GOVERNMENT OF WESTERN AUSTRALIA

Water facts 4

WATER AND RIVERS COMMISSION JANUARY 1998

Living Streams

A living stream is a complex ecosystem supporting a wide range of plants and animals. It may be a narrow creek which runs only in winter, a permanent creek, a large river, or the lower estuarine reach of a mighty river system which drains a huge area of land. Whatever its size, a living stream has characteristics that distinguish it from a simple flow of water. It has stable vegetated banks with many plant species and provides habitats for animals such as freshwater crayfish, fish, frogs and waterbirds. It is also a beautiful feature of the landscape for people to enjoy, and a refuge for bush birds and other native animals.

Many streams in towns and in farmland have been cleared of native vegetation, become eroded and polluted, and have turned into ugly open drains. This Fact Sheet describes the pressures on streams in south-west Western Australia and the principles of streamline restoration. It is intended to encourage a change in the way we look at streams in local areas and to stimulate projects to preserve and maintain natural creeks and to restore degraded creeklines and foreshores to living streams. It is not a manual of restoration methods. A reading list provides more detailed information, and advice is available from the organisations listed at the back.

A living stream is a sign of a caring community.

The Living Streams Award

You or your school, business or community group could be eligible to win an award and $1000 to help a project to care for a local stream or foreshore.
The Living Streams Award is offered to encourage protection, rehabilitation and management of drains and creeks, river and estuary foreshores.

The award, inaugurated in 1993, is a part of the Western Australian round of the biannual National Landcare Australia Awards. It is open to individuals or groups who have achieved significant results, or initiated a significant project, to rehabilitate a drain, creek, river or estuary foreshore.

Bringing back living streams

The loss of living streams

When rain first fell on the earth, the movement of water across the land formed streams which eroded the land and carried sediment downstream to the ocean. Over millions of years plants colonised the stream valleys, binding the soil together and greatly retarding erosion. This enabled stable habitats to become available for plants and animals, and over time streams not only functioned as drainage systems but also as ecosystems.

Aboriginal people put a very high value on streams and estuaries for water, fishing, hunting and harvesting plant foods. Streams are often special places of spiritual significance to Aboriginal communites.

European settlement in the south west heralded great changes for our streams. Approaches to making land suitable for agricultural and urban development often involved removal of water from low-lying land. An extensive drainage network was constructed on the Swan Coastal Plain and in other parts of the south west. Natural creeks and rivers were also altered to improve their flow capacities. This involved clearing natural debris such as logs and branches, straightening watercourses, and even the replacement of creeks with concrete channel pipes.

Unrestricted grazing, clearing, altered runoff patterns, and urban, industrial and rural landuses further degraded water

quality. Many of our south west streams have become saltier. Most now carry excessive quantities of plant nutrients and sediment, and in some cases pesticides and other pollutants. These streams carry their pollutant loads downstream to estuaries and inshore oceanic waters, causing environmental problems in those areas as well.

One of the continuing major impacts on stream environments is the loss of fringing vegetation. Past and present clearing, accompanied by stock or human activity, is causing erosion, undermining of trees, and the loss of the rivers' scenic, recreational and habitat values.

Many urban streams have become open drains carrying polluted water, excessive algae and sediment along a narrow strip of disused land behind an ugly fence.

Changing attitudes to urban streams

In residential areas, old creeklines and open drains represent a very common form of wetland. Unfortunately they are primarily valued for their drainage function and are typically weed infested and polluted. Many urban streams have become open drains carrying polluted water, excessive algae and sediment along a narrow strip of disused land behind an ugly fence. Often, little consideration is given to other values, such as wildlife habitat, ecological corridors, erosion control, biofiltering of pollutants, landscape and recreational amenity. However, in recent years, due to developments in water resources planning and recognition of the biofiltering or nutrient stripping function of well-vegetated streams, stream revegetation has received some attention as part of an effort to reduce the amount of pollutants being carried to downstream waterways. In the Peel-Harvey catchment and Perth metropolitan region, this has led to the establishment of fringing vegetation along some old and new drainage lines in a process known as "streamlining"[1] and the promotion of Water Sensitive Urban Design.[2]

Putting the native vegetation back along streamlines, or incorporating it into new drains, not only achieves the narrow objective of creating biofilters, it also creates a more attractive landscape, as well as wildlife habitats and corridors. The realisation of this has fostered the broader objective of creating "living streams" of native plant and animal communities, which have some if not all of the values of a natural stream. In this way the drain may become a living feature of the town environment, rather than just an essential, and often unattractive, part of its infrastructure.

With increasing environmental awareness in the community has come a growing appreciation of creeklines as part of the urban ecology and landscape. The Australian urban or even country town environment provides little opportunity for the individual to gain an awareness of the natural environment. With the creation and restoration of natural habitats and corridors, native plant and animal communities can become more widespread and diverse. This will bring some of the unique characteristics of the region into the environment of the urban community and promote a sense of local ecology which will pay dividends in an increased awareness of the greater ecology of Australia and of the Earth.

Modifying drains can provide opportunities to recreate unique south-west Australian landscapes and streamline ecosystems.

Living streams and catchment management

Farmers, landcare groups, community and catchment groups are increasingly recognising the value of fencing and replanting degraded streamlines to improve the local environment and to meet the wider aims of integrated catchment management. Each section of rehabilitated streamline will contribute less sediment to its river system and help to reduce nutrient loss. Furthermore, linking stream rehabilitation projects throughout a catchment may produce wider benefits to the ecology of a region.

If many native plants and animals are to survive, they will do so because of remnant habitats present in conservation reserves, Crown Land, and private land. The viability of these conservation areas can be increased by connecting them via ecological corridors. The protection and rehabilitation of native vegetation on road verges is one example of this. Stream reserves vegetated with native plants offer another connection between parks, reserves, native bush in farmland and even trees in suburban back yards.

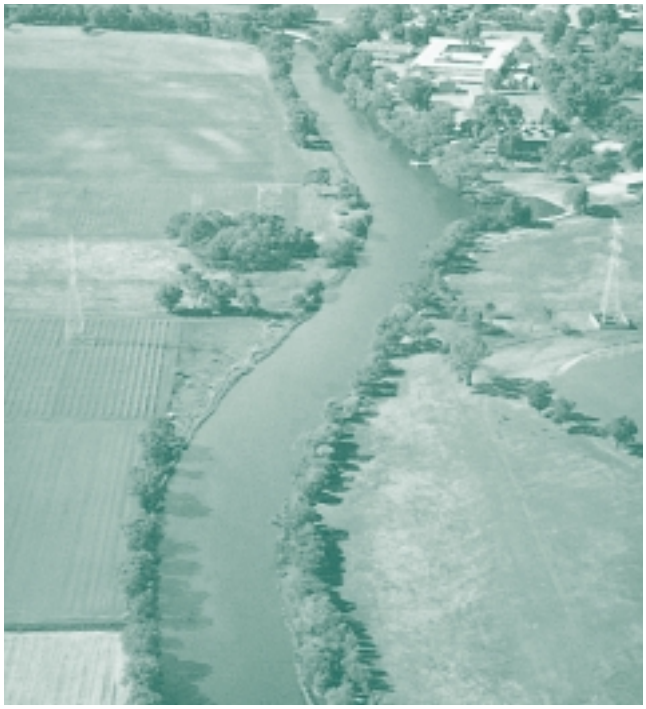
Farmers and landcare groups in the Pinjarra region, with support from the Community Catchment Centre in Pinjarra, are "streamlining" creeks thoughout much of the catchment, providing an example of the results that can be achieved when neighbouring farmers and the community pull together on a visionary scale.[1]

Water sensitive design

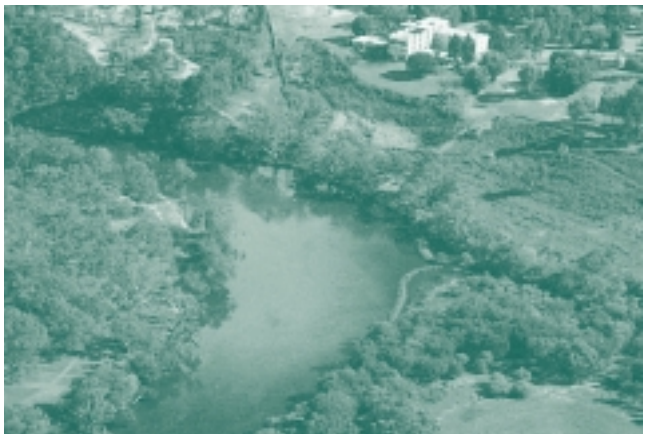
Drain and waterway rehabilitation is only a part of managing the total water cycle in urban and rural areas. An understanding of the whole catchment water balance is needed so that excess water from rainfall or shallow groundwater can be managed. It is preferable to keep and benefit from water within catchments, rather than to "dispose" of it to watercourses. For example, directing water into the soil via landscaped areas on site, and increasing water use through planting vegetation, help to reduce stormwater impacts on natural creeks and wetlands. Irrigating gardens, parks and ovals and landscaping with native plants to a water efficient design will save water and reduce stream pollution.

A bare agricultural drain has little value other than drainage.

Vegetated drains provide animal habitats and act as ecological corridors for birds and other animals.



A narrow, unfenced buffer zone (on the upper Swan near Midland) offers little or no protection against erosion or nutrient pollution.



A broader vegetation buffer zone between development and the river (at the junction of Bennett Brook and the Swan River near Guildford) provides good habitat for birds and animals, stabilises the river bank, shades water to reduce weed and algal growth, and provides nutrient stripping.

The value of bringing streams back to life

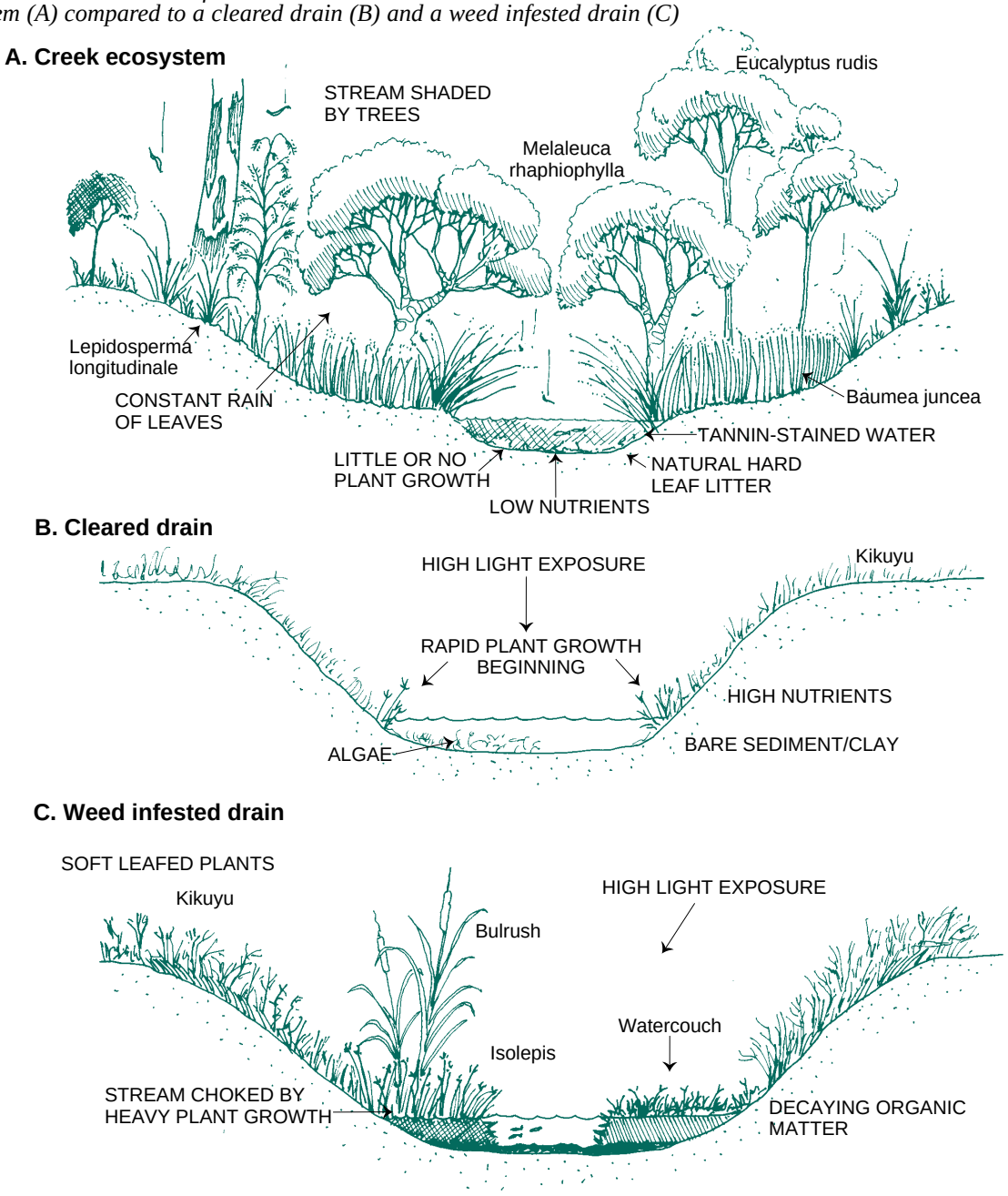
The natural creek versus the drain

The differences between a natural southern Australian river or creek ecosystem and a drain may seem obvious, but are actually little appreciated in a ecological sense. However, this fundamental appreciation is essential to the creation of living streams. Work at the Zoology Department at the University of WA, and elsewhere, has shown that the primary source of energy, carbon and nutrients in the natural creekline is not from within the stream itself [3 4 5 6 7]. This is because the heavily shaded, nutrient-poor and dark tannin-stained water supports very little algae or aquatic plant growth. Instead, the instream part of the creek ecosystem is fuelled by the slowly rotting hard leaves and woody debris that have fallen from the overhanging fringing vegetation [4 5 6].

Contrast this situation with that of the urban drain which is open to the light and nutrient rich [8]. Here, relatively free of grazing, introduced aquatic weeds are able to grow in abundance in the stream channel itself and block the flow of water [9]. Also, the natural stream has a great diversity of relatively undisturbed habitats and refuges with differing combinations of light and shade, exposure and cover, fast flowing and still, and shallow and deep water [3]. This variety of habitats can support a large variety of plants and animals, whereas the drain has little more than one highly disturbed and often polluted habitat [3 10].

If living streams are to be created in southern Australia, they must be stable and have a diversity of habitats with the essential elements of shade, hard leaves and tannin-stained water. These “ingredients” can be used to develop, as far as possible, a natural stream ecosystem and to keep the stream channel free of choking aquatic vegetation and algae. They can be added simply by establishing fringing native vegetation along streamlines.

Figure 1: The environment of the natural creek ecosystem (A) compared to a cleared drain (B) and a weed infested drain (C)



The value of natural streamlines

Erosion control The roots of trees and large shrubs serve to bind the soil of the stream embankments and prevent them from slumping and subsiding into the stream valley [11]. The tiny root systems of smaller shrubs, herbs, grasses and sedges serve an equally important role of holding the soil together, above and between the large roots of the trees and large shrubs, preventing the soil from being washed away and protecting the trees and shrubs from being undermined.

Biological filter Healthy fringing and aquatic vegetation acts as a biological filter to improve water quality [12]. It sieves out both organic and inorganic material carried in floodwaters and will assimilate a portion of the nutrients flushed from the catchment. Certain aquatic plants can be used to filter out pollutants [9].

Energy dissipation Flowing water has the energy to erode, transport and deposit sediment and nutrients. The faster the water flows, the more work it can do and the more destructive it can be to bed and banks. Fringing vegetation is the ultimate in stream "roughness" and acts to slow the water, thereby reducing its capacity to erode and transport sediment [11]. Natural stream form, with alternating pools and riffles and meanders, also acts to control the energy of flowing water [13]. In this way natural streams reduce the destructive capacity of flowing water and filter out sediments and nutrients.

Habitat A living stream provides a huge range of habitats for a great variety of plants and animals. Fringing vegetation provides habitat for spiders, insects, lizards and birds. Submergent and emergent aquatic vegetation, along with stream debris, provide shelter for frogs and fish. In town areas revegetating streamlines would create extra habitat and extend the number of animal species able to survive in these areas. These animals can be used as biological indicators of environmental quality.

The provision of shade by fringing vegetation is especially important. Many of the cold blooded native animals, especially fish, require shade, not only as shelter from predators, but also to help them regulate their metabolisms on warm days when dissolved oxygen levels may be too low to sustain high metabolic rates.

Creating a food web Dead plant material accumulates and decays on the stream bed, as bacteria and other micro-decomposers initiate the food chain. The micro-decomposers add nutrients to the water column which support the growth of algae, which in turn support herbivorous crustaceans and insects. These, together with the decomposers, are food for predatory insects and crustaceans, which in turn will be eaten by large insects, crustaceans and fish. Finally the larger insects, crustaceans, fish and amphibians provide a rich food supply for large animals such as turtles and birds. Fringing vegetation can also provide food directly. This can be in the form of fallen insects which have been blown from leaves and blossoms onto the water's surface. This provides a rich harvest for water walkers, spiders and fish.

Ecological corridors A living stream provides a corridor of land and water along which many animals can move [14,15]. Some animals will move up and down the corridor looking for food, while others may use it to get from one stand of remnant habitat to another. Still others will need to migrate as part of their reproductive behaviour [16]. Creeks are superb habitat corridors and if well managed have advantages over the complementary network of road verges.

Conserving our natural resources The rehabilitation of streamlines provides an opportunity to conserve many of the local native plant and animal species, many of which would have been displaced by urban development. In a wider sense, the strategic linking of living streams with remnant stands of native vegetation will increase the viability of many native plant and animals populations.

Landscape The landscape of many urban areas can be improved by revegetating streamlines. What are now open drains or eroded creek lines could be aesthetically pleasing corridors of trees and shrubs. Using the local plant species will enable the development of landscape attributes which will help to retain the unique ecological character of different regions [2 17 18 19].

Catchment management The rehabilitation of degraded creek lines to "living streams" will contribute towards the overall process of catchment management [20].

Education Natural streams can provide a window on the ecology of running waters which can be used by local schools, TAFE colleges and universities in education programs on the ecology of Australia. They are all the more useful if they are demonstrations of how to build a fully functioning stream ecosystem. Living streams also provide local opportunities to research the behaviour of the plants and animals which live side by side by side with humans.

Recreation Streams, rivers and estuaries provide refuges for people as well as wildlife. Healthy stream ecosystems can provide a range of recreational opportunities, including canoeing, fishing, marroning, bird watching, bush walking, wildflower tours and the simple exploration of nature. They can be shady green corridors through housing developments, places to walk, relax and enjoy.

Streamline restoration

Types of degraded streams

The town drain

A typical urban or town drain is a straight flow of water along a deep open ditch. The banks are usually steep and support a dense growth of introduced grasses and other weeds, as does the adjoining land of the drain reserve. The drain bed itself is usually white sand or clay obscured by the abundant growth of introduced aquatic weeds and slimy algae. Animals are often present, but these are usually the commonplace ones such as the introduced mosquito fish. Few native species are present.

From time to time the drain becomes clogged with plant material and accumulated sediment and litter that obstruct flow. This requires that the drain be cleaned out, usually by spraying weeds and digging away the grasses from the embankments. In this way many drains have become wider over time, as material has been removed from the bed and embankments and placed on the adjoining land. The disturbance involved in drain cleaning means that only the most resilient of plants and animals can find a home along the drain. Unfortunately, nearly all of these are introduced weeds and pest animal species.

The farmland drain

In farming areas, drains are usually old natural creeklines which have been cleared of their natural vegetation. The abundant growth of grasses and other weeds along the drainage line, so typical of urban drains, is prevented by livestock grazing. Unfortunately, the livestock also damage the embankments, dislodging soil and exposing areas to water erosion. This means that farm drains carry heavy sediment loads and are marked by severe disturbance. As with urban drains, they can only support the most resilient of species.

Degraded creeklines

Many natural creeks and small river systems are now part of urban or country drainage systems, and although never cleared of their natural fringing vegetation, have become eroded or infested with weeds [21].

Bringing streams back to life

There is no reason why many streams cannot function both as part of drainage systems and as aquatic ecosystems, greatly increasing their value to people and other living things.

With work, a drain can be brought to life. Whether it be a stream passing through pastured farmland, a section of urban drain, a degraded creekline or section of estuarine foreshore, individuals or groups of people can restore the elements of a living stream. In time, the revitalised stream will become a valued part of the environment, with some if not all of the aesthetic, educational, recreational and ecological values which natural streams offer.

Understanding stream ecosystems and their values develops a sensitivity to the natural environment and its place in the urban or rural landscape.

Soft versus hard leaves

Drains mainly support introduced plant species with soft leaves which decay relatively quickly in the water. Many of these plants, including a number of large trees, are also deciduous, dropping their leaves at one time of the year. In this case, a relatively large quantity of leaves represents a form of organic pollution which can deplete the water of dissolved oxygen. Furthermore, the lighting conditions of the stream range between full shade to suddenly full light, a regime which is alien to most southern Australian streams. This situation contrasts greatly with that of the natural stream described above, where the hard leaves of most native plant species fall at a relatively constant rate and break down only slowly in the stream, and where shade remains more or less constant [12 22].

Degrees of streamline restoration

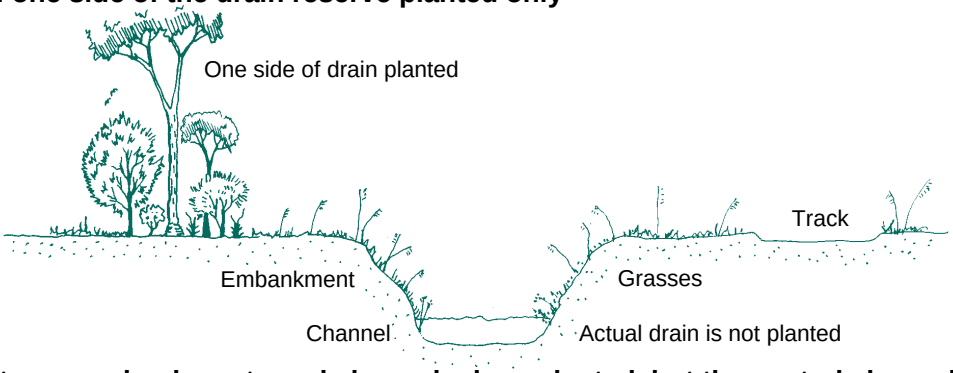
Not all streamlines can be restored or developed into something similar to fully functioning creek ecosystems. Many will have to be left as they are, to serve in their primary role as totally unimpeded drainage lines. For example, some drains will be made of stone or concrete while others will simply carry too great a volume of water at certain times of the year to enable the success of plantings. However, most streams will permit some degree of living stream development. It may only be a line of trees or shrubs along one side of a drain reserve, but even this small plantation will provide food and shelter for invertebrates and birds.

Some drains or old creeklines, with or without modification, may easily handle the volume of water discharged to them and could support bands of fringing vegetation without impeding flow and causing upstream flooding. In this case, a partial or completely vegetated zone could be developed along the entire stream or sections of it, with trees and shrubs at the upper level of the embankment and above it and sedges and rushes along the immediate periphery of the stream itself. Maintenance of the channel would consist of clearing the actual channel of the drain of any obstructions to flow, such as fallen branches and aquatic weed growth.

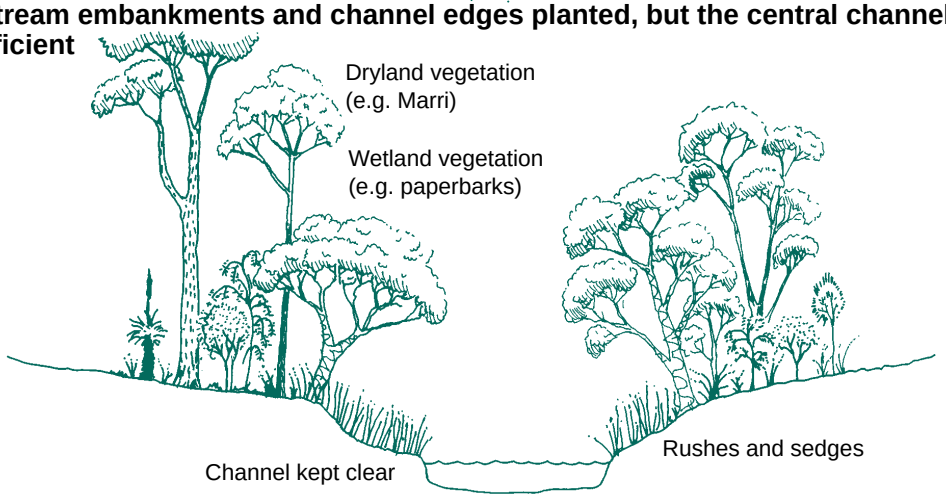
In areas where flooding may not be a problem, such as on farmland or near parkland, fully functioning creek ecosystems may be appropriate. In this case a dense band of fringing vegetation, sometimes growing right across the stream, could be developed and other habitat elements which would obstruct flow, such as logs and stones, could also be added to the main channel.

Figure 2: Degrees of living stream development: limited (A), partial (B) and full (C)

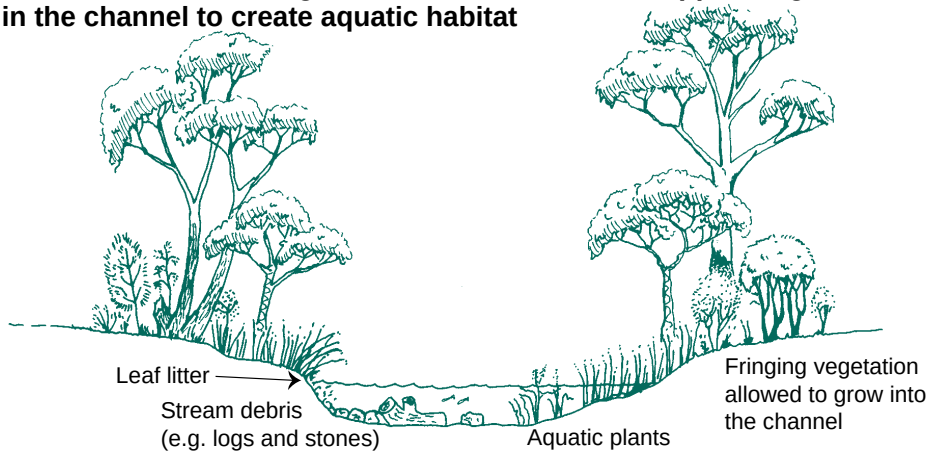
A. Limited one side of the drain reserve planted only



B. Partial stream embankments and channel edges planted, but the central channel kept clear for efficient drainage



C. Full embankments, channel edges and the channel itself support vegetation, and debris are placed in the channel to create aquatic habitat



How to create a Living Stream

A full description of how to go about creating a living stream is beyond the scope of this booklet. This section provides an overview of what is involved in building a living stream. For detailed descriptions of revegetation methods the reader is referred to the references and further reading sections where a number of excellent references on the subject are listed, including Heady and Guise 1994,[1] Hemphill and Bramley 1989,[23] Katsantoni 1993,[3] Land Systems EBC 1993,[24] Newbury and Gaboury 1993 a and b,[25 26] Whelans et al. 1993,[2] Petersen et al. 1992,[27] and Water Resources 1993[28].

Evaluation and planning

Whose stream is it?

Before you can do anything, it is necessary to find out who owns the stream or which government agency is responsible. A visit to your local council or a letter to the Department of Land Administration should give you the answer.

If the land is privately owned you will obviously need to gain the permission of the landowner. Many farmers or hobby farmers may be happy to obtain help to restore a degraded creekline as part of a community landcare effort. Local councils may encourage community involvement in rehabilitating a foreshore reserve, and creeks flowing through school grounds can provide an ideal opportunity for a project that supports teaching of subjects across the curriculum.

Most urban drains and many of the larger country drains are vested in the Water Corporation. If the stream is a gazetted drain, you must consult the Water Corporation or the local government responsible for its maintenance, obtain approval and ensure your project will not interfere with the prime function of the drain.

How much is appropriate?

Once a section of streamline has been selected, it is necessary to evaluate the site to determine how much can be done. The landowner or vesting authority may place restrictions on the project, but to a large extent what can be achieved will be determined by the site itself. For example, a deep v-shaped drain offers little opportunity to plant the embankments, but the area above the embankment on one side of the drain where access is not required, could be planted with trees and shrubs. On the other hand, a shallow drain or an old creekline which carries only moderate amounts of water could be developed to a full creek ecosystem.

The major restriction to building a living stream is flooding. Will the project result in flooding which is likely to cause unacceptable damage to property? This can only be evaluated by knowing something about the history of the site. If it is part of a gazetted drainage network, the Water Corporation or your local council will advise how much can be done. If the creek is not a drain, talk to someone who has lived in the area for 30 years or more and preferably to several people, as memories may vary. Stories of major floods can be checked in old newspapers. Soil and remnant native trees can often be good indicators of extreme conditions repeated over time. For example, rich red alluvial soil overlying sand is a strong indicator of past flooding, as are species such as paperbarks and flooded gums which are normally associated with seasonally wet conditions. Local landowners or landcare groups could provide advice.

Timetable

A living stream cannot be created all at once. A simple band of trees and shrubs above an embankment can be planted and forgotten, but to be more effective, weeding, vermin control, and replacement of dead plants will have to be carried out for at least a few years.

More complex living stream projects may take many years. For example, if a highly eroded creekline subject to livestock trampling is to be restored, it will first be necessary to fence it off. The higher stable areas should be planted with trees and shrubs to stabilise the embankments. Over time, as erosion is brought under control, planting and seeding can be carried out where sediment has become stabilised, progressing in from the embankments and downstream. The different stages are planned for appropriate times of year, and a timetable can be prepared for obtaining plants and organising volunteers.

Planning

Use of aerial photographs is the most effective way of marking out areas to be planted. If these are unavailable, simple sketch maps (using a compass, reference points and pacing out distances) are effective.

Site preparation

Water quality

Water quality is often a problem in both urban and rural areas. Silt, salt, nutrients (from fertilisers and animal wastes) and pesticides are the main problems in farmland. Urban runoff can also add litter, oil, petrol, heavy metals (e.g. lead) and other chemicals spilled, washed or dumped into drains.

If the water quality is poor, with excessive algae, litter, an oily sheen or an unpleasant odour, you will need to identify where the pollution is coming from, and to take steps to reduce the pollution at its source. This may involve fertiliser and pesticide management on rural land, or a more complicated process of community education in urban areas. Oil and silt traps can help to remove

particulate matter from stormwater. Once the vegetation becomes established, it will act as a natural filter to improve water quality.

Controlling disturbance

Physical disturbance by vehicles and large animals, including people, needs to be controlled before any planting is undertaken. Livestock must be fenced out. If wave action from boats is a problem along a foreshore, some sort of wave dampener (such as a board secured in the sand or tyres strung together) will be needed to protect the plantings. People using foreshores in residential and recreational areas will have to be directed away from planted areas. Simple wire fences or logs are often effective. Signs explaining the aims of the project will help to gain community support.

Weed suppression

Weeds are the major threat to the success of revegetation projects. To give seedlings a competitive edge in the first year, physical removal of weeds or, as a last resort spraying with herbicide, is essential. When spraying is being carried out, small native shrubs and sedges should be protected from the herbicide by placing a bucket over them. Choose only a herbicide with low toxicity to aquatic life and a short residual life. Take care to prevent spray drift into the waterway.

Pest control

The plantings will be grazed or damaged by a range of insects and some birds and mammals. The dominant grazer in disturbed areas is likely to be the rabbit, although kangaroos are often abundant. Even a few rabbits can cause havoc among plantings. Poisoning and the destruction of warrens is the most effective means of control, with minimal effect on native fauna. It is necessary to obtain permission from Agriculture Western Australia and to follow their procedure for baiting. Local landowners must be informed so that they can protect their pets and livestock. Any poisoning carried out in semi-rural areas where dead rabbits may be conspicuous may have to be monitored to enable the quick disposal of carcasses.

Soil preparation

Ripping the soil to a depth of 30 cm can improve water infiltration and drainage. It makes planting much easier and encourages growth by promoting rapid root development. Soils which are normally very wet in the winter/spring period and have a high organic content should not be ripped.

Planting and regeneration

Planting trees and shrubs

Where frosts are not a problem and summers are hot and dry, trees should be planted in autumn. In areas where frosts commonly occur and summers are mild, spring plantings are preferred. Seedlings should be ordered at least six months in advance. Planting at densities of 1000 to 1300 seedlings per hectare is typical where no native vegetation remains. For example, 1000 seedlings would be needed to revegetate a bank 1 kilometre long and 10 metres wide. In areas of sparse remnant vegetation, a density of 500-600 per hectare is suitable.

Wherever possible, local native plant species should be planted in preference to introduced species. Local native species are adapted to the conditions and are most likely to get established, and will support the local fauna. They are also very likely to regenerate. These factors are essential to the development of a natural ecosystem. Advice on native species can be obtained from Greening Western Australia, Workpower, APACE, or from your local branch of the Wildflower Society (see For More Information on back page).

At some later stage in the development of the living stream, less vigorous native plant species which have become relatively rare can be planted to restore their populations. For example, particularly beautiful wildflowers, or interesting plants such as sundews and trigger plants can be introduced.

Transplanting sedges and rushes

Obtaining sedges and rushes from nurseries may be very difficult. Workpower is one source in Perth. The alternative is to transplant them from a site where they are abundant or where they are about to be destroyed by development. The best time of year is early winter when growth is minimal, just before the maximum growth

Signage shows that a community cares and helps to gain support for projects.

period of late winter to early summer. To reduce the shock of transplanting, the leaves should be cut off at about 10 cm above the root stock. Before transplanting any plants, you will need to obtain the permission of the landowner or the responsible state or local government authority.

Direct seeding

Direct seeding is the broad-scale sowing of native tree and shrub seed onto a prepared site. It enables establishment of a range of native species with little labour and at relatively low cost. To be effective however, a very high degree of weed and pest control is necessary. Even so, results can be highly variable. Combined with a program of collecting local native seed, it can be a most effective means of restoring the local varieties of native plant species.

Encouraging natural regeneration

In many areas, native species are present along a streamline but are not successfully regenerating. There can be a number of reasons for this, including competition from weeds, grazing by rabbits, or frequent fires which kill native plant offspring while encouraging introduced grasses. Keeping these added pressures on the native flora under control will encourage successful regeneration. For example, weeds can be cleared away from seedlings to enable successful early growth, exclosures can be built to keep rabbits at bay, and the frequency of fires can be reduced.

Adding habitats and introducing animals

Creating a food web

Simply removing weeds and planting local native plants will provide habitat for a variety of animals. Soon, leaves and twigs fall into the water. Bacteria and other micro-organisms come into action and the food chain is started. The micro-decomposers recycle nutrients in the water which feed algae, which in turn support animals such as tadpoles, aquatic snails and tiny crustaceans. These, together with the micro-organisms, will be food for predatory insects and crustaceans, which in turn will be eaten by large insects like dragonfly larvae, and by marron, frogs, fish and small birds. These provide a rich food supply for large animals such as turtles, predatory birds and people.

Fringing vegetation also provides food in the form of fallen insects blown from leaves and blossoms onto the water surface. This provides a rich harvest for water walkers, spiders and fish.

Adding habitat elements

Once a corridor of vegetation has been established along a streamline, it may be time to consider adding other habitat elements. The placement of logs, large stones and heaps of small stones will provide shelter and breeding habitat for a number of aquatic animal species. Similarly, introduction of an aquatic plant, such as water ribbons, will provide cover for fish and frogs and habitat for water spiders, while not obstructing flow. On a larger scale there may be opportunities to diversify the habitats available by creating lagoons of still water and rocky narrow riffle zones of fast flowing water.

To further broaden the range of habitats, a natural stream form could be re-established with riffles, pools and meanders and incorporating small islands, lagoons and floodplains. However, before this can be done account should be taken of the quantity and velocity of water which comes down in a typical flood, as these factors determine the stable form (channel width and depth, pool/riffle distances and meander radius) that a natural stream works to achieve. For the method of doing this and establishing natural stream form see Newbury and Gaboury (1993 a and b) [25] [26]. In many cases neglected drains and degraded creeklines will have already achieved a stable form or would be in the process of doing so. Stable areas will be evident, as will eroding areas, and these features should give a good indication of the final form to be achieved. Newbury and Gaboury (1993b) [26] also describe the means of stabilising unstable areas with stone to build artificial pools and riffles. The Department of Water Resources, NSW, has a series of guidelines for the stabilisation and rehabilitation of river banks [27].

Essentially, the natural streamline of south-west Western Australia is an ephemeral drainage line, for the most part dry over the summer and autumn period. But in the winter, previously dry creeks, floodways and floodplains flood out and create a diverse range of habitats for aquatic life. In most river systems, only the river pools retain water over the entire year.

Introducing animals

Once you have recreated these stream habits, many of the native stream-dwelling animals will make their own way back to the stream. The number of species should increase as the stream matures. If species do not return despite the establishment of their habitat, it may be desirable to introduce animals from nearby streams. Freshwater fish, frogs, crayfish and shrimps can be taken from nearby creeks and placed in the new living stream. Approvals from the Fisheries Department and the Department of Conservation and Land Management (CALM) will be required before any re-introductions are conducted.

Creating streamline habitats

Some streamline habitats are illustrated in Figures 3.

Pools These provide an area of permanent water essential to many species of aquatic fauna, including fish, freshwater crayfish, the long necked turtle, the shrimp, the mussel and some waterbirds. There may be an opportunity to create pool habitats in retention and infiltration basins, but they must include the habitat elements typical of pool environments. These include overhanging vegetation, shade, leaf litter, logs and stones. Fringing emergent vegetation is optional, but recommended, especially if fish and bird breeding is to be encouraged.

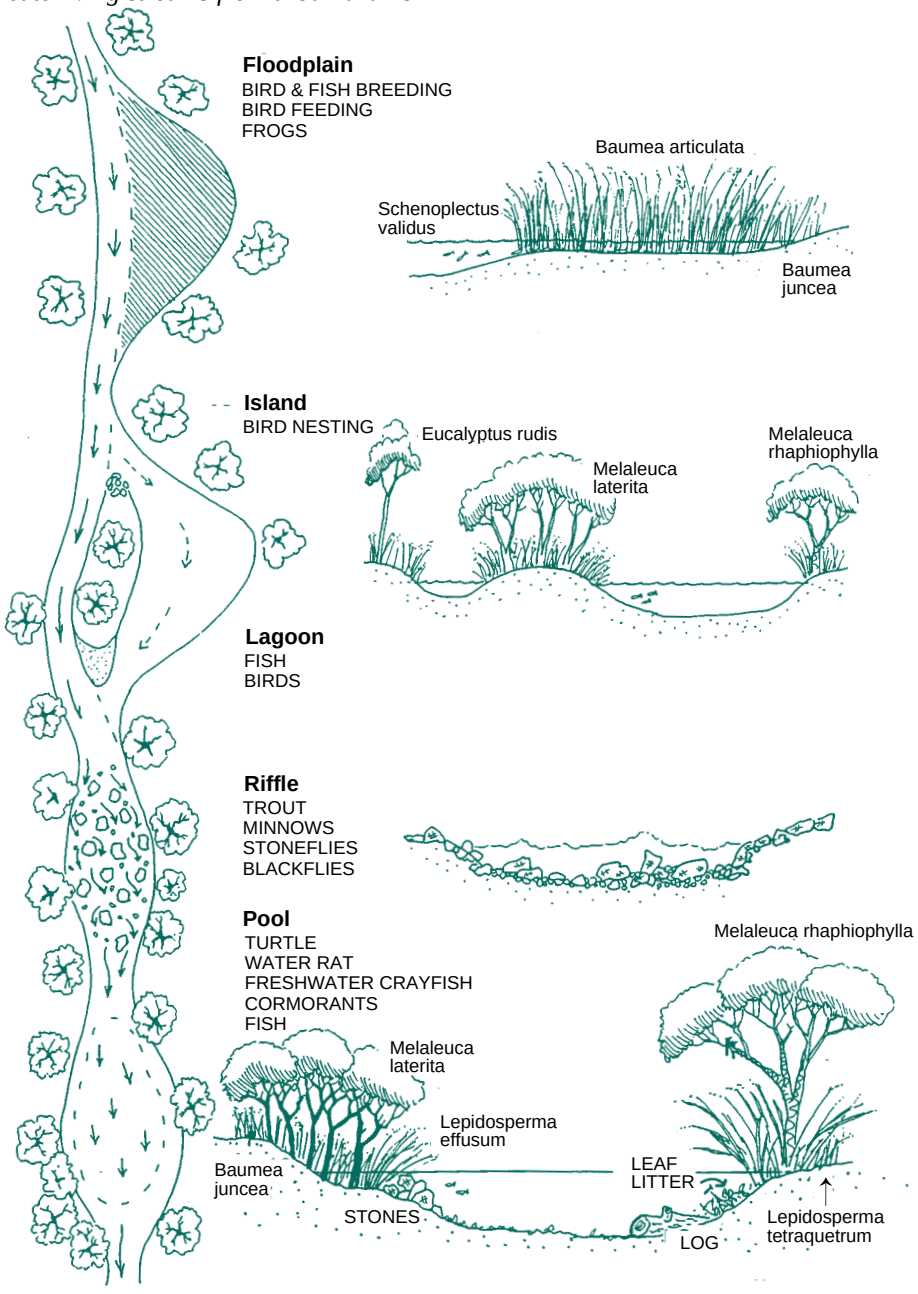
Riffles Pebbles, rocks and logs can be placed in fast flowing zones to create riffles. Blackflies, stoneflies, native minnows and trout enjoy this type of habitat. However, in nutrient-rich waters, algae fouling may become a problem, so shading with trees is recommended.

Runs Long reaches of unobstructed streamline are often called runs. They may be wide or narrow. In the south-west they are usually well vegetated with trees and so can be easily created along drains by planting trees in the appropriate location to maximise shade and the fall of leaf litter over water. Most drains should offer the opportunity to create this type of habitat.

Floodplain In areas where occasional flooding is not a serious problem, such as parklands and sporting grounds, the creation of seasonal floodplains along drains may be possible. Seasonal floodwaters among native vegetation would provide breeding habitat for a range of animals such as fish and frogs, and feeding habitat for birds.

Sedge and rush stands Filter beds consisting of dense stands of sedges or rushes will also provide very useful feeding and breeding habitat for water birds. In areas frequented by people, such dense stands of vegetation provide a ready refuge for waterbirds seeking shelter from humans and dogs.

Figure 3: Habitats to create living streams from urban drains



Caring for living streams

To a large extent living streams will take care of themselves, but a certain amount of maintenance will be necessary to prevent a slow degradation of the system.

War against weeds and vermin

Once the native vegetation has become established and disturbance is minimal, most weed species will not replace the native plants. However, some large introduced weeds gain the upper hand in moist environments. They include pampas grass, edible fig, fountain grass, bamboo, caster oil bush, blackberries, Japanese pepper, silver poplar, and the vines blue periwinkle, morning glory, Japanese honey suckle, lantana and dolichos pea. Only constant vigilance and quick eradication will control infestations of these species. Vegetated streamlines will provide habitat for rabbits and foxes, particularly in rural areas.

Fire management

The vegetation along streamlines can present a fire hazard, and will require management. Simple fire breaks, fuel reduction exercises and periodic controlled fires (about once every 10 years) will suffice. It should be noted that the perennial trees and shrubs of the living stream are less of a fire hazard than the annual grasses which often grow along the upper embankments.

Maintaining drainage function

The important function of drainage cannot be forgotten, especially in urban areas where drains must be allowed to flow unimpeded. The main channel of the drainage line may have to be cleared every so often. Vegetation may have to be cut back and fallen branches removed. Most of all, any obstruction which is likely to catch debris and cause a dam to form must be removed at the earliest opportunity. Where serious flooding and damage to property could occur, check for obstructions before the break of winter.

Habitat monitoring and protection

Natural losses may require that follow-up plantings are carried out to prevent weeds from once again dominating in certain areas. Plantings should be inspected regularly to assess their condition and identify areas needing attention.

It is a sad fact, but in urban areas, living streams may be subjected to littering, vandalism and arson. Trees may be hacked down, birds attacked, vegetation damaged by vehicles. The only way this sort of violence can be controlled is through the presence of local people and by community education, for example by articles in local newspapers and signage to make it evident that the streamline is valued by the local community.

Control of herbicide and pesticide use

Some animals, particularly frogs, are very sensitive to herbicides and other pesticides. Even with a moderate contamination of the food chain they soon die out. If frogs are to be encouraged to return to a streamline, the use of these chemicals will have to be kept to a minimum anywhere in the catchment of the stream.

Sharing experience

For many years, building living streams will be a learning process. Success will be achieved and mistakes will be made and a wealth of knowledge will be gained. Recording this knowledge will help to improve the materials and methods used. Some methods will be relevant to particular regions or environments, while others will be applicable over a wide range of environments.

Anyone embarking on their first living stream project would benefit immensely from a store of knowledge passed from one group to another. If you have just completed a successful stream restoration project or have revegetated part of you local drain, and are happy to share this information, send your records to the Water and Rivers Commission. Please write down what you did, noting times, areas worked, quantities of materials, methods, successes and failures. Another way to share your experience is to enter the Living Streams Award.

The Blackwood Environment Society, winner of the 1997 Living Streams Award, planted native seedlings grown from local seed on the upper slopes of the Blackwood River.

There is no reason why many streams can't function both as parts of drainage systems and as aquatic ecosystems, greatly increasing their value to people and other living things. With work, a simple drain can be brought to life. Whether it be a stream passing through pastured farmland, a section of urban drain or a degraded creekline, streamline habitats can be restored or incorporated into drainage design. In time, the stream could become a vital part of a human community, with some if not all of the potential aesthetic, educational and ecological values which natural streams can offer.

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For further information

The Swan Catchment Centre at 108 Adelaide Terrace, East Perth, has a small resource library and can help to put you in touch with relevant advice and community groups for projects in the Swan-Avon region.
Phone: (08) 9221 3840, Facsimile: (08) 9221 4960

Specific advice can be obtained from the following organisations:

Stream and foreshore rehabilitation
(educational video available)
Water and Rivers Commission (08) 9278 0300
or regional offices

Reporting pollution
Water and Rivers Commission (08) 9278 0300
or regional offices
Swan River Trust (08) 9278 0400, pager 016 982 027
For hazardous or major chemical spills Statewide dial '000'.

School and community projects
Swan River Trust (08) 9278 0400
Swan Catchment Centre, (08) 9221 3840
Ribbons of Blue (08) 9278 0300
Men of the Trees (08) 9250 1888
Department of Environmental Protection (Ecoplan) (08) 9222 7000

Revegetation using native species and vegetation management
Agriculture Western Australia at the Community Catchment Centre Pinjarra (08) 9531 1954
Greening Western Australia (08) 9481 2144
APACE (08) 9336 1262
Workpower (Ecosystem Management Services) (08) 9375 3751
Wildflower Society of WA (08) 9383 7979 (Tuesday, Thursday, 10.00am-2.30pm)

Introduction of fish and other animals
Fisheries Department (08) 9482 7333
Department of Conservation and Land Management (08) 9334 0333 or any region or district office

Controlling feral animals
Agriculture Western Australia (08) 9368 3333

For more information contact

WATER AND RIVERS
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Level 2, Hyatt Centre
3 Plain Street
East Perth Western Australia 6004
Telephone: (08) 9278 0300
Facsimile: (08) 9278 0301
or your regional office

This Water Facts sheet is one in a series providing information on water issues of interest to the community. It has been updated from Pen L and Majer K (1993) Living Streams: a guide to bringing watercourses back to life in south-west Western Australia. Waterways Information No. 7, Waterways Commission, WA.

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