



## DS5 – Stormwater

### Contents

DS5	Stormwater .....	3
5.1	Design Requirements and Standards.....	3
5.1.1	Design Methodology .....	3
5.1.2	Primary and Secondary Flowpaths .....	3
5.1.3	Freeboard .....	4
5.1.4	Rainfall Intensity.....	5
5.1.5	Stormwater Consents .....	5
5.1.6	High Levels of Groundwater .....	5
5.2	Primary System .....	5
5.2.1	Minimum Requirements - Pipe System.....	5
5.2.2	Reticulation Layout .....	6
5.2.3	Pipe Locations .....	6
5.2.4	Manhole Locations.....	7
5.2.5	Pipe Joints .....	7
5.2.6	Special Design Requirements.....	7
5.2.7	Open Water Courses .....	8
5.2.8	Swales & Rain Gardens.....	9
5.3	Secondary Drainage System.....	9
5.3.1	Secondary System of Overland Flowpath.....	9
5.4	Service Connections.....	10
5.4.1	Domestic Connection Destinations .....	10
5.4.2	Commercial and Industrial Connections .....	12
5.5	Structures and Manholes.....	12
5.5.1	Inlet and Outlet Structures .....	12
5.5.2	Road Sumps, Bridges and Culverts .....	12
5.5.3	Maintenance Structures .....	12
5.5.4	Roadside Swales .....	13
5.6	Stormwater Detention / Treatment Ponds .....	13
5.6.1	Stormwater ponds.....	13
5.6.2	Dry Ponds .....	13
5.6.3	Stormwater Discharge Consent .....	14
5.6.4	Specific design matters to consider in relation to ponds .....	14
5.6.5	Pollutants and contamination issues.....	14
5.7	Sustainable Low Impact Disposal.....	15
5.7.1	Alternative and innovative stormwater disposal designs.....	15
5.8	Rain Gardens .....	15
5.9	Rural 1,2 and 3.....	15
5.9.1	Discharge Consents.....	15
5.9.2	Mitigation of Effects.....	15
5.9.3	Easements in Gross.....	16



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5.10	Creation of Stormwater Easement in Gross .....	16
5.11	Fencing.....	16
5.12	Disposal of Stormwater by Ground Soakage.....	16
5.12.1	General .....	16
5.12.2	Considerations for Design.....	17
5.12.3	Further Design Requirements.....	17
	Rainfall Intensity Charts .....	19



## **DS5 Stormwater**

### **5.1 Design Requirements and Standards**

#### **5.1.1 Design Methodology**

Unless otherwise approved the design of the stormwater system shall be in accordance with one or more of the current versions of the following publications:

- i. The IPENZ Procedure for Hydrological Design of Urban Stormwater Systems, December 1980
- ii. The Building Industry Authority's (E1 Surface Water),
- iii. TP10 (Stormwater Management Devices; Design Guidelines Manual)
- iv. TP124 (Low Impact Design Manual),
- v. An approved catchment/stormwater computer modelling system.

**Note:** For v. above the Council's Stormwater Engineer can confirm an acceptable modelling system on request.

#### **Selection of a Primary SW System**

The type of primary system installed will be dependent on factors such as quantity, quality, aquatic resource protection, topography, soil type, location and space constraints.

The design requirements specified in this document and the documents referred to above will provide the design elements required for each of the options.

Assistance with determining primary system type can be found in chapter 4 of Auckland Regional Council's Technical Publication number 10.

Alternative options may be considered via written application to Council. Each situation will be assessed on a case by case basis but will need to provide the minimum stormwater control standards stipulated in this document.

#### **5.1.2 Primary and Secondary Flowpaths**

The primary flowpath for stormwater shall be designed to cope with the runoff from the design storm including allowance for domestic connections as outlined in section 5.5.

The stormwater system may include:

- i. pipe systems
- ii. lined open channels
- iii. swale drains



- iv. open channels, or
- v. alternative solution

The secondary flowpath is the route taken by stormwater when the primary path is unable to cope either because of blockages or because the hydraulic capacity of the primary path is exceeded by a larger than design storm.

In designing the stormwater system, both the primary and secondary flowpath shall be identified to ensure the stormwater management system provides a minimum standard of flood protection according to the following criteria:

- a. **5 year return period flood (20% AEP)** The minimum design standard for any primary piped stormwater system in the Western Bay of Plenty District.
- b. **10 year return period flood (10% AEP)** The minimum design standard for stormwater systems to protect important recreation fields, and streets without alternative access.
- c. **50 year return period flood (2% AEP)** For design of primary and secondary stormwater systems to protect urban, commercial and industrial areas.
- d. **100 year return period flood (1% AEP)** For design of primary and secondary stormwater systems to protect major communal facilities related to supply of electricity, gas telecommunications water supply and wastewater facilities and bridges.

The secondary flowpaths shall be clearly defined on the engineering drawings, and as built drawings, see also Section 5.4.

All overland secondary flowpaths over urban private property shall be covered by an easement in favour of Council and a transfer document shall be created in accordance with Council's approved format.

### 5.1.3 Freeboard

Freeboard above design flood level shall be provided as shown.

Type of Structure	Freeboard to 50 year Flood Level
Non-habitable residential buildings, garage floors etc	200 mm
Commercial and industrial floors	300 mm
Habitable dwelling floors	500 mm
Major communal facilities related to supply of electricity, telecommunications and water supply and wastewater disposal systems and bridges	500 mm



### 5.1.4 Rainfall Intensity

Designers should use the rainfall tables in the drawings attached to this design standard. These tables have been created using the rainfall intensity values from the NIWA Software package HIRDS V1.5b and have been adjusted to allow for climate change to the year 2040 as documented in the Ministry for the Environment – Climate Change Effects and Impacts Assessment publication 2008 and any revised editions.

**Note:** It should be noted that several of the large streams which flow through the region may have their headwaters remote from the site of the development. For the design of drainage elements in these areas, care needs to be taken to utilise appropriate rainfall intensities.

### 5.1.5 Stormwater Consents

In addition to other requirements relating to permanent discharges of stormwater to a natural watercourse or the sea and onto land, the consent holder shall be responsible for obtaining any consent(s) relating to the construction or ongoing operation of the development.

The Developer is responsible for obtaining all necessary consents for the discharge of stormwater. These include, but may not be limited to, Regional Council consents for the discharge, both during and after construction, and the permissions from landowners where additional stormwater is being discharged to their properties as a result of development. The developer must note that their consents may be required even when the development activity is a permitted activity under the WBOPDC District Plan.

The Developer must consult with NZTA where there is the potential for additional stormwater to be discharged to land administered by NZTA, or designated by NZTA under the RMA 1991, as a result of the development. Where it is confirmed that additional discharges of stormwater will enter land administered by NZTA, or designated by NZTA under the RMA 1991, as result of the development, the Developer must obtain the written approval of NZTA.

### 5.1.6 High Levels of Groundwater

In areas of high or potentially high groundwater, designers shall provide a method for allowing excess groundwater into the stormwater system in a controlled manner. Such a solution may incorporate perforated inlet pipes together with drainage rock and geotextile.

## 5.2 Primary System

### 5.2.1 Minimum Requirements - Pipe System

The primary piped system is to be designed to the following minimum requirements:



- i. The minimum pipe size other than for connections shall be 225mm diameter.
- ii. The piped system shall be designed to cater for the design flow, without surcharge.
- iii. A minimum flow velocity of 0.7 m/s for pipes flowing full is to be provided.

In any pipeline where a pipe-full velocity is less than 1.3 m/s measures shall be taken to provide for silt collection. This shall typically take the form of unbenched manholes with a sump below the lowest invert level. The extra depth required is half the diameter of the outlet pipe or as otherwise approved. This sump allows silt to be trapped and removed by simple suction methods.

- iv. Manholes are required at each change of grade or direction, and the upper end of all primary, piped stormwater reticulation.

Manhole spacings shall not exceed 100m for pipe lines up to 900mm diameter. Greater spacings may be approved for larger diameter pipes.

Each branch line (excluding connections) shall join the main line at a manhole junction, except that:

- 225mm diameter pipes may be saddled into 600mm diameter pipes or larger with specific engineering approval from Council
  - Branch lines 300 mm diameter may be saddled onto pipes 1200mm diameter or larger with specific engineering approval from Council
- v. Alternatives to the primary piped system such as swales and other design systems will be considered on a case by case basis.

## 5.2.2 Reticulation Layout

The layout of the primary reticulation system is to follow the street pattern. Where it is demonstrated that a pipe cover of 900mm is unable to be achieved, then an alternate route will be considered. Lesser cover may be adopted in accordance with the manufacturer's specification and sound engineering design to be approved by the Authorised Officer

## 5.2.3 Pipe Locations

Reticulation pipelines shall be sited, on the low side of any proposed sites that have a cross-fall of more than 1.5m.

Where pipelines are located within private lots they shall be run parallel to and within 1.5 metres of the lot boundaries. They should where possible be located such that the available building area is not reduced, i.e. laid within side, front or rear yards with a minimum cover of 600mm.



### 5.2.4 Manhole Locations

Manholes shall be located within Council property or road reserves, and clear of road carriageway where possible.

The entire manhole structure shall be located clear of all boundaries and shall be unobstructed and easily accessible.

### 5.2.5 Pipe Joints

All pipelines shall be fully sealed by use of rubber joint rings or welding as appropriate unless approved by Council.

### 5.2.6 Special Design Requirements

All pipelines shall be designed to withstand all the likely loads that they will be subject to during the life of the system. AS/NZS3725 "Loads on Buried Concrete Pipes" and AS2566 "Plastic Pipeline Design" shall be used as design guides as applicable.

Where minimum cover as outlined in Section 5.3.2 cannot be achieved, specific design of pipe and cover is required to achieve manufacturer's requirements. Concrete capping will be designed on a site-by-site basis taking into account both pipe protection and roading integrity requirements.

#### Construction Loads

All pipelines shall be designed to withstand the loads that that pipeline will experience during construction of the pipeline and other development works.

These loads as a minimum include any loads relating to backfill techniques, construction traffic, and temporary storage of materials.

#### Steep Grades

Scour blocks and trench stop configuration shall be detailed on the design drawings and shall be designed in accordance with the drawings provided in the Construction specification. Spacing of scour blocks shall be in accordance with the following table:

Grade %	Requirement	Spacing (S) (m)
15 – 35	Concrete bulkhead	$S = 100/\text{Grade } (\%)$
>35	Special design	Refer to Council
<b>NOTE:</b> On flat grades where scour is a problem, sand bags are often used to stabilize the trench backfill. Where the natural transfer of water from the trench into the surrounding ground will not provide sufficient drainage, trench drainage shall be provided to divert the water.		



## 5.2.7 Open Water Courses

Where natural open stream systems or artificially formed channels are to be incorporated in the stormwater drainage system, they shall be located within a drainage reserve of sufficient width to contain the full design flood flow together with a freeboard of appropriate engineering design

- i. The flow characteristics of natural open stream systems shall be based on the likely long term stream condition in terms of density of vegetation and take due account of the possibility of blockage under peak flood conditions.
- ii. Where natural open stream areas form part of the stormwater drainage system they shall be cleared of all unsuitable plant growth and replanted to an appropriately approved landscape design. These works shall include protection of the low flow channel against scour and erosion of the stream bed where necessary. Access from public carriageways shall be provided for maintenance purposes.
- iii. The natural flow conditions of the stream should not be changed by the discharge of stormwater resulting from development or a new discharge to the stream. Flow rate characteristics of the stream should be maintained to avoid erosion of the stream embankments. Catchment or detention factors that may lead to an increase in the temperature of the stormwater (e.g. large sealed areas) also need to be considered

### Access

Such reserves shall have maximum batters of 1 in 6 and when access for maintenance is required, shall include:

- An all weather surface
- 4m wide berm able to be accessed by a 8.2t axle weight vehicle for its entire length
- Drawings of the proposed access shall be submitted to Council for approval prior to commencing construction of the access

### Drainage Reserves

To encourage the best use of the Drainage reserves the drainage reserves shall be linked with other reserves and open spaces such as school sites, to accommodate off road pedestrian and cycle access. Access points for public use and maintenance shall be provided at regular intervals along the system together with footpath and pedestrian bridges, as may be defined in the resource consent.

### Unsuitable Plant Growth

Where natural open stream areas form part of the stormwater drainage system they shall be cleared of all unsuitable plant growth and replanted to a landscape design approved by Council.





### **Protection of Low Flow Channel**

These works shall include protection of the low flow channel against scour and erosion of the stream bed where necessary. Access shall be provided for maintenance purposes.

## **5.2.8 Swales & Rain Gardens**

### **Swales**

In some cases, swales can be used to provide an alternative to a piped system. The following criteria shall be used in the design of these systems:

- Longitudinal Slope 1 – 5%
- 100mm maximum water depth above vegetation
- 2m maximum bottom width
- 30m minimum length
- 3:1 maximum side slope
- In conjunction with reticulated drainage.

Further design information can be found in Auckland Regional Council's Technical Publication 10.

### **Rain Gardens**

The minimum requirements for a rain garden are:

- An under drain must be used
- Minimum 50mm gravel cover over the under drain
- Must include a ponding area
- Filter Fabric must be used on at least the side walls (open weave in stable soils and impervious in unstable soils).

Further design information can be found in Auckland Regional Council's Technical Publication 10.

## **5.3 Secondary Drainage System**

### **5.3.1 Secondary System of Overland Flowpath**

A secondary system of overland flowpath is to be designed to safely convey excess stormwater to maintain the freeboards as specified in 5.1.3 above without undue nuisance. Acceptable solutions include:

- Temporary ponding on local and collector roads.
- Temporary flow along local and collector roads.
- Where roads are designed as part of a secondary flow path, adequate access and egress shall be provided to affected properties. Light vehicles shall be able to pass along the road in a 50 year ARI event, and large 4WD in a 100 year ARI event.



- Flow across private property. Flow must be in a defined channel or swale, clear of existing or future building sites and protected by an easement in favour of Council and a Consent Notice which prohibits ground reshaping and the erection of any barriers to the secondary flows.
- Fencing shall not be permitted across overland flowpaths unless it is approved by Council.

Piped secondary systems are discouraged due to the risk of blockages. These may only be used where no other option exists and are subject to approval of the Authorising Officer

## 5.4 Service Connections

### 5.4.1 Domestic Connection Destinations

Each service connection shall connect to one of the following points of discharge.

1. A piped system
2. An open drain
3. A road or bubble up sump
4. A public roadside kerb and channel connection
5. A specifically designed soakage mechanism

#### 1. Piped System

- a. To provide a point of connection to each allotment a minimum 100mm diameter line shall be extended from the main reticulation system to terminate at a minimum distance of 1.0m within each site, whether created by cross-lease, unit title or fee-simple subdivision. In all cases service connections shall serve as much of the site as practically possible, but at least the full extent of the proposed building platform and access, parking and manoeuvring areas.
- b. Service connections shall be brought to within 1.2m of the final ground surface level.
- c. All service connections to the site boundary shall form part of the public system.
- d. Minimum pipe sizes are 225mm diameter for reticulation/laterals and a minimum 100mm diameter for connections. In addition the following shall apply:
  - Where practicable and where connection is to be within 5m of the manhole the connection shall be to the manhole.
  - Where the main pipeline is within 5m of the property boundary a separate connection shall be provided to each allotment where practicable.
- e. The following connections can be connected directly to the stormwater main.
  - 150mm diameter connection can connect to 150mm diameter line or greater.
  - 225mm diameter connection can connect to 600mm diameter line or greater.



- 300mm diameter connection can connect to 1200mm line or greater.

Any combinations outside the above shall connect via a manhole.

f. For infill (subdivision 3 lots or less, including the parent lot)

- Infill subdivisions are to be reticulated on a site-by-site basis.
- For minor infill subdivision type works all private drainage works are to be constructed in accordance with the Building Code regulations.
- For major land use development where significant reticulation works are being constructed: all works shall be designed and constructed in accordance with the Development Code requirements.

**2. An Open Drain**

- Permitted, but only where an existing open public drains is available and access to a piped system is not available. This method may require a resource consent from Environment Bay of Plenty.

**3. Road or Bubble-up Sumps**

- A connection to a road sump or construction of a bubble up sump requires the written approval of the Authorising Officer.
- Drains reticulating groundwater seepage shall be connected to road sumps.

**4. A Public Roadside Kerb or Channel**

- Kerb connections can only occur to vertical kerb and channel (see Drawings). A connection to a road sump may be approved by the Authorising Officer.

**5. Soakage Systems**

- i. Disposal of stormwater by ground soakage or ground water recharge is suitable in some areas of the Western Bay of Plenty District area. In these areas ground soakage is generally permitted where the soil and groundwater characteristics are favourable, no offsite land instability is likely and no adverse run off effects are caused where the soakage system, when overloaded, overflows.
- ii. The use of soakholes for stormwater disposal is not permitted without approval from Council.
- iii. All soakage systems shall be specifically designed to the satisfaction of the authorizing Officer.

**6. Stormwater Pumps**

- Stormwater pumping systems are not recommended and will require the approval of the Authorising Officer.



## 5.4.2 Commercial and Industrial Connections

- All commercial and industrial lots shall be provided with a stormwater connection. The connection and mains shall be sized for the fully developed scenario taking into account all finished impermeable surfaces. All paved areas shall be reticulated for piped stormwater disposal.
- Pollutants and contamination issues shall be identified and managed to the satisfaction of Council and consents.

## 5.5 Structures and Manholes

### 5.5.1 Inlet and Outlet Structures

Structures shall be provided at the inlets and outlets of pipelines to the details shown on the Drawings. The design shall ensure non-scouring velocities at the point of discharge.

### 5.5.2 Road Sumps, Bridges and Culverts

Refer to the Transportation Section DS 4

### 5.5.3 Maintenance Structures

#### General

This section describes the requirements for structures which permit access to the Stormwater system for maintenance. These are categorised as:

#### Manholes (MH)

The selection of a suitable location for maintenance structures may influence the pipe alignment. Generally, a minimum clearance of 1000mm should be provided around maintenance structures clear of the opening to facilitate maintenance and rescue. Council may determine other specific requirements subject to the individual site characteristics.

- i. Standard Stormwater manholes and Manholes of greater depth than 5m shall be constructed as detailed on the Drawings. Shallow manholes may be used in certain circumstances subject to the approval of Council.
- ii. Standard 1050mm diameter manhole risers are not permitted where either pipes are larger than 675mm diameter or where multiple pipes enter a manhole causing loss of manhole wall integrity. Designers shall upsize manholes in these cases to maintain wall integrity.
- iii. The fall through a manhole shall be the greater of either:



- a. The invert of the outlet pipe from a manhole shall be 20mm plus 0.5mm per degree of horizontal angle change between the two lines lower than the lowest incoming pipeline invert.
  - b. The soffit of the outlet pipe shall be level with or below the soffit of the lowest incoming pipeline.
  - c. The extension of the grade of the steepest pipe across the width of the manhole.
- iv. Manholes shall not be located within the live lane of the road carriageway unless specifically approved by the Authorised Officer. Manholes located along the centerlines or in parking lanes may be considered.

#### **5.5.4 Roadside Swales**

Roadside swales may be provided in the Rural-Residential zone at the discretion of Council.

Where a roadside swale is proposed an application shall be submitted to Council for approval. Prior to submitting the proposal contact Council for details of the information required to be submitted.

### **5.6 Stormwater Detention / Treatment Ponds**

#### **5.6.1 Stormwater ponds**

Stormwater ponds are an accepted method of improving stormwater quality and reducing peak downstream flow rates. All pond design shall be generally in accordance with ARC TP10.

#### **5.6.2 Dry Ponds**

Council requires that dry ponds be utilised in preference to wet ponds.

Where it is shown that the only design solution is the use of a wet pond, then prior to submitting engineering plans of the pond to Council for approval the Consent Holder's Representative/Engineer shall apply in writing to Council for consent to utilise the wet pond option.

All ponds are subject to specific approval of Council and shall be designed in accordance with Section this code.

All ponds are to be earthbunded, landscaped and grassed. In some cases Council may require additional access requirements around the pond to be formed to allow for appropriate long term maintenance of the pond.



**Note:** A requirement for use of a wet pond maybe that the pond be fully lined. This will depend on local ground conditions and soil properties.

### 5.6.3 Stormwater Discharge Consent

Where ponds require consent from Environment Bay of Plenty as part of the stormwater discharge consent these shall be obtained by the Consent Holder along with approval from the Authorised Officer.

### 5.6.4 Specific design matters to consider in relation to ponds

Ponds and related reserves shall have maximum batters of 1 in 5 and when access for maintenance is required, shall include:

- An all weather surface
- 4m wide berm able to be accessed by an 8.2t axle weight vehicle for its entire perimeter.
- Drawings of the proposed access shall be submitted to Council for approval prior to commencing construction of the access
- Side slopes with safety considerations (maximum 1:5 slope).
- Ease of maintenance including mowing and silt clean-out and access to public roads.
- Shape and contour for amenity value.
- An effective outlet structure.
- Overflow design.
- Pest control. (rats, mosquitoes)
- Sustainability of aquatic life.

All stormwater detention ponds are to be located on land owned by, or to be vested in Council, or covered by appropriate easements at the discretion of and approved by the Authorised Officer. The pond is to be designed to accommodate 20% AEP and 2% AEP storm events and must also safely pass larger storms without damage to the pond structure.

Council is not in favour of encouraging a proliferation of small stormwater ponds, preferring instead a total catchment approach.

### 5.6.5 Pollutants and contamination issues

Pollutants and contamination issues shall be identified and managed to the satisfaction of Council and The Regional Council.



## **5.7 Sustainable Low Impact Disposal**

### **5.7.1 Alternative and innovative stormwater disposal designs**

Alternative and innovative stormwater disposal designs, where appropriate, will be considered by Council, especially where sustainable, low impact disposal systems are proposed. Such disposal methods could include swales, rain gardens, or wetland treatment of areas instead of the conventional retention ponds or in conjunction with ponds

## **5.8 Rain Gardens**

Rain gardens are a useful tool for reducing the increased flow effects of development.

These may be used as an alternative to conventional soakage and detention ponds, but must be used in conjunction with a subsoil piped systems, catering for the effects of a full 20% AEP design storm on the development.

Covenants on each lot title are to be created to require owners to maintain these rain gardens.

Concept approval is required from Council prior to undertaking detailed design. Detailed design will be required at the time of engineering plan approval.

## **5.9 Rural 1,2 and 3**

### **5.9.1 Discharge Consents**

- Stormwater from roads and rights-of-way shall be collected and directed via water tables, swales and drains, or via appropriately designed stormwater management systems, to suitable discharge points in accordance with EBOP Regional Land and Water Plan, or with a specific stormwater discharge Consent.
- It is recommended that discharge points at waterways on adjoining properties should be secured by appropriate easements and consents of adjoining landowner.

### **5.9.2 Mitigation of Effects**

- Stormwater is to be discharged of in such a manner to avoid, remedy or mitigate adverse effects on adjoining and down stream properties.
- Discharge to soakage or open discharge shall take into account localised slope or erosion stability and to prevent flooding or creating a nuisance for downstream property owners.



### **5.9.3 Easements in Gross**

If relevant, overland flow paths are to be determined and covered by an easement in gross in favour of Council.

### **5.10 Creation of Stormwater Easement in Gross**

See General Provisions section of this Code for Details

### **5.11 Fencing**

There are no statutory requirements to fence waterways. The fencing off of natural urban waterways is not generally recommended. Where a site-specific risk to health and safety exists Council may require a fence to be erected.

Fencing may be a condition of easements for constructed waterways or drainage structures. An open, see through type rather than a solid fence is recommended.

Fences shall not impede flood flows up to the minimum protection.

### **5.12 Disposal of Stormwater by Ground Soakage**

#### **5.12.1 General**

The disposal of stormwater from building roofs, parking access and manoeuvring areas has historically been successfully undertaken by discharging the stormwater to drilled soakholes or soakpits on private property within the Western Bay of Plenty environs.

Such disposal methods have contributed to land instability and the creation of nuisance due to groundwater seepage in elevated urban areas abounding the extents of the Tauranga Harbour perimeter and also at locations such as the Minden, Maketu etc.

The degree of success and long-term serviceability of such soakage systems is also very dependent on the presence of permeable sub-soils and their permeability, the construction of the soakage system and the degree of maintenance undertaken on the system.

The soils present in the Council region vary with the more permeable soils likely to exist for stormwater disposal by soakage adjacent to the Tauranga Harbour perimeter, elevated ground at Te Puke, along the coastal margins where sand derivative soils are present, Pukehina and on most elevated rural areas (generally east of Te Puke).





### 5.12.2 Considerations for Design

For infill subdivision or development sites in existing urban areas, disposal of stormwater runoff by soakage will only be consented to if:

No other means of disposal are available such as:

- A piped reticulation system as part of the public drain network
- Discharge to a piped or open drain system
- Discharge to a kerb connection including the use of a sealed hydraulic system as shown on the Drawings.
- An adjacent watercourse.

If the soil and groundwater characteristics are proven favourable (i.e. soakage is available; and the rate of soakage is determined) as determined by an appropriate site investigation conducted by an appropriately qualified and experienced Chartered Professional Engineer, how the following conditions will be addressed: (In some cases a Category 1 or 2 Geotechnical Engineer will be required. Refer geotechnical section for details).

- A soakage rate reduction factor is applied to ensure that the system is designed for what can be expected in its operating environment. (Generally 0.5 is acceptable).
- Certification that use of the proposed soakage system will not have an adverse effect on other land or property from land stability, seepage or overland flow perspective. i.e. that adjoining slopes, basements, retained and unretained batters are identified and the possible effects on these features are quantified.
- Confirmation of expected overland flowpaths where the soakage system overflows and how this will be managed.
- The volume of storage required where the rate of inflow exceeds the rate of soakage for the design storm.
- The method of storage.
- How the soakage system will be constructed, accessed.
- What the long term maintenance regime for the system is to be.

### 5.12.3 Further Design Requirements

Soakholes, soakpits or entry points shall be located away from driveways or other hardstand areas so that access for maintenance (cleaning) is possible.

Each soakhole, soakpit or entry point pit shall be fitted with a removable lid for ease of access and maintenance.

Positions of soakholes, soakpits or entry points are to be submitted for Council records prior to the issue of building code compliance certificates.



Stormwater entry to soakholes, soakpits or other soakage mechanism from external hardstand areas shall be through a yard sump as shown on the drawings

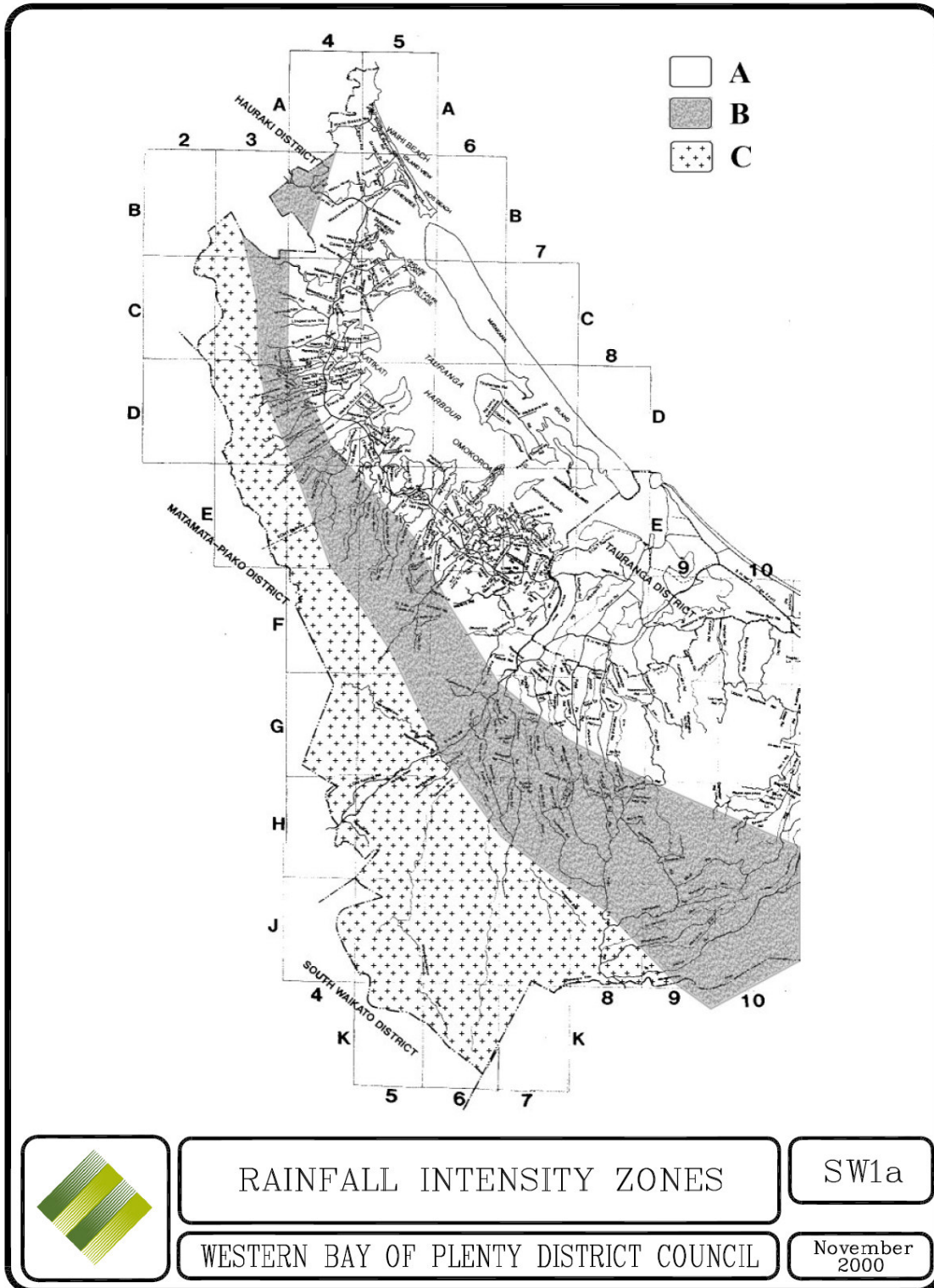
The entire soakhole, soakpit or soakage mechanism shall be located above the static groundwater level in heavy rain conditions.



## Rainfall Intensity Charts

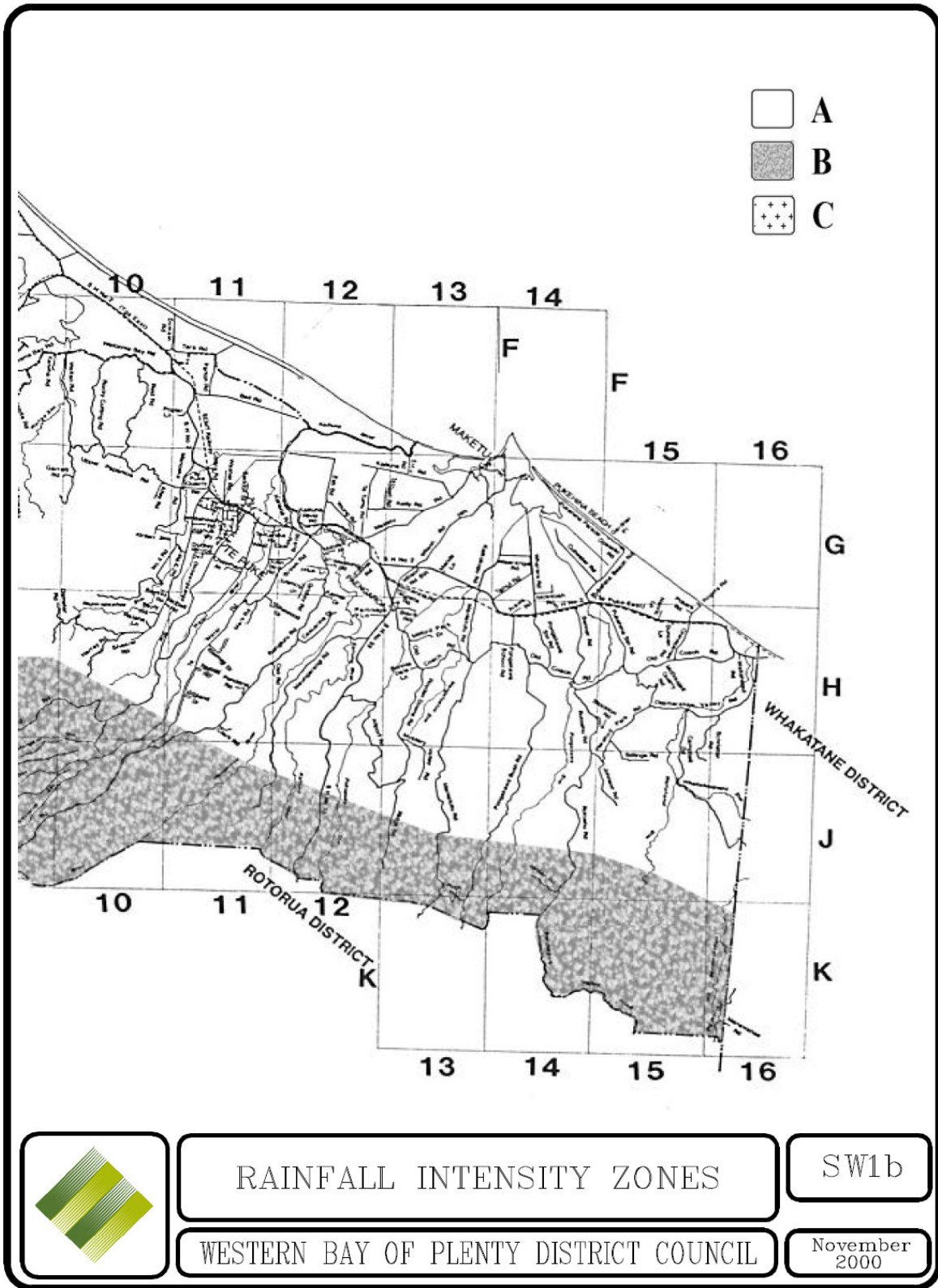


Rainfall Intensity Chart – SW1A





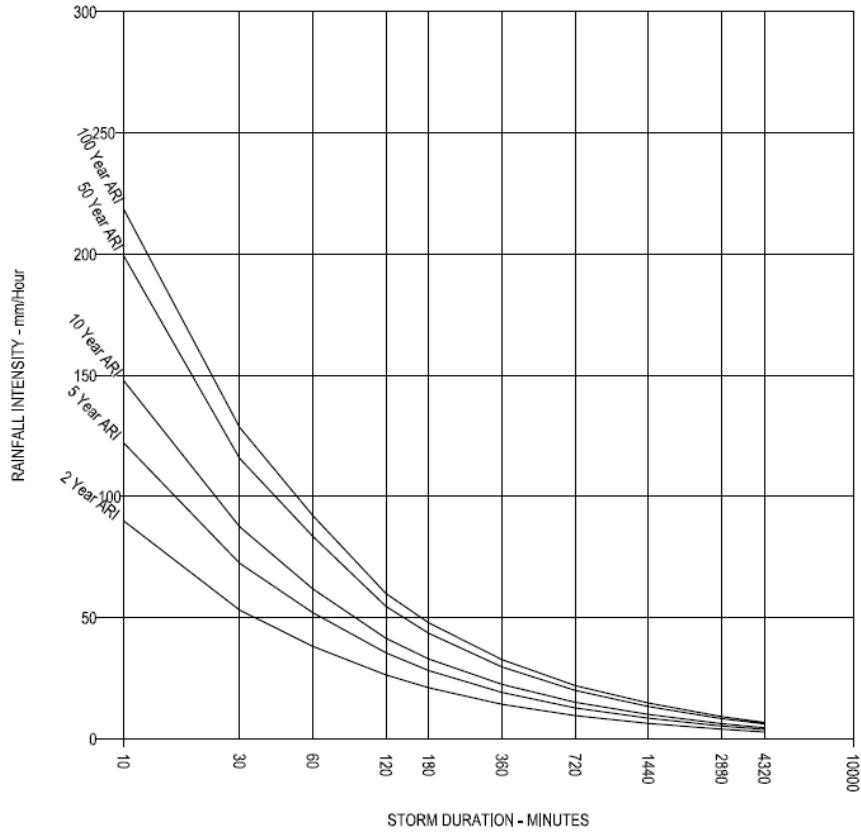
### Rainfall Intensity Chart – SW1B





### Rainfall Intensity Chart – SW2A

Waihi Beach, Athenree, Tanners Point, Tuapiro Point, Ongare Point, Kauri Point, Katikati, Omokoroa, Te Puna and Minden  
URBAN AREAS



RAINFALL INTENSITY (mm/Hour)

Annual Return Interval (Years)	STORM DURATION (Minutes)									
	10	30	60	120	180	360	720	1440	2880	4320
2	90.0	53.2	38.2	26.4	21.1	14.3	9.6	6.4	4.0	2.9
5	122.2	72.5	52.1	35.5	28.2	19.2	12.8	8.6	5.3	3.9
10	147.9	87.6	61.9	41.5	33.0	22.5	15.1	10.1	6.3	4.6
50	199.4	115.8	83.6	54.7	43.6	29.7	20.0	13.4	8.4	6.2
100	219.7	129.6	92.2	60.0	47.9	32.7	22.0	14.8	9.2	6.8

Rainfall Intensities derived from rainfall depths for Katikati (Latitude 37°34' S; longitude 175°55' E) and include an adjustment to allow for Climate Change to the Year 2040 as documented in the Ministry for the Environment Climate Change Effects and Impacts Assessment publication.



RAINFALL INTENSITY CHARTS  
(FROM HIRDS v1.5b)

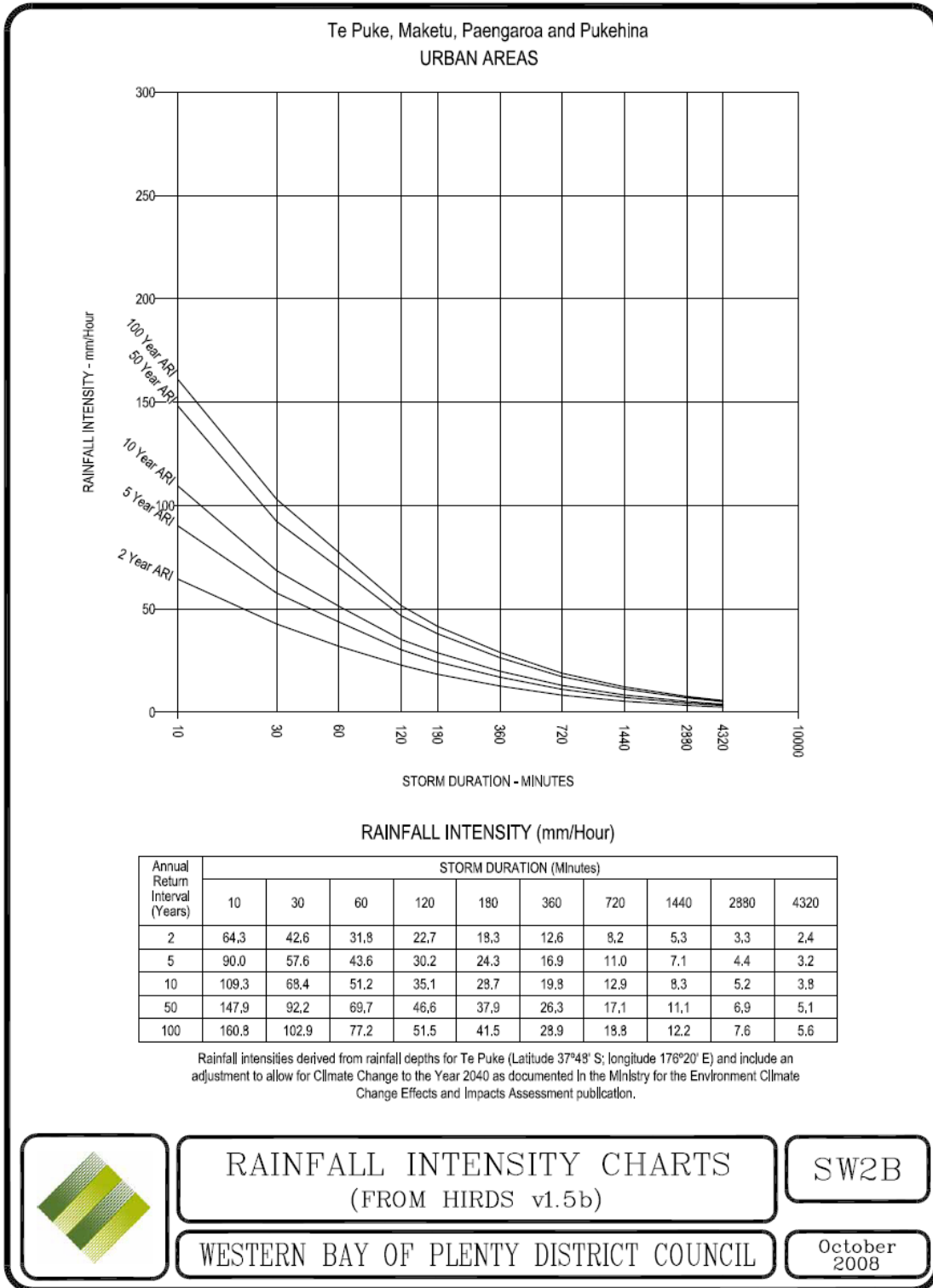
SW2A

WESTERN BAY OF PLENTY DISTRICT COUNCIL

October  
2008

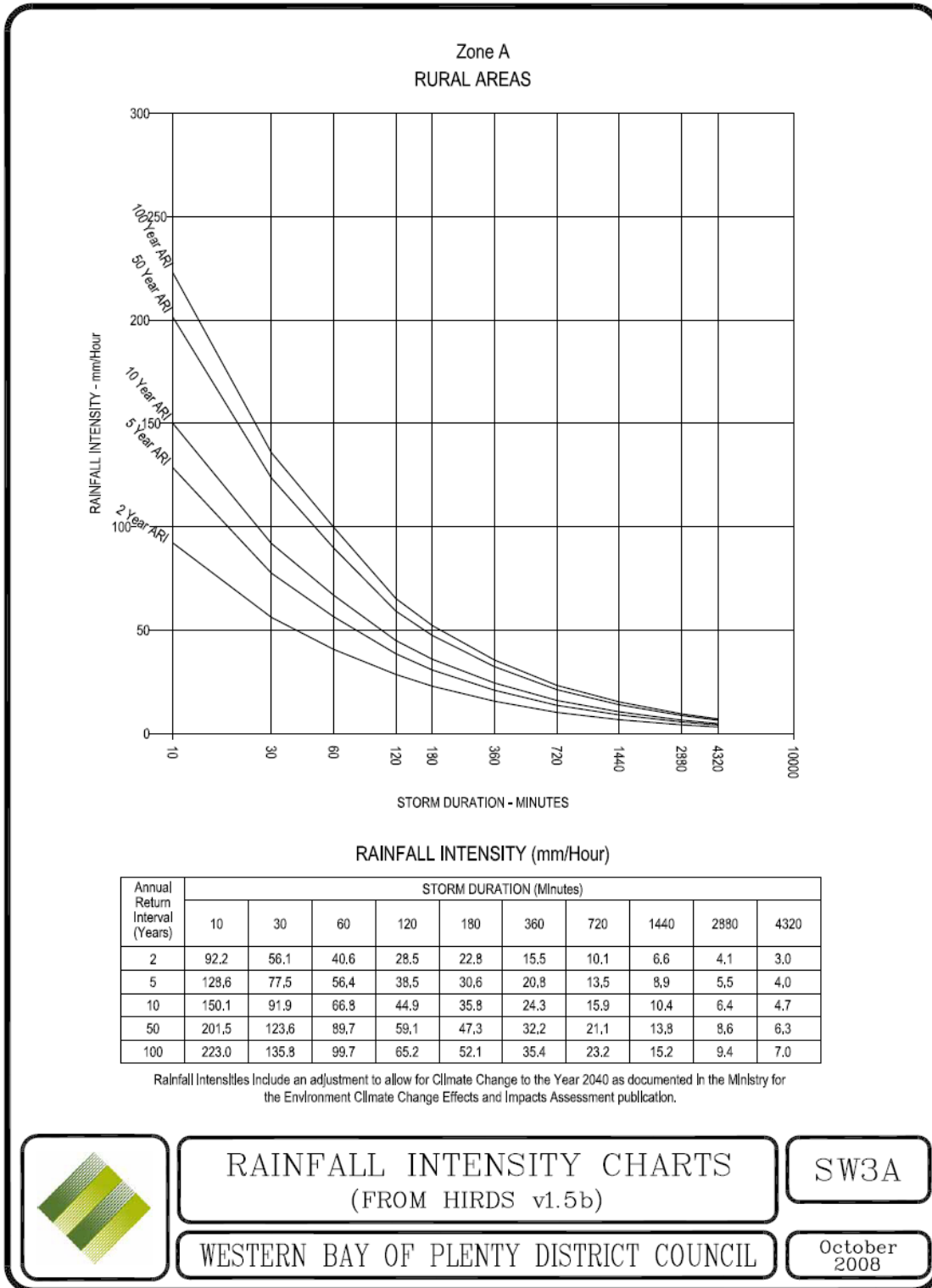


### Rainfall Intensity Chart – SW2B





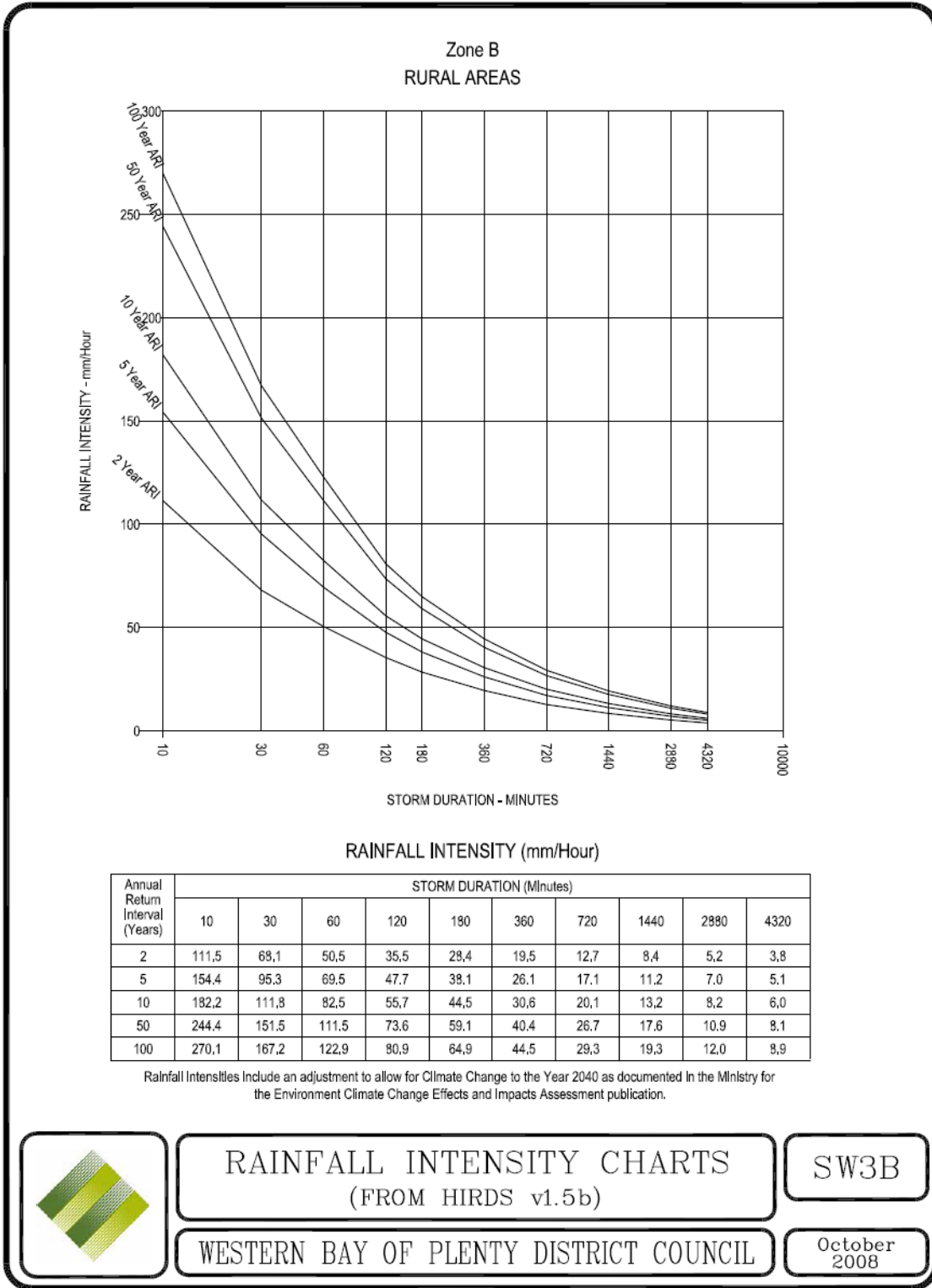
### Rainfall Intensity Chart – SW3A







### Rainfall Intensity Chart – SW3B





### Rainfall Intensity Chart – SW3C

