Bulletin 4279

DEPARTMENT OF AGRICULTURE
WESTERN AUSTRALIA

Streamlining

An environmentally sustainable drainage network for the Swan Coastal Plain (Peel-Harvey Catchment)

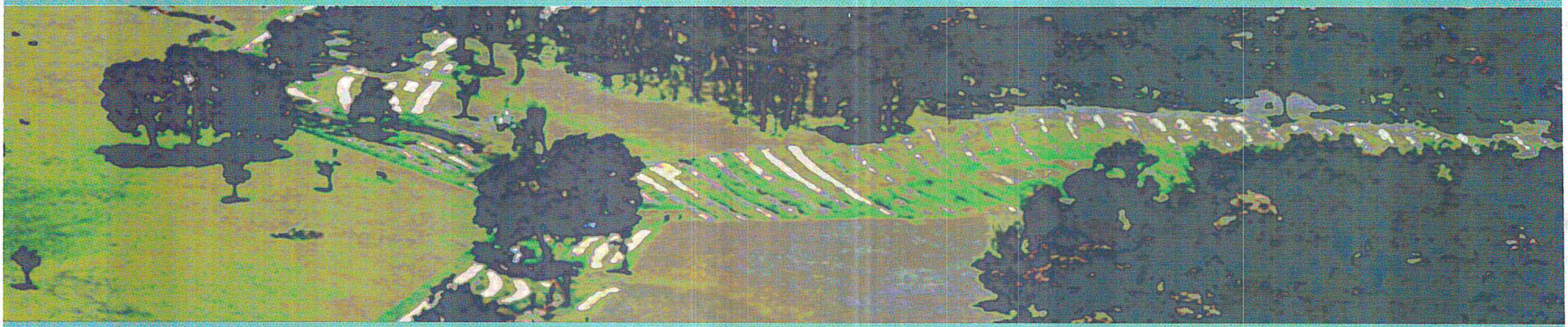
by

Garry Heady

and

Neil Guise

Community Catchment Centre Pinjarra



DEPARTMENT OF AGRICULTURE
WESTERN AUSTRALIA

Agdex 557
ISSN 0927-0012
August 1994

Streamlining

An environmentally sustainable drainage network for the Swan Coastal Plain (Peel-Harvey Catchment)

By

Garry Heady
and
Neil Guise

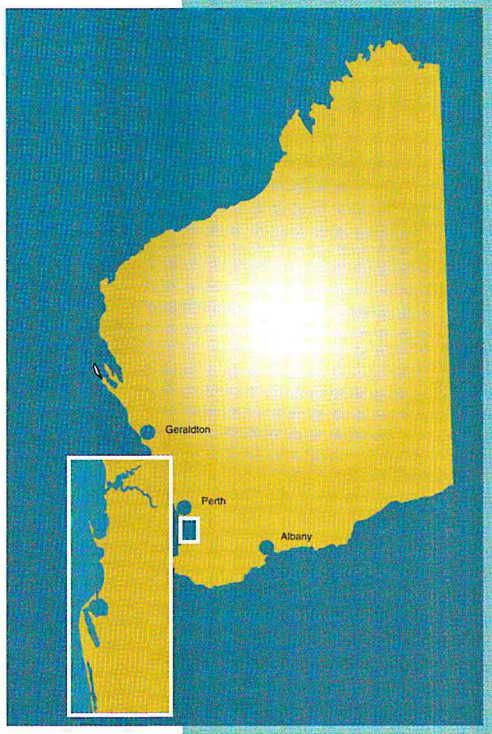
Community Catchment Centre
Pinjarra

Background

A network of over 1400 kilometres of drains and modified natural waterways constructed by the Public Works Department criss-crosses the Peel-Harvey catchment. There are also over 3300 kilometres of minor drains and natural waterways in this same region.

The expansion of agriculture relied on this extensive drainage network, which was designed to ensure rapid drainage of the region. Unfortunately there was little regard to future environmental consequences.

Along with drainage water, these same drains now carry high loads of silt and nutrients. Many of the drains are also degraded and require expensive maintenance annually.



Location of Peel-Harvey coastal catchment

The Peel-Harvey coastal catchment showing the major drainage network

'Streamlining' is a more environmentally acceptable drainage management system.

Streamling is a long-term approach to changing high maintenance artificial drainage into a more natural water course.

It is a technique which can partially overcome long term maintenance costs, nutrient loads to the estuary and various ecological concerns.

The Peel-Harvey Catchment Support Group, in conjunction with local landcare groups, have initiated the first major demonstrations of several streamling projects in the Peel-Harvey Catchment. Streamlining is very popular amongst these landholders and, for most, has become the primary landcare activity. The drain is the common link that has fostered cooperation amongst them.

Current drainage practices must change because of high maintenance costs on the present system and new tighter environmental standards. Streamlining has the potential to minimise many of the present environmental, social and financial concerns.

Major changes are being made to the administrative management of the Swan Coastal Plain drainage. Drainage rates have recently been waived and the Western Australian Water Authority has signalled a significant withdrawal from involvement in managing the system.

Current drain situation

Although some drains are within drainage or road reserves, the majority pass through private property. They are generally unfenced and therefore unprotected from livestock damage. It is this uncontrolled access to the drain that causes most of the current problems.

Two typical examples of the type of drain erosion

An unprotected feeder drain entry point

Financial costs

Instability of the drain bank and the resultant erosion caused by farm livestock have considerable costs to the community.

Uncontrolled grazing of the drains' fringing native vegetation or the replacement pasture grasses has denuded the banks. This loss of binding vegetation combined with stock trampling has resulted in wind and water erosion and slumping of the bank.

Feeder drains from the surrounding property usually enter directly into the main drainage network. Direct entry of unfenced minor farm drains into the main drainage network potentially increases the silt load of the main drain. Water erosion is occurring at many of these entry points.

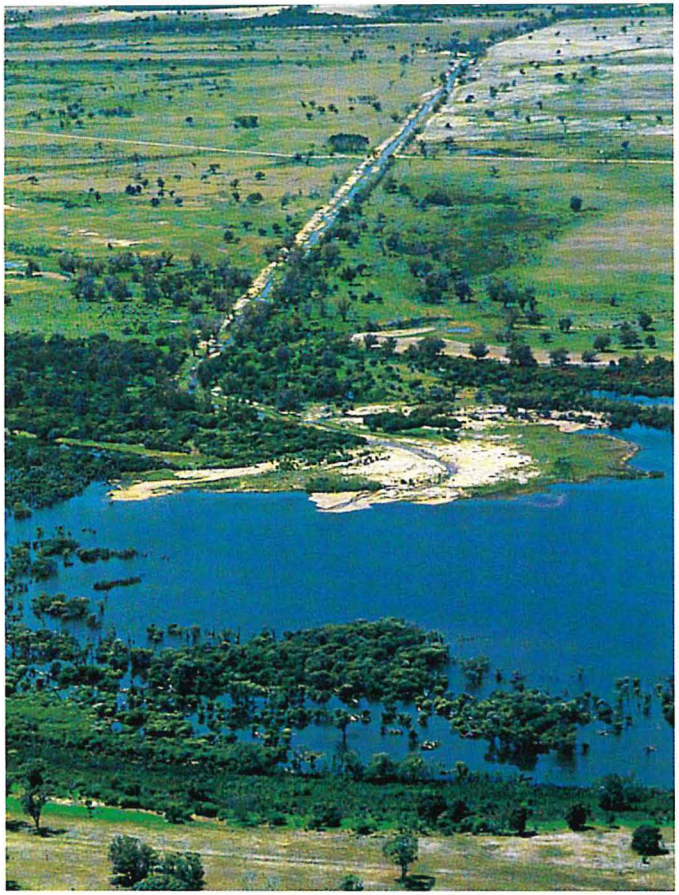
In 1990/91, the Western Australian Water Authority spent $1,360,304 on operating costs for the Waroona, Harvey and Mundijong areas. In the same period the Authority received $604,735 in drainage rates levied on landowners.

Environmental costs

The causes of the eutrophication of the Peel-Harvey Estuary system have been well documented. Recent reports have highlighted the role played by the current drainage network.

The design of the network ensures rapid drainage but also allows the transportation of nutrient enriched drainage water to the estuary.

The deep channels, combined with the lack of fringing vegetation, reduce the in-stream assimilation of nutrients that would be associated with more natural waterways.



In some drains, particulate and organic phosphorus carried in silt contributes up to 50 per cent of the total phosphorus load. Silt reduction measures would reduce this load, however, the existing drainage design provides little opportunity for controlled silt deposition.

Increased in-stream silt loads have filled many of the permanent water holes in streams and rivers. Over the past 20 years rivers such as the South Dandalup have lost many of the deep holes. Water holes, once more than 2 metres deep, are now reduced to ankle deep trickles. All major rivers, such as the Murray, Harvey and Serpentine, have been significantly affected by silt deposition.

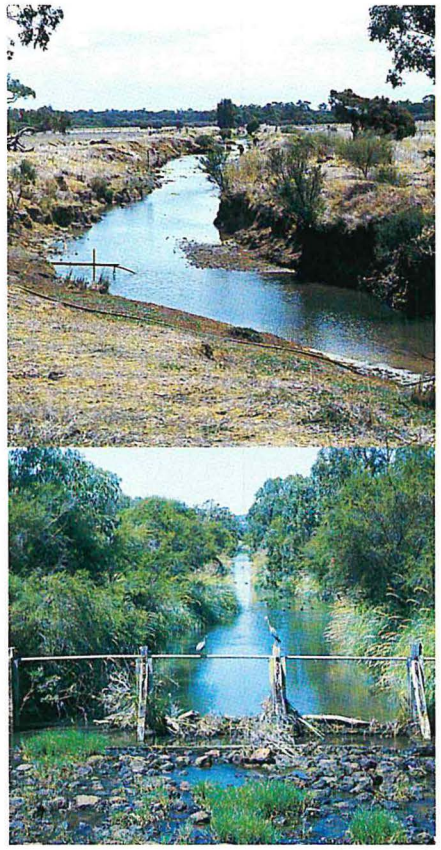
In the hundred years since local settlement, silt deposition has reduced the mean depth of the Peel-Harvey Estuary by almost 1 metre. This is estimated to have reduced its life span by 7000 years.

Costs to the landowner

The drainage network is, on average, over 1 metre deep, and this results in groundwater seepage into the drain. This seepage can continue into the drier months and in some locations lowers the soil moisture close to the drain, causing pasture decline. Groundwater monitoring has shown that this shallow groundwater can be high in nutrients. The loss of this water resource is of concern to many farmers.

Generally landowners agree that while the current drainage system is necessary, it is an unattractive eyesore and adversely affects property values.

ABOVE: Silt deposition at the mouth of the Dirk Brook Drain. The resultant delta in the Serpentine River has increased from 0.23 hectares in 1982 to 4.9 hectares in 1991. At its widest point it is now 290 metres across.



(a)

(b)

The Waroona Main Drain at Somers Road, showing the difference a fence can make. (a) Looking west (unfenced). (b) Looking east (fenced).

A few examples of naturally vegetated drain reserves exist, such as the Waroona Main Drain, often the simple result of permanent stock exclusion.

In seeking solutions to the Peel-Harvey eutrophication problem, we recognised the attributes of the drainage network, and have initiated a program, in conjunction with landowners and other Government authorities, to modify the drains.

The degree and type of modification is site specific but has been characterised as Streamlining.

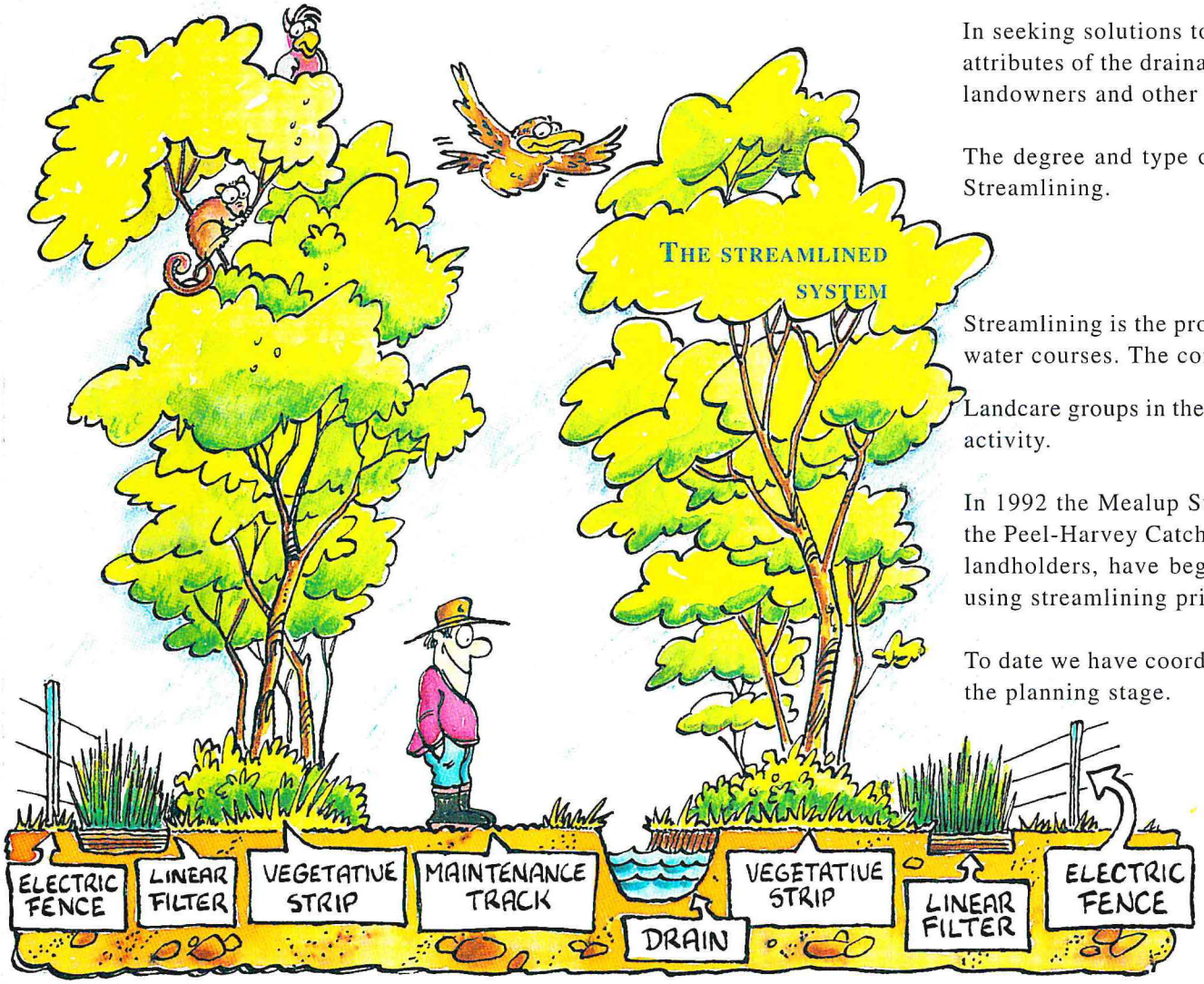
THE STREAMLINED SYSTEM

Streamlining is the process of changing existing artificial drainage into more natural water courses. The concept has attracted community and media attention.

Landcare groups in the region have focussed on streamlining as their primary landcare activity.

In 1992 the Mealup Streamlining project was the first demonstration of its kind in the Peel-Harvey Catchment. Since then, other local Landcare groups, and individual landholders, have begun streamlining a range of drainage lines. Other people are using streamlining principles to rehabilitate natural water courses.

To date we have coordinated over 60 kilometres of streamlining, with many more in the planning stage.



An artist's impression of what streamlining can look like

A streamlined system has three major components:

- physical drain modification;
- exclusion of stock; and
- revegetation of drain banks and reserves

PHYSICAL DRAIN MODIFICATION

The existing drainage network can handle a wide range of flow events over many years. As a guiding rule any drainage modification should not reduce the drain's capacity to remove peak flows.

A maintenance track, adjacent to the drain, is essential as it may be necessary to remove occasional obstructions that could impede flow. This track needs to be about 5 metres wide to allow safe passage of a 4WD vehicle or a tractor.

Generally, most work will be confined to outside the drain invert. Spoil banks and feeder drain entry points may need to be modified, and in some cases in-drain retention structures can be appropriate.

Spoil banks

Most existing drains have relatively large spoil banks. These banks can be partially spread with a grader to provide a better area for vegetation establishment. Weed control is also improved by this 'scalping' process.

As most of these drains pass through flats prone to waterlogging, elevation of the spoil bank is an advantage. The raised banks are often the best areas in a paddock on which to establish trees and shrubs, and they also allow a wider choice of species to be grown.

Grading the spoil bank of a drain in Kangaroo Creek area

Water entering the Mealup Drain from this farm drain is made to pass through a vegetated area, which slows the flow and acts as a filter

Feeder drain entries

(a)

(b)

(a) Four hectares of sump being amended with bauxite residue in west Waroona. (b) The following summer's forage sorghum crop produced 36 tonnes of feed and has retained an estimated 100 kilograms of phosphorus run-off

Some people prefer to remove the entire spoil bank and use the excess soil to fill low patches in paddocks, or place around water troughs that are prone to erosion. The modified tapering banks of the drain can be revegetated to form a very effective Vegetative Filter Strip (VFS), that can be as simple as leaving a strip of ungrazed pasture adjacent to the drain. The ungrazed buffer zone reduces nutrient and sediment concentrations in surface run-off. This area can be used strategically as an access way and for grazing after winter rains have ceased.

Water entry into the drain must be controlled to prevent erosion and reduce silt, nutrients and organic matter entering the main drain. This can be achieved by using vegetation as a filter, and/or physically slowing down the drainage water in combination with other on-farm water control systems.

Original drain construction often created the potential for parallel linear filters. Raised spoil banks mean that feeder drains tend to travel parallel to the main drain before finding an entry point. These sections of feeder drain can be modified to increase their filtering capacity.

Vegetation capable of nutrient and silt stripping can be introduced into the parallel drains (some local reeds and rushes are ideal). It is also feasible to increase the capacity of the drain to 'fix' nutrients by amending the base with bauxite residue (red mud).

Stilling sumps can be constructed at the ends of feeder drains, just before the main drain. These can simply be sumps dug out with a front-end loader or bulldozer to allow silt and sediment to be dropped; or more complex systems incorporating plants and soil amendment.

On-farm water control is an integral part of drainage modification. Minimising water loss from the farm paddock and filtering any drainage water before it gets to the main drains will help spread the load. This also provides opportunities for increasing production in areas where the extra silt and nutrients are harvested.

Existing low-lying areas can be mounded and planted to trees, shrubs and perennial pastures to take advantage of the conditions. It is sometimes practical to divert feeder drains to flow through sumps of this type.

Another innovative approach has been to amend a series of sumps with bauxite residue and divert drains into this network. Silt and nutrients are trapped and then used by a summer fodder crop planted after water levels subside.

Water retention structures

Water retention structures built within the drain, such as weirs and locks, can be used to control the movement of drainage water.

These structures impound spring and summer seepage water, effectively creating a linear wetland and reducing over drainage of fringing pasture. Any structure must be well designed and managed so that winter peak flows and storm water flows are not impeded. Site selection and correct design are critical; get advice before installing any structure and note that WAWA approval is required if within a gazetted drainage area.

Water retention structures can only be used where salinity is not an issue. Retention of drainage water in saline areas will reduce the beneficial leaching effect of the drainage.

Most of the drainage network has extremely low gradients; blocking the water flow will result in it banking up over considerable distances. The dammed water could affect adjoining properties so agreement between neighbours is essential before any blockage is implemented.

Weirs are permanent blockages that rely on sufficient drain width to provide adequate overflow capacity during peak flows. Where the drain profile is relatively uniform the drain will require widening.

Water retention structure (lock) built on the Mealup Drain to better manage the drainage in the area

Drain bank damage of the Mealup Drain caused by stock trampling

Exclusion of stock

A lock is basically a removable dam. Two successful designs have been constructed on the Mealup Drain. Water has banked up for over 3 kilometres behind one lock, effectively creating a linear wetland and reducing the leaching of high nutrient groundwater into the drain.

Locks and weirs can vary greatly in cost depending on the size of the drain and complexity of the design. They have been constructed for less than $1000.

Fencing the drain to exclude stock is a major component of streamlining, otherwise bank erosion will be an on-going problem. Sand banks are trampled into the drain and regular cleaning is required. Clay drains tend to slump when stock have access to the saturated banks. Once again maintenance requirements are high and costly.

The style and type of fencing and the subsequent management of the enclosed area will depend on the land manager.

Conventional fencing techniques have been favoured as a robust low-maintenance alternative but electric fencing is now generally favoured as being more cost effective and allowing greater flexibility in design. In addition, electric fencing can be used to exclude native grazing animals such as kangaroos.

Further savings can be made by sharing an energiser. Both the Kangaroo Creek Landcare Group and the Mealup Catchment Group have Conservation Hotwires operating, with five farmers sharing an energiser in both cases.

Many major drains are already fenced on one side so they are logical places to provide shelterbelts, drain filters and access tracks. Only one additional fence is needed.

To maintain a permanent and effective streamlined system, stock must be fenced out. The understorey will be rapidly grazed out if open to stock and this will greatly reduce the benefits of windbreaks. Wildlife corridor value is also enhanced by permanent stock exclusion.

In some cases, such as with the Vegetative Filter Strip, it is possible to run a single hot-wire along the edge of the drain and strategically graze the area for weed control when bank erosion is not a problem. This same technique can be used to harvest the growth from the Vegetative Filter Strip.

Revegetation of banks

Intertwined roots of trees and shrubs bind the banks together like the reinforcing mesh in concrete.

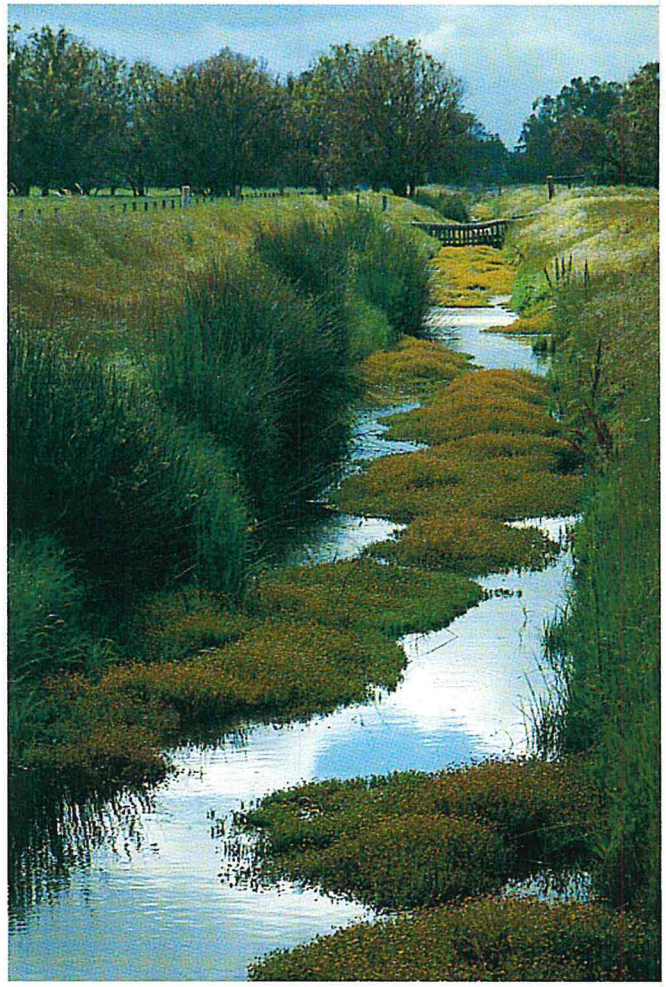
The type of vegetation grown adjacent to the drain will depend on the landowner's requirements and the site's capabilities.

When contemplating streamlining, landowners should determine what they want it to achieve and how it fits into their property strategy. There can be multiple benefits to streamlining. Species selection and placement will have a significant effect and can result in a combination of features.

The establishment of fringing vegetation, whether it be native vegetation or pasture, will reduce erosion of the drain bank.

Waterlogging tolerant grasses, such as couch and kikuyu, reeds and sedges will help stabilise the drain embankments. This vegetation will filter drainage water, help retain silt and organic matter, absorb nutrients and provide an improved habitat for fauna.

The inclusion of a weir or a lock will increase the retention time of the drainage water. This will encourage an aquatic ecosystem to develop. The resultant proliferation of fauna and flora will increase nutrient cycling and therefore improve the drain's assimilation capacity.



Mealup Drain showing stable drain profile colonised by grasses and reeds after fencing

The streamlining of a farm drain in the South Dandalup area has created a valuable wildlife corridor which links two isolated patches of bush

The nutrient and silt stripping capacity of these fringing plants can also be used in the parallel linear filters, stilling sumps and vegetative filters. Nutrient removal from these areas can be enhanced by harvesting or strategic grazing which will redistribute nutrients into the surrounding landscape. Regrowth within the filter area will increase nutrient uptake from the soil. The careful selection of species can provide a source of high protein stock feed which can be particularly useful during the drier summer months when feed is limited.

The type and height of vegetation on the maintenance track, adjacent to the drain, must be limited to allow easy passage of a vehicle along the drain.

The track can be planted with low or prostrate shrubs and creepers to improve its value as a wildlife habitat. Alternatively it can be planted and managed to produce cut flowers that are of commercial value.

Meredith Drain streamlining, including the maintenance track

Perennial grass species allow easy access but without proper management they can harbour weeds and result in an increased fire risk. Periodic grazing, slashing or harvesting will reduce these problems. Fodder crops can also be grown in these areas.

Planting trees and shrubs will create the greatest visual impact while offering the widest range of benefits.

General tree decline on farmland is increasing exposure of stock and pastures to the prevailing winds. The most obvious result of this is wind erosion but there is also mounting evidence that productivity of stock and pastures declines with increased exposure.

The drain is already an obstacle to stock and vehicular movement, is prone to erosion and generally unattractive, therefore it makes sense to position a windbreak adjacent to it.

Many existing windbreaks are inefficient because they are planted with tall trees. As the trees mature they lose their lower branches and allow the wind to pass under the foliage, creating a wind tunnel. The inclusion of lower shrubs on the outside rows of the windbreak improves its efficiency and its value as a wildlife habitat.

Ninety per cent of remnant vegetation within the coastal plain portion of the Peel-Harvey Catchment has been lost. What remains is generally isolated into islands of bush surrounded by farmland or urban expansion. This has left many native animals vulnerable to predation, shortage of feed, in-breeding and fire.

Much of the existing remnant vegetation is degraded and, because of continued grazing, has lost much of its species diversity. This, combined with their isolated nature, has resulted in periods when sources of nectar are scarce. Careful species selection in the linking corridors can ensure year round flowering to offset some of these shortages and encourage the return of some fauna.

Rare or commercially valuable species can be chosen for seed production or floriculture. A range of proteas, banksias, foliage eucalypts and so on could provide an alternative income.

The trees and shrubs selected could provide a valuable feed source for stock. For example, tagasaste, wattles, carobs and poplars can be established to supplement paddock feed. Strategic grazing of these areas will also ensure that grasses and their associated fire risk are easily managed.

Streamlining the drainage network offers the unique opportunity of creating an extensive, interlinked, network of wildlife corridors. They would be relatively undisturbed and not subject to vehicular traffic, a disadvantage of roadside vegetation.

The take home message to both landowners and government authorities is:

You don't have to do it by yourself!

Streamlining can form part of a farm agroforestry system. Tree species can be selected and managed to produce a range of products. These include paper pulp, saw logs, fire wood and fence posts. This system benefits the farm and the environment while an additional source of income is being grown. Most species will coppice after harvesting and the cycle can continue for many years.

Trees and shrubs use groundwater better than shallow rooted pasture plants. Clearing has increased run-off and recharge, resulting in a range of land degradation problems. The strategic use of trees and shrubs on farms will reduce pasture decline resulting from waterlogging and/or salinity. When planted along drains, they create linear cones of depression in the water-table. This will reduce the amount of seepage water and nutrients entering the drain.

Who can help?

In the past three years we have shown that streamlining can get people with diverse interests to work cooperatively and harmoniously.

Few Landcare issues respect property boundaries so it makes sense that these issues should be tackled in conjunction with your neighbours. A number of neighbourhood groups have formed and have made considerable progress towards addressing some of their local issues.

Cost savings through this approach can be considerable. For example the South Dandalup Catchment Group saved about $500 in dozer relocation costs by coordinating the contractor's time between 5 properties. This group is also bulk buying materials to reduce costs.

Kangaroo Creek Landcare Group, west Waroona, shares a single electric fence energiser between 5 properties. This group's 'conservation hotwire' concept has saved them several thousand dollars.

Students from Melville Primary School planting the trees that they have raised

A range of organisations will provide financial support for Landcare-type projects. Although open to individuals, historically groups have received greater access to funding.

Streamlining has proven to be popular with all funding organisations. The concept addresses many of their major environmental concerns and to date has received assistance worth $60,000 in the Peel-Harvey catchment area.

Expenditure on Landcare projects, including streamlining, is 100 per cent tax deductible when it is part of an endorsed farm plan.

Within the Peel-Harvey catchment area the general public has been a relatively untapped resource. Communities such as Mandurah are capable of helping in many ways. Past experience has shown that there are many potential volunteers just waiting to be asked to help.

One of the more organised groups that operates Australia-wide is the Men of the Trees organisation. The Peel branch of the organisation offers many services which include growing and planting trees, help with planning and supply of farm nursery kits.

Many schools have developed their own nurseries in which they grow trees for community projects. These schools are now linked with Landcare groups and annually supply and plant trees for group projects. Streamlining projects planted by primary school children now amount to 7 kilometres.

Government facilities such as the Community Catchment Centre in Pinjarra and the Harvey office of the Department of Agriculture are here to help. The staff have extensive knowledge as to the best approach to follow. They can ensure that many of the pitfalls can be avoided and can help with obtaining funds from a range of organisations.

You can start by contacting:

Garry Heady

and

Jan Paul van Moort

at the

Community Catchment Centre

(09) 531 1788

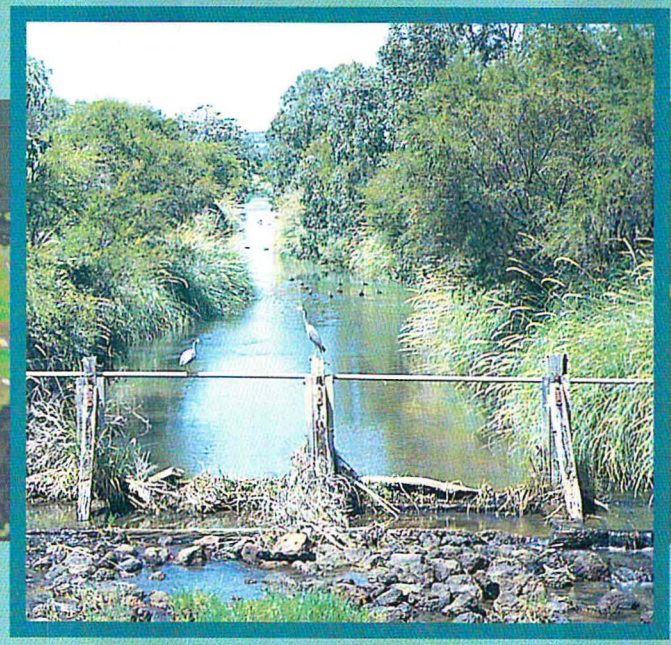
Neil Guise

at the

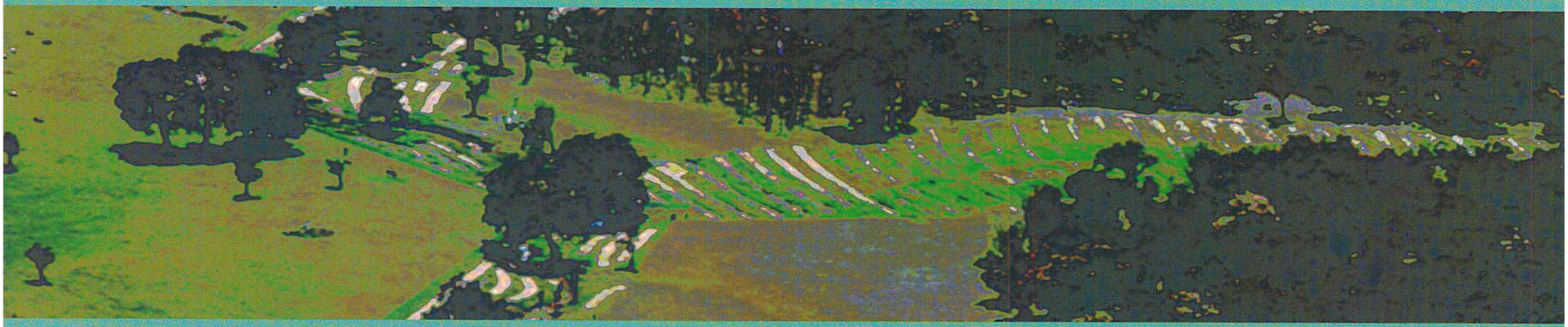
Department of Agriculture, Harvey

(097) 29 1507

FENCE OR NO FENCE . . . the choice is yours



Waroona Main Drain at Somers Road.
The same drain showing the difference a fence can make.
Looking west (left) and to the east (right).



94002/4026-8-3000

Print Post Approved PP 665002/00030