

# Stormwater Design Guidelines for Infill Small Subdivision and Property Development

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## 1. Introduction

This guide is intended to be used by developers, builders and consulting engineers to produce consistent designs for Stormwater Management Systems for residential, commercial, and industrial developments within the City of Kalamunda.

The objectives are:

1. The increased runoff generated from impervious areas does not adversely impact downstream properties, including storm events up to the one percent annual exceedance probability (1% AEP).
2. The water volumes, flow rates, time of concentration, and water quality support the functions of the greater catchment.

The 1% AEP is also referred to as the one-hundred-year Average Rainfall Incidence (1 in 100 ARI).

This guideline should be read in conjunction with the following documents:

- Department of Water: *Stormwater Management Manual* (2004)
- Department of Water: *Better Urban Water Management* (2008)
- Department of Water: *Water Sensitive Urban Design* (2011)
- Australian Rainfall and Runoff: *A Guide to Flood Estimation*
- IPWEA and WAPC: *Local Government Guidelines for Subdivisional Development*

## 2. Making Submissions

No works are to commence that involve changing the groundwater or public stormwater system without written approval from the City of Kalamunda.

A detailed design of the Stormwater Management System shall be submitted in the following situations:

- To comply with conditions of approval for a subdivision application,
- To comply with conditions of approval for a development application,
- When required for complex or unusual building applications,
- When any change to or where connection will be made to the public stormwater system, and
- When there is any change in overland flow or groundwater flow into or from a public area.

The System shall be designed by a suitably qualified Civil Engineer.

The Stormwater Management System consists of the information outlined in **Appendix A**.

Submissions are to be sent to the Enquiries details below (refer to section 10 below), attention to "Development Engineering".

An assessment fee in line with the City's adopted Fees and Charges may apply depending on the nature of the submission.

These guidelines may change from time to time and it is recommended that you refer to the City of Kalamunda website [www.kalamunda.wa.gov.au](http://www.kalamunda.wa.gov.au) to ensure that you have the current version.

### **3. Stormwater Management Strategies**

Where a Stormwater Management Strategy or UWMP has been prepared and approved by the City for the area, the Stormwater Management System must incorporate the recommendations and requirements of the Strategy and UWMP.

### **4. Geotechnical Investigation**

A geotechnical investigation is required to determine the drainage method, being either Onsite Retention (OSR) or Onsite Detention (OSD).

Geotechnical investigations shall be carried out in accordance with AS 1726:2017 Geotechnical Site Investigations.

The requirements are:

- The maximum allowable infiltration rate is 5m/day at base level of proposed soakwell or at least 1 m depth.
- The minimum infiltration rate shall not be less than 1.0m/day at base level of proposed soakwell or at least 1 m depth for retention strategy.
- A clearance of 500mm from maximum groundwater table (MGL) or 300mm for average annual maximum groundwater table (AAMGL) with subsoil pipe to the invert level is required to allow for infiltration.
- If the site classification report is 'A' class a full geotechnical report is not required.
- If the site classification is below 'A' class a full geotechnical report with drainage recommendation is required.
- A geotechnical report may not be required for hilly regions which commonly have shallow sand layers with gravelly/laterite substrates, and where OSD is the common drainage strategy.
- The determination of saturated infiltration rate should be carried out at the invert level of soakwells in accordance with the procedures outlined in AS/NZS 1547:2012 Onsite Domestic Wastewater Management.

## 5. Onsite Retention System (OSR)

OSR is usually used in sandy areas of the foothills including Forrestfield, High Wycombe, and Wattle Grove.

Following geotechnical investigation, if the site is suitable for an Onsite Retention System, then the OSR shall be designed as follows:

### OSR for Residential Development

- Retention devices are to be sized for 5% AEP (1 in 20 ARI), critical stormwater duration, if lot levels are above the road level.
- Retention devices are to be sized for 1% AEP (1 in 100 ARI), critical stormwater duration, if lot levels are below the road level.
- If the lot size is less than 350m<sup>2</sup>, a discharge rate of 20% AEP (1 in 5 ARI) predevelopment flow rate is allowed to connect to the City's drainage system. This is to be achieved by using a bubble-up pit or similar infrastructure located at the property boundary and typically discharged via the vehicle crossover or hardstand.
- A combination of below and above ground storage can be considered for battle axe or common access driveways. Underground retention is to be sized for a minimum of 5% AEP (1 in 20 ARI) events. The maximum inundation depth for above ground storage is 50mm.
- If the development is land-locked, the minimum pad level is to be set at 150mm above the lowest lid point of the inlet pit.
- All storage devices are to be connected at or near the top of the device.
- Developers are encouraged to introduce water quality improvement devices such as rainwater gardens, vegetated swales and biofiltration. Please visit <https://www.newwaterways.org.au> for more information.

### OSR for Commercial/Industrial Development

- Retention devices are to be sized for 1% AEP (1 in 100), critical stormwater duration.
- A combination of below and above ground storage can be considered for carpark areas. Underground retention is to be sized for a minimum of 5% AEP (1 in 20 ARI) events. The maximum inundation depth for above ground storage is 50mm.
- All storage devices are to be connected at or near the top of the device.
- Developers are encouraged to introduce water quality improvement devices such as rainwater gardens, vegetated swales and biofiltration to treat 1 year AEP (1 in 1 ARI). Please visit [www.water.wa.gov.au](http://www.water.wa.gov.au) for more information.

## 6. Onsite Detention System (OSD)

Following the geotechnical investigation, if the site soil is not suitable for Onsite Retention, then an Onsite Detention system (OSD) will need to be installed. OSD provides temporary storage of stormwater runoff from developments and restricts the discharge from the site to a rate that the City's drainage system is capable of accepting.

The OSD shall be designed as follows:

### OSD for Residential Development

- Detention devices are to be sized for 5% AEP (1 in 20 ARI), critical stormwater duration, if the lot levels are above the road level. A discharge rate of no more than 20% AEP (1 in 5 ARI) predevelopment flow rate may be connected with the City's drainage system, with the flow rate controlled by an orifice.
- Detention devices are to be sized for 1% AEP (1 in 100 ARI), critical stormwater duration, if the lot levels are below the road level with permissible site discharge (PSD) connected at a legal point of discharge.
- A combination of below and above ground storage can be considered for battle axe or common access driveways. Underground devices are to be sized for a minimum 5% AEP (1 in 20 ARI) events, and the maximum inundation depth for above ground storage is 50mm.
- All storage devices are to be connected at or near the base of the device.
- If the development is land locked, the minimum pad level is to be set at 150mm above the lowest lid level of the inlet pit.

### OSD for Commercial/Industrial Development

- Detention devices are to be sized for 1% AEP (1 in 100 ARI), critical stormwater duration with permissible site discharge (PSD) connected at a legal point of discharge controlled by an orifice.
- A combination of below and above ground storage can be considered for carpark areas. Underground detention is to be sized for a minimum of 5% AEP (1 in 20 ARI) events. The maximum inundation depth for above ground storage is 50mm.
- All storage devices are to be connected at or near the base of the device.
- Developers are encouraged to introduce water quality improvement devices such as rainwater gardens, vegetated swales and biofiltration to treat 1 year AEP events (1 in 1 ARI). Please visit [www.water.wa.gov.au](http://www.water.wa.gov.au) for more information.

## **7. Permissible Site Discharge (PSD) and Time of Concentration (TC)**

The Permissible Site Discharge (PSD) is calculated using a predevelopment runoff coefficient of 0.15-0.35 depending on conditions of predevelopment land (vegetations, slope, type of soil etc.) for 20% AEP (1 in 5 ARI) with minimum time of concentration of 5 minutes. During calculation of storage, need to consider critical storm duration (not time of concentration) to determine PSD.

## **8. Legal Point of Discharge (LPD)**

The legal point of discharge (LDP) is a point agreed by the City where stormwater from a property can be discharged. This point is usually Council's stormwater drainage system. Water courses shall only be used following acceptance by the relevant authority (the Water Corporation, Department of Water or City of Kalamunda).

In some situations, adjacent property owners may also need to be contacted to confirm the discharge point.

Where required to create the legal point of discharge, the City may consider extending its drainage system at the developer's cost and to the specification and satisfaction of the City of Kalamunda.

A drainage easement may be required to be created where it is necessary to convey stormwater across lands, other than the development site, to gain access to the public drainage system or a natural watercourse.

Note: All drainage easements and drainage systems located within private property will be solely owned and maintained by the Landowner/s up to the LPD

### **Requirements for Discharging To LPD**

- The requirements for connecting a lot connection with the LPD are as follows:
- The applicant provides an approval letter from the relevant authority for the proposed Legal Point of Discharge (for example the Water Corporation or Department of Water).
- If there is a drainage pipe in front of the property with no connection pit, a new pit will be installed by the applicant, at the most perpendicular alignment to the property discharge pipe.
- Where specified by the City, gross pollutant traps, oil-water separators, and silt traps shall be installed in the drainage system prior to discharging into the public drainage system (including drainage basins or creeks).

## Pump System

A pump system may be permitted when all of the following conditions are met:

- The lot level of the development site is lower than the receiving drainage system,
- There is no legal point of discharge though a drainage easement, and
- The pump discharge rate does not exceed the permissible site discharge into the Legal Point of Discharge.

When possible, the pump line shall terminate within the property at an allocated discharge pit, with gravity discharge to the City's drainage system.

Pump systems shall be designed in accordance with AS3500.3:2015 Plumbing and Drainage Stormwater Drainage with separate pipe to prevent backflow.

## 9. Drainage in the Road Reserve

Road drainage network shall be designed for

- 20% AEP for residential areas
- 10% AEP for industrial areas and distributor A and B Roads

This standard has been in place since approximately 2007 therefor older road networks do not meet these criteria

## 10. Work in the Road Reserve of Public Area

Work in the road reserve may require a Traffic Management Plan (TMP). This will be advised during the assessment of the Stormwater Management System.

When required, a Traffic Management Plan shall be prepared by an individual accredited in Advanced Worksite Traffic Management, and submitted for review by the City, before the work commences on site. Note that the assessment of plans may require a minimum of two weeks.

**Any work in the road reserve or public area may require an asset protection bond.**

The requirements are (in brief):

1. The applicant will need to pay for the bond and administration fee.
2. Works are not to commence until the bond has been processed.
3. Once the applicant receives the bond receipt from the City, and has received approval for the Stormwater Management System and TMP (if applicable), then the applicant may proceed with the works.

4. All local government infrastructure is to be reinstated in accordance with the "Restoration and Reinstatement Specifications" published by the Institute of Public Works Engineering Australasia (IPWEA)
5. Once the work is completed, the applicant needs to submit a refund request form for the asset protection bond. If the work is completed in full and no rectification is needed after an inspection has been undertaken by the City, then the bond will be released in line with the City's adopted Fees and Charges.

## 11. Enquiries

Enquiries may be directed to the Asset Services team by calling the City on 9257 9999 or emailing [enquiries@kalamunda.wa.gov.au](mailto:enquiries@kalamunda.wa.gov.au).

## 12. References

- Western Australian Planning Commission, 2006, State Planning Policy 2.9 Water Resources. Available at [https://www.dplh.wa.gov.au/getmedia/c7b9a4d5-160b-45e1-8e3e-0de8dd6a11f1/SPP\\_2-9\\_water\\_resources](https://www.dplh.wa.gov.au/getmedia/c7b9a4d5-160b-45e1-8e3e-0de8dd6a11f1/SPP_2-9_water_resources)
- Department of Water and Environmental Regulation, 2004, Stormwater Management Manual for WA. Available at <http://www.water.wa.gov.au/urban-water/urban-development/stormwater/stormwater-management-manual>
- Institution of Engineers, Australia, 1987, Australian Rainfall and Runoff (ARR87).
- Institute of Public Works Engineering Australasia (IPWEA), 2017, Local Government Guidelines for Subdivisional Development. Available at <https://www.dplh.wa.gov.au/getmedia/4b5222bc-b5e4-45b8-a6aa-33effd8b47f3/GD-SDV-Local-government-subdivisional-guidelines>

## 13. Glossary

**Annual Exceedance Probability (AEP)** - Annual Exceedance Probability (AEP) refers to the probability of a flood event occurring in any year. The probability is expressed as a percentage. For example, a large flood which may be calculated to have a 1% chance to occur in any one year, is described as 1%AEP

**An annual recurrence (ARI)** - An annual recurrence interval is sometimes also known as 'return period'. It is the average number of years that it is predicted will pass before an event of a given magnitude occurs. For example, a 50-year ARI event would on average happen every 50 years.

**Legal point of Discharge (LPD)** - A legal point of discharge is the point that stormwater from any building or development on your property is directed to. This is usually: an



underground Council drain either within the property's easement or within the street, the kerb and channel, or. an open earth drain next to the property.

**Onsite Detention System (OSD)** - on-site stormwater detention is a means of detaining the stormwater for a short period of time within the site, before the stormwater is discharged in a controlled manner.

**Onsite Retention System (OSR)** - on-site stormwater detention is a means of detaining the stormwater permanently within the site, with no discharge for the design rainfall events. Typically this assumes the system provides either a permeable surface where the stormwater infiltrates into the ground, or a permanent water body.

**Permissible Site Discharge (PSD)** - The 'Permissible Site Discharge'(PSD), which is a maximum flow rate, will normally be set by your Council based on the block area. The flow rate is usually controlled by making all the flow pass through an Orifice (a small diameter hole) before it can be discharged.

**Time of Concentration (Tc)** - The Tc is generally defined as the time required for a drop of water to travel from the most hydrologically remote point in the sub catchment to the point of collection.

## Appendix A: Stormwater Drainage Details for an Individual Lot

Modifications to site stormwater management or new stormwater proposals are to be completed in accordance with the City's Stormwater Design Guidelines for Subdivisional and Property Development, the conditions of development or building approval, and the City's requirements.

When submitting stormwater plans, designs, or proposals for an individual lot the following details need to be completed. Applicants are encouraged to seek the services of a civil engineer to ensure the values are correctly entered.

	Parameters	Units	Requirement
<b>A</b>	<b>CORE DETAILS</b>		
A01	Geotechnical report		If the site classification is below 'A' class a full geotechnical report with drainage recommendation is required. A geotechnical report may not be required for hilly regions where onsite detention device is proposed. For "S" Class site infiltration test result is necessary to support retention strategy through soakwells.
A02	Site levels		Site levels including spot levels of adjacent properties. Where the level difference between the subdivided lot and a neighbouring lot is greater than 200mm, a retaining wall will be required.
A03	Sand pad level		Sand pad level of lots to achieve the minimum site class "S"
A04	Total Catchment Area	m <sup>2</sup>	Include a plan showing the area
A05	Total Impervious Area (TIA)	m <sup>2</sup>	To be used for rational method
A06	Effective Impervious area (EIA)	m <sup>2</sup>	EIA=70-80% of Directly Connected Impervious Area (DCIA) and for small subcatchment, it can trend upto 100% of TIA. EIA is approximately 60% of TIA. To be used for modelling.
A07	Roof Area	m <sup>2</sup>	

A08	Other paved area	m <sup>2</sup>	
A09	Pervious Area	m <sup>2</sup>	
A10	Permeability/Infiltration Rate	m/d	If permeability test is done more than one BH/point. Result of all the points need to submit. Infiltration rate shall be not less than 1m/d at the base level of soakwells if retention strategy is proposed with soakwells
A11	Ground Water Table (GWT) depth	m	Confirm any perched ground water exits. GW depth both from surface and from sea level (AHD) are required.
A12	Lot Floor Finished Level (FFL) to Road Level	mm	Higher / Lower?
A13	Overland flow length if applicable	m	
A14	Slope of overland flow if applicable	%	
A15	Time of Concentration for pre-development flow ( $T_c$ PRE)	min	Min 5 min. Friend's equation (preferred)/ Kinematic wave equation can be used for overland sheet flow time. 15 years back pre-existing condition to be considered. $T_c$ for post development will differ and need to be determined combinedly (PA& IA) including partial area effect if applicable.
A16	Predevelopment runoff coefficient ( $C_{PRE}$ value)		$C=0.15$ for minor storm (1 in 5/10/20 years) $C=0.18$ for major storm (1 in 50/100 years) $C$ -value for post development will differ and needs to be determined.
A17	Critical Time of Duration	min	Check 6 min to 72 hrs and /ARR2019
A18	Pre-development discharge ( $Q_{PRE}$ ) OR Permissible Site Discharge (PSD)	m <sup>3</sup> /s	1 in 5 ARI (20% AEP) rainfall intensity ( $I$ -value in mm/hr) with above $C_{PRE}$ value and $T_c$ PRE

B	STORAGE DETAILS		
B01	Required Storage Capacity	m <sup>3</sup>	
B02	Proposed Storage Capacity	m <sup>3</sup>	
B03	Type of storage with reasoning:		

C	DISCHARGE DETAILS
C01	Does the applicant need to connect the drainage to the legal point of discharge?
	Yes, Permission needed / Yes, Permission received / No
C02	If the proposal is to connect to the City's drainage system, describe the connection method
C03	If the proposal is for point discharge other than to the City's drainage system, describe the receiving infrastructure and erosion protection.
C04	If the proposal is for distributed discharge, describe the receiving environment and erosion protection.
D	SUPPORTING INFORMATION
D01	Is the design consistent with an Urban Water Management Plan (UWMP), Stormwater Management Strategy, or Development Application (DA)? If so, provide the report title and date.
	Yes, based on UWMP / Stormwater Strategy / DA / No

D02	Geotechnical Report attached with permeability rate, GWT info and suggestion of storm water drainage
	Yes / To be provided
D03	Report submitted that includes assumptions considered during design, description of the modelling method, manual calculation method, and provide.
D04	Copies of calculations submitted
D05	Catchment plan submitted

G	DRAINAGE PLAN The drainage plan includes:	Tick or "Yes", Cross or "No"
G01	Drainage design, plan, and long section	
G02	Invert levels of upstream and downstream pipes, and surface contour levels	
G03	All existing drainage infrastructures and proposed structures on the site including enclosed drainage, open drains, stormwater gullies, field inlets, headwalls, culverts, swales, outlets, inter-allotment roof water drainage, kerb and channel, detention basins, bio-retention basins etc. if related or connected/applicable with this plan.	
G04	The first flush treatment device if applicable	
G05	Arrows showing the flow direction and location of surface water runoff on the site including disposal path and outlet with contour	
G06	The system that will be used to convey runoff away from structures and any impervious surfaces on the site	
G07	Public drainage infrastructure if related/applicable	
G08	Utility services and underground assets if affected	
G09	Pavement ponding area if applicable	
G10	The location of easement with beneficiary to whom, if applicable	
G11	The location for access during construction	

Please submit the completed form with attachments to [enquiries@kalamunda.wa.gov.au](mailto:enquiries@kalamunda.wa.gov.au). Enquiries regarding the form can be directed to the City of Kalamunda Asset Planning team.