Portion 240 of the Farm Zwartkop 356 JR:

STORMWATER MANAGEMENT PLAN

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VERIFICATION						
Report Title	Portion 240 of the Farm Zwartkop 356 JR – STORMWATER MANAGEMENT PLAN					
Document ID	Stormwater Management Plan			Project Number		R-01-10-22
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3						
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Approval			
Author Signature		Approver Signature	
Name	R Sukhlal	Name	R Sukhlal
ECSA	PrTechEng	ECSA	PrTechEng
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1 EXECUTIVE SUMMARY

1.1 OVERALL SCOPE OF WORKS

This appointment is for the Stormwater Management Report that will be submitted to City of Tshwane for approval.

The report addresses the proposed stormwater management for the development and the impact of this on the existing municipal infrastructure,

1.2 PROJECT DURATION

The anticipated project duration is as follows;

- Two (2) months for report preparation and approval by City of Tshwane.

1.3 PROJECT LOCATION

The area is located approximately 1.8 km from the residential area Laudium and 2.8 km from Erasmia.

The Zwartkops Raceway borders the site to the west, with the S.W.A.T National Firearms Centre bordering the property of the proposed application area to the north.

The Department of Defence SA Special Forces Joint Operations Division utilize the bordering property for military purposes, with the Department of Transport's offices and housing infrastructure bordering the proposed area to the south.

1.4 PROJECT DELIVERABLES

Hard copies and soft copies of the following;

i) Stormwater Management Plan

2 INTRODUCTION / BACKGROUND

The client proposes to use the site as a stockpile area for construction material.

2.1 BASIS FOR THIS REPORT

The Engineering Services Inception Report is a means of ensuring mutual understanding of the consultant's approach towards addressing all engineering services required for the Project, which will include:

- Stormwater Management

The purpose of this document is to present the City of Tshwane with an appraisal of the engineering services standards and requirements for the project.

2.2 PROJECT OBJECTIVES

The ultimate objective of this project is to obtain essential discipline-specific planning information required to inform and proceed with the project in accordance with the outcomes of the current planning.
The following more specific objectives relate to each respective discipline forming part of this appointment:

- Compilation of the Stormwater Management Report
- Approval of the Stormwater Management Report

3 DEVELOPER & CONSULTING ENGINEER'S DETAILS

3.1 APPLICANT DETAILS

Client	Greenmined Environmental
Physical Address	106 Baker Square Block1, Paardeview, De Beers Avenue, Somerset West, 7130
Postal Address	106 Baker Square Block1, Paardeview, De Beers Avenue, Somerset West, 7130
Contact Person	S Smit
Email	Zoe@greenmined.co.za
Telephone Number	067 417 2657

3.2 CONSULTING ENGINEERS DETAILS

Consulting Engineer	R Sukhlal
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Postal Address	Suite 374, Private Bag X10010, Edenvale, 1610
Contact Person	Rajesh Sukhlal PrTechEng
Email	rajeshs@etlconsulting.co.za
Telephone Number	082 851 9841

3.3 COUNCIL REFERENCE

Property Description	Portion 240, of the Farm Zwartkop 356 JR, City of Tshwane
Council Reference	
Department	City of Tshwane, Roads & Stormwater,

4 PROJECT LOCALITY

4.1 LOCALITY

The proposed footprint will be 15.7 ha and will be developed over a site previously used for mining purposes. The area is located approximately 1.8 km from the residential area Laudium and 2.8 km from Erasmia.

The Zwartkops Raceway borders the site to the west, with the S.W.A.T National Firearms Centre bordering the property of the proposed application area to the north.

The Department of Defence SA Special Forces Joint Operations Division utilize the bordering property for military purposes, with the Department of Transport's offices and housing infrastructure bordering the proposed area to the south.

Figure 1: Locality Map

4.2 SITE ACCESS

Access to the proposed application area will be via the R55, making use of the internal/haul roads to access the proposed area.

Access roads to the proposed area will be established (if needed) in consultation with the landowner and existing roads will be used as far as practicable and will be rehabilitated as part of the final reinstatement of the area.

Trucks delivering the materials to the destinations will take the R55 provincial route.

4.3 GEOLOGY:

The topography of the area is characterised by prominent rocky chert ridges and plains.

These landscape features mainly consist of quartzite, conglomerate, shale dolomite and sometimes andesitic lava.

Deep red to yellow apedal soils (Hutton and Clovelly forms) occur sporadically, representing the Ab land type.

4.4 HYDROLOGY:

The proposed study area falls within the A21B quaternary catchment which falls within in the Crocodile (West) and Marico Water Management Area which is managed by the Department of Water and Sanitation (DWS). No open watercourses or drainage line is located in close proximity of the site according to the National Wetlands and NFEPA map of SANBI.

4.5 LAND USES

Portion 240 of the farm Zwartkop 356 JR is located approximately 1.8 km from the residential area Laudium and 2.8 km from Erasmia.

The Zwartkops Raceway borders the site to the west, with the S.W.A.T National Firearms Centre bordering the property of the proposed application area to the north.

The Department of Defence SA Special Forces Joint Operations Division utilize the bordering property for military purposes, with the Department of Transport's offices and housing infrastructure bordering the proposed area to the south.

The property (Portion 240 of the farm Zwartkop 356JR) was previously used for mining purposes with the existing quarry on site, for the winning of dolomite in the 1960's

5 PROJECT SCOPE

5.1 SCOPE OF THE INTENDED DEVELOPMENT

5.1.1 FACILITY MAIN AREAS

The facility will comprise of the following areas:

- Unpaved stockpile area for construction material
- Mobile offices
- Possibly a paved access road

The intended general layout of the site is not yet available.

6 STORMWATER RETICULATION

6.1 APPROACH AND METHODOLOGY

The following methodology will be adopted in the design of the roads network and stormwater drainage system:

- Establish design criteria applicable to the stormwater drainage network;
- Establish connection points to the existing municipal drainage network;
- Perform surface water run-off calculations and floodline determinations;
- Conduct an analysis of the proposed network to determine stormwater drainage requirements;
- Compilation of stormwater drainage plans.

6.2 DESIGN CRITERIA

Design of the services will be in accordance with the "Guideline for Human Settlement Planning and Design" (Red book). Construction will be specified to be in accordance with SANS 1200.

The design criteria listed in the below Table will be used for the design of stormwater drainage network.

DESIGN PARAMETER	VALUE
Design Method	Rational Method – SANRAL
Stormwater details	Red Book and Drainage Manual
Design Flood Frequency – Minor system	1 in 2 year
Design Flood Frequency – Major system	1 in 20 year
Maximum design velocity	3.5 m/s
Minimum design velocity	1.0 m/s
Minimum gradients	0.667% slope
Minimum pipe diameter	450 mm diameter (to avoid blockages)
Pipe type	Concrete
Minimum manhole	1000mm
Maximum manhole spacing	80m
Gradients	Min 1:180 Max 1 :12 (where not avoidable connecting manholes to be anchored with concrete)

Table 1: Stormwater Design Criteria

6.3 STORMWATER MANAGEMENT PLAN

6.3.1 INTRODUCTION

The entire site has a total surface area of approximately 157 000m².

NO existing storm water infrastructure is available in the vicinity of the property. Existing stormwater run in sheet flow to the south of the site towards R55.

As per the City of Tshwane (CoT) Storm Water Management requirements, a storm water assessment is required to outline the management of the storm water run-off originating from the site and to design & detail the appropriate attenuation facilities suitable to manage the run-off volumes, if applicable.

This section of the services report serves as a detailed analysis of the pre-development & post-development storm water conditions on the site taking cognizance of all current aspects, pre-development on the site and simulating the possible site conditions in the future, post-development.

The objectives are as follows:

- Calculate the pre- and post-development Q2 and Q20 peaks discharged from the site.
- Route the peak post-development Q2 into the existing storm water systems if available.
- or alternatively the pre-development Q20 through an attenuation pond facility using.
- various storm durations to determine the peak outflow and outlet orifice combination.
- When attenuating to size the outlet control mechanism such that the peak outflows
- do not exceed Q20 pre-development flow conditions.

6.3.2 SITE TOPOGRAPHY

The site has a natural drainage pattern from north to south towards the R55 road.

As the site does not have any natural drainage line, the average slope of the natural ground was used being 1:34.09 or 2.9% across the entire site in south easterly direction.

6.3.3 GENERAL INFORMATION

The latest ‘Digital Terrain Model’ obtained from Project Surveyor in conjunction with the proposed Site Development Plan received from the planners and draft General Plan has been used firstly to determine the catchment characteristics and secondly to calculate more accurately the post-development conditions run-off coefficients.

6.3.4 EXISTING STORMWATER DRAINAGE SYSTEMS

There is NO existing stormwater reticulation in the vicinity of the site.

Therefore, No direct pipe connection will be made to the municipal stormwater system.

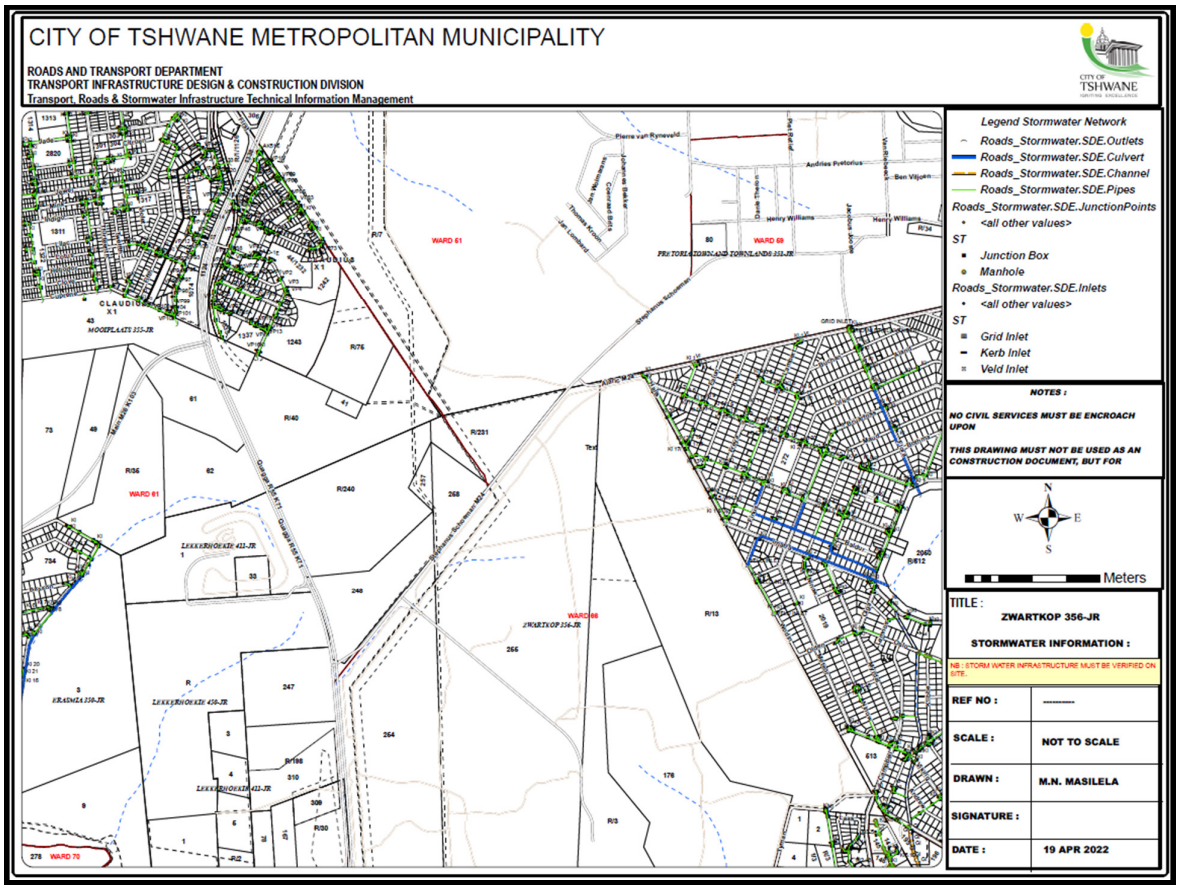

Figure 2: Existing Stormwater

6.3.5 MODELLING

Empirical and Statistical methods were not considered for this project as not enough hydrological records of the area along with observed events were available. A deterministic method has thus been selected to determine the results.

This method comprises of mainly manual, graphic, and computer-generated spreadsheets.

Therefore, our selection of the 'UNIT HYDROGRAPH METHOD '(HRU 1972) and the 'Rational Method' we believe is appropriate on the bases that the site does not have a varying degree of post development land change and does not have any existing permanent dams and sub-catchments. Computerized spread sheets have been used to assist with iterations and to eliminate manual calculation errors.

The Rational Method was used to estimate the peak stormwater flows generated in the development for the pre-development and post-development scenarios. The method can be applied to rural and urban catchment areas smaller than 15km².

The application of the Rational Formula is based on the following assumptions:

- the drainage area should be smaller than 15km²
- the rainfall intensity is uniform over the entire catchment area
- the peak discharge occurs when the whole catchment area is contributing to the flow
- the storm has a duration equal to Time of Concentration (Tc)
- the frequency of the peak discharge is equal to the frequency of the Rainfall Intensity

The simulation of the design storm was performed for both the pre- and post-development scenarios. In order to understand the pre-development conditions on the site, field investigations were conducted to determine the type of soil and vegetation cover. Topographical survey data was used to check the natural slope and drainage paths on the ground.

The Time of Concentration (Tc) is defined as the time required for a drop of water to travel from the most hydrologically remote point in the catchment to the point of collection. The peak discharge occurs at Tc and the storm duration is assumed to equal to 3Tc. The volume of stormwater run-off was calculated using Tc and the peak discharge.

An overland flow was assumed for the pre-development scenario. The pre-development slope of the site was 1.25% and stormwater flow was in the form of thin layers flowing over the ground. The Kerby formula used for overland flow was used to compute the Time of Concentration for the pre-development scenario.

The natural stormwater flow paths and slope will be changed upon completion of construction of the building, roads and parking areas. Stormwater will flow along surfaced parking which will act as lined channel as well as the in-situ concrete v-drains. The formula recommended for calculating the time of concentration in channels was developed by the US Soil Conservation Service. The time of concentration for the post-development scenario was calculated with the Kirpich formula.

The Rational Formula, Kerby Formula and Kirpich Formula are shown in Table 3 below.

Rational Formula	Kerby Formula (Overland Flow)	Kirpich Formula (Defined Watercourse)
$Q = \frac{CIA}{3.6}$	$T_c = 0.604 \left(\frac{rL}{S^{0.5}}\right)^{0.467}$	$T_c = \left(\frac{0,87\ L^2}{1000\ S_o}\right)^{0.385}$
Q = Peak Flow (m^3/s) C = Run-off co-efficient (dimensionless) I = Average Rainfall Intensity (mm/hr) A = Effective Area of Catchment (km^2)	Tc =Time of Concentration (hours) L = Longest Watercourse (km) S = Average Slope (m/m) r = Roughness co-efficient	Tc =Time of Concentration (hours) L = Longest Watercourse (km) So = Average Slope (m/m)

Table 2: Time of Concentration Formula

Rainfall Intensity (I) was calculated by means of the Intensity-Depth-Frequency formula as determined by Op Ten Noort and Stephenson (1982) for the inland rainfall region. The formula for the inland region is as follows:

$$I = \frac{(7.5 + 0.034\ MAP)\ R^{0.3}}{(0.24 + t_d)^{0.89}}$$

where: I = rainfall intensity in mm

R = recurrence interval in years

td = storm duration in hours

6.3.5.1 PROPOSED DESIGN RECURRENCE INTERVAL

The site drains towards neighbouring stands and therefore the 1:20 year recurrence interval is appropriate for the design calculations.

6.3.5.2 PRE-DEVELOPMENT RUN-OFF

We envisage the **Pre-Development** conditions to comprise of the following percentages:

- Parks & Gardens – 100%

PRE-DEVELOPMENT					
Recurrence 1:20 years	**Roof**	**Paved**	**Grass**	**Q total (m^3/s)**	**Vol total (m^3)**
C - value	0	0	0.3		
Area (m^2)			157000		
I mm/hr	160	160	160		
Q	0.000	0.000	2.093	2.093	
Volume	0.0	0.0	1884.0		1884.0

Table 3: Stormwater Pre-Development Runoff

6.3.5.3 POST DEVELOPMENT RUN-OFF

We envisage the **Post-Development Stormwater Runoff** conditions to comprise of the following percentages:

- Parks & Gardens – 98.7%
- Roofs & Paved areas – 1.3%

POST DEVELOPMENT					
Recurrence 1:20 years	**Roof**	**Paved**	**Grass**	**Q total (m^3/s)**	**Vol total (m^3)**
C - value	1	0.8	0.3		
Area (m^2)	1000	1000	155000		
I mm/hr	160	160	160		
Q	0.044	0.036	2.067	2.147	
Volume	40.0	32.0	1860.0		1932.0

Table 4: Stormwater Post-Development Runoff

6.3.5.4 SUMMARY OF RUN-OFF CALCULATIONS

STORMWATER CALCULATION SUMMARY					
PHASE	**CATCHMENT (m^2)**	**FLOW (m^3/s)**		**15 MIN STORAGE (m^3)**	
		Q 2yr	**Q 20yr**	**Q 2yr**	**Q 20yr**
Pre-development	157000	0.654	2.093	588.750	1884.000
Post Development	157000	0.671	2.147	603.750	1932.000

Table 5: Stormwater Runoff Summary

6.3.6 STORM WATER PROPOSAL

The proposed stormwater solution would be as follows:

- The increase in stormwater flow from Pre-development to Post-development amounts to 3% which will have little effect on the stormwater flow towards the R55.
- Stormwater will be allowed to in sheet flow towards the southwest of the site until the R55.
- No formal stormwater reticulation is proposed for this development site.

Figure 3: Proposed Stormwater Flow

6.3.7 IMPACT OF RUN-OFF ON HIGHER AND LOWER LYING PROPERTIES

6.3.7.1 LOWER PROPERTY

This stormwater management proposal will ensure that the lower lying property will not be adversely affected by the proposed development as provision is made to cater for run-off generated during the 1:20 recurrence storm in the proposed stormwater solution.

6.3.7.2 HIGHER PROPERTY

The higher lying property will have it's own stormwater system that cuts off water from entering the site. Water from the higher portion will be therefore have no effect on the run-off for the site.

6.3.8 MAINTENANCE REQUIREMENTS

No intensive maintenance is required on the stormwater system. However, regular visual inspections should be carried to confirm the integrity of the stormwater flow.

6.3.9 RELEVANT PERMISSIONS

Permission will be required for the following:

- City of Tshwane as the stormwater will run towards and onto the R55 road reserve.

6.3.10 WAYLEAVE REQUIREMENTS

No wayleaves will be required for the stormwater.

Any affected parties will be notified. The list of relevant stakeholders is attached in **Annexure D**, as supplied by CoT.

7 PROJECT COST ESTIMATE

A **Provisional Cost Estimate** is shown below.

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HIGH LEVEL COST ESTIMATE					
No	**Description**	**Unit**	**Qty**	**Rate**	**Amount**
SECTION A - INTERNAL INFRASTRUCTURE					
1	Stormwater kerbs, gabions, etc	Sum	1	R 50 000.00	R 50 000.00
TOTAL INFRASTRUCTURE					**R 50 000.00**
Add - P&G - 15%					R 7 500.00
Sub-Total					**R 57 500.00**
Add Professional Fees - 10%					R 5 750.00
Sub-Total					**R 63 250.00**
Add Contingncies - 10%					R 6 325.00
Sub-Total					**R 69 575.00**
Add - VAT @15%					R 10 436.25
TOTAL					**R 80 011.25**

Table 3: Preliminary Cost Estimate

8 CONCLUSION

The Stormwater Management Report considers the Pre-Development and Post-Development flows to investigate the impact of the proposed development on the existing bulk stormwater infrastructure and the erosion caused to existing watercourses.

The pre-development flow:

PRE-DEVELOPMENT					
Recurrence 1:20 years	**Roof**	**Paved**	**Grass**	**Q total (m^3/s)**	**Vol total (m^3)**
C - value	0	0	0.3		
Area (m^2)			157000		
I mm/hr	160	160	160		
Q	0.000	0.000	2.093	2.093	
Volume	0.0	0.0	1884.0		1884.0

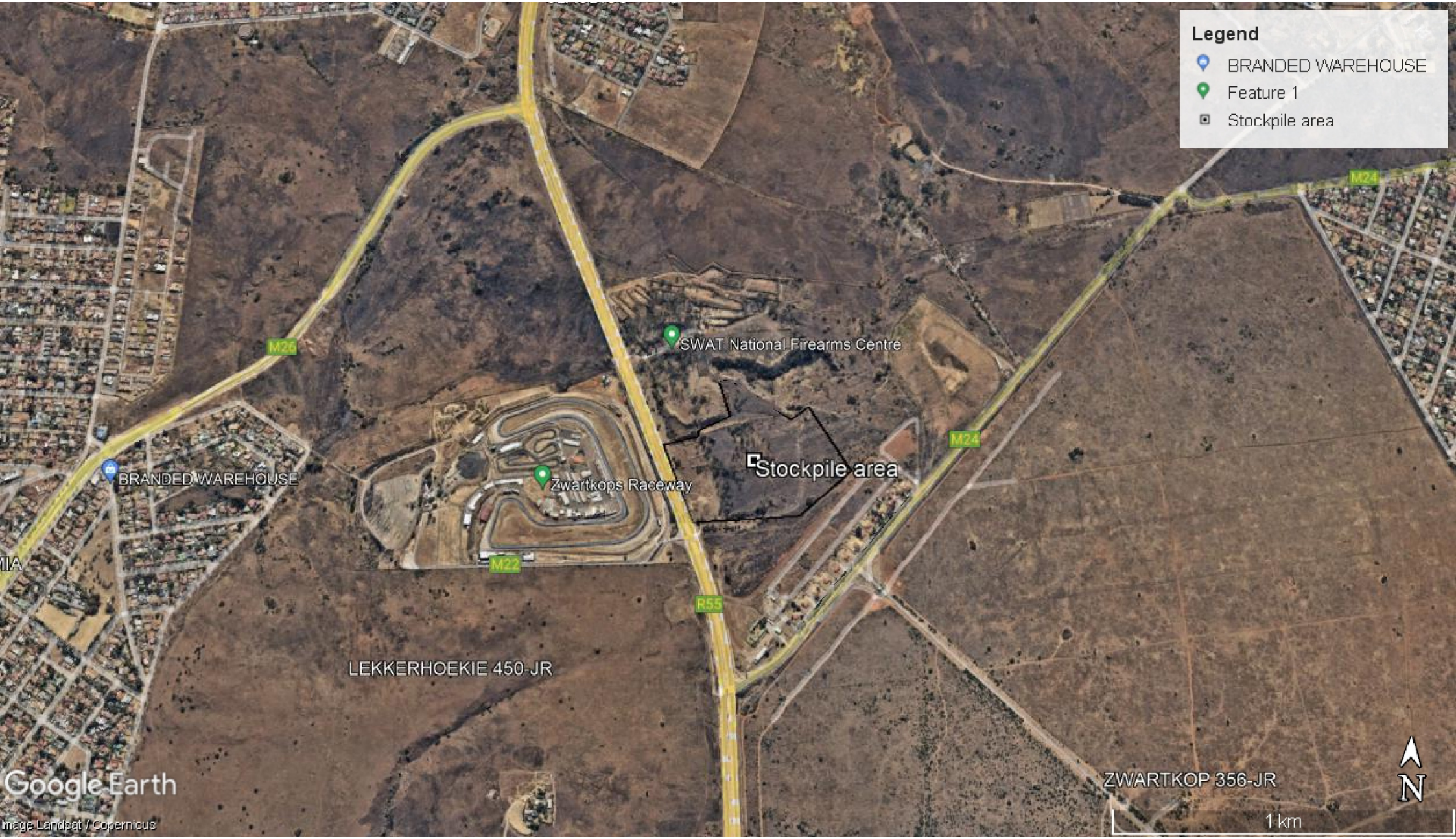
The post-development flow:

POST DEVELOPMENT					
Recurrence 1:20 years	**Roof**	**Paved**	**Grass**	**Q total (m^3/s)**	**Vol total (m^3)**
C - value	1	0.8	0.3		
Area (m^2)	1000	1000	155000		
I mm/hr	160	160	160		
Q	0.044	0.036	2.067	2.147	
Volume	40.0	32.0	1860.0		1932.0

The difference of the pre and post development flows shows a 3% increase in stormwater flow.

This will have a minimal impact on infrastructure downstream of the site.

Appendix A: Site Locality


Legend
BRANDED WAREHOUSE
Feature 1
Stockpile area
M26
M24
M24
M22
R55
SWAT National Firearms Centre
Zwartkops Raceway
Stockpile area
BRANDED WAREHOUSE
LEKKERHOEKIE 450-JR
ZWARTKOP 356-JR
Google Earth
Image Landsat / Copernicus
N
1 km

Appendix B: CoT Annexure T

DOCUMENT NOT YET ISSUED

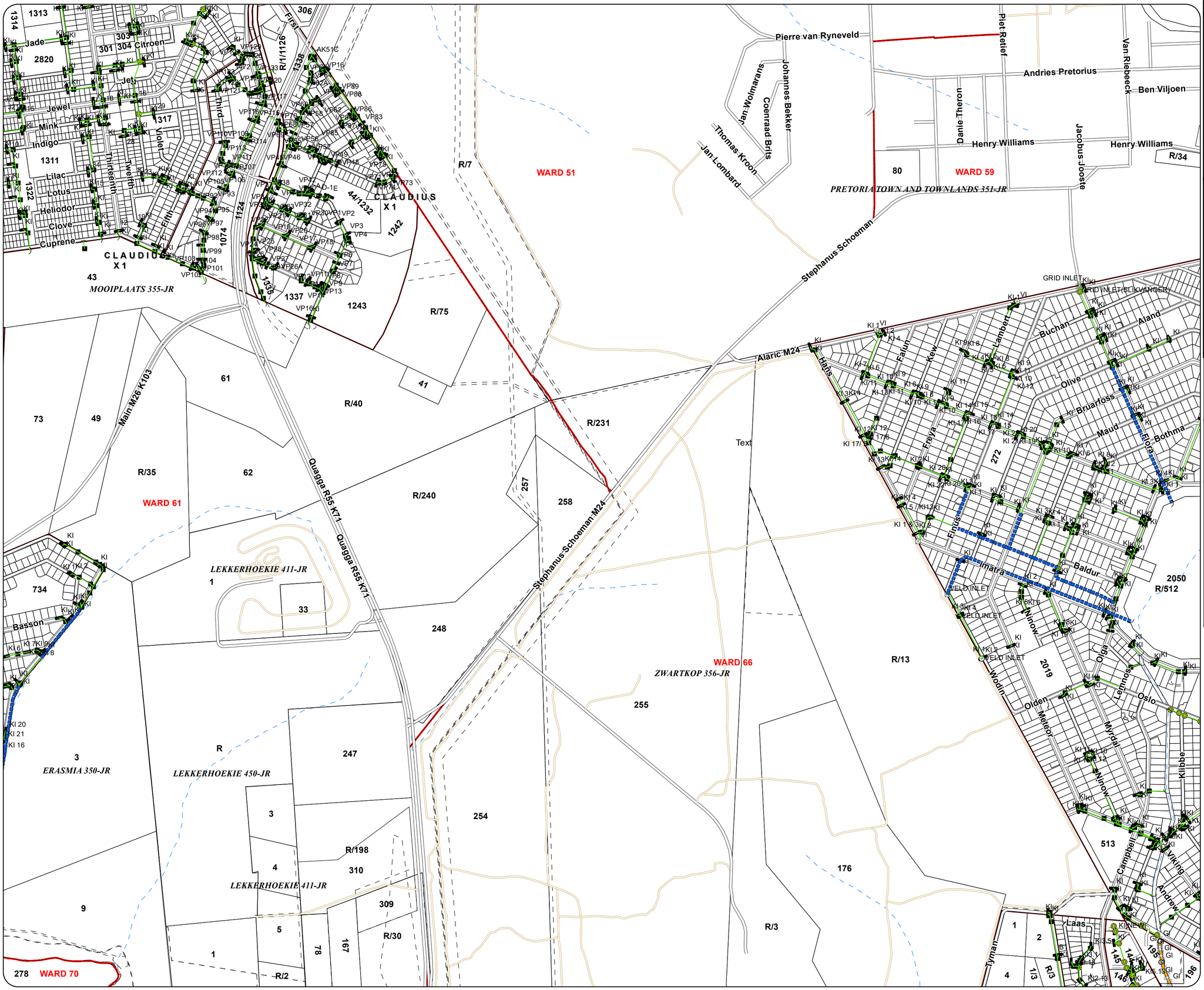
(CTMM issue directly to Client – forms part of Conditions of Establishment)

Appendix C: Stormwater Masterplan

CITY OF TSHWANE METROPOLITAN MUNICIPALITY

ROADS AND TRANSPORT DEPARTMENT
TRANSPORT INFRASTRUCTURE DESIGN & CONSTRUCTION DIVISION
Transport, Roads & Stormwater Infrastructure Technical Information Management

CITY OF TSHWANE
IGNITING EXCELLENCE



Legend Stormwater Network

- ***Roads_Stormwater.SDE.Outlets***
- ***Roads_Stormwater.SDE.Culvert***
- ***Roads_Stormwater.SDE.Channel***
- ***Roads_Stormwater.SDE.Pipes***

Roads_Stormwater.SDE.JunctionPoints

- ***<all other values>***

ST

- ***Junction Box***
- ***Manhole***

Roads_Stormwater.SDE.Inlets

- ***<all other values>***

ST

- ***Grid Inlet***
- ***Kerb Inlet***
- ***Veld Inlet***

NOTES :

NO CIVIL SERVICES MUST BE ENCROACH UPON

THIS DRAWING MUST NOT BE USED AS AN CONSTRUCTION DOCUMENT, BUT FOR

N
W E
S

Meters

TITLE :

ZWARTKOP 356-JR

STORMWATER INFORMATION :

NB : STORM WATER INFRASTRUCTURE MUST BE VERIFIED ON SITE.

REF NO :	----------
SCALE :	**NOT TO SCALE**
DRAWN :	**M.N. MASILELA**
SIGNATURE :	
DATE :	**19 APR 2022**

Appendix D: Wayleave List

CITY OF TSHWANE
IGNITING EXCELLENCE

Transport Department
Infrastructure Design, Construction and Maintenance Division
Service Coordinator
Tel: (012) 358 7740
Fax: (012) 358 4923
Email: deonvi@tshwane.gov.za
Address: 225 Madiba Street, Capitol Towers North Building, Pretoria, 0002

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1. Streetscape Management (Open Spaces)
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(Tel) 012 358 8920

2**. Environmental Management (Parks)**

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2	Len Briedenhann	343 0688	083 414 2833
3	Thami Ntamo	358 8701	076 335 5114
4	Ntokozo Xaba	358 8814	076 031 9829
5	Bertie Dry	343 0697	083 631 5665
6	Christine Myburg	358 3097	083 469 9918
7	John Cooper	3411415	0833762546

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PUBLIC TRANSPORT Mike Krynauw mikek@tshwane.gov.za	**HB Philips Building 4th Floor Room 428 (Bosman Street)** (Tel) 012 358 1454 / 083 4412 768 (Cell)
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Vodacom **Marius 082 997 4568** **dawid.duplessis@vodacom.co.za'** **Johan.petorius2@vodacom.co.za**	**Neotel** Shane Cannon 082 879 3618 'shane.cannon@neotel.co.za'

ODI Water **S Baronian** **'sarkis@swa.co.za'** Cell: 083 331 7074 Tel: 012 702 1155 Fax: 012 702 7101	**DFA** Nadia Verhoog Epos: services@dfafrica.co.za. Tel: 012 345 7520 Cell: 082 392 5624 Fax: 086 694 1233 Zandi Kuiper 012 443 1000 Address: 55 Regency Drive Route 21 Corporate Park Nellmapius road Irene