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ESTABLISHED 1953

ERF 6482 GRASSY PARK

STORMWATER MANAGEMENT PLAN

Western Cape Government

MARCH 2025

K&T PROJECT REFERENCE: 16849T

REVISION 2

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Details of this report

Client Name	Western Cape Government
Document Title	Stormwater Management Plan
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File Name	Stormwater Management Plan-Rev2
Prepared By	RL Murray
Reviewed By	RL Murray

Report Revision Record

Revision	Date	Description
0	11/03/2025	Draft - First issue
1	17/03/2025	SUDS depths added
2	28/03/2025	Comments addressed

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For and on behalf of Kantey & Templer (Pty) Ltd

For and on behalf of

Kantey & Templer (Pty) Ltd

Prepared by: RL Murray

Signed: RL MURRAY

Position: Associate Director

Date: 28-03-2025

STORMWATER MANAGEMENT REPORT
ERF 6482 - GRASSY PARK HOUSING PROJECT

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1. INTRODUCTION AND BACKGROUND

On behalf of the Western Cape Government – Department of Infrastructure, the projects Town Planners and Project Manager, Planning Partners, appointed Kantey & Templer Consulting Engineers (Pty) Ltd (K&T) as the civil, structural and electrical engineers for the proposed development of Erf 6482 Grassy Park, Cape Town.

1.1 Development Proposal

The Western Cape Government intends to provide Affordable housing opportunities on the above-mentioned property.

The proposed Site Development Plan is reflected in Annexure A.

2. SITE DESCRIPTION

2.1 Site Location

The proposed development is located in Grassy Park, Cape Town. It is located at the southwestern corner of Edward Avenue and Hector Avenue.

Figure 1: Site Location

2.2 Topography

The site appears generally flat with a fall in a south westerly direction towards the existing open stormwater channel. The site has an average gradient of 0,5% with no observed significant level differences on the site.

The site is considered as favourable for the establishment of the housing development.

3. EXISTING INFRASTRUCTURE

Annexure B contains details of the existing infrastructure which has been obtained.

Water

Visual observations on site indicate that there are existing water mains in Edward Avenue and Hector Avenue. This is supported by the GIS information.

Sewer

Visual observations on site indicate that there is an existing sewer outfall located to the west of the site. This is supported by the GIS information. A servitude is registered over the service in favour of the City of Cape Town where it crosses the property.

Stormwater

The Lotus River canal is located to the west of the site.

Electrical

Based on the GIS information obtained from the City of Cape Town, there is existing electrical infrastructure in the vicinity of the site.

2. CITY OF CAPE TOWN POLICY AND REGULATIONS

According to City of Cape Town's "Management of Urban Stormwater Impacts Policy" all stormwater management systems shall be planned and designed in accordance with best practise criteria and guidelines as set out by council which support water sensitive urban design principles and more specifically address the following objectives by means of using Sustainable Urban Drainage Systems (SuDS);

- Improve quality of stormwater runoff,
- Control the quantity and the rate of stormwater runoff,
- Encourage groundwater recharge where acceptable.

In order to achieve these objectives, the City of Cape Town (CCT) requires that the requirements as set out in Annexure D be implemented for developments.

3. FLOODLINES

Floodlines where obtained from the City of Cape Town which are attached in Annexure C. As can be seen the site falls above the 1:50 year floodline and development should not be restricted as a result of the floodlines.

4. ENVIROMENTAL AND TOWN PLANNING

The development would need to comply with the relevant Environmental Legislation and City of Cape Town's regulations / policies.

5. PRELIMINARY DESIGN

5.1 Catchment Boundary Determination

The catchment boundaries for the site were determined using the following information:

- Ortho photos.
- City of Cape Town (GIS Information/Shape Files).
- Existing services.
- Site Visits.
- Autodesk Infraworks 360.

5.2 Preliminary Design Considerations

The following items were considered in the design:

- Stormwater runoff from within the property boundary.
- Consideration of stormwater runoff from higher lying properties.
- The use of a combination of open channels, roads, and underground pipe systems.
- The proposed use of the property.
- Various Sustainable Urban Drainage (SUD) devices to ensure compliance with CCT's Policy.

5.3 Design Parameters

Existing services information was obtained from the local authorities showing the extent of the existing stormwater infrastructure around the proposed development. A detailed site investigation was also conducted to verify the information.

In determining the stormwater runoff, the following assumptions were made:

- That the Site Development Plan (SDP) would in principle remain the same (refer to Annexure A).
- All roads will be surfaced with either asphalt or brick paving.
- All roads will be bounded by kerbs and/ or channels which will act as major stormwater conduits.
- An underground stormwater system will be installed to at least convey the runoff from minor stormwater events.
- The underground drainage system on the site will accommodate at least the 1:5-year storm event.

5.4 Calculation of Stormwater Runoff

Rainfall data was obtained from City of Cape Town's Design Rainfall Depth Grid which reportedly includes a 15% factor for Climate Change. Based on the depth duration frequency information obtained, the corresponding IDF Curves were produced for the catchment.

Runoff from the catchment within the development site was calculated using the Rational Method. These values can be found in *Table 1*. The C-factors used for pre-development and post development are 0.3 and 0.7 respectively.

Table 1: Runoff values and Required Attenuation

Storm Event	Peak Runoff values (m³/s)		
	Pre-development m³/s	Post-development (un-attenuated site) m³/s	Required Attenuation (m³)
1 in 1	0.043	0.219	376
1 in 2	0.060	0.308	548
1 in 5	0.080	0.418	741
1 in 10	0.097	0.497	862
1 in 20	0.111	0.577	1016
1 in 50	0.134	0.686	1205
1 in 100	0.151	0.786	

(Refer to ***Annexure E*** *for calculations)*

Table 2: Water Quality and Extended Detention Volumes

Water Quality Volume (W_{QV}) 1:1/2 Year 24hrs RI Storm (m³)	Adjusted Water Quality Volume (W_{QV}) 1:1/2 Year 24hrs RI Storm (m³)	Extended Detention Volume (W_{ED}) 1:1 Year 24hrs RI Storm (m³)
75	75	376

(Refer to ***Annexure E*** *for calculations)*

5.5 Existing Infrastructure and Capacities

The GIS data, as-built drawings, surveys and visual inspection on site denote that there is no existing underground and above ground stormwater infrastructure located on the site.

The site currently drains towards an existing Lotus River canal located to the west of the site.

6. STORMWATER RUNOFF

6.1 Minor Flows

The internal stormwater system consists of surface channels, a pipe network and inlet structures which will drain the roads and hard surface areas towards the stormwater attenuation and water quality devices. This sub-surface drainage system will typically be designed to have sufficient capacity to accommodate a 1:5-year return interval rainfall event.

The proposed development will create impervious surfaces which will have an increase on the volume of stormwater runoff from the site. The stormwater system as described above will result in concentration of stormwater and will thus require dissipation of the increased energy while at the same time controlling the rate of runoff to its pre-development rate of runoff.

6.2 Major Flows

During the rainfall events with a return period in excess of 1:5 years, the roads, walkways, channels and open spaces will act as overland escape routes to drain stormwater runoff towards the attenuation structure. The site layout and levels will need to make allowance for these escape routes in order to prevent possible flooding and damage to property.

The attenuation structure will be designed to provide sufficient capacity to convey and attenuate the stormwater runoff from up to the 1:50 year return interval storm event. The attenuated stormwater flows will be released at or below the respective pre-development flow rates into the existing storm water systems thereby ensuring compliance with the CCT policy.

6.3 Attenuation Facility

The proposed development of this site will result in increased stormwater runoff when compared to its original undeveloped state.

In accordance with the CCT's "Management of Urban Stormwater Impacts Policy", the proposed development needs to reduce the peak flows from the rainfall events to their respective pre-development runoff rate so as not to increase the volume and risk associated with the increased runoff from the development which could lead to capacity problems further downstream in the stormwater drainage network.

The proposed Sustainable Urban Drainage System will need to be sized to handle the extended detention volume (W_{ED}) and attenuation volumes as reflected in Table 1 and Table 2. In this instance as the maximum attenuation volume of 1205m³ exceeds the required W_{ED} volume of 376m³, the minimum required storage is therefore considered as 1205m³ with a 24-hour discharge rate of not more than 0.043m³/s. In order to discharge W_{ED} volume of 376m³ over a 24-hour period the allowable rate of discharge of 0.02m³/s which is lower than for the attenuation volumes which will therefore require a variable rate of discharge in order to ensure compliance with the policies requirements.

6.4 Stormwater Runoff Quality Management

The City of Cape Town's stormwater management policy requires that best management practices be applied to proposed developments in order to improve the quality of stormwater runoff from the site so as to prevent pollutants from entering downstream stormwater systems.

The Policy calls for an 80% reduction in the Suspended Solids and a 45% reduction of Total Phosphorus. It is a further requirement that all developments are required to trap litter, oil and grease at source. All pollutants should then be safely disposed of offsite in accordance with legislation and municipal by-laws.

6.5 Proposed Stormwater Device

Given that the development sites already have a stormwater network and some stormwater infrastructure it is proposed that this existing infrastructure will be utilised as far as possible. The proposed SUDS for the development will consist of a combination of:

- Wet extended detention pond.
- Ground water re-charge.
- Bio-retention swales.

6.5.1 Wet extended detention pond

It is proposed that the stormwater from the site will all ultimately discharge into and through a wet extended detention basin. The basin will promote the settling of sediments through the reduction of flow velocities and temporary detention. The pond consists of two components, the permanent pool settling zone and the sediment storage zone. The pond has been sized with a capacity of 1500m³ to cater for the aforementioned zones.

The pond has also been designed with access in mind to facilitate maintenance and the removal of sediment from the pond.

The pond will require suitable landscaping to create a local habitat for fauna and flora. The plants will also assist with the reduction of nutrients contained in the stormwater.

6.5.2 Ground water recharge

Groundwater recharge will be achieved via the bio-retention swales.

6.5.3 Bio-retention swale

It is proposed that the stormwater from the site be discharged either overland or piped into a bio-retention swale. The swale will typically need to comply with the following requirements:

- Planted vegetation in swale (plant types to be approved by the CCT),
- Agricultural underdrain filled with 500mm filter media (hydraulic conductivity of 0,0001m/s) and a 110 dia. slotted pipe.

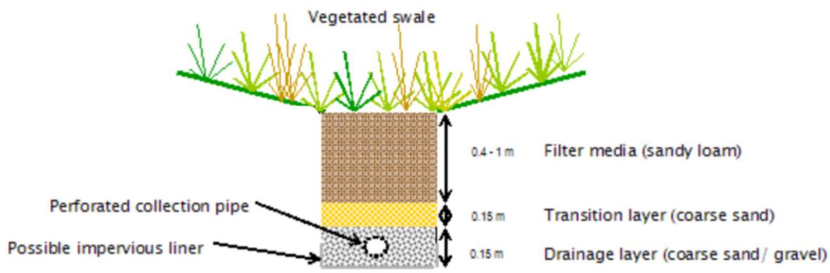


Figure 2: Bio-retention swale

6.6 Discharge from the device

As already mentioned, the discharge from the SUDS facility will be sized in order to have a controlled discharge of the stormwater in to meet the requirements of the CCT's policy in terms of the discharge of lowest of the Attenuation discharge rate or the W_{ED} volume over 24hrs, or a variable rate of discharge in this instance it is proposed to limit the rate of discharge to a variable rate of between 0.089 and 0,009 m³/s.

The outlet will be by means of a reverse pipe which will therefore not allow any floating accumulated debris from been discharged from the facility or clogging the outlet.

The rate of runoff from the development site is at or lower than its pre-development rate of runoff thus the stormwater system will not be detrimentally impacted upon for the Return Events for which it was designed for.

The additional flows in excess of this rate will push back into the sediment chamber and over a weir between the sediment chamber and the existing point of discharge.

6.7 Maintenance of Sustainable Urban Drainage System

In accordance with CCT's requirements the owners will have to accept responsibility for the operation and maintenance of the proposed SUDS facilities outlined in this report.

The following tables summarises the maintenance activities that will be required.

Activity	Schedule
Wet extended pond	
Check all outlet pipes for blockages	Monthly, throughout the year
Remove trash and debris	Monthly, throughout the year
Maintain vegetation in swales	Monthly, in winter months – April to August
Remove any sediment build-up	Annually in April, at beginning of winter months
Remove invasive vegetation	Annually in April, at beginning of winter months
Bio-retention swales	
Check all outlet pipes for blockages	Monthly, throughout the year
Remove trash and debris	Monthly, throughout the year
Maintain vegetation in swales	Monthly, in winter months – April to August
Remove any sediment build-up	Annually in April, at beginning of winter months
Remove invasive vegetation	Annually in April, at beginning of winter months

7. DISCLAIMERS

This report does not take into account any future changes in land-use or changes in operations on any of the sites. Any such changes should be evaluated when such a change is considered.

8. CONCLUSION

Based on the contents of this report the proposed development will be able to address the City of Cape Town's stormwater policy with respect to improvement of the water quality, attenuation to pre-development rate, extended detention and for the safe conveyance of runoff from major storm events across the site.

The measures proposed in this report are both practical and feasible for the reduction of pollutant levels and the attenuation of the runoff flows in accordance with the best management practices and can be readily managed by the property owner.

One can thus conclude that with the implementation of the above the proposed development will comply with the policies requirements once the measures as set out in this report have been implemented and are maintained.

9. REFERENCES

9.1 Management of Urban Stormwater Impacts Policy – published by the City of Cape Town

9.2 Guidelines for Human Settlement Planning and Design – published by CSIR

9.3 Municipal Stormwater Management (2nd Edition) – Thomas N Debo and Andrew J Reese

9.4 Design Rainfall Depth Grid – supplied by the City of Cape Town

9.5 Georgia Stormwater Management Manual Volume 2 (Technical Handbook)

9.6 Technical Design Guidelines for Southeast Queensland (Version 1 June 2006) (WSUD)

9.7 The South African National Roads Agency Limited Drainage Manual 5th Edition

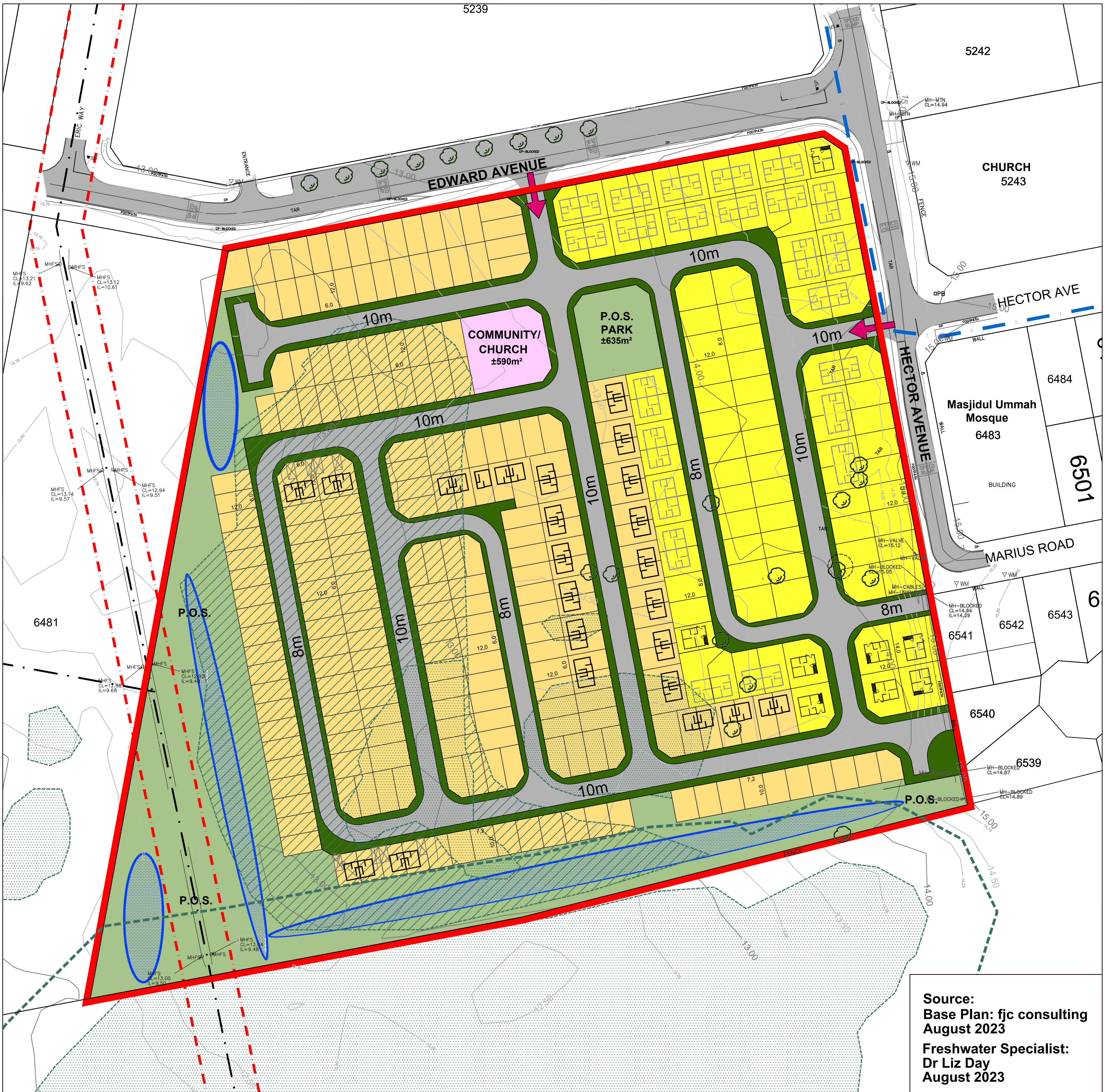
9.8 Peter Wium Consulting Engineer

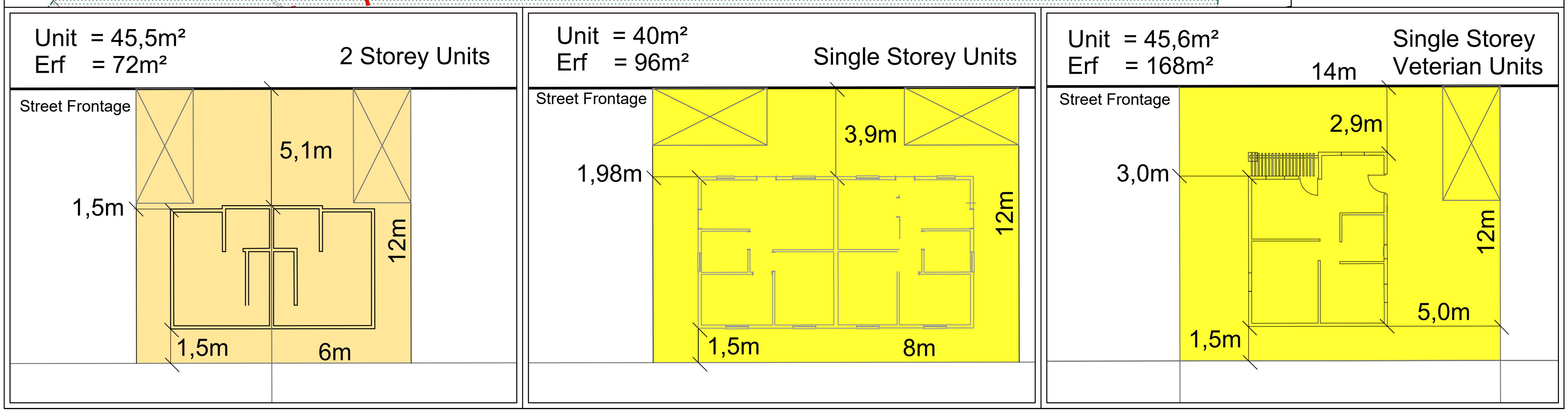
9.9 Interpave Permeable Pavements (Edition 6)

9.10 North Shore City – Permeable Pavement Design Guidelines (September 2004)

ANNEXURE A

SITE DEVELOPMENT PLAN





THE SITE	WATER PIPE	ACCESS
WETLAND	SEWAGE PIPE	STORMWATER ATTENUATION POND / SWALE
INFILL	SERVITUDE	Average Erf Size 8 x 12 = 96m² 95 Units
20m OFFSET BUFFER	VEGETATION	Average Erf Size 6 x 12 = 72m² 228 Units

ERF 6482 GRASSY PARK

SINGLE & 2 STOREY WALK UPS

N
SCALE 1:1250

PLANNING PARTNERS

NOVEMBER 2023
JOB No 4436

Option 6

ANNEXURE B

EXISTING SERVICES DRAWINGS

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

THIS MAP WAS GENERATED BY THE

Water and Sanitation Business Viewer

Water and Sanitation Department

LEGEND

- Isolation
- Retic Water - Hydrant
- 1 - 200
- 201 - 400
- Sewer - Pump Station
- Sewer - Manhole
- Sewer - Connection Line (Leading)
- Sewer - Gravity Main (Flow Direction)
- -999 - 0 (Unknown diameter)
- 1 - 160
- 161 - 300
- 301 - 600
- 601 - 999999
- Manhole
- Catchpit
- Stormwater Inlet Outlet
- Pipe
- Culvert
- Connection
- Canal Lined (Main)
- Canal Lined
- Street Name
- Active Land Parcels
- City of Cape Town Boundary
- Main Roads
- Streets
- Suburbs

Land Topo 50000

RGB

- Red: Band_1
- Green: Band_2
- Blue: Band_3

1:3 000

Author:

Date: 07 August 2023

Projection: Transverse Mercator
Central Meridian: 19º East
Ellipsoid: WGS84
Datum: Hartebeesthoek94

PLEASE NOTE:

- Every effort has been made to ensure the accuracy of information in this map at the time of publication.

- The spatial data portrayed in this map is as current, accurate and complete as provided by the various line departments responsible for the maintenance of these datasets.

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

THIS MAP WAS GENERATED BY THE

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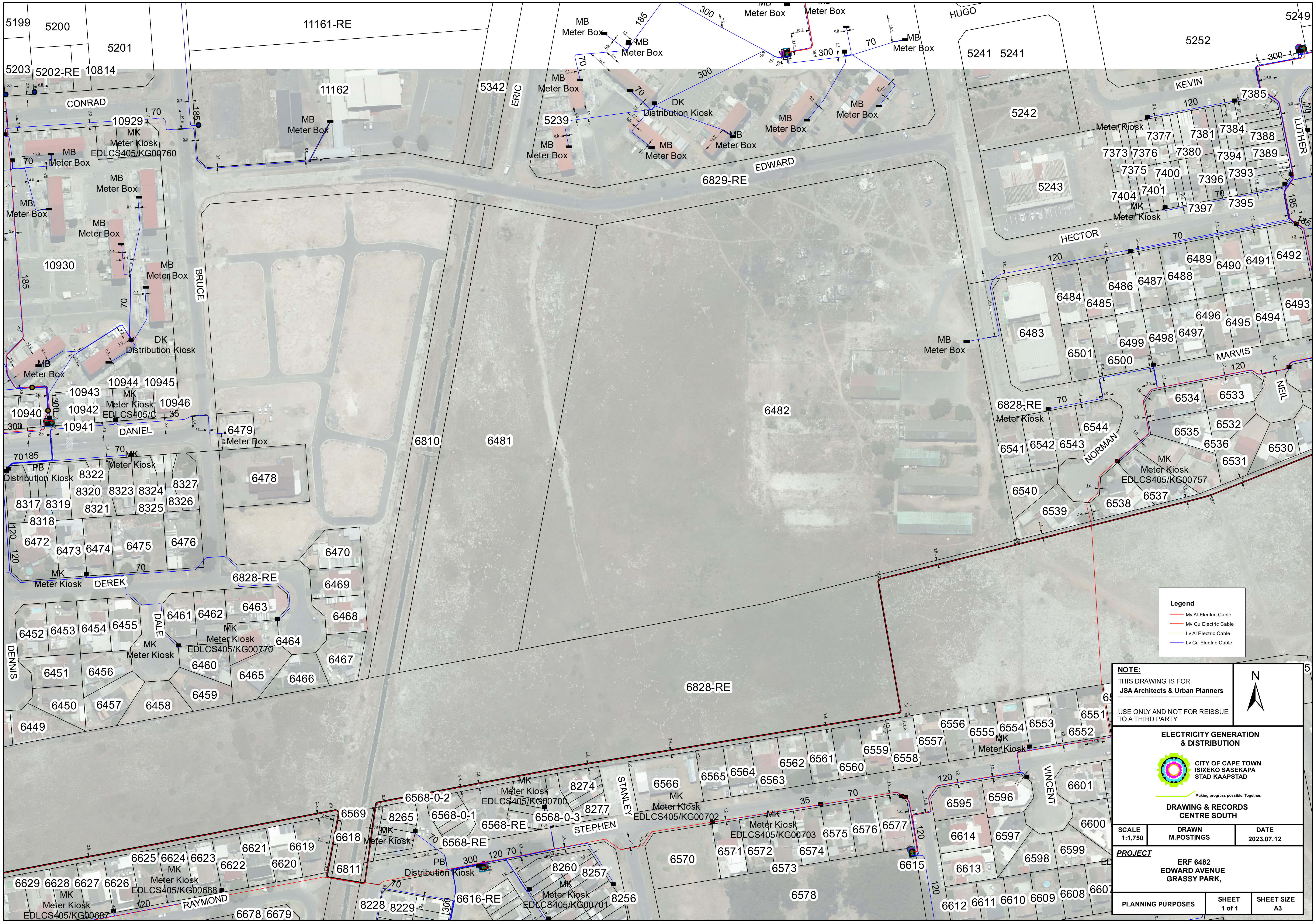

NOTE:
THIS DRAWING IS FOR
JSA Architects & Urban Planners
USE ONLY AND NOT FOR REISSUE TO A THIRD PARTY

ELECTRICITY GENERATION & DISTRIBUTION

CITY OF CAPE TOWN
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STAD KAAPSTAD
Making progress possible. Together.

DRAWING & RECORDS CENTRE SOUTH

SCALE	DRAWN	DATE
1:1,750	M.POSTINGS	2023.07.12

PROJECT
ERF 6482
EDWARD AVENUE
GRASSY PARK,

PLANNING PURPOSES	SHEET 1 of 1	SHEET SIZE A3

ANNEXURE C

FLOODLINES

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CATCHMENT, STORMWATER AND RIVER MANAGEMENT
WATER AND SANITATION DIRECTORATE

Kristin Botes
Principal GIS Analyst

T: 021 444 4938
E: kristin.botes@capetown.gov.za

REF: Erf 6482 Grassy Park

DATE: 14 February 2025

Dear Sir/Madam

INFORMATION REGARDING FLOOD RISK AND FLOODLINES

Property: Erf 6482 Grassy Park

With reference to your enquiry at this Department, the following information is given in respect of the above property:

Flood Terms & Definitions

The term "100 year Flood" can be misleading because it leads people to believe that it will occur only once in a 100 year period. The truth is that uncommonly big floods can happen at any time in any year. The term "100 year flood" is a statistical designation, and means that there is a 1-in-100 chance that a flood of this size will occur during any given year. The "100 year flood" can also be referred to as the 1 in 100 year Return Period or Recurrence Interval flood event.

What it actually implies, is that over a very long period in time, a flood of this size, will occur on average every 100 years or that over a period of 1 000 years there are likely to be 10 such events.

The probability of a 100 year occurring at least once in the next 5 years is 5%, in the next 50 years is 40% and in the next 100 years is 63%.

It is possible to experience 2 or more 100 year floods within a relatively short time, even in the same place.

The National Water Act

The National Water Act (Act No. 36 of 1998) *Part 3* requires that information relating to floods and potential risks be made available to the public, and that township layout plans must indicate a specific floodline. Floodlines should be determined using the most appropriate means to inform the public about anticipated floods or risks posed by water quality, the failure of any dam and so forth. Early warning systems may be established to anticipate such events.

Section 144 of the National Water Act stipulates that no person may establish a township unless the layout plan shows, in a form acceptable to the City, lines indicating the maximum level likely to be reached by floodwaters on average once in every 100 years. This stipulation is to ensure that all persons who might be affected have access to information regarding potential flood hazards.

City of Cape Town: Floodplain and River Corridor Management Policy

The City's "Floodplain and River Corridor Management Policy" (the Policy) was approved and adopted by the City Council on 27 May 2009. The purpose of the policy is to reduce the impact of flooding on people and property, to safeguard human health, aquatic environments whilst improving and maintaining water quality.

The Policy compels a merit-based approach for dealing with land-use, development or activity proposals near watercourses and wetlands that:

- Limits or reduces exposure to flood risk by avoiding hazardous, uneconomic or unwise use of floodplains thereby protecting life, property and community infrastructure.
- Protects the natural flood carrying capacity of watercourses and wetlands.
- Protects and enhances the intrinsic value and the environmental function provided by watercourses and wetlands and their associated riparian areas and floodplains through the inclusion of ecological buffer requirements.
- Facilitates the beneficial integration of watercourses and wetlands into the urban landscape by creating an aesthetically pleasing public resource which will ultimately allow for the social and economic upliftment of communities adjacent to watercourses and wetlands.
- Provides an effective decision making tool for City officials, developers, land owners and built environment professionals by introducing an element of predictability with regard to applications for development along watercourses, in river corridors and adjacent to wetlands.
- Promotes sustainable development from engineering, environmental and socio economic perspectives.

The degree of flood and/or environmental protection recommended by this policy is considered reasonable for regulatory purposes and is based on engineering and scientific methods of study.

The Policy is available on the City's web site http://www.capetown.gov.za/en/Policies/ along with the other policy relating to stormwater, the "Management of Urban Stormwater Impacts Policy" which was also approved by the City Council on 27 May 2009. Alternatively either of these Policies can be viewed at the Catchment, Stormwater & River Management Branch office on the 3rd Floor, Water & Sanitation Head Office, 8 Voortrekker Road, c/o Voortrekker and Mike Pienaar, Bellville, Cape Town. Please call Annestia Morta on 021 400 1205 to make arrangements.

Flood Levels and Associated Floodlines and Hazard Zones

The determination of flood levels and their associated floodlines and hazard zones are based on relevant catchment hydrology considering the catchment's land-use and runoff characteristics and the river's geomorphology at the time of their determination, and therefore these can generally only be regarded as indicative.

The City conducted a floodline study along the Lotus River in 1994.

Should your property /erf fall below or partially below the estimated flood levels and / or the flood high hazard zone, as shown on the attached plan, then your proposed Rezoning / Sub-division / Land-use departure / Consent use / Amendment of plans / Conditions of approval / Building plan application are subject to the requirements of the City's "Floodplain and River Corridor Management Policy".

Should you wish to challenge the flood information provided by the City, we recommend you seek professional advice from a registered professional specialising in hydrological and hydraulic engineering.

For your guidance, the professional will be required to provide The City with the information regarding the flood level determination in relation to the development of the property, as given in Appendix A.

Additional information may also be requested in respect of any particular development.

Yours faithfully

……………………………………. Date: ……………………..

APPENDIX A: CITY OF CAPE TOWN FLOOD LEVEL DETERMINATION REQUIREMENTS

(i) Methodology / techniques used to determine and verify peak flow rates for the various flood events.
(ii) Contributing catchment hydrological characteristics and information e.g. catchment area, land-use, etc. including a map showing the property location and catchment area.
(iii) Rainfall data and information used to determine peak flow rates.
(iv) River geomorphological data and information used to determine flood levels e.g. topographical survey.
(v) Method used to undertake backwater analysis to determine flood levels and hazard zones.
(vi) Backwater analyses results in tabular form with accompanying river station cross-sectional and longitudinal section results drawings
(vii) Certified drawing showing a plan view of the property and the pertinent river reach for which the flood levels have been determined, positions of river cross-sections, river centreline, floodlines, hazard zones, contours and any other pertinent features that may impact on the flood levels e.g. culverts and a table indicating the flood level at the various cross-sections.

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CATCHMENT, STORMWATER & RIVER MANAGEMENT

FLOODLINES

Erf 6482, Grassy Park

LEGEND

Floodlines

50yr

Floodplain

Watercourse

Conduit

Culvert

Open Watercourse

Canal Lined

Land Parcel

N

1:2 500

Compiled: KBotes | Date: Feb 2025

ROADS & STORMWATER DEPARTMENT

Catchment, Stormwater and River Management Branch

Management of Urban Stormwater Impacts Policy

Version 1.1

Approved by Council
27 May 2009
C 58/05/09

CITY OF CAPE TOWN | ISIXEKO SASEKAPA | STAD KAAPSTAD

Table of Contents

1 Preamble

Well-managed urban water bodies are valuable resources providing environmental and recreational services which require protection and enhancement. This is particularly important in the context of changing weather patterns and the associated local, national and international strategies targeting sustainability, climate and energy issues. However it is a world-wide phenomenon that such water bodies rapidly deteriorate under the impact of urbanisation with a resultant loss of aquatic ecosystems, biodiversity, and amenity value, as well as the creation of significant health risks.

This Policy is intended to minimise the undesirable impacts of stormwater runoff from developed areas by introducing Water Sensitive Urban Design principles to urban planning and stormwater management in the Cape Town metropolitan area.

2 Definitions

In this policy, unless inconsistent with the context:–

“Best Management Practices (BMPs)” are devices, practices or methods for removing, reducing, or retarding runoff flows, or preventing targeted stormwater runoff constituents, pollutants and contaminants from reaching receiving waters. BMPs include structural and non-structural controls and devices as well as operation and management procedures;

“bioretention cell or basin” consists of an excavated basin or trench that is filled with porous media layers and planted with vegetation. Water quality treatment of stormwater runoff occurs through removal of sediment, trace metals, nutrients, bacteria and organics as the water percolates downwards;

“brownfield” means a site or land that is or was occupied by a permanent structure, which may have become vacant, under-used or derelict and has the potential for redevelopment;

“catchment” means the area from which any rainfall will drain into a watercourse or wetland (or part thereof) through surface flow to a common point or common points;

"Council” means the City of Cape Town;

“development” means any man-made change to property, including but not limited to construction or upgrading of buildings or other structures, filling, paving, municipal services, etc, or the associated preparation of land;

“directly connected impervious area” means impervious areas (i.e. areas covered by buildings and other impervious surfaces) which drain directly into stormwater drains without first infiltrating or flowing across permeable land;

“floodplain” means the land adjoining a watercourse which Council considers susceptible to inundation by floods up to the one hundred year recurrence interval;

“greenfield” means a site or land such as parkland, open space and agricultural land which have previously been undeveloped. Development on such land generally requires a change of land use / zoning;

“impervious surface” is land where water cannot infiltrate to the subsurface but is conducted by gravity on the surface as overland flow. Roads, parking lots, sidewalks and rooftops are examples of impervious surfaces in urban areas.

“non-structural measures” are planning, institutional and pollution prevention practices designed to prevent or minimize pollutants from entering stormwater runoff and/or reduce the volume of stormwater requiring management;

“pre-development” means prior to any development on that property;

“receiving waters” are natural or man-made aquatic systems which receive stormwater runoff e.g. watercourses, wetlands, canals, estuaries, groundwater and coastal areas;

“recurrence interval” or **“RI”** means the average interval in years between rainfall or flood events equaling or exceeding a specified severity;

“redevelopment” includes the creation, replacement, or addition/expansion of impervious area and/or structures on an already developed site;

“retrofitting” means the process of modification or installation of additional or alternative stormwater management devices or approaches in an existing developed area in order to achieve best management of stormwater;

“sensitive receiving water” means a watercourse, wetland or coastal area which has been or is deemed by Council to be sensitive or important from an ecological, social and/or economic perspective/s;

“source controls” are non-structural or structural best management practices to minimize the generation of excessive stormwater runoff and/or pollution of stormwater at or near the source;

“stormwater” means water resulting from natural precipitation and/or the accumulation thereof and includes groundwater and spring water ordinarily conveyed by the stormwater system, as well as sea water within estuaries, but excludes water in a drinking water or waste water reticulation system;

“stormwater system” means both the constructed and natural facilities, including pipes, culverts and watercourses, whether over or under public or privately owned land, used or required for the management, collection, conveyance, temporary storage, control, monitoring, treatment, use and disposal of stormwater;

“structural measures (controls, best management practices)” are permanent, engineered devices implemented to control, treat or prevent stormwater pollution and/or reduce the volume of stormwater requiring management;

“sustainable urban drainage systems (SUDS)” is a branch of Water Sensitive Urban Design which focuses specifically on stormwater management;

“treatment train” means a combination of different methods implemented in sequence or concurrently to achieve best management of stormwater. These methods include source control, non-structural and structural measures;

“watercourse” means a river, stream, channel, canal, vlei, wetland, dam or lake in or into which water flows regularly or intermittently. Reference to a watercourse includes, where relevant, its bed and banks;

“wetland” means land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil. This definition thus includes, but is not necessarily limited to, water bodies such as lakes, salt marshes, coastal lakes, estuaries, marshes, swamps, vleis, pools, ponds, pans and artificial impoundments;

“Water Sensitive Urban Design (WSUD)” is an approach which seeks to ensure that development in urban areas is holistically planned, designed, constructed and maintained so as to reduce negative impacts on the natural water cycle and protect aquatic ecosystems. Sustainable water supply, sanitation and stormwater management are encompassed within the WSUD approach.

3 Introduction

Watercourses and wetlands are integral to the stormwater management system, are an important component of the City’s biodiversity network, and represent an essential element within the urban fabric of the City by providing both recreational and economic opportunities.

This Policy supports the Roads and Stormwater Department objectives incorporated in the Integrated Development Plan for the City of Cape Town, namely to;

- Reduce the impact of flooding on community livelihoods and regional economies
- Safeguard human health, protect natural aquatic environments, and improve and maintain recreational water quality

The deleterious impacts of urbanisation on receiving waters, that is rivers, streams, wetlands, groundwater and coastal waters, are a worldwide phenomenon. Such impacts include:

- Declining water quality;
- Diminishing groundwater recharge and quality;
- Degradation of stream channels;
- Increased overbank flooding;
- Floodplain expansion;
- Loss of ecosystem integrity and function;
- Loss of biodiversity.

In the last 20 years, increasing emphasis internationally has been placed on addressing urbanisation impacts on natural water bodies, and the guiding principles that have evolved have become known as Water Sensitive Urban Design (WSUD).

WSUD recognises that the primary reason for deterioration of urban waters is the disruption of the natural water cycle. From the stormwater management perspective this is a result of the creation of impervious surfaces, and the concentration and acceleration of stormwater runoff through pipe and canal networks. Absorption, attenuation, and quality improvement of runoff through natural processes are lost. Sustainable Urban Drainage Systems (SUDS) is a branch of WSUD dealing specifically with stormwater management measures which attempt as far as possible to maintain or mimic the natural flow systems as well as prevent the washoff of urban pollutants to receiving waters. These measures, referred to as Best Management Practices (BMPs), fall into two groups, viz. structural controls and non-structural controls:

> Structural controls are engineered devices implemented to manage runoff quality and quantity. Examples include litter traps, infiltration devices, bioretention cells or basins, detention ponds and constructed wetlands
>
> Non-structural controls are institutional and pollution-prevention practices designed to prevent or minimise pollutants from entering stormwater runoff and/or reduce the volume of stormwater requiring management. Non-structural controls include, *inter alia*, town planning incentives, stormwater masterplans, pollution prevention maintenance practices, and public education.

It is seldom that a single measure is adequate for water quality treatment and a “treatment train” approach is more often necessary. This is a combination of different methods implemented sequentially or concurrently, and varying typically from preventative measures at source, through development site controls to regional controls, before discharge to the receiving waters.

Over the past decade the City of Cape Town has experienced unprecedented development, both in greenfield areas as well as within existing developed / brownfield areas. The City’s Roads and Stormwater Department, in recognition of the threats to already degraded rivers and wetlands, responded by introducing development guidelines which would limit these impacts, viz.:

- **Stormwater Management Planning and Design Guidelines for New Developments, adopted by the City’s Transport Roads and Stormwater Portfolio Committee on 4 September 2002.**

  In essence this document promotes the principles of Water Sensitive Urban Design. It emphasizes planning and design solutions that are cost effective, sustainable in terms of future maintenance requirements, environmentally sensitive and that maximise, within these constraints, social as well as amenity value.

- **Floodplain Management Guidelines, adopted by the Mayoral Committee on 19th November 2003.**

  This document provides a framework for the management of land use, development, and activities near watercourses in a manner that minimises potential flood damages and protects and enhances the environment.

  These guidelines are currently being reviewed and updated to a policy entitled “Floodplain and River Corridor Management Policy”.

- **Draft Policy for Provision of Stormwater Services to Informal Areas, March 2003.**

  This document provides a framework for flood control and management to at least minimum levels within informal areas on public land, until such time as the settlements are upgraded to full services, or relocated to alternative sites if the land is not suitable for development.

4 Legislative Context and Legal Mandate

Land use, development and associated activities influenced by this Policy are dealt with in terms of the statutes and planning frameworks highlighted in the following sections.

4.1 National

- National Building Regulations & Building Standards Act, 1997 (Act 103 of 1977)
- Conservation of Agricultural Resources Act (Act 43 of 1983)
- National Water Act (Act 36 of 1998)
- National Environmental Management Act (Act 107 of 1998)
- Disaster Management Act (Act 57 of 2002)
- National Environmental Management: Biodiversity Act (Act 10 of 2004)

4.2 Provincial

- Western Cape Planning & Development Act (Act 7 of 1999) (This Act will apply upon its coming into operation).

- Land Use Planning Ordinance, 1985 (Ordinance 15 of 1985)

4.3 City of Cape Town

- Integrated Development Plan (2007/8 to 2011/12)

  The Roads and Stormwater Department objectives are incorporated in the Integrated Development Plan for the City of Cape Town:

  Reduce the impact of flooding on community livelihoods and regional economies;

  Safeguard human health, protect natural aquatic environments, and improve and maintain recreational water quality.

- By-law relating to Stormwater Management (Promulgated September 2005 – PG 6300) together with which this policy is to be read and interpreted.

In addition, a number of other documents have been produced over the years which have referred to the management of development and this Policy is generally consistent with these. Some of the more pertinent are listed.

- Greening the City Open Space and Recreation Plan of Cape Town (1982)
- Roads and Stormwater Department: Catchment, Stormwater and River Management Strategy (2002)
- Biodiversity Strategy for the City of Cape Town (2003)
- Coastal Zone Strategy (2003)
- CMOSS – An Open Space Strategy (2005)
- Planning for Future Cape Town (2006)

5 Policy Rationale and Principles

Whilst the Roads and Stormwater Department's Stormwater Management Guidelines for New Developments are generally adhered to in respect of limiting peak flows off new developments, the measures to limit other impacts on receiving waters have been less successful. The Guidelines do not prescribe under what circumstances water quality treatment and other best management practices (BMPs) must be applied to new developments, nor do they specify the parameters and required outcomes to enable detailed town planning and engineering design of BMPs.

The City's By-law Relating to Stormwater Management, approved by Council on 30 August, 2005, prohibits discharge of anything other than stormwater into the stormwater system (Clause 3), and Clauses 4 and 5 of the By-law deal with protection of the stormwater system (including damage and prevention of pollution), and the prevention of flood risk. The By-law further enables Council to impose conditions with regard to these matters. This Policy is intended to support the By-law and strengthen the City's ability to introduce and implement measures which will arrest the deterioration of, and in the longer term improve, the state of its natural water assets as part of the stormwater system.

A fundamental principle is that the person or body, whether private enterprise or an organ of state, who creates a development should do so responsibly and should ensure that such development does not adversely impact on present and future communities and on natural ecosystems.

This Policy is important in achieving the service outcomes as highlighted in Section 3 above. It furthermore ensures administrative actions with respect to land use planning applications that are lawful, reasonable and procedurally fair.

6 Policy

6.1 Policy Statement

In order to reduce impacts of urban stormwater systems on receiving waters, all stormwater management systems shall be planned and designed in accordance with best practice criteria and guidelines laid down by Council, to support Water Sensitive Urban Design principles and the following specific sustainable urban drainage system objectives:

- Improve quality of stormwater runoff;
- Control quantity and rate of stormwater runoff;
- Encourage natural groundwater recharge.

6.2 Policy Implementation

6.2.1 Application of Water Sensitive Urban Design Principles in Stormwater Management

Water Sensitive Urban Design principles will be incorporated into urban development through the application of sustainable urban drainage systems as follows:

A. New Developments

New developments, including both greenfield areas and redevelopment in brownfield areas, as well as additional development on an already developed site, shall be planned and designed to incorporate sustainable urban drainage systems generally in accordance with the City's Stormwater Management Planning and Design Guidelines for New Developments as well as with local and international best practice.

B. Existing Developed Areas

Sustainable urban drainage systems will be incorporated into existing developed areas through retrofitting of appropriate structural best management practices as well as through non-structural measures. These will generally be implemented by the City based on needs identified at a regional level through Catchment and River Management Planning and in accordance with Stormwater Masterplans.

The extent to which the various best management practices are selected for implementation will depend on criteria laid down by the City Council as annexed to this policy.

6.2.2 Criteria for achieving Sustainable Urban Drainage System Objectives in Various Development Scenarios (Annexure)

Criteria for the application of sustainable urban drainage systems shall indicate:

- Where and under what circumstances the objectives of WSUD must be incorporated into design and planning of new developments or into existing developed areas, and
- The extent and target requirements of best management practices applicable to the development area concerned.

In determining the criteria, Council will consider, *inter alia*:

- The size of the development site;
- The type of development (e.g. residential, industrial, commercial);
- The location of the development site;
- The sensitivity, importance and the potential for rehabilitation of the receiving waters;
- Existing Catchment and River Management Plans for the area;
- Existing Stormwater Masterplans for the area.

The criteria shall be reviewed from time to time by Council according to changing local circumstances and new advances in the field of WSUD and SUDS. The criteria are provided in the annexure to this policy, and revisions to the criteria may be adopted by Council without re-adoption of the entire Policy.

6.2.3 Approval of Stormwater Management Systems

Stormwater management systems for new development planned and designed in terms of this Policy must be approved by Council.

In certain circumstances, Council will require a stormwater management plan to be submitted.

6.2.4 Low Income and Informal Settlement Areas

Best management practices must be adapted to suit local circumstances, in particular in low income and informal areas where there is often a shortage of land making treatment at source impractical. Regional measures may be appropriate in these areas.

6.2.5 Planning Process

<u>Metro-wide Spatial Development Framework</u>

Issues relating to water, in particular receiving waters, must be included in the planning process in order to achieve sustainable outcomes. Sustainable use of water resources should consider water as an asset and within the context of the total urban water cycle. Stormwater drainage, nutrient management, WSUD, protection of water resources, water efficiency, recycling and re-use thus must form elements of holistic and integrated planning for the City; as such the aforementioned should be embodied in the Metro-wide Spatial Development Framework as well as into other regional spatial planning approaches and mechanisms.

<u>Local Planning</u>

Catchment and River Management Plans should be developed in order to inform regional and local planning processes. Close liaison is required between stormwater management practitioners and local area planners in preparing stormwater masterplans, as well as in the promotion of WSUD in urban subdivisions.

<u>Catchment Management Overlay Zones</u>

Protection and specific management needs of receiving waters (which include WSUD requirements), may be indicated by means of Catchment Management Overlay Zones in terms of Council's proposed Integrated Zoning Scheme.

6.2.6 Non-structural Measures

Non-structural measures (e.g. public awareness, education programmes, operating and maintenance practices) will supplement structural design and planning measures.

6.2.7 Integration into the Environment

Best management practices should promote urban biodiversity, and enhance the amenity and aesthetics of the development site and its surroundings.

6.2.8 Incentive Schemes

Council may introduce incentive schemes to promote and facilitate adoption of WSUD measures by private developers and individual households where appropriate.

6.2.9 Operation and Maintenance

Structural best management practices must be designed and constructed to facilitate and minimize operational and maintenance requirements.

6.2.10 Monitoring

The performance of stormwater treatment BMPs should be monitored on an ongoing basis and appropriate action taken where performance is unsatisfactory.

6.2.11 Water Sensitive Urban Design on Private Developments

Council may require BMP measures to be constructed and remain located within the boundaries of a private development. This is particularly applicable to private single erf developments or private enclosed and/or gated office parks, industrial parks, blocks of flats, group housing estates, or similar developments where the infrastructure within the boundary of the development site remains in private ownership.

Unless otherwise agreed by Council, where BMPs are located on such private land, responsibility for the operation, maintenance, monitoring (see 6.2.9 and 6.2.10 above) and continued effective functioning of the BMPs, including meeting the costs thereof, will lie with the property owner, body corporate or other appropriate legal representative body.

An agreement between the developer and Council to this effect will need to be concluded, or alternatively included in the body corporate/home owners' association constitution and approved by Council, before transfer of any property on the development site may take place. Such agreement will be made binding on the owner, and successors-in-title, or on the representative body concerned, as applicable. The agreement shall include, inter-alia, that monitoring results must to be made available to Council, and that Council will have the right to undertake auditing of the facilities (which may include its own monitoring and inspections), and require remedial measures to be implemented by the property owner should any facility fail to perform as required.

6.2.12 Alignment with Other Sustainability Programmes

Wherever possible, sustainable urban drainage systems should be combined with other WSUD programmes (such as reduction of potable water use through re-use of wastewater effluent, rainwater harvesting, stormwater re-use, etc.), and with other broader sustainability initiatives.

7 Scope and Application

This Policy is applicable to any land use, development or activity proposals within the metropolitan area of Cape Town draining to any watercourse, wetland or coastal area. It is further binding for both private individuals and businesses as well as for all organs of state.

This Policy relates to minimizing the impact of stormwater on receiving waters and is not intended to deal with all other aspects of stormwater management such as, *inter alia*, protection of property and community health and safety.

8 Outcomes

Application of this Policy in newly developing and existing areas will lead to:

- Minimisation of the impacts of stormwater from new developments on receiving waters such as watercourses, wetlands, coastal waters, etc
- Prevention of further degradation of receiving waters by stormwater draining from existing developments, as well as in the long term the reversal of current undesirable stormwater impacts.

9 Commencement Date

Unless otherwise specified, the commencement date for this Policy will be the date of adoption by Council.

10 General

10.1 Statutory Permits and Approvals

Certain WSUDS developments may be subject to approvals in terms of legislation by Provincial and National Government Departments.

Examples include, but are not limited to:

- Storing water
- Impeding or diverting the flow of water in a watercourse
- Altering the bed, banks, course or characteristics of a watercourse

10.2 Indemnity

This policy shall not create liability on the part of the City of Cape Town or any officer thereof, for any damage that may result from reliance thereon.

10.3 Copyright

ANNEXURE: INTERIM CRITERIA FOR ACHIEVING SUSTAINABLE URBAN DRAINAGE SYSTEM OBJECTIVES IN VARIOUS DEVELOPMENT SCENARIOS

SUDS **OBJECTIVES**	**Greenfield Developments** ***and*** **Brownfield and Existing Development Sites located in catchments of sensitive receiving water systems**	**Brownfield and Existing Development Sites** **> 50 000 m^2**	**Brownfield and Existing Development Sites** **4000 m^2 – 50 000 m^2** ***and*** **Total impervious area (exist & new) > 15% of site**	**Brownfield and Existing Development Sites** **< 4000 m^2** ***and*** **Total impervious area (exist and new) > 600m^2**
IMPROVE QUALITY OF RUNOFF *Remove pollutants through combination of reducing and/or disconnecting impervious areas, and the use of BMPs which infiltrate or capture and treat stormwater runoff*	Design storm event for water quality treatment: 1/2-year RI, 24 h storm			
	Pollutant removal target: Reduction of post-development annual stormwater pollutant load discharged from dev. site: SS & TP - reduce to undeveloped catchment levels, *or* SS - 80% reduction TP - 45% reduction *whichever requires higher level of treatment*	Pollutant removal target: On-site reduction of post-development annual stormwater pollutant load discharged from developmenrt site: SS - 80% reduction TP - 45% reduction	Pollutant removal target: Combination of on-site and regional off-site measures to achieve target reductions: SS - 80% reduction TP - 45% reduction	On-site stormwater treatment not required but encouraged where practicable. Regional off-site treatment measures to achieve target reductions: SS - 80% reduction TP - 45% reduction
	All developments are required to trap litter, oil, grease at source			

Table continued on next page….

<table>
<tr><th colspan="2"><u>SUDS</u>

<u>OBJECTIVES</u></th><th>Greenfield Developments

and

Brownfield and Existing Development Sites located in catchments of sensitive receiving water systems</th><th>Brownfield and Existing Development Sites

> 50 000 m^2</th><th>Brownfield and Existing Development Sites

4000 m^2 – 50 000 m^2

and

Total impervious area (exist & new) > 15% of site</th><th>Brownfield and Existing Development Sites

< 4000 m^2

and

Total impervious area (exist and new) > 600m^2</th></tr>
<tr><td rowspan="4"><u>CONTROL QUANTITY AND RATE OF RUNOFF</u></td><td>Protect the stability of downstream channels</td><td>24 hour extended detention of the1-year RI, 24h storm event</td><td>24 hour extended detention of the1-year RI, 24h storm event</td><td rowspan="3">Combination of on-site and regional off-site measures to achieve requirements as for development sites >50 000m^2</td><td rowspan="3">On-site runoff control measures not required but encouraged where practicable

Regional off-site runoff control measures to be provided to achieve requirements as for development sites > 50 000m^2</td></tr>
<tr><td>Protect downstream properties from fairly frequent nuisance floods</td><td>Up to 10-year RI peak flow reduced to pre-development level</td><td>Up to 10-year RI peak flow reduced to pre-development level</td></tr>
<tr><td rowspan="2">Protect floodplain developments and floodplains from adverse impacts of extreme floods</td><td>Up to 50-year RI peak flow reduced to existing development levels. Evaluate the effects of the 100-year RI storm event on the stormwater management system, adjacent property, and downstream facilities and property.
Manage the impacts through detention controls and / or floodplain management</td><td>Up to 50-year RI peak flow reduced to existing development levels. Evaluate the effects of the 100-year RI storm event on the stormwater management system, adjacent property, and downstream facilities and property.
Manage the impacts through detention controls and / or floodplain management</td></tr>
<tr><td colspan="4">Developments adjacent to floodplains must adhere to the requirements of the Floodplain and River Corridor Management Policy</td></tr>
<tr><td colspan="2"><u>ENCOURAGE NATURAL GROUNDWATER RECHARGE</u></td><td colspan="4">Where appropriate, site specific requirements to be considered in consultation with Council</td></tr>
</table>

NOTES:

1. Council shall impose additional requirements where it is of the opinion that specific pollutant threats pertaining to the nature of the new development may arise or where warranted by particular catchment or receiving water conditions.

2. Stormwater runoff quality and quantity control is to be achieved by reducing directly connected impervious areas and/or measures outlined in Council's Stormwater Management Planning and Design Guidelines for New Developments, Version 1.0, July 2002 as amended, and or other approved methods. All measures (BMPs) are to be sized and designed to meet the targets specified using best practice methodologies, parameters and assumptions approved by Council.

3. On-site measures refer to measures within the development site as a whole but may include measures on each subdivision unit. In general a treatment train approach shall be required using a combination of smaller BMPs upstream in the development to larger pond type measures at the downstream discharge point from the development.

4. In certain areas, different requirements may exist in terms of a Council approved regional Stormwater Masterplan. It is at Council discretion as to which requirements will apply.

5. For formal, low-income, national government subsidized housing, on-site treatment and/or runoff peak reduction requirements may be reduced where a regional stormwater masterplan is in place and provides for regional measures to reduce pollution and runoff peaks. On-site measures should however be located in parks and other public open spaces of such housing schemes where feasible.

6. For informal settlement areas, stormwater management measures should be in accordance with the City's draft document: Policy for Provision of Stormwater Services to Informal Areas, Version 1, Draft 2, March 2003, as ammended.

7. BMPs should promote urban biodiversity and enhance amenity and aesthetics of the site and its surroundings.

8. Definitions: TP = Total phosphorus; SS = Suspended solids; "design storm" = the rainfall storm used to size the treatment facility; RI = Recurrence Interval means the average interval in years between rainfall or flood events equaling or exceeding a specified severity.

ANNEXURE D

CITY OF CAPE TOWN'S SUSTAINABLE URBAN DRAINAGE SYSTEMS POLICY

PROJECT TITLE: Jagtershof School
PROJECT NO: 16431T
DATE: 14/10/2021

RATIONAL METHOD RAINFALL CALCULATION

INPUT Cells
Output Cells

Catchment:

	Enter catchment Areas	
Total Catchment Area	62600	Sqm
Total Catchment Area	6.26	ha
Catchment Area not contributing to runoff	0	ha
Catchment Area contributing to runoff	6.26	ha
Impervious Area of contributing Area	3	ha

Time of Concentration:

Compute time of concentration

	Total Catchment Area		Existing Developed Site	
	Pre-development	Post-development	Existing	
Surface				
Surface Description	sparse grass over fairly rough surface	paved areas	thick grass cover	
Roughness Coeficient 'r	0.3	0.02	0.8	r
Length of watercourse	0.415			km
Height	6			m
Sav	0.014457831			m/m
Defined watercourse				
Length of defined watercourse		0.28		km
Height		1.5		m
S_{av}		0.005357143		m/m
Pipeline				
Length of pipe		220		m
Assumed flow velocity		1		m/s

Overland flow T_c	36.834	0	0	minutes
Defined Watercourse T_c	0	2.145	0	minutes
Flow in pipe T_c	0	3.667	0	minutes
Total T_c	36.834	5.811	0.000	minutes
T_c to be used	36.834	15.000	15.000	minutes

Minimum Tc of 15 minutes

Storm Rainfall:

	Total Catchment Area		Existing Developed Site
	Pre-dev	Post-dev	Existing
Return Interval	(mm/hr)	(mm/hr)	(mm/hr)
1/2	10	16	16
1	16	26	26
2	23	38	38
5	31	51	51
10	37	60	60
20	43	70	70
50	51	84	84
100	58	95	95
200	66	107	107

Rational Method: Runoff coefficients:

Populate C factors for each sub area in the Catchment (refer to recommended values in table)

	Combined	Area 1		Area 2		Area 3		Area 4		Area 4	
	C	%	C	%	C	%	C	%	C	%	C
Total Catchment Area											
C - before any development (greenfield)	0.1	100	0.1								
C- after development	0.35	50	0.6	50	0.1						
Existing Developed Site											
C - existing	0	0	0								

Peak Flows:

	Total Catchment Area		Existing Developed Site
	Pre-development (green field)	Post-development (No Attenuation)	Existing
1 in	(m³/s)	(m³/s)	(m³/s)
1/2	0.017	0.097	0.000
1	0.028	0.158	0.000
2	0.040	0.231	0.000
5	0.054	0.310	0.000
10	0.064	0.365	0.000
20	0.075	0.426	0.000
50	0.089	0.511	0.000
100	0.101	0.578	0.000
200	0.115	0.651	0.000

RECOMMENDED VALUES OF RUN-OFF FACTOR C

RURAL C_1				
COMPONENT	CLASSIFICATION	MEAN AVERAGE RAINFALL (mm) 600	600-900	900
SURFACE SLOPE Ch	VLEI'S AND PANS (<3%)	0,01	0,03	0,05
	FLAT AREAS (3 TO 10%)	0,06	0,08	0,11
	HILLY (10 TO 30%)	0,12	0,16	0,20
	STEEP AREAS (>30%)	0,22	0,26	0,30
PERMEABLITY Cd	VERY PERMEABLE	0,03	0,04	0,05
	PERMEABLE	0,06	0,08	0,10
	SEMI-PERMEABLE	0,12	0,16	0,20
	IMPERMEABLE	0,21	0,26	0,30
VEGETATION Cp	THICK BUSH AND PLANTATION	0,03	0,04	0,05
	LIGHT BUSH AND FARM-LANDS	0,07	0,11	0,15
	GRASS-LANDS	0,17	0,21	0,25
	NO VEGETATION	0,26	0,28	0,30

RETURN PERIOD (YEARS)	100	50	20	10	5	2
ADJUSTMENT FACTOR Ft	1,00	0,95	0,90	0,85	0,80	0,75

URBAN C_2	
USE	FACTOR
LAWNS	
SANDY, FLAT (2%)	0,05-0,10
SANDY, STEEP (7%)	0,15-0,20
HEAVY SOIL, FLAT (2%)	0,13-0,17
HEAVY SOIL, STEEP(7%)	0,25-0,35
RESIDENTIAL AREAS	
HOUSES	0,30-0,50
FLATS	0,50-0,70
INDUSTRY	
LIGHT INDUSTRY	0,50-0,80
HEAVY INDUSTRY	0,60-0,90
BUSINESS	
CITY CENTRE	0,70-0,95
SUBURBAN	0,50-0,70
STREETS	0,70-0,95
MAXIMUM FLOOD	1,00

Total Catchment Area

Recurrence Interval 1:	1	2	5	10	20	50	yrs
Q: Outflow (Pre Development)	0.028	0.040	0.054	0.064	0.075	0.089	m³/s
Required Attenuation volume	164	235	315	373	430	519	m³

Water Quality Requirements:

$W_{QV\ unadjusted}$	675	m³
$W_{QV\ adjusted}$	675	m³
Q FOR 1 IN ½ YEAR 24HR RI	0.097	m³/s

Adjusted volume based on Mass Balance approach

Extended Detention Requirements:

W_{ED}	202	m³
W_{ED}	164	m³
Maximum Allowable Rate of Discharge	0.009	m³/s

Abt and Grigg Method (1978)
Hydrographs

PROJECT TITLE: Jagtershof School
PROJECT NO: 16431T
DATE: 14/10/2021

INPUT Cells
Output Cells

WATER QUALITY VOLUME - (½ Year Return Period)

WQv = PRvA/1000	$WQ_{v=}$	**Water Quality Volume**
	P =	**Precipitation to be included**
	$R_{v=}$	**Volumetric runoff coefficient**
	A =	**Area in m^2**
	$R_v =$	**0.05 + .009I**

Water Quality Volume Calc

Total Area	6.26	ha
P	22.41	mm
Impervious Area	3.00	ha
I (%)	47.92	
R_v	0.48	
WQ_v	675	m^3

ADJUSTMENT OF WATER QUALITY VOLUME (W_{QV}) BASED ON A MASS BALANCE APPROACH

Description		Land Use Type	Area		%
General Land Use		Other Urban	72900	m² area	100%
Predominant Land Surface		Other Urban	72900	m² area	100%

$$\frac{WQV_2}{WQV_1} = \frac{C_2 - (1 - R_{eff}) \times C_1}{R_{eff} \times C_2}$$

Where:

WQV_1	Water quality volume as specified in the Policy (i.e. the runoff from the ½ y 24h storm)
WQV_1	adjusted WQV based on the predominant land surface draining to the facility
R_{eff}	treatment facility removal efficiency (decimal fraction)
C_1 , C_2	pollutant concentration for the gerenal land useage (1) and the predominant land surface (2)

Pollutant	**Pollutant Median Concentration (Fig 3.3 / 3.4)**			$\frac{WQV_2}{WQV_1}$
	Other Urban	**Other Urban**		
	C_1 (mg/l)	**C_2 (mg/l)**	**R_{eff} ***	
TSS	180	180	0.8	1
TP	0.31	0.31	0.45	1

* As per Policy: 80% removal of TSS, 45% removal of TP

The adjusted WQV for sizing the treatment facility would be based on the larger of the ratios (WQV_2)/(WQV_1) in the last column,

Therefore the water quality volume facility can be sized for a WQ_V of:

1 x 675.33 = **675** m³

PROJECT TITLE: Jagtershof School
PROJECT NO: 16431T
DATE: 14/10/2021

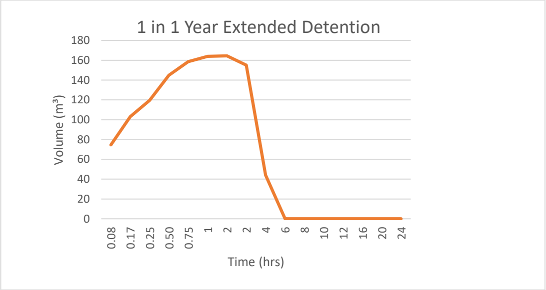
ATTENUATION CATCHMENT CALCULATIONS

Developed Entire Catchment Attenuation requirements:

Recurrence Interval 1:	1	2	5	10	20	50	yrs
Q: Outflow (Pre Development)	0.028	0.04	0.054	0.064	0.075	0.089	m^3/s
Required Attenuation volume	164	235	315	373	430	519	m^3

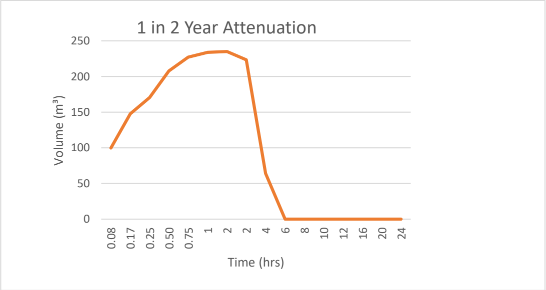
1 in 1

Dur		Rain Int	Runoff rate	Outflow rate	Storage rate	Gross Storage
min	Hr	mm/h	m^3/h	m^3/h	m^3/h	m^3
5	0.08	47.19	1034	101	933	75
10	0.17	32.28	707	101	606	103
15	0.25	26.43	579	101	478	120
30	0.50	17.83	391	101	290	145
45	0.75	14.25	312	101	211	159
60	1	12.09	265	101	164	164
90	2	9.61	210	101	110	164
120	2	8.14	178	101	78	155
240	4	5.10	112	101	11	44
360	6	3.90	85	101	-15	0
480	8	3.20	70	101	-31	0
600	10	2.76	61	101	-40	0
720	12	2.44	54	101	-47	0
960	16	2.02	44	101	-57	0
1200	20	1.73	38	101	-63	0
1440	24	1.53	34	101	-67	0



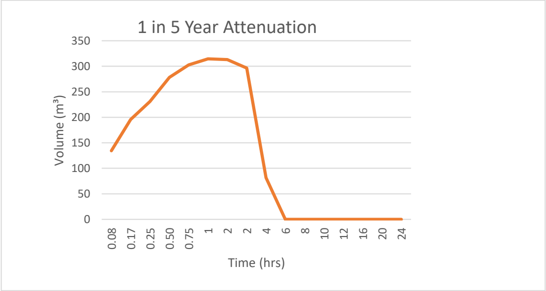
1 in 2

Dur		Rain Int	Runoff rate	Outflow rate	Storage rate	Gross Storage
min	Hr	mm/h	m^3/h	m^3/h	m^3/h	m^3
5	0.08	63.48	1391	144	1247	100
10	0.17	46.23	1013	144	869	148
15	0.25	37.72	826	144	682	171
30	0.50	25.53	559	144	415	208
45	0.75	20.39	447	144	303	227
60	1	17.25	378	144	234	234
90	2	13.72	301	144	157	235
120	2	11.67	256	144	112	223
240	4	7.30	160	144	16	64
360	6	5.58	122	144	-22	0
480	8	4.59	100	144	-44	0
600	10	3.96	87	144	-57	0
720	12	3.50	77	144	-67	0
960	16	2.88	63	144	-81	0
1200	20	2.48	54	144	-90	0
1440	24	1.88	41	144	-103	0



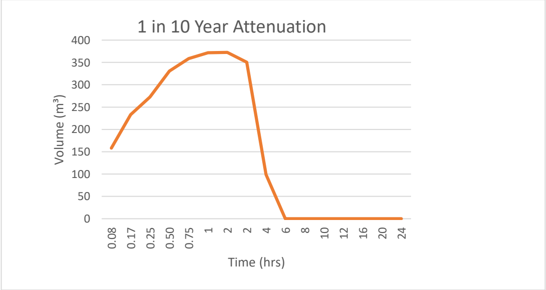
1 in 5

Dur		Rain Int	Runoff rate	Outflow rate	Storage rate	Gross Storage
min	Hr	mm/h	m^3/h	m^3/h	m^3/h	m^3
5	0.08	85.56	1875	194	1680	134
10	0.17	61.41	1345	194	1151	196
15	0.25	51.06	1119	194	924	231
30	0.50	34.27	751	194	556	278
45	0.75	27.29	598	194	404	303
60	1	23.23	509	194	315	315
90	2	18.40	403	194	209	313
120	2	15.64	343	194	148	297
240	4	9.80	215	194	20	82
360	6	7.48	164	194	-31	0
480	8	6.15	135	194	-60	0
600	10	5.30	116	194	-78	0
720	12	4.69	103	194	-92	0
960	16	3.87	85	194	-110	0
1200	20	3.32	73	194	-122	0
1440	24	2.53	55	194	-139	0



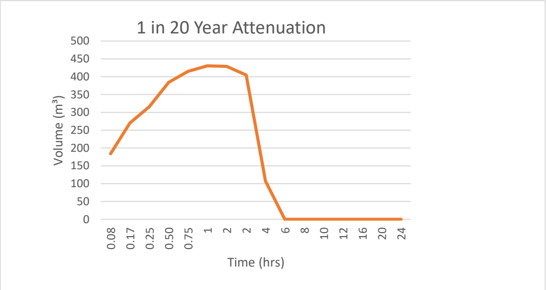
1 in 10

Dur		Rain Int	Runoff rate	Outflow rate	Storage rate	Gross Storage
min	Hr	mm/h	m^3/h	m^3/h	m^3/h	m^3
5	0.08	100.74	2207	230	1977	158
10	0.17	73.14	1602	230	1372	233
15	0.25	60.26	1320	230	1090	272
30	0.50	40.71	892	230	662	331
45	0.75	32.35	709	230	478	359
60	1	27.49	602	230	372	372
90	2	21.85	479	230	248	373
120	2	18.52	406	230	175	351
240	4	11.64	255	230	25	99
360	6	8.86	194	230	-36	0
480	8	7.30	160	230	-70	0
600	10	6.28	138	230	-93	0
720	12	5.56	122	230	-109	0
960	16	4.58	100	230	-130	0
1200	20	3.94	86	230	-144	0
1440	24	3.00	66	230	-165	0



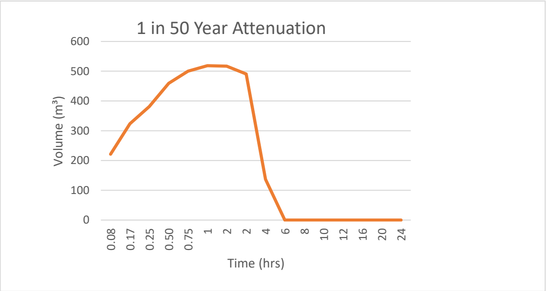
Dur		Rain Int	Runoff rate	Outflow rate	Storage rate	Gross Storage
min	Hr	mm/h	m³/h	m³/h	m³/h	m³
5	0.08	117.30	2570	270	2300	184
10	0.17	84.87	1860	270	1590	270
15	0.25	69.92	1532	270	1262	315
30	0.50	47.38	1038	270	768	384
45	0.75	37.57	823	270	553	415
60	1	31.97	700	270	430	430
90	2	25.38	556	270	286	429
120	2	21.56	472	270	202	405
240	4	13.54	297	270	27	107
360	6	10.29	226	270	-44	0
480	8	8.48	186	270	-84	0
600	10	7.30	160	270	-110	0
720	12	6.46	142	270	-128	0
960	16	5.33	117	270	-153	0
1200	20	4.58	100	270	-170	0
1440	24	3.49	76	270	-194	0

1 in 20



Dur		Rain Int	Runoff rate	Outflow rate	Storage rate	Gross Storage
min	Hr	mm/h	m³/h	m³/h	m³/h	m³
5	0.08	140.76	3084	320	2764	221
10	0.17	101.43	2222	320	1902	323
15	0.25	84.18	1844	320	1524	381
30	0.50	56.58	1240	320	919	460
45	0.75	45.08	988	320	667	500
60	1	38.30	839	320	519	519
90	2	30.36	665	320	345	517
120	2	25.82	566	320	245	491
240	4	16.19	355	320	34	137
360	6	12.32	270	320	-50	0
480	8	10.16	223	320	-98	0
600	10	8.74	191	320	-129	0
720	12	7.73	169	320	-151	0
960	16	6.38	140	320	-181	0
1200	20	5.49	120	320	-200	0
1440	24	4.17	91	320	-229	0

1 in 50



ANNEXURE E

STORMWATER CALCULATIONS

PROJECT TITLE:	ERF 6482 - Grass Park
PROJECT NO:	16894T
DATE:	10/03/2025

RATIONAL METHOD RAINFALL CALCULATION

INPUT Cells
Output Cells

Catchment:

	Enter catchment Areas	
Total Catchment Area	51140	Sqm
Total Catchment Area	5.114	ha
Catchment Area not contributing to runoff	0	ha
Catchment Area contributing to runoff	5.114	ha
Impervious Area of contributing Area	0	ha

Time of Concentration:

Compute time of concentration

	Total Catchment Area		Existing Developed Site	
	Pre-development	Post-development	Existing	
Surface				
Surface Description	thick grass cover	paved areas	thick grass cover	
Roughness Coeficient 'r	0.8	0.02	0.8	r
Length of watercourse	0.365			km
Height	6			m
Sav	0.016438356			m/m
Defined watercourse				
Length of defined watercourse		1		km
Height		6		m
S_{av}		0.006		m/m
Pipeline				
Length of pipe				m
Assumed flow velocity		1		m/s

Overland flow T_c	53.225	0	0	minutes	
Defined Watercourse T_c	0	26.187	0	minutes	
Flow in pipe T_c	0	0	0	minutes	
Total T_c	53.225	26.187	0.000	minutes	
T_c to be used	53.225	26.187	15.000	minutes	Minimum Tc of 15 minutes

Storm Rainfall:

	Total Catchment Area		Existing Developed Site
	Pre-dev	Post-dev	Existing
Return Interval	(mm/hr)	(mm/hr)	(mm/hr)
1/2	9	13	17
1	15	22	28
2	21	31	40
5	28	42	54
10	34	50	64
20	39	58	75
50	47	69	90
100	53	79	102
200	60	89	115

Rational Method: Runoff coefficients:

Populate C factors for each sub area in the Catchment (refer to recommended values in table)

	Combined	Area 1		Area 2		Area 3		Area 4		Area 4	
	C	%	C	%	C	%	C	%	C	%	C
Total Catchment Area											
C - before any development (greenfield)	0.2	100	0.2								
C- after development	0.7	100	0.7								
Existing Developed Site											
C - existing	0	0	0								

Peak Flows:

	Total Catchment Area		Existing Developed Site
	Pre-development (green field)	Post-development (No Attenuation)	Existing
1 in	(m^3/s)	(m^3/s)	(m^3/s)
1/2	0.026	0.129	0.000
1	0.043	0.219	0.000
2	0.060	0.308	0.000
5	0.080	0.418	0.000
10	0.097	0.497	0.000
20	0.111	0.577	0.000
50	0.134	0.686	0.000
100	0.151	0.786	0.000
200	0.170	0.885	0.000

RECOMMENDED VALUES OF RUN-OFF FACTOR C

RURAL C_1				
COMPONENT	CLASSIFICATION	MEAN AVERAGE RAINFALL (mm) 600	600-900	900
SURFACE SLOPE Ch	VLEI'S AND PANS (<3%)	0,01	0,03	0,05
	FLAT AREAS (3 TO 10%)	0,06	0,08	0,11
	HILLY (10 TO 30%)	0,12	0,16	0,20
	STEEP AREAS (>30%)	0,22	0,26	0,30
PERMEABLITY Cd	VERY PERMEABLE	0,03	0,04	0,05
	PERMEABLE	0,06	0,08	0,10
	SEMI-PERMEABLE	0,12	0,16	0,20
	IMPERMEABLE	0,21	0,26	0,30
VEGETATION Cp	THICK BUSH AND PLANTATION	0,03	0,04	0,05
	LIGHT BUSH AND FARM-LANDS	0,07	0,11	0,15
	GRASS-LANDS	0,17	0,21	0,25
	NO VEGETATION	0,26	0,28	0,30

RETURN PERIOD (YEARS)	100	50	20	10	5	2
ADJUSTMENT FACTOR Ft	1,00	0,95	0,90	0,85	9,80	0,75

URBAN C_2	
USE	FACTOR
LAWNS	
SANDY, FLAT (2%)	0,05-0,10
SANDY, STEEP (7%)	0,15-0,20
HEAVY SOIL, FLAT (2%)	0,13-0,17
HEAVY SOIL, STEEP(7%)	0,25-0,35
RESIDENTIAL AREAS	
HOUSES	0,30-0,50
FLATS	0,50-0,70
INDUSTRY	
LIGHT INDUSTRY	0,50-0,80
HEAVY INDUSTRY	0,60-0,90
BUSINESS	
CITY CENTRE	0,70-0,95
SUBURBAN	0,50-0,70
STREETS	0,70-0,95
MAXIMUM FLOOD	1,00

Total Catchment Area

Recurrence Interval 1:	1	2	5	10	20	50	yrs
Q: Outflow (Pre Development)	0.043	0.060	0.080	0.097	0.111	0.134	m^3/s
Required Attenuation volume	376	548	741	862	1016	1205	m^3

Water Quality Requirements:

$W_{QV\ unadjusted}$	75	m^3
$W_{QV\ adjusted}$	75	m^3
Q FOR 1 IN ½ YEAR 24HR RI	0.129	m^3/s

Adjusted volume based on Mass Balance approach

Extended Detention Requirements:

W_{ED}	428	m^3
W_{ED}	376	m^3
Maximum Allowable Rate of Discharge	0.020	m^3/s

Abt and Grigg Method (1978)
Hydrographs

PROJECT TITLE: ERF 6482 - Grass Park
PROJECT NO: 16894T
DATE: 10/03/2025

INPUT Cells
Output Cells

WATER QUALITY VOLUME - (½ Year Return Period)

WQv = PRvA/1000	**WQ_v =**	**Water Quality Volume**
	P =	**Precipitation to be included**
	R_v =	**Volumetric runoff coefficient**
	A =	**Area in m^2**
	R_v =	**0.05 + .009I**

Water Quality Volume Calc

Total Area	5.11	ha
P	29.16	mm
Impervious Area	0.00	ha
I (%)	0.00	
R_v	0.05	
WQ_v	75	m^3

ADJUSTMENT OF WATER QUALITY VOLUME (W_{QV}) BASED ON A MASS BALANCE APPROACH

Description		Land Use Type	Area		%
General Land Use		Residential	51138.6	m² area	100%
Predominant Land Surface		Residential	51138.6	m² area	100%

$$\frac{WQV_2}{WQV_1} = \frac{C_2 - (1 - R_{eff}) \times C_1}{R_{eff} \times C_2}$$

Where:

WQV_1	Water quality volume as specified in the Policy (i.e. the runoff from the ½ y 24h storm)
WQV_1	adjusted WQV based on the predominant land surface draining to the facility
R_{eff}	treatment facility removal efficiency (decimal fraction)
C_1 , C_2	pollutant concentration for the gerenal land useage (1) and the predominant land surface (2)

Pollutant	**Pollutant Median Concentration (Fig 3.3 / 3.4)**			$\frac{WQV_2}{WQV_1}$
	Residential	**Residential**		
	C_1 (mg/l)	**C_2 (mg/l)**	**R_{eff} ***	
TSS	140	140	0.8	1
TP	0.40	0.40	0.45	1

* As per Policy: 80% removal of TSS, 45% removal of TP

The adjusted WQV for sizing the treatment facility would be based on the larger of the ratios (WQV_2)/(WQV_1) in the last column,

Therefore the water quality volume facility can be sized for a WQ_V of:

1 x 74.56 = 75 m³

PROJECT TITLE: ERF 6482 - Grass Park
PROJECT NO: 16894T
DATE: 10/03/2025

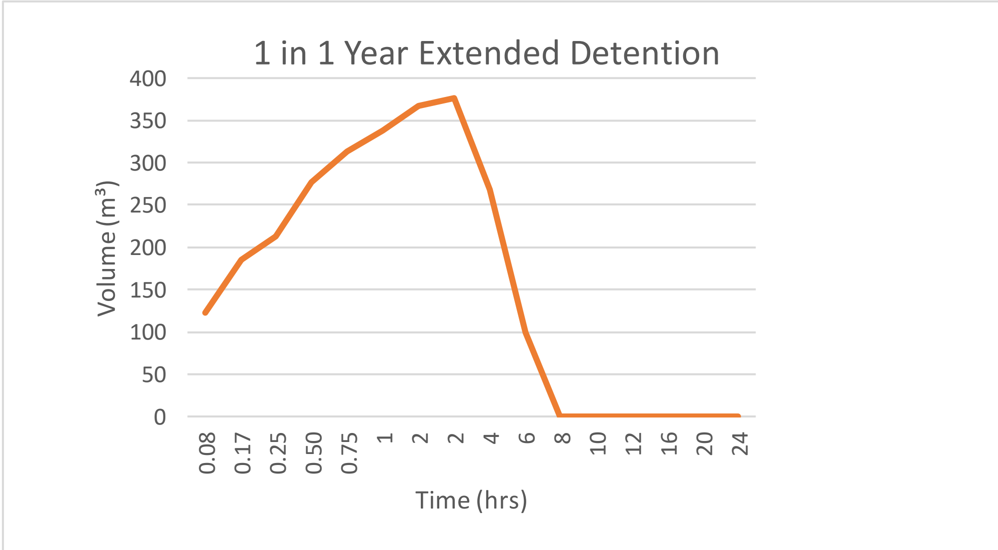
ATTENUATION CATCHMENT CALCULATIONS

Developed Entire Catchment Attenuation requirements:

Recurrence Interval 1:	1	2	5	10	20	50	yrs
Q: Outflow (Pre Development)	0.043	0.06	0.08	0.097	0.111	0.134	m^3/s
Required Attenuation volume	376	548	741	862	1016	1205	m^3

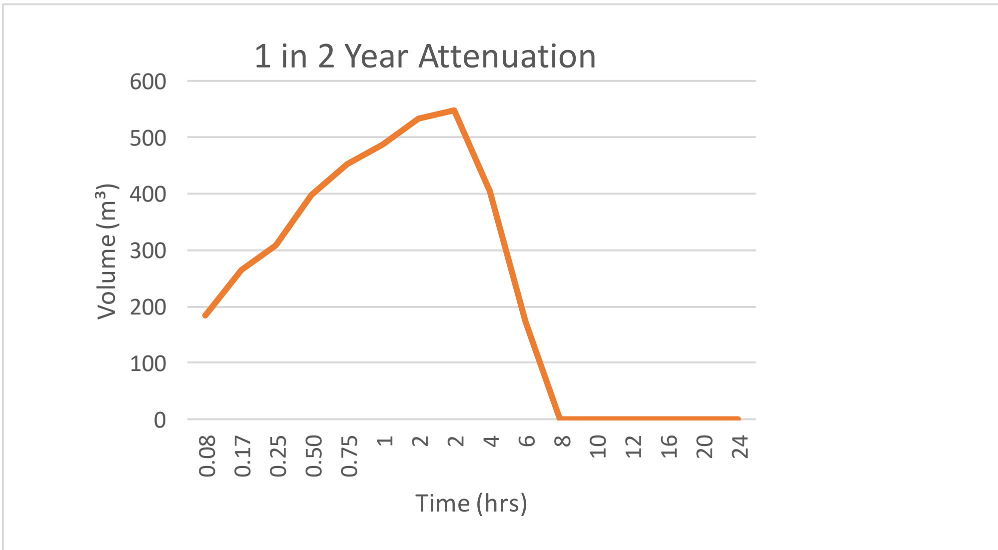
1 in 1

Dur		Rain Int	Runoff rate	Outflow rate	Storage rate	Gross Storage
min	Hr	mm/h	m^3/h	m^3/h	m^3/h	m^3
5	0.08	47.19	1689	155	1535	123
10	0.17	34.64	1240	155	1085	184
15	0.25	28.10	1006	155	851	213
30	0.50	19.77	708	155	553	276
45	0.75	15.97	572	155	417	313
60	1	13.75	492	155	337	337
90	2	11.16	400	155	245	367
120	2	9.58	343	155	188	376
240	4	6.19	222	155	67	268
360	6	4.78	171	155	16	99
480	8	3.99	143	155	-12	0
600	10	3.46	124	155	-31	0
720	12	3.09	111	155	-44	0
960	16	2.58	92	155	-63	0
1200	20	2.24	80	155	-75	0
1440	24	1.99	71	155	-83	0



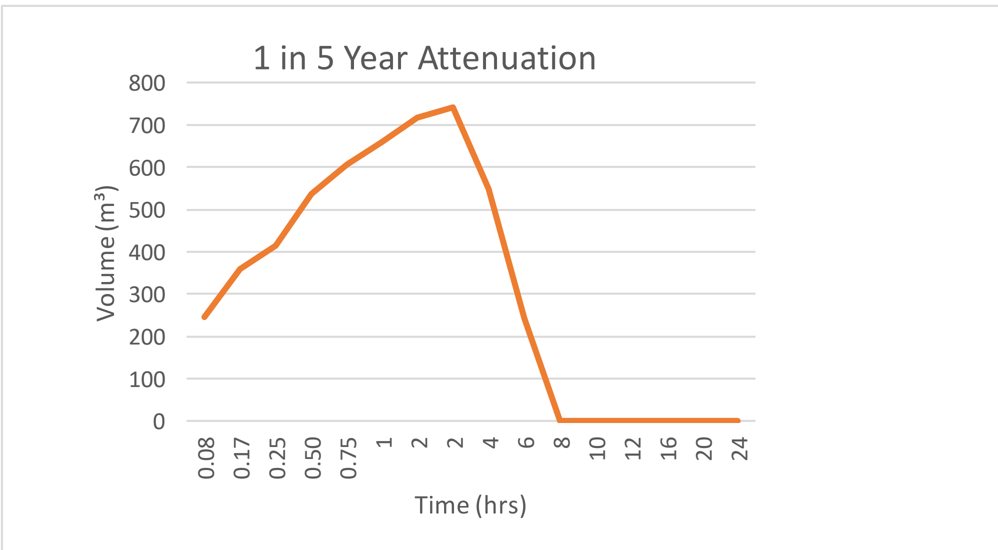
1 in 2

Dur		Rain Int	Runoff rate	Outflow rate	Storage rate	Gross Storage
min	Hr	mm/h	m^3/h	m^3/h	m^3/h	m^3
5	0.08	70.38	2519	216	2303	184
10	0.17	49.68	1778	216	1562	266
15	0.25	40.48	1449	216	1233	308
30	0.50	28.29	1013	216	797	398
45	0.75	22.85	818	216	602	451
60	1	19.67	704	216	488	488
90	2	15.95	571	216	355	532
120	2	13.69	490	216	274	548
240	4	8.86	317	216	101	404
360	6	6.84	245	216	29	174
480	8	5.71	204	216	-12	0
600	10	4.96	177	216	-39	0
720	12	4.42	158	216	-58	0
960	16	3.69	132	216	-84	0
1200	20	3.20	115	216	-101	0
1440	24	2.45	88	216	-128	0



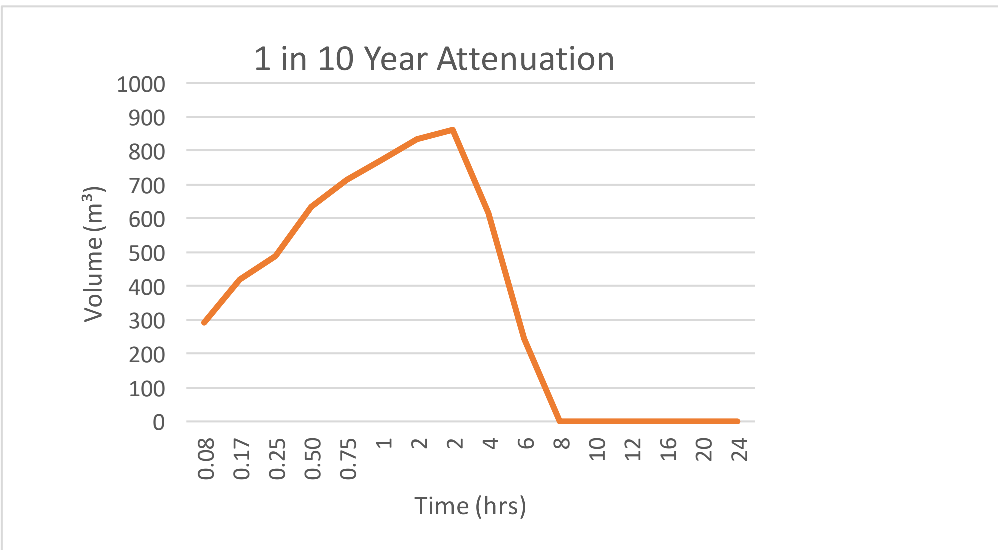
1 in 5

Dur		Rain Int	Runoff rate	Outflow rate	Storage rate	Gross Storage
min	Hr	mm/h	m^3/h	m^3/h	m^3/h	m^3
5	0.08	93.84	3359	288	3071	246
10	0.17	66.93	2396	288	2108	358
15	0.25	54.28	1943	288	1655	414
30	0.50	37.95	1359	288	1071	535
45	0.75	30.67	1098	288	810	607
60	1	26.45	947	288	659	659
90	2	21.39	766	288	478	717
120	2	18.40	659	288	371	741
240	4	11.87	425	288	137	548
360	6	9.18	329	288	41	244
480	8	7.66	274	288	-14	0
600	10	6.65	238	288	-50	0
720	12	5.93	212	288	-76	0
960	16	4.95	177	288	-111	0
1200	20	4.30	154	288	-134	0
1440	24	3.29	118	288	-170	0



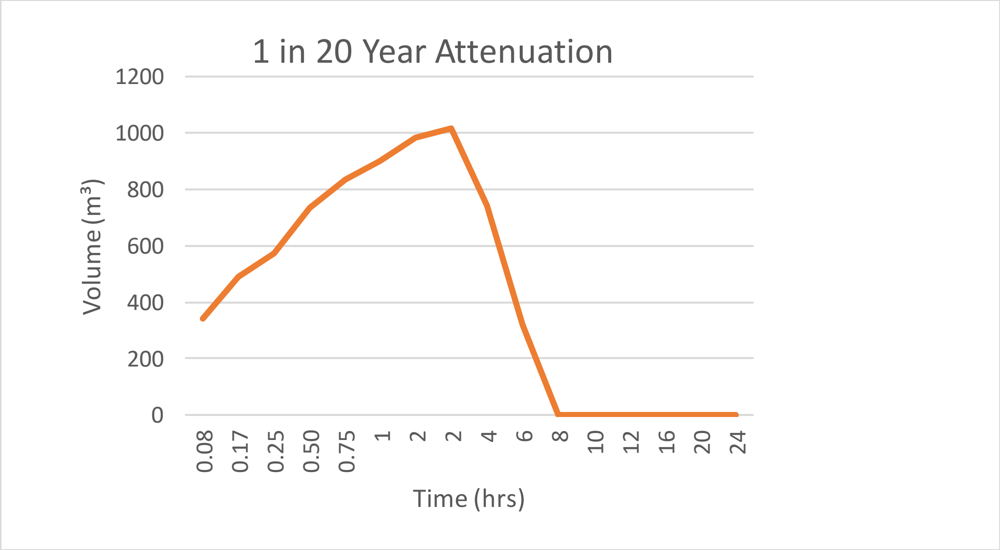
1 in 10

Dur		Rain Int	Runoff rate	Outflow rate	Storage rate	Gross Storage
min	Hr	mm/h	m^3/h	m^3/h	m^3/h	m^3
5	0.08	111.78	4002	349	3652	292
10	0.17	78.66	2816	349	2467	419
15	0.25	64.40	2305	349	1956	489
30	0.50	45.08	1614	349	1265	632
45	0.75	36.34	1301	349	952	714
60	1	31.28	1120	349	771	771
90	2	25.30	906	349	556	835
120	2	21.79	780	349	431	862
240	4	14.06	503	349	154	616
360	6	10.89	390	349	41	243
480	8	9.09	325	349	-24	0
600	10	7.89	282	349	-67	0
720	12	7.02	251	349	-98	0
960	16	5.86	210	349	-140	0
1200	20	5.09	182	349	-167	0
1440	24	3.90	140	349	-210	0



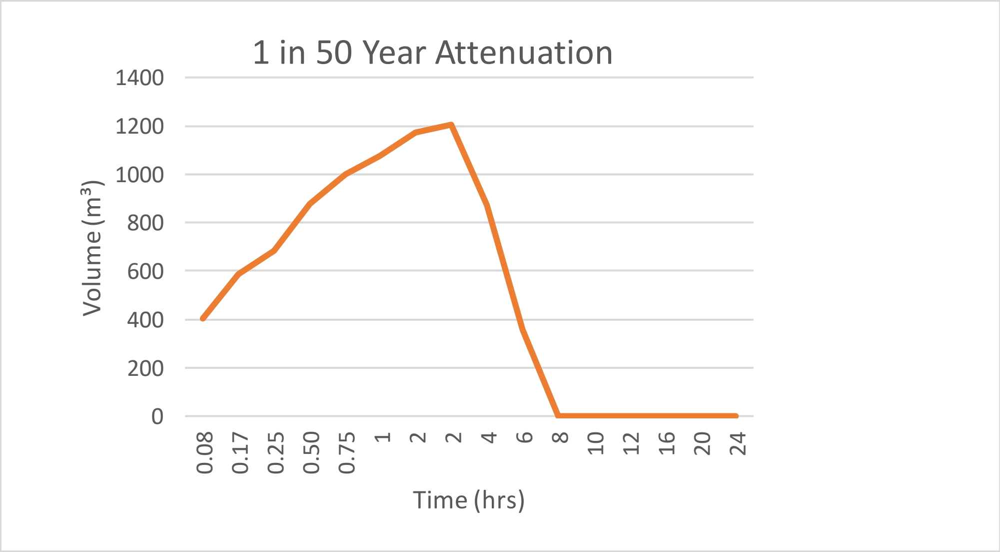
1 in 20

Dur		Rain Int	Runoff rate	Outflow rate	Storage rate	Gross Storage
min	Hr	mm/h	m³/h	m³/h	m³/h	m³
5	0.08	129.72	4644	400	4244	340
10	0.17	91.77	3285	400	2886	491
15	0.25	74.98	2684	400	2285	571
30	0.50	52.21	1869	400	1469	735
45	0.75	42.32	1515	400	1115	837
60	1	36.34	1301	400	901	901
90	2	29.44	1054	400	654	981
120	2	25.36	908	400	508	1016
240	4	16.36	586	400	186	744
360	6	12.65	453	400	53	319
480	8	10.55	378	400	-22	0
600	10	9.17	328	400	-71	0
720	12	8.17	293	400	-107	0
960	16	6.81	244	400	-156	0
1200	20	5.92	212	400	-188	0
1440	24	4.53	162	400	-237	0



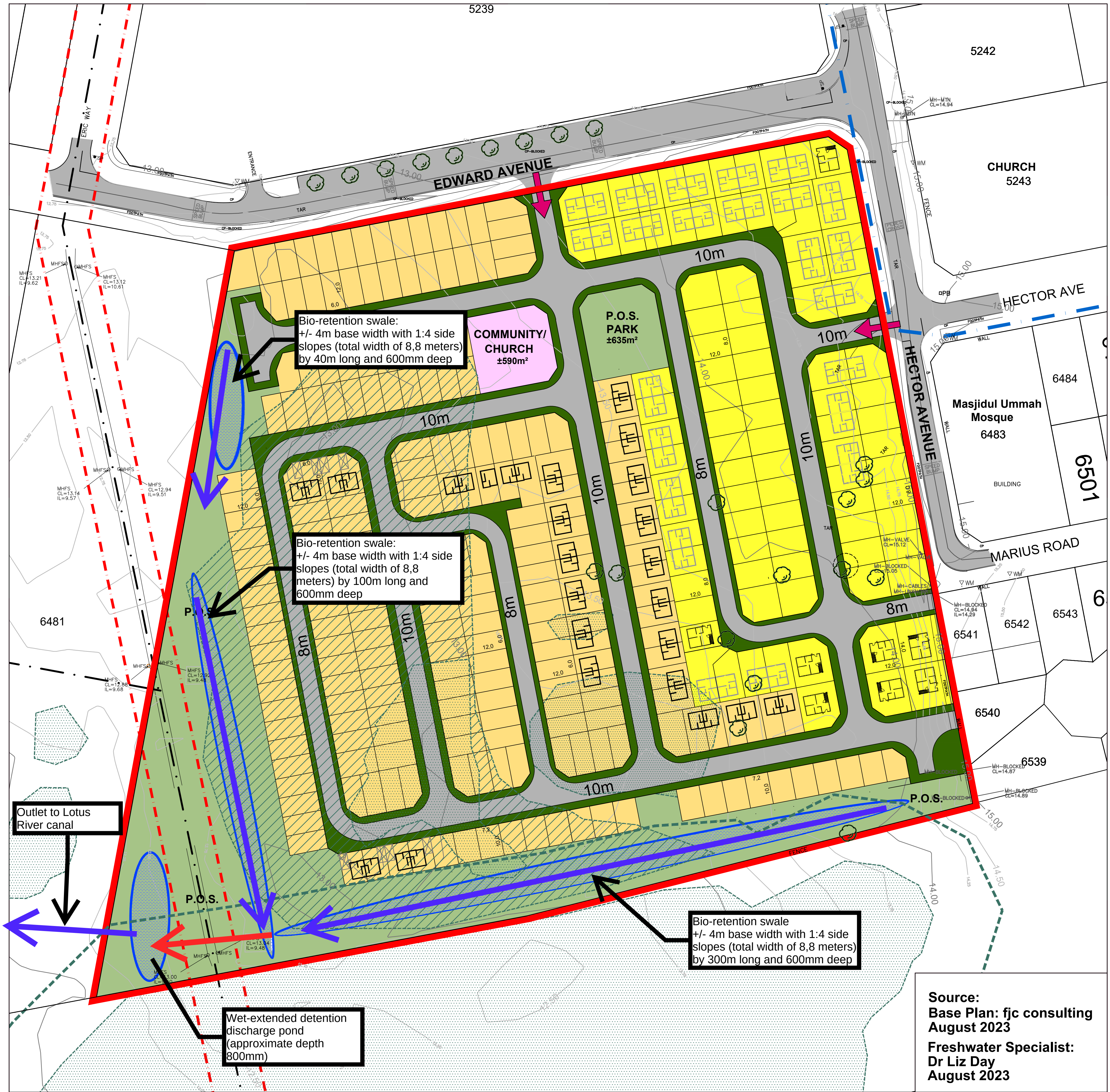
1 in 50

Dur		Rain Int	Runoff rate	Outflow rate	Storage rate	Gross Storage
min	Hr	mm/h	m³/h	m³/h	m³/h	m³
5	0.08	154.56	5533	482	5051	404
10	0.17	109.71	3927	482	3445	586
15	0.25	89.70	3211	482	2729	682
30	0.50	62.56	2240	482	1757	879
45	0.75	50.60	1811	482	1329	997
60	1	43.59	1560	482	1078	1078
90	2	35.27	1262	482	780	1170
120	2	30.30	1085	482	602	1205
240	4	19.58	701	482	218	874
360	6	15.14	542	482	60	358
480	8	12.64	452	482	-30	0
600	10	10.97	393	482	-90	0
720	12	9.78	350	482	-132	0
960	16	8.16	292	482	-190	0
1200	20	7.08	254	482	-229	0
1440	24	5.43	194	482	-288	0



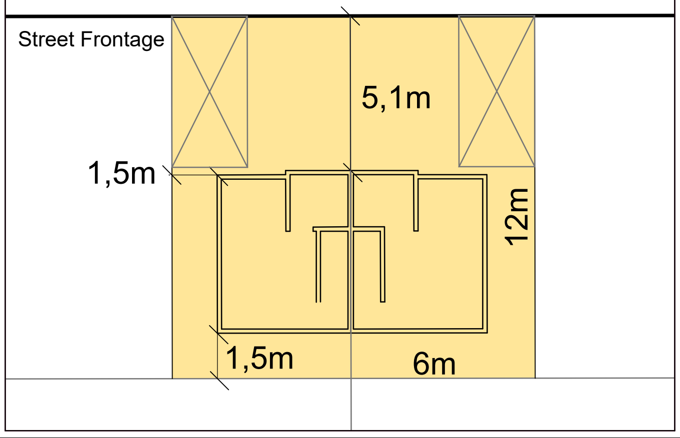
ANNEXURE F

PROPOSED STORMWATER

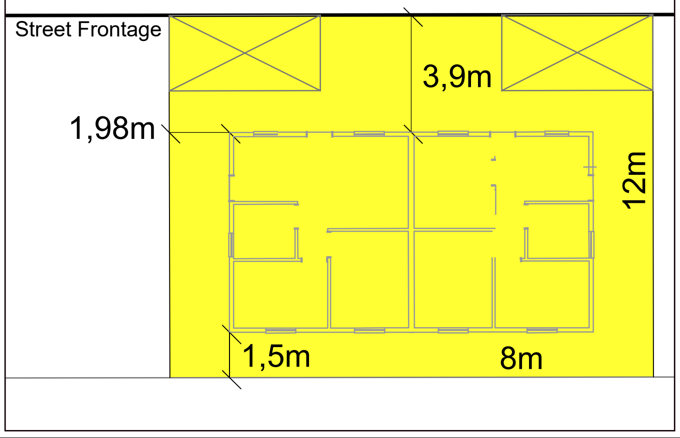


Source:
Base Plan: fjc consulting
August 2023
Freshwater Specialist:
Dr Liz Day
August 2023

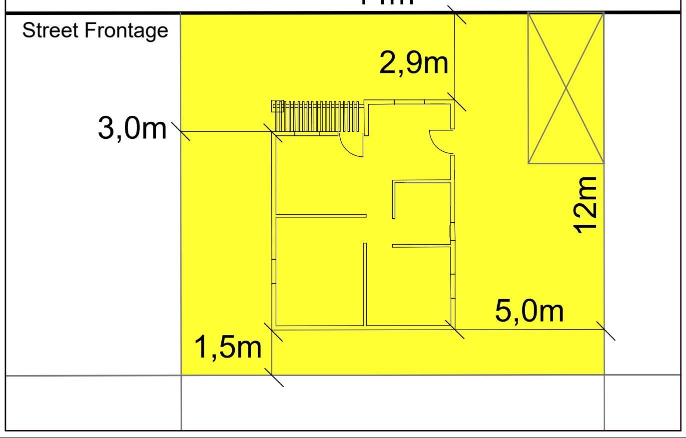
Unit = 45,5m²
Erf = 72m²
2 Storey Units



Unit = 40m²
Erf = 96m²
Single Storey Units



Unit = 45,6m²
Erf = 168m²
Single Storey Veterian Units



THE SITE
WETLAND
INFILL
20m OFFSET BUFFER
WATER PIPE
SEWAGE PIPE
SERVITUDE
VEGETATION
ACCESS
STORMWATER ATTENUATION POND / SWALE
Average Erf Size 8 x 12 = 96m² 95 Units
Average Erf Size 6 x 12 = 72m² 228 Units

ERF 6482 GRASSY PARK

SINGLE & 2 STOREY WALK UPS

N
SCALE 1:1250

PLANNING PARTNERS

NOVEMBER 2023
JOB No 4436

Option 6

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