

1. INTRODUCTION

The City of Armadale is characterised by the Darling Range to the east, and the Swan Coastal Plain to the west. The Darling Range has numerous attractive watercourses that can be damaged if water flows and water quality from new developments are not properly managed. Much of the Swan Coastal Plain portion of Armadale has a high watertable or is seasonally waterlogged, so development needs to be managed to ensure that pollutants including nutrients do not contaminate natural watercourses or the Canning River, Southern River or Wungong Brook. Watercourses and wetlands play important roles in the conservation of natural resources and biodiversity richness in the City. They also contribute to the quality of living for the residents of Armadale.

This policy seeks to integrate quality urban development with the natural environment. The policy seeks to enhance the qualities and benefits of our natural environment by:

- preventing contamination of stormwater through education and design;
- using appropriate technology;
- using the natural ability of watercourses and well managed water bodies to improve water quality; and
- revegetating City's stormwater drainage system with local species to enhance its values and visual appeal.

With current technology and forward planning as set out by this policy, the costs of management can be minimised to achieve practical benefits.

This water sensitive design policy, along with the City's Engineering specifications and conditions relating to developments and subdivision brings together a number of Council resolutions, documents adopted by Council and relevant State Government policies into a coherent framework to ensure best management practices are used.

There have been many publications, policy statements and related legislation relevant to water sensitive design. Council has responded to many of these and passed several resolutions (e.g. T271/97, D534/97, T285/98 & CS21/2000) that endorse or adopt various aspects of water sensitive design.

Relevant publications include, but are not limited to:

- City of Armadale (2011) *State of the Environment Report*
- Western Australian Planning Commission (2008) *Better Urban Water Management*
- The Institution of Public Works Engineering Australia (WA Division Inc) (IPWEA) *Subdivisional Guidelines (Edition No. 2 – 2009)*
- Upper Canning Southern Wungong Catchment Team (1999) *Upper Canning Southern Wungong Catchment Management Plan*

- Western Australian Planning Commission (2009) *Liveable Neighbourhoods*
- Government of Western Australia (1997) Wetlands Conservation Policy for Western Australia
- [EPA Position Statement 4: *Environmental Protection of Wetlands*](#)
- Department of Water (2004) *Stormwater Management Manual for Western Australia*
- *Swan and Canning Rivers Management Act 2006*
- *Southern River Land and Water Management Plan*
- *Wungong Urban Water Master Plan*

The policy has been written for use by professionals in the development industry, and should be read in conjunction with the City's Engineering specifications and conditions relating to developments and subdivision which largely follows the specifications recommended in The Institution of Public Works Engineering Australia (WA Division Inc) (IPWEA) Subdivisional Guidelines (Edition No. 2 – 2009).

2. APPLICATION OF POLICY

This policy applies to structure plans, subdivisions and development proposals throughout the City of Armadale.

3. POLICY OBJECTIVES

- To assist in protecting the beneficial uses of the Canning River and watercourses. In particular, beneficial uses of the Canning River and waterways to be protected under this Water Sensitive Design policy are their use:
 - (a) as a habitat for:
 - locally indigenous fauna, including migratory or threatened species; or
 - locally indigenous flora, including threatened species;
 - (b) For the maintenance of the diversity and abundance of locally indigenous fauna and flora species;
 - (c) To provide a biologically productive and genetically diverse natural environment;
 - (d) To maintain ecological processes;
 - (e) As an important passive recreational element in parts of the City of Armadale; and
 - (f) Together with their beds, banks and contours, the use of fringing native vegetation as an important element of the natural landscape of the policy area.
- To ensure water sensitive design best management practices are implemented for all new proposals so as to minimise nutrient and other pollutant export to the City's Rivers;

- To protect and where possible restore and enhance environmental and social (ie. recreational and scenic) values of waterways and protected wetlands;
- To retain or enhance open drains by converting them to multiple use corridors that provide habitat for wildlife and passive recreation opportunities wherever possible.
- To ensure that upland vegetation is considered for protection in addition to wetland vegetation.

4. POLICY STATEMENT

4.1 Principles for Design and Assessment of Best Management Practice

When the City is exercising its decision-making in respect to, structure plans, subdivision guide plans, subdivisions or development approvals, the City will ensure that land use subdivision and development utilises best management practice for drainage and watercourse protection. Criteria associated with the following principles will be used to assess the extent to which a proposal meets best management practice.

- (a) Water resource management is addressed at the sub-catchment level;
- (b) Multiple use corridors located within Public Open Space are used when appropriate;
- (c) Storage, stormwater use and stormwater treatment occur as high as possible in the catchment, a treatment train approach is used and components of stormwater management are located so they follow natural contours;
- (d) Stormwater system design incorporates as much as possible features of waterways that improve water quality;
- (e) Fringing vegetation along watercourses and around protected wetlands and associated significant upland vegetation is considered for retention and rehabilitation where practical;
- (f) Property is protected from flooding or damage by surface water or groundwater;
- (g) Post urban development conditions in watercourses approximate pre urban conditions (i.e. water level and flow regimes are maintained) *(unless it can be demonstrated that the downstream channel and floodplain has the capacity to accept higher flows to the satisfaction of the Department of Water)*;
- (h) The area of open drain habitat is maintained or increased over time.

Each of these principles is considered further below. Principles (f) to (h) are standard assessment criteria.

Based on these principles, the following best management practices from the Department of Water's Stormwater Management Manual for Western Australia are preferred (in approximate order of preference with (a) being the most preferred):

- (a) Pollution trapping manhole device removing sediment down to 100 microns in diameter
- (b) Revegetated streamlines/streamlined meandering channels
- (c) Infiltration basins
- (d) Grass or reed swales
- (e) Filter strips
- (f) Extended detention basins
- (g) Constructed wetlands / wet basins subject to detailed assessment and approval in accordance with the landscaping policy.

Unacceptable stormwater management practices include:

- Chemical treatment with alum
- Low flow pipes under open space drainage corridors as generally indicated in the Southern River/ Forrestdale/ Brookdale/ Wungong District Structure Plan are unacceptable Piping storms with a recurrence interval of 2-5 years and providing overland flow paths for the 100 year occurrence flows is acceptable.

Selection of best management practices should follow suggestions in the Department of Water's Stormwater Management Manual for Western Australia.

4.2 Addressing Water Resource Management at the Sub-Catchment Level

Sub-catchments should be used to determine drainage system design. Proposals low in the sub-catchment should be designed with due regard to proposed land use as reflected in the Town Planning Scheme, Structure Plan or Local Planning Strategy and the volumes of stormwater or subsoil drainage water likely to be generated upstream.

4.3 Using a treatment train approach

Stormwater treatment such as detention and water use should occur at source or on-site if practicable.

Best management practices should be combined in series (i.e. as a treatment train) preferably connected by grass (or reed) swales or multiple use corridors with streamlined meandering channels. Areas for the temporary storage of stormwater from peak rainfall events should be an integral component of the urban or rural landscape, whenever possible.

In providing adequate detention capacity the use of larger well-vegetated detention basins, instead of a series of smaller detention basins in a meandering channel, is acceptable if these achieve social or visual/aesthetic goals. For example, the basins in Minnowarra Park enhance the aesthetics of the park and increase its value for social functions.

The detention capacity of the treatment train should be capable of retaining the first flush (i.e. stormwater from the first Autumn rains). Design criteria to determine the detention capacity required to retain the first flush can be found in the Department of Water's Stormwater Management Manual for Western Australia.

Additional detention criteria can be found in the Southern River/ Forrestdale/ Brookdale/ Wungong District Structure Plan and Southern River Integrated Land and Water Management Strategy.

Wherever possible use should be made of stormwater runoff. Car parks should direct runoff water into landscaped swales to reduce irrigation requirements and catch pollutants. Components of stormwater management should be located so they follow natural contours. Mechanisms to trap sediment should be in place to remove sediment 100 microns or more.

4.4 Protecting property from flooding

4.4.1 Major Watercourses and main drains

All development along watercourses, main drains and overland flow paths for the 100 year storm recurrence interval shall have floor levels at least 300mm above the 100 year flood level. This is a minimum standard, and the City would prefer floor levels to be 500mm above the 100 year level, particularly in areas with heavy soils.

Major watercourse and main drainage reserves should be of sufficient width to allow for 1:6 batters, appropriate access for maintenance, and the floodway associated with the 100 year event. This would normally result in a minimum reserve width of 30m. However, to allow for natural meandering of a watercourse and the flood plain, a 50m reserve width is preferred.

4.4.2 Groundwater levels

To protect housing from flooding and rising damp from groundwater, development in areas where the maximum groundwater level (MGL) is at or within 1.2m of the surface (as determined by correlation to Department of Water WinBore data and a minimum of 18 months onsite monitoring that is to include two winter high groundwater table readings), measures will be required to control the rise of groundwater.

Control measures may include importation of clean fill having characteristics agreed by City of Armadale Technical Services and / or the use of drainage to control the ground water level. Details of the exact measures to be employed for the control of groundwater need to be endorsed by the City of Armadale Technical Services and

relevant government authorities. If sub surface drainage is employed then agreement of the invert level and grade of sub surface pipe work will be required from the City of Armadale Technical Services, Department of Water and if affecting environmentally sensitive areas, the Department of Environment & Conservation. Approval from other relevant authorities may also be necessary.

In certain instances seasonal groundwater level as indicated by the MGL is not the critical factor to prevent flooding. The presence of low permeability clays and silts may result in a situation where Perched Groundwater Level (PGWL) requires management to avoid undesirable outcomes. As such, dependant on the site characteristics, it may be necessary to adopt measures to control groundwater and ensure adequate separation of building floor levels from groundwater in areas where the MGL is more than 1.2m from the surface.

Where usage is agreed with relevant authorities, subsoil systems should be designed with the following minimum parameters factored in:

- A % capacity reduction for loss of efficiency over the life time of the system due to factors such as clogging of the subsoil line.
- The subsoil drainage pipes are to be laid on a minimum 1 in 500 meters fall to ensure a self cleansing velocity is maintained within the pipe work.
- Subsoil lines will not be permitted to be laid in the rear of lots and should be located in areas which are easy to access for maintenance.
- The design should allow for the ground above the subsoil line to be disturbed for eventual replacement with no permanent structures located above the subsoil pipe.
- The subsoil pipe network is to have a free outfall minimum 300mm above the invert of treatment areas.
- Treatment areas are to be set minimum 300mm above peak groundwater level (PGL). PGL refers to either perched or seasonal groundwater levels, whichever is the more critical factor.

To prevent unfavourable environmental and aesthetic conditions from developing, the City of Armadale generally requires a separation of PGL from Public Open Space (POS) surface levels. For POS areas where active pursuits are planned, the City requires a minimum separation of 600mm from ground surface level to PGL. In Passive POS and areas where infiltration of stormwater is planned, a minimum separation of 300mm from ground surface to PGL is required. Where wetlands are accepted as POS contributions a separate detailed assessment will be required. Separations of PGL from building footings are to comply with Building Codes Australia requirements. For serviceability of lots, a minimum separation of

1.2m from PGL to ground surface is required. In systems where the groundwater level is controlled then minimum separations are to be taken from the peak of the phreatic crest.

4.5 Maintaining water level and flow regimes

4.5.1 Water levels - Protected wetlands

Where it is deemed that a proposal is likely to have a potential impact on the hydrological regime of the groundwater dependent vegetation of a protected wetland a hydrological study will be required to determine how the water level regime of the wetland can be maintained to support the groundwater dependent vegetation.

As a general guideline, a hydrological study is likely to be required where drains that alter groundwater levels (e.g. subsoil drains) are used within 100m of a protected wetland, or if drainage into a wetland is proposed.

4.5.2 Water flows – watercourses

In order to prevent in-stream erosion, peak flows in watercourses should not exceed pre-development conditions for the particular storm average recurrence interval (e.g. the peak flow reaching the watercourse from the catchment in a 10 year event should remain the same after development), unless it can be demonstrated that the downstream channel and floodplain has the capacity to accept higher flows to the satisfaction of the Department of Water.

Longer duration low-level flows in watercourses to maximise detention times in detention ponds consistent with advice in the Department of Water's Stormwater Management Manual for Western Australia are acceptable to enable increased water volumes to be discharged off-site.

Adequate on-site detention is required to ensure this criterion can be met.

4.6 Incorporating landscape enhancing features to improve water quality

Features that improve water quality that should be incorporated into stormwater drainage systems include:

- (a) Native vegetation - particularly reeds and rushes to promote filtering;
- (b) Boulders or riffles to improve aeration and oxygenation;
- (c) Temporary or intermittent ponds, pools or stormwater gullies designed as sediment traps (if necessary);
- (d) Drain or watercourse profiles that provide a range of fauna habitats.

4.7 Retaining and rehabilitating protected upland wetland and watercourse fringing or associated vegetation

Fringing vegetation associated with wetlands should not be removed from within buffer zones. Where significant upland vegetation is associated it should be considered for retention. The recommended size of buffers is as follows:

watercourses with permanent water or protected wetlands	50m
seasonally flowing watercourses	30m
watercourses which flow in response to specific rain events	10m

Where private ownership of land with wetlands or watercourses is maintained, lot boundaries should be aligned to minimise the number of owners with wetland/ watercourse management responsibilities. The need for public open space and foreshore reserves will continue to be guided by Western Australian Planning Commission policies and Department of Water advice.

Removal of non-native vegetation in a manner that replaces it with native vegetation and minimises potential soil erosion is encouraged, except where the non-native vegetation has identified landscape or heritage value.

Foreshore management proposals are assessed in terms of their achievement / replication of natural processes, maintenance of conservation values and integration of passive recreation.

As a minimum, watercourses should be revegetated with native vegetation for 10m either side of watercourses which flow in response to specific rain events and 15m either side of other watercourses*.

As a minimum, protected wetlands should be revegetated consistent with vegetation zones that would naturally occur in a wetland to at least 15m from the high water mark or 1m higher than the high water mark whichever is the smaller.

Batters and reserve widths are addressed under “Protection of property from flooding” above.

* The 15m is based on a study of fish and fish habitat in the Canning River and its tributaries that found a correlation between the presence of in-stream and foreshore vegetation to 15m either side of a watercourse and the number of native fish species. There are many other benefits of foreshore revegetation.

4.8 Using multiple use corridors and open drains

Existing open drains should be assessed for their potential to provide for the multiple uses of recreation, stormwater management and the restoration and maintenance of environmental values through conversion

into streamlined meandering channels, particularly where major land use change is being planned.

There should be no net loss of existing open drain habitat, based on the extent (i.e. area) of open water and wetland vegetation provided by the drain. Transfer of habitat to a multiple use corridor/streamlined meandering channel is acceptable, but timing to minimise the period when habitat is not available should be considered.

Multiple use corridor width located within POS will vary according to site characteristics, infrastructure requirements and structure plan assessments. Where practical, a minimum 50m is recommended with additional width if needed for recognising floodway characteristics and protection of foreshore vegetation.

Management plans should be prepared for multiple use corridors. Multiple use corridors should be divided into zones or priority use areas for management purposes.

4.9 Community Education

Developers of large-scale subdivisions are encouraged to distribute to new residents educational material that focuses on reducing nutrient loading to the stormwater system.

5. DEFINITIONS

“best management practice” means devices, practices or methods for removing, reducing, retarding or preventing targeted stormwater runoff constituents, pollutants and contaminants from reaching receiving waters (*Non-structural Stormwater Quality Best Management Practice, Taylor and Wong 2002*). Options for Best Management Practices are included within the *Stormwater Management Manual for Western Australia* (Department of Water 2004-2007).

“wetland buffer zones” means the area surrounding s wetland area where the vegetation is dependent on the water levels and an appropriate hydrological regime being maintained in the wetland or water course. Buffer dimensions are determined by hydrological studies on a case by case basis with reference to policy.

“fringing vegetation” means native vegetation that:

- (a) Occurs in or adjacent to; or
- (b) Is dependent for its survival upon,

a watercourse or protected wetland.

“first flush” in this policy refers to the stormwater runoff either from the first rains in autumn (i.e. March/ April). (The first flush of pollutants from the first

rains in Autumn has been identified as of significance and requiring special treatment.)

“native vegetation” means any locally indigenous plant species or community of plants.

“open drain habitat” means that part of the drain that is permanently or seasonally inundated or vegetated with aquatic vegetation. Its area can be determined (in square metres) from the extent of inundation or aquatic vegetation (local and introduced). Open drain habitat usually provides habitat for aquatic fauna such as water beetles and frogs. In some instances and particularly in rural areas, open drain habitat occurs along roads, but it is generally confined to trunk drainage.

“riffles” are shallow parts of a stream where water flows brokenly, so that it is aerated. Pebbles, rocks and logs can be placed in fast flowing zones to create riffles.

“sub-catchment” means a sub-catchment shown on Figure 2 of the Upper Canning Southern Wungong Catchment Management Plan or water management strategy adopted by the Department of Water and attached to this policy.

“streamlined meandering channel” means a route for the passage of drainage water that incorporates multiple detention areas to achieve detention criteria, has meanders designed on river restoration principles (e.g. as described in *Managing Our Rivers* by Dr Luke J Pen), and is revegetated with local native vegetation including rushes and sedges and trees to shade the water.

“protected wetland” means a wetland protected under the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 or any wetland mapped as a Conservation Category wetland by the Department of Environment and Conservation. *However*, where a proponent disputes the wetland category, it may be re-assessed in accordance with the Department of Environment and Conservation’s protocol, which includes submission of the reassessment to the Commission for determination.

“upland vegetation” means native vegetation which occurs above the floodplain or watercourse and is dependant on rainfall for survival.

“watercourse” means —

- (a) any river, creek, stream or brook, whether improved or altered or not;
- (b) any conduit that wholly or partially diverts a river, creek, stream or brook from its natural course and forms part of that river, creek, stream or brook; or
- (c) any natural collection of water into, through, or out of which any thing referred to in paragraph (a) or (b) flows, whether artificially improved or altered or not,

*in which water flows or is contained whether permanently,
intermittently or occasionally.*

6. APPLICATION TO PROPOSALS

The following checklist provides a general guide and highlights policy application to proposals. It is premised on a planning process that requires a structure plan or subdivision guide plan ahead of subdivision and development. A grey shaded box indicates that the principle should apply in the design processes.

Section	Policy Application	Structure Plan	Subdivision	Development Application
4.1	Drainage design based on sub-catchments			
4.2	Treatment train approach from top of catchment			
	Stormwater management components follow natural contours			
	Detention <i>capacity able</i> to retain first flush			
	Detention <i>capacity</i> meets appropriate hydrologic and detention time criteria			
	Car park runoff to landscaped detention swales			
	Sediment less than 100 microns trapped			
4.3	Floor levels > 300mm above 1:100 year flood			
	Waterway batter slopes maximum 1:6			
	Waterway reserve adequate width			
	MGL calculation meets WRC requirements			
	Drainage at or above MGL <u>and</u> soil surface >1.2m above MGL			
4.4	Hydrological study undertaken for protected wetlands			
	Post-development flows approximate pre-development flows through adequate detention			
4.5	Natural features incorporated into stormwater design (e.g. native vegetation, riffles & pools).			
	Easily maintained sediment traps included			
4.6	Existing fringing vegetation protected			
	Fringing vegetation rehabilitated (10 or 15m)			
	Passive recreation catered for along foreshores			
4.7	No net loss of existing open drain habitat			
	Potential for Multiple Use Corridors evaluated			
	Multiple Use Corridors zoned			
	Retention of wetland and watercourse fringing vegetation and significant upland vegetation.			
4.8	Educational materials on reducing nutrient inputs to stormwater systems distributed to new residents (larger subdivisions only)			

D106/6/03 Development Services Committee 9 June 2003 - Adopted by Council 16 June 2003
D160/9/04 Development Services Committee 13 Sept 2004 - Adopted by Council 20 Sept 2004
D25/4/13 Development Services Committee 15 April 2013 - Adopted by Council 22 April 2013