

Stormwater Management Plan

**DEVELOPMENT OF A PORTION OF THE
REMAINDER OF ERVEN 464 GEORGE, 324 AND
2819 PACALTS DORP (GWAYANG
DEVELOPMENT SITE)**

George Municipality

Submission date: 2024/06/14

Document number: 1004332-000-REP-CC-2402

Revision: Rev 0

Document control record

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Document Control						
Project name		Development of a Portion of the Remainder of Erven 464 George, 324 and 2819 Pacaltsdorp (Gwayang Development Site)				
Document number		1004332-000-REP-CC-2402	Project number		1004332	
Client		George Municipality				
Client contact		Ms Lynette Groenewald	Client reference		Gwayang Development	
Rev	Date	Revision details/status	Author	Reviewer	Verifier (if required)	Approver
0	2024/06/14	Draft	M van Wyk	R Schröder	N/A	M Botha
Current revision		Rev 0				

Approval			
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Draft Site Development Plan

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Typical Energy Dissipation and stormwater Details

1 Introduction

1.1 Background to Report

The George Municipal area has seen a period of rapid growth in recent years, resulting in an increased demand for affordable housing and commercial properties.

The preliminary project proposal is to prepare the entire property for full development of the site, in a phased manner, to include the following components:

- a) A municipal utility area component;
- b) A heavy industry precinct;
- c) A light industry component;
- d) A residential area including various typologies and urban-living supportive uses;
- e) A continuous and sustainable conservation/open space system which ties into a sustainable urban drainage system (SUDS);
- f) A tourism/trade corridor area and urban gateway uses; and
- g) Possible Energy projects.

The ultimate intent of the Municipality is to create fully serviced erven for sale, if required, to support an integrated mixed-use development: the aim being optimal use of the land, within the strategic site context.

The current layout consists of 145 group housing units on 4 stands, 1762 apartment housing units on 7 stands, 32 light- and 16 heavy industrial zoned stands, 4 stands earmarked for public facilities such as creches and religious centers, 4 stands zoned as open or conservation areas and 8 business zoned sites.

Zutari will look at the road design and civil services for the proposed development which includes the necessary infrastructure to collect and control stormwater runoff where required.

1.2 General and Development Location

The proposed development area is located within the urban area of George, situated to the south and east of Groeneweide Park residential area and the George Show Grounds and to the west of the Tamsui Industrial area. The site is restricted to the North by the R102 (Airport Road), and to the South by the N2 National Road. The western side of the site encompasses the Gwayang Wastewater Treatment Works (WWTW) and shooting range. The remaining area of the site is generally vacant and used for cattle grazing.



Figure 1 : Locality Map

2 Objective of Report

The objective of this report is to :

- ▶ Analyze the local catchment area in order to :
 - Determine the 1:5 year (minor system) flow rates at points of interest; and
 - Determine sizes for stormwater drainage pipes, culverts and / or channels within the proposed development.
 - Determine the effect of external stormwater runoff and how this can be accommodated through the proposed development.
- ▶ Make recommendations with respect to the discharge of runoff.
- ▶ Prepare drawings showing the outlet structure components and possible mitigating measures for stormwater drainage and erosion control i.e. energy dissipation and attenuation.

3 Design Criteria and Standards

3.1 Design Criteria

The following document serves as the basis for the detail design criteria and standards:

- ▶ The Neighbourhood Planning and Design Guide (“Red Book”).

3.2 Construction Specifications

All materials and workmanship shall comply with the specifications as set out in the South African National Standards for Civil Engineering (SANS).

3.3 Stormwater System

The stormwater system forms an integral part of the road and urban planning layout. The system rests on three legs, the minor system, the major system and an emergency system. Minor storms are catered for in the pipe system while major storms are routed through a linked system of roads and public open spaces using attenuation techniques. The emergency system recognizes failure of the minor and major system by storms greater than provided for in the major system or in the event of malfunction of the minor system by providing continuous overland flow routes to minimize flooding of residential areas.

3.3.1 Minimum design criteria for stormwater system

The criteria to be used for the design of the system are the following:

- ▶ Minor system: 5 year return period conveyed in an underground pipe system. Preferably the overland flow shall not exceed a depth of 200mm;
- ▶ Major system: 50 year return period. The difference between the 5 year and 50 year to be conveyed in the road prism with flow depth not exceeding 150mm within the road reserve width;
- ▶ The minimum gradients for pipelines will be designed to give a minimum velocity of 0.7m per second with the pipes flowing full;
- ▶ The maximum flow velocity shall be 3.5m per second;
- ▶ Major Stormwater overflows are to be provided to convey the excess storm water from the streets into designated public open spaces;
- ▶ Stormwater flow velocities in road ways will be kept as low as possible and related to the surface finish to prevent scour and erosion; and
- ▶ Roads will be graded to ensure free and continuous flow to the main Stormwater system and to prevent localized ponding at intersections.

3.3.2 Pipelines/Culverts

- ▶ Stormwater pipes will generally be class 50D, 75D or 100D as required by the loading and installation conditions;
- ▶ Pipes will be laid on Class C bedding;
- ▶ The minimum cover on pipes will be 0.80m; and
- ▶ The minimum pipe diameter will be 450mm for longitudinal runs and catch pit connections.

3.4 Road System

The road system forms an integral part of the local area plan.

3.4.1 Design criteria for roads

The design criteria for roads are the following:

- ▶ Road reserve widths: 10m, 13m, 16m and 25m;
- ▶ Design life of the roads: 20 years;
- ▶ Subgrade CBR: 15 to 20;

- ▶ Subbase CBR: 45 minimum (processed crushed stone);
- ▶ Base course CBR: 80 minimum (processed crushed stone);
- ▶ Surfacing: Asphalt, paving or cape seal;
- ▶ Minimum road longitudinal grade: 0.475%; and
- ▶ Minimum road cross fall: 2-3% depending on final road surfacing type.

3.5 Standard of Engineering Services to be provided

Level of services regarding roads and stormwater are as follows:

3.5.1 Roads and stormwater

- ▶ Road widths will be 4.5m in 10m and 13m reserves and 6m in 16m reserves;
- ▶ Subgrade, Subbase and Base materials will be imported;
- ▶ Subsurface drainage will not be required;
- ▶ The underground piped stormwater drainage system will have a minimum of 450mm diameter;
- ▶ Where roads are surfaced, paving or asphalt surface will be provided;
- ▶ Combination kerbs, CK5 will be provided on the low side of all roads to drain stormwater towards catch pits;
- ▶ Mountable kerb, MK10 will be provided on the higher side of the roads;
- ▶ Barrier kerbs, BK2 and Channel, C1 will be installed around bell mouths. Bellmouth radiuses will be a minimum of 6m.
- ▶ All stormwater drains will be provided with a sand trap of at least 500mm deep.

4 Existing Stormwater Network

Currently, no formal stormwater infrastructure exists within the boundaries of the proposed site. The site has a fairly low slope gradient, increasing towards natural drainage lines, and the in-situ soils have a low permeability. The Geotechnical Investigation indicated that surface water was encountered in some small existing dams and localised depressions across the site.

Historical irrigation with wastewater from the Gwayang Wastewater Treatment Works have created what appears to be wetlands in some of the fields previously used for grazing, which forms part of the proposed development. Several small instream dams have been constructed along the wetland on the eastern extent of the site, bordering the Pacaltsdorp Industrial area. These dams provide habitat for various birds and animals and are providing a valuable ecosystem, as well as serving as stormwater detention ponds during periods of high rainfall. The site also contains several small natural drainage lines.

The watercourses and wetlands are the current catchment source point of the proposed site. The internal stormwater will be designed in such a manner that it follows the natural topography of the site, and the outflow will be dispersed via energy dissipating outlets towards the natural drainage paths and existing wetland towards the eastern extent of the site. to assist in reducing the risk of erosion and the establishment of wetlands for the purpose of stormwater attenuation.

5 Stormwater Runoff Calculation

The calculated stormwater runoff is as follows:

Description	Gwayang Development Site	
MAP (mm)	787mm	
Area	333 ha	
Design Period	1:5 years	
Runoff Q (l/s)	Pre-Development	Post Development
	414	631
Dispersal areas	Watercourses/wetlands	Watercourses/wetlands

From the above it can be seen that there will be an increase in volume of stormwater as a result of the proposed development.

6 Proposed Design

The proposed layout of the development is still in draft format and the final stormwater layout and design will be done as soon as the layout has been finalized and approved. **Annexure A** shows the proposed extent of the development as well as proposed coverage.

The objective is to disperse stormwater by applying sustainable urban drainage systems (SUDS), such as attenuation/detention space, and swales. The topography slopes naturally to the southwestern corner of the site. Possible locations of attenuation ponds will be investigated during the detailed design stages of the project, but this specific area would ideally be incorporated as a stormwater attenuation area, including utilisation of the existing small dams on the site. From a pollution reduction and flow velocity perspective, provision will be made to include sufficient attenuation space in this respect, especially for the industrial areas, of which the details of the type of industries are unknown at present.

A conventional stormwater network consisting of stormwater catch pits, manholes and headwalls will convey the stormwater generated in the area towards the proposed energy dissipation outlets and attenuation areas, as mentioned before. This will reduce the peak runoff towards the existing drainage lines. **Annexure B** shows typical examples of energy dissipation and silt retention structures.

Accumulated stormwater will be dispersed by means of energy dissipating structures to minimize the effect of peak runoff downstream. Detention could be required to maintain current flow conditions; however, these detention facilities will have to be adequately designed during the detailed design stages of the project. The area defined as an artificial wetland with the combination of existing instream dams, offer an opportunity for the improvement of water quality and it is therefore considered to incorporate this feature into the stormwater management of the planned development.

It is proposed that the stormwater generated upstream of the development be conveyed through the development by means of both an underground system as well as an emergency overland flow system. However, all upstream stormwater generated by the existing developed area will have to be dealt with through the proposed development. Various roads will be crossing the watercourses within the proposed layout. Box culverts or stormwater pipes will be used to allow uninterrupted flow under the roads.

A site specific and detailed stormwater design including mitigating measures as described in this report will be done within this framework following the finalization of the layout and may vary slightly from what is presented in this plan.

7 Floodlines

None of the industrial and residential properties forming part of the proposed development project is directly affected by any floodline.

8 Spatial Planning Considerations

It is proposed that the SDP take cognisance of the required stormwater management. This includes:

- ▶ Provision of stormwater escape routes between erven to direct minor and major flows towards the existing watercourse and wetlands areas;
- ▶ Roads linking the proposed site with the proposed access road should not restrict stormwater run-off;
- ▶ No erven should be constructed too close to existing watercourses to impede overland flows or be infringing on the National Water Act (1998) Section 144; and
- ▶ Incorporation of the existing watercourses and attenuation ponds in the final SDP, if applicable.

9 Stormwater Management Techniques: During Construction

The stormwater surface run-off water will be managed carefully during construction. The following management techniques will be implemented:

- ▶ Temporary cut-off channels and berms;
- ▶ Routing of run-off towards the existing watercourse and current drainage routes;
- ▶ Erosion protection by means of gabions, Reno mattresses, Geofabric and/or any combination thereof;
- ▶ Compliance with a site specific Environmental Management Plan;
- ▶ Provision for dealing with water, in accordance with SABS 1200, will be stipulated in the Project Specification and Contract Documents. Of specific importance will be the following clauses:
 - i. Clause 5.5 in SABS 1200 A;
 - ii. Clause 5.3 in SABS 1200 AA;
 - iii. Clause 5.1.3 in SABS 1200 D; and
 - iv. Clause 5.1.2 in SABS 1200 DB.

10 Stormwater Management Techniques: Post-Construction

The factors to consider in Stormwater Management falls broadly into two main categories, namely those related to quantity and those related to quality.

Any development brings about changes to the natural environment of a site, which in turn has an effect or disrupts the natural hydrological cycle. Changes include, among other:

- ▶ Increase in impermeable surfaces (roads, roofs etc.) resulting in lower infiltration, higher run-off volumes and velocities;
- ▶ Changes to natural flow routes through earthworks, infrastructure and shaping of terrain; and
- ▶ Changes to local water course environment and ecology.

The management of the increased run-off volumes and velocities is important as it can be detrimental to the receiving drainage system and communities downstream of the site, as it could cause severe erosion, property damage and even loss of life.

By restricting peak flows to pre-development levels, the *status quo* of the catchment is maintained. This could be achieved through the implementation of the following recommended practices, as described in paragraphs 10.1 and 10.2 below.

10.1 Infiltration and Dissipation

By dispersing the run-off to various outfalls spread across the site, the recharge of the underground water table is promoted, and the risk of erosion reduced.

Energy dissipating structures combined with Reno mattresses to prevent scouring and erosion will be utilised creating a high friction factor and thereby reduce the velocity of stormwater. Refer to Appendix B for further information regarding energy dissipation.

The installation of Reno mattresses and gabion boxes at outlets acts as energy dissipaters and stilling basins. These structures are also used as silt traps to prevent the loss of silt to the natural water courses. Silt that gets trapped on the Reno mattresses acts as a growing medium for vegetation which thereby accelerates the re-establishment of natural vegetation. This rehabilitated vegetation also acts as a dissipation medium, resulting in attenuated run-off.

10.2 Attenuation

Attenuation functions by the principle of allowing large flows of water to enter a facility but limiting the outflow by having a small opening at the low point in the facility. The difference between in- and outflows is temporarily stored in an allocated space within which safe storage/detention can occur.

Attenuation in the form of large dams will not be possible in this instance, but rainwater in the proposed development will be discharged onto the road and flow into inlet works/catchpits. The water will then proceed to the lowest point flowing out to the headwall. The aim is to ensure the maximum percentage of rainwater flows to the catchment source point near the proposed development area.

11 Conclusions and Recommendations

The planning of stormwater design elements must always be seen as a holistic process which incorporates much more than the infrastructural elements required in adequately dealing with stormwater. It affects a range of environmental goals and management principles and aims not only to mitigate negative impacts, but actively promote positive modifications in its application.

The design approach to be adopted for the proposed development and as discussed above, can be summarised as follows:

- ▶ Promotion of on-site infiltration;
- ▶ Minimise concentration of stormwater;
- ▶ Maintain pre-development run-off levels as far as possible;
- ▶ Enforcement of management principles;
- ▶ Identify escape routes for major floods;
- ▶ Responsible discharge of stormwater into downstream systems; and
- ▶ Allowing for the necessary attenuation where possible.

Certain aspects will require further consideration during the detail design stage, they are:

- ▶ Stormwater needs to be responsibly conveyed to the existing watercourse;
- ▶ Stormwater collected along the watercourse needs to be able to reach the existing drainage infrastructure downstream;
- ▶ The site development plan needs to adequately provide for servitudes to accommodate major flows;
- ▶ Maximisation of attenuation of the rainwater that most water can be caught.

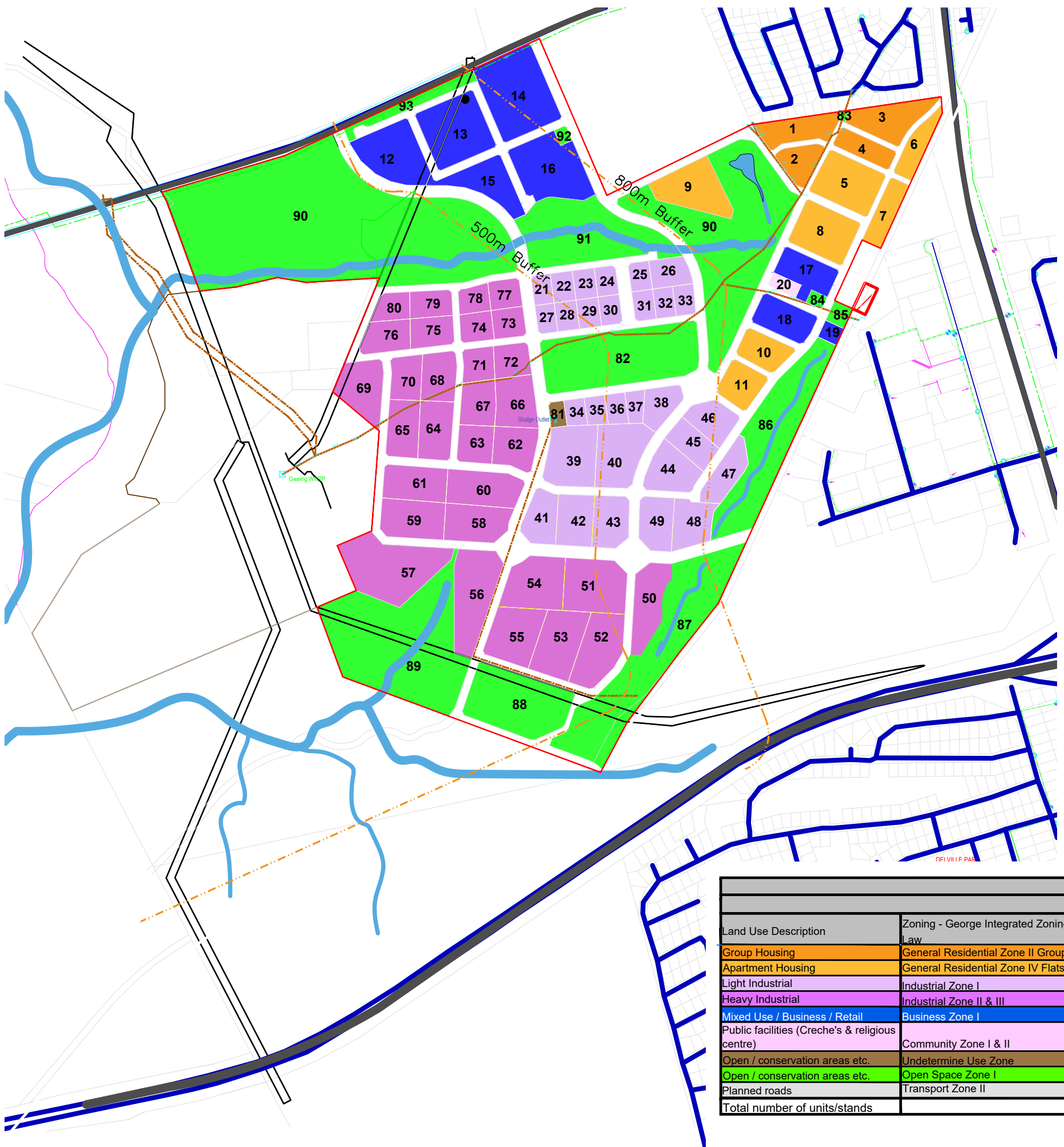
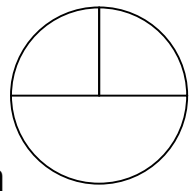
As indicated in this report, the proposed site's stormwater will be managed in a responsible manner and be safely discharged into the surrounding drainage system, without any detrimental impacts to the environment or communities.

The application of this Plan on this particular project will lead to:

- ▶ Minimisation of the impacts of stormwater from new developments on receiving waters such as watercourses, wetlands, coastal waters, etc; and
- ▶ 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.

Annexure A
Site Development Plan





NOTATION	ERF NUMBER	ERF AREA sqm	ZONING (GEORGE INTEGRATED ZONING SCHEME)	NOTATION	ERF NUMBER	ERF AREA sqm	ZONING (GEORGE INTEGRATED ZONING SCHEME)
1	11683 sqm	GENERAL RESIDENTIAL ZONE II GROUP HOUSING	48	11186 sqm	INDUSTRIAL ZONE I		
2	7796 sqm	GENERAL RESIDENTIAL ZONE II GROUP HOUSING	49	10840 sqm	INDUSTRIAL ZONE I		
3	14208 sqm	GENERAL RESIDENTIAL ZONE II GROUP HOUSING	50	15388 sqm	INDUSTRIAL ZONE II & III		
4	7528 sqm	GENERAL RESIDENTIAL ZONE II GROUP HOUSING	51	20075 sqm	INDUSTRIAL ZONE II & III		
5	18087 sqm	GENERAL RESIDENTIAL ZONE IV FLATS/APARTMENT	52	17609 sqm	INDUSTRIAL ZONE II & III		
6	7985 sqm	GENERAL RESIDENTIAL ZONE IV FLATS/APARTMENT	53	17743 sqm	INDUSTRIAL ZONE II & III		
7	8636 sqm	GENERAL RESIDENTIAL ZONE IV FLATS/APARTMENT	54	18195 sqm	INDUSTRIAL ZONE II & III		
8	17032 sqm	GENERAL RESIDENTIAL ZONE IV FLATS/APARTMENT	55	16705 sqm	INDUSTRIAL ZONE II & III		
9	17985 sqm	GENERAL RESIDENTIAL ZONE IV FLATS/APARTMENT	56	22980 sqm	INDUSTRIAL ZONE II & III		
10	9048 sqm	GENERAL RESIDENTIAL ZONE IV FLATS/APARTMENT	57	30915 sqm	INDUSTRIAL ZONE II & III		
11	9308 sqm	GENERAL RESIDENTIAL ZONE IV FLATS/APARTMENT	58	14178 sqm	INDUSTRIAL ZONE II & III		
12	20710 sqm	BUSINESS ZONE 1	59	14856 sqm	INDUSTRIAL ZONE II & III		
13	24045 sqm	BUSINESS ZONE 1	60	15540 sqm	INDUSTRIAL ZONE II & III		
14	40809 sqm	BUSINESS ZONE 1	61	13406 sqm	INDUSTRIAL ZONE II & III		
15	14550 sqm	BUSINESS ZONE 1	62	10749 sqm	INDUSTRIAL ZONE II & III		
16	24578 sqm	BUSINESS ZONE 1	63	8159 sqm	INDUSTRIAL ZONE II & III		
17	11580 sqm	BUSINESS ZONE 1	64	12026 sqm	INDUSTRIAL ZONE II & III		
18	11601 sqm	BUSINESS ZONE 1	65	11218 sqm	INDUSTRIAL ZONE II & III		
19	2302 sqm	BUSINESS ZONE 1	66	12585 sqm	INDUSTRIAL ZONE II & III		
20	2607 sqm	COMMUNITY ZONE I & II	67	9494 sqm	INDUSTRIAL ZONE II & III		
21	3569 sqm	INDUSTRIAL ZONE I	68	10423 sqm	INDUSTRIAL ZONE II & III		
22	4054 sqm	INDUSTRIAL ZONE I	69	14266 sqm	INDUSTRIAL ZONE II & III		
23	4038 sqm	INDUSTRIAL ZONE I	70	8357 sqm	INDUSTRIAL ZONE II & III		
24	3850 sqm	INDUSTRIAL ZONE I	71	6471 sqm	INDUSTRIAL ZONE II & III		
25	3714 sqm	INDUSTRIAL ZONE I	72	7287 sqm	INDUSTRIAL ZONE II & III		
26	6868 sqm	INDUSTRIAL ZONE I	73	5859 sqm	INDUSTRIAL ZONE II & III		
27	3445 sqm	INDUSTRIAL ZONE I	74	5832 sqm	INDUSTRIAL ZONE II & III		
28	3974 sqm	INDUSTRIAL ZONE I	75	7924 sqm	INDUSTRIAL ZONE II & III		
29	3990 sqm	INDUSTRIAL ZONE I	76	8972 sqm	INDUSTRIAL ZONE II & III		
30	3834 sqm	INDUSTRIAL ZONE I	77	5627 sqm	INDUSTRIAL ZONE II & III		
31	3876 sqm	INDUSTRIAL ZONE I	78	5052 sqm	INDUSTRIAL ZONE II & III		
32	3739 sqm	INDUSTRIAL ZONE I	79	6945 sqm	INDUSTRIAL ZONE II & III		
33	3811 sqm	INDUSTRIAL ZONE I	80	5781 sqm	INDUSTRIAL ZONE II & III		
34	3381 sqm	INDUSTRIAL ZONE I	81	2502 sqm	UNDETERMINED USE ZONE		
35	3632 sqm	INDUSTRIAL ZONE I	82	51958 sqm	OPEN SPACE ZONE I		
36	3893 sqm	INDUSTRIAL ZONE I	83	506 sqm	OPEN SPACE ZONE I		
37	3441 sqm	INDUSTRIAL ZONE I	84	1473 sqm	OPEN SPACE ZONE I		
38	7928 sqm	INDUSTRIAL ZONE I	85	2733 sqm	OPEN SPACE ZONE I		
39	18341 sqm	INDUSTRIAL ZONE I	86	50103 sqm	OPEN SPACE ZONE I		
40	18224 sqm	INDUSTRIAL ZONE I	87	65625 sqm	OPEN SPACE ZONE I		
41	10060 sqm	INDUSTRIAL ZONE I	88	34257 sqm	OPEN SPACE ZONE I		
42	11495 sqm	INDUSTRIAL ZONE I	89	83737 sqm	OPEN SPACE ZONE I		
43	11097 sqm	INDUSTRIAL ZONE I	90	211685 sqm	OPEN SPACE ZONE I		
44	12538 sqm	INDUSTRIAL ZONE I	91	46465 sqm	OPEN SPACE ZONE I		
45	8699 sqm	INDUSTRIAL ZONE I	92	1298 sqm	OPEN SPACE ZONE I		
46	9627 sqm	INDUSTRIAL ZONE I	93	8894 sqm	OPEN SPACE ZONE I		
47	9947 sqm	INDUSTRIAL ZONE I					

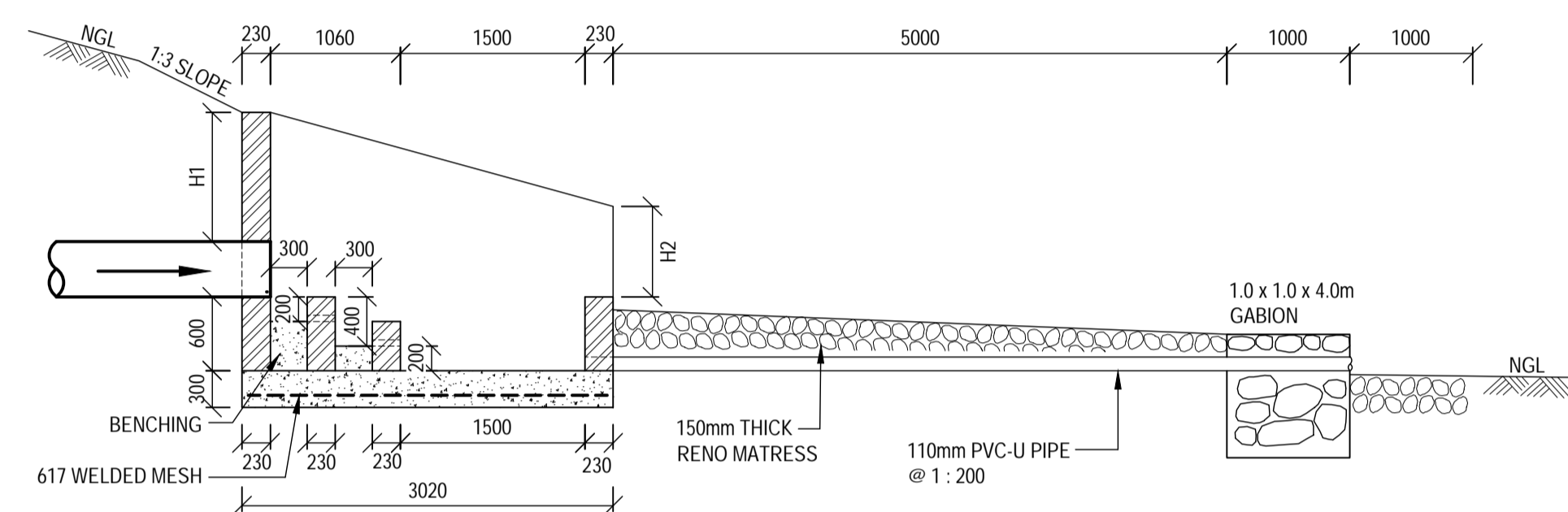
Gwayang Development - George										
Projected Land Use										
Land Use Description	Zoning - George Integrated Zoning Scheme By-Law	Units	Stands	Density	stand size (average)	Area (ha)	FAR	GLA (m2)	% of total area	% of units
Group Housing	General Residential Zone II Group Housing	145	4	35	285	4.1	na	na	4.1%	7.6%
Apartment Housing	General Residential Zone IV Flats/Apartments	1762	7	200	1.3	8.8	1.0	88081	8.8%	92.4%
Light Industrial	Industrial Zone I	na	32	na	0.6	20.7	1.5	310637	11.4%	na
Heavy Industrial	Industrial Zone II & III	na	17	na	2.2	38.1	1.5	570926	21.0%	na
Mixed Use / Business / Retail	Business Zone I	na	8	na	2	15.0	3.0	450525	8.3%	na
Public facilities (Creche's & religious centre)	Community Zone I & II	na	4	na	0.07	0.3	1.0	2607	0.1%	na
Open / conservation areas etc.	Undetermine Use Zone	na	na	na	na	0.3	na	na	0.1%	na
Open / conservation areas etc.	Open Space Zone I	na	4	na	1.0	55.9	na	na	30.8%	na
Planned roads	Transport Zone II	na	tbd	na	na	38.2	na	na	21.1%	na
Total number of units/stands		1907	75			181.3			100%	100%

Annexure B

Energy Dissipation and stormwater Details

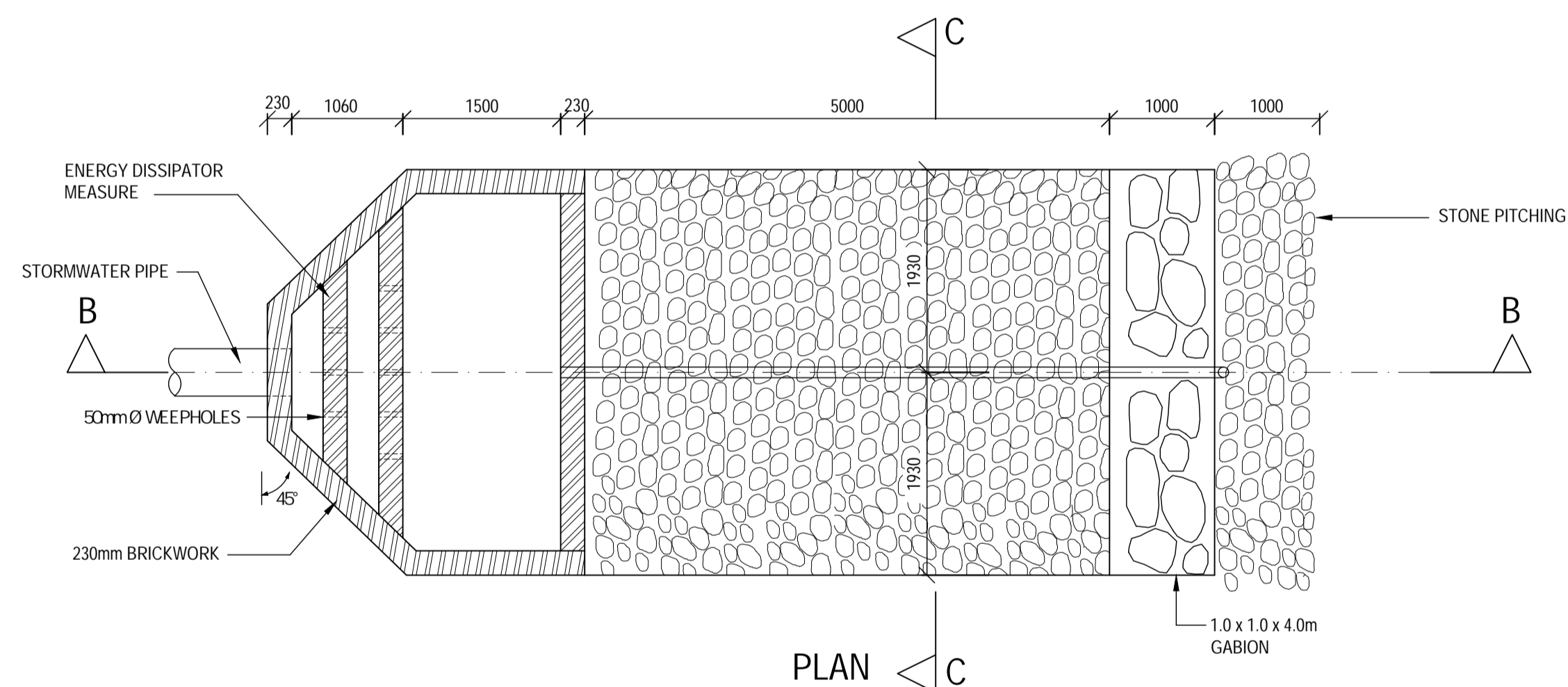


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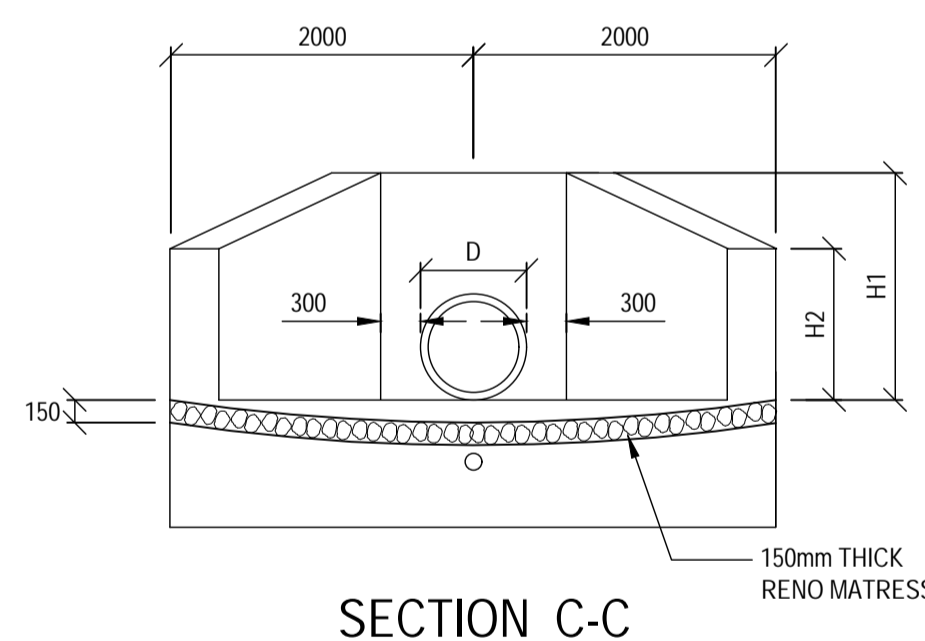


SECTION B-B

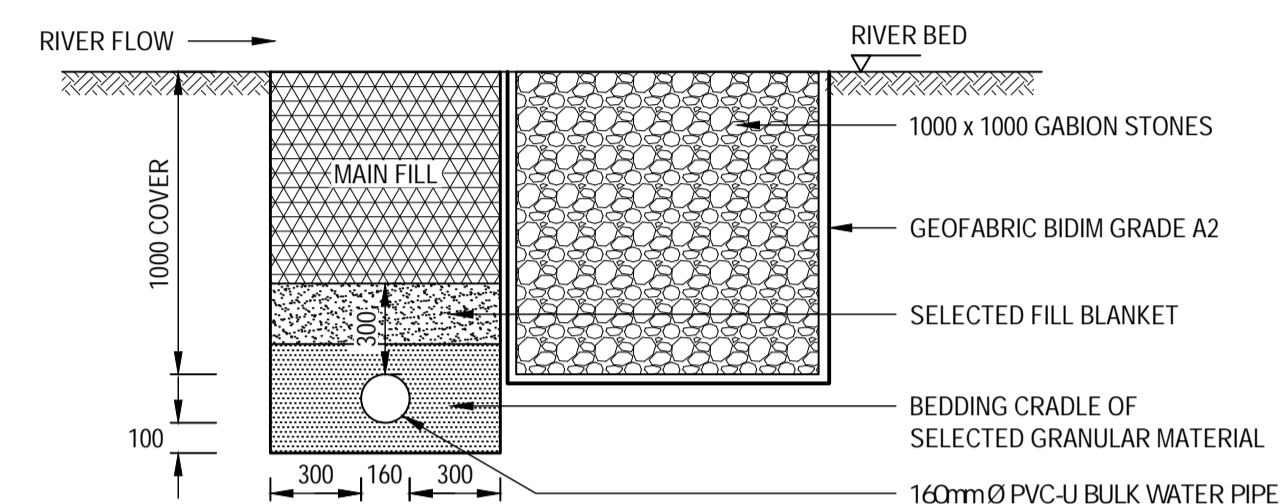
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450mm	800mm	550mm
525mm	900mm	650mm
600mm	1000mm	750mm
900mm	1400mm	900mm



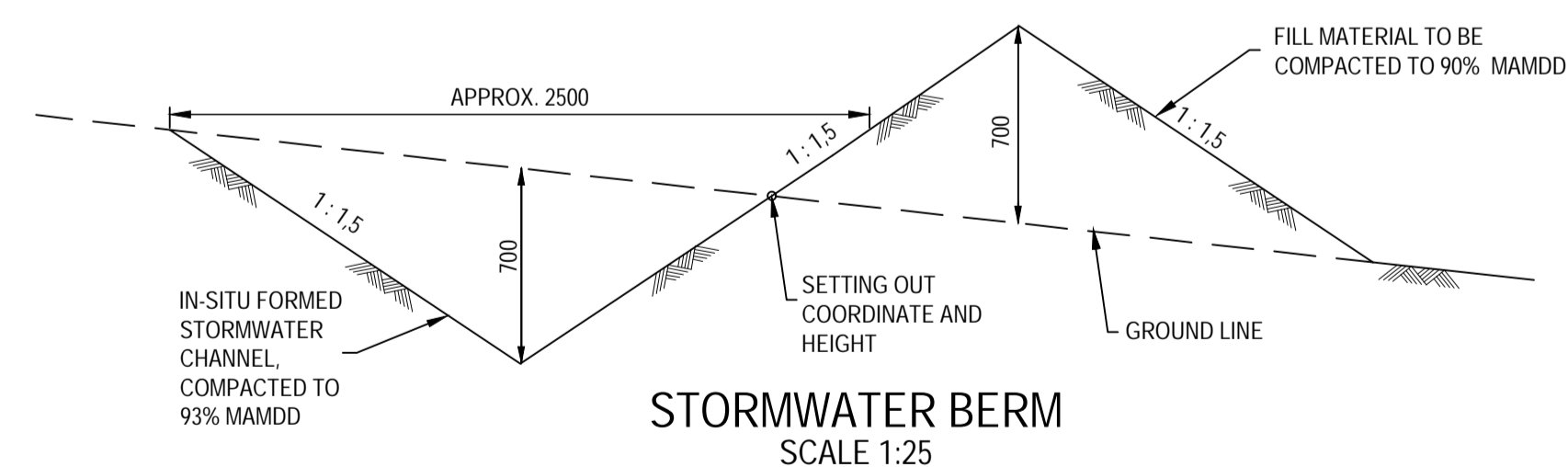
SILT RETENTION AND ENERGY DISSIPATER HEADWALL (375 - 900mm ND)
 SCALE 1:50



SECTION C-C



TYPICAL PIPE TRENCH AT RIVER CROSSING
 (SECTION B)
 SCALE 1:25



STORMWATER BERM
 SCALE 1:25

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CLIENT



REV	DATE	REVISION DETAILS	APPROVED
A	18/6/2024	FOR INFORMATION PURPOSES ONLY	AC KEYSER

SCALE	SIZE	REPORT
AS SHOWN	A1	NOT FOR CONSTRUCTION
DRAWN	M RICHARDS	APPROVED DATE
DESIGNED	M RICHARDS	
REVIEWED	M VAN WYK	
PROJECT		AC KEYSER ECSA-2006701881

Development of a Portion of the Remainder of Erven 464 George, 324 and 2819 Pacaltsdorp (Gwyang Development Site)

TITLE
 STORMWATER DETAILS

DRAWING NUMBER					
PROJECT No.	WBS	TYPE	DISC	NUMBER	REV
1004332	0000	DRG	CC	0300	A

In diversity there is beauty and
there is strength.

MAYA ANGELOU

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