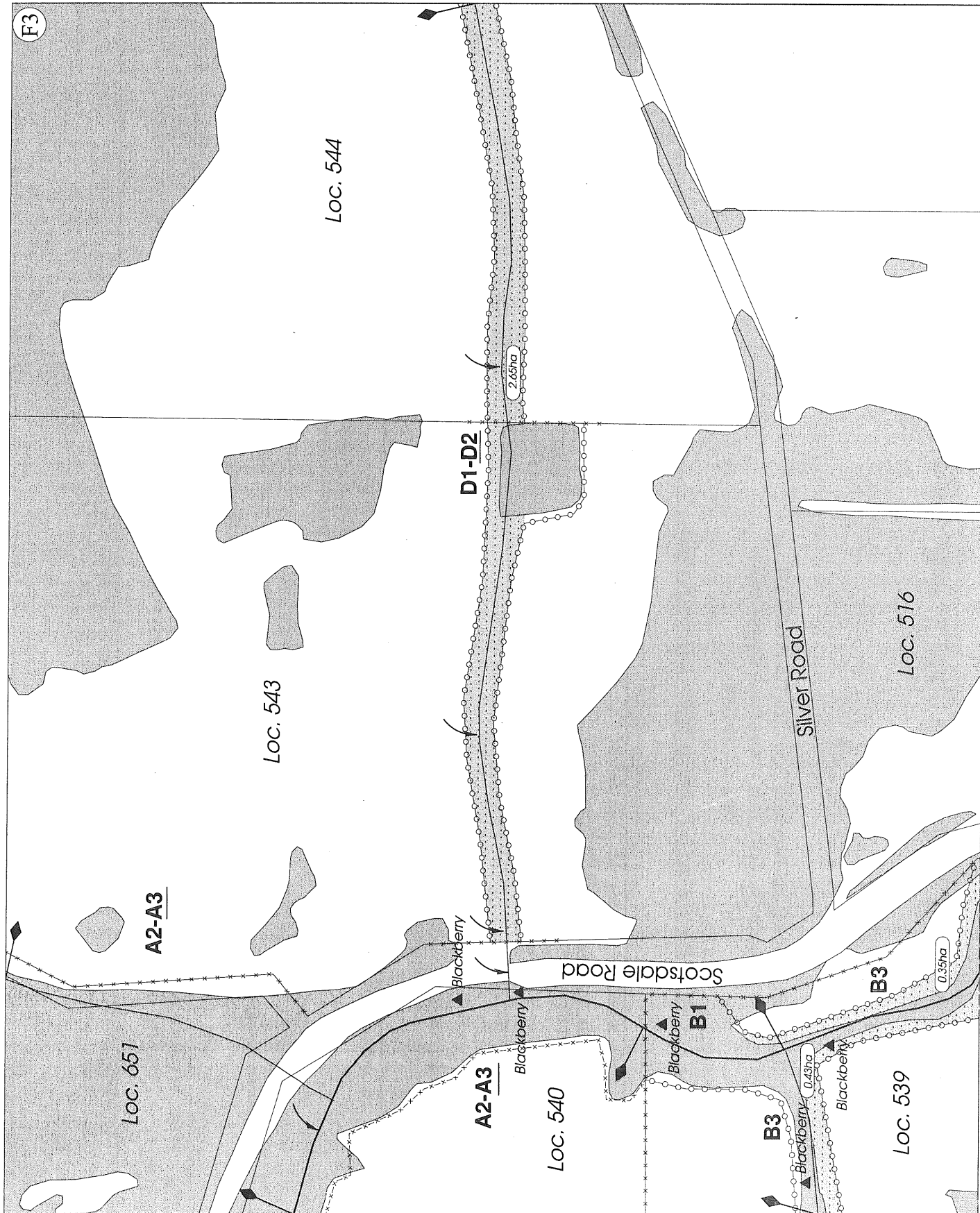
MAP KEY



Loc. Numbers of Adjacent Properties: 515,524,516,495,481,539.
 Survey Project Officer: Alex Syme; Robyn Glenister.
 Date: May 1997

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Scotsdale Brook	Tributaries/Tributary
Length of watercourse Fencing In Place	740 metres	2163 metres
Length of watercourse Fencing Recommended	1495 metres	550 metres
Number of severe erosion sites	Nil	Nil
Advice on remedial measures required for these sites	Recommendation: N/A	Recommendation: N/A
Approximate area along watercourse/s requiring revegetation	Area (Ha.): 0.21	Area (Ha.): 0.13
Advice on Revegetation Species and Preparation	Hand plant Adjacent vegetation is <i>Agonis juniperina</i> , <i>E. diversicolor</i> <i>Eucalyptus calophylla</i> . (Select further species from Appendix 1)	Hand plant Adjacent vegetation is <i>Agonis juniperina</i> , <i>E. diversicolor</i> <i>Eucalyptus calophylla</i> , <i>Eucalyptus patens</i> , <i>Melaleuca rhaphiophylla</i> , <i>Agonis hypericifolia</i> . (Select further species from Appendix 1)
Number of other sites requiring rehabilitation work (ie Serious weed infestations)	Numerous Blackberry infestations One site with Bridal Creeper and numerous garden escapes.	Numerous Blackberry infestations
Advice on Rehabilitation of these sites	Recommendation: Control Blackberry and garden escapes	Recommendation: Control Blackberry
Other Management Related Information for this map	Steep slopes on northern banks require fencing to be placed well away from Brook. i.e. 25 metres minimum.	Nil



Survey Class	Foreshore Condition
A	A1 Pristine
	A2 Near Pristine
	A3 Slightly disturbed
B	B1 Degraded-weed infested
	B2 Degraded-heavily weed infested
	B3 Degraded-weed dominated
C	C1 Erosion prone
	C2 Soil exposed
	C3 Eroded
D	D1 Ditch-eroding
	D2 Ditch-freely eroding
	D3 Drain-weed dominated

Example foreshore condition:-
River foreshore condition
A1-A2 mainly A2 with some A1

	Remnant vegetation
	Existing tree plantation
	Vineyard
	Orchard
	Recommended area needing rehabilitation/revegetation plus approximate area
	Road
	Location boundary
	Catchment boundary
	River
	Tributary
	Foreshore class boundary
	Relevant existing fence at time of survey
	Recommended fencing
	Point of severe erosion or subsidence
	Watercourse crossing point
	Watsonia
	Map sheet number

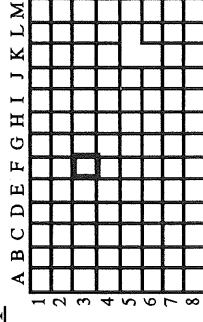


0 50 100 150
METRES
Scale 1:5,000

Projection: Universal Transverse Mercator
Grid: A.M.G., zone 50
Date: August 18, 1997
Source Data:
Based on field survey and interpretation of 1:20,000 aerial photographs, Job 960851, Jan '97 Runs 13 to 17
Cadastral and topographic digital information supplied by the Dept. of Land Administration West. Aust.
Prepared for APACE Green Skills as part of the riparian survey of the Scotsdale Brook catchment.
Funded by the Wilson Inlet Management Authority
Project co-ordinator APACE Green Skills
Produced by Watershed Digital Mapping
RMB 1015 Lapkos Rd Denmark WA Ph (098) 482428

SCOTSDALE BROOK SURVEY- Map F3 (See Map 1.2 pg.4 for general location)

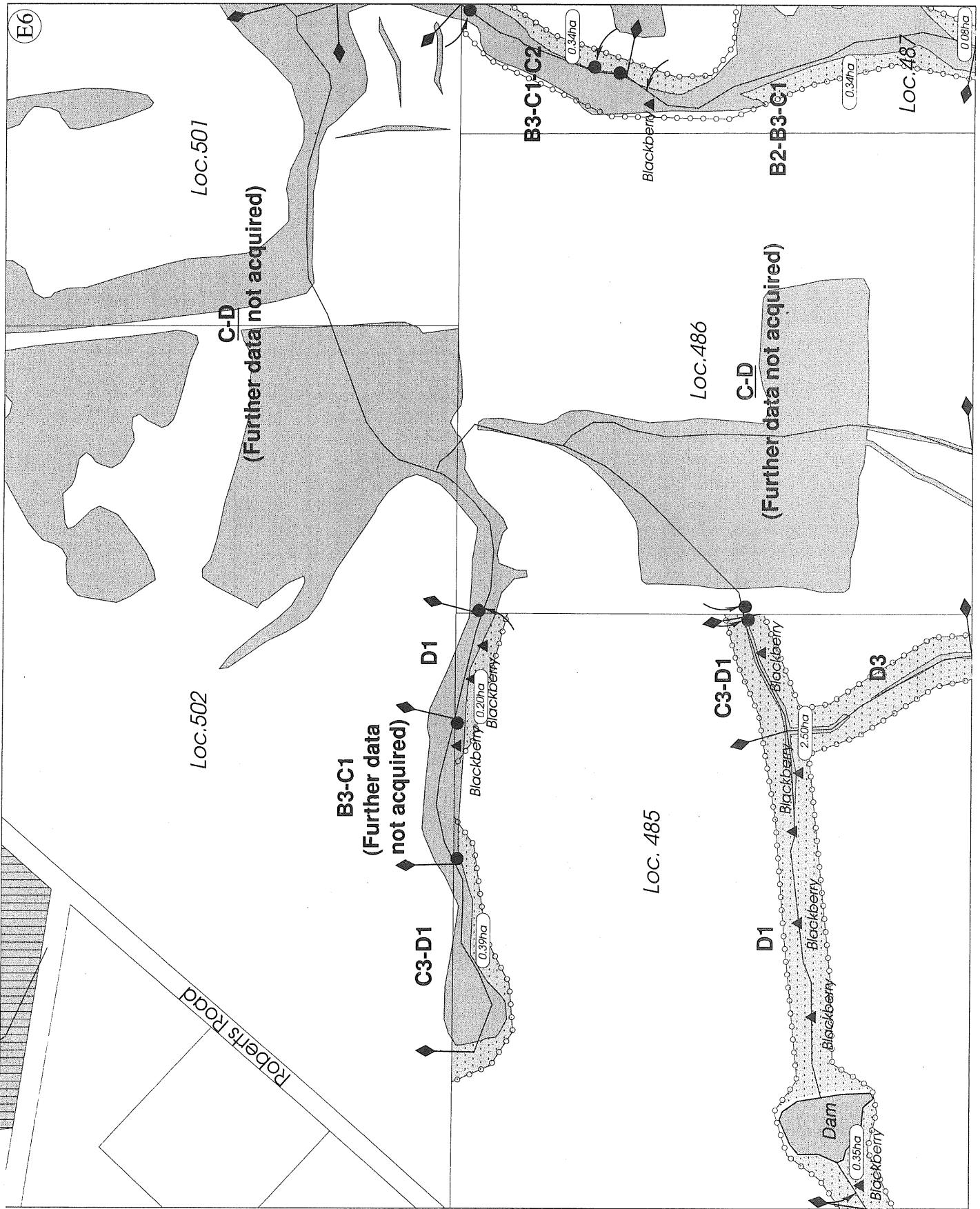
MAP KEY



Loc. Numbers of Adjacent Properties: 539,538,540,543,651.
Survey Project Officer: Alex Syme; Robyn Glenister.
Date: May 1997

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Scotsdale Brook	Tributaries/Tributary
Length of watercourse Fencing In Place	1324 metres	300 metres
Length of watercourse Fencing Recommended	595 metres	2173 metres
Number of severe erosion sites	Nil	Numerous
Advice on remedial measures required for these sites	Recommendation: N/A	Recommendation: Fence and revegetate
Approximate area along watercourse/s requiring revegetation	Area (Ha.): 0.35	Area (Ha.): 3.08
Advice on Revegetation Species and Preparation	Hand plant Adjacent vegetation is <i>Agonis juniperina</i> , <i>E. diversicolor</i> <i>Eucalyptus calophylla</i> , <i>Melaleuca raphiophylla</i> (Select further species from Appendix 1)	Hand plant Adjacent vegetation is <i>Agonis juniperina</i> , <i>E. diversicolor</i> <i>Eucalyptus calophylla</i> . (Select further species from Appendix 1)
Number of other sites requiring rehabilitation work (ie Serious weed infestations)	Several Blackberry infestations	Nil
Advice on Rehabilitation of these sites	Recommendation: Carefully treat Blackberry and monitor results	Recommendation: N/A
Other Management Related Information for this map	Nil	Newly bulldozed track on road reserve between to Loc. 543 and 651, unnecessarily encroaches on stream riparian zone. Should relocate track to already cleared firebreak adjacent to boundary fence of Loc. 543.



LEGEND

Survey Class	Foreshore Condition
A	A1 Pristine A2 Near Pristine A3 Slightly disturbed
B	B1 Degraded-weed infested B2 Degraded-heavy weed infested B3 Degraded-weed dominated
C	C1 Erosion prone C2 Soil exposed C3 Eroded
D	D1 Ditch-eroding D2 Ditch-freely eroding D3 Drain-weed dominated

Example foreshore condition:-

A1-A2 River foreshore condition mainly A2 with some A1



Remnant vegetation

Existing tree plantation

Vineyard

Orchard

Recommended area needing rehabilitation/ revegetation plus approximate area

3.45ha

Road

Location boundary

Catchment boundary

River

Tributary

Foreshore class boundary

Relevant existing fence at time of survey

Recommended fencing

Point of severe erosion or subsidence

Watercourse crossing point

Serious weed infestation and species

Watsonia

Map sheet number

E6

Scale 1:5,000

0 50 100 150 METRES

Projection: Universal Transverse Mercator

GDA M.G. zone 50

Date: August 18, 1997

Source Data:
Based on field survey and interpretation of 1:20,000 aerial photographs Job 960851, Jan '97 Runs 13 to 17

Cadastral and topographic digital information supplied by the Dept. of Land Administration West. Aust.

Prepared for APACE Green Skills as part of the riparian survey of the Scotsdale Brook catchment.

Funded by the Wilson Inlet Management Authority

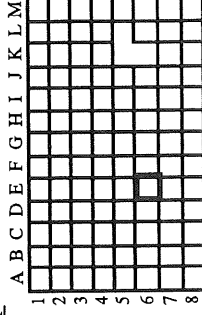
Project co-ordinator APACE Green Skills

Produced by Watershed Digital Mapping

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SCOTSDALE BROOK SURVEY- Map E6 (See Map 1.2 pg.4 for general location)

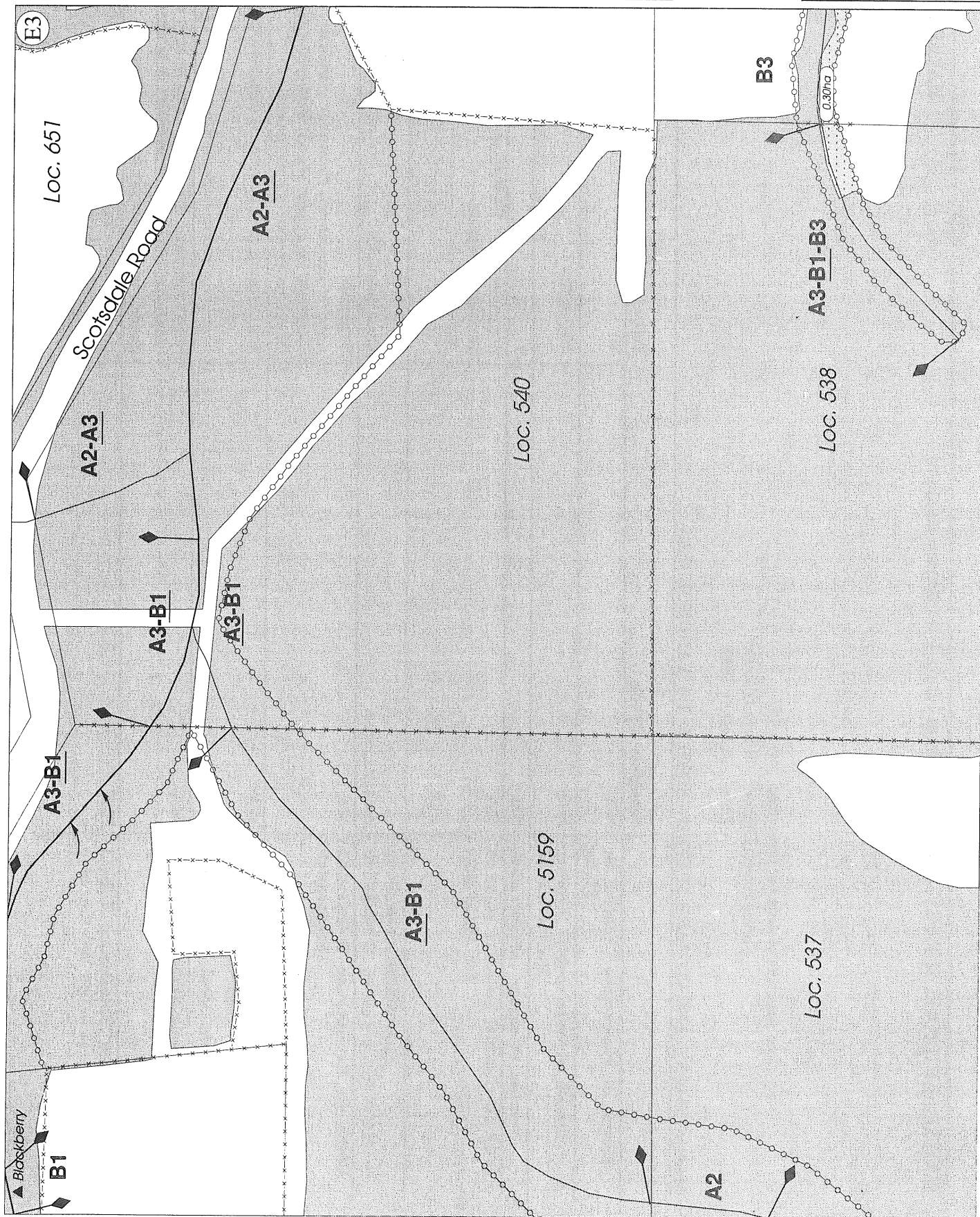
MAP KEY



Loc. Numbers of Adjacent Properties: 485,487
 Survey Project Officer: Robyn Glenister.
 Date: June/July 1997

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Scotsdale Brook	Tributaries/Tributary
Length of watercourse Fencing In Place	N/A	Nil
Length of watercourse Fencing Recommended	N/A	2867 metres
Number of severe erosion sites	N/A	8
Advice on remedial measures required for these sites	N/A	Recommendation: Exclude stock and/or construct crossings. Brush and revegetate.
Approximate area along watercourse/s requiring revegetation	Area (Ha.): N/A	Area (Ha.): 4.15
Advice on Revegetation Species and Preparation	N/A	Hand plant Adjacent vegetation is <i>Eucalyptus marginata</i> , <i>Eucalyptus calophylla</i> , <i>Eucalyptus patens</i> , <i>Melaleuca raphiophylla</i> (Select further species from Appendix 1)
Number of other sites requiring rehabilitation work (ie Serious weed infestations)	N/A	Stock crossing points and blackberry infestations.
Advice on Rehabilitation of these sites	N/A	Recommendation: Stock crossing points need to be constructed and stock excluded from them when not in use. Carefully treat Blackberry and monitor results
Other Management Related Information for this map	N/A	If no alternative water supply for stock is available, then constructed watering points on streams that minimise bank erosion are desirable.



LEGEND

Survey Class	Foreshore Condition
A	A1 Pistine
	A2 Near Pistine
	A3 Slightly disturbed
B	B1 Degraded-weed infested
	B2 Degraded-heavily weed infested
	B3 Degraded-weed dominated
C	C1 Erosion prone
	C2 Soil exposed
	C3 Eroded
D	D1 Ditch-eroding
	D2 Ditch-freely eroding
	D3 Drain-weed dominated

Example foreshore condition:-

A1-A2 River foreshore condition
mainly A2 with some A1



Remnant vegetation



Existing free plantation



Vineyard



Orchard



Recommended area



Needing rehabilitation/
revegetation plus
approximate area



Road



Location boundary



Catchment boundary



River



Tributary



Foreshore class boundary



Relevant existing fence
at time of survey



Recommended fencing



Point of severe erosion
or subsidence



Watercourse crossing point



Serious weed infestation
and species



Watsonia



Map sheet number



0 50 100 150

METRES

Scale 1:5,000

Projection: Universal Transverse Mercator

Grid: A.M.G., zone 50

Date: August 18, 1997

Source Data:

Based on field survey and interpretation of 1:20,000

aerial photographs, Job 960851, Jan 97 Runs 13 to 17

Cadastral and topographic digital information supplied

by the Dept. of Land Administration West. Aust.

Prepared for APACE Green Skills as part of the

riparian survey of the Scotsdale Brook catchment.

Funded by the Wilson Inlet Management Authority

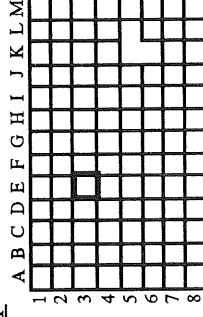
Project co-ordinator APACE Green Skills

Produced by Watershed Digital Mapping

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SCOTSDALE BROOK SURVEY- Map E3 (See Map 1.2 pg.4 for general location)

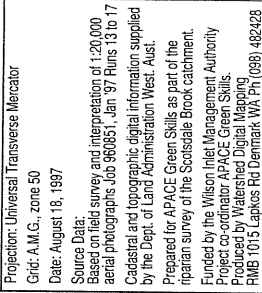
MAP KEY



Loc. Numbers of Adjacent Properties: 651, 540, 539, 538, 537, part 5159.
 Survey Project Officer: Alex Syme.
 Date: June 1997

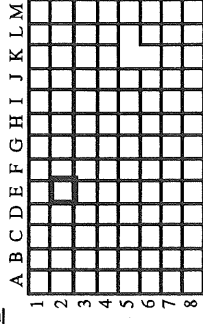
MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Scotsdale Brook	Tributaries/Tributary
Length of watercourse Fencing In Place	836 metres	2317 metres
Length of watercourse Fencing Recommended	914 metres (Note: Only if current landuse changes)	2234 metres (Note: Only if current landuse changes)
Number of severe erosion sites	Nil	Nil
Advice on remedial measures required for these sites	Recommendation: N/A	Recommendation: N/A
Approximate area along watercourse/s requiring revegetation	Area (Ha.): Nil	Area (Ha.): 0.30
Advice on Revegetation Species and Preparation	N/A	Hand plant Adjacent vegetation is <i>Eucalyptus calophylla</i> , <i>Eucalyptus patens</i> . (Select further species from Appendix 1)
Number of other sites requiring rehabilitation work (ie Serious weed infestations)	Nil	Nil
Advice on Rehabilitation of these sites	Recommendation: N/A	Recommendation: N/A
Other Management Related Information for this map	Some of the best condition and well managed waterway foreshore vegetation, both on Scotsdale Brook and the tributaries.	Some of the best condition and well managed waterway foreshore vegetation, both on Scotsdale Brook and the tributaries.



SCOTSDALE BROOK SURVEY- Map E2 (See Map 1.2 pg.4 for general location)

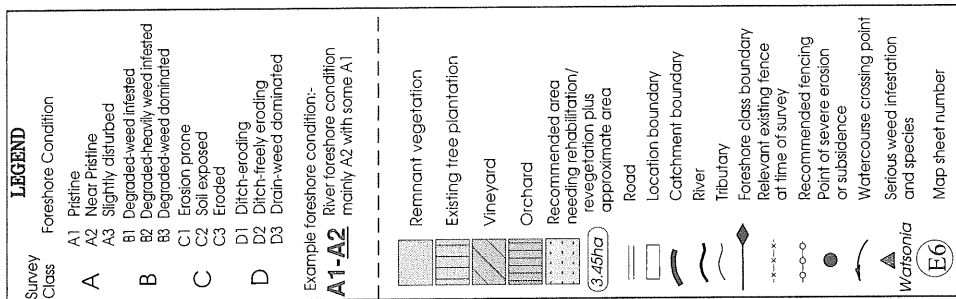
MAP KEY



Loc. Numbers of Adjacent Properties: 658, 659, 651, 540, part 5159.
 Survey Project Officer: Alex Syme.
 Date: June 1997

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

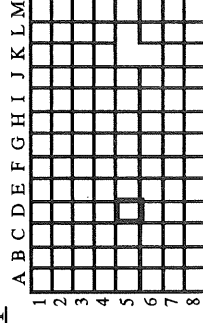
	Scotsdale Brook	Tributaries/Tributary
Length of watercourse Fencing In Place	Nil	924 metres
Length of watercourse Fencing Recommended	Nil	2736 metres
Number of severe erosion sites	Nil	10
Advice on remedial measures required for these sites	Recommendation: N/A	Recommendation: Fence and revegetate. Construct riffles on dam overflows.
Approximate area along watercourse/s requiring revegetation	Area (Ha.): Nil	Area (Ha.): 2.77
Advice on Revegetation Species and Preparation	N/A	Hand plant Adjacent vegetation is <i>Agonis juniperina</i> , <i>E. diversicolor</i> <i>Eucalyptus calophylla</i> , <i>Eucalyptus patens</i> , <i>Eucalyptus megacarpa</i> . (Select further species from Appendix 1)
Number of other sites requiring rehabilitation work (ie Serious weed infestations)	Nil	Nil
Advice on Rehabilitation of these sites	Recommendation: N/A	Recommendation: N/A
Other Management Related Information for this map	Nil	Streams on loc. 659 need urgent rehabilitation and revegetation.



Projection: Universal Transverse Mercator
Grid: A.M.G., zone 50
Date: August 18, 1987
Source Data:
Based on field survey and interpretation of 1:20,000
aerial photographs Job 960851, Jan '87 Runs 13 to 17
by the Dept. of Land Administration West. Aust.
Cadastral and topographic digital information supplied
by the Dept. of Land Administration West. Aust.
Prepared for APACE Green Skills as part of the
riparian survey of the Scottsdale Brook catchment.
Funded by the Wilson Inlet Management Authority
Project co-ordinator APACE Green Skills.
Produced by Watershed Digital Mapping
RMB 1015 Lakops Rd Denmark WA Ph (089) 482428

SCOTSDALE BROOK SURVEY- Map D5 (See Map 1.2 pg.4 for general location)

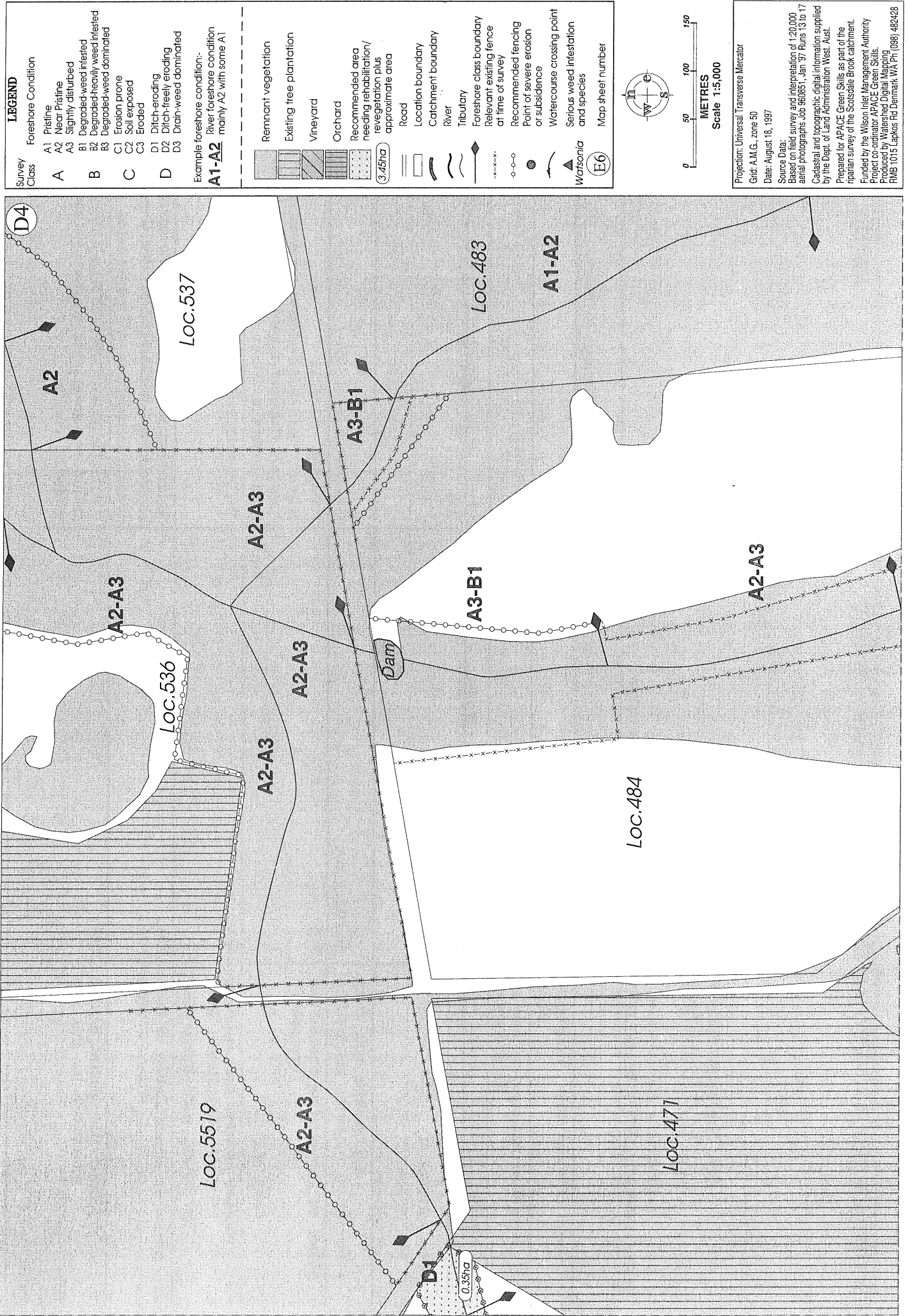
MAP KEY



Loc. Numbers of Adjacent Properties: 477,484.
 Survey Project Officer: Robyn Glenister.
 Date: July 1997

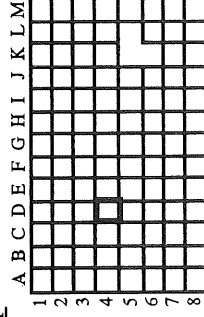
MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Scotsdale Brook	Tributaries/Tributary
Length of watercourse Fencing In Place	N/A	476 metres
Length of watercourse Fencing Recommended	N/A	1476 metres
Number of severe erosion sites	N/A	Nil
Advice on remedial measures required for these sites	N/A	N/A
Approximate area along watercourse/s requiring revegetation	Area (Ha.): N/A	Area (Ha.): 2.20
Advice on Revegetation Species and Preparation	N/A	Hand plant Adjacent vegetation is <i>Eucalyptus marginata</i> , <i>Eucalyptus calophylla</i> , <i>Melaleuca raphiophylla</i> . (Select further species from Appendix 1)
Number of other sites requiring rehabilitation work (ie Serious weed infestations)	N/A	Stock crossing points and blackberry infestations.
Advice on Rehabilitation of these sites	N/A	Recommendation: Stock crossing points need to be constructed and stock excluded from them when not in use. Carefully treat Blackberry and monitor results
Other Management Related Information for this map	N/A	If no alternative water supply for stock is available, then constructed watering points on streams that minimise bank erosion are desirable.



SCOTSDALE BROOK SURVEY- Map D4 (See Map 1.2 pg.4 for general location)

MAP KEY



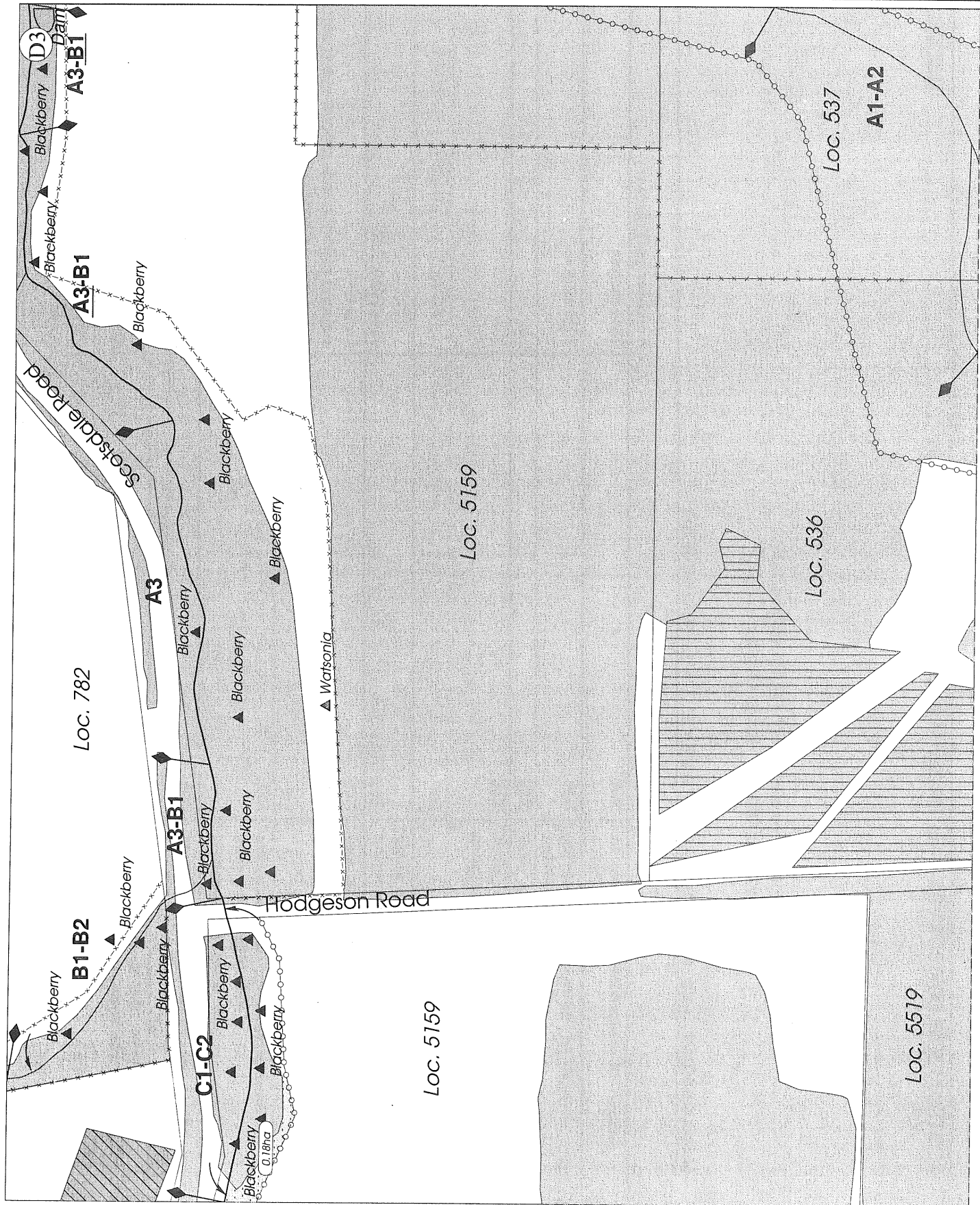
Loc. Numbers of Adjacent Properties: 471,484,536,483,part 5519.

Survey Project Officer: Robyn Glenister.

Date: July 1997

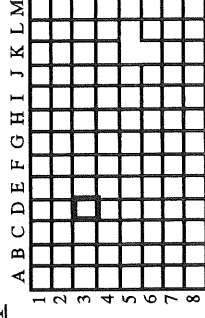
MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

Scotsdale Brook		Tributaries/Tributary
Length of watercourse	Fencing In Place	N/A
Length of watercourse	Fencing Recommended	N/A
Number of severe erosion sites		Nil
Advice on remedial measures required for these sites		N/A
Approximate area along watercourse/s requiring revegetation		Area (Ha.): 0.35
Advice on Revegetation Species and Preparation		Hand plant Adjacent vegetation is <i>Eucalyptus marginata</i> , <i>Eucalyptus calophylla</i> , <i>Eucalyptus patens</i> , <i>Eucalyptus megacarpa</i> . (Select further species from Appendix 1)
Number of other sites requiring rehabilitation work (ie Serious weed infestations)		Blackberry infestation.
Advice on Rehabilitation of these sites		Recommendation: Carefully treat Blackberry and monitor results.
Other Management Related Information for this map		High quality remnant vegetation still remains along almost all waterways shown on this map. Action to ensure its continued integrity would be of value to the health of the catchment.



SCOTSDALE BROOK SURVEY- Map D3 (See Map 1.2 pg.4 for general location)

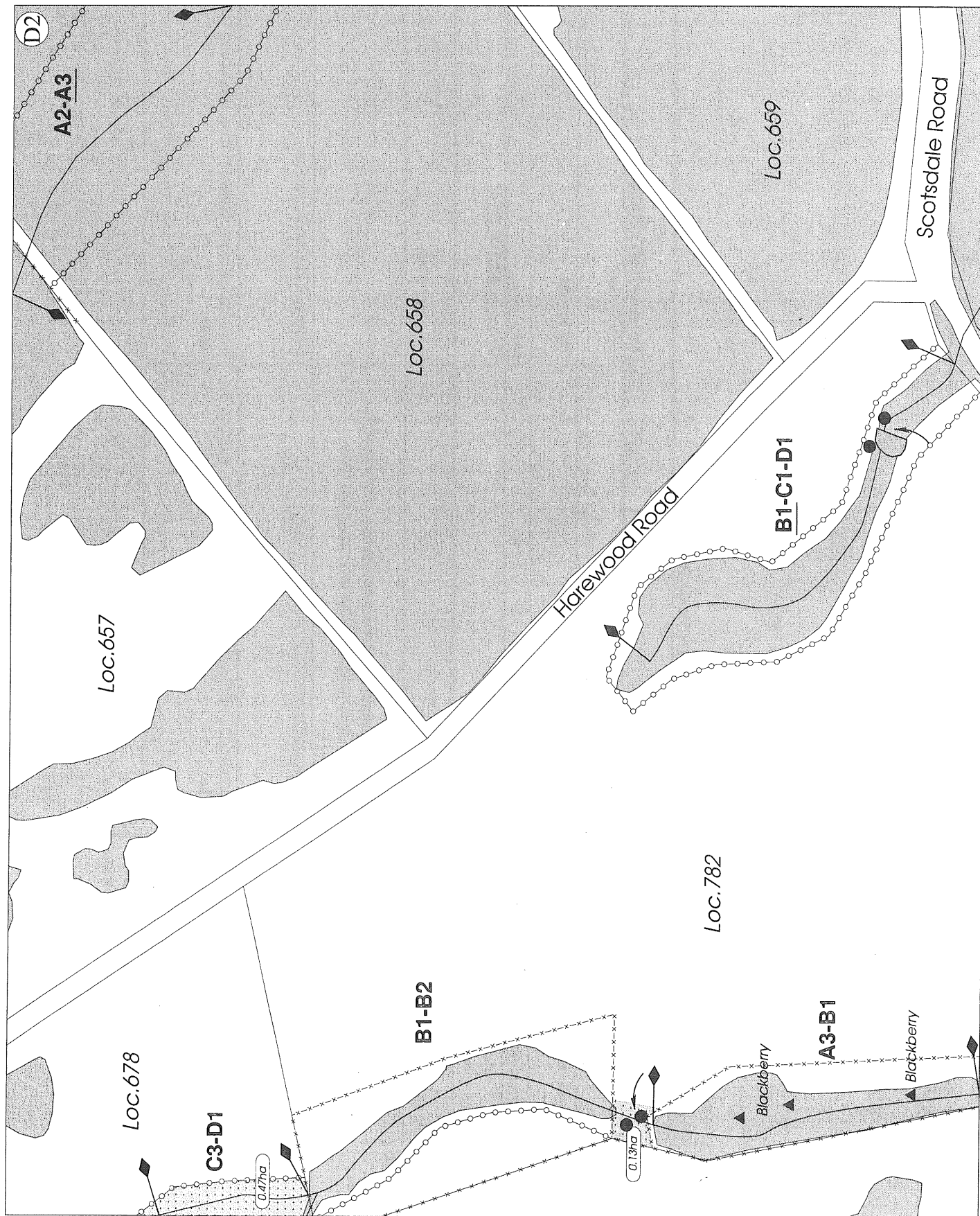
MAP KEY



Loc. Numbers of Adjacent Properties: 5519,5159,536,782.
Survey Project Officer: Alex Syme.
Date: June/July 1997

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Scotsdale Brook	Tributaries/Tributary
Length of watercourse Fencing In Place	1115 metres	1425 metres
Length of watercourse Fencing Recommended	350 metres	758 metres
Number of severe erosion sites	Nil	Nil
Advice on remedial measures required for these sites	Recommendation: N/A	Recommendation: N/A
Approximate area along watercourse/s requiring revegetation	Area (Ha.): 0.18	Area (Ha.): Nil
Advice on Revegetation Species and Preparation	Hand plant Adjacent vegetation is <i>Agonis juniperina</i> , <i>E. diversicolor</i> <i>Eucalyptus calophylla</i> . (Select further species from Appendix 1)	N/A
Number of other sites requiring rehabilitation work (ie Serious weed infestations)	Severe blackberry infestations	Some blackberry infestation
Advice on Rehabilitation of these sites	Recommendation: Carefully treat Blackberry and monitor results	Recommendation: Carefully treat Blackberry and monitor results
Other Management Related Information for this map	Nil	Nil



Survey Class	Foreshore Condition
A	A1 Pristine A2 Near Pristine A3 Slightly disturbed
B	B1 Degraded-weed infested B2 Degraded-heavily weed infested B3 Degraded-weed dominated
C	C1 Erosion prone C2 Soil exposed C3 Eroded
D	D1 Ditch-eroding D2 Ditch-freely eroding D3 Drain-weed dominated
Example foreshore condition:- River foreshore condition A1-A2 mainly A2 with some A1	
Remnant vegetation Existing tree plantation Vineyard Orchard Recommended area needing rehabilitation/ revegetation plus approximate area 3.45ha Road Location boundary Catchment boundary River Tributary Foreshore class boundary Relevant existing fence at time of survey Recommended fencing Point of severe erosion or subsidence Watercourse crossing point Serious weed infestation and species Watsonia Map sheet number E6	

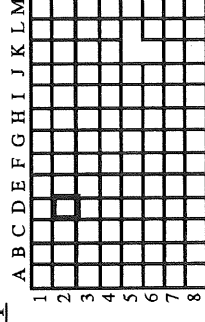


0 50 100 150
METRES
Scale 1:5,000

Projection: Universal Transverse Mercator
Grid: A.M.G. zone 50
Date: August 18, 1997
Source Data:
Based on field survey and interpretation of 1:20,000
aerial photographs Jan 95/05, Jan '97 Runs 13 to 17
Cadastral and topographic digital information supplied
by the Dept. of Land Administration West. Aust.
Prepared for APACE Green Skills as part of the
riparian survey of the Scotsdale Brook catchment.
Funded by the Wilson Inlet Management Authority
Project co-ordinator APACE Green Skills
Produced by Watershed Digital Mapping
RMB 1015 Lapkos Rd Denmark WA Ph (089) 482428

SCOTSDALE BROOK SURVEY- Map D2 (See Map 1.2 pg.4 for general location)

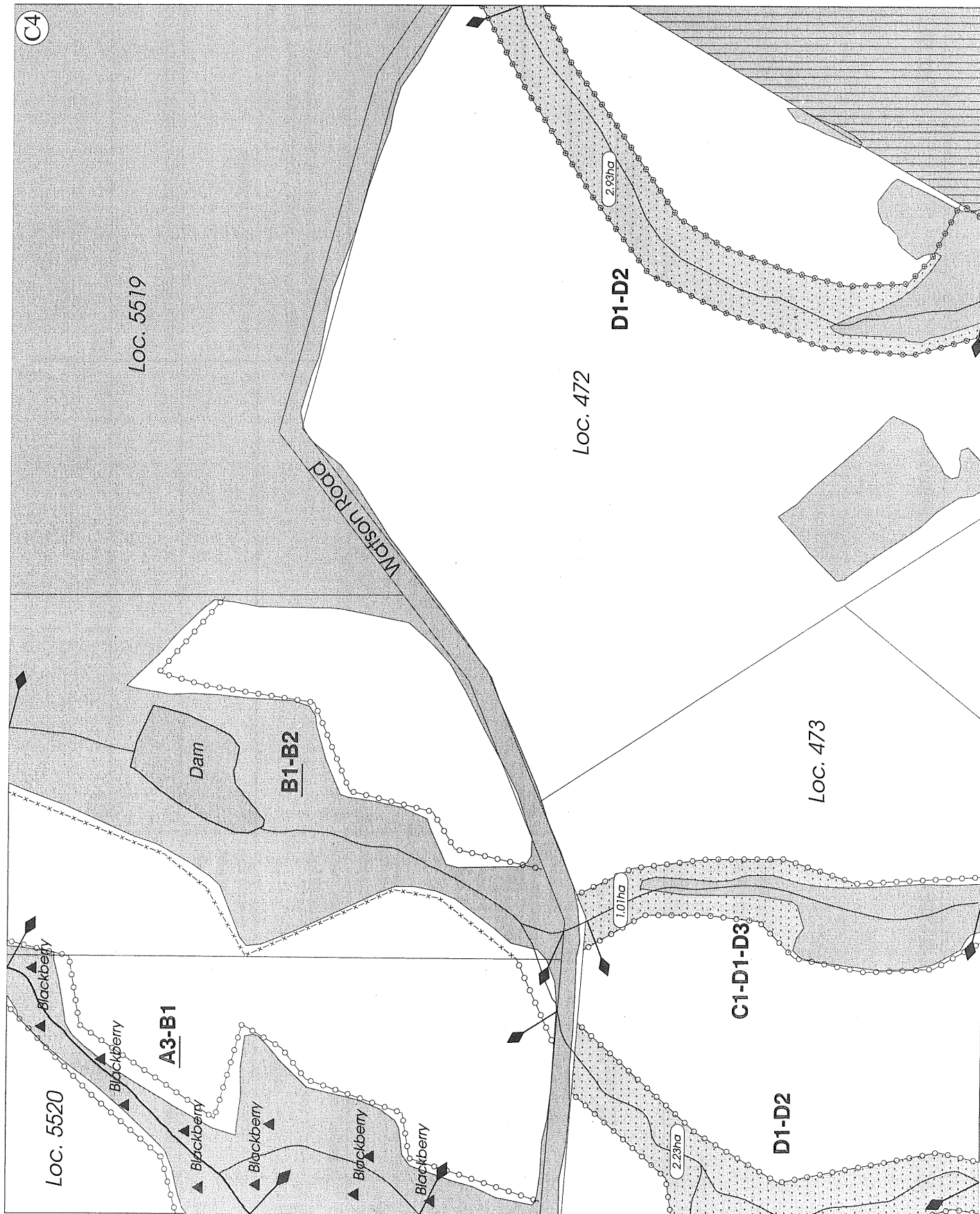
MAP KEY



Loc. Numbers of Adjacent Properties: 782,658.
 Survey Project Officer: Alex Syme.
 Date: July 1997

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Scotsdale Brook	Tributaries/Tributary
Length of watercourse Fencing In Place	N/A	1604 metres
Length of watercourse Fencing Recommended	N/A	1999 metres
Number of severe erosion sites	N/A	2
Advice on remedial measures required for these sites	N/A	Recommendation: Fence, construct crossings, exclude stock and revegetate.
Approximate area along watercourse/s requiring revegetation	Area (Ha.): N/A	Area (Ha.): 0.62
Advice on Revegetation Species and Preparation	N/A	Hand plant Adjacent vegetation is <i>Agonis juniperina</i> , <i>E. diversicolor</i> <i>Eucalyptus calophylla</i> , <i>Eucalyptus patens</i> , <i>Eucalyptus megacarpa</i> . (Select further species from Appendix 1)
Number of other sites requiring rehabilitation work (ie Serious weed infestations)	N/A	Some blackberry infestation
Advice on Rehabilitation of these sites	N/A	Recommendation: Carefully treat Blackberry and monitor results
Other Management Related Information for this map	N/A	Nil



Survey Class	Foreshore Condition
A	A1 Pristine
	A2 Near Pristine
	A3 Slightly disturbed
B	B1 Degraded-weed infested
	B2 Degraded-heavy weed infested
	B3 Degraded-weed dominated
C	C1 Erosion prone
	C2 Soil exposed
	C3 Eroded
D	D1 Ditch-eroding
	D2 Ditch-freely eroding
	D3 Drain-weed dominated

Example foreshore condition:-
River foreshore condition mainly A2 with some A1

A1-A2

	Remnant vegetation
	Existing tree plantation
	Vineyard
	Orchard
	Recommended area needing rehabilitation/revegetation plus approximate area
	Road
	Location boundary
	Catchment boundary
	River
	Tributary
	Foreshore class boundary
	Relevant existing fence at time of survey
	Recommended fencing or subsidence
	Point of severe erosion
	Watercourse crossing point and species
	Watsonia
	Map sheet number

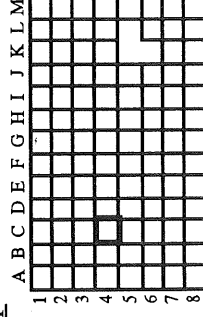


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METRES
Scale 1:5,000

Projection: Universal Transverse Mercator
Grid: A.M.G. zone 50
Date: August 18, 1997
Source Data:
Based on field survey and interpretation of 1:20,000 aerial photographs (Job 960851, Jan '97 Runs 13 to 17)
Cadastral and topographic digital information supplied by the Dept. of Land Administration West, Aust.
Prepared for APACE Green Skills as part of the riparian survey of the Scotsdale Brook catchment.
Funded by the Wilson Inlet Management Authority
Project co-ordinator: APACE Green Skills
Produced by Watershed Digital Mapping
RMB 1015 Lapsus Rd Denmark WA Pt 1099 482428

SCOTSDALE BROOK SURVEY- Map C4 (See Map 1.2 pg.4 for general location)

MAP KEY



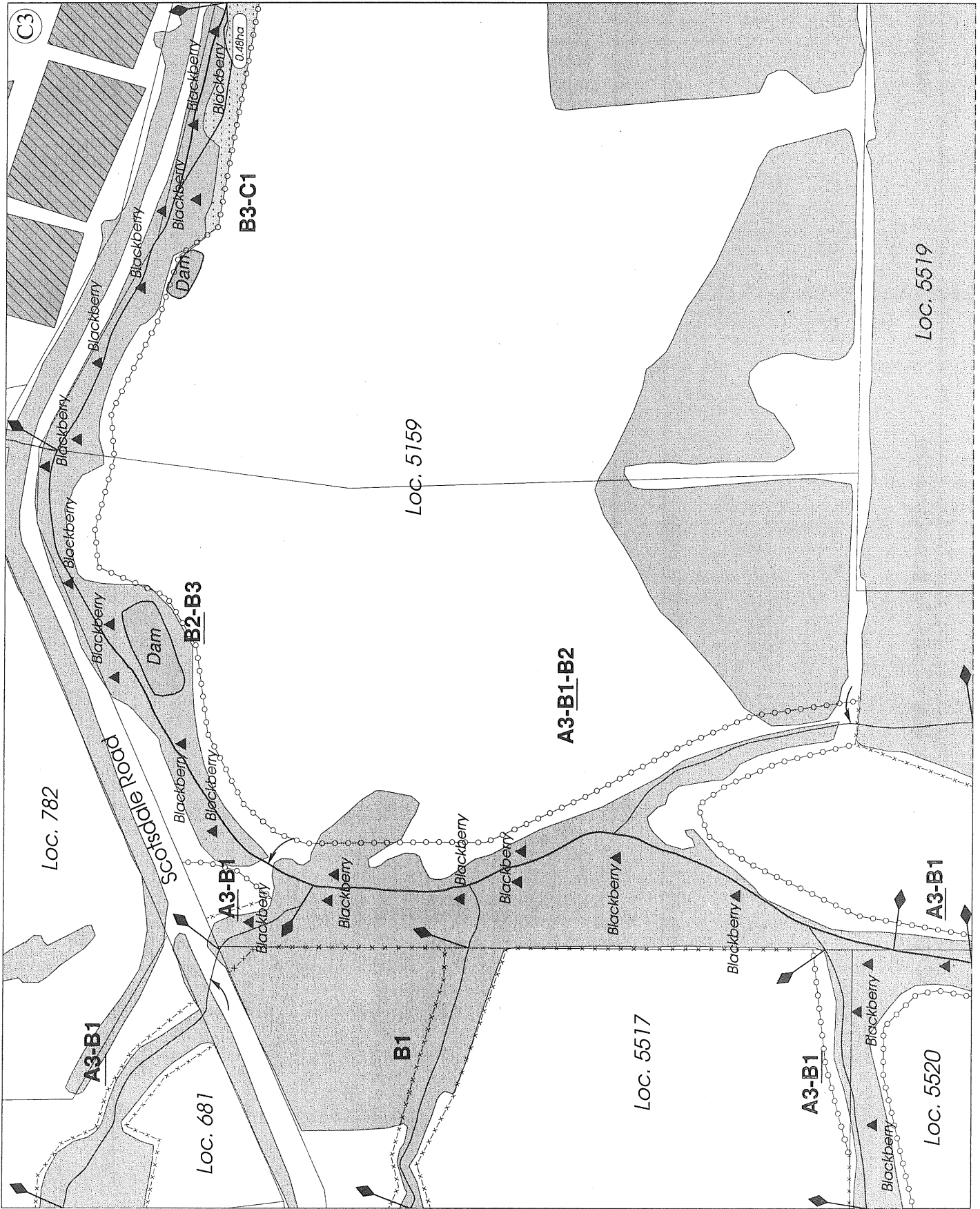
Loc. Numbers of Adjacent Properties: 5520,5519,473,472.

Survey Project Officer: Alex Syme.

Date: June 1997

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Scotsdale Brook	Tributaries/Tributary
Length of watercourse	Nil	810 metres
Fencing In Place		
Length of watercourse	830 metres	3304 metres
Fencing Recommended		
Number of severe erosion sites	Nil	Nil
Advice on remedial measures required for these sites	Recommendation: N/A	Recommendation: N/A
Approximate area along watercourse/s requiring revegetation		
Advice on Revegetation Species and Preparation	Area (Ha.): Nil N/A	Area (Ha.): 6.17 Hand plant Adjacent vegetation is <i>Agonis juniperina</i> , <i>E. diversicolor</i> <i>Eucalyptus calophylla</i> , <i>Eucalyptus patens</i> , <i>Eucalyptus megacarpa</i> . (Select further species from Appendix 1). Consult a landcare technician in surveying in rip and mound lines.
Number of other sites requiring rehabilitation work (ie Serious weed infestations)	Nil	Nil
Advice on Rehabilitation of these sites	Recommendation: N/A	Recommendation: N/A
Other Management Related Information for this map	Nil	Nil



LEGEND

Survey Class	Foreshore Condition
A	A1 Pistine
	A2 Near Pistine
	A3 Slightly disturbed
B	B1 Degraded-weed infested
	B2 Degraded-heavily weed infested
	B3 Degraded-weed dominated
C	C1 Erosion prone
	C2 Soil exposed
	C3 Eroded
D	D1 Ditch-eroding
	D2 Ditch-freely eroding
	D3 Drain-weed dominated

Example foreshore condition:-
River foreshore condition
A1-A2 mainly A2 with some A1

	Remnant vegetation
	Existing tree plantation
	Vineyard
	Orchard
	Recommended area needing rehabilitation/ revegetation plus approximate area
	Road
	Location boundary
	Catchment boundary
	River
	Tributary
	Foreshore class boundary
	Relevant existing fence at time of survey
	Recommended fencing or subsidence
	Point of severe erosion
	Watercourse crossing point and species
	Watsonia
	Map sheet number



0 50 100 150
METRES
Scale 1:5,000

Projection: Universal Transverse Mercator

Grid: A.M.G. zone 50

Date: August 18, 1997

Source Data:

Based on field survey and interpretation of 1:20,000 aerial photographs, Job 960851, Jan '97 Runs 13 to 17

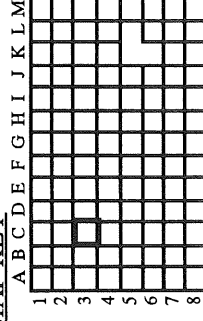
Cadastral and topographic digital information supplied by the Dept. of Land Administration West. Aust.

Prepared for APACE Green Skills as part of the riparian survey of the Scotsdale Brook catchment.

Project co-ordinator APACE Green Skills
Produced by Watershed Digital Mapping
RMB 1015 Lakes Rd Denmark WA Ph (08) 482428

SCOTSDALE BROOK SURVEY- Map C3 (See Map 1.2 pg.4 for general location)

MAP KEY



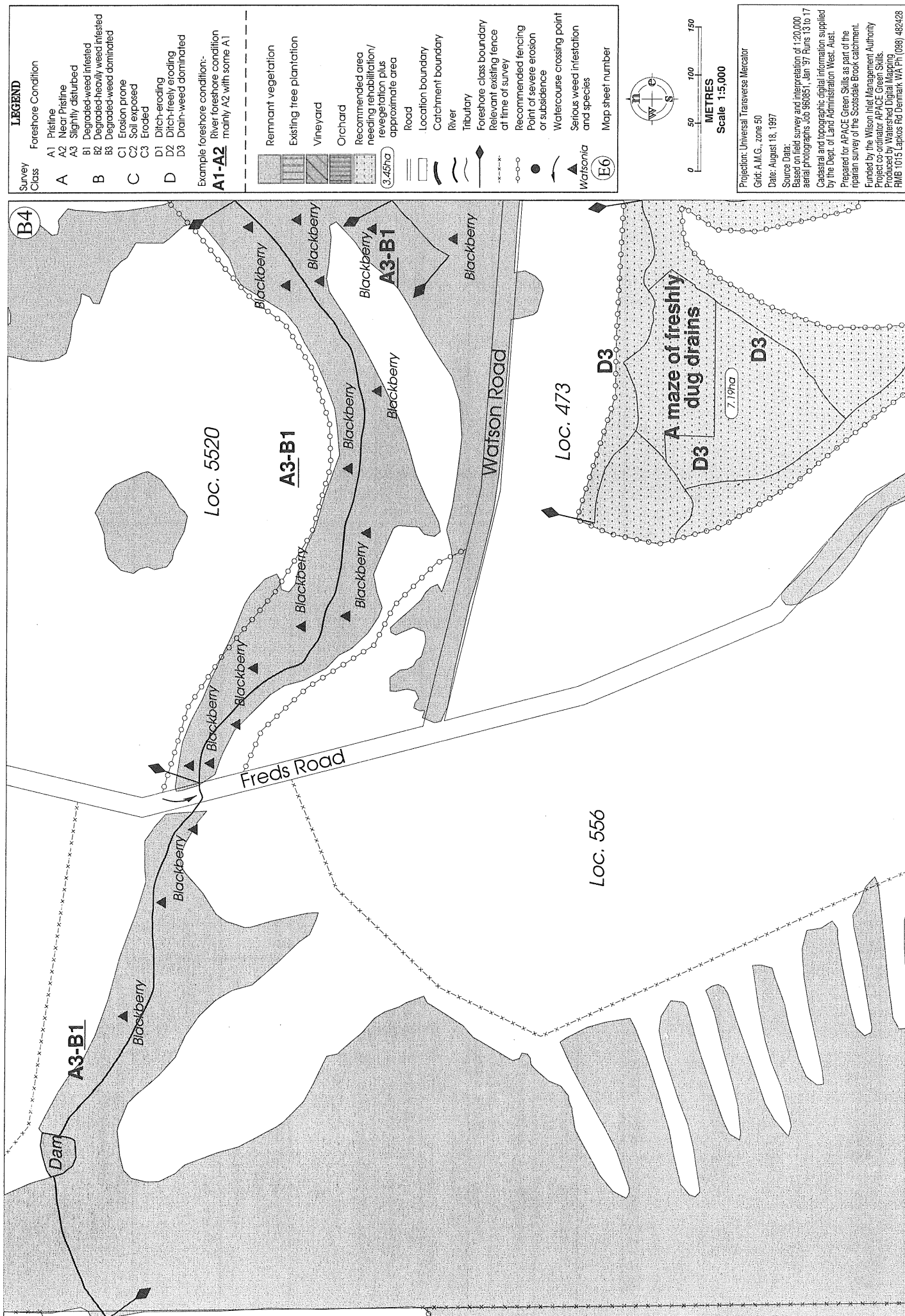
Loc. Numbers of Adjacent Properties: 5519,5520,5517,5159,782,681.

Survey Project Officer: Alex Syme.

Date: June 1997

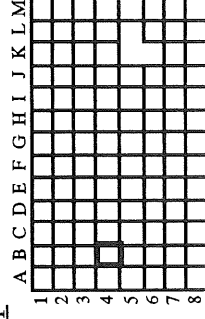
MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Scotsdale Brook	Tributaries/Tributary
Length of watercourse Fencing In Place	720 metres	1098 metres
Length of watercourse Fencing Recommended	1876 metres	675 metres
Number of severe erosion sites	Nil	Nil
Advice on remedial measures required for these sites	Recommendation: N/A	Recommendation: N/A
Approximate area along watercourse/s requiring revegetation	Area (Ha.): 0.48	Area (Ha.): Nil
Advice on Revegetation Species and Preparation	Hand plant Adjacent vegetation is <i>Agonis juniperina</i> , <i>E. diversicolor</i> <i>Eucalyptus calophylla</i> , <i>Eucalyptus patens</i> , <i>Eucalyptus megacarpa</i> . (Select further species from Appendix 1)	N/A
Number of other sites requiring rehabilitation work (ie Serious weed infestations)	Severe blackberry infestations	Some blackberry infestation
Advice on Rehabilitation of these sites	Recommendation: Carefully treat Blackberry and monitor results	Recommendation: Carefully treat Blackberry and monitor results
Other Management Related Information for this map	Nil	Nil



SCOTSDALE BROOK SURVEY- Map B4 (See Map 1.2 pg.4 for general location)

MAP KEY



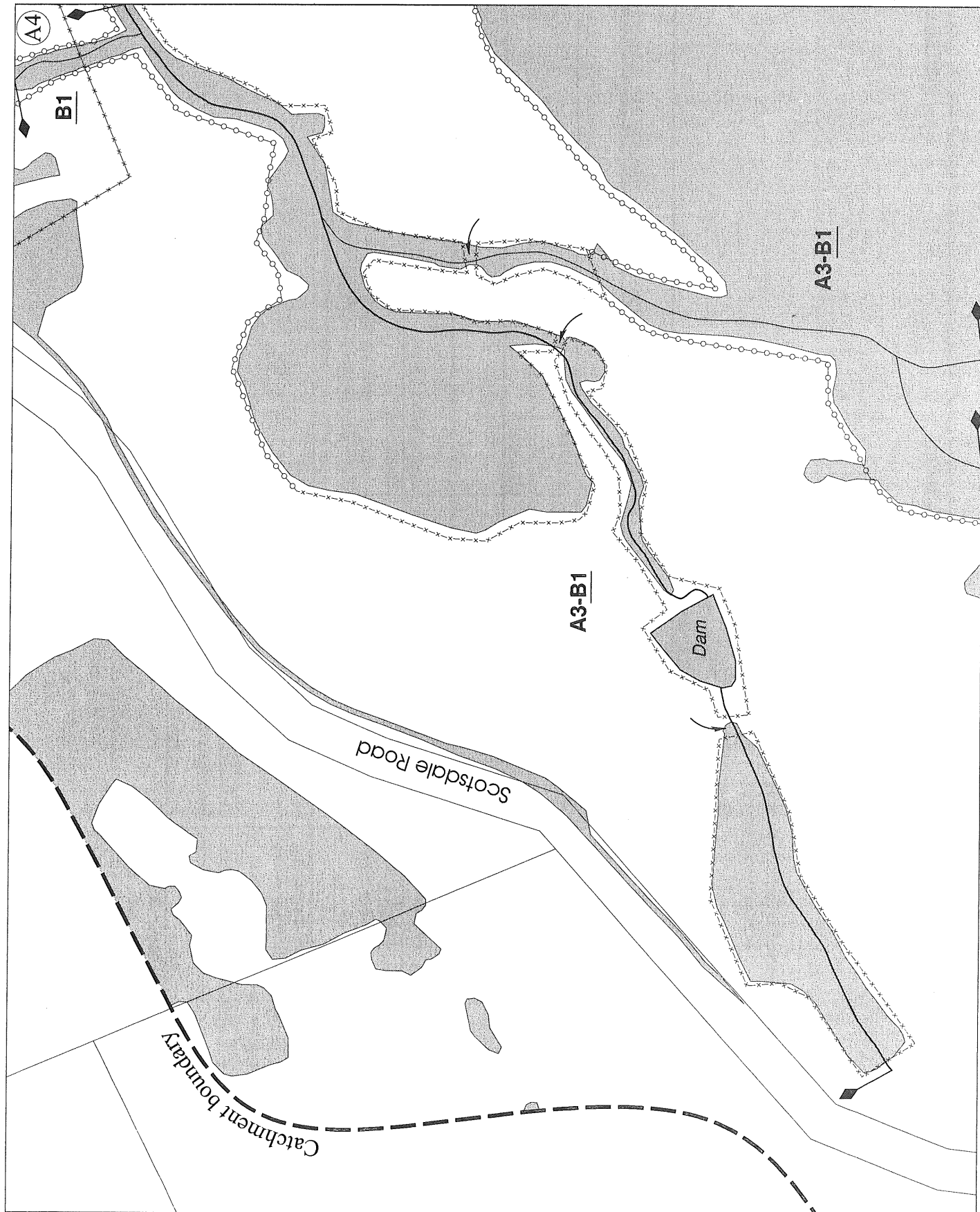
Loc. Numbers of Adjacent Properties: 556,5520,473.

Survey Project Officer: Alex Syme.

Date: June 1997

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Scotsdale Brook	Tributaries/Tributary
Length of watercourse Fencing In Place	1437 metres	Nil
Length of watercourse Fencing Recommended	1073 metres	1530 metres
Number of severe erosion sites	Nil	Numerous
Advice on remedial measures required for these sites	Recommendation: N/A	Recommendation: Fence, construct crossings, exclude stock and revegetate.
Approximate area along watercourse/s requiring revegetation	Area (Ha.): Nil	Area (Ha.): 7.19
Advice on Revegetation Species and Preparation	N/A	Hand plant Adjacent vegetation is <i>Eucalyptus marginata</i> , <i>Eucalyptus calophylla</i> , <i>Eucalyptus patens</i> , <i>Eucalyptus megacarpa</i> . (Select further species from Appendix 1). Consult a landcare technician in surveying in rip and mound lines.
Number of other sites requiring rehabilitation work (ie Serious weed infestations)	Severe blackberry infestations	Nil
Advice on Rehabilitation of these sites	Recommendation: Carefully treat Blackberry and monitor results	Recommendation: N/A
Other Management Related Information for this map	Nil	Nil



LEGEND

Survey Class	Foreshore Condition
A	A1 Pistine
	A2 Near Pistine
	A3 Slightly disturbed
B	B1 Degraded-weed infested
	B2 Degraded-heavily weed infested
	B3 Degraded-weed dominated
C	C1 Erosion prone
	C2 Soil exposed
	C3 Eroded
D	D1 Ditch-eroding
	D2 Ditch-freely eroding
	D3 Drain-weed dominated

Example foreshore condition:-
River foreshore condition
A1-A2 mainly A2 with some A1

	Remnant vegetation
	Existing tree plantation
	Vineyard
	Orchard
	Recommended area
	rehabilitation plus approximate area
	Road
	Location boundary
	Catchment boundary
	River
	Tributary
	Foreshore class boundary
	Relevant existing fence at time of survey
	Recommended fencing
	Point of severe erosion or subsidence
	Watercourse crossing point
	Watsonia
	Serious weed infestation and species
	Map sheet number

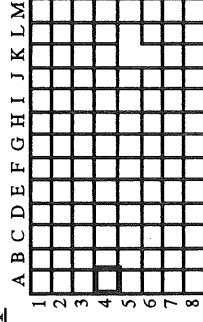


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METRES
Scale 1:5,000

Projection: Universal Transverse Mercator
Grid: A.M.G., zone 50
Date: August 18, 1997
Source Data:
Based on field survey and interpretation of 1:20,000 aerial photographs Job 960851, Jan 97 Runs 13 to 17
Cadastral and topographic digital information supplied by the Dept. of Land Administration West, Aust.
Prepared for APACE Green Skills as part of the riparian survey of the Scotsdale Brook catchment.
Funded by the Western Inlet Management Authority
Project coordinator: APACE Green Skills
Produced by: Waterbird Digital Mapping
RWB 1015 Lapras Rd Denmark WA Ph: (088) 482428

SCOTSDALE BROOK SURVEY- Map A4 (See Map 1.2 pg.4 for general location)

MAP KEY



Loc. Numbers of Adjacent Properties: Parts 557.
Survey Project Officer: Alex Syme.
Date: June 1997

MANAGEMENT AND REHABILITATION ADVICE TO LANDHOLDERS

	Scotsdale Brook	Tributaries/Tributary
Length of watercourse Fencing In Place	3059 metres	700 metres
Length of watercourse Fencing Recommended	680 metres	1097 metres
Number of severe erosion sites	Nil	Nil
Advice on remedial measures required for these sites	Recommendation: N/A	Recommendation: N/A
Approximate area along watercourse/s requiring revegetation	Area (Ha.): Nil	Area (Ha.): Nil
Advice on Revegetation Species and Preparation	N/A	N/A
Number of other sites requiring rehabilitation work (ie Serious weed infestations)	Nil	Nil
Advice on Rehabilitation of these sites	Recommendation: N/A	Recommendation: N/A
Other Management Related Information for this map	Recently constructed fencing is well located and incorporates innovative design features. A good example for other landowners to follow for this vegetation and landscape type.	Recently constructed fencing is well located and incorporates innovative design features. A good example for other landowners to follow for this vegetation and landscape type.

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Appendices

Appendix 1: List of local plant species for foreshore rehabilitation and revegetation in the Scotsdale Brook Catchment.

This Appendix presents information gained from a botanical survey carried out by Mark Parre of sites in the Scotsdale Brook Catchment and from Tables 1 and 2 from Janicke (1994). *An Inventory of plant species found at six locations along the Denmark and Hay Rivers.* A report prepared for the Wilson Inlet Management Authority and South Coast Estuaries Project.

SCOTSDALE BROOK RIVER SPECIES	Common Names	Height and if suitable for very wet areas W	Highly recommended ✓
Trees			
<i>Agonis flexuosa</i>	Peppermint	6m+	✓
<i>Agonis juniperina</i>	Watti	6m W	✓
<i>Allocasuarina deccusata</i>	Karri sheoak	5m+	✓
<i>Banksia grandis</i>	Bull Banksia	3m +	✓
<i>Banksia seminuda</i>	River Banksia	6m +	✓
<i>Calistachys lanceolata</i>	Wonnich, Swamp Willow	6m W	✓
<i>Eucalyptus (Corymbia) calophylla</i>	Marri	15 +	✓
<i>Eucalyptus diversicolor</i>	Karri	15m +	✓
<i>Eucalyptus marginata</i>	Jarrah	10m +	✓
<i>Eucalyptus megacarpa</i>	Bullich	6m + W	✓
<i>Eucalyptus patens</i>	Blackbutt	6m W	✓
<i>Hakea oleifolia</i>	Olive Leaved Hakea	6m	✓
<i>Melaleuca hamulosa</i>		6m W	✓
<i>Melaleuca preissiana</i>	Freshwater paperbark	4m + W	Not local but found elsewhere in Denmark river catchment
<i>Melaleuca raphiophylla</i>	Swamp paperbark	4m + W	Not local but found elsewhere in Denmark river catchment
<i>Trymalium florbundum</i>	Hazel	6m+	✓
Shrubs			
<i>Acacia pentadenia</i>	Karri wattle	3m +	✓
<i>Acacia divergens</i>		1m	
<i>Acacia hastulata</i>		1m W	
<i>Acacia pulchella</i>	Prickly Moses	2m W	✓
<i>Acacia myrtifolia</i> var. <i>angustifolia</i>		2m	
<i>Agonis hypericifolia</i>		2m	✓
<i>Agonis linearifolia</i>	Rosa Ti Tree	3m W	✓
<i>Agonis parviceps</i>	Fine Ti Tree	3m W	✓
<i>Anigosanthos flavidus</i>	Green Kangaroo paw	1m W	✓
<i>Aotus intermedia</i>		2m W	✓
<i>Beaufortia sparsa</i>	Bottlebrush	2m W	✓
<i>Bossiaea linophylla</i>	Egg and bacon	2m	
<i>Hakea amplexicaulis</i>		3m	
<i>Hakea linearis</i>		3m W	✓
<i>Homalospermum firmum</i> (previously <i>Leptospermum firmum</i>)		4m W	✓
<i>Hovea elliptica</i>	Karri blue bush	2m	

Appendix 1 continued

SCOTSDALE BROOK SPECIES	Common Names	Height and if suitable for very wet areas W	Highly recommended ✓
Kunzea ericaefolia		3m W	✓
Opercularia hispidula	Dunnybush	1m	
Melaleuca thymoides		2m W	✓
Monotoca tamariscina		1m	
Petrophile diversifolia		2m	
Pultenea calycina		2m W	✓
Pultenea reticulata		2m	✓
Thomasia paniculata		1m W	✓
Sollya heterophylla	Blue bell bush	1m+ W	✓
Sedges			
Isolepis nodosus	nodding club sedge	1m	
Lepidosperma drummondii	fisherman's canes	2m W	✓
Lepidosperma effusum	sword sedge	2m W	✓
Lepidosperma gracile	fisherman's canes	1m	
Lepidosperma gladiatum		1m	
Lepidosperma tetraquetum		2m W	✓
Mesomelaena tetragona	semaphor sedge	1m	
Loxocarya flexuosa		0.5m W	✓
Grasses			
Poa porphyroclados		0.5m	
Tetrarrhena laevis		0.5m	

Appendix 2: Recommended books and other literature on bush management and native vegetation rehabilitation

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