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Native Plant Species to be Used in Stabilization and Enhancement of Water Corporation Rural Main Drains in the South West Drainage Districts

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Executive Summary

An analysis was made of the current problems replanting of Water Corporation Drain Reserves have made to the maintenance of these drains both in the long and short terms. This analysis showed:

- Plants located in a position which restricts a clear access track adjacent to the drain,
- Trees planted too close to the drain resulting in the shedding of limbs and leaves into the drain causing subsequent culvert blockage and impediment of water flow; and
- Planting the drain invert or drain slopes with the wrong plant species.

A literature review was undertaken to document the various recommendations that have been made in regards to the establishment of native vegetation along water ways and natural streams. This review indicated that techniques and species selection developed for planting natural streams could not be directly applied to man made drains.

To develop the appropriate species selection and replanting technique for use around drains in the south west an analysis was made of

- The legal obligations of the Water Corporation in regards to the operation and management of the drains.
- The range of drain types found in the southwest.
- The type of maintenance carried out on the various drain types
- The characteristics of the local native plant species that would be compatible with the drains found in the area, the maintenance under taken on south west drains and the legal obligations of the Water Corporation in managing the drains

Finally, from this analysis, a list of local native plant species for planting in different parts of the drain was developed. The species selected were ones that seed and seedlings were available from seed merchants and nurseries respectively.

Introduction

The Water Corporation has a statutory obligation under its license from the Office of Water Regulation to maintain rural main drains (see Appendix 1) within the six southwest drainage districts (see Map 1) to ensure that local flooding and damage to assets does not occur. It should be noted that the majority of drains outside the irrigation areas are dry during the summer months.

Very little remnant vegetation remains in the drainage districts and there is increased concern by farmers and the community about this lack of remnant vegetation. These groups acknowledge the importance of vegetation and have looked upon rural main drains as a potential area to carry out planting and stabilization to improve conservation values and water quality in the local area.

The Water Corporation supports such efforts in principle, however a number of community planting programs have not involved the Corporation during the planning phase. In a large number of cases, this lack of consultation has resulted in degradation of the statutory function of the drain and reduced the ability of the Water Corporation to maintain the drains without damaging the vegetation. This has resulted in the following three problems:

- Plants located in a position which restricts a clear access track adjacent to the drain,
- Trees planted too close to the drain resulting in the shedding of limbs and leaves into the drain causing subsequent culvert blockage and impediment of water flow; and
- Planting the drain invert or drain slopes with the wrong plant species.

This publication seeks to:

- Review the information available on drainage line stabilization and to document its limitation(s).
- Document the legal statutory obligations of the Water Corporation as they relate to carrying out planting programs on or adjacent to drains.
- List plant species and vegetation/stabilization methods that can be used to maximize the conservation values of the drains without effecting drain function or the obligations of the Water Corporation to maintain drains to the required standard.

Literature Review

Published literature on the stabilization of drains is limited to article by Heady and Guise (1994) and Bramwell. The former article is an excellent document with a number of very positive rural main drain stabilization suggestions. These include the involvement of adjacent landowners and local Land Care Groups in the stabilization of drains so as to improve the conservation values of the drains and the surrounding agriculture area. In addition, water quality in the drains is improved through management of the water runoff from the farms themselves. The publication confirms the negative contribution farms make to the erosion of drainage banks and the degradation of run off water from farmlands. Valuable suggestions (see Table 1) are made on what stabilization works can be undertaken to maximize conservation values and improve water quality in the drains. The suggestions are made while ensuring that the Water Corporation can continue to maintain the function of the drain. These include leaving a 5m wide access track from the top edge of the drain for maintenance activities (the Corporation recommends 6m). Plantings can occur on the access track, but

only in a limited way and with plants of low height (low or prostrate shrubs and creepers) to allow possible movement of vehicles along the access track. Plants should not be established within the drain invert.

The publication includes a photograph of an ideal stabilization result. Other pictures (pp2) show examples of stabilization, which if implemented, would provide immense difficulties for the Water Corporation to maintain and continue to meet its statutory obligations.

Table 1

Possible environmental remedial works on drains on private property or in drainage reserves abutting private property (from Heady and Guise (1994)

- Creation of parallel linear filters to improve the quality of water entering the drain from farms
- Construction of stilling sumps at the end of feeder drains
- Removal of spoil banks if not required as a levee.
- Creation of modified tapering banks from the steep current banks
- Fencing to exclude stock
- Revegetation of drainage banks for commercial (cut flower, fodder, woodchips shelterbelts etc) or conservation (wildlife corridors) values.

Bramwell stresses the importance of not allowing planted vegetation to impede the function of the drain and leaving access tracks adjacent to the drain. However the philosophy behind the article is orientated towards the creation of a creek ecosystem within the drain and adjacent reserve. As creek ecosystem involves planting of the drain invert, this will impact considerably upon drain function.

The other publications, Blyth (1997) and Hussey (1997), deal with re vegetation of degraded creek lines. These publications are often used as a guide by adjacent landowners and local Land Care groups in efforts to establish creek ecosystems on Water Corporation rural main drains. If this philosophy were followed, the new vegetation would impede the function of the drains and make it very difficult for the Water Corporation to maintain the drains and meet statutory obligations.

Water Corporation Managed Drains in the south west of Western Australia.

Drain Characteristics

There are 6 drainage districts in the lower south west of Western Australia (see Map 1). Each of these systems drains what was once either water logged or seasonally or permanently inundated land (sumpland, palusplains or lakes (Hill, et al 1994). Once drained these soils, complemented in some case with irrigation, constitute some of the most productive lands in WA supplying a wide range of agricultural produce including milk, meat, vegetables and orchard products. The drainage system takes excess water from these low-lying areas to the coast either through adjacent estuarine or ocean outlets.

The drains in a drainage district are of various sizes (depth and width) (see Photographs 1 to 6). Most drains are steep sided due to lower construction costs, width of drainage and road reserves and the commercial value of the land in the district.

The drains range from 1m to 10m deep and 2m to 50m wide with a levee bank or soil spoil heap on one or (rarely) both sides and an access track immediately adjacent to the drain on one or both sides. The levee banks and spoil heaps are deliberately placed beside the drainage channel to ensure disposal of water from private land into the drains is only possible through specified and controlled outlets. In most cases, the access track has to be wide enough for mechanical maintenance of the drain. Therefore, the access track is usually 4-6 m wide depending upon the size of the drain and the size of the machinery required to maintain the drain.

The rural main drainage system that has been created within the drainage districts deteriorates over time and requires regular maintenance. This deterioration includes:

1. Production of excessive growth of critical weed species within the drain that can block the drain and decrease their water carrying capacity. These need to be removed either by control with herbicide spraying or mechanical removal.
2. Siltation of the drain through soil erosion of adjacent land and the formation of sand bars within the drain which redirect water flow to the sides of the drain causing undercutting of the banks and further drain erosion. The extra soil load and its associated vegetation within the drain decrease it's capacity and can therefore cause flooding. The excess soil/vegetation is mechanically removed and deposited on the edge of the drain, usually on the access track if this does not impede its use.
3. Deterioration of assets such as bridges, culverts and connecting pipes.

A number of exotic species occur in drainage reserves and only those that grow in the invert or impinge into the invert from the banks need to be removed. These species cause problems (see Figure 1) as they assist in trapping sediment and decrease the carrying capacity of the drain. Some examples include Pampass and Kikuyu grass and exotic *Juncus* and *Carex* species. Weeds such as *Watsonia* spp that only grow on the banks do not slow water flow as they bend and allow water to readily flow over them with little impediment even at high water flow rates. In addition *Watsonia* spp stabilizes banks of drains very efficiently preventing their undercutting and erosion. Some declared weed species grow in drain reserves and need to be removed irrespective of whether they affect drain function. These include Black Berry, Cape Tulip, Arum Lily and Cotton Bush.

Maintenance of a particular drain occurs during summer between 2 and 10 years apart (see photographs 7 to 9). Smaller drains tend to require more frequent maintenance than larger ones. To remove weeds and sediment access to the drain is required. Depending upon the width of the drain this access may be on one side or both.

The water quality of the drains depends upon the various activities that occur within the catchment area of the drainage system. Outputs over the property boundaries depend primarily upon the various practices of the landowner. If best agricultural practices are not employed in agriculture production, then various nutrients (phosphorus and nitrogen), pesticides and soil erosion products (sediment) can escape from the property and enter the drainage system.

Because of the commercial value of the drainage areas very little native vegetation was left in the drainage districts. The remnant native vegetation that still exists occurs as narrow corridors along road reserves and large drainage reserves. Thus the conservation values of the drainage areas is low.

However even with this lack of remnant vegetation some fauna utilize the drainage areas especially during the spring to autumn period. Large flocks of Ibises and Spoonbills roam the open paddocks feeding on insects. Duck species utilize the open water filled drains. Other bird species that inhabit open paddock systems also utilize the vegetated drainage lines.

Water Corporation Legal Obligations

Policy decisions, regulatory requirements and the objectives of the drainage system in the State are the responsibility of the Office of Water Regulation. The Drainage Section of the Water Corporation are the managers of the drainage districts and implement the rural drainage license issued by the Office of Water and the Drainage Act (1925). Some of the legal responsibilities of the Water Corporation under the Drainage Act (1925) are documented in Appendix 1.

In summary, the Water Corporation is responsible for ensuring that rural main drains are maintained at a level which ensures landowners within drainage districts are not inundated for periods that will significantly impact upon the assets and commercial activities being carried out on the land. If the drains do not function to their designed capacity through inadequate maintenance and damage areas on adjacent land, then the Water Corporation may be legally responsible for monitory compensation.

Current Vegetation Works around and within Drains

As mentioned previously, various local Land Care groups have focused on the re-establishment of native vegetation (shrubs and trees) within the drainage district so as to stabilize drains and increase conservation values, productivity and sustainability of the areas. The purpose of these plantings has been in general terms to create shelterbelts, create vegetative corridors to link isolated remnant vegetation and establishment of riparian vegetation along drains. Though the latter two programs utilize local native plant species shelterbelts have often been established using exotic species such as Blue gums (*Eucalyptus globulus*) and River Gums (*E camaldulensis*).

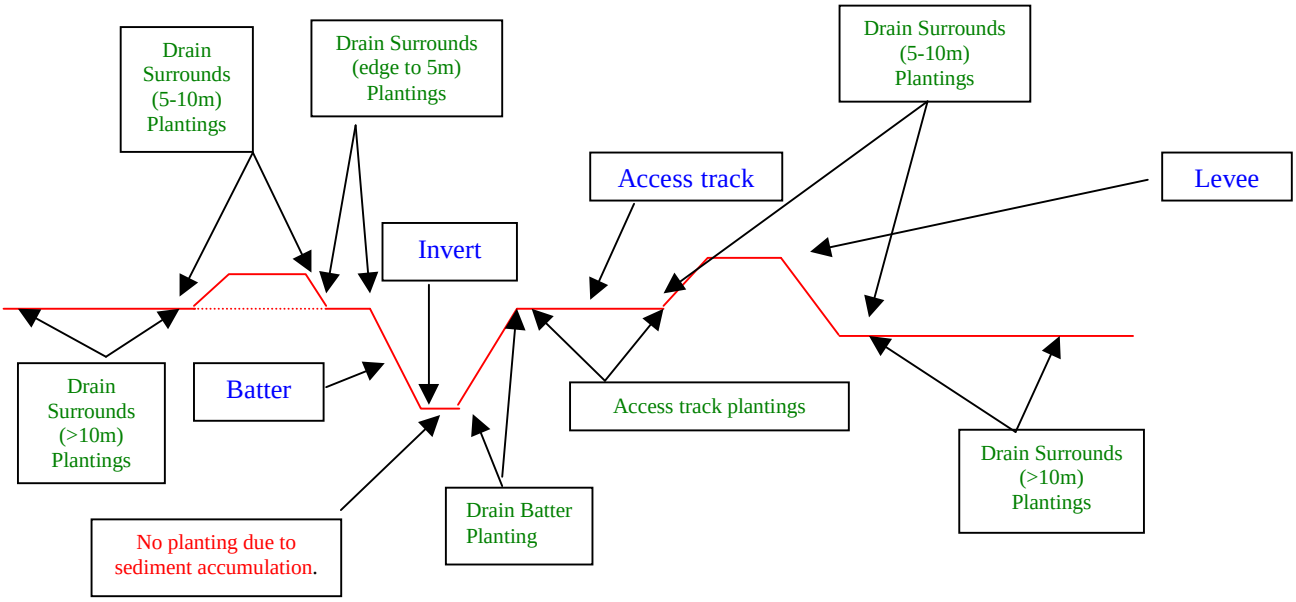
The main locations on which plantings have occurred include areas adjacent to drains either on private property, shire road reserves or drainage reserves vested in the Water Corporation, as well as along fence lines, road and rail reserves.

Where plantings have taken place adjacent to drains, there have been a number of occasions where they have severely impeded the function of the drain and the ability of the Water Corporation to maintain the drains to a standard that they continue to drain water and so allow the Water Corporation to meet their legal obligations to adjacent landowners (see Photographs 10 to 13). Therefore, some of the plantings have had to be unavoidably destroyed or damaged during the routine drainage maintenance program. This obviously causes friction between landowners, Land Care groups and the Water Corporation.

The policy of the Water Corporation Drainage Section is to co-operate with local groups and adjacent landowners in carrying out land conservation activities such as planting programs within the drainage district. Implementation of this policy has involved informing clients and third parties of the legal obligations of the Water Corporation regarding the maintenance of the drainage system (see Client Charter Summary- Appendix 1) and to develop an information system to guide people in their planting programs along drains. This document constitutes part of this information system and documents:

- Lists of plant species that are indigenous to the particular drainage district are easily produced at a reasonable cost and complement the functions of the drain.
- The location in the drain reserve where different species are to be planted so as to minimize the effects on future maintenance programs that need to be carried out in the drain and its surrounds.

Figure 1
Typical drain cross-section and possible stabilization zones.



From examples listed previously the following should be avoided:

1. No plantings within the invert of the drain (see Figure 1). Though there are reed species that are low growing and bend with water flow, they do trap sediment and would eventually cause the impediment of water flow. In high rainfall events this can cause flooding and damage to adjacent land.

2. The 4 to 6 m access tracks can be planted with small shrubs and heath land species **less than 0.5 m mature height**. No shrubs or trees that grow taller than this should be planted in this area. Any low growing species planted in this area will be crushed or covered with soil spoil from the drain during the maintenance program but have been selected to tolerate this damage and will eventually grow back after the disturbance.

3. Tall large leafed shrubs and all trees are to be planted at least 10 m from the edge of all drains. Limb and leaf drop can block the drain or culverts and pipes causing flooding and subsequent land damage.

Species Selection

Plant species selected to be used in stabilization programs along or adjacent to Water Corporation rural main drains were identified by analysis of the following characteristics.

1. *Indigenous to the area*. The use of local native plant species is important to preserve the integrity of the regional (Swan Coastal Plain) gene pool and to maximize the conservation value of the rehabilitated drain reserves.

2. *Availability of seed*. Seed can be used to produce seedlings or be used directly as broadcast seed in the stabilization program.

3. *Availability of Seedlings*. These can range from tube stock to advanced specimens and can be produced from seed or as cuttings, division of rootstock, tissue culture or transplants. This material is used where seed is not available or in areas where the site is weed infested and/or very degraded.

4. *Avoidance of species* that have a habitat requirement for moist or seasonal/permanently inundated soil conditions. Avoidance of these species will minimize the potential colonization of the drain invert and subsequent blocking of the drain.

Within the species list derived from a consideration of the above characteristics, the location of a particular species within the drain reserve will depend upon the following characteristics.

1. *Height*. Small growing plants can be planted closer to the actual drain with minimal disturbance of drain function.

2. *Above ground Form*. Reed, rush or grass like forms can be grown on the side of the drain to replace Watsonia species. This form provides minimal resistance to water flow as well as assisting in bank stabilization and soil erosion prevention.

3. *Root Form*. Species with lignotube, rhyzomes and tuberous roots will re sprout if the tops are destroyed, disturbed or covered with soil and so can be grown on access tracks where they will tolerate fairly extensive disturbance including crushing, cutting and being covered with soil. Such species will also tolerate fires and will quickly regenerate after fires and could minimize the re colonization of weedy species which is common after fires on the Swan Coastal Plain.

4. *Life form*. Annual species can be considered as if present they could quickly recolonise disturbed areas and assist in keeping out weed species.

Methods of Species Selection

Indigenous Plant Species.

To identify the native species that occur naturally within the various Water Corporation Drainage Districts, the WA Herbarium data file was queried. Various rectangular shaped areas were identified that included only the drains of a sub region and the species collected within these areas were identified. Appendix 1 identifies these areas and the plant species found within each sub area.

Though a polygon shape would better describe the area encompassed by the Water Corporation drains and could delineate the actual Drainage District boundaries, the CALM software program to query the data file is only able to query rectangular shapes.

Plant Characteristics

Height, above and below ground form and life form was obtained from Paczkowska and Chapman (2000).

Seed and Seedling Availability

A list of species for which seed was available was determined by analysis of the Catalogues of the local seed merchants. A survey was carried out with some of the largest native plant wholesale nurseries to determine the species that would be available as seedlings derived either from seed, cuttings, transplants or tissue cultured techniques.

Plant Species to use in Various parts of the Drain Reserve

Drain Batter

Quite often this area has been colonized by *Watsonia* spp and is fairly stable with minimal disturbance to water flow. However this environment can be occupied by native plant species. Characteristics of native plant species that could be established in this environment include:

- Rhyzomes/tuberous root system.
- Reed or rush like character.
- Drought tolerant.
- Max size 0.5m.

The challenge is to replace the *Watsonia* spp with minimal disturbance to the soil. The best technique would be to spray the *Watsonia* sp. during early winter with a Glyphosate solution. The use of a brush applicator and 50% Glyphosate 450 solution would kill the Watsonia species. Drilling a hole with a hand held auger in amongst the Watsonia that had been treated about a week after application of the Glyphosate and planting the native plant species would then follow.

Table 3 lists the plant species that could be used in this area of the drain reserve.

Table 3
Plant species to use to plant on the sides of the drain

Family	Genera	Species	Seedlings r=regularly produced. a= are able to produce	Seed Availability	Ht	Reproduction or form t/r=tuberous rhizomes r s=seed re sprout lig=lignotube	%germination r=re sprouter	Treatment of Seed sm=smoke h=heat t'ment
Anthericaceae	*Laxmannia*	*minor*		y	0.25	t/r		
Anthericaceae	*Laxmannia*	*squarrosa*		y	0.10	t/r		
Anthericaceae	*Sowerbaea*	*laxiflora*	a	y	0.45	t/r		
Anthericaceae	*Thysanotus*	*multiflorus*		y	0.50	t/r		sm
Anthericaceae	*Thysanotus*	*thyrsoideus*		y	0.35	t/r		
Anthericaceae	*Tricoryne*	*elatior*	a	y	0.50	t/r		no sm
Colchicaceae	*Burchardia*	*umbellata*	r	y	0.65	tuberous		sm
Cyperaceae	*Isolepis*	*cernua*	a		0.20	t/r		
Cyperaceae	*Isolepis*	*cyperoides*	a		0.50	t/r		
Cyperaceae	*Isolepis*	*fluitans*	a		0.40	t/r		
Cyperaceae	*Lepidosperma*	*carphoides*	a		0.60	t/r		
Cyperaceae	*Lepidosperma*	*gracile*	a		0.60	t/r		

Family	Genera	Species	Seedlings r=regularly produced. a= are able to produce	Seed Availability	Ht	Reproduction or form t/r=tuberous rhizomes r s=seed re sprout lig=lignotube	%germination r=re sprouter	Treatment of Seed sm=smoke h=heat t'ment
Cyperaceae	*Lepidosperma*	*pubisquameum*	a		0.40	t/r		
Dasypogonaceae	*Lomandra*	*brittanii*	a	y	0.20	t/r	low	
Dasypogonaceae	*Lomandra*	*caespitosa*	a	y	0.40	t/r	low	
Dasypogonaceae	*Lomandra*	*hermaphrodita*	a	y	0.20	t/r	low	
Dasypogonaceae	*Lomandra*	*integra*	a	y	0.50	t/r	low	no
Dasypogonaceae	*Lomandra*	*odora*	a	y	0.35	t/r	low	
Dasypogonaceae	*Lomandra*	*pauciflora*	a		0.50	t/r	low	
Dasypogonaceae	*Lomandra*	*preissii*	a	y	0.60	t/r	low	no
Dasypogonaceae	*Lomandra*	*purpurea*	a	y	0.60	t/r	low	no
Dasypogonaceae	*Lomandra*	*sericea*	a	y	0.40	t/r	low	
Dasypogonaceae	*Lomandra*	*sonderi*	a	y	0.50	t/r	low	no
Dasypogonaceae	*Lomandra*	*spartea*	a	y	0.40	t/r	low	no
Dasypogonaceae	*Lomandra*	*suaveolens*	a	y	0.30	t/r	low	
Haemodoraceae	*Conostylis*	*aculeata*	r	y	0.50	t/r	low	sm
Haemodoraceae	*Conostylis*	*juncea*	a		0.40	t/r	low	
Haemodoraceae	*Conostylis*	*laxiflora*	a		0.40	t/r	low	
Haemodoraceae	*Conostylis*	*serrulata*	a	y	0.40	t/r	low	
Haemodoraceae	*Conostylis*	*setigera*	a	y	0.36	t/r	low	
Iridaceae	*Orthrosanthus*	*laxus*		y	0.55	t/r		
Iridaceae	*Patersonia*	*babianoides*	a		0.20	t/r	low	
Iridaceae	*Patersonia*	*drummondii*	a		0.40	t/r	low	
Iridaceae	*Patersonia*	*juncea*	a		0.30	t/r	low	
Iridaceae	*Patersonia*	*pygmaea*	a		0.20	t/r	low	
Juncaceae	*Juncus*	*caespiticius*	a		0.60	t/r		
Poaceae	*Amphipogon*	*laguroides*	a		0.50	t/r tuffed		
Poaceae	*Neurachne*	*alopecuroidea*		y	0.50	t/r		sm
Poaceae	*Tetrarrhena*	*laevis*		y	0.60	t/r		
Restionaceae	*Anarthria*	*laevis*	a		0.45	r s		
Restionaceae	*Anarthria*	*prolifera*	a		0.60	r s		

Access Track

If there is no objection from the Water Corporation, the 6m area encompassing the access track adjacent to the drain can be planted up. Plant characteristics of native species that can be planted in this area include

- No more than 0.65m high.
- A lignotuber, rhyzome, or tuberous root systems. Species that have such root systems tend to be re sprouters and can recover if the above ground parts of the plant are damaged. Production of seedlings of these species can be problematic as seed production and viability can be low. The use of smoke to stimulate the germination of the seed that is produced tends to be successful in the production of such plants. The use of transplants can also be considered.

Table 4 lists the plant species to be used in this area

Table 4
Plant species to use on the Access Track Adjacent to Drains

Family	Genera	Species	Seedlings r= have produced a= are able to produce	Seed Availability	Ht (m)	Reproduction or form t/r=tuberous rhizomes r s=seed re sprout lig=lignotube	%germination r=re sprouter	Treatment of Seed sm=smoke h=heat t'ment
Anthericaceae	*Laxmannia*	*squarrosa*		y	0.10	t/r		
Cyperaceae	*Isolepis*	*cernua*	a		0.20	t/r		
Dasypogonaceae	*Lomandra*	*brittanii*	a	y	0.20	t/r	low	
Dasypogonaceae	*Lomandra*	*hermaphrodita*	a	y	0.20	t/r	low	
Iridaceae	*Patersonia*	*babianoides*	a		0.20	t/r	low	
Iridaceae	*Patersonia*	*pygmaea*	a		0.20	t/r	low	
Anthericaceae	*Laxmannia*	*minor*		y	0.25	t/r		
Dasypogonaceae	*Lomandra*	*suaveolens*	a	y	0.30	t/r	low	
Iridaceae	*Patersonia*	*juncea*	a		0.30	t/r	low	
Dasypogonaceae	*Lomandra*	*odora*	a	y	0.35	t/r	low	
Anthericaceae	*Thysanotus*	*thyrsoideus*		y	0.35	t/r		
Haemodoraceae	*Conostylis*	*setigera*	a	y	0.36	t/r	low	
Haemodoraceae	*Conostylis*	*juncea*	a		0.40	t/r	low	
Haemodoraceae	*Conostylis*	*laxiflora*	a		0.40	t/r	low	
Haemodoraceae	*Conostylis*	*serrulata*	a	y	0.40	t/r	low	
Cyperaceae	*Isolepis*	*fluitans*	a		0.40	t/r		
Cyperaceae	*Lepidosperma*	*pubisquameum*	a		0.40	t/r		
Dasypogonaceae	*Lomandra*	*caespitosa*	a	y	0.40	t/r	low	
Dasypogonaceae	*Lomandra*	*sericea*	a	y	0.40	t/r	low	
Dasypogonaceae	*Lomandra*	*spartea*	a	y	0.40	t/r	low	no
Iridaceae	*Patersonia*	*drummondii*	a		0.40	t/r	low	
Restionaceae	*Anarthria*	*laevis*	a		0.45	r s		
Anthericaceae	*Sowerbaea*	*laxiflora*	a	y	0.45	t/r		
Poaceae	*Amphipogon*	*laguroides*	a		0.50	t/r tuffed		
Haemodoraceae	*Conostylis*	*aculeata*	r	y	0.50	t/r	low	sm
Cyperaceae	*Isolepis*	*cyperoides*	a		0.50	t/r		
Dasypogonaceae	*Lomandra*	*integra*	a	y	0.50	t/r	low	no
Dasypogonaceae	*Lomandra*	*pauciflora*	a		0.50	t/r	low	
Dasypogonaceae	*Lomandra*	*sonderi*	a	y	0.50	t/r	low	no
Poaceae	*Neurachne*	*alopecuroidea*		y	0.50	t/r		sm
Anthericaceae	*Thysanotus*	*multiflorus*		y	0.50	t/r		sm
Anthericaceae	*Tricoryne*	*elatior*	a	y	0.50	t/r		no sm
Iridaceae	*Orthrosanthus*	*laxus*		y	0.55	t/r		
Restionaceae	*Anarthria*	*prolifera*	a		0.60	r s		
Juncaceae	*Juncus*	*caespiticius*	a		0.60	t/r		
Cyperaceae	*Lepidosperma*	*carphoides*	a		0.60	t/r		
Cyperaceae	*Lepidosperma*	*gracile*	a		0.60	t/r		
Dasypogonaceae	*Lomandra*	*preissii*	a	y	0.60	t/r	low	no
Dasypogonaceae	*Lomandra*	*purpurea*	a	y	0.60	t/r	low	no
Poaceae	*Tetrarrhena*	*laevis*		y	0.60	t/r		
Colchicaceae	*Burchardia*	*umbellata*	r	y	0.65	tuberous		sm

Drain Surrounds (drain edge to 5m)

The major characteristic for this area of the main drain is being < 3 m tall. Plants within 2m of the drain should be < 1m tall. This species list is found in Table 5

Use of the species contained in Table 5 below only applies to drainage channels where an access track is necessary on only one side of the drain. These species may be used on the opposite side to the access track.

Table 5

Species to plant within 5 m of the drain edge

Family	Genera	Species	Seedlings r=regularly produced a= able to produce	Ht (m)	Reproduction or form t/r=tuberous rhizomes r s=seed re sprout lig=lignotube	Seed Availability	%germination r=re sprouter	Treatment of Seed sm=smoke h=heat t'ment
Anthericaceae	*Laxmannia*	*squarrosa*		0.1	t/r	y		
Epacridaceae	*Lysinema*	*ciliatum*		0.1		y		sm
Asteraceae	*Brachyscome*	*bellidioides*	a	0.15	annual		good	
Cyperaceae	*Isolepis*	*hookeriana*	a	0.15	annual/tuffed			
Cyperaceae	*Isolepis*	*cernua*	a	0.2	t/r			
Epacridaceae	*Leucopogon*	*capitellatus*		0.2		y		sm
Dasypogonaceae	*Lomandra*	*brittanii*	a	0.2	t/r	y	low	
Dasypogonaceae	*Lomandra*	*hermaphrodita*	a	0.2	t/r	y	low	
Iridaceae	*Patersonia*	*babianoides*	a	0.2	t/r		low	
Iridaceae	*Patersonia*	*pygmaea*	a	0.2	t/r		low	
Poaceae	*Amphipogon*	*debilis*	a	0.25	tuffed grass			
Asteraceae	*Cotula*	*coronopifolia*	a	0.25			good	
Anthericaceae	*Laxmannia*	*minor*		0.25	t/r	y		
Apiaceae	*Xanthosia*	*huegelii*		0.25		y		sm
Epacridaceae	*Astroloma*	*ciliatum*		0.3		y		
Epacridaceae	*Astroloma*	*pallidum*		0.3	prostrate	y		none sm
Myrtaceae	*Darwinia*	*oederoides*	a	0.3				
Proteaceae	*Dryandra*	*bipinnatifida*	a	0.3		y		none
Goodeniaceae	*Goodenia*	*incana*		0.3		y	low r	
Dilleniaceae	*Hibbertia*	*acerosa*		0.3		y		
Dilleniaceae	*Hibbertia*	*rhadinopoda*		0.3	prostrate	y	low r	
Papilionaceae	*Isotropis*	*cuneifolia*		0.3		y		
Papilionaceae	*Jacksonia*	*alata*		0.3		y		
Lobeliaceae	*Lobelia*	*rhombifolia*		0.3	annual	y		
Dasypogonaceae	*Lomandra*	*suaveolens*	a	0.3	t/r	y	low	
Rubiaceae	*Opercularia*	*echinocephala*		0.3		y	low r	
Iridaceae	*Patersonia*	*juncea*	a	0.3	t/r		low	
Asteraceae	*Rhodanthe*	*floribunda*		0.3	annual	y		
Colchicaceae	*Wurmbea*	*dioica*		0.3	comous	y		
Colchicaceae	*Burchardia*	*monantha*	a	0.34				
Mimosaceae	*Acacia*	*preissiana*	a	0.35		y		h
Dasypogonaceae	*Lomandra*	*odora*	a	0.35	t/r	y	low	
Anthericaceae	*Thysanotus*	*thyrsoideus*		0.35	t/r	y		
Haemodoraceae	*Conostylis*	*setigera*	a	0.36	t/r	y	low	

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Anthericaceae	*Chamaescilla*	*corymbosa*		0.4		y		sm
Papilionaceae	*Chorizema*	*nanum*	a	0.4				h
Papilionaceae	*Chorizema*	*spathulatum*	a	0.4				h
Proteaceae	*Conospermum*	*capitatum*		0.4		y		
Haemodoraceae	*Conostylis*	*juncea*	a	0.4	t/r		low	
Haemodoraceae	*Conostylis*	*laxiflora*	a	0.4	t/r		low	
Haemodoraceae	*Conostylis*	*serrulata*	a	0.4	t/r	y	low	
Proteaceae	*Dryandra*	*mimica*	a	0.4				none
Papilionaceae	*Gompholobium*	*marginatum*	a	0.4		y		h
Papilionaceae	*Gompholobium*	*preissii*	a	0.4		y	med	h
Dilleniaceae	*Hibbertia*	*perfoliata*		0.4	prostrate	y		
Dilleniaceae	*Hibbertia*	*silvestris*		0.4	prostrate	y		
Cyperaceae	*Isolepis*	*fluitans*	a	0.4	t/r			
Cyperaceae	*Lepidosperma*	*pubisquameum*	a	0.4	t/r			
Dasypogonaceae	*Lomandra*	*caespitosa*	a	0.4	t/r	y	low	
Dasypogonaceae	*Lomandra*	*sericea*	a	0.4	t/r	y	low	
Dasypogonaceae	*Lomandra*	*spartea*	a	0.4	t/r	y	low	no
Iridaceae	*Patersonia*	*drummondii*	a	0.4	t/r		low	
Asteraceae	*Podolepis*	*lessonii*		0.4	annual	y		
Euphorbiaceae	*Poranthera*	*huegelii*		0.4		y	low r	
Asteraceae	*Rhodanthe*	*manglesii*		0.4	annual	y		
Goodeniaceae	*Scaevola*	*calliptera*		0.4	prostrate	y	low r	sm
Cyperaceae	*Schoenus*	*curvifolius*		0.4	tuffed	y		
Papilionaceae	*Sphaerolobium*	*linophyllum*		0.4		y		
Apiaceae	*Actinotus*	*leucocephalus*		0.45	annual	y		
Restionaceae	*Anarthria*	*laevis*	a	0.45	r s			
Rubiaceae	*Opercularia*	*vaginata*		0.45		y		
Anthericaceae	*Sowerbaea*	*laxiflora*	a	0.45	t/r	y		
Mimosaceae	*Acacia*	*applanata*	a	0.5		y		h
Mimosaceae	*Acacia*	*barbinervis*	r	0.5		y		h
Mimosaceae	*Acacia*	*costata*	a	0.5				h
Mimosaceae	*Acacia*	*incurva*	a	0.5		y		h
Mimosaceae	*Acacia*	*ingrata*	a	0.5				h
Mimosaceae	*Acacia*	*nervosa*	a	0.5		y		h
Mimosaceae	*Acacia*	*tetragonocarpa*	a	0.5		y		h
Poaceae	*Amphipogon*	*laguroides*	a	0.5	t/r tuffed			
Epacridaceae	*Andersonia*	*aristata*		0.5		y		
Epacridaceae	*Andersonia*	*involucrata*		0.5		y		sm
Epacridaceae	*Andersonia*	*latiflora*		0.5		y		sm
Papilionaceae	*Aotus*	*procumbens*	a	0.5		y		
Papilionaceae	*Chorizema*	*aciculare*	a	0.5		y	low r	
Papilionaceae	*Chorizema*	*reticulatum*	a	0.5		y		h
Papilionaceae	*Chorizema*	*rhombeum*	a	0.5		y	med r	h
Polygalaceae	*Comesperma*	*calymega*		0.5		y		
Haemodoraceae	*Conostylis*	*aculeata*	r	0.5	t/r	y	low	sm
Goodeniaceae	*Dampiera*	*coronata*	a	0.5			low r	
Goodeniaceae	*Dampiera*	*trigona*	a	0.5			low r	

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Phormiaceae	*Dianella*	*brevicaulis*	a	0.5	r tuffed			
Frankeniaceae	*Frankenia*	*pauciflora*	a	0.5				
Papilionaceae	*Gompholobium*	*knightianum*	a	0.5		y	high	h
Papilionaceae	*Gompholobium*	*ovatum*	a	0.5		y		h
Papilionaceae	*Gompholobium*	*shuttleworthii*	a	0.5		y	high	h
Goodeniaceae	*Goodenia*	*caerulea*		0.5		y	low r	no sm
Proteaceae	*Grevillea*	*brachystylis*	a	0.5				
Proteaceae	*Grevillea*	*centristigma*	a	0.5				
Cyperaceae	*Isolepis*	*cyperoides*	a	0.5	t/r			
Papilionaceae	*Jacksonia*	*lehmannii*		0.5		y		
Lobeliaceae	*Lobelia*	*tenuior*		0.5	annual	y		
Loganiaceae	*Logania*	*serpyllifolia*		0.5		y	low	
Dasypogonaceae	*Lomandra*	*integra*	a	0.5	t/r	y	low	no
Dasypogonaceae	*Lomandra*	*pauciflora*	a	0.5	t/r		low	
Dasypogonaceae	*Lomandra*	*sonderi*	a	0.5	t/r	y	low	no
Poaceae	*Neurachne*	*alopecuroidea*		0.5	t/r	y		sm
Anthericaceae	*Thysanotus*	*multiflorus*		0.5	t/r	y		sm
Anthericaceae	*Tricoryne*	*elatior*	a	0.5	t/r	y		no sm
Goodeniaceae	*Velleia*	*trinervis*		0.5		y	low r	
Iridaceae	*Orthrosanthus*	*laxus*		0.55	t/r	y		
Mimosaceae	*Acacia*	*horridula*	a	0.6		y		h
Mimosaceae	*Acacia*	*obovata*	a	0.6		y		h
Mimosaceae	*Acacia*	*varia*	a	0.6		y		h
Mimosaceae	*Acacia*	*willdenowiana*	r	0.6		y		h
Restionaceae	*Anarthria*	*prolifera*	a	0.6	r s			
Epacridaceae	*Andersonia*	*lehmanniana*		0.6		y		
Poaceae	*Austrodanthonia*	*acerosa*	a	0.6	tuffed			
Poaceae	*Austrodanthonia*	*occidentalis*	a	0.6	tuffed			
Poaceae	*Austrodanthonia*	*setacea*	r	0.6	grass			
Rutaceae	*Boronia*	*ramosa*		0.6		y		
Anthericaceae	*Caesia*	*micrantha*	a	0.6				sm*
Myrtaceae	*Calothamnus*	*schaueri*	a	0.6				
Papilionaceae	*Chorizema*	*carinatum*	a	0.6				h
Goodeniaceae	*Dampiera*	*linearis*	a	0.6		y	low r	
Papilionaceae	*Daviesia*	*preissii*	a	0.6		y	low	h
Papilionaceae	*Gompholobium*	*cyaninum*	a	0.6				h
Papilionaceae	*Gompholobium*	*polymorphum*	a	0.6		y	med	h
Lamiaceae	*Hemiandra*	*linearis*		0.6	prostrate	y		
Dilleniaceae	*Hibbertia*	*amplexicaulis*		0.6		y	low r	sm
Dilleniaceae	*Hibbertia*	*commutata*		0.6		y	low r	
Dilleniaceae	*Hibbertia*	*glomerata*		0.6		y		
Dilleniaceae	*Hibbertia*	*huegelii*		0.6		y		
Papilionaceae	*Hovea*	*chorizemifolia*		0.6		y	med r	h
Violaceae	*Hybanthus*	*calycinus*	a	0.6		y		sm
Lobeliaceae	*Isotoma*	*hypocrateriformis*		0.6	annual	y	low	
Juncaceae	*Juncus*	*caespiticius*	a	0.6	t/r			

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Cyperaceae	*Lepidosperma*	*carphoides*	a	0.6	t/r			
Cyperaceae	*Lepidosperma*	*gracile*	a	0.6	t/r			
Dasypogonaceae	*Lomandra*	*preissii*	a	0.6	t/r	y	low	no
Dasypogonaceae	*Lomandra*	*purpurea*	a	0.6	t/r	y	low	no
Olacaceae	*Olax*	*benthamiana*		0.6		y		
Proteaceae	*Petrophile*	*media*		0.6		y	high	
Papilionaceae	*Sphaerolobium*	*medium*		0.6		y	med r	
Papilionaceae	*Sphaerolobium*	*scabriusculum*		0.6		y		
Proteaceae	*Stirlingia*	*simplex*		0.6		y	low s	
Proteaceae	*Synaphea*	*petiolaris*		0.6		y		
Poaceae	*Tetrarrhena*	*laevis*		0.6	t/r	y		
Asteraceae	*Waitzia*	*suaveolens*		0.6	annual	y	low	
Colchicaceae	*Burchardia*	*umbellata*	r	0.65	tuberous	y		sm
Stackhousiaceae	*Stackhousia*	*scoparia*		0.65		y		
Mimosaceae	*Acacia*	*semitrullata*	a	0.7		y		h
Mimosaceae	*Acacia*	*stenoptera*	a	0.7		y		h
Dasypogonaceae	*Acanthocarpus*	*preissii*	r	0.7	t/r		low	sm
Rutaceae	*Boronia*	*dichotoma*		0.7		y		
Myrtaceae	*Calothamnus*	*pallidifolius*	a	0.7				
Goodeniaceae	*Dampiera*	*pedunculata*	a	0.7			low r	
Cyperaceae	*Eleocharis*	*acuta*	a	0.7	t/r			
Proteaceae	*Grevillea*	*quercifolia*		0.7	lig	y	low r	sm
Dilleniaceae	*Hibbertia*	*cunninghamii*		0.7		y		
Papilionaceae	*Hovea*	*trisperma*	r	0.7		y	med r	h
Cyperaceae	*Lepidosperma*	*costale*	a	0.7	t/r			
Epacridaceae	*Leucopogon*	*striatus*		0.7		y		
Dasypogonaceae	*Lomandra*	*micrantha*	a	0.7	t/r	y	low	no
Dasypogonaceae	*Lomandra*	*nigricans*	a	0.7	t/r	y	low	no
Iridaceae	*Patersonia*	*occidentalis*	r	0.7	t/r		low	sm
Goodeniaceae	*Scaevola*	*pilosa*		0.7		y	low r	no sm
Stackhousiaceae	*Stackhousia*	*monogyna*		0.7		y		sm?
Mimosaceae	*Acacia*	*flagelliformis*	a	0.75		y		h
Cupressaceae	*Actinostrobus*	*acuminatus*	a	0.75				
Cyperaceae	*Carex*	*inversa*	a	0.75	t/r			
Dilleniaceae	*Hibbertia*	*racemosa*		0.75		y		
Juncaceae	*Juncus*	*planifolius*	a	0.75	tuffed			
Papilionaceae	*Nemcia*	*capitata*	r	0.75		y		
Apiaceae	*Schoenolaena*	*juncea*		0.75	t/r rush like	y		
Restionaceae	*Anarthria*	*gracilis*	a	0.8	r s			
Anthericaceae	*Caesia*	*occidentalis*	a	0.8				sm*
Myrtaceae	*Calytrix*	*flavescens*	r	0.8		y	low r	no sm
Papilionaceae	*Daviesia*	*polyphylla*	a	0.8				h
Papilionaceae	*Daviesia*	*rhombifolia*	a	0.8		y		h
Anthericaceae	*Johnsonia*	*lupulina*		0.8	t/r	y		
Cyperaceae	*Lepidosperma*	*striatum*	a	0.8	t/r			

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Cyperaceae	*Lepidosperma*	*tenue*	a	0.8	t/r			
Cyperaceae	*Mesomelaena*	*tetragona*		0.8	tuffed	y		
Poaceae	*Poa*	*drummondiana*	a	0.8	t/r			
Amaranthaceae	*Ptilotus*	*drummondii*		0.8		y		
Papilionaceae	*Sphaerolobium*	*macranthum*		0.8		y	low r	
Tremandraceae	*Tetratheca*	*setigera*		0.8		y		
Sterculiaceae	*Thomasia*	*glutinosa*		0.8		y		
Stackhousiaceae	*Tripterococcus*	*brunonis*		0.8		y	low	sm
Haemodoraceae	*Anigozanthos*	*viridis*	r	0.85	t/r	y	low	
Poaceae	*Austrodanthonia*	*caespitosa*	a	0.9	tuffed			
Poaceae	*Austrodanthonia*	*pilosa*	a	0.9	tuffed			
Iridaceae	*Patersonia*	*umbrosa*	a	0.9	t/r		low	
Poaceae	*Poa*	*poiformis*	r	0.9				
Mimosaceae	*Acacia*	*drummondii*	r	1		y		h
Mimosaceae	*Acacia*	*huegelii*	a	1		y		h
Mimosaceae	*Acacia*	*mooreana*	a	1				h
Mimosaceae	*Acacia*	*sessilis*	a	1		y		h
Anthericaceae	*Agrostocrinum*	*scabrum*		1		y		sm
Amaranthaceae	*Alternanthera*	*nodiflora*	a	1	annual			sm*
Haemodoraceae	*Anigozanthos*	*humilis*	r	1	t/r	y	low	sm
Poaceae	*Austrostipa*	*campylachne*	a	1				
Poaceae	*Austrostipa*	*hemipogon*	a	1	tuffed			
Myrtaceae	*Baeckea*	*camphorosmae*	a	1		y	low r	sm
Myrtaceae	*Baeckea*	*grandiflora*	a	1				
Rutaceae	*Boronia*	*spathulata*		1		y	med r	
Papilionaceae	*Bossiaea*	*eriocarpa*	r	1		y	med r	h
Papilionaceae	*Bossiaea*	*ornata*	r	1		y	med r	h
Papilionaceae	*Bossiaea*	*praetermissa*	a	1				h
Myrtaceae	*Calytrix*	*angulata*	a	1		y	r	
Myrtaceae	*Calytrix*	*fraseri*	a	1		y	r	
Myrtaceae	*Calytrix*	*leschenaultii*	a	1		y	r	
Cyperaceae	*Chorizandra*	*enodis*		1	t/t	y		
Polygalaceae	*Comesperma*	*flavum*		1		y		
Proteaceae	*Conospermum*	*incurvum*		1		y	low r	sm
Myrtaceae	*Darwinia*	*vestita*	a	1				
Dasypogonaceae	*Dasypogon*	*bromeliifolius*	a	1	t/r	y	low	
Papilionaceae	*Daviesia*	*brachyphylla*	a	1				h
Papilionaceae	*Daviesia*	*costata*	a	1		y		h
Papilionaceae	*Daviesia*	*decurrens*	a	1		y		h
Papilionaceae	*Daviesia*	*elongata*	a	1				h
Papilionaceae	*Daviesia*	*hakeoides*	a	1		y		h
Papilionaceae	*Daviesia*	*major*	a	1				h
Papilionaceae	*Gompholobium*	*capitatum*	a	1		y	med	h
Papilionaceae	*Gompholobium*	*confertum*	a	1		y		h
Papilionaceae	*Gompholobium*	*tomentosum*	r	1		y		h
Proteaceae	*Grevillea*	*bipinnatifida*	a	1	lig	y	low r	

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Proteaceae	*Grevillea*	*pilulifera*		1		y	low r	
Proteaceae	*Grevillea*	*wilsonii*		1	lig	y	low r	sm
Lamiaceae	*Hemiandra*	*pungens*	r	1		y	low r	
Dilleniaceae	*Hibbertia*	*aurea*		1		y		
Dilleniaceae	*Hibbertia*	*hypericoides*		1		y	low r	
Myrtaceae	*Hypocalymma*	*angustifolium*	r	1		y	low r	sm
Myrtaceae	*Hypocalymma*	*robustum*	r	1		y	low r	
Cyperaceae	*Isolepis*	*nodosa*	r	1	t/r	y		
Proteaceae	*Isopogon*	*polycephalus*		1		y		
Juncaceae	*Juncus*	*holoschoenus*	a	1	t/r	y		
Juncaceae	*Juncus*	*pauciflorus*	r	1	t/r			
Juncaceae	*Juncus*	*subsecundus*	a	1	colonial			
Caesalpiniaceae	*Labichea*	*punctata*		1	prostrate	y		
Goodeniaceae	*Lechenaultia*	*biloba*	r	1		y	low r	sm
Goodeniaceae	*Lechenaultia*	*floribunda*		1		y	low r	sm
Cyperaceae	*Lepidosperma*	*squamatum*	a	1	t/r			
Santalaceae	*Leptomeria*	*cunninghamii*		1		y	low	sm
Epacridaceae	*Leucopogon*	*sprengelioides*		1		y		
Restionaceae	*Loxocarya*	*cinerea*		1	r	y		
Myrtaceae	*Melaleuca*	*trichophylla*	a	1		y		
Papilionaceae	*Nemcia*	*cordata*	r	1				
Papilionaceae	*Nemcia*	*dilatata*	a	1		y		
Asteraceae	*Olearia*	*rudis*		1	shrub dry	y	low	
Proteaceae	*Petrophile*	*linearis*		1	lig	y	low r	sm
Proteaceae	*Petrophile*	*striata*		1		y		
Thymelaeaceae	*Pimelea*	*ciliata*		1		y		sm
Thymelaeaceae	*Pimelea*	*imbricata*		1		y		sm
Thymelaeaceae	*Pimelea*	*rosea*		1		y		
Poaceae	*Poa*	*porphyroclados*	a	1	tuffed			
Papilionaceae	*Pultenaea*	*ericifolia*		1		y		
Goodeniaceae	*Scaevola*	*thesioides*		1		y	low r	
Asteraceae	*Senecio*	*hispidulus*		1		y	low	
Asteraceae	*Senecio*	*lautus*		1	a/p to	y	low	
Solanaceae	*Solanum*	*lasiophyllum*		1		y		
Epacridaceae	*Sphenotoma*	*gracile*		1		y		
Phormiaceae	*Stypandra*	*glauca*		1		y	no sm	
Epacridaceae	*Styphelia*	*tenuiflora*		1		y	low	no sm
Sterculiaceae	*Thomasia*	*foliosa*		1		y		
Anthericaceae	*Thysanotus*	*dichotomus*		1	t/r	y		
Anthericaceae	*Thysanotus*	*sparteus*		1	t/r	y		
Myrtaceae	*Verticordia*	*acerosa*		1		y		
Apiaceae	*Xanthosia*	*atkinsoniana*		1		y		
Haemodoraceae	*Anigozanthos*	*manglesii*	r	1.1	t/r	y	low	sm
Poaceae	*Austrostipa*	*semibarbata*	a	1.1	tuffed			
Myrtaceae	*Eremaea*	*asterocarpa*		1.1		y		

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Poaceae	*Austrostipa*	*flavescens*	a	1.2	tuffed			
Poaceae	*Austrostipa*	*tenuifolia*	a	1.2	tuffed			
Cyperaceae	*Baumea*	*arthrophylla*	a	1.2	t/r			
Cyperaceae	*Baumea*	*juncea*	r	1.2	t/r			
Cyperaceae	*Bolboschoenus*	*caldwellii*	r	1.2	t/r			
Rutaceae	*Boronia*	*crenulata*		1.2		y	low r	
Papilionaceae	*Daviesia*	*incrassata*	a	1.2		y		h
Papilionaceae	*Euchilopsis*	*linearis*		1.2		y		h
Juncaceae	*Juncus*	*kraussii*	r	1.2	t/r	y		
Asteraceae	*Olearia*	*paucidentata*		1.2	shrub damp	y	low	
Euphorbiaceae	*Phyllanthus*	*calycinus*	r	1.2		y	low r	
Thymelaeaceae	*Pimelea*	*lehmanniana*		1.2		y		
Papilionaceae	*Pultenaea*	*drummondii*		1.2		y		
Goodeniaceae	*Scaevola*	*globulifera*		1.2		y	low r	
Papilionaceae	*Sphaerolobium*	*vimineum*		1.2		y	med r	
Myrtaceae	*Calytrix*	*aurea*	a	1.3		y	r	
Thymelaeaceae	*Pimelea*	*longiflora*		1.3		y		
Myrtaceae	*Verticordia*	*huegelii*		1.4		y		sm
Mimosaceae	*Acacia*	*lasiocarpa*	r	1.5		y		h
Mimosaceae	*Acacia*	*lateriticola*	a	1.5		y		h
Restionaceae	*Anarthria*	*scabra*	a	1.5	r s			
Cyperaceae	*Baumea*	*vaginalis*	r	1.5	t/r			
Papilionaceae	*Bossiaea*	*pulchella*	a	1.5		y	high r	h
Myrtaceae	*Calothamnus*	*lateralis*	r	1.5		y		
Myrtaceae	*Calothamnus*	*planifolius*	a	1.5		y		
Papilionaceae	*Chorizema*	*cordatum*	r	1.5		y		h
Papilionaceae	*Chorizema*	*cordatum*	r	1.5				h
Epacridaceae	*Conostephium*	*pendulum*		1.5		y		
Myrtaceae	*Darwinia*	*citriodora*	a	1.5		y	low ?	
Papilionaceae	*Daviesia*	*angulata*	a	1.5		y		h
Papilionaceae	*Daviesia*	*inflata*	a	1.5				h
Papilionaceae	*Daviesia*	*longifolia*	a	1.5		y	low r	h
Papilionaceae	*Daviesia*	*nudiflora*	a	1.5		y		h
Phormiaceae	*Dianella*	*revoluta*	r	1.5		y	low r	
Papilionaceae	*Dillwynia*	*uncinata*		1.5		y		h
Sapindaceae	*Diplopeltis*	*huegelii*		1.5		y		
Proteaceae	*Dryandra*	*nivea*	a	1.5		y	high	none
Cyperaceae	*Gahnia*	*trifida*	a	1.5	t/r			sm*
Proteaceae	*Grevillea*	*pulchella*		1.5		y		
Proteaceae	*Hakea*	*lissocarpha*	r	1.5	lig	y	high	none
Proteaceae	*Hakea*	*marginata*	a	1.5		y		none
Dilleniaceae	*Hibbertia*	*pilosa*		1.5		y		
Myrtaceae	*Hypocalymma*	*cordifolium*	a	1.5				
Proteaceae	*Isopogon*	*sphaerocephalus*		1.5	lig	y	low r	
Myrtaceae	*Kunzea*	*micrantha*		1.5		y		

Family	Genera	Species	Seedlings r=regularly produced a= able to produce	Ht (m)	Reproduction or form t/r=tuberous rhizomes r s=seed re sprout lig=lignotube	Seed Availability	%germination r=re sprouter	Treatment of Seed sm=smoke h=heat t'ment
Myrtaceae	*Kunzea*	*micromera*		1.5		y		
Cyperaceae	*Lepidosperma*	*gladiatum*	r	1.5	t/r	y		
Myrtaceae	*Melaleuca*	*pauciflora*	r	1.5		y		
Myrtaceae	*Melaleuca*	*scabra*	r	1.5		y	med r	
Papilionaceae	*Nemcia*	*retusa*	a	1.5		y		
Proteaceae	*Persoonia*	*saccata*		1.5		y		
Proteaceae	*Petrophile*	*serruriae*		1.5		y		
Thymelaeaceae	*Pimelea*	*suaveolens*		1.5		y		sm
Pittosporaceae	*Pronaya*	*fraseri*		1.5		y	low	
Goodeniaceae	*Scaevola*	*crassifolia*	r	1.5		y	low r	sm
Proteaceae	*Stirlingia*	*latifolia*		1.5	lig	y	low r	sm
Myrtaceae	*Verticordia*	*plumosa*		1.5		y		
Xanthorrhoeaceae	*Xanthorrhoea*	*brunonis*	a	1.5	trunk	y	high	none
Polygalaceae	*Comesperma*	*virgatum*		1.6		y		sm
Cyperaceae	*Cyathochaeta*	*avenacea*		1.6	t/r	y		
Proteaceae	*Grevillea*	*bronwenae*	a	1.6				
Myrtaceae	*Agonis*	*grandiflora*	a	1.7		y		
Proteaceae	*Conospermum*	*acerosum*		1.7		y		
Proteaceae	*Grevillea*	*preissii*	r	1.7				
Papilionaceae	*Aotus*	*passerinoides*	a	1.8				
Papilionaceae	*Daviesia*	*physodes*	a	1.8		y	high r	h
Papilionaceae	*Hovea*	*pungens*	r	1.8		y	med r	h
Mimosaceae	*Acacia*	*browniana*	a	2		y		h
Mimosaceae	*Acacia*	*extensa*	r	2		y		h
Myrtaceae	*Agonis*	*hypericifolia*	a	2		y		
Casuarinaceae	*Allocasuarina*	*humilis*	r	2		y	high	none
Casuarinaceae	*Allocasuarina*	*thuyoides*	a	2		y	high	none
Papilionaceae	*Aotus*	*gracillima*	a	2		y		h*
Papilionaceae	*Aotus*	*intermedia*	a	2		y		
Proteaceae	*Banksia*	*meisneri*	a	2		y	high	no
Myrtaceae	*Beaufortia*	*squarrosa*	r	2		y	high	sm*
Rutaceae	*Boronia*	*denticulata*		2		y		
Rutaceae	*Boronia*	*fastigiata*		2		y	low r	
Papilionaceae	*Bossiaea*	*rufa*	a	2		y		h
Myrtaceae	*Calothamnus*	*quadrifidus*	r	2		y	med r	
Myrtaceae	*Calothamnus*	*sanguineus*	r	2		y	high r	
Cyperaceae	*Cyathochaeta*	*clandestina*		2	t/r	y		
Papilionaceae	*Daviesia*	*cordata*	r	2				h
Rutaceae	*Diplolaena*	*dampieri*		2		y		sm
Proteaceae	*Dryandra*	*falcata*	a	2				none
Myrtaceae	*Eremaea*	*pauciflora*	r	2		y		
Papilionaceae	*Gastrolobium*	*parviflorum*		2		y		h
Proteaceae	*Grevillea*	*crithmifolia*	r	2		y		
Proteaceae	*Hakea*	*ceratophylla*		2	lig	y		none
Proteaceae	*Hakea*	*cyclocarpa*		2	lig	y	high	none
Proteaceae	*Hakea*	*sulcata*	a	2		y		none

Family	Genera	Species	Seedlings r=regularly produced a= able to produce	Ht (m)	Reproduction or form t/r=tuberous rhizomes r s=seed re sprout lig=lignotube	Seed Availability	%germination r=re sprouter	Treatment of Seed sm=smoke h=heat t'ment
Dilleniaceae	*Hibbertia*	*serrata*		2				sm
Violaceae	*Hybanthus*	*floribundus*		2		y	low r	
Proteaceae	*Isopogon*	*attenuatus*		2	lig	y		
Proteaceae	*Isopogon*	*formosus*		2	2	y		
Juncaceae	*Juncus*	*aridicola*	a	2	t/r			
Juncaceae	*Juncus*	*pallidus*	r	2	t/r	y		not tested
Myrtaceae	*Kunzea*	*recurva*	r	2		y	med r	
Cyperaceae	*Lepidosperma*	*longitudinale*	a	2	t/r			
Epacridaceae	*Leucopogon*	*australis*		2		y		
Epacridaceae	*Leucopogon*	*propinquus*		2		y		no sm
Epacridaceae	*Leucopogon*	*revolutus*		2		y		
Myrtaceae	*Melaleuca*	*lateritia*	r	2		y		
Thymelaeaceae	*Pimelea*	*argentea*		2		y		
Thymelaeaceae	*Pimelea*	*leucantha*		2		y		sm
Thymelaeaceae	*Pimelea*	*spectabilis*		2		y		sm
Thymelaeaceae	*Pimelea*	*sylvestris*		2		y		sm
Papilionaceae	*Pultenaea*	*reticulata*		2		y		
Myrtaceae	*Regelia*	*ciliata*	r	2		y	med r?	
Cyperaceae	*Schoenoplectus*	*validus*	r	2	t/r	y		
Solanaceae	*Solanum*	*symonii*		2		y		
Myrtaceae	*Verticordia*	*densiflora*	a	2		y		sm
Myrtaceae	*Verticordia*	*nitens*	a	2		y	low s	
Xanthorrhoeaceae	*Xanthorrhoea*	*gracilis*	a	2	tuffed	y	high	none
Mimosaceae	*Acacia*	*alata*	r	2.1		y		h
Papilionaceae	*Bossiaea*	*linophylla*	r	2.2		y		h
Cyperaceae	*Evandra*	*aristata*		2.2	t/r	y		
Proteaceae	*Isopogon*	*cuneatus*		2.3		y		
Mimosaceae	*Acacia*	*divergens*	a	2.5		y		h
Mimosaceae	*Acacia*	*trigonophylla*	a	2.5		y		h
Sapindaceae	*Dodonaea*	*ceratocarpa*		2.5		y		
Proteaceae	*Dryandra*	*baxteri*	a	2.5				none
Proteaceae	*Dryandra*	*mucronulata*	a	2.5		y		none
Proteaceae	*Dryandra*	*sessilis*	a	2.5		y	high	none
Papilionaceae	*Gastrolobium*	*calycinum*		2.5		y	med r	h
Proteaceae	*Hakea*	*oldfieldii*		2.5		y		none
Proteaceae	*Lambertia*	*multiflora*		2.5		y		
Cyperaceae	*Lepidosperma*	*effusum*	a	2.5	t/r	y		
Loganiaceae	*Logania*	*vaginalis*		2.5		y		
Papilionaceae	*Nemcia*	*coriacea*	a	2.5		y		
Myrtaceae	*Regelia*	*inops*	r	2.5		y		
Rhamnaceae	*Trymalium*	*ledifolium*		2.5		y	med	h
Cyperaceae	*Baumea*	*articulata*	r	2.6	t/r			
Mimosaceae	*Acacia*	*cochlearis*	r	3		y		h
Mimosaceae	*Acacia*	*dentifera*	a	3		y		h
Mimosaceae	*Acacia*	*littorea*	a	3		y		h
Mimosaceae	*Acacia*	*pulchella*	r	3		y		h

Family	Genera	Species	Seedlings r=regularly produced a= able to produce	Ht (m)	Reproduction or form t/r=tuberous rhizomes r s=seed re sprout lig=lignotube	Seed Availability	%germination r=re sprouter	Treatment of Seed sm=smoke h=heat t'ment
Mimosaceae	*Acacia*	*urophylla*	a	3		y		h
Malvaceae	*Alyogyne*	*hakeifolia*		3		y		
Haemodoraceae	*Anigozanthos*	*flavidus*	r	3	t/r	y	low	
Myrtaceae	*Astartea*	*fascicularis*	r	3		y	low r	sm
Myrtaceae	*Beaufortia*	*sparsa*	r	3		y		
Myrtaceae	*Callistemon*	*glaucus*	a	3		y	r	
Dasypogonaceae	*Dasypogon*	*hookeri*	a	3	r		low	
Papilionaceae	*Daviesia*	*divaricata*	a	3		y		h
Proteaceae	*Dryandra*	*formosa*	a	3		y	high	none
Cyperaceae	*Gahnia*	*decomposita*		3	t/r	y		sm*
Proteaceae	*Grevillea*	*vestita*		3		y		
Proteaceae	*Hakea*	*ruscifolia*	a	3	lig	y		none
Proteaceae	*Hakea*	*varia*	a	3		y		none
Dilleniaceae	*Hibbertia*	*cuneiformis*		3		y		
Papilionaceae	*Hovea*	*elliptica*		3		y		h
Caesalpiniaceae	*Labichea*	*lanceolata*		3		y		
Epacridaceae	*Leucopogon*	*parviflorus*		3		y		
Papilionaceae	*Mirbelia*	*dilatata*	a	3		y	med	
myoporaceae	*Myoporum*	*caprariodes*		3		y		
Myrtaceae	*Pericalymma*	*ellipticum*	r	3		y	low s	
Proteaceae	*Petrophile*	*squamata*		3		y		
Goodeniaceae	*Scaevola*	*nitida*		3		y	low r	
Pittosporaceae	*Sollya*	*heterophylla*	a	3		y	low r	sm
Rutaceae	*Crowea*	*angustifolia*		3.5		y		
Proteaceae	*Hakea*	*amplexicaulis*	a	3.5		y	high	none
Pittosporaceae	*Billardiera*	*floribunda*			climber	y	low r	
Pittosporaceae	*Billardiera*	*variifolia*			climber	y	low r	sm
Lauraceae	*Cassytha*	*pomiformis*			climber	y		
Lauraceae	*Cassytha*	*racemosa*			climber	y		
Papilionaceae	*Chorizema*	*diversifolium*	a		climber			h
Papilionaceae	*Chorizema*	*glycinifolium*	a		sprawling			h
Ranunculaceae	*Clematis*	*linearifolia*	a		creeper			
Ranunculaceae	*Clematis*	*pubescens*	a		creeper	y		sm
Proteaceae	*Conospermum*	*caeruleum*			prostrate	y		
Proteaceae	*Dryandra*	*lindleyana*	a		prostrate			none
Papilionaceae	*Hardenbergia*	*comptoniana*	r		creeper	y	med r	h
Papilionaceae	*Kennedia*	*carinata*	a		creeper	y	low	
Papilionaceae	*Kennedia*	*coccinea*	r		creeper	y	med	
Papilionaceae	*Kennedia*	*macrophylla*	a		creeper	y		
Papilionaceae	*Kennedia*	*nigricans*	a		creeper	y		
Papilionaceae	*Kennedia*	*prostrata*	r		creeper	y	med	
Papilionaceae	*Kennedia*	*stirlingii*	a		creeper	y		
Apiaceae	*Pentapeltis*	*peltigera*			prostrate	y		no sm
Apiaceae	*Platysace*	*compressa*			prostrate	y		
Amaranthaceae	*Ptilotus*	*divaricatus*			prostrate	y		
Amaranthaceae	*Ptilotus*	*manglesii*			prostrate	y		
Tremandraceae	*Tetratheca*	*hirsuta*			climber	y		

Drain Surrounds (5m to 10m from Drain edge

The main characteristic is being 8 m tall with plants 4-5 m tall being planted closer to the 5 m mark. The species list is found in Table 6

Table 6
Plant specie to plant 5m to 10m from the drain

Family	Genera	Species	Seedlings r=regularly produced these species a= are able to produce these species	Ht (m)	Reproduction or form t/r=tuberous rhizomes r s=seed re sprout lig=lignotube	Seed Availability	%germination r=re sprouter	Treatment of Seed sm=smoke h=heat t'ment
Mimosaceae	*Acacia*	*paradoxa*	a	4		y		H
Cupressaceae	*Actinostrobus*	*pyramidalis*	r	4		y		
Myrtaceae	*Agonis*	*linearifolia*	r	4		y	low r	
Myrtaceae	*Agonis*	*parviceps*	r	4		y		
Proteaceae	*Banksia*	*sphaerocarpa*	a	4		y	high	no
Cyperaceae	*Baumea*	*rubiginosa*	r	4	t/r	y		
Proteaceae	*Dryandra*	*squarrosa*	a	4				none
Santalaceae	*Exocarpos*	*sparteus*		4		y		sm
Papilionaceae	*Gastrolobium*	*bilobum*		4		y		h
Proteaceae	*Hakea*	*trifurcata*	r	4		y	high	none
Papilionaceae	*Jacksonia*	*furcellata*	r	4		y	med	
Myrtaceae	*Kunzea*	*ericifolia*	r	4		y	mid r	
Myrtaceae	*Melaleuca*	*brevifolia*	a	4		y		
Papilionaceae	*Oxylobium*	*lineare*		4		y		
Papilionaceae	*Templetonia*	*retusa*	r	4		y	low	
Papilionaceae	*Viminaria*	*juncea*	r	4		y	med	
Cupressaceae	*Callitris*	*canescens*	a	5		y		
Sapindaceae	*Dodonaea*	*viscosa*		5		y		
Proteaceae	*Dryandra*	*hewardiana*	a	5		y		none
Proteaceae	*Hakea*	*linearis*	a	5		y		none
Proteaceae	*Hakea*	*prostrata*	r	5		y	high	none
Papilionaceae	*Jacksonia*	*sternbergiana*	r	5		y	high	
Zamiaceae	*Macrozamia*	*riedlei*	r	5	tree size	y	high	none
Pittosporaceae	*Marianthus*	*candidus*		5		y		sm
Myrtaceae	*Melaleuca*	*huegelii*	r	5		y	high r	
Myrtaceae	*Melaleuca*	*incana*	r	5		y	med r	
Myrtaceae	*Melaleuca*	*seriata*	a	5		y		
Myrtaceae	*Melaleuca*	*teretifolia*	r	5		y	high r	
Myrtaceae	*Melaleuca*	*thymoides*	r	5		y		
Myrtaceae	*Melaleuca*	*uncinata*	a	5		y	high r	
Myrtaceae	*Melaleuca*	*viminea*	r	5		y	mid r	
Proteaceae	*Persoonia*	*longifolia*		5		y	low r	
Rhamnaceae	*Spyridium*	*globulosum*	r	5		y	low	sm
Xanthorrhoeaceae	*Xanthorrhoea*	*preissii*	r	5	trunk	y	high	none
Mimosaceae	*Acacia*	*saligna*	r	6		y		H

Family	Genera	Species	Seedlings r=regularly produced these species a= are able to produce these species	Ht (m)	Reproduction or form t/r=tuberous rhizomes r s=seed re sprout lig=lignotube	Seed Availability	%germination r=re sprouter	Treatment of Seed sm=smoke h=heat t'ment
Proteaceae	*Grevillea*	*diversifolia*		6		y		
Proteaceae	*Hakea*	*lasianthoides*		6		y		none
Proteaceae	*Hakea*	*preissii*	a	6		y		none
Papilionaceae	*Callistachys*	*lanceolata*		7		y		
Myrtaceae	*Melaleuca*	*cuticularis*	r	7		y		
Papilionaceae	*Bossiaea*	*aquifolium*	r	8		y	med	h
Myrtaceae	*Melaleuca*	*lanceolata*	r	8		y		
Myrtaceae	*Melaleuca*	*lateriflora*	a	8		y	high r	
Loranthaceae	*Nuytsia*	*floribunda*	a	8		y	low	
Proteaceae	*Persoonia*	*elliptica*		8		y	low r	
Proteaceae	*Xylomelum*	*occidentale*	a	8		y	high r	

Drain Surround (>10 m from drain edge)

Plant Characteristics mainly includes:

- The species being a local native plant.
- Not being more than 15m tall. The further away from the drain the taller the species to be planted can be.

The plant species to use in this area are found in Table 7

Table 7

Plant species to plant > 10m from the drain edge

Family	Genera	Species	Seedlings r=reglarly produced these species a= are able to produce these species	Ht (m)	Reproduction or form t/r=tuberous rhizomes r s=seed re sprout lig=lignotube	Seed Availability	%germination r=re sprouter	Treatment of Seed sm=smoke h=heat t'ment
Myrtaceae	*Melaleuca*	*preissiana*	r	9		y	med r	
Rhamnaceae	*Trymalium*	*floribundum*		9		y	med	h
Myrtaceae	*Agonis*	*flexuosa*	r	10		y	high	sm
Casuarinaceae	*Allocasuarina*	*obesa*	r	10		y	high	none
Proteaceae	*Banksia*	*attenuata*	r	10		y	high	no
Proteaceae	*Banksia*	*ilicifolia*	r	10		y	high	no
Myrtaceae	*Melaleuca*	*rhaphiophylla*	r	10		y	mid r	
Mimosaceae	*Paraserianthes*	*lophantha*		10		y		
Myrtaceae	*Agonis*	*juniperina*	a	12		y		
Proteaceae	*Banksia*	*littoralis*	r	12		y	high	no
Casuarinaceae	*Allocasuarina*	*fraseriana*	r	15		y	high	none
Proteaceae	*Banksia*	*grandis*	r	15		y	high	no
Myrtaceae	*Corymbia*	*haematoxylon*	a	15		y	high	none

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Photograph 1
Small drain adjacent to road

Photograph 2
Small drain within private property

Photograph 3
Medium sized drain along side a road

Photograph 4
Medium sized drain within a drain reserve

Photograph 5
Medium sized drain within private property

Photograph 6
Large drain within a drain reserve

Photograph 7

Photograph 8

Problems that develop with drains include trees growing within the drain invert (7), siltation of the drain invert and subsequent growth of reeds causing reducing the drains water carrying capacity and impeding water flow (7 and 8) and erosion of the banks of the drain (8). This can cause local flooding and property damage in extreme rainfall events.

Photograph 9
Remedial and Maintenance works requires digging out the drain from one side a disposing of the silt material along the top of the drain.

Photograph 10

Photograph 11

Rehabilitation works of medium sized drains in reserves involving planting close to the drain on both sides (10 and 11). The result is that it is difficult to carry out routine maintenance on the drain and allow the water Corporation to meet its statutory obligations. The result is that the Water Corporation damages the plantings to get access to the drain

Photograph 12
Rehabilitation works adjacent to a small drain on private property. The Blue gums (Eucalyptus globulus) in the above example are planted too close to the drain with the likely hood of leaves, bark and limbs falling into the drain, blocking the culverts and pipes and possibly causing local flooding.

Photograph 13
Rehabilitation along a drainage reserve. Again it would be difficult for Water Corporation to maintain the drain without effecting the trees planted close to the drain on both sides

Photograph 14

Photograph 15

Trees are planted away from the edge of the drain on the side of the drain with the access track (14 and 15). The trees on the other side are planted closer to the drain edge but not too close that will allow limbs and leaves to fall in the drain potentially causing blockage and subsequent local flooding. Maintenance work can be carried out on the drain with minimal disturbance to the planted trees. Further rehabilitation works can involve planting small shrubs (<1 m ht) closer to the edge of the drain, native reeds and rushes on the drain sides and disturbance tolerant small shrubs/heath plants along the access track.

Appendix 1

Extracts from the consultation process used to develop our information brochure "Rural Drainage Services – Customer Information" *

The Corporation, while fulfilling its primary obligation to provide drainage services in compliance with its operating licence, and efficient outlet to its rural customers, is committed to maintaining its drains in order to minimise negative impacts on the receiving water bodies. This will be achieved by the adoption of engineering or landscaping (Streamlining) practices where appropriate and economically achievable. Assistance to landowners or catchment groups can be offered where improvements to water quality and management advantages to the Corporation are identified. These initiatives will be considered on an individual basis on application by the proponent to the Corporation.

In addition to its legal obligations to control declared plants and animals the Corporation will endeavour to eradicate weeds and vermin over the area of its works when landowners undertake eradication programs on properties adjoining its drains.

The Corporation is charged with the task of maintaining its existing drains to ensure they are capable of clearing water from adjacent rural properties within 3 days of a storm event where contours and internal drainage make this physically possible.

The drains are not designed to give total drainage at all times and some inundation of land can be expected in times of heavy rain.

Spoil removed from drains during cleaning operations will generally be spread on the access track adjacent to the drain unless in a developed area or there is insufficient space. In these latter cases the spoil will be made available to landowners or removed from the property.

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Sediments from the land deposited in the drains, estuaries and ocean are not only expensive to remove but tend to carry nutrients all of which can contribute to problems such as death of aquatic life and algae blooms. It is a requirement for land owners to control entry of runoff water from the property into the drain to prevent erosion and provide maximum opportunity for nutrient uptake by pastures. It is also a requirement under the Soil and Land Conservation Act to prevent uncontrolled erosion of the land.

- A complete copy of this brochure can be obtained from our Customer Service Centre on 13 13 85