IWWMP: Integrated Water and Waste Management Plan

Compiled in support of a Water Use Licence Application for:

PROPOSED DSW WESTERN WASTE MANAGEMENT FACILITY (WWMF) NEAR SHONGWENI

ETHEKWINI METROPOLITAN MUNICIPALITY, KWAZULU-NATAL

Version 1

(Revision 0)

Date: 7th December 2021

Applicant:

ETHEKWINI MUNICIPALITY: DSW (Durban Solid Waste)

Consultant acting on behalf of the Applicant:

Metamorphosis Environmental Consultants

Report compiled by

Ms Vicki King and Adam Teixeira-Leite

Water Use Licence Application

NAME OF SITE/PROJECT	**Proposed DSW Western Waste Management Facility (WMMF), Shongweni Landfill**	**DATE**	**7 December 2021**
NAME OF APPLICANT	Durban Solid Waste (DSW) eThekwini Municipality	**LOCATION**	Portion [A] of the Remainder of the farm Kirkfalls No 14227 eThekwini Metropolitan Municipality, KZN
NAME OF CONSULTANT	METAMORPHOSIS ENVIRONMENTAL CONSULTANTS In Consultation with Eco-Pulse Consulting Services Report format provided by Eco-Pulse.	**AUTHOR(S)**	 Vicki King *Pr.Sci.Nat.*  Adam Teixeira-Leite *Pr.Sci.Nat.*

Applicable Section 21 Water Uses (indicated with an 'X')

NWA Section 21 Water Use	Description	Existing licenced use	Existing un-licenced use	Future use	Applied for	Location Occurring
21 (a)	*Taking water from a water resource*					
21 (b)	*Storing water*			X	X	Portion [A] of the Remainder of Kirkfalls No. 14227
21(c)	*Impeding or diverting the flow of water in a watercourse*			X	X	Portion [A] of the Remainder of Kirkfalls No. 14227
21 (d)	*Engaging in a stream flow reduction activity*					
21 (e)	*Engaging in a controlled activity*			X	X	Portion [A] of the Remainder of Kirkfalls No. 14227
21 (f)	*Discharging waste or water containing waste into a water resource through a pipe, canal, sewer or other conduit*					
21 (g)	*Disposing of waste in a manner which may detrimentally impact on a water resource*			X	X	Portion [A] of the Remainder of Kirkfalls No. 14227
21 (h)	*Disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process*					
21(i)	*Altering the bed, banks, course or characteristics of a watercourse*			X	X	Portion [A] of the Remainder of Kirkfalls No. 14227
21 (j)	*Removing, discharging or disposing of water found underground if it is necessary for the effective continuation of an activity or for the safety of people*					
21 (k)	*Using water for recreational purposes*					

List of Applicable Licence Application Forms

[NOTE ONLINE FORMS SUBMITTED ON E-WULAAS ONLY]

Application Forms			
Form Name	**Form No.**	**Applicable?**	**Included in Application**
Individual	DW 756	No	
Water Service Provider	DW 757	No	
Company, Business or Government	**DW 758**	**Yes**	**Yes**
Water Use Association	DW 759	No	
Property where Water Use Occurs	**DW 901**	**Yes**	**Yes**
Details of Property Owner	**DW 902**	**Yes**	**Yes**
Section 21 (a): taking water from a water resource			
Taking water from a water resource	DW 760	No	
Pump Technical Data	DW 784	No	
Canal Technical Data	DW 786cnl	No	
Irrigation field and crop info	DW 787irg	No	
Industry, mining, power generation	DW 788	No	
Water supply service	DW 789loc	No	
Section 21 (b): storing water			
Dam registration	**DW 762**	**Yes**	**Yes**
Dam registration supp. Info	**DW 793cls**	**Yes**	**Yes**
Section 21 (c): impeding or diverting flow and Section 21 (i) altering characteristics of a watercourse			
Impeding or diverting water flow	**DW 763**	**Yes**	**Yes**
Altering bed, banks, channel, characteristics	**DW 768**	**Yes**	**Yes**
Supplementary (c) and (i) info form	**DW 775/781**	**Yes**	**Yes**
Section 21 (d): engaging in a stream flow reduction activity			
Activity reducing streamflow	DW 764	No	
Section 21 (e), (f), (g), (h)			
Engaging in a controlled activity	**DW 765n**	**Yes**	**Yes**
Discharging waste or wastewater	**DW 766n**	**Yes**	**Yes**
Section 21 (g): Disposing of waste which may impact the environment in terms	**DW 767**	**Yes**	**Yes**
Disposing of industrial process heated waste	DW 780n	No	
Waste disposal facility	**DW 808R2gw**	**Yes**	**Yes**
Section 21 (e)/(g) supp. Info	**DW 904n**	**Yes**	**Yes**
Supplementary Section 21 (g) water use information: details of waste management facility	**DW905**	**Yes**	**Yes**
Section 21 (f)/(h) supp. Info	DW 903	No	
Section 21 (j)			
Releasing for groundwater	DW 805n	No	
Section 21 (k)			
Recreational water use	DW 806	No	

List of Additional Information

Description	Applicable/Included
ID Copy of Person Signing (Applicant)	Yes
Letter of Authority	Yes
BBBEE Certificate	N/A (Government Department)
Title Deeds	Yes
Letter of Financial Provision	Yes
Engineers Professional Registration Certificate	Yes
Land Clearance Letter from Land Affairs	Yes

List of Appendices

Appendix	Description	Included
1	Certified copy of ID of applicant and company registration certificate	**Yes**
2	Copy of property's title deed where water use occurs	**Yes**
3	Lease Agreements and certified copy of ID of landowner	N/A (land owned by applicant)
4	Copy of Property Zoning Documents where water use occurs	**Yes**
5	Clearance letter from the Department of Rural Development and Land Reform	**Yes**
6	Proof of BBBEE Status	N/A (Government Department)
7	Licence application forms	No hard copy forms, only online forms completed on e-WULAAs
8	1:50 000 topographic map / 1:10 000 map	**Yes**
9	Master Layout Plan	**Yes**
10	Alternatives Report and map	**Yes**
11	Environmental Impact Assessment (EIA) Report	**Yes**
12	Environmental Authorisation (RoD)	**Yes**
13	Environmental Management Plan (EMP)	**Yes**
14	Wetland Assessment Report & Hydropedological Assessment Report	N/A (no wetlands)
15	Geotechnical Studies	**Yes**
16	Aquatic Assessment	**Yes**
17	Geohydrological Study	**Yes**
18	Hydrological Study	**Yes**
19	Water Supply and Demand Analysis + Water Balance	**Yes**
20	Method Statements	**Yes**
21	Stormwater Management Plan	**Yes**
22	Civil designs	**Yes**
23	Monitoring programme for surface and groundwater, and biomonitoring	**Yes**
24	Contingency Plan	**Yes**
25	Public Participation	**Yes**
26	Financial provision	**Yes**
27	Mining Permit, Prospecting Right, Signed Social and Labour Plan	N/A (no mining)
28	Exemption from GN 704	N/A (no mining)
29	Service Level Agreements	**Yes**
30	Existing Authorisations/Licenses (Waste Management License)	**Yes**

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGEMENT(S)

The following IWWMP has been compiled by Metamorphosis Environmental Consultants in consultation with Eco-Pulse Environmental Consulting Services to satisfy the requirements of the eThekwini Department of Human Settlements, Water and Sanitation (DHSWS) for Water Use Licensing, as outlined in the ***'Regulations Regarding the Procedural Requirements for Water Use Licence Applications and Appeals'*** contained in the Government Gazette No. 40713 of 24 March 2017.

The IWWMP was compiled in line with the following document: ***Operational Guideline: Integrated Water and Waste Management Plan for the Preparation of the Water Quality Management Technical Document to support the Application for Licences for Mining and Industries in Terms of the Requirements of the National Water Act, 1998 (Act 36 of 1998).*** It is acknowledged that this guideline was developed to assist mining and related industries with water use licensing, and whilst many facets of the document do not apply to the licensing of light industrial type development projects, there are components that are relevant and which were referred to in developing the IWWMP for the Proposed DSW Western Waste Management Facility (Shongweni), KZN.

1 INTRODUCTION

1.1 Activity Background (WSP Landfill Addendum Jan 2016)

EThekwini Municipality's Cleansing and Solid Waste Department (Durban Solid Waste, DSW) intends to develop a General Municipal landfill in the eThekwini Outer West region near Shongweni, to be known as the 'Western Waste Management Facility' (WWMF) on the Remainder of the Farm Kirkfalls No. 14227 in Shongweni.

The history associated with the proposed Shongweni Regional Landfill site spans almost 20 years, as the environmental approval process for the landfill site commenced in the early 2000's, with Environmental Authorisation (EA) being obtained for the landfill development in 2016. A brief overview of the background to the landfill investigation, and specifically the timeline associated with the application for the Shongweni landfill, is provided below.

A process was undertaken to identify and select sites suitable for landfill development in the eThekwini Municipal Area. Within the west zone four broad "windows of opportunity" (areas potentially suitable for large general waste disposal site development) were identified. These four broad windows were known as Shongweni, Ferralloys/Radnor, Doornrug/Bonny Brae and Lion Park. The window areas were evaluated and specific sites within the broader areas were identified. Sites suitable for landfill development were taken forward for further investigation and subjected to an EIA process to obtain the necessary environmental approvals.

Section 1 of the Final EIR (2010) provides a detailed description of the landfill site selection and evaluation process.

In respect of the west zone, DSW submitted two separate applications, one for the proposed Shongweni Regional Landfill site, and a second application for the proposed Cato Ridge Regional Landfill site.

A brief summary of the EIA process undertaken for the proposed Shongweni landfill site is presented in Table 1.

Table 1 Shongweni Landfill – Timeline associated with the EIA process.

Date	Description
June 1996	'Windows' process to identify suitable landfill sites
1998 - 1999	EIA Application was lodged with DAEA in terms of the Environment Conservation Act EIA regulations.
2000	Scoping phase: Scoping report described and assessed window areas, and identified the Assmang (Cato Ridge) site as the most suitable
2000	The EIA for Cato Ridge site was put on hold due to uncertainty surrounding the potential airport developments. Window areas were reconsidered, and Shongweni emerged as the only remaining potentially suitable alternative
November 2002	WSP was appointed to undertake the Scoping and EIA for Shongweni site
May 2003	Scoping Report submitted to DAEA
June 2004	Draft EIA Report circulated for public comment
October 2004	Additional specialist studies commissioned
June 2006	Amended Draft EIA Report issued for comment until 31 July 2006
September 2006	DAEA requested a comparative assessment between the Shongweni and Assmang/Cato Ridge sites

Date	Description
March 2007	DAEA agreed comparative assessment not appropriate as DSW required both sites to be secured. It was agreed that the Shongweni Final EIR was to be compiled, addressing comments received on Draft and then submitted (in terms of original Environmental Conservation Act (ECA) application)
October 2009	WSP considered the new Waste Management Licence (WML) requirements promulgated under the National Environmental Management Waste Act (2008). WML requirements were confirmed.
March 2010	The Final EIR was submitted to DAEARD accompanied by EIA and WML application forms
19 September 2014	Letter from DEDTEA requesting additional information be submitted to facilitate the decision-making process on the Shongweni Landfill Site.
April 2015	WSP appointment to meet additional information requirements.
4 August 2016	Environmental Authorisation issued (DM/0009/10 Waste Management Licence issued (DM/WML/0009/10
August 2016	Numerous appeals lodged (69 appellants)
16 July 2019	Appeal decision (DM/0009/2015) upholding the Environmental Authorisation.

Metamorphosis Environmental Consultants was appointed by DSW to compile and submit an application for a Water Use Licence through DHSWS for identified “consumptive” and “non-consumptive” water uses in terms of Section 21 (b), (c), (e), (g) and (i) of the National Water Act, (NWA) No. 36 of 1998 that will be involved with the development.

1.2 Contact Details

APPLICANT CONTACT DETAILS:

Organisation:	**Cleansing and Solid Waste Unit of eThekwini Municipality (DSW: Durban Solid Waste)**
Representative:	**Mr. Raymond Rampersad**
Designation:	Head of Unit
Tel:	031 311 8825 / 083 760 7736
Email:	raymond.rampersad@durban.gov.za
Postal address:	PO Box 1038, Durban 4000

CONSULTANT CONTACT DETAILS:

Organisation:	**Metamorphosis Environmental Consultants**
Contact Person:	**Ms Vicki King** *Pr.Sci.Nat.*
Designation:	Senior Environmental Consultant
Tel:	076 420 1441
Email:	vicki@metamorphosisdbn.co.za
Postal address:	PO Box 2116, Link Hills, 3652

1.3 Regional Setting & Project Location

The property is located approximately 3km south of the N3 highway, approximately 35km west of Durban and approximately 45km from Pietermaritzburg south of the town of Hillcrest and the N3 highway near Shongweni, with the informal 'Dassenhoek' settlement being to the south and east and the uMlazi River to the far south (Figure 1).

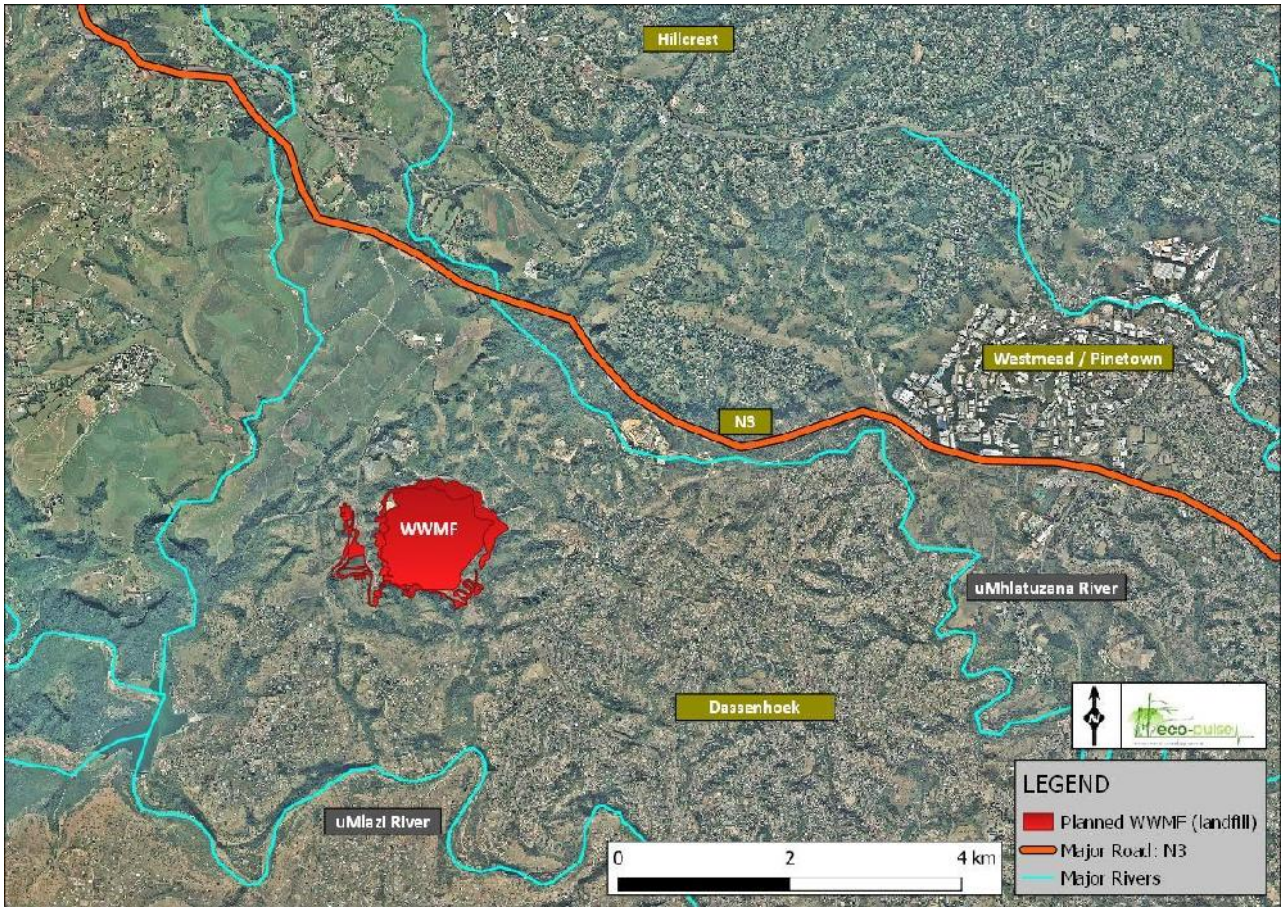


Figure 1 Locality map showing the location of the planned WWMF (new general waste landfill site) located off the local road mR456 within the catchment of the uMlazi River, west of Dassenhoek township, eThekwini Municipality, KZN.

1.4 Property Description

General:

The property is situated on the remainder of the Farm Kirkfalls No 14227, Shongweni, eThekwini Municipality – KZN at the following -29º 50' 30" S | 30º 45' 30" E. See topographic map in Figure 2. The site is bounded by the main Johannesburg/Durban railway line to the north. Delville Wood and KwaNdengezi sidings are located along this route to the west and east of the site respectively.

The site lies immediately south (and downslope) of the Shongweni Class 1 (hazardous waste) landfill which is operated and managed by Enviroserv Holdings.

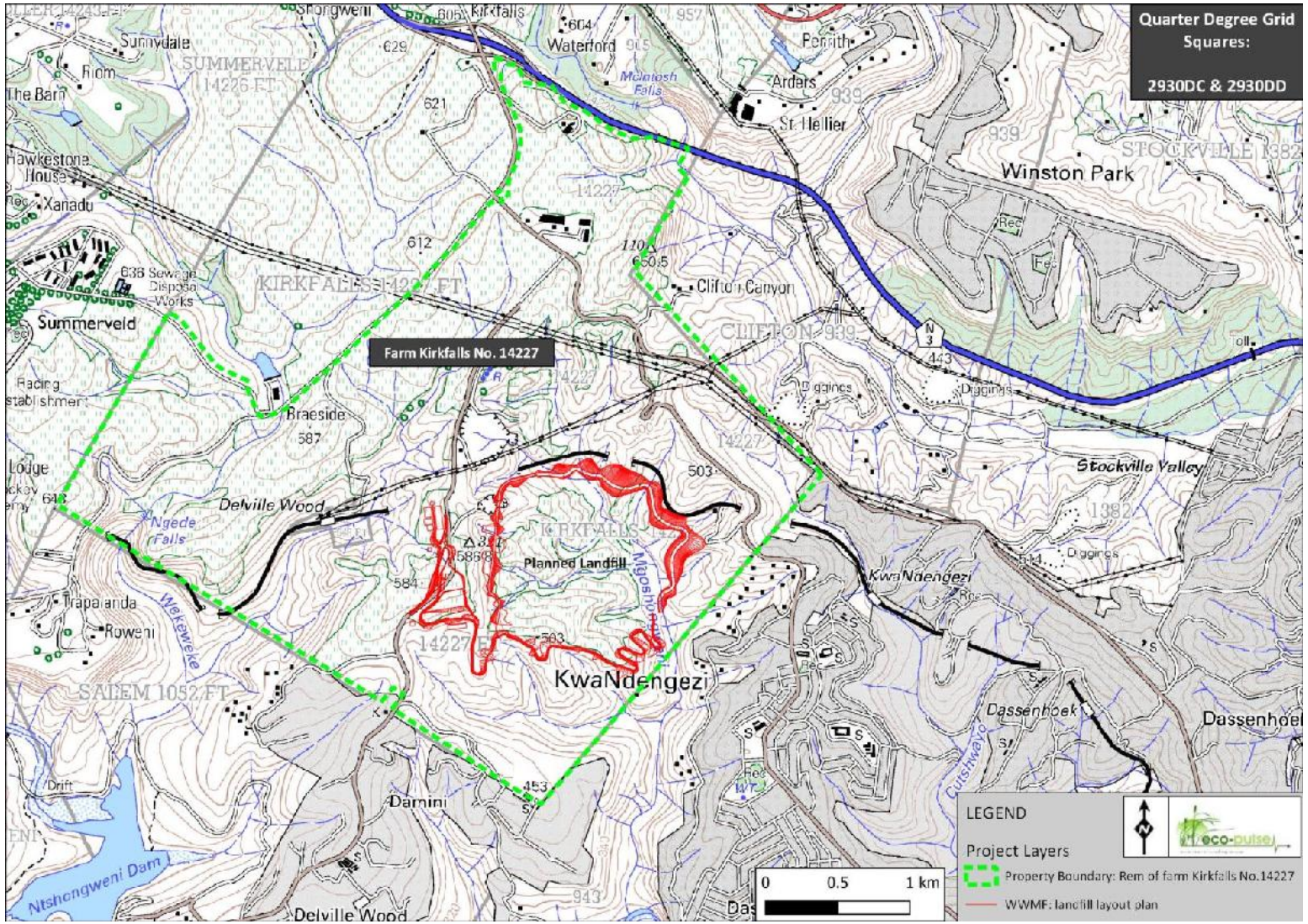


Figure 2 1:10 000 topographic map of the landfill development site on the farm Kirkfalls No. 14227 (quarter degree grid squares 2930DC and 2930DD).

Land use:

General land use on the development site and within the surrounding areas (within a 2km radius of the site) has been mapped and is shown in Figure 3. This includes the following:

- Approximately 35% of the development area is presently under sugarcane or old lands recovering from previous sugarcane cultivation and comprising degraded, secondary vegetation.
- The remaining land is covered by indigenous grasslands, terrestrial thornveld and scarp forest pockets concentrated along the cooler south-facing slopes and drainage lines and in areas of steeper topography.
- The site is drained by the seasonal Mgoghongweni River which flows in a southerly direction towards the uMlazi River.
- **There are no wetlands on the site or downstream or within 500m likely to be affected by the development (only the Mgoshongweni River and two tributary ephemeral streams).**
- There is existing commercial sugarcane farming taking place to the north-west some 500m from the site.
- An old disused quarry is located to the immediate north-west.
- The existing EnviroServ hazardous waste landfill site is situated to the immediate north of the development site.
- An existing railway line bounds the site to the north.
- Road access is from the provincial road to the immediate west of the site.
- Informal settlements are located within 500 – 900m of the site, mainly to the south and east. Most of the settlements are concentrated on the flatter, high lying land on the plateaus to the south and east (Dassenhoek township). The settlements are mainly informal to semi-formal residential, with associated community structures such as schools, shops and community centres.
- The land extending into the valleys is used mainly for informal housing and grazing for goats and cattle. Limited subsistence cropping also takes place in these areas.
- The nearest formal residential area of Winston Park lies approximately 2.5km to the north-east of the site whilst there is a mixed-use area about 3kms to the west of the site comprising residential, light industrial uses, boarding kennels and horse-riding establishments. Summerveld races is situated 3.5kms to the northwest of the site.

Ownership:

The property is currently owned by eThekwini Municipality as it was expropriated on the 30th June 2019 from the previous registered land owner, Tongaat Hulett Developments (PTY) Ltd, held under title deed number T29569/1989 (see letter dated 22 May 2019 and documentation as proof of the finalisation of the expropriation and proof of payment to Tongaat Hulett Propertie contained in **Appendix 2**).

The original title deed held by Tongaat Hulett Properties is also attached. The property purchased by eThekwini Municipality is in the process of being registered with the deeds office and a title deed in the name of eThekwini Municipality has not yet been issued. The proposed **Portion [A] of the Remainder of the farm Kirkfalls No. 14227** will be **550.46 hectares (ha)** in extent.

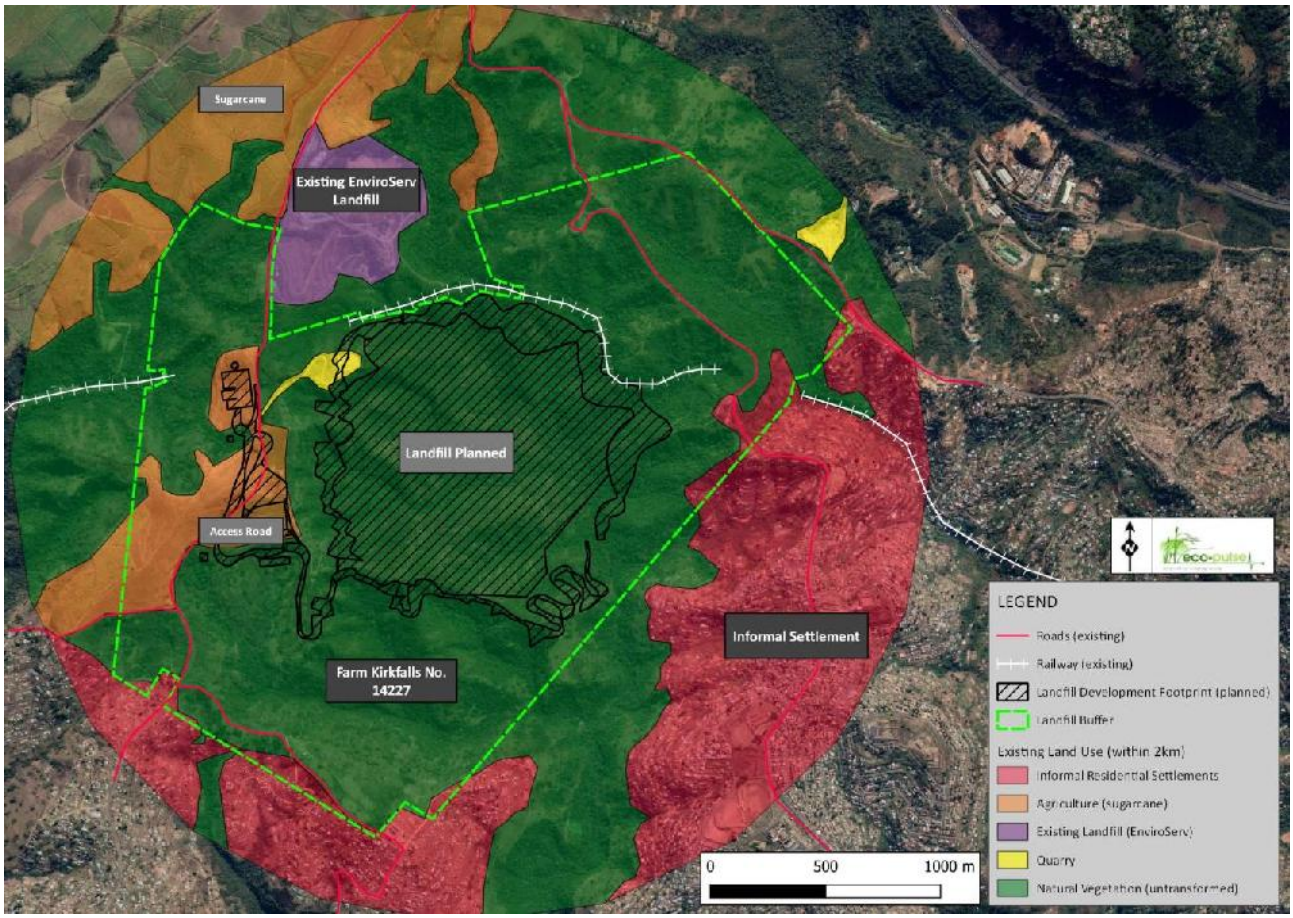


Figure 3 Map showing land use on the landfill development site and immediate surrounds within 2km of the site.

Zoning:

The property zoning is currently 'Land Use Management Holding Area' and an application has been made to rezone the property (proposed 'Portion A of the remainder of the farm Kirkfalls No. 14227') to '**Refuse Site'** (see letter dated 9 April 2021 contained in **Appendix 4**).

Land claims:

There are no recorded land claims lodged for the property in question, as verified by the Office of the Regional Land Claims Commissioner: Department of Rural Development and Land Reform (DRDLR) in their letter dated 3 March 2021 (attached as **Appendix 5.**

1.5 Purpose of the IWWMP

The purpose of this IWWMP is two-fold:

1. To compile a site specific, implementable, management plan addressing all the identified water uses and waste management related aspects of the proposed development activity, in order to meet the goals and objectives in accordance with Integrated Water Resource Management (IWRM) principles; and

2. To provide DWS with sufficient and relevant information to inform their decision regarding the granting of a Water Use Licence (WUL) for the development and related activities that are regarded as water uses in terms of Chapter 4 and Section 21 of the National Water Act, No. 36 of 1998 (NWA).

The IWWMP presents the background to the project and site, together with important details of the proposed development and an assessment of risks associated with the development proposal. Detailed specifications are then provided for the management and mitigation of any anticipated risks, with specific action plans provided where relevant and necessary.

2 CONCEPTUALISATION OF THE PROJECT AND ACTIVITY

2.1 Project Description & Related Activities

Durban Solid Waste (DSW) intends to develop a General Municipal landfill on the Farm Kirkfalls No 14227 in Shongweni.

The total footprint of the proposed landfill development is 550,2ha with the landfill footprint estimated to be 176ha and the buffer zone as 374ha. The buffer zone will serve as a combined health/odour management zone and receiving area for terrestrial a biodiversity offset required for the project.

The landfill life span is estimated to be 69 years. Waste volumes are likely to be approximately 1000 tons/day in 2023, increasing to 1990 tons/day in 2092. Only General waste (domestic, commercial and general dry industrial waste, builders rubble and garden waste) will be disposed at the site which will be classified as a Class B landfill site (GLB+) according to the NEMWA Norms and Standards for Disposal of Waste to Landfill (Regulation 636). The site will be designed to allow for the disposal of municipal solid waste (Type 2 waste) produced by the areas which generate approximately 260 000 tonnes of waste per annum currently. Any hazardous waste received at the gate will be rejected and diverted to the adjacent Enviroserve Shongweni Hazardous Waste Disposal Site.

The anticipated method of landfilling will involve the filling of valleys in 10m high 10m with 2m high cell lifts. Land building will be required at later stages of the sites life once the valleys have been filled. The final height of the landfill will be 525m above mean sea level on completion.

Available cover material is the limiting factor in design life of the site, giving the landfill an estimated lifespan of 69 years.

Waste will be disposed and compacted into cells and covered daily. Similar compaction equipment to that used at other DSW sites will be used to compact waste to a minimum of 1000kg/m^3. Stormwater and groundwater diversion and control measures have been proposed to minimise the impact of the landfill on water resources and these are discussed in more detail in the report.

The Mgoshongweni River runs through the site and a culvert will be built in the streambed to enable waste to be landfilled over the river valley. This is the preferred option. An alternative option proposed is for flows to be diverted around the landfill via a system of diversion canals, and both options have been assessed in this report and included in the WULA.

Collection and treatment systems for landfill gas and leachate have been designed and integrated with site operations. There are several options for the disposal of leachate, and these have been discussed in the report, ultimately what has been applied for is collection of leachate in onsite lined leachate dams which will be pumped and tinkered to a regional municipal WWTW (Waste Water Treatment Works) for treatment and disposal, since there is no regional waterborne sewage network servicing the study area presently.

2.2 Extent of Activities

The total footprint of the proposed landfill development is 550,2ha with the landfill footprint estimated to be 176ha and the landfill buffer zone as 374ha. The buffer zone will serve as a combined health/odour management zone and receiving area for terrestrial a biodiversity offset required for the project.

The spatial location and extent of the development proposed is shown on the infrastructure layout plan and map (Figure 2) and attached WULA Master Layout Plan included as **Appendix 9** to the IWWMP.

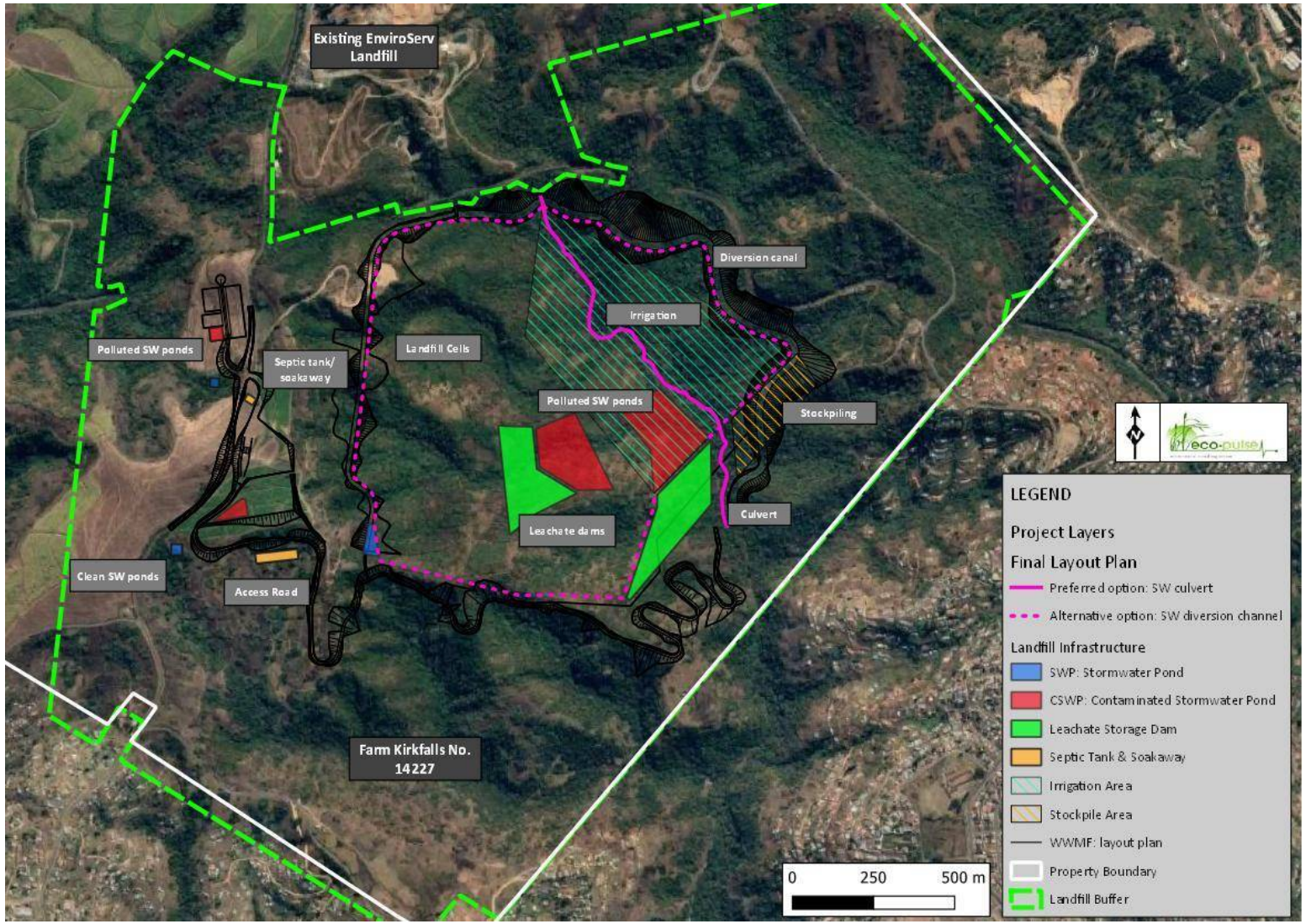


Figure 4 Layout plan and map showing the proposed WWMF Landfill development and related infrastructure.

2.3 Key Activity Related Process & Products

The activity involves the construction of a new landfill site and associated infrastructure for the receipt of General Waste only.

The development of the site will involve the construction of infrastructure to support the landfill activities, as well as the incremental construction of the cells to be landfilled.

The related infrastructure will include:

- Access roads and internal roads
- Fencing around the site and security infrastructure
- Culvert/tunnel over the Mgoshongweni stream (preferred option), or a bypass/divession canal around the landfill site (alternative option),
- Stormwater management system (including separation of 'clean' and 'dirty' storm water,
- Leachate collection system, sump and treatment facilities,
- Landfill Gas extraction infrastructure,
- Stockpiles of excavated material,
- Potentially contaminated stormwater dams,
- Weighbridges,
- Offices and changerooms/ablutions,
- Education centre.

There are no mining or industrial processes planned.

Water will not be abstracted from the existing river systems or groundwater system for potable/non-potable use, with water supply to be solely via existing municipal supply and any rainwater harvesting measures implemented at the site of the development.

2.4 Activity Life Description

The proposed landfill development has an estimated design life of 69 years, based on current predictions of waste volumes and cover material. Several activities on the site, however, such as landfill gas and leachate management, will extend beyond the life of the site. The life of the site could, however, be affected by external factors such as changes in waste volumes, etc.

The site will be developed in multiple stages and phases over the project life (see plan in Figure 3 showing the phasing plan for the landfill). Construction activities will be approximately 3 to 5 years apart. The total airspace volume for both Phase 1 and Phase 2 is approximately 40 million m^3 situated on a footprint of approximately 176 ha in total.

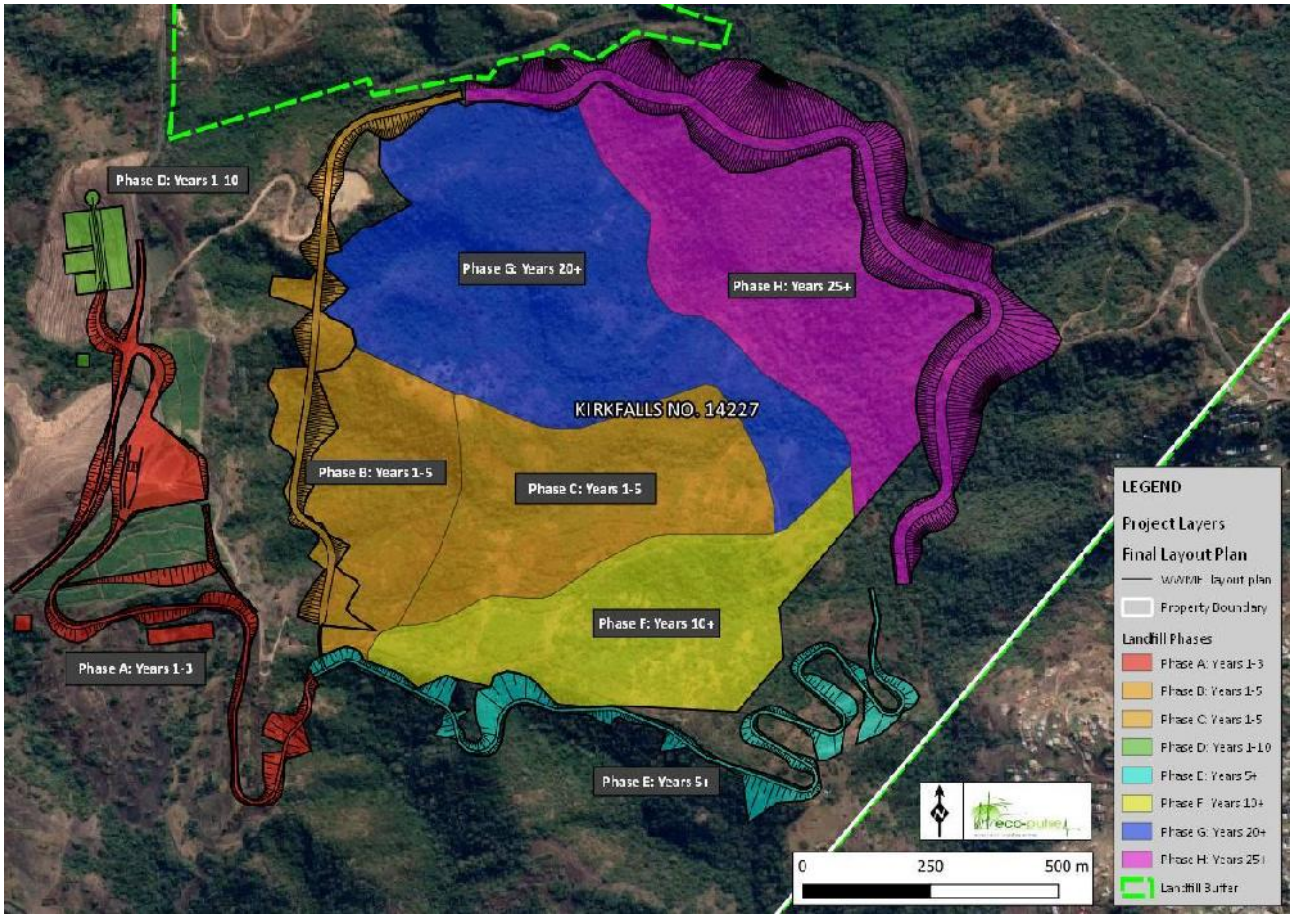


Figure 5 WWMF landfill site development phasing plan, showing phase 1 (sub-phases A to G: years 1-25) and phase 2 (sub-phase H: year 25+).

Phase 1: years 1- 25

It is anticipated that Phase 1 will be complete with the first 25 years at the predicted rate of deposition. This will include development on the western valley side of the Mgoshongweni River, leaving the main river channel unaffected. This phase is expected to have a total airspace volume of approximately 13 million m^3, giving a lifespan of approximately 25-30 years.

- Phase 1, Stage 1: Construction of cell 1 stability berm, base and liner, leachate control dam 1, fencing, Relocation of portion of MR461, access road and gate, infrastructure and laydown areas, bulk excavation in future cells 2 and 3.
- Phase 1, Stage 2: Construction of cell 2 base and liner, temporary capping to stage 1, bulk excavation in future cells 3 and 4.
- Excavation of bulk earthworks for the bench along the eastern boundary for cut-off drains as well for a culvert along the valley (if provided) must be completed in this Phase.

Phase 2: years 25+

On completion of Phase 1, Phase 2 will comprise filling the Shongweni valley over the stream up to the steep eastern slopes. Phase 2 includes the landfill cell development on the eastern side of the Mgoshongweni River valley from year 25 onwards until landfill completion. This phase is expected to have a total airspace volume of approximately 24.5 million m^3, giving a lifespan of approximately 40 years.

- Phase 2, Stage 1 will involve the Construction of Phase 2 cell 1 stability berm, base and liner, bulk excavation in future Phase 2 cells 2 and 3, Construction of first section of bypass channel or culvert.
- Phase 2, Stage 2: Construction of Phase 2 cell 1 temporary capping, Phase 2 cell 2 stability berm, base and liner bulk excavation in future cells 3 and 4

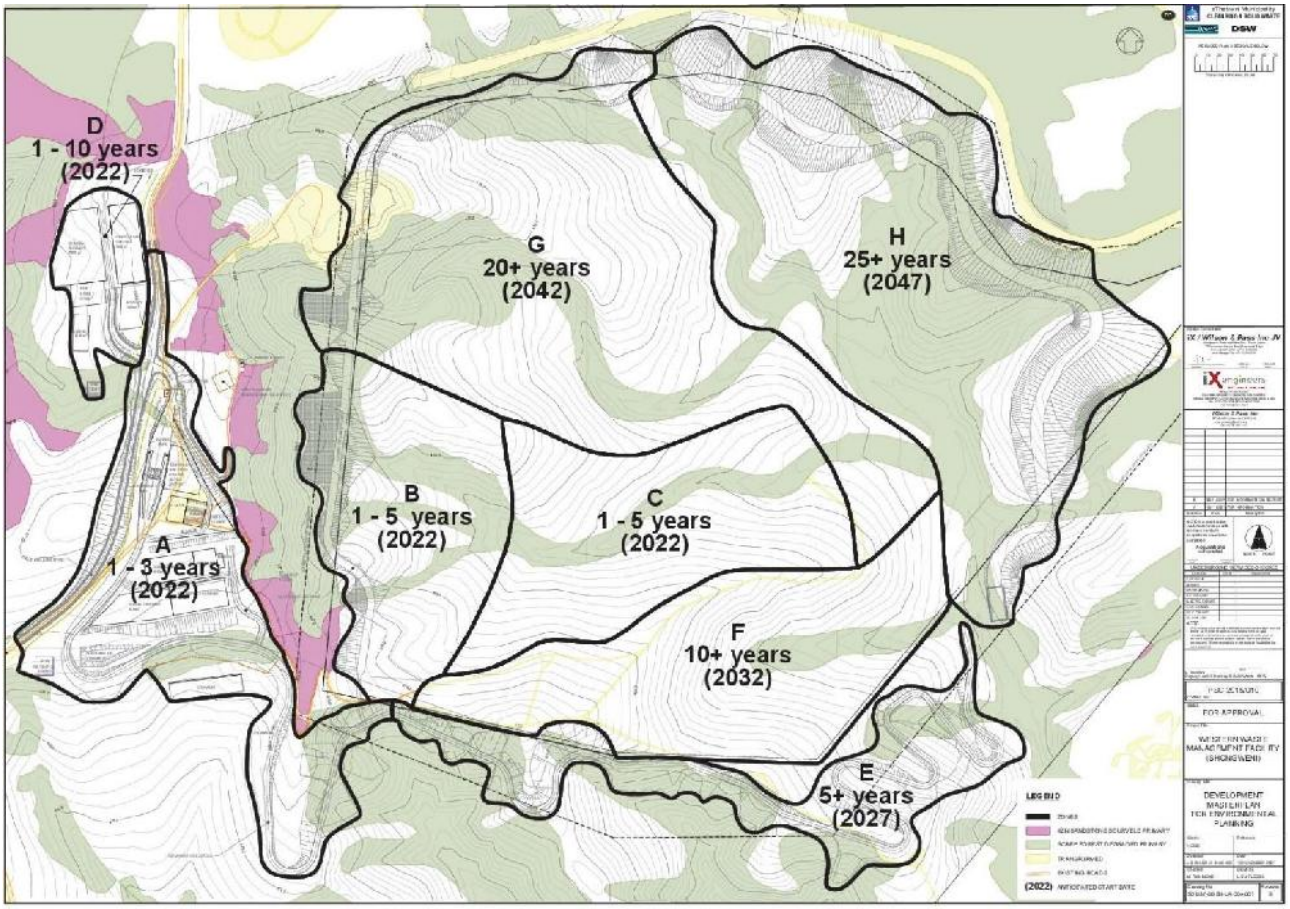


Figure 6 WWMF landfill site development plan Revision B (iX Engineers, 2021).

2.5 Activity Infrastructure Description

Activities associated with new infrastructure for the landfill development will include:

- Earthworks associated with preparations for Cell 1 development;
- The construction of the earthwork's platform for infrastructure;
- Construction of Phase 1 infrastructure to include:
    - Access roads
    - Offices and changerooms
    - Fencing and security infrastructure
    - Weighbridges and kiosks
    - Parking
    - Visitors/Education centre
    - Workshop and Vehicle Washbays

  - Staff facilities
  - Skip storage area
  - Wet weather handling area
  - Material sorting/recovery area
  - Domestic waste drop off/recycling area
  - Plant nursery
  - Chipping/composting area
  - Skip store
  - Rubble crushing area
  - Possible Materials Recovery Facility (MRF)
- Earthworks for the leachate dams and storm water ponds;
- Stockpiles of cover material;
- Potentially contaminated stormwater dam;
- Associated storm water management infrastructure;
- Linking of electrical and water supply services;
- Upgrading and extension of the existing gravel access road;
- Development of internal access roads;
- Construction of leachate management infrastructure; and
- Landfill gas extraction infrastructure (during Phase 2).

There is no planned water abstraction from the ground or surface water on the site. Water will be sourced from the municipality's potable water supply to the region.

Further details for each of these development activities are included in the water uses table (Section 13 of the IWWMP) and shown on the layout plan/map and **Appendix 9** of the IWWMP.

2.6 Key Water Uses and Waste Streams

Key water uses identified for the landfill development project are as follows:

Section 21 (b): Storage of water within a watercourse

- Interim (temporary) phase 1 leachate dam within an ephemeral stream channel;
- Interim (temporary) phase 1 contaminated storm water pond within an ephemeral stream channel;
- Final phase 2 contaminated storm water pond (to replace interim phase 1 pond) within an ephemeral stream channel.

Section 21 (c): Impeding or diverting the flow of water in a watercourse

Section 21 (i): Altering the bed, banks, course or characteristics of a watercourse

- Infilling of the rivers and streams within the landfill footprint;
- Impoundment of flows associated river/stream road crossings;

- Construction or main concrete culvert along the Mgoshongweni River reach within the landfill footprint (canalisation necessary); or
- Alternative to the concrete culvert, construction of a stormwater diversion trench/canal around the landfill site;
- All ancillary infrastructure within 100m of a river/stream (includes clean storm water ponds, septic tanks, material stockpiling);
- Leachate management, treatment and disposal/discharge;
- Management of dirty stormwater runoff through attenuation ponds.

Section 21 (e): Engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1)

- Irrigation of lands using contaminated stormwater from storm water ponds.

Section 21 (g): Disposing of waste in a manner which may detrimentally impact on a water resource

- 2 x Septic tanks and soakaways;
- Leachate dams (one temporary/interim dam for phase 1, to be replaced later by final dam during phase 2);
- Contaminated stormwater ponds (one temporary/interim pond for phase 1, to be replaced later by final pond during phase 2);
- Temporary stockpiling of topsoil as cover material.

There are no mining or industrial processes planned. Water will not be abstracted from the existing river systems or groundwater system for potable/non-potable use, with water supply to be solely via existing municipal supply and any rainwater harvesting measures implemented at the site of the development.

2.7 Organisational Structure

- The project will be managed and implemented by the DSW (or CSW: Cleansing and Solid Waste Department, part of eThekwini Municipality) together with their appointed project engineers (JV between: iX Engineers and Wilson Pass & Associates).
- Civil works for buildings and infrastructure will be undertaken by the main contractor (still to be appointed).
- The aquatic ecologists/consultants are Eco-Pulse Environmental Consulting.

2.8 Business and Corporate Policies

The site will be owned and operated by CSW (Cleansing and Solid Waste Department), part of eThekwini Municipality (Government Department and municipal service provider).

3 REGULATORY FRAMEWORK

3.1 Summary of Water Uses

Table 2 Summary of water uses for Remainder of the farm Kirkfalls 14227 in Shongweni.

NWA Section 21 Water Use	Description (DWAF, 2009)	Relevance to the site	Property
21 (b): Storing water in a watercourse	*Storing water within dams for example located within watercourses.*	• Interim (temporary) phase 1 leachate dam within an ephemeral stream channel • Interim (temporary) phase 1 contaminated storm water pond within an ephemeral stream channel • Final phase 2 contaminated storm water pond (to replace interim phase 1 pond) within an ephemeral stream channel	Remainder of the Farm KirkFalls 14227 Shongweni
21(c): Impeding or diverting the flow of water in a watercourse	*This water use includes the temporary or permanent obstruction or hindrance to the flow of water into watercourse by structures built either fully or partially in or across a watercourse; or a temporary or permanent structure causing the flow of water to be re-routed in a watercourse for any purpose.*	This water use is generally a standard requirement for any development within 500m of any wetland or within the 1:100 year floodline of a watercourse (river/stream). This is applicable to: • Infilling of the rivers and streams within the landfill footprint • Impoundment of flows associated river/stream road crossings • Construction or main concrete culvert along the Mgoshongweni River reach within the landfill footprint (canalisation necessary) or • Alternative to the concrete culvert, construction of a stormwater diversion trench/canal around the landfill site • All ancillary infrastructure within 100m of a river/stream (includes clean storm water ponds, septic tanks, material stockpiling) • Leachate management, treatment and disposal/discharge • Management of dirty stormwater runoff through attenuation ponds	
21(i): Altering the bed, banks, course or characteristics of a water course	*This water use relates to any change affecting the resource quality of the watercourse (the area within the riparian habitat or 1:100 year floodline, whichever is the greatest).*		
21(e) Engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1)	*This water use relates to any listed activity affecting the resource quality of the watercourse (the area within the riparian habitat or 1:100 year floodline, whichever is the greatest).* *S37(1)(a) irrigation of any land with wastewater or water containing waste generated through any industrial activity or by a waterwork.*	• Irrigation of lands using contaminated stormwater from storm water ponds	
21(g) Disposing of waste in a manner which may detrimentally impact on a water resource	*This water use relates to any disposal of waste affecting the resource quality of the watercourse (the area within the riparian habitat or 1:100 year floodline, whichever is the greatest).*	• Landfill development as a waste disposal facility • 2 x Septic tanks and soakaways • Leachate dams (one temporary/interim dam for phase 1, to be replaced later by final dam during phase 2) • Contaminated stormwater ponds (one temporary/interim pond for phase 1, to be replaced later by final pond during phase 2) • Temporary stockpiling of topsoil as cover material	

3.2 Existing Lawful Water Use

An 'existing lawful water use' is defined as 'a water use which has taken place at any time during the period of 2 years immediately prior to the date of commencement of the Act (30 September 1998) and which:

i) was authorised by or under any law which was in force immediately before commencement of the Act;
ii) is a stream flow reduction activity contemplated in S36(1); or
iii) is a controlled activity contemplated in S 37(1); or
iv) which has been declared as an existing lawful use in terms of Section 33 – S 32, National Water Act'.

No existing lawful water uses have been identified for the property, with no known existing water use licences in place.

3.3 Existing 'Unlawful' Water Use

There are no known existing water uses on the property that may be considered 'unlawful'.

3.4 Relevant Exemptions

There are no exemptions relating to the development on Remainder of Kirkfalls 14227.

3.5 General Authorisations

Given that the overall risk posed by the construction and operation of the proposed landfill site is considered to be 'Moderate' for multiple aspects/hazard factors (even where properly mitigated and managed), the development project cannot be generally authorised under the GA and will require a full WULA, this was confirmed by the Department of Water & Sanitation (DWS) at a pre-application meeting for the project WULA held on 23rd October 2020 (see pre-application meeting minutes dated 27 October 2020 compiled by Metamorphosos Consultants).

For further details on risk assessment scores and ratings refer to 'Risk Assessment' contained in Chapter 6 of this IWWMP.

3.6 New Water Uses being applied for

New water uses identified for the development project are as follows:

1. **Section 21 (b): Storing water in a watercourse**
2. **Section 21 (c): Impeding or diverting the flow of water in a watercourse**
3. **Section 21 (g): Disposing of waste in a manner which may detrimentally impact on a water resource**
4. **Section 21 (i): Altering the bed, banks, course or characteristics of a watercourse**
5. **Section 21 (e): Engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1)**

3.7 Waste Management Activities (NEMWA)

The activity has a Waste Management Licence (DM/WML/0009/10 – 4 August 2016) issued in terms of the National Environmental Management: Waste Act (GN921 of 29 November 2013, as amended), the listed activities are as follows:

- Activity B(8) The disposal of general waste to land covering an area in excess of 200m^2 and with a total capacity exceeding 25 000 tons.
- Activity B(10) The construction of a facility for a waste management activity listed in Category B of this schedule (not in isolation to associated waste management activity).

An appeal was lodged and a further decision was issued in July 2019. Both the original Waste Management Licence (WML) and appeal decision are provided in **Appendix 30** of this IWWMP.

3.8 Waste-related Authorisations

As above, the activity has a Waste Management Licence (WML: DM/WML/0009/10 – 4 August 2016) issued in terms of the National Environmental Management: Waste Act (GN921 of 29 November 2013 – as amended).

The leachate collection system will collect only leachate from the leachate collection pipes of completed cells as the contaminated runoff from the surface of the active cell will be diverted to a separate contaminated stormwater dam. Leachate dams will be utilised to store leachate on the landfill site.

The interim and final dam(s) will be approximately 5 000 m^3 and 49 500 m^3 respectively in size.

The interim (temporary) Leachate Collection Dam will have an approximately 8-year life, collecting leachate from closed and active cells and contaminated runoff from the uncovered waste in the active cell. This will serve cells 1 and 2, following which the interim Leachate Collection Dam will be incorporated into the next cell, at which stage a new (final) Leachate Collection Dam will be constructed. It is proposed that the final Leachate Collection Dam will be situated in the valley of the Shongweni stream immediately downstream of the landfill.

The leachate collection dam(s) will be lined to retain all leachate. This lining will match the requirements of a Class B liner, and as indicated in the design report.

Leachate will be removed from the leachate collection dam by tanker and transported to a licensed WWTW. It is proposed at this stage that the Southern Waste Water Treatment Works will be used. The works is licenced and has sufficient capacity (see **Appendix 29**).

In the medium to long term, leachate may be piped to sewer when waterborne sewerage becomes available in the area or treated on site in a specially designed and constructed leachate treatment plant. **Note that a leachate plant options has not been included or applied for in this WULA and a separate WULA or amendment application will be undertaken in future where necessary.**

Sewage from domestic flush toilets will be disposed of via 2 x septic tanks connected to soakways on site until such time as a formal municipal waterborne sewerage network is available in the region and on the site in future.

3.9 Other authorisations and regulations

3.9.1 Environmental Authorisation in terms of the NEMA: EIA Regulations

The planned waste management facility is regarded as a Listed Activity in terms of the National Environmental Management Act: Environmental Impact Assessment (EIA) Regulations of 2017 (as amended) and therefore triggers the need for Environmental Authorisation for the development to proceed.

An Environmental Impact Assessment was undertaken by WSP Environmental (Pty) Ltd and an Environmental Authorisation was issued in August 2016 (DM/0009/10). An appeal was lodged and a further decision was issued in July 2019. Both the original Authorisation and appeal decision are provided in **Appendix 12** of this IWWMP.

3.9.2 Protected Plant Permits

Protected plant permit requirements will be for terrestrial plant species only and are being investigated as part of a separate terrestrial biodiversity offset process and plant rescue, translocation and permitting process being pursued through Ezemvelo KZN Wildlife (EKZNW) and the Department of Forestry, Fisheries and Environment (DFFE).

3.10 Financial Provision

The Municipality has already invested heavily into the planned development and endeavours to provide the necessary financial provisions to undertake the project in accordance with the requirements and conditions of the WULA and specialist reports/plans. To this effect, a letter confirming financial provision for the project has been included as **Appendix 26.**

4 PRESENT ENVIRONMENTAL SITUATION

4.1 Climate

Climate, amongst other factors, influences soil-water processes and peak flows. The most influential climatic parameter is rainfall. Rainfall intensity, duration, evaporative demand and runoff were considered in this study to indicate rainfall partitioning within the project area.

The typical climate of the study area is generally characterised by warm summers and cool, dry winters. The area has an average annual rainfall of 1009mm with an average humidity of 80%. The average ambient temperature is 21ºC with a typical range of 8 ºC. The highest temperatures occur in February and the lowest in July. Source of information: Proposed Shongweni South Landfill EIA – WSP 2010. Climatic data was taken from Section 3 of the Hydrological Report compiled by GCS as part of the WUL application process (see **Appendix 18**).

4.1.1 Temperature

Average yearly temperature (refer to Figure 7) for the Shongweni area ranges from 21 to 35 °C (high) and -0 to 16 °C (Low). The study area is situated in a sub-tropical climate area, as per the Köppen Climate Classification (Kottek, Grieser, Beck, Rudolf, & Rubel, 2006). Hence, the area receives summer rainfall (Nov – Apr).

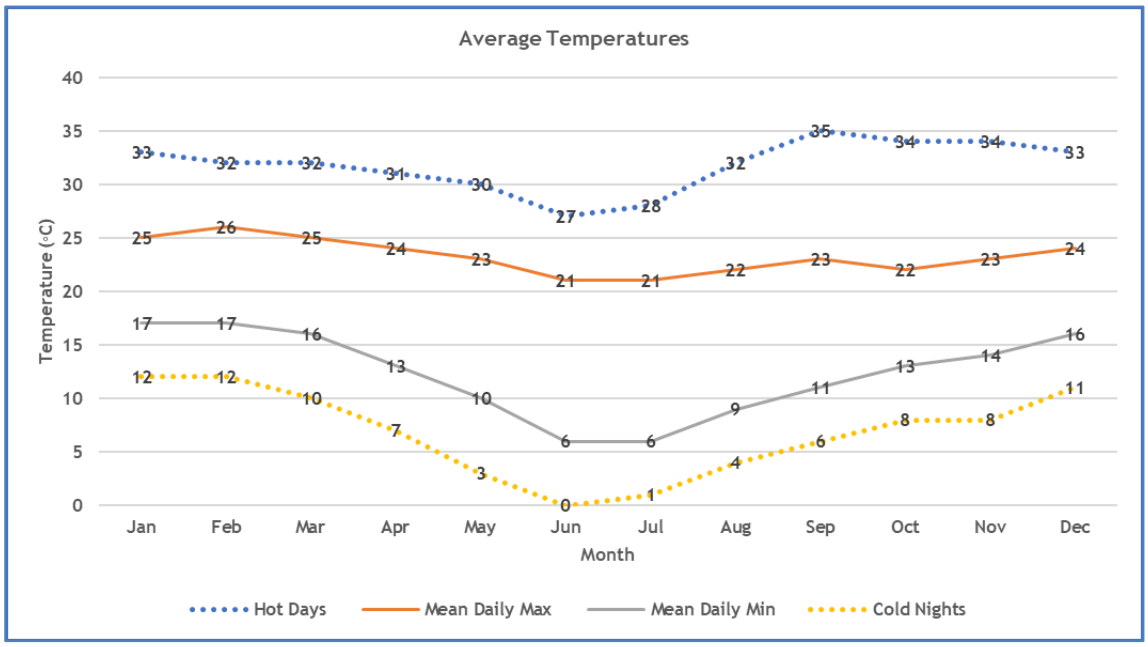


Figure 7 Average temperatures (NOAA, 2020).

4.1.2 Wind speed and direction

Figure 8 shows the wind rose for Shongweni area and presents the amount of hours per year the wind blows from the indicated direction. Wind generally blows from NNE & SSW to SSW & NNE, and S to N. Precipitation intensity during wind will likely cause intensity changes on slopes perpendicular to the wind direction, throughout the year.

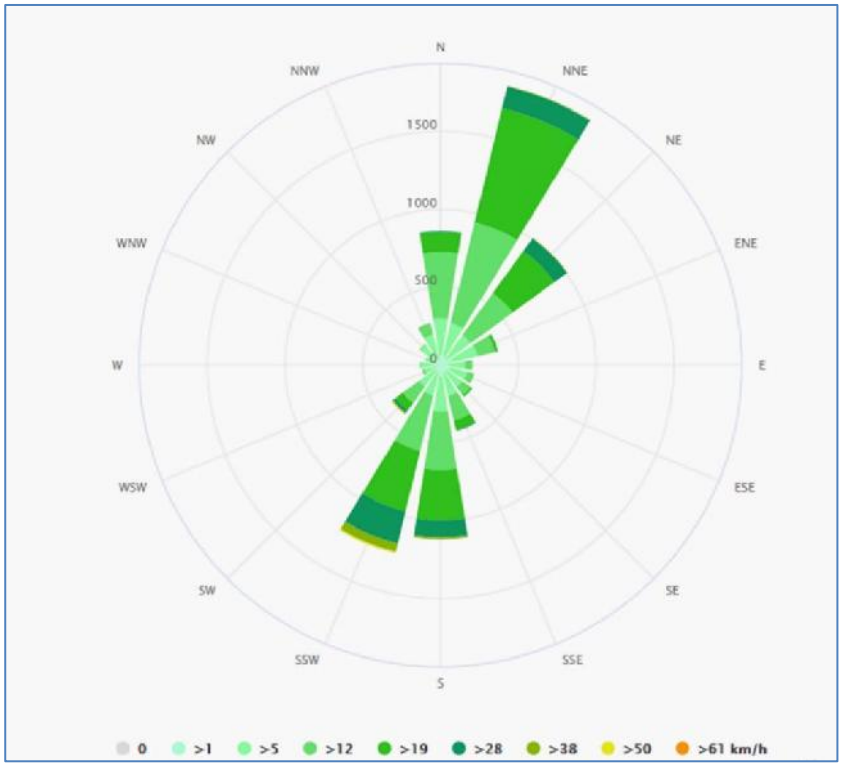
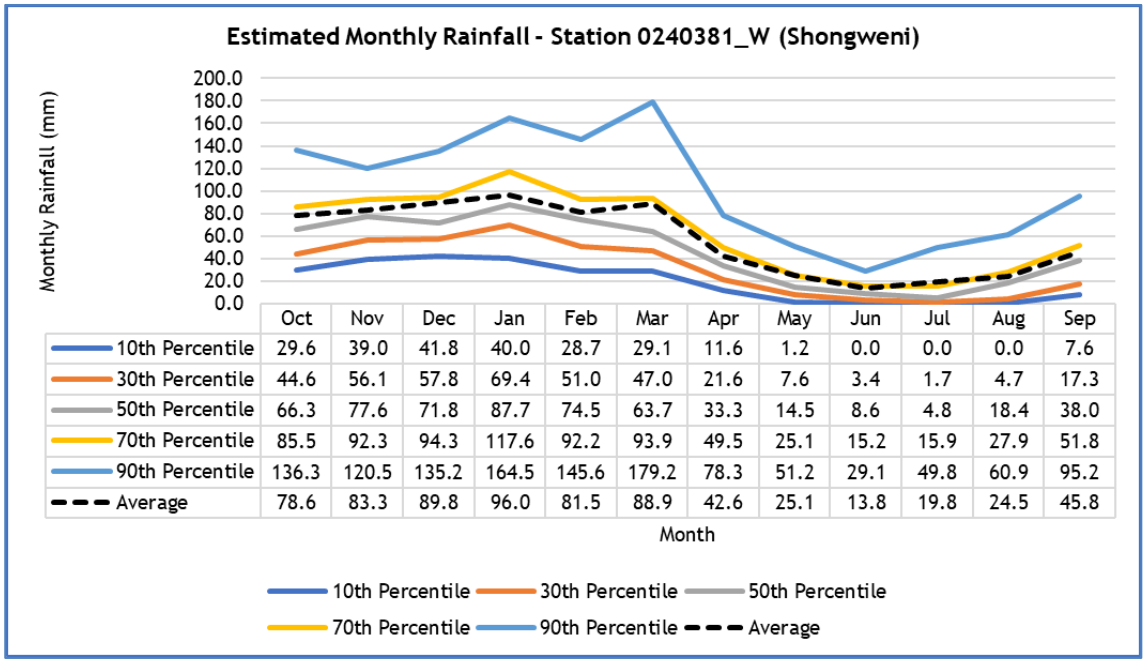


Figure 8 Wind rose (Meteoblue, 2020).

4.1.3 Rainfall

The rainfall data used to calculate Mean Annual Precipitation (MAP) was obtained from rainfall station 0240381 W / U6E006 situated approximately 3.5km west of the site (near Shongweni). Available rainfall data suggest a MAP ranging from 382 (30th percentile – dry periods) to 1 245 (90th percentile – wet periods) mm/yr, based on a historical record of 85 years (i.e. 1924 to 2009). Average rainfall is in the order of 694.9 mm/yr.

Monthly rainfall for the site is likely to be distributed as shown in Figure 9. WR2012 data suggest a MAP for catchment U60D in the order of 887 mm/yr (WRC, 2015) and design rainfall data suggest a MAP in the range 694 to 705 mm/yr. Available rainfall data is in the same order of magnitude. Monthly and annual rainfall statistics & data are available in Appendix A of the hydrological report by GCS (2020) (see **Appendix 18** of the IWWMP).



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
10th Percentile	29.6	39.0	41.8	40.0	28.7	29.1	11.6	1.2	0.0	0.0	0.0	7.6
30th Percentile	44.6	56.1	57.8	69.4	51.0	47.0	21.6	7.6	3.4	1.7	4.7	17.3
50th Percentile	66.3	77.6	71.8	87.7	74.5	63.7	33.3	14.5	8.6	4.8	18.4	38.0
70th Percentile	85.5	92.3	94.3	117.6	92.2	93.9	49.5	25.1	15.2	15.9	27.9	51.8
90th Percentile	136.3	120.5	135.2	164.5	145.6	179.2	78.3	51.2	29.1	49.8	60.9	95.2
Average	78.6	83.3	89.8	96.0	81.5	88.9	42.6	25.1	13.8	19.8	24.5	45.8

Figure 9 Rainfall distribution (station 0240381 W).

Figure 10 shows the monthly number of sunny, partly cloudy, overcast and precipitation days. Days with less than 20% cloud cover are considered as sunny, with 20-80% cloud cover as partly cloudy and with more than 80% as overcast.

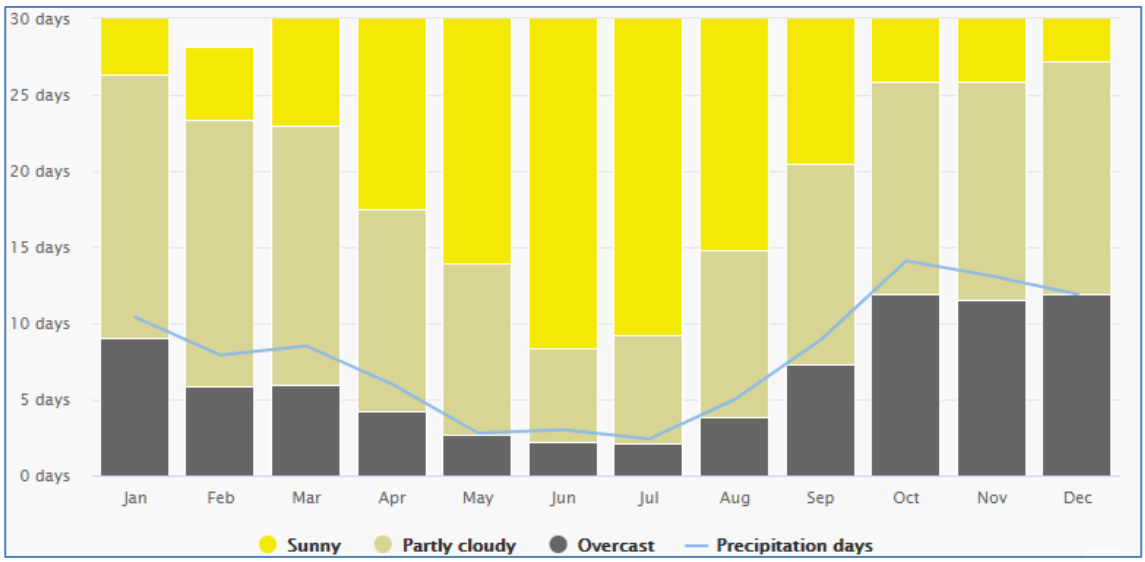


Figure 10 Cloudy, sunny, and precipitation days (Meteoblue, 2020).

4.1.4 Evaporation

Catchment U60D falls within evaporation zone 30A, of which Mean Annual Evaporation (MAE) ranges from 1 100 to 1 200 mm/yr, averaged 822 mm/yr. The MAE far exceeds the MAP for the site, which implies greater evaporative losses when compared to incident rainfall. Monthly evapotranspiration for the site is likely to be distributed as shown in Figure 8. Monthly and annual evaporation statistics & data are available in Appendix A of the hydrological report by GCS (2020). (see **Appendix 18** of the IWWMP).

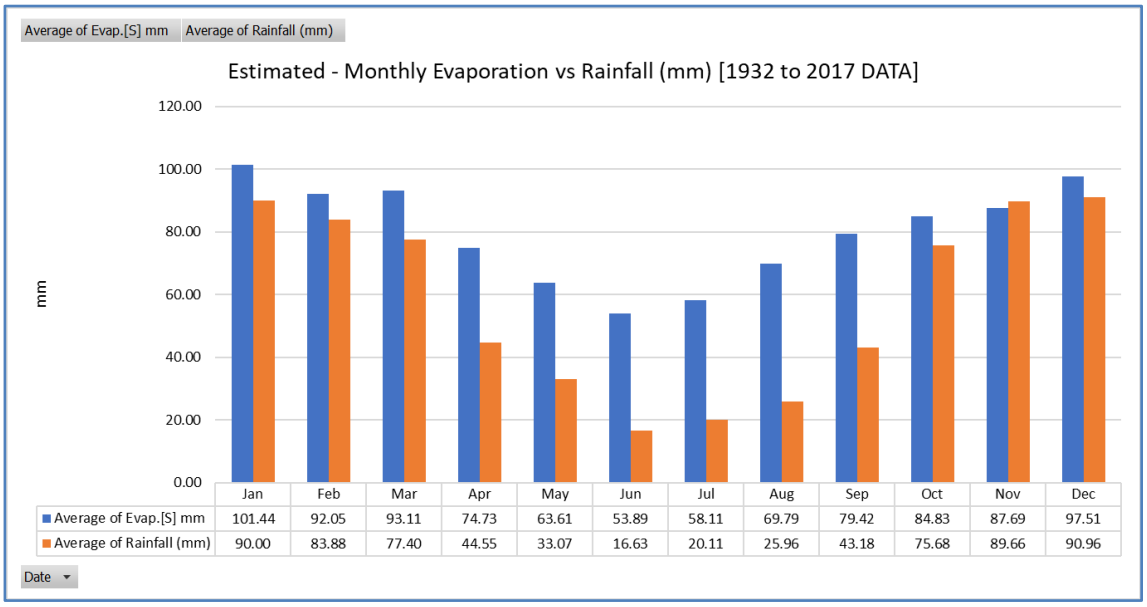


Figure 11 Evaporation vs rainfall distribution (DWS, Hydrological Services, 2019).

4.1.5 Runoff

Runoff from natural (unmodified) catchments in Catchment U60D is simulated in WR2012 as being equivalent to 117 mm/yr over the surface area (WRC, 2015). This is equal to approximately 17% of the MAP. Monthly runoff is distributed as shown in Figure 12.

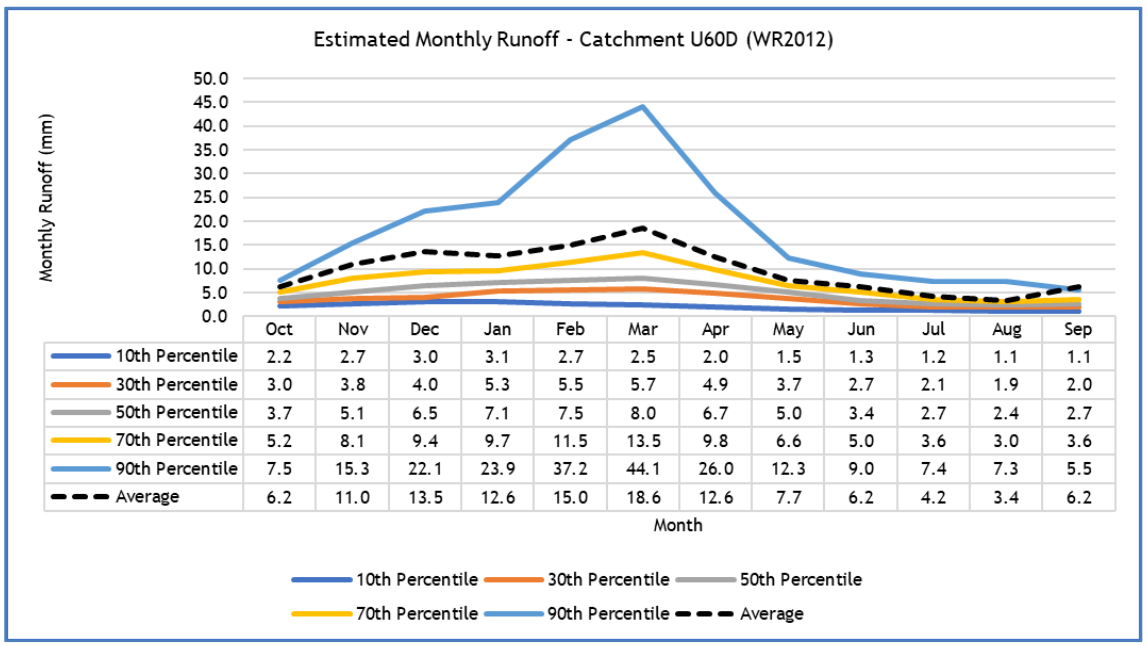


Figure 12 Simulated runoff for quaternary catchment U60D (WRC, 2015).

4.2 Water Management Area

The WWMF site is located within DWS Quaternary Catchment U60D which is drained by the perennial uMlazi River (Figure 10), which forms part of the Pongola – Mtamvuma Water Management Area (WMA). The site is drained by the Mgoshongweni River which flows in a south easterly direction and later joins the uMlazi River at the confluence located some 1600m south of the property (Figure 13).

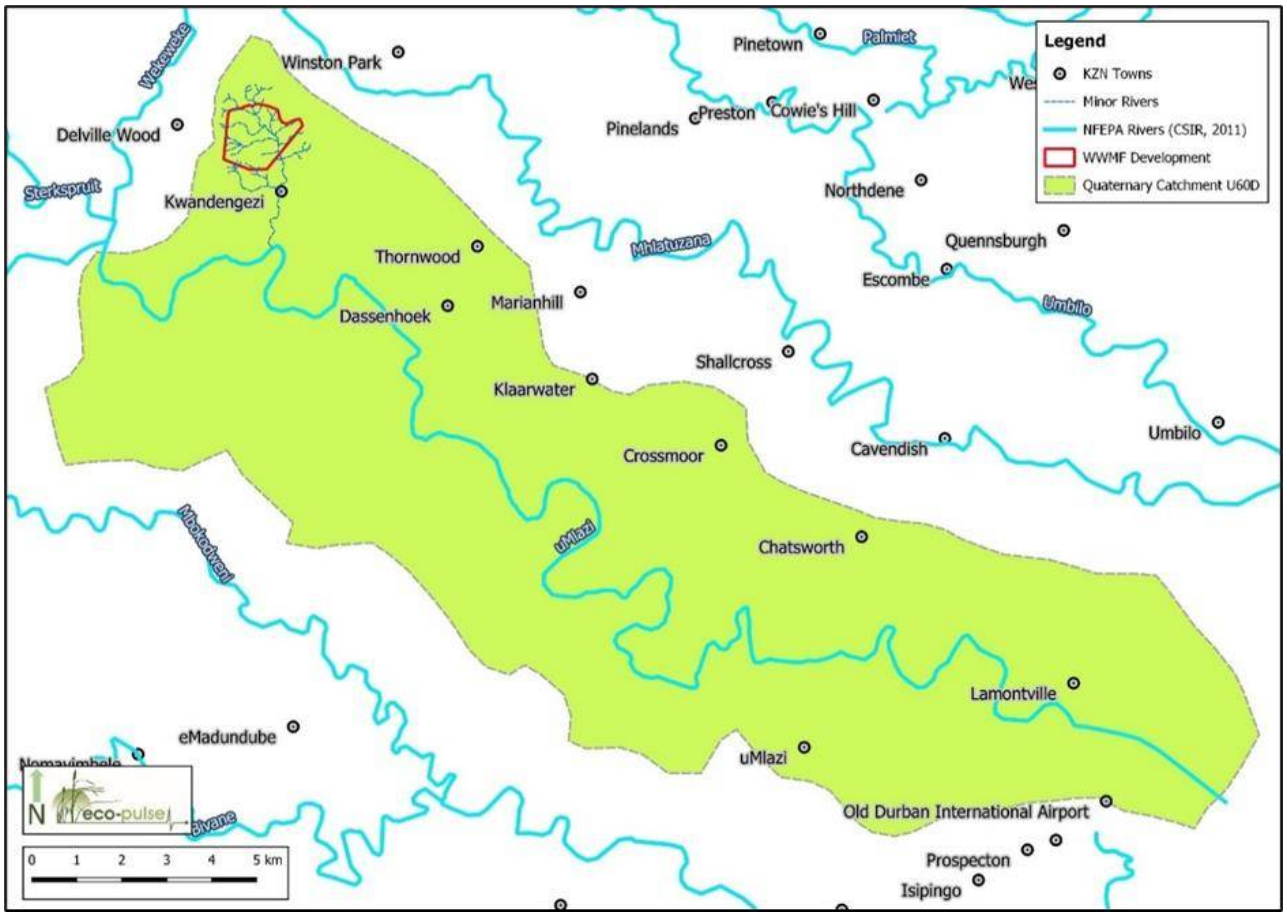


Figure 13 Map showing the planned development site located within Quaternary Catchment U60D, drained by the uMlazi River (Eco-Pulse, 2020).

4.3 Surface Water

4.3.1 Surface Water Resources Identified

Soil and vegetation sampling in conjunction with the recording of topographical features enabled the infield delineation of the outer boundaries of the three (3) channelled watercourses (streams) identified as warranting further investigation during the desktop risk screening assessment.

- **Unit R01-2 – Seasonal river (Mgoshongweni River)**
- **Unit R03 & R04 – Ephemeral streams**
- **uMlazi River** (main collecting river further downstream)

1. **River unit R01-2**: classified as a seasonal ('B-type') transitional river, occurring within a highly confined valley floor setting and characterised by low channel sinuosity. R01 had clearly a defined active and macro channel with a well-developed channel bed comprising bedrock, boulder, stone and sandy substrates. Vegetation within the unit was clearly distinct from adjacent terrestrial areas.

2. **River units R02 and R03:** classified as an ephemeral/intermittent ('A-type') mountain stream, occurring within a very steep and highly confined valley and characterised by low channel sinuosity. R02 and R03 had clearly defined but narrow channels and lacked characteristic riparian vegetation due to the intermittent nature of flows and limited saturation of soils.

NOTE THAT NO WETLANDS HAVE BEEN IDENTIFIED ON THE DEVELOPMENT SITE OR DOWNSTREAM AS BEING AT RISK OF BEING IMPACTED:

Based on the combined desktop assessment and field verification exercise, **NO WETLANDS WERE IDENTIFIED** within the area of study and downstream as being at risk of potential impact by the proposed landfill site. The absence of wetlands is attributed to the steep topography and confined river valleys that lends itself to the formation of river channels rather than wetland habitat types.

Details of the riverine units has been included in Tables 3 and 4 below and the location and extent is shown on the map in Figure 14.

Table 3 Biophysical characteristics of river and riparian habitat for seasonal river R01-2.

River Unit	River R01-2	
River Type	Seasonal Transitional River	
Channel features	Presence of a clear confined active channel and macro-channel banks. Moderately steep channel, stepped longitudinal stream bed comprising alternating bedrock, gravel, and boulder sections.	
Vegetation	**Dominant Indigenous Vegetation**	**Dominant Alien vegetation**
	Instream and marginal: *Cyperus dives, Leersia hexandra, Cynodon dactylon, Commelina spp., Phragmites australis, Cyclosorus interruptus,* and *Persicaria sp.* Riparian: *Phragmites australis, Setaria megaphylla, Cyperus dives, Acacia nilotica, Acacia schweinfurthii, Trema orientalis, Ficus sir, Dalbergia armata, Dalbergia obovata, Albizia adianthifolia* and *Ficus natalensis.*	*Tithonia diversifolia, Senna didymobotrya, Lantana camara, Chromolaena odorata, Melia azedarach, Biancaea decapetala, Cestrum laevigatum, Solanum mauritianum and Hedychium sp.*
Impacts	**Within-resource impacts**	**Catchment impacts**
	• Channel incision • Bank erosion • Alien plants and weed infestation • Limited local harvesting of wood for fire/building material • Instream water used by local cattle grazing • Localised pedestrian crossings	• Historic sugarcane cultivation • Alien plants and weed infestation • General soil disturbance due to local tillage • Railway development • Dirt roads • Landfill infrastructure and activities upstream (Enviroserv Waste Management Facility)

River Unit	River R01-2
Photos	 View of the invaded riparian vegetation. A fairly steep, bedrock/alluvial channel runs through the centre of the dense riparian vegetation comprised of tall trees, low shrubs and an invaded understorey.  View of the bedrock channel characterised by a mixed boulder-pebble and sandy river bed.  Shallow flowing water associated with riffles and runs within the channel, providing habitat for aquatic organisms.  View of a semi open-canopy section of riparian habitat that has been invaded by exotic trees and shrubs such as *Melia azedarach, Tithonia diversifolia* and *Solanum mauritianum.*  View of localised bank erosion.  View showing localised river crossings and the invaded riverine habitat.

Table 4 Biophysical characteristics of the stream and riparian habitat for ephemeral streams R03 & R04.

River Unit	Ephemeral Streams R03 & R04	
Type	Ephemeral Mountain Stream	
Channel Features	Presence of a clear intermittently inundated channel and a steep longitudinal stream bed.	
Vegetation	Dominant Indigenous Vegetation	Dominant Alien vegetation

<table>
<tr><td>River Unit</td><td colspan="2">Ephemeral Streams R03 & R04</td></tr>
<tr><td></td><td><u>Channel:</u> Understory Grass, Setaria megaphylla, commelina sp and Cyperus albostriatus.
<u>Riparian</u>: Setaria megaphylla, Trema orientalis, Ficus sir and Albizia adianthifolia</td><td>Tithonia diversifolia, Senna didymobotrya, Lantana camara, Chromolaena odorata, Melia azedarach, Biancaea decapetala, Cestrum laevigatum and Hedychium sp.</td></tr>
<tr><td rowspan="2">Impacts</td><td>Within-resource impacts</td><td>Catchment impacts</td></tr>
<tr><td>• Channel incision
• Heavy alien plants and weed infestation
• Harvesting of wood for fire/building
• General soil disturbance due to local tillage
• Dirt roads</td><td>• Possible artificial drainage
• Historic sugarcane cultivation
• Heavy alien plants and weed infestation
• General soil disturbance due to historic and local tillage
• Dirt roads</td></tr>
<tr><td>Photos</td><td colspan="2"> 
View showing the ephemeral bedrock channel characterised by a mixture of boulders-pebbles.
 
View looking upstream showing the invaded riparian habitat that has been almost entirely transformed to exotic thicket.
 
View showing the upper riparian zone invaded with Syringa trees (Melia azedarach) and Chromolaena odorata.
 
View of the incised channel and vertical banks with the instream channel invaded by exotic plants.</td></tr>
</table>

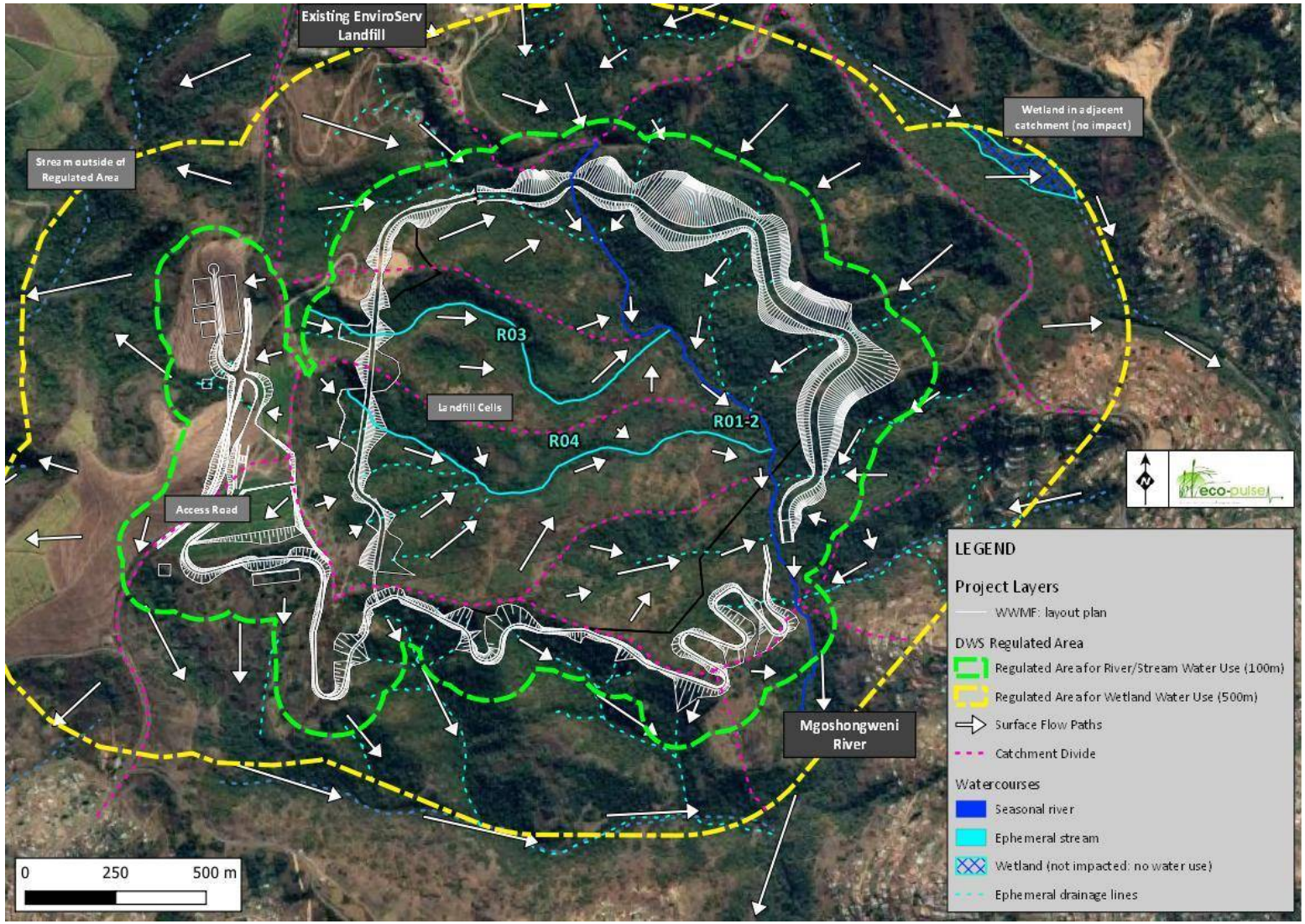


Figure 14 Map showing the location of identified and delineated watercourses: rivers and streams relative to the planned landfill development layout.

4.3.2 *Aquatic Macro-invertebrates (SASS5)*

Based on the SASS5 sampling and analysis according to the SASS Data Interpretation Guidelines (Dallas, 2007) for the 'North-eastern Coastal Belt' level 1 DWAF (2005) ecoregion, and the 'uplands' SASS spatial zonation, the Mgoshongweni River reach is considered to be in a **'poor' ecological condition (Ecological Category: 'D'**).

Whilst elevated nitrite/nitrate levels at the time of the assessment reflect a degree of decline in water quality compared to the expected reference state, the presence of several moderately and highly sensitive taxa indicates that water quality conditions are adequate to sustain most aquatic macroinvertebrate taxa. The biotope score for the assessed reach does however indicate that available SASS5 biotopes were extremely limited. It is therefore speculated that limited biotope availability is the most prominent cause for the low SASS5 index scores for the Mgoshongweni River, with nutrient pollution being a secondary driver affecting the outcomes of the SASS5 assessment. Key to the reduced availability of instream biotopes was the prevailing low-flow conditions at the time of the SASS5 assessment. Given the biotope limitations at the site during the SASS5 assessment, a definitive SASS5 derived Ecological Category has not been assigned to the assessed reach of the Mgoshongweni River.

NOTE that SASS5 sampling could not be undertaken for the remaining ephemeral streams in the study area due to lack of flow and habitat to support macro-invertebrates.

4.3.3 *Instream and Riparian Habitat*

Present Ecological State (PES) refers to the health or integrity of a river system and includes both in-stream habitat as well as riparian habitat adjacent to the main channel. The main Mgoshongweni river system R01-2 and units R03 and R04 were assessed as being in a **'Fair' or 'Moderately modified' condition ('C' PES Category)**. The PES of these systems is primarily driven by the following:

- The presence and abundance of alien vegetation throughout the river units.
- Localised modifications to the bed and banks from road crossings and cattle paths.
- Flow modifications from catchment run-off modifications and stormwater inputs.
- Water quality modifications from upstream landfill site and cattle.
- Somewhat increased rates of bed and bank erosion due to catchment run-off modifications and localised road crossings and cattle paths.

Table 5 below provides a summary of the PES results for the three river units assessed.

Table 5 Summary of the PES assessment for river units R01-2, R03 and R04.

TYPE	Instream Habitat PES	Riparian Habitat PES	Overall combined PES	PES Description
R01-2 (Mgoshongweni River)	C/B	B	C (fair)	*Moderately Modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.*
R03 & R04 (ephemeral tributary streams)	C/B	D	C	

4.3.4 *Riverine Ecological Importance and Sensitivity (EIS)*

For the purposes of this assessment, river EIS was based on rating the importance and sensitivity of riparian & in-stream biota (including fauna & flora) and habitat, using both desktop and on-site indicators (as indicated below). **R01-2 was assessed as being of 'Moderate' EIS** and **ephemeral stream units R03 and R04 were considered of 'Low' EIS**.

A summary of the EIS scores and ratings for riverine units is provided in Table 6, below

Table 6 Summary of the EIS assessment results for rivers/streams R01-2, R03 and R04.

River/Stream	Median Score (0-4)	EIS	Description
R01-2	**1.8**	**Moderate**	Features that are considered to be ecologically important and sensitive at a local scale. The functioning and/or biodiversity of these features is not usually sensitive to anthropogenic disturbances. They typically play a small role in providing ecological services at the local scale.
R03 & R04	**1.3**	**Low**	Features regarded as somewhat ecologically important and sensitive at a local scale. The functioning and/or biodiversity features have a low-medium sensitivity to anthropogenic disturbances. They typically play a very small role in providing ecological services at the local scale.

Table 7 Summary of key factors driving the EIS ratings.

EIS Criteria	Description
Rare & endangered species	Rivers and streams sampled generally lacked rare and endangered aquatic biota due to the seasonal and intermittent/ ephemeral nature of flows and the somewhat degraded nature of the systems.
Unique species (endemic, isolated, etc.):	No unique, endemic or isolated species or populations were encountered.
Intolerant species sensitive to flow/water quality modifications	Only R01-2 provides some habitat for sensitive instream biota (macroinvertebrates) as indicated in the SASS5 assessment. These biota are considered sensitive to changes in flow (due to the seasonal nature of the stream) and water quality due to the intolerant nature of selected taxa to modified water quality.
Species/taxon richness	Species/taxon richness was assessed as moderately-low with regards to instream biota (such macroinvertebrates) and flora which was limited in diversity due to the moderately degraded nature of the stream.
Diversity of habitat types	Habitat diversity at R01-2 was moderately low due to the presence of flows which made it suitable to support viable populations of some macroinvertebrate taxa. R01-2 also had a clear riparian zone which, despite widespread alien vegetation still retains remnants of primary indigenous riparian thicket. R02 and R03 on the other hand was rated as low due to the lack of flow and generally low habitat diversity.
Refugia	All three rivers sampled are considered to be of low importance in terms of providing refugia to support biota during times of environmental stress.
Sensitivity to flow changes	Small, intermittent streams can be quite sensitive to changes in flows, particular low flows and flows during periods that support instream habitats. This is the case for R01-2 which is a seasonal stream and provides habitat to relatively sensitive biota for part of the year. R02 and R03 on the other hand was rated as low due to the lack of flow and therefore the lack of sensitivity to changes in flow.
Sensitivity to flow related water quality changes	Due to the seasonal nature of flows in R01-2, instream habitats were considered sensitive to flow modifications largely due to the limited buffering/assimilative capacity attributed to small river systems in general. R02 and R03 are not sensitive to flow related water quality changes due to the lack of persistent flow (i.e. ephemeral/ intermittent)
Migration route/corridor (instream & riparian):	Due to the low flows and limited instream habitat, these streams/rivers are not considered important in terms of instream movement of biota (such as fish migration corridors), however, the semi-natural dense wooded riparian habitat associated with the river R01-2 may be utilised as corridor for small mammals, birds and reptiles, etc.
Importance of conservation & natural areas	The stream network in the study area has not been highlighted in terms of national, provincial or local level conservation planning datasets and therefore is not considered to be of a particularly high level of importance in terms of aquatic biodiversity/ecosystem conservation.

4.3.5 *PES and EIS of Downstream Water Resources (i.e. the uMlazi River)*

Due to the proposed landfill being situated on the Mgoshongweni River, which is a tributary of the uMlazi river, it is important to understand the downstream river system (i.e. the uMlazi river) as water quality and flow related impacts due to the proposed landfill will ultimately culminate in potential aquatic impacts to this river system. A number of existing studies for the uMlazi River were reviewed to determine the status and importance of the river to inform the WULA for the landfill site, which has been documented below.

Desktop PES and EIS assessment DWS (2013):

According to the desktop PES and EIS assessments undertaken by DWS (2013), the uMlazi River reach (U60D-04661) downstream of the property is regarded as 'Moderately Modified' ('C' PES Category) and has a 'High' Ecological Importance (EI) and a 'Very High' Ecological Sensitivity (ES) (see Table 8, below).

Table 8 Summary of the DWS desktop (2013) PES and EIS information for the uMlazi River.

Quaternary Catchment	River Name	Reach length	Assessed by experts	PES (present ecological state)	EI (ecological importance)	ES (ecological sensitivity)
U60D-04661	uMlazi	42.07km	Yes	C: Moderately Modified	High	Very High

Table 9 summaries key criteria that contribute to the PES, EI and ES classes rated as part of the assessment by DWS (2013).

Table 9 Summary of the DWS desktop (2013) PES and EIS information.

	Criteria	Rating/ Score
Present Ecological State (PES)	Instream habitat continuity mod	Small
	Rip/wetland zone continuity mod	Moderate
	Potential instream habitat mod act.	Moderate
	Riparian-wetland zone mod	Moderate
	Potential flow mod act.	Large
	Potential physico-chemical mod activities	Serious
	PES Class	**C: Moderately Modified**
Ecological Importance (EI)	Fish spp per sub-quaternary catchment	22.00
	Fish: average confidence	4.00
	Fish representivity per secondary: class	Very High
	Fish representivity per secondary: class	Very High
	Fish rarity per secondary: class	Very High
	Ecological importance: riparian-wetland-instream vertebrates (excluding fish) rating	-
	Riparian-wetland natural veg rating based on % natural veg in 500m	High
	Riparian-wetland natural veg importance based on expert rating	High
	Invert taxa per sub-quaternary catchment	67.00
	Invert average confidence	4.40
	Invert representivity per secondary: class	High
	Invert rarity per secondary: class	Low
	Ecological importance: riparian-wetland-instream vertebrates (excluding fish) rating	-
	Habitat diversity class	Low
	Habitat size (length) class	High
	Instream migration link class	Very high
	Riparian-wetland zone migration link	High
	Riparian-wetland zone habitat integrity class	High
	Instream habitat integrity class	High

	Criteria	Rating/ Score
	Mean EI Class	**High**
Ecological Sensitivity (ES)	Fish phys-chem sensitivity description	Very high
	Fish no-flow sensitivity description	Very high
	Invert phys-chem sensitivity description	Very high
	Inverts velocity sensitivity	Very high
	Riparian-wetland-instream vertebrates (excluding fish) intolerance water level/flow changes description	-
	Stream size sensitivity to modified flow/water level changes description	High
	Riparian-wetland veg intolerance to water level changes description	Low
	Mean ES Class	**Very high**

Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area (DWS, 2015):

Building on the Desktop PES and EIS assessment by DWS (2013), DWS (2015) undertook a Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area. According to this study the uMlazi River reach (U60D-04661) is regarded as being 'Moderately Modified to Largely Modified' ('C/D' PES Category) and the Recommended Ecological Category (REC) is to maintain the current ecological state ('C/D' PES Category), see Table 10.

Table 10 Summary of classification of water resources (DWS, 2015).

Quaternary Catchment	River Name	Reach length	PES	PES Drivers	REC
U60D-04661	uMlazi	42.1km	**C/D: Moderately to Largely Modified**	Water quality. Non-Flow: Vegetation removal from wood harvesting.	**C/D: Moderately to Largely Modified**

In addition, DWS (2015) set the following water Resource Quality Objectives (RQOs) for the lower uMlazi river reach in question:

- Ensure that turbidity/clarity or TSS levels stay within Acceptable limits: A moderate change from present with temporary high sediment loads and turbidity during runoff event (Aquatic ecosystems: driver).
- Ensure that nutrient levels (phosphate and Total Inorganic Nitrogen; TIN) are within Tolerable limits: 50th percentile of the data must be less than 0.075 mg/L PO4-P. 50th percentile of the data must be less than 2.5 mg/L TIN-N (Aquatic ecosystems: driver).
- Ensure that electrical conductivity (salt) and toxics levels are within appropriate limits for intended use, e.g. industrial use: Numerical limits can be found in DWAF (1996e) (Industrial use: driver).
- Meet faecal coliform and *E. coli* targets for recreational / other (full or partial contact) use[1].

Activities affecting watercourses within this catchment must therefore take measures to support the C/D REC and RQO's set for this reach of the uMlazi River so that regional targets are met collectively by all water users. Note that the information presented by DWS (2013, 2015) for the sub-quaternary river reach U60D-04661 was used as supplementary information when undertaking local-level river reach assessments (PES, EIS and REC). *It must also be noted that the PES/EIS assessments undertaken by DWS (2013, 2015) as summarised above, extend some distance up and/or downstream of the project study area.*

[1] <600 counts/100ml (low health risk), 600-2 000 counts/100ml (medium health risk and >2 000 counts/100ml (high health risk).

Other Specialist Studies:

In addition to the above studies, Eco-Pulse in 2014 conducted a baseline assessment of the uMlazi River reach downstream of the proposed landfill. This information has been summarised below:

- **uMlazi River PES/EIS**

Typical impacts affected the PES of the uMlazi River reach are related mainly to human settlement in the upstream catchment as well as direct impacts of human activities within the river system. The results of the PES (Present Ecological State) and EIS (Ecological Importance and Sensitivity) for the uMlazi River as per Eco-Pulse (2014) is summarized in Table 11.

Table 11 Summary of the DWS desktop (2013) PES and EIS information

Reference	Overall PES	EIS
uMlazi River	C (Fair)	Moderate

- **uMlazi River Water Quality**

Water quality results for the uMlazi River reach downstream of the planned landfill site are presented below in Table 12. The results of the analysis of water chemistry indicate contamination by faecal matter, which is reflected by the high levels of *E. coli* bacteria and elevated nutrient levels (nitrate, ammonia & phosphate) which generally exceed the TWQR (Target Water Quality Range) for aquatic ecosystems (DWAF, 1996). Ammonia, nitrate and orthophosphate concentrations were also elevated. Elevated levels of these constituents are attributed to faecal contamination as biological processers degrade human's wastes and make these compounds available within the aquatic environment. These compounds are limiting nutrients in aquatic systems and excess in them can result in eutrophication. Elevated nutrient levels pose a risk of eutrophication and a health risk to intolerant aquatic biota as well as for human/animal consumption. Water quality associated with the uMlazi was regarded as '**Poor'** (Eco-Pulse, 2014).

Table 12 Summary results of the water chemistry analysis undertaken for the uMlazi river (Eco-Pulse, 2014)

	Water Quality Variables			Sample Sites
	Variable	**Unit**	**TWQR**	**uMlazi River**
Laboratory Analysis	Ammonia	mg N/l	> 0.007	0.31
	E. coli	colonies per 100ml	130	3000
	Nitrate/Nitrite	mg N/l	<0.5	2.01
	Orthophosphate	mg P/l	<0.025	0.173
	Electrical Conductivity	mS/m	-	48
	COD (Chemical Oxygen Demand)	mg O_2/l	-	20
	Suspended Solids	Mg/l	<100	33
	Chloride	Mg Cl/l	-	56
Not Available				
Within TWQR – Aquatic Ecosystems (DWAF, 1996a)				
Exceeds TWQR for 'Aquatic Ecosystems' (DWAF, 1996a)				

- **uMlazi River Aquatic Invertebrate Assessment (SASS5)**

SASS5 results indicate that ecological integrity within the uMlazi river was regarded as **Largely Modified** ("D" PES category), with a summary of the results shown below in Table 13. The poor health status derived from the SASS assessment is considered a reflection of the prevailing poor environmental water quality. Invertebrates have evolved to

survive in a particular suite of habitat conditions/ preferences and SASS results are a reflection of in-stream water quality as well as habitat quality, diversity and availability (Eco-Pulse, 2014).

Table 13 Summary results of the water chemistry analysis undertaken for the uMlazi river (Eco-Pulse, 2014)

River	Habitat score	SASS Score	No. of Taxa	ASPT	PES	Class
uMlazi River	43	112	24	4.7	**D**	**Largely Modified**

A summary of the PES (Present Ecological State) and EIS (Ecological Importance & Sensitivity) assessment results are as follows:

Table 14 Overall summary of PES and EIS with RMO.

Water Resource Unit	PES	EIS	Recommended Management Objective (RMO)
R01-2: Mgoshongweni River	C: Moderately modified	Moderate	*Maintain PES/EIS*
R03 & R04	C: Moderately modified	Low	
uMlazi River	D: Largely Modified	Moderate	

4.3.6 Surface Water Hydrology

The study area and rivers are located within DWS Quaternary Catchment U60D which is drained by the perennial uMlazi River, situated in the Pongola – Mtamvuma Water Management Area (WMA). The site is drained by the Mgoshongweni River which flows in a south easterly direction and later joins the uMlazi River at the confluence located some 1.6 km south of the development site and property.

A specialist hydrological assessment was undertaken for the purposes of the Water Use Licence application by GCS (Pty) Ltd – Report 20-0473, 28 September 2020 ((see **Appendix 18** of the IWWMP). Five (5) sub-catchment, entailing sixteen (16) micro-catchments (hydrological response units - HRUs) describe the natural drainage for the study area that will be impacted (using a 1:10 000 stream count and a 1.5m DTM) - refer to Figure 15.

Moreover, the streams at the proposed Shongweni landfill site are not high flooding risk areas. However, based on field observations the streams may be subjected to minor flooding damage (i.e. the flow velocity risk is moderate-high due to steep slopes). Areas where culverts will be installed (post-development) may get blocked and are higher risk due to the momentum of flow from the floods prevailing direction. This could lead to undercutting and rapid erosion/bank failing during peak events. It is recommended that stormwater and energy dampening systems be put in place to decreases the risk of upper bank erosion.

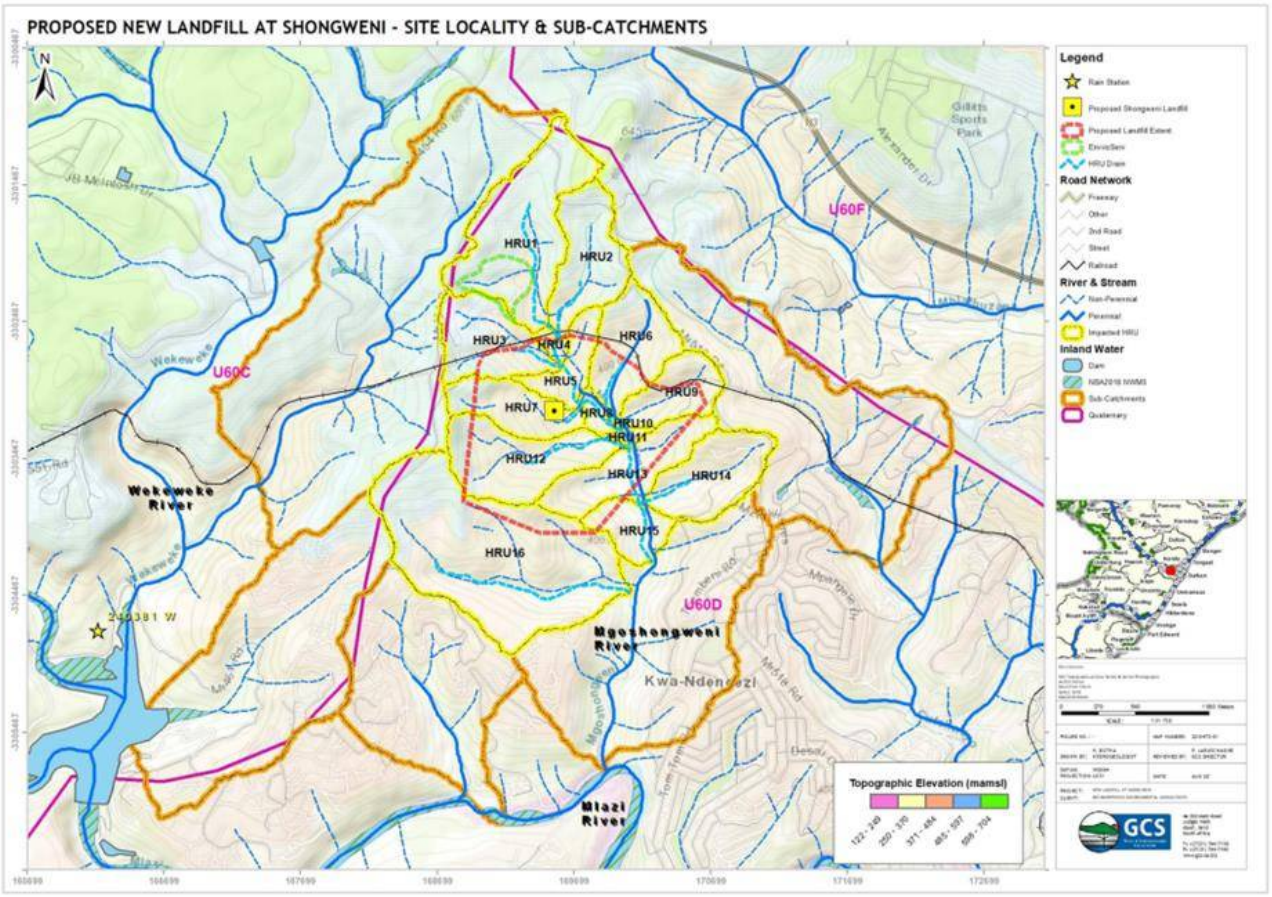


Figure 15 Subcatcment areas defined by GCS during hydrological modelling (GCS, 2020).

Floodline modelling and a conceptual water balance were also undertaken.

Available surface water sample data (upstream and downstream in the Mgoshongweni Stream) plot well within (DWAF, 1996b) ideal water quality ranges for potable water use, except for Turbidity and microbes (Ecoli, faecal coliforms and total coliforms). A hydrological risk assessment was undertaken and mitigation measures were proposed to circumvent potential impacts (refer to Section 7 of the Hydrological Report by GCS contained in **Appendix 18**) Several hydrological risks were identified at the site, of which poor-quality runoff and seepage from the landfill, sedimentation, soil pollution and erosion are the greatest risks.

4.3.7 Surface Water Quality

The accessible rivers/streams draining the landfill site catchment area were inspected in the field and the two ephemeral streams were found to be dry (no flow), and as such water sampling could not be undertaken where there was no flow experienced. Only the seasonal to weakly perennial 'Mgoshongweni River' that drains the sub-catchment had sustained flow at the time of the field survey and this was where the focus of water sampling and SASS5 assessment took place. Eight (8) determinands were analysed at a SANAS accredited laboratory, including Ammonia, Chemical Oxygen Demand (COD), *E. coli*, Electrical conductivity, Nitrate/Nitrite, Orthophosphate, pH and Suspended Solids.

The results (Table 15) revealed somewhat elevated nitrogen (nitrate/nitrite), conductivity and *E. coli* levels, the likely cause of which is a combination of possible leachate from the upstream Enviroserv Landfill and faecal matter from cattle using

the watercourse and adjacent areas of the river catchment It is important to note that the possibility of leachate entering the system from the Enviroserv facility needs to be confirmed by seasonal monitoring at locations immediately downstream of the landfill. Based on the once off grab sample taken during this study, prevailing water quality can be considered 'fair'.

Table 15 Detailed results of water sample analysis for the sampling site.

Variable	Unit of measure	Site 1 R01-2: Mgoshongweni River below landfill site
Ammonia	mg N/l	<0.11
E. coli	colonies per 100ml	816
Nitrate/Nitrite	mg N/l	3.15
Orthophosphate	mg P/l	<0.04
Electrical Conductivity	mS/m	39
COD (Chemical Oxygen Demand)	mg O_2/l	16
Suspended Solids	Mg/l	24

NOTE: *It is important to acknowledge that the once-off grab samples taken were used as ancillary data to gauge the current integrity, importance and sensitivity of the receiving environment, not for the purposes of a detailed water quality assessment. Without detailed routine water quality monitoring, the once off grab sample cannot be considered conclusive evidence of leachate contaminating surface watercourses. This should be informed by an on-going surface and groundwater monitoring programme, as stipulated in the DWAF guideline 'Minimum Requirements for Water Monitoring at Waste Management Facilities, Second Edition' (DWAF, 1998).*

Surface water sampling was also undertaken as part of the GCS Hydrological assessment and the findings are as follows:

Two (2) surface water samples were obtained upstream and downstream in the Mgoshongweni Stream. SW1 (upstream) is situated downstream of the EnviroServ site. SW2 is situated downstream of the proposed Shongweni landfill (before the confluence with the Mlazi River). The remainder of the drainage streams identified were dry or stagnant, hence no samples were taken. The analytical results are listed in Table 16. The results are compared against DWAF ideal water quality values (DWAF, 1996b) for potable water use, to contextualise the water quality data. The results are summarised as follows:

- Available sample data is well within (DWAF, 1996b) ideal water quality ranges for potable water use, except for Turbidity and microbes (Ecoli, faecal coliforms and total coliforms);
- High microbial activity is observed in the surface water above chronic limits; and
- High microbial activity is reflected by turbidity, and hence explains why turbidity is high as well.

Table 16 Summary of Surface Water Hydrochemistry.

Determinant	Unit	SW1	SW2	DWAF 1996 Domestic Use – TWQR
pH at 25°C	pH units	7.4	7.3	4 - 9
Electrical Conductivity at 25°C	mS/m	40.5	38.1	0 - 70
Bicarbonate Alkalinity*	mg HCO_3^-/ℓ	36	24	ns
Total Alkalinity	mg $CaCO_3$/ℓ	36	24	ns
Dissolved Calcium	mg Ca/ℓ	10.4	8.57	0 - 32
Dissolved Magnesium	mg Mg/ℓ	11.5	12.1	0 - 30
Sodium	mg Na/ℓ	44	41	0 - 100
Potassium	mg K/ℓ	3.52	4.18	0 - 50
Chloride	mg Cl/ℓ	68	68	0 - 100

Determinant	Unit	SW1	SW2	DWAF 1996 Domestic Use – TWQR
Fluoride	mg F/ℓ	0.76	0.45	0 - 1
Nitrate	mg N/ℓ	3.78	4.67	0 - 6
Sulphate	mg SO_4/ℓ	30.2	30.1	0 - 200
Total Coliforms	colonies/100mℓ	7270	7700	0 - 5
E.coli	colonies/100mℓ	58	62	0
Faecal Coliforms	colonies/100mℓ	59	62	0
Turbidity	NTU	1.9	3.6	0 - 1
ns = No Quality Range in Reference Guideline, Orange = Above DWAF (1996) Ideal Water Quality Ranges				

4.3.8 Surface Water Users

The perennial surface water sources are limited to the Mgoshongweni Stream but seasonal springs may develop in the valley axis of this extensive dendritic drainage feature during summer and early autumn. These springs emerge when rainwater percolates through the scant soil cover into the weathered granite profile and fills the available storage. Under these conditions, the perched water is forced to emerge on surface in valley axis areas due to the limited weathered profile and steep hydraulic gradients.

The Mgoshongweni Stream has an effective catchment of about 6 km, which extends north and north-westwards as far as the tar road to Dassenhoek or the "Milky Way". The following surface water resources (Table 17) were identified in the Geomeasure Group 2000 hydrocensus.

Table 17 Surface Water Hydro-census Data.

Site ID	Coordinates		Source	Flow ℓ/s	Field EC mS/m
	South	East			
SUR1	29º 49.14'	30º 45.49'	Kwandengezi Tributary	0.3	38
SUR2	29º 49.81'	30º 45.28'	Mgoshongweni – Upstream	1.5	23
SUR3	29º 49.78'	30º 45.25'	EnviroServ – Downstream	0.2	240
SUR4	29º 50.68'	30º 45.68'	Mgoshongweni – D/stream	2.0	46

According to Water Allocation Registration Management System (WARMS) and Groundwater Resource Information Project (GRIP, 2016), only one surface water users exist within a 2.5km radius of the proposed landfill site (Table 18). An updated hydrocensus undertaken by Geomeasure in November 2020 did not identify any surface water users within 5km of the site.

Table 18 Surface water users within 2.5km of the site (WARMS dataset).

ID	Latitude (WGS84)	Longitude (WGS84)	User	Resource Type	Resource	Register Status	Lawfulness Finding	Registered Volume (m^3/yr.)
21148811	-29.6998	31.0757	TOREMAR INV 50	RIVER/ STREAM	TRIBUTARY OF MLAZI RIVER	ACTIVE	LAWFULNESS STILL TO BE DETERMINED	0

4.3.9 Sensitive Areas Survey

An assessment of the sensitive areas on and around the site was undertaken by Eco-Pulse in their Aquatic Assessment Report (see **Appendix 16**).

Understanding the ecological and conservation context and importance of the study area and surrounds in terms of conservation planning is important to inform decision making regarding the management of the aquatic resources in the area. In this regard, national, provincial and regional ecosystem / vegetation classification and conservation planning information was interrogated to obtain an overview of the study site (Table 19).

'At a national level the Vegetation Map (SANBI, 2018) has flagged areas within the study areas as comprising patches of KwaZulu-Natal Sandstone Sourveld (SVs5) grassland vegetation, which is regarded as 'Endangered' at a national level and 'Critically Endangered' at a Provincial level (Jewitt, 2016). In terms of provincial conservation planning datasets, portions of the study area have been classified as a 'Critical Biodiversity Area (CBA): Irreplaceable' in terms of the KZN Terrestrial Systematic Conservation Assessment (EKZNW, 2016). On interrogation of the KZN Terrestrial Systematic Conservation Plan (EKZNW, 2010), it is apparent that the following factors have resulted in the classification of the area as a CBA:

- The (potential) presence of KwaZulu-Natal Sandstone Sourveld (Critically Endangered) and KwaZulu-Natal Coastal Forests: Southern Mesic Coastal Lowlands Forest (Critically Endangered)
- The potential modelled presence of a number of rare terrestrial millipedes and molluscs dependent on intact grassland/forest/bushveld habitat (e.g. *Odontomelus Eshowe, Eremidium erectus*, *Doratogonus rubipodus, Cochlitoma semidecussata).*
- The potential modelled presence of a number of rare/endangered plant species dependent on intact grassland/forest habitat (e.g. *Gerrardanthus tomentosus, Streptocarpus molweniensis, Dahlgrenodendron natalense, Begonia rudatisii, Diaphananthe millarii, Pseudoscolopia polyantha*, and *Helichrysum woodii)*

Table 19 Key ecological and conservation context details for the study area.

Conservation Planning Dataset	Relevant Feature	Location in Relation to Project Site	Conservation Planning Status
NATIONAL ECOSYSTEM AND VEGETATION CLASSIFICATIONS AND CONSERVATION ASSESSMENTS			
National Vegetation Map (SANBI, 2018) – Terrestrial Vegetation	KwaZulu-Natal Coastal Belt Thornveld (CB6)	Primary coastal vegetation no longer represented on site (Secondary thicket and alien bushland/thicket only)	**Vulnerable**
	Scarp Forest (FOz5)		**Least Concern**
	Northern Coastal Forest (FOz7)		
	KwaZulu-Natal Sandstone Sourveld (SVs5)		**Endangered**
South African Inventory of Inland Aquatic Ecosystems (SAIIAE), 2018 – River Ecosystems	uMlazi River (Reach U60D010000)	Development activities located upstream of the uMlazi River	**Least Threatened**
The National Freshwater Ecosystem Priority Area (NFEPA) Assessment (CSIR, 2011) – Wetland FEPAs	No Wetland FEPAs within 500m of the proposed development.	No wetlands present on site or downstream	N/A

Conservation Planning Dataset	Relevant Feature	Location in Relation to Project Site	Conservation Planning Status
The National Freshwater Ecosystem Priority Area (NFEPA) Assessment (CSIR, 2011) – River FEPAs	The development site catchment has not been flagged in terms of NFEPA	No wetlands present on site or downstream	N/A
PROVINCIAL & REGIONAL ECOSYSTEM AND VEGETATION CLASSIFICATIONS AND CONSERVATION ASSESSMENTS			
KZN Vegetation Map (Scott-Shaw & Escott, 2011)	KwaZulu-Natal Coastal Belt Thornveld	Primary coastal vegetation no longer represented on site (Secondary thicket and alien bushland/thicket only)	**Vulnerable**
	Eastern Scarp Forests: Southern Coastal Scarp Forest		**Least Threatened**
	KwaZulu-Natal Coastal Forests: Southern Mesic Coastal Lowlands Forest		**Critically Endangered**
	KwaZulu-Natal Sandstone Sourveld		
KZN Terrestrial Systematic Conservation Plan (EKZNW, 2010)	Planning Units No. 56707, 56735, 56751, 56757, 56789 & 56798	Project site	**CBA 1 (or CBA: Irreplaceable[2])**
KZN Terrestrial Systematic Conservation Assessment (EKZNW, 2016)	KZN CBA: Irreplaceable	Project site	**CBA: Irreplaceable**

There were no wetlands identified on the site or downstream.

4.3.10 Groundwater

A detailed ground water assessment was undertaken for the project during the EIA Phase of the investigation. A Geohydrological Report was produced by Geomeasure Services in January 2001 and is included in **Appendix 17**. An updated hydrocensus was undertaken in 2020 by Geomeasure and this, together with a letter stating that the findings of the original report are still applicable, is also included in **Appendix 17**.

The findings of the hydrogeological report are as follows:

- This region has been subjected to severe tectonic activity and numerous, mainly North, Northwest and Northeast trending faults occur in the region resulting in the formation of “tilted blocks” and a repetition of geological formations in this broken topography.
- A major NNW trending fault forms the ridgeline and western boundary of the site whilst a NE trending displacement represent the southern limit and the entire footprint area of the proposed candidate site is underlain by granite gneiss of the Mapumulo Suite of the Natal Structural and Metamorphic Province. The displacement faults effectively isolate the site from the faulted sandstone blocks to the west and south, to form a granite compartment with poor hydraulic connection with the surrounding lithologies.
- The natural watershed between the catchment areas of the Mlazi and Mhlatuzana catchments occurs on the Dassenhoek spur trending NW-SE approximately 3 km NE of the site and the Shongweni Dam access road represents a watershed within this limited sub-catchment of the Mlazi River. The extensive plateau area to the northwest of the site represents a significant rainfall and groundwater catchment area. However, this zone of

[2] CBA: Irreplaceable are areas that are irreplaceable or near-irreplaceable (i.e. high selection frequency) for meeting biodiversity targets. There are no or very few other options for meeting biodiversity targets for the features associated with these areas.

groundwater recharge is isolated from the project area by the deeply incised valley west of the Shongweni Dam access road.

- Groundwater movement and recharge into the granite compartment underlying the site is "deflected" by the N/S and E/W trending faults and the effective groundwater recharge area is minimal due to the steep topography, limited catchment and preferential flow paths offered by these faults.
- The drilling and test pumping results have proved that hydraulic connection between the lithologies separated by the faults is poor and with the exception of the N/S trending fractured zone in the main valley axis, no well developed fractured zones were identified within the proposed landfill footprint area.
- The sustainable yields of the groundwater exploration boreholes drilled within the project area are marginal with only one borehole (SS4) producing a sustainable yield of 80 kl/day (>1 l/s). Groundwater quality in the granite gneiss is poor due to excessive concentrations of fluoride and iron. Residents of this region are supplied with treated water via a reticulation system operated by Umgeni Water at the Shongweni Dam and there are no groundwater users hydraulically down-gradient if this site.
- Water-bearing fractures in the granite gneiss underlying the candidate site are confined to the intermediate or transition zone between the highly weathered and unweathered bedrock and hydraulic conductivity measurements (Packer tests) have returned k-values ranging between 10^{-4} and 10^{-7} cm/s or 10^{-1} or 10^{-4} m/day.
- The conceptual geological and geohydrological models developed from the available data clearly illustrates the compartmentalised nature of the site and the limited effective groundwater catchment and the marginal yields and poor recovery characteristics of the groundwater exploration boreholes drilled during this investigation reflect this.
- A perched water table has developed within the weathered granite saprolite, with the transition zone between the highly weathered and unweathered bedrock representing the preferential lateral groundwater migration pathway. The phreatic surface rises to within 2m of ground level on some portions of the site. The inferred groundwater contours derived from static water level data recorded in exploration boreholes and monitoring wells located in proximity to the study area show that groundwater movement is generally south-eastwards at a gradient of 1 : 10 towards the Mgoshongweni Stream.
- The geotechnical information provided by Messrs Thekweni GeoCivils show that the gravelly silty clay soil cover within the proposed landfill footprint area is generally >1m and fall within the Rev. US Classification ranges A-2-4 to A-7-6. The deeply weathered gravelly granite profile extends to depths of 6 – 10m over the unweathered bedrock and this presents the opportunity to reshape the site considerably to improve slope stability and gain surplus material for use as daily cover. Laboratory and field permeability tests have returned hydraulic conductivity values ranging between 10^{-3} and 10^{-5} cm/s for both the soils and weathered granite and although this is ideal daily cover, these materials will require conditioning or modification prior to use in construction of the liner system.
- In terms of the DWAF Aquifer Classification, the groundwater resource falls within the non-aquifer category due to the marginal sustainable yields and poor quality and the risk assessment in terms of the proposed regional G:L:B^+ landfill site development show that this site is marginally suitable for development due to the limited natural barrier protection.
- The minimum design guidelines for a G:L:B^+ landfill site however, requires a substantial engineered liner system which must incorporate leachate detection and subsoil drainage layers which will drastically improve the retention characteristics of this limited vadose zone and mitigate the minor surface and groundwater contamination risk posed by this proposed landfill site development.
- From our knowledge and experience of the geohydrological conditions prevailing in the Shongweni area we consider that it is highly unlikely that a more geohydrologically favourable site for landfill development can be found within the available undeveloped areas.

- **This investigation therefore concludes that the Shongweni South Candidate Site is geohydrologically SUITABLE for development as a regional general waste landfill, subject to the implementation of the engineering and other measures recommended in this report.**

The conceptual geological model shown below illustrates the geologically isolated raised block of granite in the geological "compartment" created by the N/S and E/W trending intersecting faults, which represent the southern and western margins of this project area. (see Figure 16).

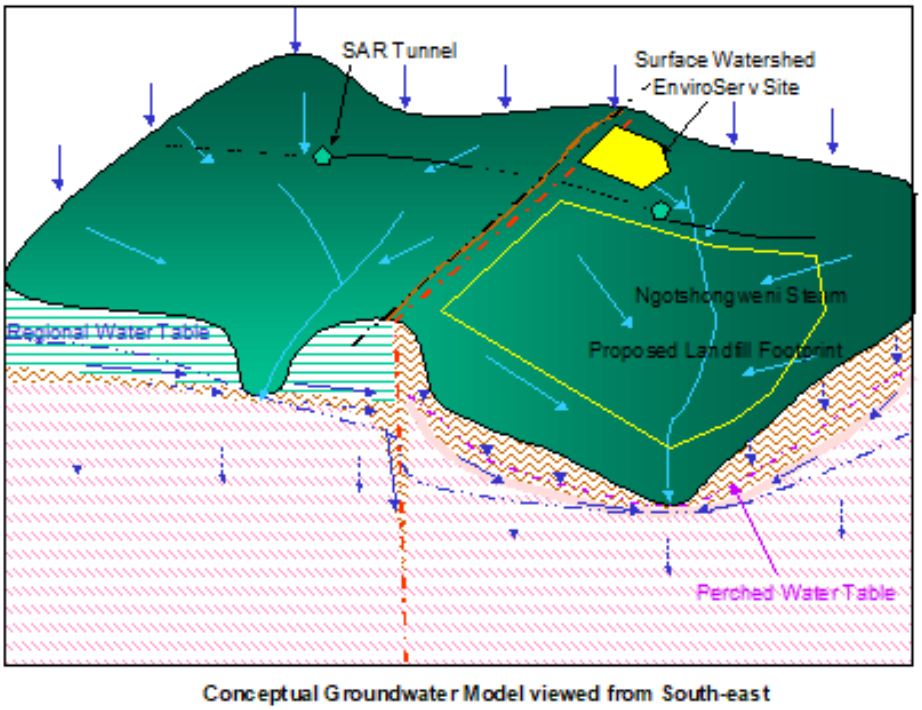


Figure 16 Conceptual Groundwater Model viewed from the south-east (Geomeasure, 2001).

Hydrocensus:

The original hydrocensus was undertaken within a 2km radius of the site. The locations of the perennial springs and water supply boreholes are shown on the map in Figure 17.

The hydro census data collected in April 2000 are presented in Table 20.

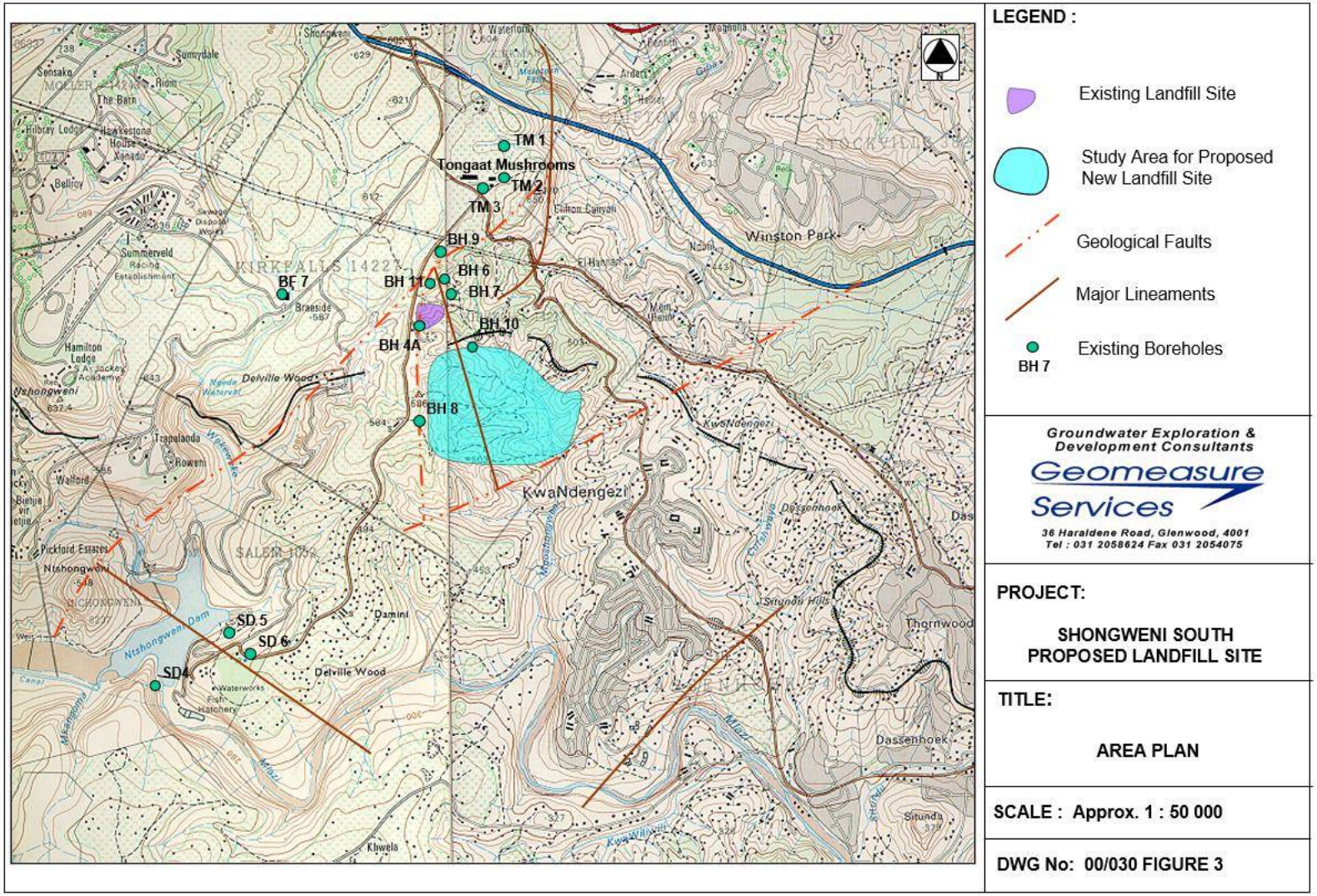


Figure 17 Springs and Water Supply Boreholes (2000 data) (Geomeasure, 2001).

Table 20 Hydrocensus Data from 2000.

BH No.	Location	Co-ordinates		Depth M	S.W.L. m b.g.l.	Yield l/s	Usage
		South	East				
TM1	Tongaat Mushrooms	29°48'51.41"	30°45'13.79"	100	15.6	2.5	Domestic/Agricult. Use
TM2	Tongaat Mushrooms	29°48'45.61"	30°45'24.59"	102	<1	6.3	Domestic/Agricult. Use
TM3	Tongaat Mushrooms	29°48'58.21"	30°45'19.80"	108	27.3	4.2	Domestic/Agricult. Use
SD4	Shongweni Dam	29°51'40.79"	30°43'08.40"	?	?	?	Handpump – not in use
SD5	Shongweni Dam	29°51'22.21"	30°43'31.80"	?	?	?	Handpump – not in use
SD6	Shongweni Dam	29°51'29.99"	30°3'43.21"	?	?	?	Handpump – not in use
BF7	Braeside Farm	29°49'31.19"	30°43'52.79"	?	?	?	Handpump – not in use
BH 1	Existing Landfill Site	29°49'43.17"	30°44'53.94"	60	1.1	0.1	Decommissioned in 1997
BH 2	Existing Landfill Site	29°49'47.89"	30°44'46.23"	10	Dry	Dry	Monitoring borehole
BH 3	Existing Landfill Site	29°49'48.42"	30°44'57.5"	34.9	33.5	Dry	Monitoring Borehole
BH 4	Existing Landfill Site	29°49'48.35"	30°44'47.43"	30	17.5	< 1 l/s	Decommissioned
BH 4B	Existing Landfill Site	29°49'52.00"	30°44'46.97"	60	14.93	Seepage	Monitoring borehole
BH 5A	Existing Landfill Site	29°49'10.20"	30°44'48.59"	101	44.63	0.3	Decommissioned / Backfilled
BH 5B	Existing Landfill Site	29°49'10.20"	30°44'49.2"	102	34.52	Dry	Decommissioned / Backfilled
BH 6	Existing Landfill Site	29°49'38.39"	30°44'58.81"	90	40.2	0.05	Monitoring
BH 7	Existing Landfill Site	29°49'43.79"	30°45'04.79"	80	26.43	Seepage	Monitoring
BH 8	Existing Landfill Site	29°50'26.02"	30°44'53.99"	120	47.74	0.08	Monitoring
BH 9	Existing Landfill Site	29°49'25.00"	30°44'48.98"	138	46.88	1.3	Monitoring
BH 10	Existing Landfill Site	29°49'57.00"	30°45'20.99"	120	4.6	0.4	Monitoring
BH 11	Existing Landfill Site	29°49'37.99"	30°44'53.99"	120	2.77	0.2	Monitoring

m.b.g.l. - meters below ground level
S.W.L. - static water level
l/s - litres per second

The hydrocensus was updated and extended to a 5km radius from the site in 2020 by Geomeasure Group. An initial site visit was conducted on the 8th October 2020 during which it was attempted to locate and sample the existing on site boreholes BH SS 1 to BH SS 4. During the site visit, it was discovered that site access was very difficult and that roads would have to be cleared for access with a vehicle (vehicle required to access the boreholes due to the equipment required to pump and sample the boreholes). During this visit, a hydrocensus was conducted down-gradient of the site and no boreholes were located down-gradient of the site. Following this site visit, DWS stated that the sampling of the on-site boreholes was not necessary and that only boreholes in the 3 km band needed to be investigated.A follow up site visit was conducted on the 3rd November 2020. A site walkover was attempted, and a borehole was discovered on the site. The borehole was labelled BH 10, which from the database records and hydrocensus data from the initial investigation corresponds to an Enviroserv Shongweni Landfill monitoring borehole. The remaining hydrocensus was undertaken within the 3 km band radius, in the areas deemed geohydrologically sensitive by an on-site assessment of the study area.

From the hydrocensus, no boreholes were found to be located geohydrologically down-gradient of the site. The boreholes identified at a desktop level located to the south of the Mlazi River were not investigated, as these are located in a different geohydrological setting. Since no boreholes were located down-gradient of the site, a sample from the on-site stream was taken.

The areas to the west, north and east of the site within the 3 km band radius were then investigated. The only boreholes located were boreholes located at Denny Mushrooms to the north of the site. Two (2) of the six (6) Denny Mushroom boreholes were visited, whilst one (1) was sampled. These boreholes are reportedly used for consumption. However, further details could not be attained. The boreholes indicated to the west of the site could not be located.

The locations of the identified boreholes and hydrocensus points are shown on the map in Figure 18. It was discovered that the majority of the area (residential areas) is served by reticulated municipal water supply.

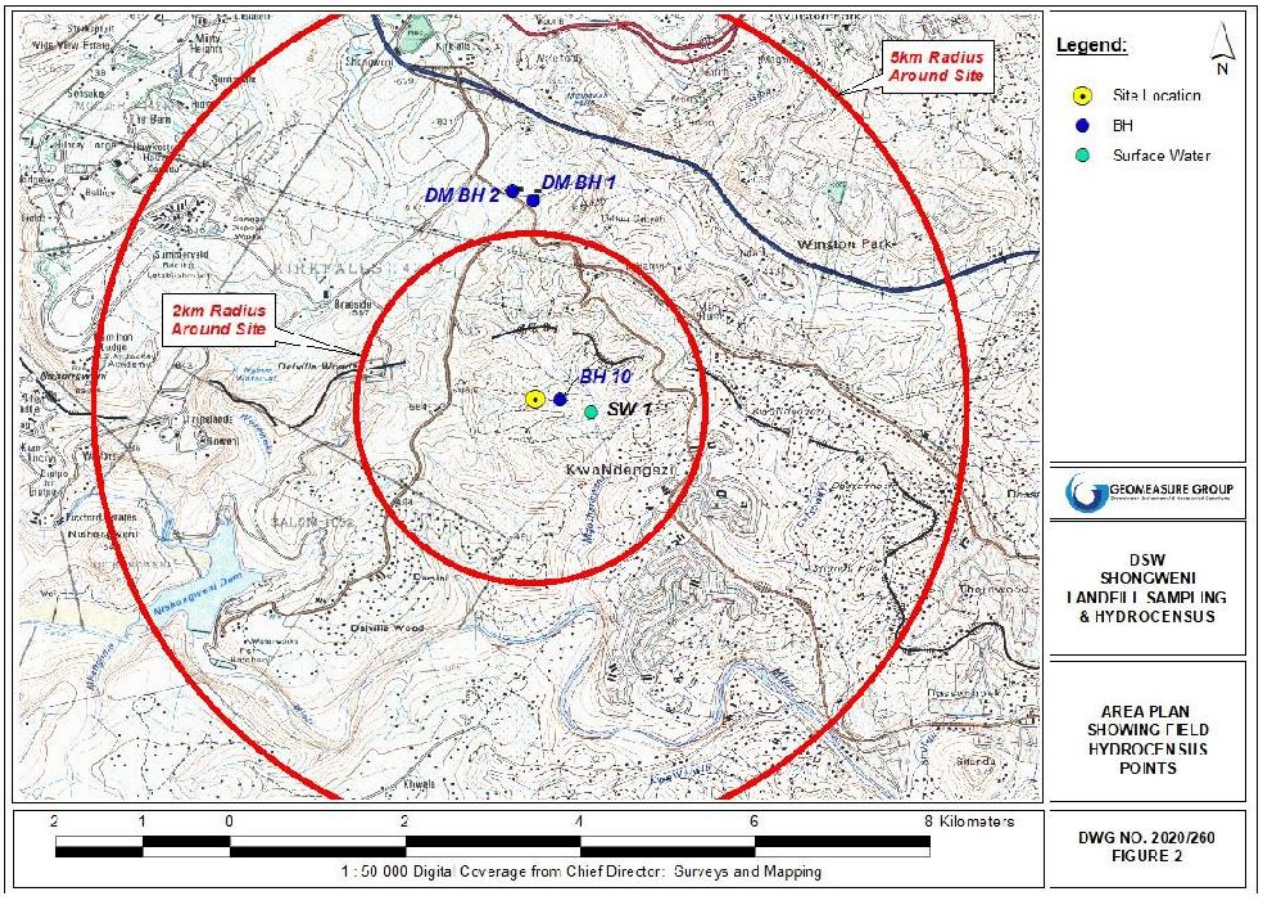


Figure 18 Updated 2020 Hydrocensus Data (Geomeasure, 2020).

Groundwater Quality:

Groundwater samples were collected in 2000 (Geomeasure) from boreholes SS1 to SS4 and their quality analysed. The results of these analysis are shown in Table 21. None of these boreholes could be located during the 2020 extended hydrocensus. A total of one (1) groundwater sample was taken from borehole BH DM 1 at the Denny Mushrooms site during the 2020 hydrocensus. **The groundwater quality results returned indicated that the water is generally of an excellent quality with none of the determinants analysed for exceeding the SANS 241: 2015 drinking water standards.**

Table 21 Summarised Groundwater Quality Results.

Borehole No.	Kempster Class	Remarks
SS1	III	High Faecal Coliform Count (188/100ml)
SS2	III	High F concentration (4.64 mg/l) and Faecal Coliform Count (12/100ml)
SS3	III	High Fe concentration (3.54 mg/l) and Faecal Coliform Count (200/100ml)
SS4	III	High F concentration (3.92 mg/l)

4.4 Socio-economic Environment

The Shongweni area is in the eThekwini Municipality, within the province of KwaZulu-Natal. Shongweni is the least developed local planning area in eThekwini and contains 11% of the metro population on 13% of the land. Agricultural activity predominates and the open space system comprises 32% of the area (taken from the Outer West Spatial Development Plan Annual review 2012/2013). The Eastern Precinct within the Local Area Plan is identified as the natural resource and future landfill site area. Management of land use around the landfill site may present opportunities for carefully managed agricultural development. Public works programmes focussed on alien eradication, erosion control and establishing basic tourism infrastructure need to be investigated and encouraged according to the Local Area Plan.

Data published by Stats-SA after the 2011 census (http://www.statssa.gov.za/?page_id=4286&id=10444) indicates that, in general, the population density within is roughly 25 persons/km2, with the dominant race group being black African and male dominated. Most people falling within the low to middle income bracket Most (96.6%) of the water in the area is sourced from regional/local supply schemes, with a low dependency on water from boreholes. Most (67.3%) toilets run on flush toilets are connected to septic tank systems, with only 25% linked to a sewerage system. Refuse is removed the local municipality for 75% of cases.

Table 22 Summary of key statistics for Shongweni (http://www.statssa.gov.za/?page_id=4286&id=10444).

Characteristics	Statistic
Young (0-14)	12.5%
Working Age (15-64)	87.5%
Elderly (65+)	0%
Dependency ratio	14.3
Sex ratio	166.7
Population density	25 persons/km^2
No schooling aged 20+	5.9%
Higher education aged 20+	11.8%
Matric aged 20+	29.4%
Average household size	3.3
Female headed households	50%
Flush toilet connected to sewerage	25%
Weekly refuse removal	75%
Piped water inside dwelling	75%
Electricity for lighting	100%

5 CHARACTERISATION OF PLANNED ACTIVITY

5.1 Site Infrastructure Planned

The proposed landfill development has an estimated design life of 69 years, based on current predictions of waste volumes and cover material, with development to be phased over the project life (see plan in Figure 3 showing the phasing plan for the landfill).

Phase 1: years 1- 25

Phase 1 will include development on the western valley side of the Mgoshongweni River, leaving the main river channel unaffected. The infrastructure for the landfill be concentrated near the entrance on the western edge above the escarpment. Large bulk earthworks platforms are required to accommodate the various storage, stacking and recycling areas. These will be constructed in stages, as demand increases.

The following infrastructure will be built:

- **Security house**
  - Located next to the entrance gate and will also include washing and toilet facilities.
- **Offices**
  - A single storey building of 400 m^2 will be provided, containing offices, meeting rooms, and staff facilities such as a canteen and ablutions.
  - This building is to have electrical reticulation, as well as external security lighting. Parking will be provided for employee's cars and. Green Building principles will be applied to buildings, including such measure as collection of rainwater for reuse, and solar panels to provide internal lighting during working hours.
  - A separate environmental centre will be constructed at a later date.
  - Sufficient parking for employees and visitors will be provided.
- **Ablution facilities & sewer**
  - These will be conventional waterborne sewerage, draining to 2 x septic tanks and soakaways south of the entrance.
  - There is no sewer infrastructure in the vicinity of the Entrance Works. Initially sewers will drain to septic tanks and soakaways located south of the infrastructure works in undeveloped land.
  - In future, it may be possible to link into new municipal sewer reticulation as the area to the north of the landfill develops.
- **Weighbridges**
  - 2 x 18 m long weighbridges will be constructed initially, with provision for a third weighbridge in future if required due to increased waste volumes.
  - A weighbridge control office of 25 m^2 will be provided at the weighbridges.
  - Sufficient hardstanding for queuing of vehicles will be provided alongside the access road leading to the weighbridge.
- **Vehicle Wash Bays**

- 2 Vehicle wash bays will be provided to clear refuse collector trucks and plant operating on site. Provision will be made to recycle dirty water from the wash bay, which will ultimately be collected in the contaminated stormwater dam.

- **Vehicle maintenance shed**
  - This will be a shed type building with a concrete floor, electric lighting and power points allowing for work to be done under adverse weather conditions.
  - The entire workshop floor area will drain to an oil and grease trap and then to the contaminated stormwater dam. A three-phase welding point is required.

- **Maintenance storage area**
  - This will house all maintenance equipment, viz. oils, greases, fuels and lubricants, which will therefore have an oil trap area to be cleaned on a regular basis.
  - A fuel bund will be positioned outside the building for ease of access during refuelling of the plant and equipment**.**

- **Recycling area**
  - In order to reduce the likelihood of people reclaiming from within the disposal cell, a sorting area with reclamation facilities will be constructed next to the laydown area. This will include a shed type building with a concrete floor allowing for work to be done under adverse weather conditions.
  - Skips and containers will be placed on the laydown area from where the recyclable materials will be removed and placed in the reclamation bins placed nearby under a roof. This will reduce the likelihood of wind-blown litter and the recycled materials will be removed from site as and when the skips are full.

- **Composting area**
  - This area will comprise a hardened hardstand area which can be used for composting purposes.
  - Bulk composting will be done in windrows with water added as necessary from the clean storm water dams.

- **Builders Rubble Stockpile and Crushing area**
  - An area will be dedicated close to the entrance to the site where all incoming builders rubble will be screened, separated to size (by mobile crushing plant) for use in drainage layers, road layers, wet cell areas etc. Surplus material will be used for cover material on the site. All builders' rubble will therefore be utilised on site for operational tasks.

- **Wet weather handling area**
  - This area will comprise a hardened area which can be used for temporary placement of waste during periods of sustained wet weather. Sufficient space will be available for 7 days waste to be accommodated.
  - This area will drain to the contaminated stormwater dam south of the entrance.

- **Contaminated Stormwater dam for Infrastructure**
  - A contaminated stormwater dam of 3500 m^2 area will be constructed south of the entrance works to collect runoff form the vehicle wash bays, the workshop area and the wet weather handling area.
  - The water in this dam may only be discharged if it complies with water quality standards, otherwise it may only be used for irrigation or dust suppression over lined areas of the landfill.
  - The capacity of this dam will be sufficient to contain the 1 in 50 year 24 hour storm with full freeboard.

- **Clean Water Detention Pond for Infrastructure**
    - Clean storm water runoff will be collected in a piped system and diverted to a detention pond situated south of the infrastructure works.
    - This water may be stored and used for dust suppression or discharged to the environment at a flow rate not greater than the pre-development flow for storms in the range of 1 in 10 years and 1 in 50 years.
- **Water**
    - Water will be supplied by eThekwini Municipality from an existing reservoir near the western corner of the buffer zone. A pumping main of 75mm dia. water main will need to be constructed along MR461 to the site. Water will be required for offices, wash bays, workshops and landscaping purposes. Water will be stored in a storage tank of 220 m^3 capacity situated above the infrastructure where it can supply water for domestic use and firefighting purposes by static head.
    - The water mains will also supply water for firefighting purposes, and hydrants and fire hoses will be provided as required by the Building regulations.
- **Electricity**
    - 3 Phase electricity will be supplied to a minisub by eThekwini Municipality. There is an existing 33kV overhead line along MR461. This line will have to be relocated along the new section of road MR461. This will provide power to the weighbridges, offices and lighting. A backup generator will be provided to ensure continuity of operation of the landfill. Power will also be required in future for leachate pumps, leachate treatment works, evaporation plant and gas collection systems.
- **Telecommunications**
    - mA fibre optic line will be required to a point near the entrance for communications.
- **Green Buildings**
    - It is intended to provide environmentally friendly buildings as far as possible. To this end, rainwater from roofs will be collected for reuse, grey water may be collected and recycled, and solar power installed for lighting of buildings during operating hours.

The security house, weighbridge control room and offices, vehicle maintenance shed, maintenance storage area and recycling area will be constructed as per the drawings complying with all the required local municipal building regulations and guidelines as well as the South African National Building Regulations and Standards.

The weighbridge civil and mechanical construction will be undertaken as per the design drawings to be submitted by the successful tenderer.

Phase 2: years 25+

On completion of Phase 1, Phase 2 will comprise filling the Shongweni valley over the stream up to the steep eastern slopes. Phase 2 includes the landfill cell development on the eastern side of the Mgoshongweni River valley from year 25 onwards until landfill completion:

- Phase 2, Stage 1 will involve the Construction of Phase 2 cell 1 stability berm, base and liner, bulk excavation in future Phase 2 cells 2 and 3 (*see landfill cell development plan in Figure* 4), Construction of first section of bypass channel or culvert.

- Phase 2, Stage 2: Construction of Phase 2 cell 1 temporary capping, Phase 2 cell 2 stability berm, base and liner bulk excavation in future cells 3 and 4(*see landfill cell development plan in Figure* 4).

5.2 Construction Phase

5.2.1 Environmental Management Programme (EMPr)

The **Environmental Management Programme (EMPr)** (contained in **Appendix 13** compiled by WSP Environmental (2016) provides for the management of the construction activities on the property and includes the recommendations of the specialist aquatic assessment undertaken by Eco-Pulse Consulting (2020). The EMPr is a structure document that provides practical guidelines for environmental management to ensure all works undertaken by the developer, engineer/s, contractor/s and subcontractor/s have minimal impact on the environment and are in accordance with all conditions of development and approved best practices in regard to environmental management. The EMPr contains the following key information to guide the construction process and manage environmental risks and impacts:

- Roles & responsibilities for implementation;
- Site establishment and initial construction activities including the management of site access, construction camps, storage areas, materials, education, dust/air pollution, soil erosion, storm water, water quality, fauna/flora, waste management, social impacts (visual/noise); and
- Operational activities: buffer zone, water and leachate management, hazardous substances, health, air quality, noise, vegetation management (rehabilitation), training, etc.

5.2.2 Environmental Education & Awareness

All contractors undertaking construction activities on site will have to be inducted and this will include training on the requirements of the **Environmental Management Programme (EMPr)** (contained in **Appendix 13**). The main contractor will need to appoint an independent Environmental Control Officer (ECO) to undertake the required environmental training in accordance with the requirements of the **EMPr** and the **Specialist Aquatic Assessment Report** (Eco-Pulse, 2020: Report No. EP499-01) contained in **Appendix 14**. It is anticipated also that regular environmental 'toolbox talks' will be carried out with all contracting labour on site.

5.2.3 Communication

During construction, the project manager from or appointed by the Municipality will endeavour to undertake regular meetings with all contractors on site to ensure effective communication of any issues arising. Environmental Audits will be undertaken on a monthly basis during the construction phase by an appointed independent ECO, the findings of which will then be communicated to the main contractor and the Municipality. The audit reports and all other communication around environmental incidents will be sent to KZN EDTEA monthly and a final audit will be undertaken and sent to the authorities upon completion of the project.

5.2.4 Sensitive 'No-Go' Areas & Buffer Zones

There are no wetlands on site, therefore the channelled watercourses (rivers and streams and riparian habitat associated with the Mgoshongweni River channel) are considered the most sensitive aquatic environments on the site. **Areas outside of the development footprint include sensitive and ecologically important terrestrial forest and grassland habitats**

that need to be avoided and conserved. Importantly, these areas will form part of the terrestrial biodiversity offset (plan still in the process of being finalised by Eco-Pulse) and will need to be avoided during construction.

Based on the outputs of the buffers assessment run using the Aquatic Buffers Tool for the project area, a fixed buffer width of 30m is recommended for all watercourses within the study area, including riparian areas associated with rivers and streams.

IMPORTANT NOTE ON THE APPLICATION OF AQUATIC 'BUFFERS'

Whilst the recommended 30m aquatic buffer zones have been recommended for the development, it needs to be mentioned explicitly that the landfill development intends to infill a significant portion of the Mgoshongweni River valley, hence there will be a direct loss of riverine habitat due to infilling. Practically then, buffer recommendations therefore do not apply to area to be infilled but to the remaining rive/stream network OUTSIDE of the planned development footprint and storm water attenuation structures (i.e. within the landfill buffer).

5.2.5 Waste Management and pollution prevention

The management of potential waste and pollutants at the landfill site will be key to ensuring that downstream aquatic environments do not become polluted/contaminated to such an extent that this becomes detrimental to their integrity and functionality. Key water quality threats during landfill operation will be associated with leachate, which is defined as any liquid that migrate from the waste carrying dissolved or suspended contaminants. Leachate results from precipitation entering the landfill and from moisture that exists in the waste when it is disposed. Environmental risks associated with leachate are centred on ground and surface water contamination with key toxicants/contaminants generally associated with leachate being nutrients, toxic organic contaminants, toxic heavy metals, pesticides and salts, although this is dependent on the type of waste disposed of course. As such, the treatment of leachate is important before it is released back into the environment downstream (east) of the landfill. The following is recommended:

- The proper lining of the landfill cell and handling of waste needs to be administered.
- Leachate must be adequately treated prior to disposal.
- Correct emergency procedures and cleaning up operations should be implemented in the event of accidental spillage/overspill of leachate, any fuel, oils or other pollutant/contaminant at the landfill.

The following are recommended basic principles of leachate management as it pertains to the aquatic environment:

i. Adequate evaporation ponds must be constructed to temporarily store leachate and minimise premature discharge of untreated leachate into the environment.

i. Treated leachate must be polished further through appropriate secondary treatment via the use of artificial reed beds (wetlands) prior to discharge into a watercourse. This is necessary to assist with the removal of recalcitrant organics or inorganic materials such as high salt levels that cannot be directly discharged into the environment.

General landfill cell design guidelines and guidelines for the design and construction of secondary leachate treatment wetlands/artificial reed beds have been considered.

5.2.6 Monitoring & Control

Environmental monitoring and control during construction will take place as per the recommendations of the **Environmental Management Programme (EMPr)**, the **Specialist Aquatic Assessment Report** (Eco-Pulse, 2020: Report No. EP499-01) as well as the **Aquatic Monitoring Plan** developed by Eco-Pulse (Report No. EP499-03) and contained in **Appendices 13, 16 and 23**, respectively. The main contractor will need to appoint an independent ECO to undertake compliance monitoring in accordance with the requirements of the **EMPr**, **Specialist Aquatic Assessment Report** and **Monitoring Plan** which contain guidelines and recommendations for ecological monitoring within watercourses and buffer zones, including water sampling/analysis, visual surveys and habitat disturbance surveys with a focus on the monitoring of alien plants, erosion features, scouring and sedimentation, pollution, habitat destruction, etc.

5.3 Water Services Supply

Water will be supplied by eThekwini Municipality from an existing reservoir near the western corner of the buffer zone. A pumping main of 75mm dia. water main will need to be constructed along MR461 to the site. Water will be required for offices, wash bays, workshops and landscaping purposes. Water will be stored in a storage tank of 220 m^3 capacity situated above the infrastructure where it can supply water for domestic use and firefighting purposes by static head. The water mains will also supply water for firefighting purposes, and hydrants and fire hoses will be provided as required by the Building regulations.

No water will be abstracted from boreholes or surface water resources.

5.4 Waste Management Site Design

5.4.1 Liner Design

The landfill cells will be lined in accordance with the NEMWA National Norms and Standards for Disposal of Waste to Landfill. Figure 19 illustrates the possible engineering design requirements for the containment barrier of a Class B Landfill.

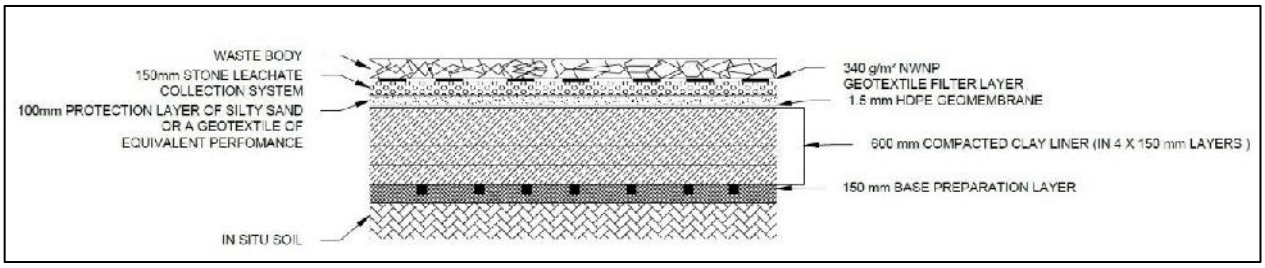


Figure 19 Class B Landfill design requirements (iX Engineers, 2021).

The clay to be used as the Compacted Clay Liner is required to conform to a B layer, which means a permeability of 0.3 m/year or $1x10^{-6}$ cm/s compacted at 95% Standard Proctor at OMC to +2% OMC.

If the clay on site does not meet the above requirements, it is proposed that Geosynthetic Clay Liner (GCL) is used as an alternative to the clay portion of the composite lining system. It is anticipated that a GCL liner will be provided to all or most of the cells, rather than compacted clay.

It is also proposed to use a primary liner consisting of a 1.5 mm HDPE Geomembrane. Therefore, the initial containment barrier system as illustrated in **Figure 20** is proposed, as per the gazetted legislation requirements, but modified to suit the available soils. The proposed containment barrier system will also be reassessed during the detailed design stage to ensure compliance with the latest available technical literature and may be amended accordingly. The liners will be anchored in the excavated trenches as will be shown on the design drawings.

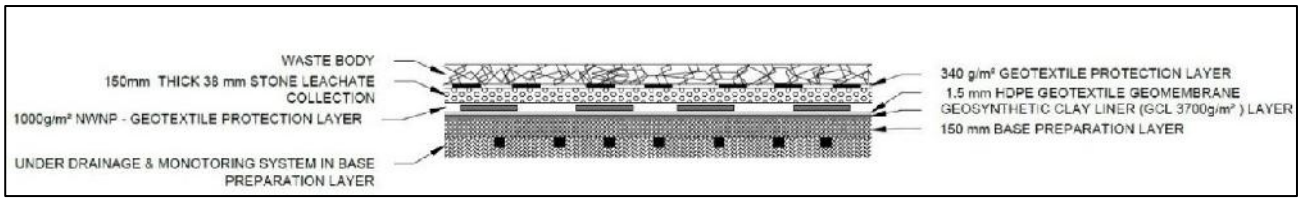


Figure 20 Proposed liner design for cells (iX Engineers, 2021).

These layers include the following:

- Rip and compact the base preparation layer as a 150 mm thick rip and compact in situ layer,
- Construct under drains for monitoring – 600 mm x 300 mm Geofabric wrapped around stone,
- Install detection/inspection manhole and outlet pipeline from under drainage network,
- Import, place and compact 150 mm thick base preparation layer,
- Import and place a Geosynthetic Clay Liner (GCL),
- Import and place 1,5 mm smooth/double textured HDPE Geomembrane layer as the primary liner,
- Import and place 1 000 g/m^2 NWNP Geotextile placed as the protection layer to the HDPE liner, alternatively a soil and/or a stabilised sand protection layer may be utilised.
- Import and place 150 mm thick 38-75 mm washed stone layer,
- Import and place 350 g/m^2 NWNP Geotextile placed as the separation layer to the stone drainage layer,
- Dispose of General waste on this layer. The first layer of waste needs to be a selected waste layer at least 300 mm thick pioneered over the drainage layer, in order to minimise the chance of damaging the drainage layer or liner.

The following is proposed to be installed on the basal and side slope areas of the interim and final leachate collection dam and the contaminated stormwater dam (refer to **Error! Reference source not found.** for an illustration of the proposed l ayers), with the interim dams proposed to be converted and utilised as part of the landfill cells as development progresses to the east.

- Rip and compact the base liner as a 150 mm thick rip and compact in situ layer,
- Construct under drains for monitoring – 600 mm x 300 mm Geofabric wrapped around stone,
- Install detection/inspection manhole and outlet pipeline from under drainage network,
- Import and place a Geosynthetic Clay Liner (GCL),
- Import and place 1,5 mm HDPE Geomembrane layer as the primary liner,
- Import and place 1000 g/m^2 NWNP Geotextile Protection Layer, alternatively a soil and/or a stabilised sand protection layer may be utilised.
- Import, place and compact 150 mm thick geocell protection layer filled with stabilised soil.

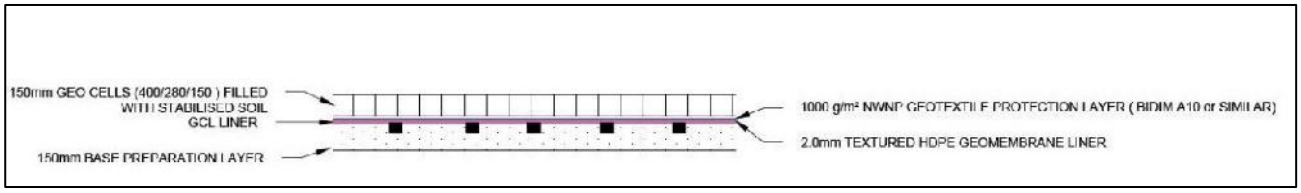


Figure 21 Proposed liner design for leachate collection dam (iX Engineers, 2021).

With the following proposed layers to be installed during the conversion, as part of the landfill cell/s:

- Import and place 150 mm thick 38-75 mm washed stone layer,
- Import and place 350 g/m^2 NWNP Geotextile placed as the separation layer to the stone drainage layer,
- Dispose of General waste on this layer. The first layer of waste needs to be a selected waste layer at least 300 mm thick pioneered over the drainage layer, in order to minimise the chance of damaging the drainage layer or liner.

5.4.2 Drainage to Base of Landfill

This comprises of three components:

Under drains:

Underdrains below the liner around the perimeter of the cell and across the base of each cell will drain to inspection manholes. These inspection manholes will be monitored to indicate any leakage through the base liner.

Leachate collection:

The base of each cell will be shaped to the design levels and falls, requiring bulk earthworks, both cut and fill. The base of each cell will slope at a gradient not less than 2% towards a central valley, which in turn will slope at not less than 2% towards the leachate collection dam.

Herringbone drains will comprise of 160 mm dia. HDPE slotted pipes at 20 m centres in the stone drainage layer, draining to the main 160 or 200 mm dia. leachate collection pipes. These main leachate collection pipes will be duplicated to minimise the risk of blockages and will have inspection manholes for rodding and to measure the leachate generation from each cell. The leachate collection pipes drain to the leachate collection dam(s).

Contaminated Runoff:

Surface runoff from the interim covered waste areas in the active cell will be collected in open channels and pipes and drained to the contaminated stormwater dam(s). On completion and capping of a cell the subsequent runoff will be diverted to the clean storm water runoff system/s.

As far as possible, the volume of contaminated stormwater will be minimised by diverting runoff from final covered or unused parts of the active cell off the cell.

This may also require that temporary covers be installed to minimise the area that water can infiltrate the waste body.

5.4.3 Leachate and Contaminated Stormwater Dams

Leachate quality:

'Leachate' refers to liquid that drains or 'leaches' from a landfill caused by precipitation entering the landfill as well as from moisture that exists within the actual waste when it is dumped. The composition of leachate is variable but is associated with the amount of precipitation as well as the quantity and type of waste that is disposed of in landfills. Leachate from municipal solid waste landfills is known to contain a myriad of hazardous chemicals which if introduced into surface and groundwater would impair or destroy the long-term ability to use the groundwater and aquifer (Lee *et al*., 2005). Of particular concern is leakage of untreated leachate due to its high toxicity level and to a lesser extent disposal of inadequately treated leachate into the environment. Hazardous chemicals in leachate can not only pollute groundwater and render it unsafe for human consumption but also influence aquatic ecosystems and biota. Two types of hazardous leachates are produced in landfill sites in South Africa:

- The one is a high TDS (50000 to 100000 mg/ℓ), high organic (10000 to 80000 mg/ℓ COD) concentration leachate containing hazardous chemicals like phenols, sulphides, ammonia-nitrogen, chromium, etc. (Industrial Solid Waste Leachate, ISWL). This ISWL is unique to South Africa, with its relatively low rainfall compared with Europe, and past waste disposal practices.
- The second leachate type is a low TDS (2000 to 6000 mg/ℓ), low organic (2000 to 6000 mg/ℓ COD) concentration leachate (Municipal Solid Waste Leachate, MSWL) (Schoeman *et al*., 2003).

Leachate quality cannot be known definitely as the site is not yet operational, however based on other operating solid waste landfill sites in eThekwini (e.g. Buffelsdraai Landfill site owned and operated by DSW), leachate quality for summer and winter has been estimated, with an average of the summer and winter concentrations used to fill our the necessary sections of the form DW767 for the leachate storage dams (see Table 23 below).

Table 23 Summary of leachate quality anticipated based on that observed at the Buffelsdraai landfill operated by DSW.

Determinand	Description	Unit of measure	Summer (January)	Winter (July)	Average
pH	pH at 25°C	pH units	8,2	8,3	**8,25**
Soap, oil & grease	Soap, oil & grease	mg/l	116	210	**163**
Free Ammonia	Ammonia as N	mg/l	79	0,73	**39,865**
Faecal coliforms	Faecal coliforms	cfu/100mℓ	1100	3800	**2450**
Electrical Conductivity	Conductivity at 25°C	mS/m	1750	2804	**2277**
Sodium	Sodium as Na	mg/l	1717	2884	**2300,5**
E. coli	E.coli	cfu/100mℓ	0	0	**0**
Chloride	Chloride	mg/l	2370	4143	**3256,5**
Chemical Oxygen Demand (COD)	COD	mg/l	2317	4060	**3188,5**
Total Suspended Solids	Suspended Solids	mg/l	69	71	**70**
Total dissolved solids	Dissolved solids	mg/l	7390	12290	**9840**
Alkalinity	Alkalinity	mg/l	3	3	**3**
Calcium	Dissolved Calcium	mg/l	113	81	**97**
Magnesium	Dissolved Magnesium	mg/l	158	196	**177**
Potassium	Potassium	mg/l	805	1359	**1082**

Determinand	Description	Unit of measure	Summer (January)	Winter (July)	Average
Nitrate	NO3 - N	mg/l	1,29	0,64	**0,965**
Sulphate	Sulphate as SO_4^{2-}	mg/l	0,21	169	**84,605**
Lead	Dissolved Lead	microgram/l	2,24	7,44	**4,84**
Cadmium	Dissolved Cadmium	microgram/l	0,1	0,61	**0,355**
Hexavalent Chromium (VI)	Hexavalent Chromium	microgram/l	0,0005	0,0005	**0,0005**
Chromium	Total Chromium as Cr	microgram/l	551	694	**622,5**
Mercury	Hg dissolved	microgram/l	1,1	11,1	**6,1**
Boron	B dissolved	microgram/l	1841	3579	**2710**
Cyanide	Cyanide as CN^- - Dissolved	microgram/l	20	37	**28,5**
Phenols	Phenolic Compounds	microgram/l	150	1260	**705**

Leachate collection dam(s):

Leachate will be disposed of by diversion to sewer or possible future treatment or evaporation from lined leachate collection dam(s).

The leachate collection dam(s) will collect only leachate from the leachate collection pipes of completed cells as the contaminated runoff from the surface of the active cell will be diverted to a separate contaminated stormwater dam.

The interim and final dam(s) will be approximately 5 000 m^3 and 49 500 m^3 respectively in size.

The interim Leachate Collection Dam will have an approximately 6.5 to maximum 8-year life, collecting leachate from closed and active cells and contaminated runoff from the uncovered waste in the active cell. This will serve cells 1 and 2, following which the interim Leachate Collection Dam will be incorporated into the next cell, at which stage a new Leachate Collection Dam will be constructed.

The leachate collection dam(s) will be suitably sized and lined to retain all leachate and prevent contamination of aquatic resources (streams and rivers). This lining will match the requirements of a **Class B liner**, and as indicated in the report above.

Leachate will be removed from the leachate collection dam by tanker and transported to a licensed WWTW for treatment and disposal (Southern WWTW).

It is proposed that the final Leachate Collection Dam will be situated in the valley of the Shongweni stream immediately downstream of the landfill.

Contaminated storm water quality:

Storm water considered contaminated or ‘dirty’ (i.e. in contact with the landfill site and waste body, but not containing leachate which will be contained within the leachate dams) will be separated from ‘clean’ storm water and contained in a closed contaminated storm water system of ponds. Contaminated storm water quality cannot be known definitely as the site is not yet operational, however based on other operating solid waste landfill sites in eThekwini (i.e. Buffelsdraai Landfill

site owned and operated by DSW), typical contaminated storm water quality has been summarised in Table 24 below. Needless to say, since the plan is for contaminated storm water to be used for irrigation in terms of Section 21 (e) water use and the relevant limits, the contaminated storm water system will be designed according to these limit values.

Table 24 Summary of the estimated contaminated storm water quality anticipated.

Determinand	Description	Unit of measure	Summer (January)	Winter (July)	Average	Design WQ Limit
pH	pH at 25°C	pH units	7,9	8,4	**8,2**	**6-9**
Free Ammonia	Ammonia as N	mg/l	20	20	**20,0**	
Faecal coliforms	Faecal coliforms	cfu/100mℓ	n/a	n/a	n/a	**<100 000**
Electrical Conductivity	Conductivity at 25°C	mS/m	162	119	**140,5**	**<200**
Sodium	Sodium as Na	mg/l	177	117	**147,0**	
E. coli	E.coli	cfu/100mℓ	n/a	n/a	n/a	
Chloride	Chloride	mg/l	240	166	**203,0**	**<400**
Chemical Oxygen Demand (COD)	COD	mg/l	94	28	**61,0**	
Total dissolved solids	Dissolved solids	mg/l	776	524	**650,0**	
Alkalinity	Alkalinity	mg/l	399	280	**339,5**	
Calcium	Dissolved Calcium	mg/l	40	40	**40,0**	
Magnesium	Dissolved Magnesium	mg/l	40	34	**37,0**	
Potassium	Potassium	mg/l	39	23	**31,0**	
Sulphate	Sulphate as SO_4^{2-}	mg/l	28	23	**25,5**	
Lead	Dissolved Lead	microgram/l	0,05	0,05	**0,05**	
Cadmium	Dissolved Cadmium	microgram/l	0,02	0,01	**0,02**	
Chromium	Total Chromium as Cr	microgram/l	5,7	0,11	**2,9**	
Mercury	Hg dissolved	microgram/l	1	1	**1,0**	
Boron	B dissolved	microgram/l	140	60	**100,0**	
Cyanide	Cyanide as CN^- - Dissolved	microgram/l	20	20	**20,0**	
Phenols	Phenolic Compounds	microgram/l	30	10	**20,0**	

Contaminated Stormwater dam(s):

The contaminated stormwater dam(s) will collect the contaminated runoff from the surface of the active cell. It will have sufficient capacity to accommodate the runoff from a single active cell during a 1:50 year 24-hour duration storm. The dam volume has also been checked for capacity to accommodate the wettest month and wettest year on record.

The interim and final dam(s) will be approximately 20 500 m^3 and 50 000 m^3 respectively in size however, these volumes may be reduced by limiting the working faces and by utilised temporary capping. **The contaminated stormwater dam(s) will be suitably sized and lined to retain all contaminated water and prevent contamination of aquatic resources (streams and rivers)**.

5.4.4 Final Landfill Shape and Capping Layer

Final Landfill Shape:

All final outside embankments will be sloped to an overall 1:3.3 (v:h) slope. This is comprised of 1:3 side slopes with 3 m wide benches every 10 m vertical height.

Cut slopes will generally be restricted to a 1:3 slope, but steeper slopes may be required, especially at the heads of the valleys. In that case, additional measures, such as geogrids, may be used to ensure stability along the liner.

The landfill will reach a final height ranging up to 525 m above mean sea level. External slopes will have benches with storm water collection drains at not more than 10 m vertical intervals.

The top of the final landfill will be sloped, the crest will slope at not less than 5% from the centre to the edge.

This is to facilitate runoff and eliminate ponding as well as to ensure that clean water flows away from any active cell during its operation. A series of berms on the crest of the completed cells and down chutes will serve to divert all runoff from the capped cells to the open veld area.

Temporary Internal Landfill Shape:

All temporary embankments including stability berms will be sloped to an overall 1:3 (v:h) slope. Internal faces of landfill may be constructed to steeper slopes subject to stability being adequate.

Capping layer:

Although there will be a competent containment barrier system beneath the landfill waste body, it is intended to provide a non-infiltration capping to the final landfill surface.

The proposed final capping layer on an intermediate cell will consist of a pervious 150 mm gas collection/drainage layer, separation geotextile, 450 mm clay and a 200 mm thick topsoil layer in order to prevent the ingress of water, as illustrated in Figure 22. The completed cells will be grassed and erosion control berms installed.

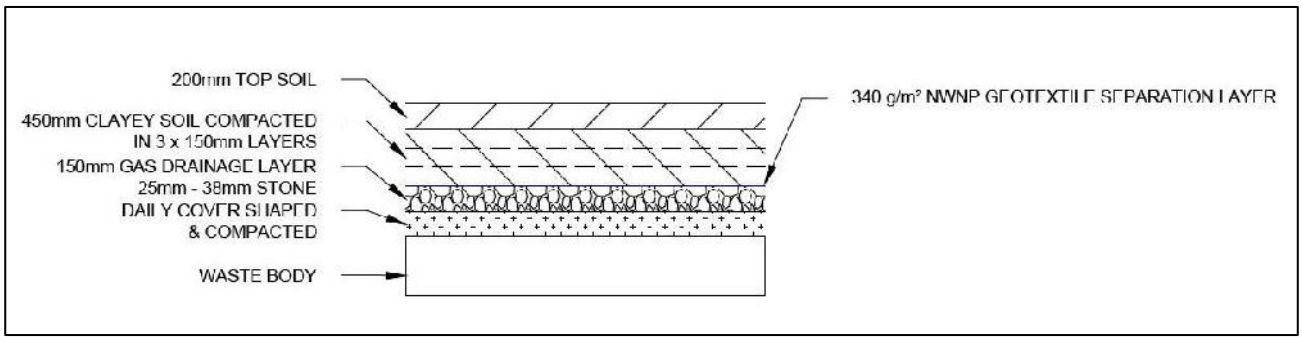


Figure 22 Minimal capping to cells that will be covered (iX Engineers, 2021).

The final landfill cell will have a non-infiltration capping layer using the layers prescribed by NEMWA. Approximately 225 180 m^3 of topsoil for the 200 mm thick topsoil layer will be required to cover the entire site. This material will be obtained from the excavated material from the cells and stockpiled topsoil and/or from commercial sources.

5.4.5 Waste Disposal

Waste diversion will be concentrated initially on builders' rubble and garden refuse. It is estimated that up to 25% of the waste can be diverted from the waste stream, mostly garden refuse with a certain amount of recycling of domestic refuse, as well as builders' rubble:

- Builders' rubble will be stockpiled for use as temporary all weather road surfacing or as cover material.
- Garden refuse will be composted and used for maintaining vegetative cover on completed cells and disturbed areas.
- All suitable topsoil will be stockpiled for use as final cover.
- A paved or concreted recycling area will be provided for collection of recyclables such as plastic, glass and metal.
- No picking will be permitted on the active landfill.
- Instead, selected waste will be diverted at the gate, with builders' rubble and garden wastes diverted to their respective laydown areas, and selected domestic waste delivered to the recycling area for processing.

5.4.6 Domestic Sewage Disposal

There is no sewer infrastructure in the vicinity of the Entrance Works. Initially domestic wastewater from flush toilets on site will drain to 2 x septic tanks connected to soakaways located south of the infrastructure works in undeveloped land.

In future, it may be possible to link into new municipal sewer reticulation as the area to the north of the landfill develops. This would be addressed under a separate WULA in future if required.

5.5 Storm Water Management

The management of storm water prior to discharge and the way water is released into the natural environment will be critical in managing and protecting downstream aquatic resources from degradation and to allow for the continued capacity of these natural areas to receive and absorb/transmit storm water from the site. With the planned hardening of surfaces on the site, due consideration has been given to the collection and attenuation of stormwater runoff prior to discharge into the natural environment.

A **Storm Water Management Plan** (SWMP) detailing the concept, approach and method of storm water management on the site has been developed for the site (iX/Wilson Pass JV, 2021) and is contained in **Appendix 21**. The main principles of stormwater management have neem aligned with the National Water Act No. 36 of 1998 and includes the following:

- Confining or diverting any unpolluted water to a clean water system, and polluted water to a dirty water system;
- Clean and dirty water systems should be designed and constructed to prevent cross contamination between the clean and dirty water systems;
- Clean and dirty water systems should contain the 1:50 year storm event and should not lie within the 1:100 year flood line or within a horizontal distance of 100m from any watercourse; and
- Appropriate maintenance and management of stormwater related infrastructure.

The following design philosophy was adopted:

- To provide for the safe removal of clean stormwater runoff from areas where there is no contamination of the water.

- To provide for the separation of silt, oils or other contaminants from the run-off prior to discharge to a watercourse.
- To provide for the collection of stormwater that is considered contaminated via a separate system that will not result in discharge to a watercourse until it is treated or deemed within required limits of contamination.
- Stormwater management will be handled by a suitable system to allow for the satisfactory discharge of attenuated surface runoff towards approved points of disposal into the natural drainage network.
- In accordance with normal good/best practice, stormwater flows are separated into a minor system, comprising formal piped reticulation catering for normal conditions and storms up to a 3-year flood (10-year at critical points) with minimal disturbance to landfill operations; and a major system, catering for major storms.
- Major storms are to be conveyed along road or platform surfaces and overland through open space to the existing watercourses.
- Peak flows downstream of the development (prior to discharge to a watercourse) are to be attenuated to less than the current peak flows for storms in the range of 10 years to 50 years. To achieve this, detention storage dams / ponds will be provided.
- All ponds containing contaminated run-off will be lined to Class B standard and will allow for a 0.5m freeboard above the design storm storage volume.

Stormwater will be attenuated to pre-development flows / flood peaks and will be handled by a suitable and appropriate stormwater management system designed to allow for the satisfactory drainage of accumulated surface water towards approved points of disposal and that adequately attenuates flows before discharging into the natural drainage network.

5.5.1 'Clean' Storm Water Management

Clean stormwater from the majority of the site will be discharged at three (3) locations after being attenuated to pre-development flows. Some of the run-off is considered contaminated and will be discharged into Contaminated Stormwater Dams for treatment or disposal at a recognized waste treatment facility. The (future) western development will have a separate contaminated stormwater dam. Clean stormwater from this area will be attenuated in the storm water attenuation dam that forms part of the initial phase of the development.

The storm water run-off generated from the completed landfill can be considered clean as the area will be capped with an impervious liner. The stormwater collection system will accommodate flows for a 3-year return period storm, with critical points / low points designed for a 10-year return period. The final landfill surface will be shaped and rehabilitated to allow for potential waste settlement, to prevent runoff ponding and to facilitate unimpeded runoff. The Mgoshongweni Stream is to either be diverted via the Eastern By-Pass Drain on the northern and eastern boundaries of the landfill (Option 1) or accommodated in a culvert passing below the landfill (Option 2), before discharging into the original water course just downstream of the landfill footprint. Option 2 includes for a smaller cut-off drain along the alignment of the Eastern By-pass Drain to divert run-off from the catchments outside of the landfill. Run-off from the final landfill surface will be collected in the 3 drains that lie on the boundaries of the landfill area:

- Western Cut-off Drain which discharges into the valley to the south of the landfill; and
- Eastern By-pass and Southern Collection drains which discharge into the Mgoshongweni Stream just downstream of the landfill footprint.

5.5.2 'Dirty' Storm Water Management

The contaminated stormwater reticulation will accommodate short duration (15-minute Tc) storms based on a 50-year return period. The storage volume is based on the precipitation depth for a 24-hour period and a 50-year return period. The infrastructure facilities that will discharge contaminated stormwater to the storage ponds are:

- Weigh bridges
- Wash bays
- Recycling / drop-off area
- Wet weather handling area
- Compactor bin storage area (used initially as a wet weather handling area)
- Chipping and composting

6 AQUATIC 'RISK' ASSESSMENT

Water resource screening and risk rating is largely a requirement for all potential water uses as contemplated in the National Water Act, No. 36 of 1998 (NWA). Risk can be defined broadly as *'a prediction of the likelihood or probability and impact of an outcome as a result of external or internal vulnerabilities operating on a system and which may be possible to avoid through pre-emptive action'.*

6.1 Watercourse Identification & Water Use Screening

An initial desktop mapping and aquatic impact potential assessment and risk screening exercise was undertaken at a desktop level and then verified in the field to determine the risk of water resources being impacted by the proposed landfill development (Western Waste Management Facility) or triggering environmental/water use licensing requirements in terms of the NEMA (National Environmental Management Act) and the NWA (National Water Act). This involved identifying and delineating all water resources (namely wetlands and riparian areas associated with channelled watercourses such as rivers & streams) within the 500m regulated area specified by DWS (i.e. within a 500m radius of the landfill site). Based on the position of the identified water resources in the landscape and in relation to the proposed development and related activities, this enabled the "risk of impact" for each watercourse to be determined based on expert opinion.

Rivers, wetlands and streams identified within the 500m regulated area shown mapped in Figures 23 and 24 (with rationale for risk rating in Table 25) and have been screened and risk rated according to the risk categories and description in the 'Aquatic Assessment Report' (Eco-Pulse, 2020). The results of the freshwater screening and aquatic risk assessment suggest that:

- Riparian units R01-2, R03, and R04 (all located within the landfill site) are likely to be at high risk of being negatively impacted by the planned development (incurring both direct and indirect impacts).

- Riparian units R01-1 and R05 are located upstream of the landfill (outside of the boundary) and are therefore unlikely to incur any direct or indirect impacts (associated with sediment and water quality impacts mainly).
- Riparian unit R06 and Wetland W01 are unlikely to incur either direct or indirect impacts due to their position in the landscape (i.e. within adjacent catchment areas to the impact zone). These systems are highly unlikely to trigger the requirements for a WULA in terms of Section 21 (c) and (i) water use based on the low risk of incurring any changes to the characteristics of these watercourses.

The ephemeral 'Drainage Line' units ('orange' colour) identified in the study area are steep (>20% longitudinal slope) with a lack of a clearly defined or developed channel. These landscape features likely convey surface flows only after significant rainfall events but are otherwise dry for >90% of the year. The drainage lines lacked instream or riparian vegetation and habitat and form part of the terrestrial bushveld and thornveld at the site. Given that these units are not distinctly riparian in nature they are not included in the detailed watercourse assessments that follow. They are however subject to layout recommendations and impact mitigation measures provided in this report.

Table 25 Summary of risk screening assessment for delineated/mapped rivers and wetlands within a 500m radius of the landfill site (Eco-Pulse, 2020).

Watercourse	Classification	Initial Risk Screening	Rationale	Triggers need for a WUL?
R01-2	Perennial river and riparian habitat	Highly Likely	The river and riparian habitat is located within the zone of impact (development footprint) and is highly likely to incur both direct and indirect impacts that will negatively affect the characteristics of the watercourse. Further assessment is required to inform the evaluation of the significance of impacts and to inform the WULA in terms of Section 21 (c) and (i) of the National Water Act.	**Yes**
R03	Seasonal river and invaded/exotic riparian habitat	Highly Likely		
R04	Seasonal river and invaded/exotic riparian habitat	Highly Likely		
R01-1	Seasonal stream and invaded/exotic riparian habitat	None	The river/stream and riparian habitat is located upstream of the development footprint and is probably unlikely to incur any direct or indirect impacts associated with the development. The characteristics of the individual watercourses will therefore not be negatively affected and will not trigger the need for further assessment. No environmental authorisation or water use license in terms of Section 21 (c) and/or (i) water use will be triggered for these systems.	No
R05	Seasonal stream and invaded/exotic riparian habitat	None		
R06	Seasonal river and riparian habitat	None	The wetland, stream and associated riparian habitat is located 400-500m to the east and are located in adjacent catchment areas and are highly unlikely to incur any direct or indirect impacts associated with the development. The characteristics of the individual watercourses will therefore not be negatively affected and will not trigger the need for further assessment. No environmental authorisation or water use license in terms of Section 21 (c) and/or (i) water use will be triggered for these systems.	No
W01	Small valley Wetland	None		No
Ephemeral Drainage Lines	Drainage Lines	N/A	These preferential flow paths (drainage lines) are located within the development zone and in adjacent catchment areas. Given that these units are not distinctly riparian in nature they are not included in the detailed watercourse assessments that follow.	No

IMPORTANTLY, NO WETLANDS ARE AT RISK OF BEING POTENTIALLY NEGATIVELY IMPACTED BY THE LANDFILL DEVELOPMENT (ONLY RIVERS AND STREAMS LIKELY TO BE AFFECTED).

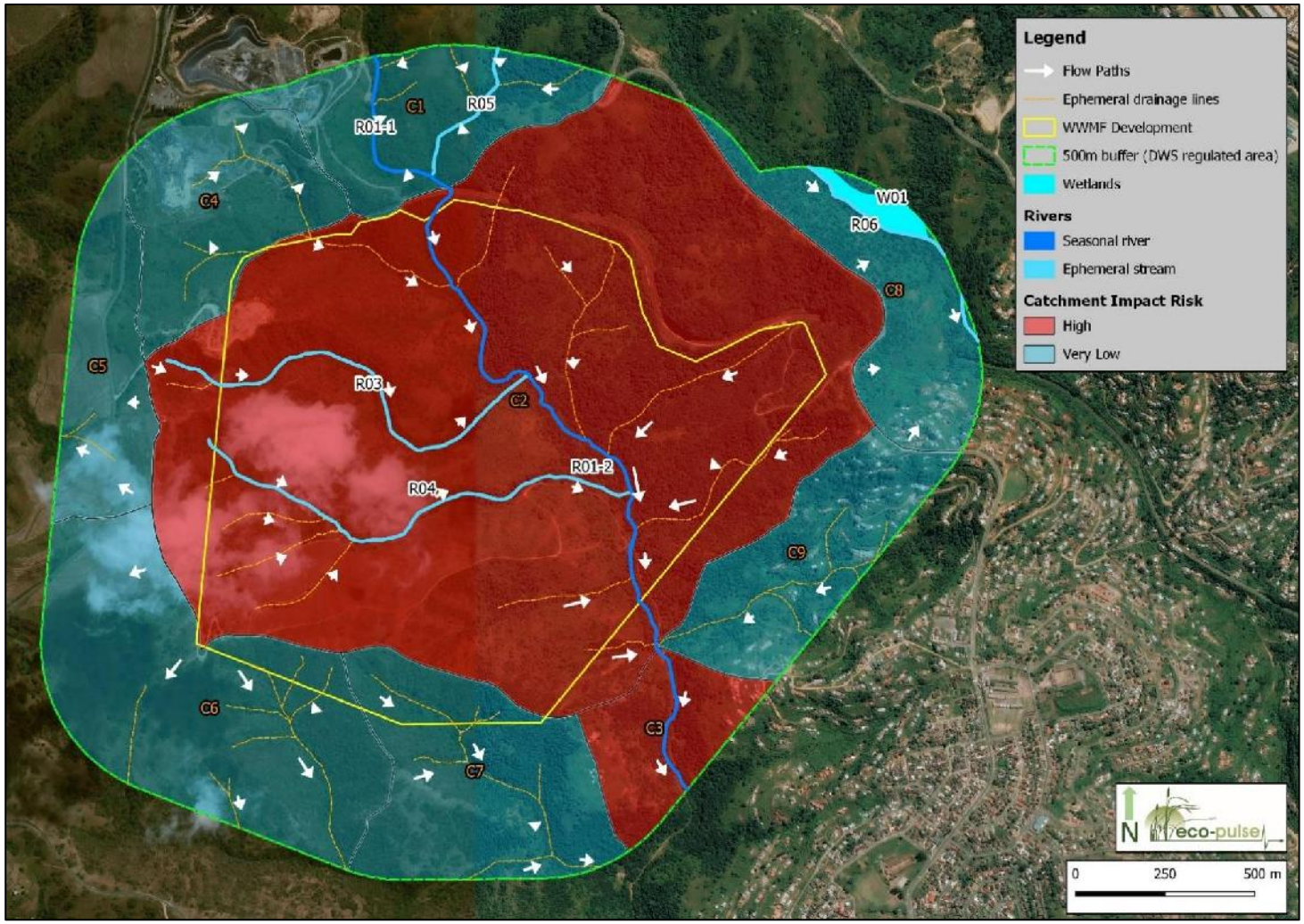


Figure 23 Outputs of the risk assessment/screening exercise undertaken for the planned WWMF. The map shows the location of the landfill property boundary ("Yellow" boundary line) with a 500m radius (DWS regulated area – "Green" dashed circle outline) with delineated aquatic resources (wetlands and riparian areas). The different micro-catchments for the water resources are shown labelled C1 – C9 with impact risk rated for each sub-catchment (areas shaded in "Red" – High Risk and "Blue" – Very Low Risk). The direction of water flow (flow paths) is indicated by the "white" arrow markers on the map.

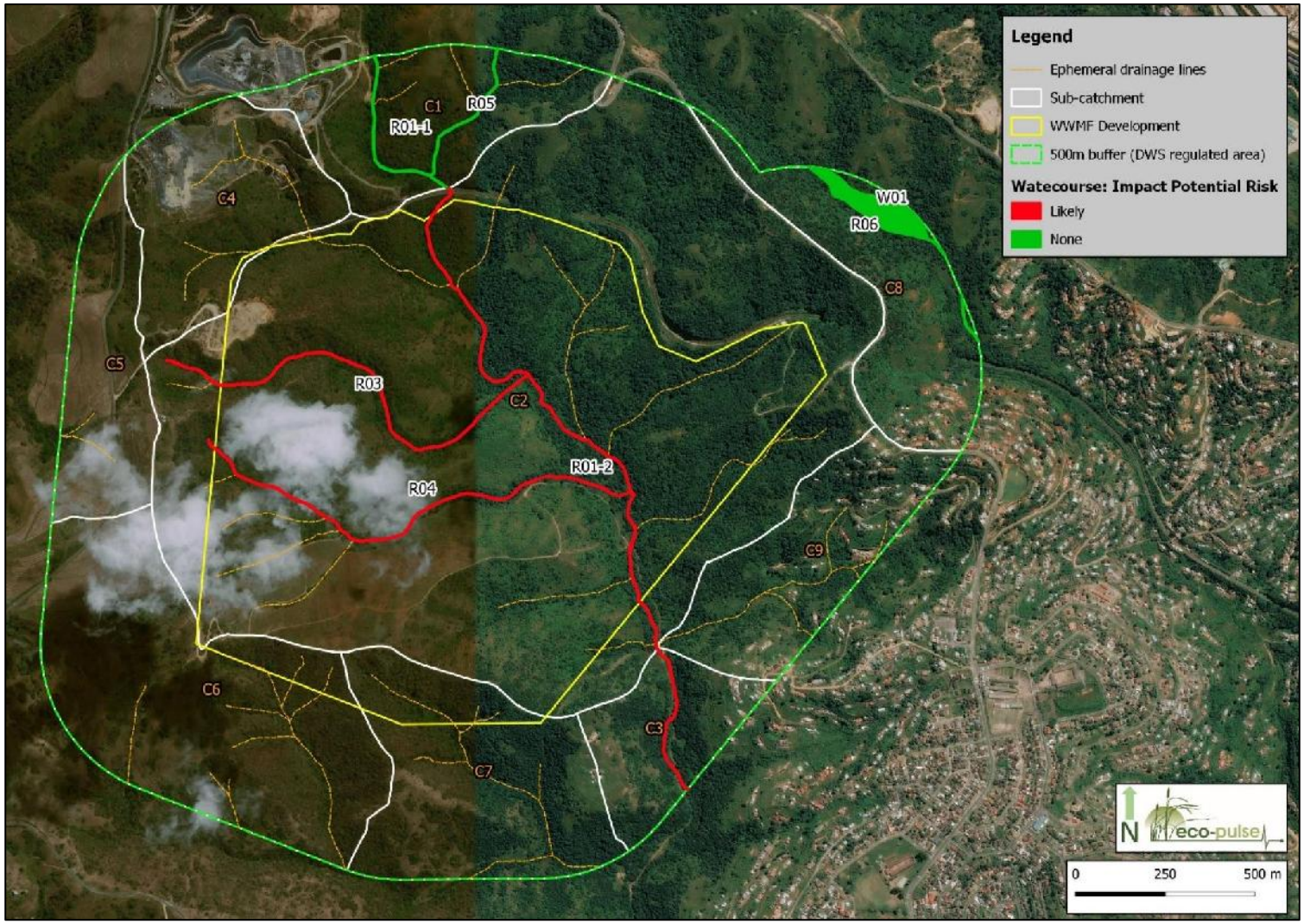


Figure 24 Outputs of the watercourse 'impact potential' ratings undertaken for the WWMF Development. The map shows the location of the landfill property boundary ("Yellow" boundary line) with a 500m radius (DWS regulated area – "Green" dashed circle outline).

6.2 Risk Assessment

The recent General Authorisation (GA) in terms of Section 39 of the National Water Act No. 36 of 1998 for Water Uses as defined in Section 21 (c) and/or Section 21 (i), (as contained in Government Gazette No. 40229, 26 August 2016) replaces the need for a water user to apply for a license in terms of the National Water Act No. 36 of 1998, '*provided that the water use is within the limits and conditions of the GA'.* Note that the GA does not apply to:

1. Water use for the rehabilitation of a wetland as contemplated in GA 1198 contained in GG 32805 (18 December 2009).
2. Use of water within the 'regulated area'[3] of a watercourse where the Risk Class is **Medium or High.**
3. Where any other water use as defined in Section 21 of the NWA must be applied for.
4. Where storage of water results from Section 21 (c) and/or (i) water use.
5. Any water use associated with the construction, installation or maintenance of any sewage pipeline**,** pipelines carrying hazardous materials and/or raw water (wastewater) to a wastewater treatment works facility.

The DWS has developed a Risk Assessment Matrix/Tool to assess the risk to watercourses associated with typical development activities. The DWS Risk Matrix/Assessment Tool was applied to the proposed development with emphasis on Section 21 (c) and (i) water uses. The Risk Assessment Matrix/Tool considers the risks posed to watercourses posed by various activities and for different phases of a project. Activities typically give rise to different environmental stressors (or aspects) which manifest in impacts to the receiving aquatic environment and ecosystems.

It is our understanding that the purpose of the risk matrix tool developed by the DHSWS is to give a preliminary indication of the likely impact / degree of change (consequence) of activities (water uses) to local and regional water resource quality. For the purposes of this study, the degree of change is reflected in PES change and/or the change in the supply of regulating ecosystem services.

Possible activities, aspects (or stressors) and potential ecological risks associated with the planned landfill development, that could potentially manifest in impacts to the four drivers of wetland condition/functioning as defined by the DWS have been identified include the following aspects/activities:

<u>Construction phase activities and aspects:</u>

- Clearing of terrestrial and riparian vegetation.
- Infilling of rivers and streams within the landfill footprint.
- Temporary impoundment and/or diversion of flows during construction.
- Temporary stormwater and sediment management, and hazardous substances handling and storage.
- **Construction of main concrete culvert along the Mgoshongweni River reach within the landfill footprint – canalisation essentially.*

[3] The 'regulated area' of a watercourse; for Section 21 (c) or (i) of the Act refers to:

i. The outer edge of the 1:100 year flood line and/or delineated riparian habitat, whichever is greatest, as measured from the centre of the watercourse of a river, spring, natural channel, lake or dam.

ii. In the absence of a determined 1:100 year flood line or riparian area, refers to the area within 100m from the edge of a watercourse (where the edge is the first identifiable annual bank fill flood bench).

iii. A 500m radius from the delineated boundary of any wetland or pan.

- ***Alternative to concrete culvert: construction of storm water diversion trench around landfill site.*

Operational phase activities and aspects:

- Landfilling and waste management.
- Leachate treatment and discharge.
- Management of clean and dirty storm water runoff through attenuation facilities with erosion/sediment controls.
- Management of alien vegetation colonisation of adjacent areas.

A summary of the potential risk and impacts ratings for the proposed development activities is provided in Table 26. ***Given that the overall risk posed by the construction and operation of the proposed landfill site is considered to be 'Moderate' for multiple aspects/hazard factors (even where properly mitigated and managed), the development project cannot be generally authorised under the GA for Section 21 c and i water uses and will require a full WULA****, however this will still need to be confirmed by the Department of Water & Sanitation (DWS) at a pre-application meeting for the project WULA phase.* Note also, that **the alternative option of a diversion trench around the landfill was considered to be of relatively lower risk in comparison to the authorised option of a concrete culvert and infilling of the Mgoshongweni River reach.**

Table 26 Summary of the risk matrix assessment scores and ratings for each activity and risk group (Eco-Pulse, 2020).

PHASE	Activity	Aspect	Risk of Impact	Significance	Risk Rating	Revised Significance	Borderline LOW / MODERATE Rating Classes
CONSTRUCTION	Construction of the new WWMF (landfill)	Vegetation clearing and bulk earthworks (cut & fill), infilling of watercourses	Direct physical loss or modification of freshwater habitat	87	Moderate		
		Temporary impoundment and/or diversion of flows around active work areas, infilling of watercourses, management of storm water runoff	Alteration of hydrological and geomorphological processes	63	Moderate	39	Low
		Risk from hydrocarbons (fuel/oil) and cement management, risk of sedimentation from exposed soils	Impacts to water quality	54	Low		
		Temporary impoundment and/or diversion of flows around active work areas, infilling of watercourses,	Impacts to ecological connectivity and/or ecological disturbance impacts	52	Low		
OPERATION	Operation of the WWMF (landfill)	Risk of Invasive Alien Plant colonisation following disturbance, accidental incursions into adjacent areas	Direct physical loss or modification of freshwater habitat	55	Low		

PHASE	Activity	Aspect	Risk of Impact	Significance	Risk Rating	Revised Significance	Borderline LOW / MODERATE Rating Classes
		*Option 1: Management of clean and dirty storm water runoff through attenuation facilities, risk of failure of concrete culvert placed within the Mgoshogweni River,	Alteration of hydrological and geomorphological processes	105	Moderate		
		**Option 2: Alternative to concrete culvert: diversion canal to manage 'clean' storm water runoff.*	Alteration of hydrological and geomorphological processes	94	Moderate	Low	
		Landfilling and waste management, treated leachate discharge, contaminated surface runoff management, risk of failure of concrete culvert placed within the Mgoshogweni River	Impacts to water quality	128	Moderate		
		Management of alien vegetation colonisation of adjacent areas	Impacts to ecological connectivity and/or ecological disturbance impacts	55	Low		

6.3 Risk Mitigation

Measures that have been recommended to mitigate key risks have been included in Table 27 below.

Table 27 Summary of the risk mitigation measures for each activity and risk group (Eco-Pulse, 2020).

Phase(s)	Activity	Aspect	Risk of Impact	Control measures	Revised Risk Rating
Construction	Construction of the new WWMF (landfill)	Vegetation clearing and bulk earthworks (cut & fill), infilling of watercourses	Direct physical loss or modification of freshwater habitat	• Undertake landfill construction during low flow period preferably (winter season). • Limit instream habitat disturbance beyond the immediate construction footprint. • Limit access to instream and riparian habitat beyond the direct footprint of the landfill. • Avoid cutting down or damaging large established indigenous trees within the river riparian zone beyond the permanent landfill footprint, where possible. • Transplant or replace protected tree species, in consultation with DEFF & EKZNW. • Implement post-construction river rehabilitation strategy for adjacent disturbed areas outside of the permanently transformed zone, where necessary. • Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible. • Incorporate riverine habitat into biodiversity offset negotiations and plans.	**Moderate**

Phase(s)	Activity	Aspect	Risk of Impact	Control measures	Revised Risk Rating
		Temporary impoundment and/or diversion of flows around active work areas, infilling of watercourses, management of storm water runoff	Alteration of hydrological and geomorphological processes	• Limit construction within rivers/streams to low flows during the dry (winter) season as far as possible. • Address potential erosion and sedimentation risks on site through the implementation of Best Management Practices (BMPs) in erosion and sediment control. • Construct storm water control dams as soon as possible (this should possibly be the first step once the site has been cleared of vegetation, prior to other bulk earthworks taking place). • Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible.	Low
		Risk from hydrocarbons (fuel/oil) and cement management, risk of sedimentation from exposed soils	Impacts to water quality	• Limit construction within rivers/streams to low flows during the dry (winter) season. • Install a temporary cut off trench to contain poor quality runoff (GCS, 2020). • Address potential erosion and sedimentation risks on site through the implementation of Best Management Practices (BMPs) in erosion and sediment control. • Address potential spill and pollution risks on site through the implementation of Best Management Practices (BMPs) in spill and pollution control and hazardous substances management.	Low
		Temporary impoundment and/or diversion of flows around active work areas, infilling of watercourses	Impacts to ecological connectivity and/or ecological disturbance impacts	• Limit instream habitat disturbance as far as possible. • Limit construction within rivers/streams to low flows during the dry (winter) season as far as possible. • Restrict worker and machinery access to intact areas outside of the landfill footprint. • Prohibit poaching or collection of plants and animals. • Remove temporary diversions and impoundments once construction is complete. • Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible.	Low
Operation	Operation of the new WWMF (landfill)	Risk of Invasive Alien Plant colonisation following disturbance, accidental incursions into adjacent areas	Direct physical loss or modification of freshwater habitat	• Undertake any future repairs and/or maintenance activities within rivers/streams during low flows (winter season) as far as possible. • Limit instream habitat disturbance during future repairs and/or maintenance. • Limit access to downstream instream and riparian habitat. • Implement river rehabilitation strategy where necessary. • Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible. • Monitoring plan to be implemented for water quality and erosion/sediment.	Low

Phase(s)	Activity	Aspect	Risk of Impact	Control measures	Revised Risk Rating
		*Management of clean and dirty storm water runoff through attenuation facilities, risk of failure of concrete culvert placed within the Mgoshogweni River	Direct physical loss or modification of freshwater habitat	• Appropriate Storm Water Management Plan (SMWP) to be implemented with a focus on reducing erosion risk. • Stormwater runoff should be managed for all proposed structures and future developments. • Stormwater and energy dampening systems be put in place to decreases the risk of upper bank erosion (GCS, 2020). • Installation of surface drains to be done before the development of landfill cells (GCS, 2020). • Structures which may be constructed during the development need to be able to withstand the estimated peak flow ranges (i.e. energy dissipation structures may be required in areas prone to erosion or flooding) (GCS, 2020). • Grey water or potential effluent leaks must be contained and not discharged in watercourses during peak events (GCS, 2020). • Culvert structures are to be maintained properly: debris and silt should be cleared from flow infrastructure to prevent side cutting (GCS, 2020). • Monitoring plan to be implemented for water quality and erosion/sediment.	Moderate
		**Alternative to concrete culvert: diversion canal to manage 'clean' storm water runoff.	Alteration of hydrological and geomorphological processes	• Appropriate Storm Water Management Plan (SMWP) to be implemented with a focus on reducing erosion risk. • Stormwater runoff should be managed for all proposed structures and future developments. • Stormwater and energy dampening systems be put in place to decreases the risk of upper bank erosion (GCS, 2020). • Installation of surface drains to be done before the development of landfill cells (GCS, 2020). • Structures which may be constructed during the development need to be able to withstand the estimated peak flow ranges (i.e. energy dissipation structures may be required in areas prone to erosion or flooding) (GCS, 2020). • Grey water or potential effluent leaks must be contained and not discharged in watercourses during peak events (GCS, 2020). • Culvert structures are to be maintained properly: debris and silt should be cleared from flow infrastructure to prevent side cutting (GCS, 2020). • Monitoring plan to be implemented for water quality and erosion/sediment.	Low
			Impacts to water quality	• Installation of the impermeable barrier before waste generation and reworking of the landfill (GCS, 2020). • Appropriate Leachate Management System to be implemented with a focus on meeting water quality standards for freshwater aquatic ecosystems. • Address potential erosion and sedimentation risks on site through the implementation of Best Management Practices (BMPs) in erosion and sediment control. • Address potential spill and pollution risks on site through the implementation of Best Management Practices (BMPs) in spill and pollution control and hazardous substances management. • Monitoring plan to be implemented for water quality and erosion/sediment.	Moderate
		Management of alien vegetation colonisation of adjacent areas	Impacts to ecological connectivity and/or ecological disturbance impacts	• Limit instream habitat disturbance as far as possible. • Limit repairs/maintenance of instream structures to low flows during the dry (winter) season. • Restrict worker and machinery access. • Prohibit poaching or collection of plants and biota. • Remove temporary diversions and impoundments once repair/maintenance work is complete. • Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible.	Low

7 POTENTIAL AQUATIC IMPACTS

7.1 Aquatic Impact Identification

Freshwater ecosystems (rivers/streams only for this project, since no wetland affected), are particularly vulnerable to human activities and these activities can often lead to irreversible damage or longer term, gradual/cumulative changes to these ecosystems. Aquatic ecological impacts associated with the landfill development project are discussed below (extract from the specialist Aquatic Assessment report (Eco-Pulse, 2020) contained in **Appendix 16**).

The assessment process begins with a description of the proposed development and associated activities (for the various phases, including construction and operation), with the various environmental stressors and direct/indirect risks associated with development activities then defined. Potential aquatic impact-causing activities identified for the construction and operational phases of the WWMF (landfill) development project are summarised in Table 28.

Table 28 WWMF development activities and aquatic risks/impacts identified for each project phase.

Construction Phase Activities & Aspects	Operational Phase Activities & Aspects
Construction of the new landfill facility: • Clearing of terrestrial and riparian vegetation. • Infilling of rivers and streams within the landfill footprint. • Temporary impoundment and/or diversion of flows during construction. • Temporary stormwater and sediment management, and hazardous substances handling and storage. • **Construction of main concrete culvert along the Mgoshongweni River reach within the landfill footprint – canalisation essentially.* • ***Alternative to concrete culvert: construction of storm water diversion trench around landfill site.*	**Operation the new landfill facility:** • Landfilling and waste management. • Leachate treatment and discharge. • Management of clean and dirty storm water runoff through attenuation facilities with erosion/sediment controls. • Management of alien vegetation colonisation of adjacent areas.

IMPORTANTLY, THE RISK ASSESSMENT AND SCREENING IN CHAPTER 6 SHOWS THAT NO WETLANDS ARE AT RISK OF BEING POTENTIALLY NEGATIVELY IMPACTED BY THE LANDFILL DEVELOPMENT (ONLY RIVERS AND STREAMS LIKELY TO BE AFFECTED).

7.2 Impact Significance Assessment

The assessment of potential freshwater impacts was undertaken using an "Impact Assessment Methodology for EIAs" adopted by Eco-Pulse (2020). This assessment was informed by baseline information contained in this report relating to the sensitivity of freshwater habitats and potential occurrence of protected species as well as information on the proposed development provided by the client, and Eco-Pulse's experience in similar projects in South Africa.

Impact significance is defined broadly as a measure of the 'desirability, importance and acceptability of an impact to society' (Lawrence, 2007). The degree of significance depends upon two dimensions: the measurable characteristics of the impact (e.g. intensity, extent, duration) and the importance societies/communities place on the impact. Put another way, impact significance is the product of the value or importance of the resources, systems and/or components that will be impacted and the intensity or magnitude (degree and extent of change) of the impact on those resources, systems and/or

components. The significance of the potential impacts of the proposed development on freshwater ecosystems was assessed for the following scenarios:

- **Realistic "poor mitigation" scenario** – this is a realistic worst-case scenario involving the poor implementation of construction mitigation, bare minimum incorporation of recommended design mitigation, poor operational maintenance, and poor onsite rehabilitation.

- **Realistic "good" mitigation scenario** – this is a realistic best-case scenario involving the effective implementation of construction mitigation, incorporation of most of the design mitigation, good operational maintenance, and successful rehabilitation. Please note that this realistic scenario does not assume that unrealistic mitigation measures will be implemented and/or measures known to have poor implementation success (>90% of the time) will be effectively implemented.

A summary of the impact significance assessment for construction and operational phases is provided below in Table 29. This shows how potential impacts can be mitigated down to from moderately-high to moderate or moderately0low/low significance through appropriate mitigation.

Table 29 Impact significance assessment summary table

Impact Type	Impact Significance	
	'poor' mitigation scenario	'good' mitigation scenario
CONSTRUCTION PHASE (C)		
C1 Direct physical loss or modification of freshwater habitat	Moderately High	Moderate
C2 Alteration of hydrological and geomorphological processes	Moderate	Moderately Low
C3 Impacts to water quality	Moderately Low	Low
C4 Impacts to ecological connectivity and/or ecological disturbance impacts	Moderate	Moderately Low
OPERATIONAL PHASE (O)		
O1 Direct physical loss or modification of freshwater habitat	Moderate	Low
O2 Alteration of hydrological and geomorphological processes	Moderately High	Moderately Low
O3 Impacts to water quality	Moderately High	Moderate
O4 Impacts to ecological connectivity and/or ecological disturbance impacts	Moderately Low	Low

A more detailed summary of the impact significance assessment for the construction and operational phases of the WWMF (landfill) development is contained in Tables 30 and 31, respectively, including recommended mitigation measures per impact type.

Landfill construction phase impacts:

Table 30 Summary results of the impact significance assessment for construction phase impacts associated with the WWMF (new landfill).

Construction Phase Impact Assessment: new WWMF (landfill)		Impact Significance	
		'poor' mitigation scenario	'good' mitigation scenario
C1	**Direct physical loss or modification of aquatic (instream and riparian) habitat**	Moderately High	Moderate
Extensive physical disturbance of riverine vegetation and riparian habitat is expected during the landfill development, with the planned (phased) infilling of the valley to be undertaken as follows: vegetation stripping and clearing, bulk earthworks: cut & fill, platforming and preparation, lining and landfill cell creation. In addition, a significant concrete culvert is planned for the Mgoshongweni River reach for the length of river within the landfill footprint (canalisation of the watercourse, essentially). This will result in the permanent loss of instream and riparian habitat and vegetation associated with the seasonal Mgoshongweni River and two small tributary ephemeral streams. The permanent physical destruction of instream and the limited degraded riparian vegetation and habitat will be inevitable. An alternative to the concrete culvert development would be to divert storm flows around the landfill site by means of a diversion canal. This would reduce the need to permanently destroy an appreciable amount of instream and riparian habitat and would also likely result in fewer significant hydrogeomorphological risks to the downstream watercourses. The remaining downstream riverine habitat beyond the landfill boundary is likely to be affected largely by secondary impacts such as sedimentation and water quality impacts. Given the degraded state of the instream and riparian vegetation and habitat ('fair' condition: 'C' PES), the intensity of the impact is likely to be moderate, with the possibility of occurrence being definite but with the extent of impact limited to the landfill footprint and immediately adjacent/downstream areas. The ecological significance of direct river/stream habitat loss can be considered to be of 'Moderately High' significance under a 'poor' mitigation scenario. With best practical mitigation implemented (*as listed below and explained in detail in Chapter 7 of this report*), impact significance can be potentially reduced to a 'Moderate' level. Key mitigation recommendations: • Undertake landfill construction during low flow period preferably (winter season). • Limit instream habitat disturbance beyond the immediate construction footprint. • Limit access to instream and riparian habitat beyond the direct footprint of the landfill. • Avoid cutting down or damaging large established indigenous trees within the river riparian zone beyond the permanent landfill footprint, where possible. • Transplant or replace protected tree species, in consultation with DEFF & EKZNW. • Implement post-construction river rehabilitation strategy for adjacent disturbed areas outside of the permanently transformed zone, where necessary. • Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible. • Incorporate riverine habitat into biodiversity offset negotiations and plans.		
C2	**Alteration of hydrological and geomorphological processes (erosion and sediment)**	**Impact Significance**	
		'poor' mitigation scenario	'good' mitigation scenario
		Moderate	Moderately Low
Construction activities associated with bulk earthworks during landfill construction (such as excavations, reshaping, back-filling, infilling and compaction) will alter natural patterns of surface runoff reaching the river down slope/downstream of the impacted area and possibly alter the movement of subsurface water flows. Increased runoff contributing to increased floodpeaks is expected during the construction period as a result of stripped vegetation. If runoff and erosion control measures are not effectively implemented by the contractors, erosion rills and gullies may form along the cleared and exposed slopes upslope within the construction footprint and lead to increased rates of erosion and sedimentation within the riparian and in-stream habitat in the vicinity of the construction zone. These impacts will be more pronounced during rainfall events and/windy conditions. Although soil erosion within excavated areas will be temporary, downstream sedimentation may be a long-term concern. The canalisation (concrete culvert) planned for the Mgoshongweni River reach is likely to be a key impact causing activity during the construction of the landfill. Potential impacts include altered flow, bed and bank erosion, and the temporary inundation of instream and riparian habitat, depending on the method of isolation/diversion used. Earthworks involved with valley infilling are also highly likely to mobilise and disturb sediment that could enter the downstream river and ultimately reach the downstream uMlazi River, temporarily increasing water turbidity whilst potentially affecting instream habitat and biota. An alternative to the concrete culvert development would be to divert storm flows around the landfill site by means of a diversion canal. This would reduce the need to permanently destroy an appreciable amount of instream and riparian habitat and would also likely result in fewer significant hydrogeomorphological risks to the downstream watercourses, with an appreciably reduced impact magnitude as a result.		

Overall, this impact is expected be limited given the short-term nature of the required construction earthworks, the seasonal nature of flows in the Mgoshongweni River and perennial flow in the uMlazi River (which will quickly 'flush' additional sediment through the system during high flows). If poorly managed, flow and sediment related impacts could be of a 'Moderate' ecological significance and where best practical mitigation is implemented (*as listed below and explained in detail in Chapter 7 of this report),* this can be potentially reduced to a 'Moderately-Low' and acceptable level.

Key mitigation recommendations:

- Limit construction within rivers/streams to low flows during the dry (winter) season as far as possible.
- Address potential erosion and sedimentation risks on site through the implementation of Best Management Practices (BMPs) in erosion and sediment control.
- Construct storm water control dams as soon as possible (this should possibly be the first step once the site has been cleared of vegetation, prior to other bulk earthworks taking place).
- Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible.

		Impact Significance	
C3	**Impacts to water quality**	'poor' mitigation scenario	'poor' mitigation scenario
		Moderately Low	Low

Water quality impacts during construction will be limited to potential increased water turbidity (*discussed under impact C2 above*) and pollution related to potential spillages of cement and any fuels stored and used onsite during construction. As already stated, turbidity impacts will be limited given the short-term and temporary nature of earthworks, and the perennial nature of the river system which will quickly 'flush' additional sediment during high flows. The extent of water quality impacts can be far-reaching due to the high level of connectivity of the landfill site with the downstream environment to the east of the site, and the duration of impacts can be long-term depending on the nature of the contamination, as certain pollutants are known to persist in the environment for long periods. Upon entering the aquatic environment pollutants will alter the chemical properties of water resulting in poor water quality which has a detrimental impact on sensitive aquatic fauna and flora. Where significant changes in water quality occur, this will ultimately result in a shift in aquatic species composition, favouring more tolerant species and potentially resulting in the localised reduction of sensitive species.

The likelihood of significant water pollution occurring during construction is relatively low given that limited pollutants/contaminants will be kept/used on site during the construction phase.

If poorly managed, impacts to water quality could be of 'Moderately Low' significance where large sediment plumes or where onsite pollution risks are not effectively mitigated. Where best practical mitigation is implemented (*as listed below and explained in detail in Chapter 7 of this report)*, this can be potentially reduced to a 'Low' and environmentally acceptable level.

Key mitigation recommendations:

- Limit construction within rivers/streams to low flows during the dry (winter) season.
- Install a temporary cut off trench to contain poor quality runoff (GCS, 2020).
- Address potential erosion and sedimentation risks on site through the implementation of Best Management Practices (BMPs) in erosion and sediment control.
- Address potential spill and pollution risks on site through the implementation of Best Management Practices (BMPs) in spill and pollution control and hazardous substances management.

		Impact Significance	
C4	**Impacts to ecological connectivity and/or ecological disturbance impacts**	'poor' mitigation scenario	'poor' mitigation scenario
		Moderate	Moderate

The permanent nature of the infilling and need to temporarily divert river flows could possibly affect the movement of important aquatic biota and the connectivity between river reaches. The presence of workers and machinery during the construction phase may also create ecological noise and vibration disturbances that can temporarily disturb amphibians, reptiles, birds and small mammals; however, these will be minor, and fauna will likely move into intact adjacent areas or revisit the site once construction has ceased and the disturbance has halted.

Where impacts and risks are poorly managed, this impact could be of a 'Moderate' significance and where best practical mitigation is implemented (*as listed below and explained in detail in Chapter 7 of this report)* and where construction is restricted to periods of lower flows this can be potentially reduced to a 'Moderately Low' and environmentally acceptable level.

Key mitigation recommendations:

- Limit instream habitat disturbance as far as possible.
- Limit construction within rivers/streams to low flows during the dry (winter) season as far as possible.
- Restrict worker and machinery access to intact areas outside of the landfill footprint.
- Prohibit poaching or collection of plants and animals.
- Remove temporary diversions and impoundments once construction is complete.
- Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible.

Landfill operational phase impacts:

Table 31 Summary results of the impact significance assessment for operational phase impacts associated with the operation of the WWMF (new landfill).

Operational Phase Impact Assessment: new WWMF (landfill)		Impact Significance	
		'poor' mitigation scenario	'good' mitigation scenario
O1	**Direct physical loss or modification of instream/riparian habitat**	Moderately Low	Low

Whilst this impact is likely to be largely limited to the landfill construction phase, riparian and instream habitat and vegetation could be impacted by cell expansion during operation and by workers and machinery during future repair and maintenance activities. There is also the risk of impacting on riverine habitat downstream of the landfill through altered water quality and storm water discharge that could cause erosion and sedimentation of downstream riverine habitats. Also, there is the risk of introducing unnatural disturbance to the adjacent/downstream riverine habitats that generally promotes the establishment of disturbance-tolerant species, including colonization by Invasive Alien Plants (IAPs), weeds and pioneer plant species. IAPs can have far-reaching detrimental effects on native biota and has been widely accepted as being a leading cause of biodiversity loss in South Africa. They typically have rapid reproductive turnover and are able to outcompete native species for environmental resources, alter soil stability, promote erosion, change litter accumulation and soil properties and promote of suppress fire.

Where impacts and risks are poorly managed, this impact could be of a 'Moderately-Low' significance and where best practical mitigation is implemented (*as listed below and explained in detail in Chapter 7 of this report),* this can be potentially reduced to a 'Low' and environmentally acceptable level.

Key mitigation recommendations:

- Undertake any future repairs and/or maintenance activities within rivers/streams during low flows (winter season) as far as possible.
- Limit instream habitat disturbance during future repairs and/or maintenance.
- Limit access to downstream instream and riparian habitat.
- Implement river rehabilitation strategy where necessary.
- Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible.
- Monitoring plan to be implemented for water quality and erosion/sediment.

		Impact Significance	
		'poor' mitigation scenario	'good' mitigation scenario
O2	**Alteration of hydrological and geomorphological processes (erosion and sediment)**	Moderately High	Moderately Low

In the long-term, plans to develop the entire landfill site will results in the complete loss of riverine habitat on the site, with impacts resulting from catchment transformation transferred to the rivers located downstream of the landfill site which are likely to experience altered water inputs, modification to the timing, frequency and volume of low flows and storm water runoff as a result of a change in catchment land use. The landfill development will result in the hardening of a considerable portion of the river sub-catchment, ultimately leading to a risk of enhanced runoff volumes and velocities (increased storm flows), with the potential to cause significant river erosion (scouring) and resultant sedimentation of aquatic habitats downstream of the landfill.

The Hydrological Assessment (GCS, 2020) modelled/estimated post-development peak flow changes within several sub-catchments likely to be impacted by the landfill development, based on the assumption that portions or complete land surface areas will become impermeable, and greater runoff will be induced. The results of this modelling exercise indicate that for most sub-catchments, runoff will increase, with considerable post-development peak flow increases under various storm event scenarios for sub-catchments HRU 5, 6, 7, 9, 12 and 13, which are associated mainly with non-perennial seasonal tributaries of the Mgoshongweni River. Ultimately, the

increased peak flows will be in effect for the main collecting Mgoshongweni River, with enhanced potential for erosion and scouring considered a significant risk. In addition, any soil erosion problems and bank instability concerns initiated during the construction phase and that are not timeously and adequately addressed through on-site rehabilitation post-construction, can persist into the operational phase of the project and continue to have a negative impact on adjacent/downstream water resources for an extended period of time. The main sources of sediment during the operational phase are likely to be associated with fill embankments and al disturbed areas if not adequately rehabilitated. Furthermore, the Hydrological Assessment (GCS, 2020) suggests that whilst the streams at the proposed landfill site are not high flooding risk areas, areas where culverts will be installed (post-development) may become blocked with debris/sediment and are higher risk of back-flooding and causing erosion problems due to the momentum of flow from the floods prevailing direction.

A key concern is the risk of failure of the proposed concrete culvert within the Mgoshongweni River. The culvert will comprise the key storm water conveyance infrastructure for the landfill, and failure of this structure could be potentially catastrophic, potentially resulting in large scale erosion and sedimentation of downstream watercourses. Where impacts and risks are poorly managed, this impact could be of a 'Moderately High' significance Whilst the probability of catastrophic failure of the concrete culvert may be considered relatively low if designed and constructed properly and where best practical mitigation is implemented (*as listed below and explained in detail in Chapter 7 of this report),* impact intensity remains high and therefore impact significance can be potentially reduced to a moderate level. An alternative to the concrete culvert development would be to divert storm flows around the landfill site by means of a diversion canal. This would reduce the need to permanently destroy an appreciable amount of instream and riparian habitat and would also likely result in fewer significant hydrogeomorphological risks to the downstream watercourses, with an appreciably reduced impact magnitude as a result.

Key mitigation recommendations:

- Appropriate Storm Water Management Plan (SMWP) to be implemented with a focus on reducing erosion risk.
- Stormwater runoff should be managed for all proposed structures and future developments.
- Stormwater and energy dampening systems be put in place to decreases the risk of upper bank erosion (GCS, 2020).
- Installation of surface drains to be done before the development of landfill cells (GCS, 2020).
- Structures which may be constructed during the development need to be able to withstand the estimated peak flow ranges (i.e. energy dissipation structures may be required in areas prone to erosion or flooding) (GCS, 2020).
- Grey water or potential effluent leaks must be contained and not discharged in watercourses during peak events (GCS, 2020).
- Culvert structures are to be maintained properly: debris and silt should be cleared from flow infrastructure to prevent side cutting (GCS, 2020).
- Monitoring plan to be implemented for water quality and erosion/sediment.

		Impact Significance	
O3	**Impacts to water quality**	'poor' mitigation scenario	'good' mitigation scenario
		Moderately High	Moderate

Water quality within the downstream watercourse (Mgoshongweni River) is at risk of being negatively impacted by dirty water runoff and the release of treated leachate, with the impact of reduced water quality to be ultimately felt by the downstream uMlazi River. Leachate from municipal solid waste landfills is known to contain a myriad of hazardous chemicals which if introduced into surface and groundwater would impair or destroy the long-term ability to use the groundwater and aquifer (Lee *et al.,* 2005). Of particular concern is leakage of untreated leachate due to its high toxicity level and to a lesser extent disposal of inadequately treated leachate into the environment. Hazardous chemicals in leachate not only pollute groundwater and render it unsafe for human consumption but also influence aquatic ecosystems and biota. Where significant changes in water quality occur, this will ultimately result in a shift in aquatic species composition, favouring more tolerant species and potentially resulting in the localised reduction of sensitive species. Moreover, the Geohydrological Assessment (Geaomeasure Group, 2001) identified several surface and groundwater water users within a 2.5km radius of the proposed landfill site during the hydrocensus, of which some may be at risk of potential contamination from the landfill site.

Proper leachate containment, management and treatment is standard practice at landfills sites in South Africa and will serve to greatly reduce the risk of this impact occurring. Leachate storage ponds, treatment ponds and reed beds are already all planned for the landfill development and should these operate adequately and efficiently, should be able to reduce the risk of potential contamination of surface and groundwater.

Whilst water quality within the uMlazi River system and catchment is considered 'poor', further deterioration due to poor quality leachate management will result in further reduced water quality in this system which is considered unacceptable should the objective for management for the river be to maintain the present state. Where impacts and risks are poorly managed, this impact could be of a 'Moderately High' significance and where best practical mitigation is implemented (*as listed below and explained in detail in Chapter 7 of this report),* this can be potentially reduced to a 'Moderate' level.

Key mitigation recommendations:

- Installation of the impermeable barrier before waste generation and reworking of the landfill (GCS, 2020).
- Appropriate Leachate Management System to be implemented with a focus on meeting water quality standards for freshwater aquatic ecosystems.
- Address potential erosion and sedimentation risks on site through the implementation of Best Management Practices (BMPs) in erosion and sediment control.
- Address potential spill and pollution risks on site through the implementation of Best Management Practices (BMPs) in spill and pollution control and hazardous substances management.
- Monitoring plan to be implemented for water quality and erosion/sediment.

		Impact Significance	
O4	**Impacts to ecological connectivity and/or ecological disturbance impacts**	'poor' mitigation scenario	'good' mitigation scenario
		Moderately Low	Low

The presence of workers and machinery during future planned road repairs and maintenance may create ecological noise and vibration disturbances that can temporarily disturb amphibians, reptiles, birds and small mammals; however, these will be minor, and short-lived with fauna likely to revisit the site once maintenance has ceased and the disturbance has halted. Where impacts and risks are poorly managed, this impact could be of a 'Moderately-Low' significance and where best practical mitigation is implemented (*as listed below and explained in detail in Chapter 7 of this report),* this can be potentially reduced to a 'Low' and environmentally acceptable level.

Key mitigation recommendations:

- Limit instream habitat disturbance as far as possible.
- Limit repairs/maintenance of instream structures to low flows during the dry (winter) season.
- Restrict worker and machinery access.
- Prohibit poaching or collection of plants and biota.
- Remove temporary diversions and impoundments once repair/maintenance work is complete.
- Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible.

The combined water uses impact table that includes water use activities tied to impacts, with mitigation, is included in Table 32 on the next page.

Table 32 Water use impact table with activities and mitigation.

Water Use Activity	Associated Water Uses	Impacts	IMPACT ASSESSMENT & MITIGATION			
			Impact Significance: Construction	Mitigation Measures: construction phase	Impact Significance: Operation	Mitigation Measures: operation phase
Activity 1: Construction and Operation of Landfill Site within 100m of a river/stream [Includes: landfill cells (buried waste, lined), access road infrastructure, weighbridge, admin buildings, 2 x septic tanks with soakaways, clean storm water attenuation ponds]	21 (c), (g) & (i)	Direct physical loss or modification of freshwater habitat	Moderate	• Each individual landfill cell must be considered an independent landfill, which will only be incorporated into the overall composite landfill once the entire footprint area has been developed (Geomeasure, 2001). • Limit instream habitat disturbance beyond the immediate construction footprint. • Avoid cutting down or damaging large established indigenous trees within the river riparian zone beyond the permanent landfill footprint, where possible. • Implement post-construction river rehabilitation strategy for adjacent disturbed areas outside of the permanently transformed zone, where necessary.	Low	• Restrict movement of vehicles and any activities beyond the approved development footprint. • Implement river rehabilitation strategy for adjacent disturbed areas outside of the permanently transformed zone, where necessary.
		Alteration of hydrological and geomorphological processes	Moderately Low	• Installation of surface drains to be done before the development of landfill cells (GCS, 2020). • Peripheral surface water interceptor drains and temporary diversion systems should be lined to prevent erosion (Geomeasure, 2001). • Undertake landfill construction during low flow period preferably (winter season). • Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible. • Address potential erosion and sedimentation risks on site through the implementation of Best Management Practices (BMPs) in erosion and sediment control. • Remove temporary diversions and impoundments once construction is complete.	Moderately Low	• Undertake any future repairs and/or maintenance activities within rivers/streams during low flows (winter season) as far as possible. • Appropriate Storm Water Management Plan (SMWP) to be implemented with a focus on reducing erosion risk. • Stormwater runoff should be managed for all proposed structures and future developments. • Installation of surface drains to be done before the development of landfill cells (GCS, 2020). • Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible.

Water Use Activity	Associated Water Uses	Impacts	IMPACT ASSESSMENT & MITIGATION			
			Impact Significance: Construction	Mitigation Measures: construction phase	Impact Significance: Operation	Mitigation Measures: operation phase
		Impacts to water quality	Low	• Phased development plan to ensure that both the short and longer-term objectives for minimising the potential risk of contamination of surface and groundwater resources are achieved (Geomeasure, 2001). • A G:L:B+ liner in accordance with Fig A.8.5 of the Minimum Requirements of the DWAF must be installed beneath each cell and extra care must be taken to ensure continuation of the liner systems between adjacent cells (Geomeasure, 2001). • Undertake landfill construction during low flow period preferably (winter season). • Install a temporary cut off trench to contain poor quality runoff (GCS, 2020). • Address potential spill and pollution risks on site through the implementation of Best Management Practices (BMPs) in spill and pollution control and hazardous substances management.	Moderate	• Installation of the impermeable barrier before waste generation and reworking of the landfill (GCS, 2020). • Appropriate Leachate Management System to be implemented with a focus on meeting water quality standards for freshwater aquatic ecosystems. • Grey water or potential effluent leaks must be contained and not discharged in watercourses during peak events (GCS, 2020). • Address potential erosion and sedimentation risks on site through the implementation of Best Management Practices (BMPs) in erosion and sediment control. • Address potential spill and pollution risks on site through the implementation of Best Management Practices (BMPs) in spill and pollution control and hazardous substances management. • Monitoring plan to be implemented for water quality and erosion/sediment.
		Impacts to ecological connectivity and/or ecological disturbance impacts	Moderately Low	• Transplant or replace protected tree species, in consultation with DEFF & EKZNW. • Incorporate riverine habitat into biodiversity offset negotiations and plans if necessary. • Restrict worker and machinery access to intact areas outside of the landfill footprint. • Prohibit poaching or collection of plants and animals.	Low	• Limit instream habitat disturbance during future repairs and/or maintenance. • Prohibit poaching or collection of plants and animals.
Activity 2: Construction of access roads across rivers/streams	21 (c) & (i)	Direct physical loss or modification of freshwater habitat	Moderately Low	• Limit instream habitat disturbance beyond the immediate construction footprint. • Avoid cutting down or damaging large established indigenous trees within the river riparian zone beyond the permanent landfill footprint, where possible.	Low	• Limit instream habitat disturbance during future road repairs, upgrades and/or maintenance.

Water Use Activity	Associated Water Uses	Impacts	IMPACT ASSESSMENT & MITIGATION			
			Impact Significance: Construction	Mitigation Measures: construction phase	Impact Significance: Operation	Mitigation Measures: operation phase
				• Implement post-construction river rehabilitation strategy for adjacent disturbed areas outside of the permanently transformed zone, where necessary.		
		Alteration of hydrological and geomorphological processes	Moderately Low	• Undertake construction during low flow period preferably (winter season). • Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible.	Low	• Undertake any future repairs and/or maintenance activities within rivers/streams during low flows (winter season) as far as possible. • Implement river rehabilitation strategy where necessary. • Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible.
		Impacts to water quality	Low	• Address potential spill and pollution risks on site through the implementation of Best Management Practices (BMPs) in spill and pollution control and hazardous substances management.	Low	• Monitoring plan to be implemented for water quality and erosion/sediment.
		Impacts to ecological connectivity and/or ecological disturbance impacts	Moderately Low	• Transplant or replace protected tree species, in consultation with DEFF & EKZNW. • Limit access to downstream instream and riparian habitat.	Low	• Limit access to downstream instream and riparian habitat during future road repairs, upgrades and/or maintenance.
Activity 3: Dirty storm water management using contaminated storm water attenuation ponds	21 (c), (g) & (i)	Direct physical loss or modification of freshwater habitat	Moderately Low	• Construct storm water control dams as soon as possible (this should possibly be the first step once the site has been cleared of vegetation, prior to other bulk earthworks taking place). • Limit instream habitat disturbance beyond the immediate construction footprint. • Implement post-construction river rehabilitation strategy for adjacent disturbed areas outside of the permanently transformed zone, where necessary.	Low	• Limit instream habitat disturbance during future repairs and/or maintenance.
		Alteration of hydrological and geomorphological processes	Moderately Low	• Structures which may be constructed during the development need to be able to withstand the estimated peak flow ranges (i.e. energy dissipation structures may be	Moderately Low	• Appropriate Storm Water Management Plan (SMWP) to be implemented with a focus on reducing erosion risk.

Water Use Activity	Associated Water Uses	Impacts	IMPACT ASSESSMENT & MITIGATION			
			Impact Significance: Construction	Mitigation Measures: construction phase	Impact Significance: Operation	Mitigation Measures: operation phase
				required in areas prone to erosion or flooding) (GCS, 2020). • Undertake construction during low flow period preferably (winter season). • Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible.		• Stormwater and energy dampening systems be put in place to decreases the risk of upper bank erosion (GCS, 2020). • Undertake any future repairs and/or maintenance activities within rivers/streams during low flows (winter season) as far as possible. • Implement river rehabilitation strategy where necessary. • Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible.
		Impacts to water quality	Low	• A herringbone subsoil drainage system should be installed in the natural drainage features below the formation levels of individual cells to collect any subsurface seepage water derived from exposed areas within the landfill footprint. Each system should be kept separate, and these drains should discharge into a temporary impoundment, down-gradient of the culvert, prior to releasing the water into the stream (Geomeasure, 2001). • Undertake landfill construction during low flow period preferably (winter season).	Low	• Monitoring plan to be implemented for water quality and erosion/sediment.
		Impacts to ecological connectivity and/or ecological disturbance impacts	Moderately Low	• Transplant or replace protected tree species, in consultation with DEFF & EKZNW. • Incorporate riverine habitat into biodiversity offset negotiations and plans.	Low	• Limit access to downstream instream and riparian habitat.
Activity 4a: Storm water culvert (preferred option)	21 (c) & (i)	Direct physical loss or modification of freshwater habitat	Moderate	• Limit instream habitat disturbance beyond the immediate construction footprint. • Avoid cutting down or damaging large established indigenous trees within the river riparian zone beyond the permanent landfill footprint, where possible. • Implement post-construction river rehabilitation strategy for adjacent disturbed areas outside of the permanently transformed zone, where necessary.	Low	• Limit instream habitat disturbance during future repairs and/or maintenance.

Water Use Activity	Associated Water Uses	Impacts	IMPACT ASSESSMENT & MITIGATION			
			Impact Significance: Construction	Mitigation Measures: construction phase	Impact Significance: Operation	Mitigation Measures: operation phase
		Alteration of hydrological and geomorphological processes	Moderately Low	• Adequate earth berms should be constructed on the flanks of the culvert headwalls to ensure that these structures are not outflanked during periods of abnormally intense rainfall events (Geomeasure, 2001). • All joints within this extensive concrete structure should be sealed to ensure that no subsoil seepage from within the landfill footprint area could enter this system (Geomeasure, 2001). • Undertake landfill construction during low flow period preferably (winter season). • Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible.	Moderately Low	• Culvert structures are to be maintained properly: debris and silt should be cleared from flow infrastructure to prevent side cutting (GCS, 2020). • Undertake any future repairs and/or maintenance activities within rivers/streams during low flows (winter season) as far as possible. • Implement river rehabilitation strategy where necessary. • Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible.
		Impacts to water quality	Low	• Undertake landfill construction during low flow period preferably (winter season).	Low	• Monitoring plan to be implemented for water quality and erosion/sediment.
		Impacts to ecological connectivity and/or ecological disturbance impacts	Moderately Low	• Transplant or replace protected tree species, in consultation with DEFF & EKZNW. • Incorporate riverine habitat into biodiversity offset negotiations and plans.	Low	• Limit access to downstream instream and riparian habitat during any future repairs and/or maintenance.
Activity 4b: Storm water diversion channel (alternative option*)	21 (c) & (i)	Direct physical loss or modification of freshwater habitat	Low	• Limit instream habitat disturbance beyond the immediate construction footprint. • Avoid cutting down or damaging large established indigenous trees within the river riparian zone beyond the permanent landfill footprint, where possible. • Implement post-construction river rehabilitation strategy for adjacent disturbed areas outside of the permanently transformed zone, where necessary.	Low	• Limit instream habitat disturbance during future repairs and/or maintenance.
		Alteration of hydrological and geomorphological processes	Moderately Low	• Undertake landfill construction during low flow period preferably (winter season).	Moderately Low	• Structures are to be maintained properly: debris and silt should be cleared from flow infrastructure to prevent side cutting (GCS, 2020).

Water Use Activity	Associated Water Uses	Impacts	IMPACT ASSESSMENT & MITIGATION			
			Impact Significance: Construction	Mitigation Measures: construction phase	Impact Significance: Operation	Mitigation Measures: operation phase
				• Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible.		• Undertake any future repairs and/or maintenance activities within rivers/streams during low flows (winter season) as far as possible. • Implement river rehabilitation strategy where necessary. • Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible.
		Impacts to water quality	Low	• Undertake construction during low flow period preferably (winter season).	Low	• Monitoring plan to be implemented for water quality and erosion/sediment.
		Impacts to ecological connectivity and/or ecological disturbance impacts	Moderately Low	• Transplant or replace protected tree species, in consultation with DEFF & EKZNW. • Incorporate riverine habitat into biodiversity offset negotiations and plans.	Low	• Limit access to downstream instream and riparian habitat.
5: Septic tanks & soakpits (for domestic wastewater disposal onsite)	21 (g)	Direct physical loss or modification of freshwater habitat	n/a	• n/a	n/a	• n/a
		Alteration of hydrological and geomorphological processes	n/a	• n/a	n/a	• n/a
		Impacts to water quality	Low	• Undertake construction during low flow period preferably (winter season).	Moderate	• Grey water or potential effluent leaks must be contained and not discharged in watercourses during peak events (GCS, 2020). • Monitoring plan to be implemented for water quality.
		Impacts to ecological connectivity and/or ecological disturbance impacts	n/a	• n/a	n/a	• n/a
Activity 6: Leachate storage dams	21 (c), (g) & (i)	Direct physical loss or modification of freshwater habitat	Moderate	• Limit instream habitat disturbance beyond the immediate construction footprint. • Avoid cutting down or damaging large established indigenous trees within the river riparian zone beyond the permanent landfill footprint, where possible.	Low	• Limit instream habitat disturbance during future repairs and/or maintenance.

Water Use Activity	Associated Water Uses	Impacts	IMPACT ASSESSMENT & MITIGATION			
			Impact Significance: Construction	Mitigation Measures: construction phase	Impact Significance: Operation	Mitigation Measures: operation phase
				• Implement post-construction river rehabilitation strategy for adjacent disturbed areas outside of the permanently transformed zone, where necessary.		
		Alteration of hydrological and geomorphological processes	Moderately Low	• Undertake landfill construction during low flow period preferably (winter season). • Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible.	Moderately Low	• Undertake any future repairs and/or maintenance activities within rivers/streams during low flows (winter season) as far as possible. • Implement river rehabilitation strategy where necessary. • Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible.
		Impacts to water quality	Low	• All leachate collected in the leachate collection systems must be piped and discharged into a lined leachate collection facility with adequate reserve storage capacity to cope with the combined flow of both the leachate collection and detection layer in the event of failure of the liner Geomeasure, 2001). • The grades below each cell must allow free drainage of the leachate collection layer and monitoring points must be installed within each cell to allow long-term regular measurement of leachate flow and concentrations (Geomeasure, 2001). • Each cell “floor” or formation level should be graded to ensure an even and positive fall into the leachate detection and leachate collection systems and leachate detection collector pipe alignment must not coincide with subsoil drainage collector pipe routes (Geomeasure, 2001). • Undertake landfill construction during low flow period preferably (winter season). • Address potential spill and pollution risks on site through the implementation of Best Management Practices (BMPs) in spill and	Moderate	• Appropriate Leachate Management System to be implemented with a focus on meeting water quality standards for freshwater aquatic ecosystems. • It is vital that an adequate monitoring system is installed to ensure that any negative impact on the surface and groundwater resources below and down-gradient of this site is detected timeously (Geomeasure, 2001). • This system should also incorporate measures aimed at determining any potential impact associated with the EnviroServ site, which is located hydraulically up-gradient of this site (Geomeasure, 2001). • Grey water or potential effluent leaks must be contained and not discharged in watercourses during peak events (GCS, 2020). • Address potential spill and pollution risks on site through the implementation of Best Management Practices (BMPs) in spill and pollution control and hazardous substances management. • Monitoring plan to be implemented for water quality and erosion/sediment. • Permanent abstraction systems must be installed in BH SS4 and subsequent groundwater exploration/monitoring boreholes, which yield in excess of 2 ℓ/s. In the event of accidental or catastrophic release of leachate into the vadose

Water Use Activity	Associated Water Uses	Impacts	IMPACT ASSESSMENT & MITIGATION			
			Impact Significance: Construction	Mitigation Measures: construction phase	Impact Significance: Operation	Mitigation Measures: operation phase
				pollution control and hazardous substances management.		zone, these boreholes must be activated to act as scavenger wells to "reverse" the natural groundwater gradient and contain the contaminant within the landfill area (Geomeasure, 2001).
		Impacts to ecological connectivity and/or ecological disturbance impacts	Moderately Low	• Transplant or replace protected tree species, in consultation with DEFF & EKZNW. • Incorporate riverine habitat into biodiversity offset negotiations and plans.	Low	• Limit access to downstream instream and riparian habitat.
Activity 7: Stockpiling of cover material (soil)	21 (g)	Direct physical loss or modification of freshwater habitat	Low	• Limit instream habitat disturbance beyond the immediate construction footprint.	Low	• Limit instream habitat disturbance during future repairs and/or maintenance.
		Alteration of hydrological and geomorphological processes	Moderately Low	• Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible.	Low	• Undertake any future repairs and/or maintenance activities within rivers/streams during low flows (winter season) as far as possible. • Implement river rehabilitation strategy where necessary. • Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible.
		Impacts to water quality	Low	• Address potential erosion and sedimentation risks on site through the implementation of Best Management Practices (BMPs) in erosion and sediment control. • Construct a cut-off drain and vegetated earth berm along the permitter of the toe of the stockpile zone to catch any sediment runoff and prevent this from entering any streams/rivers.	Moderately Low	• Address potential erosion and sedimentation risks on site through the implementation of Best Management Practices (BMPs) in erosion and sediment control. • Maintain a cut-off drain and vegetated earth berm along the permitter of the toe of the stockpile zone to catch any sediment runoff and prevent this from entering any streams/rivers. • Monitoring plan to be implemented for water quality and erosion/sediment.
		Impacts to ecological connectivity and/or ecological disturbance impacts	Low	• Transplant or replace protected tree species, in consultation with DEFF & EKZNW. • Incorporate riverine habitat into biodiversity offset negotiations and plans.	Low	• Limit access to downstream instream and riparian habitat.

Water Use Activity	Associated Water Uses	Impacts	IMPACT ASSESSMENT & MITIGATION			
			Impact Significance: Construction	Mitigation Measures: construction phase	Impact Significance: Operation	Mitigation Measures: operation phase
Activity 8: Irrigation using contaminated storm water	21 (e)	Direct physical loss or modification of freshwater habitat	n/a	• n/a	n/a	• n/a
		Alteration of hydrological and geomorphological processes	n/a	• n/a	Low	• Monitoring plan to be implemented for water quality and erosion/sediment.
		Impacts to water quality	n/a	• n/a	Moderately Low	• Meet required standards by ensuring effluent meets the required water quality prior to irrigation. • Monitoring plan to be implemented for water quality and erosion/sediment.
		Impacts to ecological connectivity and/or ecological disturbance impacts	n/a	• n/a	n/a	• n/a

8 MITIGATION AND MANAGEMENT OF IMPACTS

The protection of water resources (rivers/streams for this particular project, no wetlands involved) begins with the avoidance of adverse impacts and where such avoidance is not feasible; to apply appropriate mitigation in the form of reactive practical actions that minimizes or reduces in situ impacts. The mitigation of negative impacts on aquatic resources is a legal requirement for authorisation purposes and must take on different forms depending on the significance of impacts and the particulars of the target area being affected. This generally follows some form of 'mitigation hierarchy' which aims firstly at avoiding disturbance of ecosystems and loss of biodiversity, and where this cannot be avoided, to minimise, rehabilitate, and then finally offset any remaining significant residual impacts. A stepped approach was therefore followed in trying to minimize impacts, which included:

1. Firstly, attempting to avoid/prevent impacts through appropriate project design and location;
2. Secondly, employing mitigation aimed at minimizing the magnitude/significance of impacts where these are unavoidable; and
3. Lastly, compensating for any remaining/residual impacts through on-site rehabilitation or through the application of biodiversity offsets.

8.1 Alternative Options Analysis

An Alternatives Report was prepared by iX/Wilson and Pass Inc JV in May 2021 (see **Appendix 10**).

The Report discusses *inter alia*:

- The original site alternatives investigation prior to and during the Environmental Impact Assessment (EIA) Process in 2010;
- The option to develop the western side of the site only (to avoid any stream diversions, etc.);
- Alternatives in terms of access to the landfill to avoid sensitive and critically endangered environments and ecosystems (namely 'KZN Sandstone Sourveld' grassland patches);
- The option of the proposed Culvert (preferred option) vs Bypass/diversion channel (alternative solution);
- Alternatives related to the position of commencement of landfilling within the approved footprint;
- Leachate treatment options given constraints in the region;
- Alternatives for domestic sewage disposal and electricity supply;
- Various storm water management options for 'dirty' vs 'clean' runoff;
- Different landfill gas extraction options; and
- Procurement of construction materials alternatives.

All alternative recommendations and changes to the initial plans were agreed to by the various parties concerned.

Metamorphosis is of the opinion that the planned development has endeavoured as far as possible to avoid environmental impacts through sound environmental planning and by considering a range of suitable alternatives from an environmental/ecological perspective and that the final desired layout of the development is the best practical environmental option that seeks to balance both the development and social needs with the needs of the environment, thus ensuring that a sustainable form of development is advocated at the site. For further details on project alternatives considered, refer to the Project Alternatives Report contained in **Appendix 10** of the IWWMP.

8.2 Environmental Design

At the forefront of mitigating impacts to the downstream water resources was the incorporation of ecological and environmental sustainability concepts into the design of the landfill and associated infrastructure. These are included in Section 6 of the **Aquatic Assessment Report** (Eco-Pulse, 2020) located in **Appendix 16** of the IWWMP, the **Storm Water Management Plan** (iX/Wilson and Pass Inc JV in March 2021) provided as **Appendix 21** as well the Engineering Design Report and accompanying Designs contained in **Appendix 22**.

Key design principles and considerations have already been dealt with in **Section 5.2** of the IWWMP and include:

- Lining (barrier) of the landfill to contain leachate (*see Section 5.4.1 Liner Design*);
- Leachate collection, storage and treatment prior to disposal (*see Section 5.4.2 Drainage to Base of Landfill and Section 5.3.3 Leachate and Contaminated Stormwater Dams*);
- 'Clean' vs 'Dirty' storm water runoff management (see *Section 5.3.3 Leachate and Contaminated Stormwater Dams*);
- Landfill shape and capping (see *Section 5.3.4 Final Landfill Shape and Capping Layer);*
- Sewage disposal (*see Section 5.4.6 Domestic Sewage Disposal*).

Considering that the landfill cell will be established within an area with significant ground water interactions/seepage, it is considered of paramount importance that a thick composite liner of clay covered with a high-density impermeable geotextile/plastic lining and drainage layer be used to create an impermeable layer to protect ground water from contamination by leachate. This is standard practice and details on landfill liner designs for the different classes of landfill sites can be found in the national Norms and Standards for Disposal of Waste to Landfill in terms of Section 7(1) (c) of the National Environmental Management Waste Act No. 59 of 2008, as contained in Government Notice No. R.636 published in Government Gazette No. 36784, dated 23 August 2013.

8.3 Aquatic Buffer Zones

There are no wetlands on site, therefore the channelled watercourses (rivers and streams and riparian habitat associated with the Mgoshongweni River channel) are considered the most sensitive aquatic environments on the site.

Based on the outputs of the buffers assessment run using the Aquatic Buffers Tool for the project area, a **fixed buffer width of 30m** is recommended for all watercourses within the study area, including riparian areas associated with seasonal rivers and ephemeral streams. Buffers are shown mapped spatially in Figure 25, below.

IMPORTANT NOTE ON THE APPLICATION OF AQUATIC 'BUFFERS'

Whilst the recommended 30m aquatic buffer zones have been recommended for the development, it needs to be mentioned explicitly that the landfill development intends to infill a significant portion of the Mgoshongweni River valley, hence there will be a direct loss of riverine habitat due to infilling. Practically then, buffer recommendations therefore do not apply to area to be infilled but to the remaining rive/stream network OUTSIDE of the planned development footprint and storm water attenuation structures (i.e. within the landfill buffer).

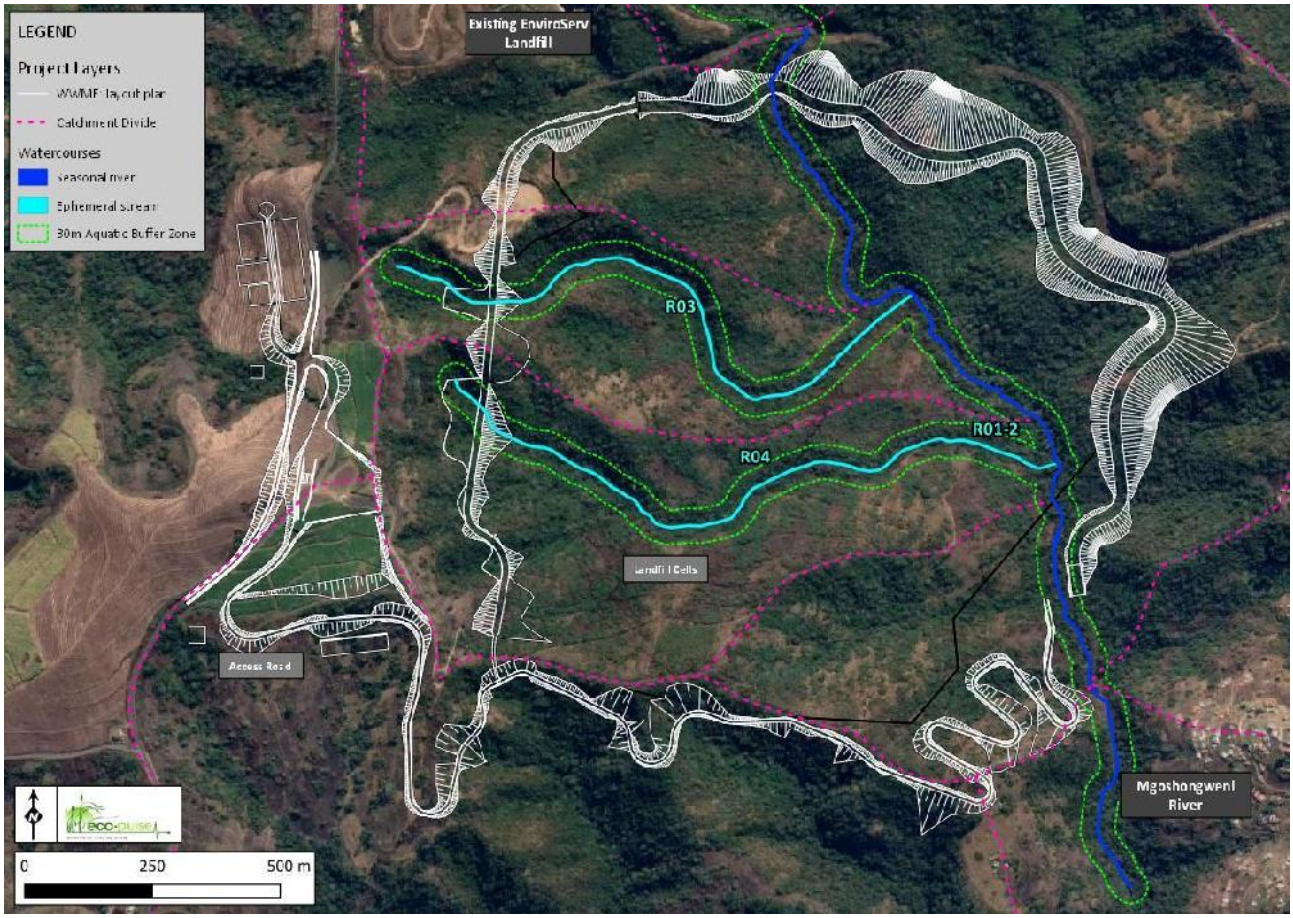


Figure 25 Map showing recommended 30m aquatic buffer zones for the study area seasonal Mgoshongweni River and ephemeral streams (Eco-Pulse, 2020).

8.4 Construction-Phase Mitigation

8.4.1 Onsite Construction phase Mitigation and Management measures

Construction-phase aquatic impact mitigation and management has been dealt with specifically in Section 6.4 on pages 56 – 61 of the **Aquatic Assessment Report** (Eco-Pulse, 2020: Report No. EP499-01) developed for the project, which is contained in **Appendix 16** of the IWWMP and include the following:

- Timing of construction;
- Access to construction areas
- Defining of sensitive “No-Go” areas and working areas for construction activities;
- Method statements for working in watercourses;
- Runoff, erosion and sediment control during the construction activities;
- Soil management;
- Establishment and management of construction camp, storage and laydown areas;
- Hazardous substances/materials management; and
- Solid waste management;
- Water abstraction and use;

- Invasive Alien Plant Control;
- Noise, dust and light pollution Minimisation;
- Wildlife Management;

These management/mitigation measures, in conjunction with those specified in the **Environmental Management Programme (EMPr**) for the development project (compiled by WSP Environmental - EAP), must be implemented at all times during the construction phase. Contingency measures to deal with unforeseen accidental/emergency situations that could lead to environmental pollution and degradation have also been considered and a **Contingency Plan** has been developed (unfinished – unsigned and undated), which is attached as **Appendix 24**.

8.4.2 Method Statements

A suite of Method Statements have also been prepared for the various water use activities (activity 1 – 8, below), to guide construction (and components of site operation) for the landfill development projects. The following Method Statements have been compiled and are included in **Appendix 20**:

- MS1: Road Construction & Bulk Earthworks (Activities 1, 2 and 7)
- MS2: Stream Crossings (Activity 2)
- MS3: Culvert under Landfill (Activity 4a)
- MS4: Diversion Channels (Activity 4b)
- MS5: Construction and Operation of Landfill Cells (Activity 1)
- MS6: Construction and Operation of Storm Water and Leachate Dams (Activities 3 and 6)
- MS7: Construction and Operation of Septic tanks and soakpits (Activity 5)
- MS8: Irrigation of lands using Contaminated Storm Water (Activity 8)

Activity	Water Uses	Method Statement Prepared?
Activity 1: Construction and Operation of Landfill Site within 100m of a river/stream	21 c, g and i	☑
Activity 2: Construction of access roads across rivers/streams	21 c and i	☑
Activity 3: Dirty storm water management using contaminated storm water attenuation ponds	21 b, c, g and i	☑
Activity 4a: Storm water culvert (primary & preferred solution)	21 c and i	☑
Activity 4b: Storm water diversion channel (alternative solution*)	21 c and i	☑
Activity 5: Septic tanks & soakpit	21 g	☑
Activity 6: Leachate storage dams	21 b, c, g & i	☑
Activity 7: Stockpiling of cover material (soil)	21 g	☑
Activity 8: Irrigation using contaminated storm water	21 e	☑

8.5 Operation-Phase Mitigation

1 Surface Water Management/Mitigation Recommendations during the operational phase

The active and on-going/long-term management of aquatic ecosystems during the operational life-span of the development project is also covered, in the Specialist **Aquatic Assessment Report** (Eco-Pulse, 2020: Report No. EP499-01) developed for the project, which is contained in **Appendix 16** of the IWWMP and includes the following key measures:

- Environmental Awareness;
- Alien Plant Monitoring and Control
- Aquatic Buffer Zone Management;
- Incursions into rivers and their relevant buffer zones;
- Water quality and aquatic monitoring;
- Wildlife management;
- Fire Management;
- Storm water management;
- Waste management and pollution prevention (leachate management);
- Management of soil erosion and sedimentation control;

A separate rehabilitation plan has been developed by Eco-Pulse (Report Ref EP499-02, 2020). This is also included in **Appendix 16** of the IWWMP.

2 Groundwater Management/Mitigation Recommendations during the operational phase

The following mandatory recommendations must be implemented as recommended in the Geomeasure Geohydrological Report (2000) (see **Appendix 17**) in the design and management of the proposed Western Waste Management Facility:

LANDFILL DEVELOPMENT

- The phased development plan as proposed by the Design Engineer should be adopted to ensure that both the short and longer-term objectives for minimising the potential risk of contamination of surface and groundwater resources are achieved.
- This plan includes construction of a culvert in the main valley axis, or diversion around the site, an integrated stormwater management diversion strategy as well as leachate capture collection and storage systems, which will cater for the individual needs of successive landfill cells.
- Each individual landfill cell must be considered an independent landfill, which will only be incorporated into the overall composite landfill once the entire footprint area has been developed.

SURFACE WATER MANAGEMENT

- The subsoils and weathered rock are highly susceptible to erosion and permanent, peripheral surface water interceptor drains and temporary diversion systems should be lined to prevent erosion.
- Adequate earth berms should be constructed on the flanks of the culvert headwalls to ensure that these structures are not outflanked during periods of abnormally intense rainfall events.
- All joints within this extensive concrete structure should be sealed to ensure that no subsoil seepage from within the landfill footprint area could enter this system.

SUB-SOIL DRAINAGE

- A herringbone subsoil drainage system should be installed in the natural drainage features below the formation levels of individual cells to collect any subsurface seepage water derived from exposed areas within the landfill footprint. Each system should be kept separate and these drains should discharge into a temporary impoundment, down-gradient of the culvert, prior to releasing the water into the stream.
- Each cell “floor” or formation level should be graded to ensure an even and positive fall into the leachate detection and leachate collection systems and leachate detection collector pipe alignment must not coincide with subsoil drainage collector pipe routes.
- The quality of the water discharged from each individual system must be monitored, preferably on a continuous basis, before the water held in the temporary storage facility is released into the environment.

LINER

- A G:L:B+ liner in accordance with Fig A.8.5 of the Minimum Requirements of the DWAF must be installed beneath each cell and extra care must be taken to ensure continuation of the liner systems between adjacent cells.
- The grades below each cell must allow free drainage of the leachate collection layer and monitoring points must be installed within each cell to allow long-term regular measurement of leachate flow and concentrations.

LEACHATE COLLECTION

- All leachate collected in the leachate collection systems must be piped and discharged into a lined leachate collection facility with adequate reserve storage capacity to cope with the combined flow of both the leachate collection and detection layer in the event of failure of the liner.

MONITORING SYSTEMS

- It is vital that an adequate monitoring system is installed to ensure that any negative impact on the surface and groundwater resources below and down-gradient of this site is detected timeously.
- This system should also incorporate measures aimed at determining any potential impact associated with the EnviroServ site, which is located hydraulically up-gradient of this site.

SYSTEM EVALUATION AND DEVELOPMENT OF SUCESSIVE CELLS

- The development of successive landfill cells must be preceded by further detailed site-specific geohydrological investigations and evaluation of the performance of the mitigating measures and management techniques implemented during the operation of the preceding cell.
- Where necessary, the surface and groundwater monitoring system must be extended to ensure effective monitoring of all surface and groundwater resources below and hydraulically down-gradient of the “new” cell.
- Permanent abstraction systems must be installed in BH SS4 and subsequent groundwater exploration/monitoring boreholes, which yield in excess of 2 ℓ/s. In the event of accidental or catastrophic release of leachate into the vadose zone, these boreholes must be activated to act as scavenger wells to “reverse” the natural groundwater gradient and contain the contaminant within the landfill area.

9 REHABILITATION

Residual impacts to freshwater habitats (instream and riparian areas of rivers/streams) associated with the landfill development project, both planned and unplanned, need to be rehabilitated successfully to the satisfaction of the regulating authorities where possible (i.e. for aquatic habitats that will not be permanently transformed and 'lost' through development). The desired state for the areas to be rehabilitated is to remediate all physical disturbances associated with landfill development activities and operations and establish suitable and appropriate indigenous vegetation cover that effectively stabilises the soil, minimises long-term erosion risks, and reduces the potential for long-term alien plant invasions of aquatic habitat.

The rehabilitation strategy must be pragmatic and focus primarily on the rehabilitation of riparian and instream habitats disturbed during the construction, operational and closure phases of the landfill. The rehabilitation strategy was informed by the baseline aquatic assessment and details of the various streams and rivers in the study area (*NOTE: no wetlands were identified, therefore no wetland rehabilitation requirements involved with this project*).

The strategy for aquatic habitat rehabilitation is as follows:

1. The target areas for stabilisation and revegetation shall include instream and riparian habitats immediately adjacent to/downstream of the landfill cell development, at all access road crossings of streams/rivers and where storm water infrastructure may lead to direct or indirect impacts that could negatively impact watercourses in the area.
2. Reshaping of all physically disturbed and modified freshwater habitat (channels and riparian areas) to take place, including any artificial diversions / drains / berms, etc.
3. Revegetation of the affected aquatic habitats to take place where necessary, using only suitable indigenous vegetation, with the aim being to achieve an adequate cover in the shortest time possible that is also financially practical. In this regard the main aim of rehabilitation efforts should be soil stabilisation and erosion control, with biodiversity aspects being secondary.
4. The preferred method for revegetation is to be via hydroseeding and/or broadcasting of seed using a suitable mix of indigenous grasses, supplemented by interspersed planting of suitable riparian trees and shrubs.
5. Areas that will be permanently transformed through valley infilling will be EXCLUDED from the rehabilitation, accordingly.

The section below defines the key rehabilitation tasks and methods to be followed as required for the landfill development project. The steps in Figure 26 (below) are to be followed during the implementation of a suitable rehabilitation programme for disturbed aquatic (riverine) habitats, as required and where necessary for prevailing or residual impacts caused directly or indirectly by landfill development activities.

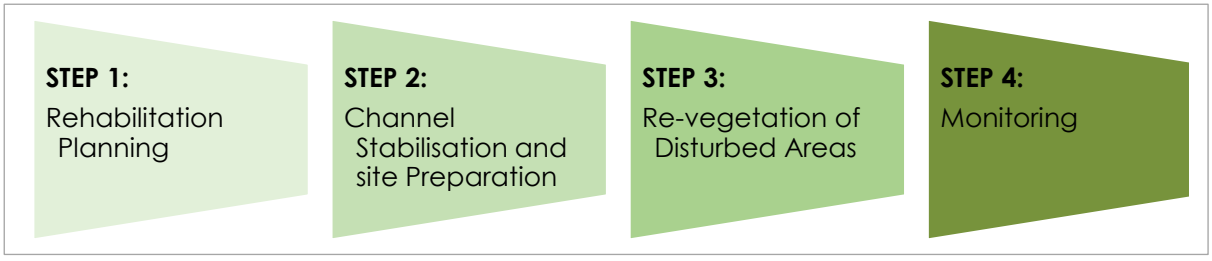


Figure 26 Key steps involved in aquatic (river/stream) habitat rehabilitation plan implementation.

The sub-sections that follow outlines the recommended rehabilitation tasks and methods to be undertaken as part of each step of the rehabilitation process in line with the overarching strategy in Chapter 2 (previous pages).

A **Conceptual Aquatic Rehabilitation Plan** has been developed by Eco-Pulse (Report Ref EP499-02, 2020). This is included in **Appendix 16** of the IWWMP. The plan focuses on the following activities and presents detail relating to each:

- Rehabilitation Planning, including the identification of preliminary rehabilitation target sites (see map in Figure 27 below), plant rescue and availability of seeds and plants,
- Channel Stabilisation and Site Preparation for Planting, including stabilisation and erosion control, sediment removal, waste removal, alien plant removal/control and soil preparation and planting,
- Revegetation, including strategy for revegetation of disturbed areas, revegetation plan for the different areas and planting methods, and
- Monitoring and Evaluation, potential impacts and future/outstanding tasks.

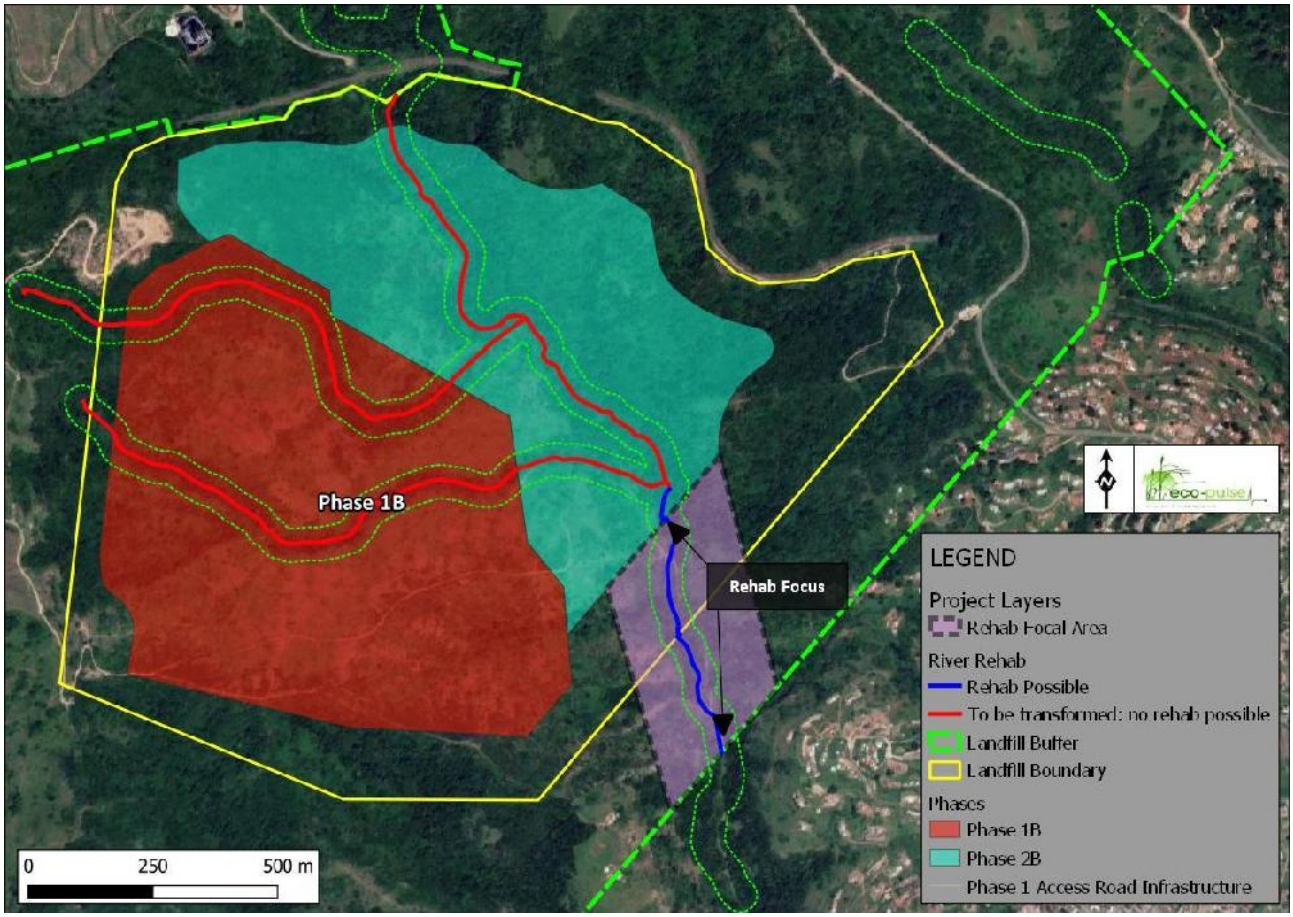


Figure 27 Map showing the key target area requiring potential rehabilitation downstream of the planned landfill site (Eco-Pulse, 2020).

10 MONITORING

Monitoring will be required during the long-term operation of the landfill site in order to ensure that adjacent/downstream rivers and streams are not negatively impacted and such that their current ecological state and functioning is maintained. Monitoring will also assist with identifying any problems requiring management/mitigation and addressing these timeously and appropriately.

A comprehensive **Surface & Groundwater Quality and Aquatic Biomonitoring Plan** has been developed by Eco-Pulse (Report No. EP499-03), which is attached as **Appendix 23** to the IWWMP. The monitoring plan sets out monitoring methods, the recommended location of monitoring sites, the sampling procedure, timing, frequency and prescribes surface water monitoring, groundwater monitoring and aquatic biomonitoring as a means of monitoring potential water pollution/contamination during both the construction and long-term operational phases of the development. The general approach to monitoring adopted in this document provides a means of monitoring changes to natural areas potentially affected by development activities and identifying impacts/problems, their causes and ways of managing/mitigating impacts. The monitoring is intended to be proactive in terms of managing impacts to wetlands and aquatic biodiversity.

Both water chemical sampling analysis of routine and reactive monitoring sites is recommended (see sampling points in Figure 28), supplemented by visual surveys and habitat disturbance surveys. Data collection and storage requirements are contained in the Plan as well as reporting requirements and the plan also described how monitoring data should be used to inform site management, in line with the recommendations of the IWWMP and Contingency Plan compiled for the development project. Roles and responsibilities for monitoring are also described.

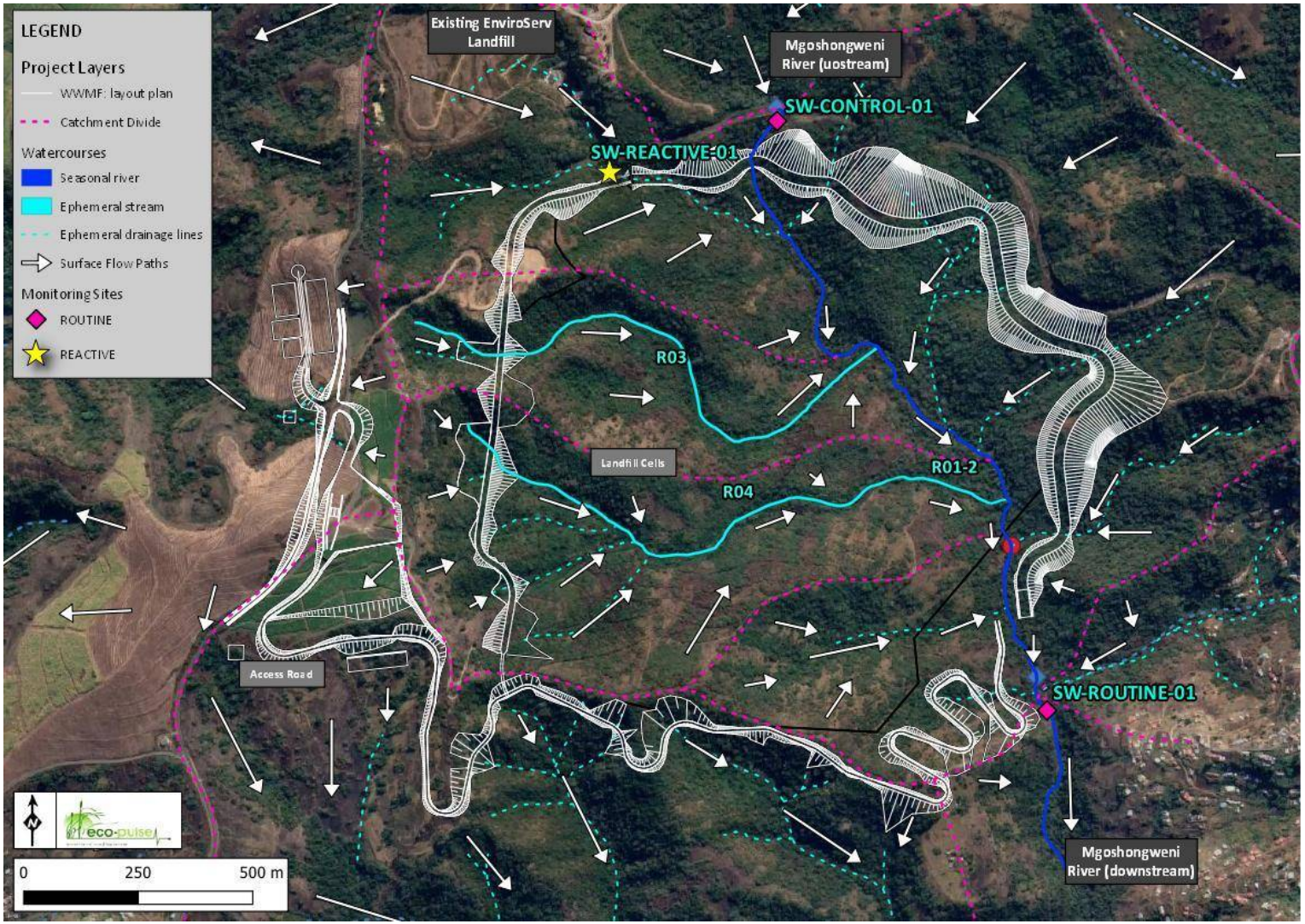


Figure 28 Map showing the location of (i) Routine and (ii) Reactive water quality and aquatic biomonitoring sites in relation to rivers and streams on the development property and downstream.

GROUNDWATER MONITORING PROGRAMME (Geomeasure, 2000)

The Monitoring Boreholes which were previously installed must be found and re-established, or re-drilled.

The existing groundwater exploration boreholes SS1 – SS4 must be upgraded to serve as long term monitoring facilities in accordance with the Monitoring Well Construction Detail shown in the Geomeasure Hydrogeological Report (2000).

At least 4 No. additional boreholes of similar construction should also be drilled at locations shown in the Geomeasure (2000) Report prior to the construction of the proposed Cell 1.

A Geohydrologist should evaluate this monitoring well layout after each monitoring event and prior to development of "new" cells, to determine if the system requires additional monitoring wells or if existing wells should be decommissioned.

Permanent continuous (Electrical Conductivity) EC monitoring equipment must be installed in BH SS4 and at the outlets of all leachate detection and subsoil drains.

All surface and groundwater monitoring systems must be sampled on a quarterly basis and EC and static water levels in boreholes and flow rates of springs and streams should also be recorded on each such occasion.

A Geohydrologist must review these results in conjunction with the results of the EnviroServ monitoring data and data thus collected must be used to develop and maintain a groundwater model of the site throughout its life and thereafter.

This groundwater model must be upgraded and updated on a regular basis to monitor the behaviour of the aquifers beneath the site and to review management practices and efficiency of the engineering systems installed to capture the leachate generated in each cell.

Samples collected from the surface monitoring points must be submitted to an accredited analytical laboratory for the following analyses:

- pH Value
- Conductivity (EC)
- Cations (Na, K, Ca, Mg)
- Anions (C, SO4, HCO3, PO4)
- COD (Chemical Oxygen Demand)

Groundwater sample analysis should include the following:

- pH Value
- Conductivity (EC)
- Cations (Na, K, Ca, Mg)
- Anions (C, SO4, HCO3, PO3)
- COD (Chemical Oxygen Demand)

Consideration must be given to the establishment of a complete meteorological station at the landfill site offices to record rainfall, A-pan evaporation as well as wind velocity and direction on a daily basis.

The effect of rainfall recharge should be determined from data recorded by the permanent down-the-hole water level and EC recording instruments to be installed in BH SS4 and SS 6.

11 CONTINGENCY MEASURES

Contingency measures to deal with unforeseen accidental/emergency situations that could lead to environmental pollution and degradation have been considered and a **Contingency Plan** has been developed for the landfill site (see **Appendix 24)**. This Plan seeks to provide practically implementable steps and specific actions to be followed in the case of an emergency/accident or unforeseen hazard/incident occurring during the construction and operational phases of the development project. These include contingency measures for the following potential emergency and unforeseen situations:

- Incident Response 1: Emergency Spills and Uncontrolled Releases (general spills
- Incident Response 2: Hazardous Spills to the Environment (untreated leachate
- Incident Response 3: Unauthorised Disposal of Waste to the Environment
- Incident Response 4: Fire or Explosion
- Incident Response 5: Failure of Storm Water Infrastructure
- Incident Response 6: Erosion and Sedimentation of Rivers
- Incident Response 7: Accidental Incursions into Rivers / Streams
- Incident Response 8: Failure/leaks from sewer septic tanks
- Incident Response 9: Major Water Supply Leaks
- Incident Response 9: Failure of River Rehabilitation Interventions

12 PUBLIC CONSULTATION PROCESS

A summary report on the Public Participation process undertaken for the WULA for the planned Western Waste Management Facility is contained in **Appendix 25**. The public participation process for this application was undertaken by Metamorphosis Environmental Consultants and was undertaken to satisfy the requirements of the Department of Water & Sanitation for Water Use Licensing, as outlined in the 'R*egulations Regarding the Procedural Requirements for Water Use Licence Applications and Appeals*' contained in the Government Gazette No. 40713 of 24 March 2017. The process essentially involved (i) the identification and notification of I&APs (Interested and Affected Parties) of the intention of the applicant to apply for a Water Use Licence as contemplated in terms of Section 21 of the National Water Act No. 36 of 1998, (ii) the recording of any responses/comments/requests received by I&APs notified and (iii) the addressing of any comments/concerns raised by I&APs as appropriate and relevant to the project. Mechanisms used to inform the public of the development and water use license being applied for included:

1. Fixing two written notice boards at two highly visible locations on the perimeter of the property; and
2. Placing an advertisement within a local newspaper.

Adequate provisions were made for I&APs to register on the stakeholder database and provide a response via email, telephone or in writing. Any responses received were registered on the I&AP Register opened and maintained by Metamorphosis. Letters of response were compiled and emailed to the respective I&APs as relevant.

For the details, refer to the **Public Participation Summary Report** contained under **Appendix 25** of the IWWMP.

13 CONCLUSION

13.1 Regulatory Status & Water Uses Applied For

Several of the proposed activities on the site require a water use license in terms of Chapter 4 and Section 21 of the National Water Act No. 36 of 1998 before these can commence. There are no existing lawful uses on the property. The water uses requiring licensing on the site of the planned waste management facility are summarised in Table 33 and have been categorised as follows:

Activity	Description	Water Uses
Activity 1: Construction and Operation of Landfill Site within 100m of a river/stream	landfill cells (buried waste, lined), access road infrastructure, weighbridge, admin buildings, 2 x septic tanks with soakaways, clean storm water attenuation ponds	21 c, g and i
Activity 2: Construction of access roads across rivers/streams	access roads crossing rivers and streams	21 c and i
Activity 3: Dirty storm water management using contaminated storm water attenuation ponds	several contaminated storm water attenuation ponds	21 b, c, g and i
Activity 4a: Storm water culvert (primary & preferred solution)	storm water culvert (preferred option) on the Mgoshongweni River channel	21 c and i
Activity 4b: Storm water diversion channel (alternative solution*)	storm water diversion channels (note this is an alternative option to the culvert in Activity 4a)	21 c and i
Activity 5: Septic tanks & soakpit	2 x septic tanks and soakpits for domestic wastewater disposal onsite	21 g
Activity 6: Leachate storage dams	temporary and final phase leachate storage dam	21 b, c, g & i
Activity 7: Stockpiling of cover material (soil)	temporary stockpiling of cover material (soils excavated during landfill creation)	21 g
Activity 8: Irrigation using contaminated storm water	irrigation of land on the property using contaminated storm water	21 e

The location of water uses applied for is shown on the WULA Master Layout Map in Figure 29 and included in **Appendix 9.**

Table 33 Summary of water uses being applied for the landfill development on the property.

Activity 1: Construction and Operation of Landfill Site within 100m of a river/stream

Includes: landfill cells (buried waste, lined), access road infrastructure, weighbridge, admin buildings, 2 x septic tanks with soakaways, clean storm water attenuation ponds
Water uses triggered: 21 c, g and i

PURPOSE/ ACTIVITY	ASSOCIATED NWA SECTION 21 WATER USE(S) IDENTIFIED	MAP LABEL / REFERENCE	DATE COMMENCING	WATERCOURSE(S) AFFECTED			Volume / Dimension(s)	PROPERTY WHERE WATER USE WILL OCCUR	COORDINATES LATITUDE (S) / LONGITUDE (E) (IN DECIMAL DEGREES)
				Watercourse	PES	EIS			
Landfill development: within 100m of a river/stream	21 (c), (g) & (i)	LF1	New: year 2042	R01-2: Mgoshongweni River	C: fair	Moderate	Length of landfill: 1 280 m Width of landfill: 1 480 m Height of landfill: 40 m Depth of landfill: 125 m (Valley landfill) Volume of landfill: 35,9 x 10^6 m^3 Materials: Compacted solid waste, synthetic geofabric liner, clay, crushed stone, HDPE pipes, earth Distance from river R01-2 = 0m (infilled) Length of watercourse R1-02 affected = 1 200 m	The Remainder of the farm Kirkfalls No. 14227	**Four external coordinates of landfill:** North: -29.830077 S ; 30.755073E South: -29.843862 S ; 30.757457 E West: -29.840245 S ; 30.743148 E East: -29.835254 S ; 30.763586 E **Start of river reach R01-2:** -29.837943 S ; 30.759983 E **End of river reach R01-2:** -29.830488 S ; 30.754215 E
	21 (c), (g) & (i)	LF2	New: year 2042	R03: Tributary stream (ephemeral)	C: fair	Low	Distance from stream R03 = 0m (infilled) Length of stream R03 affected = 1 180 m		**Start of stream R03:** -29.834353 S ; 30.757031 E **End of stream R03:**

PURPOSE/ ACTIVITY	ASSOCIATED NWA SECTION 21 WATER USE(S) IDENTIFIED	MAP LABEL / REFERENCE	DATE COMMENCING	WATERCOURSE(S) AFFECTED			Volume / Dimension(s)	PROPERTY WHERE WATER USE WILL OCCUR	COORDINATES LATITUDE (S) / LONGITUDE (E) (IN DECIMAL DEGREES)
				Watercourse	PES	EIS			
									-29.834350 S ; 30.747724 E
	21 (c), (g) & (i)	LF3	New: year 2022	R04: Tributary stream (ephemeral)	C: fair	Low	Distance from stream R04 = 0m (infilled) Length of stream R04 affected = 1 320 m		**Start of stream R04:** -29.837289 S ; 30.760015 E **End of stream R04:** -29.835968 S ; 30.747827 E

Activity 2: Construction of access roads across rivers/streams

Includes: access roads crossing rivers and streams
Water uses triggered: 21 c and i

PURPOSE/ ACTIVITY	ASSOCIATED NWA SECTION 21 WATER USE(S) IDENTIFIED	MAP LABEL / REFERENCE	DATE COMMENCING	WATERCOURSE(S) AFFECTED			Volume / Dimension(s)	PROPERTY WHERE WATER USE WILL OCCUR	COORDINATES LATITUDE (S) / LONGITUDE (E) (IN DECIMAL DEGREES)
				Watercourse	PES	EIS			
Road crossing 1	21 (c) & (i)	RC1	New: year 2023	R01-2: Mgoshongweni River	C: fair	Moderate	Length of crossing: 20.0 m Width of crossing: 6.0 m Height of crossing structure: 0.6 m Distance from river R01-2 = 0 m Materials: Earth fill, precast concrete pipes, concrete slabs, brick or stone packed headwalls, gabions, steel guardrails	The Remainder of the farm Kirkfalls No. 14227	**Start of crossing:** -29.839936 S ; 30.760245 E **End of crossing:** -29.839758 S ; 30.760227 E
Road crossing 2	21 (c) & (i)	RC2	New: year 2048	R01-2: Mgoshongweni River	C: fair	Moderate	Length of crossing: 20.0 m Width of crossing: 6.0 m Height of crossing structure: 0.6 m Distance from river R01-2 = 0 m Materials: *see road crossing 1 (above)*		**Start of crossing:** -29.838458 S ; 30.760095 E **End of crossing:** -29.838280 S ; 30.760160 E
Road crossing 3	21 (c) & (i)	RC3	New: year 2048	R01-2: Mgoshongweni River	C: fair	Moderate	Length of crossing: 20.0 m Width of crossing: 6.0 m Height of crossing structure: 0.6 m Distance from river R01-2 = 0 m Materials: *see road crossing 1 (above)*		**Start of crossing:** -29.834486 S ; 30.756052 E **End of crossing:** -29.834403 S ; 30.755861 E

PURPOSE/ ACTIVITY	ASSOCIATED NWA SECTION 21 WATER USE(S) IDENTIFIED	MAP LABEL / REFERENCE	DATE COMMENCING	WATERCOURSE(S) AFFECTED			Volume / Dimension(s)	PROPERTY WHERE WATER USE WILL OCCUR	COORDINATES LATITUDE (S) / LONGITUDE (E) (IN DECIMAL DEGREES)
				Watercourse	PES	EIS			
Road crossing 4	21 (c) & (i)	RC4	New: year 2058	R01-2: Mgoshongweni River	C: fair	Moderate	Length of crossing: 20.0 m Width of crossing: 6.0 m Height of crossing structure: 0.6 m Distance from river R01-2 = 0 m Materials: *see road crossing 1 (above)*		**Start of crossing:** -29.830781 S ; 30.754169 E **End of crossing:** -29.830613 S ; 30.754136 E
Road crossing 5	21 (c) & (i)	RC5	New: year 2058	R03: Tributary stream (ephemeral)	C: fair	Low	Length of crossing: 20.0 m Width of crossing: 6.0 m Height of crossing structure: 0.6 m Distance from stream R03 = 0 m Materials: *see road crossing 1 (above)*		**Start of crossing:** -29.834830 S ; 30.756351 E **End of crossing:** -29.834955 S ; 30.756199 E
Road crossing 6	21 (c) & (i)	RC6	New: year 2023	R04: Tributary stream (ephemeral)	C: fair	Low	Length of crossing: 20.0 m Width of crossing: 6.0 m Height of crossing structure: 0.6 m Distance from stream R04 = 0 m Materials: *see road crossing 1 (above)*		**Start of crossing:** -29.838492 S ; 30.752107 E **End of crossing:** -29.838423 S ; 30.751907 E
Road crossing 7	21 (c) & (i)	RC7	New: year 2023	R04: Tributary stream (ephemeral)	C: fair	Low	Length of crossing: 20.0 m Width of crossing: 6.0 m Height of crossing structure: 0.6 m Distance from stream R04 = 0 m Materials: *see road crossing 1 (above)*		**Start of crossing:** -29.837069 S ; 30.758799 **End of crossing:** -29.837009 S ; 30.758612 E

Activity 3: Dirty storm water management using contaminated storm water attenuation ponds

Includes: several contaminated storm water attenuation ponds
Water uses triggered: 21 b, c, g and i

PURPOSE/ ACTIVITY	ASSOCIATED NWA SECTION 21 WATER USE(S) IDENTIFIED	MAP LABEL / REFERENCE	DATE COMMENCING	WATERCOURSE(S) AFFECTED			Volume / Dimension(s)	PROPERTY WHERE WATER USE WILL OCCUR	COORDINATES LATITUDE (S) / LONGITUDE (E) (IN DECIMAL DEGREES)
				Watercourse	PES	EIS			
Interim Phase 1 Contaminated stormwater pond: temporary storage of contaminated stormwater	21 (g)	CSWP1a	New: 2023 – 2030 (temporary)	R01-2: Mgoshongweni River	C: fair	Moderate	Pond capacity = 26 000 m^3 Area: 34 160 m^2 Width of pond = 260 m Length of pond = 170 m Pond wall height = 4.0 m Max. water depth = 3.5 m Discharge volume = 90 000 m^3/annum* (*no direct discharge to environment: contaminated storm water to be pumped and used to irrigate lands under Activity 8 and Section 21e water use) Distance from river R01-2 = 410 m Length of river R01-2 affected = 300 m Materials: Earth, concrete, synthetic geofabrics, clay, crushed stone, HDPE pipes	The Remainder of the farm Kirkfalls No. 14227	**Coordinates of pond wall centre point:** -29.837566 S ; 30.755908 E **Point where pond wall crosses stream:** -29.837365 S ; 30.755793 E **Upstream point on pond:** -29.837701 S ; 30.754169 E **Five external coordinates of pond:** NW: -29.837038 S ; 30.754098 E NE: -29.836603 S ; 30.755347 E W: -29.838097 S ; 30.754228 E SW: -29.838709 S ; 30.755448 E SE: -29.838707 S ; 30.756649 E
	21 (b), (c), (g) & (i)			R04: Tributary stream (ephemeral)	C: fair	Low	Distance from stream R04 = 0 m Length of stream R04 affected = 160m		

PURPOSE/ ACTIVITY	ASSOCIATED NWA SECTION 21 WATER USE(S) IDENTIFIED	MAP LABEL / REFERENCE	DATE COMMENCING	WATERCOURSE(S) AFFECTED			Volume / Dimension(s)	PROPERTY WHERE WATER USE WILL OCCUR	COORDINATES LATITUDE (S) / LONGITUDE (E) (IN DECIMAL DEGREES)
				Watercourse	PES	EIS			
Final Phase 1 Contaminated stormwater pond: temporary storage of contaminated stormwater	21 (c), (g) & (i)	CSWP1b	New: 2030	R01-2: Mgoshongweni River	C: fair	Moderate	Pond capacity = 50 000 m^3 Area: 38 860 m^2 Width of pond = 195 m Length of pond = 230 m Pond wall height = 4.5 m Max. water depth = 4.0 m Distance from river R01-2 = 40 m Length of river R01-2 affected = 410 m Discharge volume = 90 000 m^3/annum* (*no direct discharge to environment: contaminated storm water to be pumped and used to irrigate lands under Activity 8 and Section 21e water use) Materials: *see Interim Phase 1 Contaminated storm water pond (above)*		**Coordinates of pond wall centre point:** -29.837171 S ; 30.759616 E **Point where pond wall crosses stream:** -29.837298 S ; 30.759458 E **Upstream point on pond:** -29.837007 S ; 30.757201 E **Five external coordinates of pond:** NW: -29.836573 S ; 30.756803 E NE: -29.835873 S ; 30.757992 E W: -29.837572 S ; 30.757782 E S: -29.838777 S ; 30.757947 E E: -29.837171 S ; 30.759616 E
	21 (b), (c), (g) & (i)			R04: Tributary stream (ephemeral)	C: fair	Low	Distance from stream R04 = 0 m Length of stream R04 affected = 290m		
Contaminated stormwater pond 2: temporary storage of contaminated stormwater	21 (g)	CSWP2	New: year 2022	R01-2: Mgoshongweni River	C: fair	Moderate	Pond capacity = 5 000 m^3 Area: 3 480 m^2 Width of pond = 105 m Length of pond = 55 m Pond wall height = 3 m Max. water depth = 2.5 m		**Coordinates of pond wall centre point:** -29.839640 S ; 30.744437 E **Point where pond wall crosses stream:**

PURPOSE/ ACTIVITY	ASSOCIATED NWA SECTION 21 WATER USE(S) IDENTIFIED	MAP LABEL / REFERENCE	DATE COMMENCING	WATERCOURSE(S) AFFECTED			Volume / Dimension(s)	PROPERTY WHERE WATER USE WILL OCCUR	COORDINATES LATITUDE (S) / LONGITUDE (E) (IN DECIMAL DEGREES)
				Watercourse	PES	EIS			
							Distance from river R01-2 = 700 m Length of river R01-2 affected = 200 m Discharge volume = 13810 m^3/annum* (*no direct discharge to environment: contaminated storm water to be pumped and used to irrigate lands under Activity 8 and Section 21e water use) Materials: *see Interim Phase 1 Contaminated storm water pond (above)*		n/a **Upstream point on pond:** n/a **Three external coordinates of pond:** N: -29.839083 S ; 30.744843 E W: -29.839734 S ; 30.743867 E E: -29.839563 S ; 30.744942 E
Contaminated stormwater pond 3: temporary storage of contaminated stormwater	21 (g)	CSWP3	New: year 2022	R01-2: Mgoshongweni River	C: fair	Moderate	Pond capacity = 1 800 m^3 Area: 1 590 m^2 Width of pond = 40 m Length of pond = 40 m Pond wall height = 3 m Distance from river R01-2 = 250 m Length of river R01-2 affected = 200 m Discharge volume = 4898m^3/annum* (*no direct discharge to environment: contaminated storm water to be pumped and used to irrigate lands under Activity 8 and Section 21e water use) Materials: *see Interim Phase 1 Contaminated storm water pond (above)*		**Coordinates of pond wall centre point:** -29.834703 S ; 30.743864 E **Point where pond wall crosses stream:** n/a **Upstream point on pond:** n/a **Four external coordinates of pond:** NW: -29.834376 S ; 30.743612 E NE: -29.834329 S ; 30.744009 E SW: -29.834733 S ; 30.743663 E SE: -29.834680 S ; 30.744075 E

Activity 4a: Storm water culvert (primary & preferred solution)

Includes: storm water culvert (preferred option) on the Mgoshongweni River channel
Water uses triggered: 21 c and i

PURPOSE/ ACTIVITY	ASSOCIATED NWA SECTION 21 WATER USE(S) IDENTIFIED	MAP LABEL / REFERENCE	DATE COMMENCING	WATERCOURSE(S) AFFECTED			Volume / Dimension(s)	PROPERTY WHERE WATER USE WILL OCCUR	COORDINATES LATITUDE (S) / LONGITUDE (E) (IN DECIMAL DEGREES)
				Watercourse	PES	EIS			
Storm water culvert: culvert on Mgoshongweni River	21 (c) & (i)	CU1	New: year 2048	R01-2: Mgoshongweni River	C: fair	Moderate	Width of culvert = 10.0 m Max. height of culvert = 5.0 m Length of culvert = 1 226 m Distance from river R01-2 = 0 m Length of river affected = 1 226 m Extent of river affected: 12,260 m^2 Materials: Reinforced concrete, earth, steel gratings, synthetic geofabrics, gabions	The Remainder of the farm Kirkfalls No. 14227	**Start of culvert:** -29.839940 S ; 30.760258 E **End of culvert:** -29.830601 S ; 30.754132 E

Activity 4b: Storm water diversion channel (alternative solution*)

Includes: storm water diversion channels (note this is an alternative option to the culvert in Activity 4a)
Water uses triggered: 21 c and i

PURPOSE/ ACTIVITY	ASSOCIATED NWA SECTION 21 WATER USE(S) IDENTIFIED	MAP LABEL / REFERENCE	DATE COMMENCING	WATERCOURSE(S) AFFECTED			Volume / Dimension(s)	PROPERTY WHERE WATER USE WILL OCCUR	COORDINATES LATITUDE (S) / LONGITUDE (E) (IN DECIMAL DEGREES)
				Watercourse	PES	EIS			
Storm water diversion channel 1	21 (c) & (i)	DC1	New: year 2048	R01-2: Mgoshongweni River	C: fair	Moderate	Width of diversion channel = 3.0 m Length of diversion channel = 2681 m Depth of channel = 1.0 m Distance from river R01-2 = 0 m Materials: Earth, concrete, steel gratings and safety barriers, synthetic geofabrics, gabions	The Remainder of the farm Kirkfalls No. 14227	**Start of diversion:** -29.830874 S ; 30.754221 **End of diversion:** -29.836942 S ; 30.759878 E
Storm water diversion channel 2	21 (c) & (i)	DC2	New: year 2048	R01-2: Mgoshongweni River	C: fair	Moderate	Width of diversion channel = 3.0 m Length of diversion channel = 1320 m Depth of channel = 1.0 m Distance from river R01-2 = 0 m Materials: *see Storm water diversion channel 1 (above)*		**Start of diversion:** -29.830874 S ; 30.754221 **End of diversion:** -29.836886 S ; 30.759941 E
Storm water diversion channel 3	21 (c) & (i)	DC3	New: year 2048	R03: Tributary stream (ephemeral)	C: fair	Low	Width of diversion channel = 3.0 m Length of diversion channel = 218 m Depth of channel = 1.0 m Distance from stream R03 = 0 m Materials: *see Storm water diversion channel 1 (above)*		**Start of diversion:** -29.834578 S ; 30.748705 E **End of diversion:** 29.836549 S ; 30.748474 E

PURPOSE/ ACTIVITY	ASSOCIATED NWA SECTION 21 WATER USE(S) IDENTIFIED	MAP LABEL / REFERENCE	DATE COMMENCING	WATERCOURSE(S) AFFECTED			Volume / Dimension(s)	PROPERTY WHERE WATER USE WILL OCCUR	COORDINATES LATITUDE (S) / LONGITUDE (E) (IN DECIMAL DEGREES)
				Watercourse	PES	EIS			
Storm water diversion channel 4	21 (c) & (i)	DC4	New: year 2048	R04: Tributary stream (ephemeral)	C: fair	Low	Width of diversion channel = 3.0 m Length of diversion channel = 1647 m Depth of channel = 1.0 m Distance from stream R04 = 0 m Materials: *see Storm water diversion channel 1 (above)*		**Start of diversion:** 29.836549 S ; 30.748474 E **End of diversion:** -29.836942 S ; 30.759878 E

Activity 5: Septic tanks & soakpits

Includes: 2 x septic tanks and soakpits for domestic wastewater disposal onsite
Water uses triggered: 21 g

PURPOSE/ ACTIVITY	ASSOCIATED NWA SECTION 21 WATER USE(S) IDENTIFIED	MAP LABEL / REFERENCE	DATE COMMENCING	WATERCOURSE(S) AFFECTED			Volume / Dimension(s)	PROPERTY WHERE WATER USE WILL OCCUR	COORDINATES LATITUDE (S) / LONGITUDE (E) (IN DECIMAL DEGREES)
				Watercourse	PES	EIS			
Septic tank & soakpit 1: domestic wastewater management	21 (g)	ST1	New: year 2022	R01-2: Mgoshongweni River	C: fair	Moderate	Volume (storage capacity): 27 m^3 Width: 1.5 m Length: 9.0 m Depth: 1.0 m Distance from nearest river (R01-2) = 800 m Discharge: 3 120 m^3/annum Materials:	The Remainder of the farm Kirkfalls No. 14227	**Coordinates of septic tank centre point:** -29.838489 S ; 30.746162 E
Septic tank & soakpit 2: domestic wastewater management	21 (g)	ST2	New: year 2022	R01-2: Mgoshongweni River	C: fair	Moderate	Volume (storage capacity): 4.5 m^3 Width: 1.5 m Length: 3.0 m Depth: 1.0 m Distance from nearest river (R01-2) = 1050 m Discharge: 63m^3/annum Materials: *see Septic tank 1 (above)*		**Coordinates of septic tank centre point:** -29.836356 S ; 30.744946 E

Activity 6: Leachate storage dams

Includes: temporary and final phase leachate storage dam
Water uses triggered: 21 b, c, g & i

PURPOSE/ ACTIVITY	ASSOCIATED NWA SECTION 21 WATER USE(S) IDENTIFIED	MAP LABEL / REFERENCE	DATE COMMENCING	WATERCOURSE(S) AFFECTED			Volume / Dimension(s)	PROPERTY WHERE WATER USE WILL OCCUR	COORDINATES LATITUDE (S) / LONGITUDE (E) (IN DECIMAL DEGREES)
				Watercourse	PES	EIS			
Interim Phase 1 Leachate storage dam: temporary storage of leachate* *wastewater to be pumped and tankered to WWTW for offsite treatment and disposal	21 (g)	LSD1a	New: year 2023 – 2030 (temporary)	R01-2: Mgoshongweni River	C: fair	Moderate	Pond capacity = 20 000 m^3 Area: 38 420 m^2 Width of pond = 335 m Length of pond = 100 m Pond wall height = 4 m Max. water depth = 3.5 m Distance from river R01-2 = 580 m Length of river R01-2 affected = 400m Discharge volume = 18000 m^3/annum* (**note no discharge to environment: wastewater to be pumped and tankered to WWTW for offsite treatment and disposal*) Materials: Earth, concrete, synthetic geofabrics, clay, crushed stone, HDPE pipes	The Remainder of the farm Kirkfalls No. 14227	**Coordinates of dam wall centre point:** -29.838140 S ; 30.754120 E **Point where dam wall crosses stream:** -29.837737 S ; 30.754069 E **Upstream point on dam:** -29.838435 S ; 30.753085 E **Four external coordinates of dam:** NW: -29.836962 S ; 30.752876 E NE: -29.836981 S ; 30.753961 E SW: -29.839973 S ; 30.753309 E SE: -29.838802 S ; 30.755407 E
	21 (b), (c), (g) & (i)			R04: Tributary stream (ephemeral)	C: fair	Low	Distance from stream R04 = 0m (infilled) Length of stream R04 affected = 130m		

PURPOSE/ ACTIVITY	ASSOCIATED NWA SECTION 21 WATER USE(S) IDENTIFIED	MAP LABEL / REFERENCE	DATE COMMENCING	WATERCOURSE(S) AFFECTED			Volume / Dimension(s)	PROPERTY WHERE WATER USE WILL OCCUR	COORDINATES LATITUDE (S) / LONGITUDE (E) (IN DECIMAL DEGREES)
				Watercourse	PES	EIS			
Final Phase 2 Leachate storage dam: temporary storage of leachate* *wastewater to be pumped and tankered to WWTW for offsite treatment and disposal	21 (c), (g) & (i)	LSD1b	New: year 2030	R01-2: Mgoshongweni River	C: fair	Moderate	Pond capacity = 49 500 m^3 Area: 44 560 m^2 Width of pond = 125 m Length of pond = 550 m Pond wall height = 4.5 m Max. water depth = 4.0 m Distance from river R01-2 = 40 m Length of river R01-2 affected = 250m Discharge volume = 18000 m^3/annum* (**note no discharge to environment: wastewater to be pumped and tankered to WWTW for offsite treatment and disposal*) Materials: *see Interim Phase 1 Leachate storage dam (above)*		**Coordinates of dam wall centre point:** -29.838227 S ; 30.759691 E **Four external coordinates of dam:** N: -29.837338 S ; 30.759649 E S: -29.841755 S ; 30.757190 E W: -29.838804 S ; 30.758010 E E: -29.839059 S ; 30.759722 E
	21 (c), (g) & (i)			R04: Tributary stream (ephemeral)	C: fair	Low	Distance from stream R04 = 5m Length of stream R04 affected = 40m		

Activity 7: Stockpiling of cover material (soil)

Includes: temporary stockpiling of cover material (soils excavated during landfill creation)
Water uses triggered: 21 g

PURPOSE/ ACTIVITY	ASSOCIATED NWA SECTION 21 WATER USE(S) IDENTIFIED	MAP LABEL / REFERENCE	DATE COMMENCING	WATERCOURSE(S) AFFECTED			Volume / Dimension(s)	PROPERTY WHERE WATER USE WILL OCCUR	COORDINATES LATITUDE (S) / LONGITUDE (E) (IN DECIMAL DEGREES)
				Watercourse	PES	EIS			
Stockpiling of cover material (topsoil)	21 (g)	SS1	New: year 2023	R01-2: Mgoshongweni River	C: fair	Moderate	Stockpile height: 3 m Stockpile width: 120 m Stockpile area length: 380 m Stockpile area (estimated): 40 000 m^2 Stockpile volume (estimated): 48 000 m^3 Materials: topsoil from site Distance from river R01-2 = 30 m	The Remainder of the farm Kirkfalls No. 14227	**Four external coordinates of stockpile area:** West: -29.836664 S ; 30.760325 E North: -29.834826 S ; 30.762381 South: 29.838285 S ; 30.760543 E East: -29.835661 S ; 30.763048 E

Activity 8: Irrigation using contaminated storm water

Includes: irrigation of land on the property using contaminated storm water from onsite ponds
Water uses triggered: Section 21 e

PURPOSE/ ACTIVITY	ASSOCIATED NWA SECTION 21 WATER USE(S) IDENTIFIED	MAP LABEL / REFERENCE	DATE COMMENCING	WATERCOURSE(S) AFFECTED			Volume / Dimension(s)	PROPERTY WHERE WATER USE WILL OCCUR	COORDINATES LATITUDE (S) / LONGITUDE (E) (IN DECIMAL DEGREES)
				Watercourse	PES	EIS			
Irrigation of lands (using contaminated storm water)	21 (e)	IR1	New: year 2023	R01-2: Mgoshongweni River	C: fair	Moderate	Irrigated area width: 550 m Irrigated area length 880 m Irrigated area (estimated): 360 000 m^2 Volume of water (estimated): 90 000 m^3/annum Distance from river R01-2 = 5 m	The Remainder of the farm Kirkfalls No. 14227	**Four external coordinates of area to be irrigated:** North (top-left): -29.830874 S ; 30.754221 East (top-right): -29.834781 S ; 30.762147 E West (bottom-left): -29.834477 S ; 30.753677 E South (bottom-right): -29.838773 S ; 30.757891 E
		IR2		R03: Tributary stream (ephemeral)	C: fair	Low	Distance from stream R03 = 5 m		
		IR3		R04: Tributary stream (ephemeral)	C: fair	Low	Distance from stream R04 = 5 m		

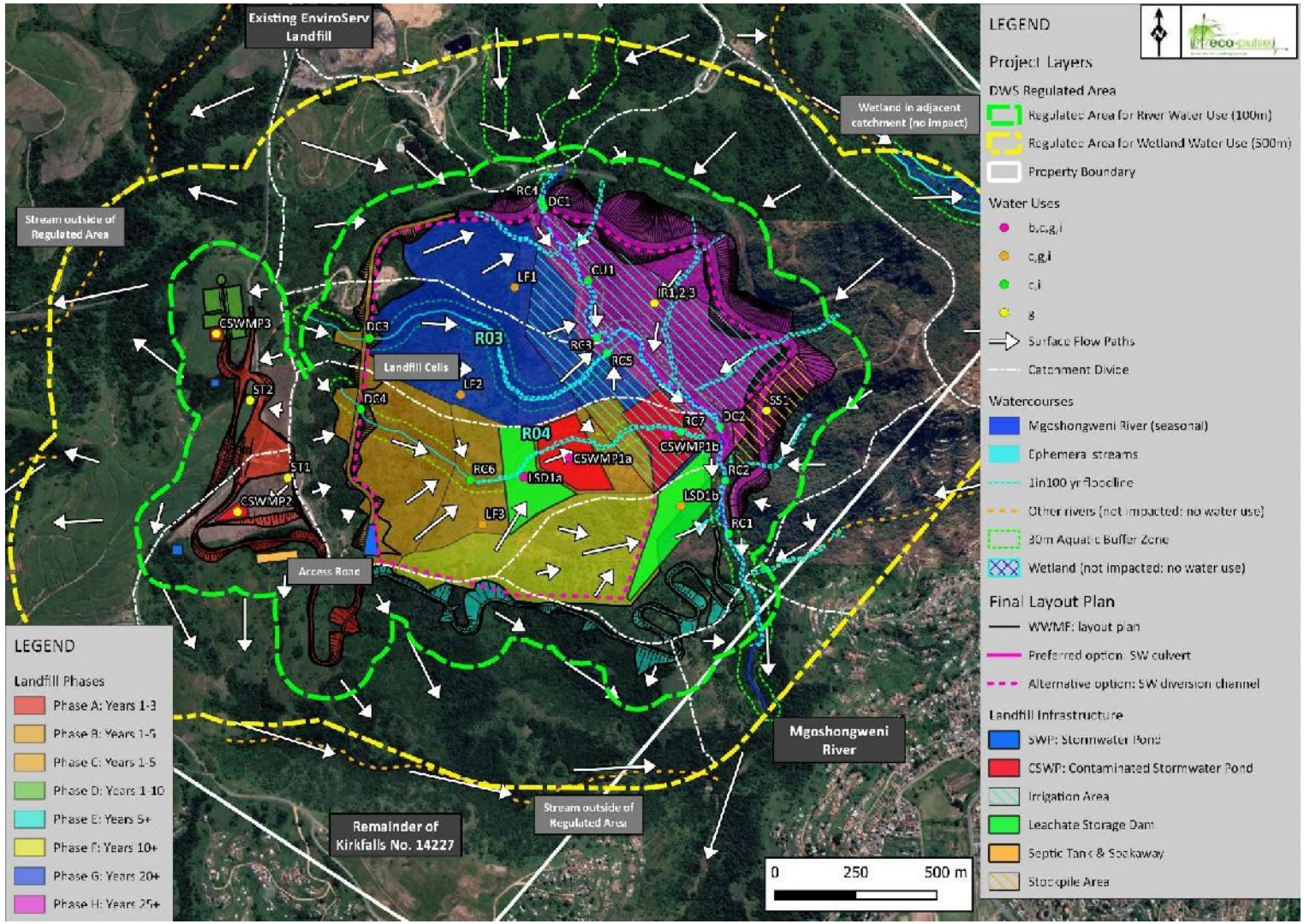


Figure 29 WULA Master Layout Plan map showing water uses, watercourses and development activities/infrastructure associated with the landfill development (Water uses are linked directly to the summary Table 32).

13.2 Section 27 (1) NWA Motivation

Waste disposal service is of great demand, resulting from increased development and growth in urban population. Cleansing & Solid Waste (CSW) has identified a proposed landfill site situated in Shongweni area to help alleviate stress caused by landfill closures and reducing airspace. CSW was awarded the Waste Management License (WML) in August 2016, allowing for the construction and operation of the Shongweni Regional General Landfill Site. CSW is now intending to apply for a Water Use License (WUL) for the planned waste management facility.

13.2.1 Section 21 (1) (a): *Existing lawful uses*

An existing lawful water use (ELWU) is defined in terms of the National Water Act (No. 36 of 1998) as a water use that lawfully took place in the period two years before the commencement of the NWA. This allows any water use that lawfully took place to continue until such time as it can be converted into a Water Use Licence.

The proposed project will be a new development and no existing lawful uses exist or have been identified for the property.

13.2.2 Section 21 (1) (b): *The need to redress the results of past racial and gender discrimination*

The procurement policies and procedures for this project will be implemented to accommodate Broad-based Black Economic Empowerment (B-BEE). The eThekwini Municipality preferential procurement policy will be used to ensure a minimum of 30% contract participation goal will be enforced for all construction contract thereby addressing this requirement.

Local labour will be used in the construction phase of the project, and training will be undertaken with the labour force to further empower them in the labour market. The project offers employment opportunities in the local unskilled and semi-skilled market.

The project will benefit the residents of the eThekwini Municipality at large, as the new landfill will allow for ease of waste collection to be made available for disadvantaged areas which will reduce health risks and improve the standard of living. The landfill site will not discriminate in terms of race and in terms of which areas and communities will be serviced by the waste management facility.

13.2.3 Section 21 (1) (c): *Efficient and beneficial use of water in the public interest*

The development will promote recycling and re-use of water, thus reducing the overall consumption of potable water, which will then be available for other users.

The project will be designed to control and appropriately manage all stormwater to ensure no contamination or erosion.

The overall project development has no intention to utilize water directly from the Mgoshongweni River or uMlazi River.

Mitigation measures outlined within the Environmental Management Programme (EMPr) will be implemented to ensure environmental protection, sustainability & management. An open-door policy will be maintained for dealing with any complaints and/or issues from public.

13.2.4 Section 21 (1) (d): *Socio-economic impact*

Authorisation of water uses will allow for efficient disposal of waste for the residents of eThekwini. Transportation costs will reduce due to locality of development which will then prevent increase in rates to the residents of eThekwini.

Authorization of water uses will allow for ease of management of the proposed landfill site. Risks of contamination of water resources will be reduced by the removal of or treatment of the leachate on site. Employment will be created as a result of the development and the ultimate construction and operation of the treatment plant.

As a short-term solution leachate will be tankered but in the future, leachate will be treated, therefore the traffic impacts and risks associated with transportation of leachate will be negated. The use of potentially contaminated runoff for dust suppression on the lined areas will also reduce the use of potable water and ensure that adequate dust suppression is undertaken at all times.

The availability of the landfill for the disposal of general waste from the entire Western area of eThekwini is significant, reducing the costs and social impacts of transporting waste long distances to other areas.

The development will promote & implement waste management and hence benefit residents.

Failure to secure the above-mentioned water uses may result in termination of the development. The landfill is urgently needed to meet the demand in the Municipality for general solid waste disposal as existing facilities have reached their capacity or are close to capacity. Without this facility, the management of solid waste in the Municipal area will be severely compromised and may result in delays in collection of waste and overflowing waste receiving depots, potentially leading to pollution of the environment, the City's storm water and ultimately water resources if the project is not authorized / licensed.

There will also be an increase in transportation costs, which has already been experienced. Additional resources will be needed to service the same amount of waste which will lead to an increase in rate to the residents of eThekwini. There is also the act of illegal dumping which is always an issue should there not be a landfill close to the area for waste disposal.

Dust suppression will not be undertaken in times of water shortage and potable water will have to be used when available.

13.2.5 Section 21 (1) (e): *Any catchment management strategy applicable to the relevant water resource(s)*

No catchment management strategy has been identified for the area. There is no catchment management strategy in place yet, but the National Water Resource Strategy emphasises the need to protect the integrity of our water resources, which the licence conditions will ensure.

13.2.6 Section 21 (1) (f): *The likely effect of water uses to be authorised on the water resource(s) and on other water users*

The effects of the water use on the site will be mainly beneficial to other water users. The only storing to be conducted will be for contaminated stormwater, all clean water will be diverted to the watercourse to maintain stream flows to the downstream resource (river).

There is a risk associated with the discharge from the leachate treatment plant, but this is deemed to be manageable. As long as construction and operational activities are managed appropriately on site (as per the EMPr and Storm Water Management Plan), there will be limited risk anticipated in terms of a reduction in the quality or quantity of water within the rivers/streams on the site and the uMlazi River downstream. Downstream users are unlikely to be affected by reduced water quality or quantity which will not result from landfill operation where properly managed.

There will not be any extraction of water from the rivers or groundwater.

All water uses to be carried out in a manner that will not be detrimental on the existing water resource and also to surrounding users i.e. there will be no impact on the quantity or quality of the water resource.

13.2.7 Section 21 (1) (g): *Class of the resource quality objectives of the water resource*

The DWS has conducted an in-depth reserve determination for the Mvoti to Umzimkulu WMA, with reference specifically made to the report titled "Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkhulu Water Management Area". The objective of the study was to classify the river in terms of Present Ecological State (PES) as well as determine the Ecological Reserve. The ecological reserve refers to the minimum quantity of water that should be allowed to run through the catchment to sustain the ecological environment. According to the DWS Report, the Mgoshongweni River has not been assessed and no receiving Resource Quality Objectives (RQO's) have been set by DWS for this resource. The Freshwater/Aquatic Assessment Report (Eco-Pulse, 2020) presents information on the Present Ecological State of the various resources in the area based on the habitat, SASS and water quality sampling undertaken. In general, the resources were found to be moderately to largely modified, with moderately low EIS. In the absence of formal classification, management objectives have been presented based on the PES and EIS of the watercourses, which should at a minimum aim to '*maintain the present condition and functioning of water resources on the property and downstream'*.

The downstream uMlazi River reach (U60D-04661) has been assessed by the DWS and is regarded as 'Moderately Modified' ('C' PES Category) and has a 'High' Ecological Importance (EI) and a 'Very High' Ecological Sensitivity (ES) and the Recommended Ecological Category (REC) is to maintain the current ecological state ('C/D' PES Category. Activities affecting watercourses within this catchment must therefore take measures to support the C/D REC and RQO's set for this reach of the uMlazi River so that regional targets are met collectively by all water users.

13.2.8 Section 21 (1) (h): *Investments already made and to be made by the water user in respect of the water use in question*

The CSW (eThekwini Municipality) has already invested significantly in the project. The scoping works including all works for the Environmental Authorisation alone is recorded to be within the region of some R3 million. In addition, purchase of the land for some R 50 million.

The construction of the first phase of the next 3 years for some R 100 million and then phase approached in development of future cells for waste disposal for some R 1 billion.

13.2.9 Section 21 (1) (i): *Strategic importance of the water use(s) to be authorised*

The required water uses are essential for the running of this landfill development. The planning involved for this landfill comprises of long-term thinking as this development could result in a landfill with an ~70 year life expectancy.

The continued operation of this development is critical to the functioning of the eThekwini Municipality. The formalization of the water uses will ensure that the City meets its targets in terms of corporate governance, and the treatment of leachate will have many benefits, including financial benefits to the City in the long term. The water uses permit the proper running of a landfill which also benefit the health of the residents of eThekwini. As already mentioned, the landfill is urgently needed to meet the demand in the Municipality for general solid waste disposal as existing facilities have reached their capacity or are close to capacity. Without this facility, the management of solid waste in the Municipal area will be severely compromised and may result in delays in collection of waste and overflowing waste receiving depots.

13.2.10 Section 21 (1) (j): *Quality of water in the water resource which may be required for the Reserve and for meeting international obligations*

As already mentioned above, in the absence of formal classification and RQO's for the Mgoshongweni River, the REC for the river should be to *'maintain the present condition and functioning of water resources on the property and downstream'.* The current water quality should therefore not be compromised. In addition, DWS (2015) set the following water Resource Quality Objectives (RQOs) for the lower uMlazi river reach further downstream of the landfill site:

- Ensure that turbidity/clarity or TSS levels stay within Acceptable limits: A moderate change from present with temporary high sediment loads and turbidity during runoff event (Aquatic ecosystems: driver).
- Ensure that nutrient levels (phosphate and Total Inorganic Nitrogen; TIN) are within Tolerable limits: 50th percentile of the data must be less than 0.075 mg/L PO4-P. 50th percentile of the data must be less than 2.5 mg/L TIN-N (Aquatic ecosystems: driver).
- Ensure that electrical conductivity (salt) and toxics levels are within appropriate limits for intended use, e.g. industrial use: Numerical limits can be found in DWAF (1996e) (Industrial use: driver).
- Meet faecal coliform and E. coli targets for recreational / other (full or partial contact) use[4].

As long as the activities are managed appropriately on site (as per the EMP, Wetland Specialist Report recommendations, IWWMP and Storm Water Management Plan), there will be no reduction in the quality of water on the site, supporting the downstream uMlazi River. The management of domestic waste and wastewater during site operation (in accordance with the specification of the EMP) and storm water runoff (as per the Storm Water Management Plan) will also ensure that water quality is not negatively impacted on site and downstream of the development.

The results of a grab sample taken by Eco- Pulse revealed somewhat elevated nitrogen (nitrate/nitrite), conductivity and E. coli levels, the likely cause of which is a combination of possible leachate from the upstream Enviroserv Landfill and faecal matter from cattle using the watercourse and adjacent areas of the river catchment.

Importantly, the planned rehabilitation on the property through the removal of alien invasive plants is likely to improve flows to downstream areas.

[4] <600 counts/100ml (low health risk), 600-2 000 counts/100ml (medium health risk and >2 000 counts/100ml (high health risk).

13.2.11 Section 21 (1) (k): *Probable duration of any undertaking for which a water use is to be authorised*

The landfill is likely to cease operation in approximately 69 years. However, it is likely that it will continue to require leachate treatment for many years after site closure. Volumes of leachate will, however, reduce significantly once the site has been closed, capped and rehabilitated.

13.3 Level of Confidence in the Information

There is a high degree of confidence in the information and data presented in the IWWMP. Numerous specialist environmental and ecological studies have been undertaken and have informed the final site layout from an ecological and water resources management perspective. All technical and specialist studies have been undertaken by reputable and suitably qualified professional personnel, including engineers and natural scientists, with the reports generated considered as being of the very highest quality.

13.4 Key Commitments

The following key commitments from the Applicant have been identified:

1. Commit to understanding and implementing the requirements and recommendations in the IWWMP;
2. Commit to any and all conditions of the Water Use Licence where granted/issued by DWS;
3. The Applicant endeavours to cover the relevant professional fees and practical costs of implementing the following environmental management measures for watercourses on the property submitted with this application for a water use license;
4. Commit to complying with all relevant environmental legislation, particularly the National Environmental Management Act No. 107 of 1998 and the National Water Act (NWA) No. 36 of 1998, and in particular clause19 (1) of the NWA which imposes ‘duty of care’ on all landowners, to ensure that water resources are not polluted;
5. Implement a Storm Water Management Plan to specification;
6. Ensure that contractors implement the EMPr and all Method Statements to specification;
7. Implement the Rehabilitation Plans to specification;
8. Implement the Surface and Ground Water Quality Monitoring Plans;
9. In the case of an emergency situation occurring, implement the relevant step(s) of the Contingency Plan to specification;
10. Provide necessary and adequate financial provisions and means to remediate possible pollution and associated pollution-causing activities on-site (should these occur in the future), which is in line with the legislative requirements of the National Water Act No. 36 of 1998;
11. Liaise with the consultant responsible for drafting the IWWMP should there be any queries or need for clarification on any aspect of the IWWMP and Water Use License application; and
12. Direct any queries to the relevant officials from the Department of Human Settlements, Water & Sanitation.

13.5 Proposed Licence Conditions

The following conditions are suggested for inclusion in the Water Use Licence issued:

- Compliance with the guidelines, conditions and requirements of the EMPr (WSP).
- Compliance with the provisions of the Stormwater Management Plan (iX/Wilson Pass, 2021).
- Compliance with all requirements and provisions of the Aquatic Assessment Report (Eco-Pulse, 2020: Report No. EP499-01), including the Ecological Monitoring Requirements contained therein.
- Implement the Conceptual Aquatic Rehabilitation Plan developed by Eco-Pulse (Report Ref EP499-02, 2020) where necessary.
- Monitoring of watercourses to be undertaken as per the Surface & Ground Water Quality and Aquatic Biomonitoring Plan developed by Eco-Pulse (Eco-Pulse, 2020: Report No. EP499-03).
- Monitoring of Groundwater to be undertaken in accordance with the Geohydrological Assessment Report (Geomeasure, 2001).
- Compliance with the recommendations of the Geohydrological Assessment Report (Geomeasure, 2001).

14 REFERENCES

DWAF (Department of Water affairs and Forestry). 2009. DWAF Training Manual: National Water Act Section 21(c) and (i) Water Uses. Version: November 2009.

DWAF Ground Water Dictionary. Available online at: https://www.dwaf.gov.za/Groundwater/Groundwater_Dictionary/index.html?introduction_ecoregions.htm

DWS. Operational Guideline: Integrated Water and Waste Management Plan for the preparation of the Water Quality Management Technical Document to support the Application for Licences for Mining and Industries in Terms of the Requirements of the National Water Act, 1998 (Act 36 of 1998).

Eco-Pulse Consulting. 2020 Western Waste Management Facility Development: *Aquatic Assessment Report*. Report No. EP499-01. Version 1.1 revision 1. 30th November 2020.

Eco-Pulse Consulting. 2020. WWMF Shongweni Landfill: *Conceptual Aquatic Rehabilitation Plan for Riparian and Instream habitats.* Report No. EP499-02. Version 1.0 revision 0. 2nd December 2020.

Eco-Pulse Consulting, 2020. Western Waste Management Facility Development: *Surface and Groundwater Quality and Aquatic Biomonitoring Plan* Report No. EP499-03. Version 1.0. 1st December 2020.

GCS, 2020. Hydrological Assessment for the proposed new landfill at Shongweni. June 2020.

Geomeasure Group 2001 Geohydrological Assessment of the Shongweni South Candidate Landfill Site. Prepared for Durban Solid Waste. 29 January 2001.

Geomeasure Group 2020 Report on the Updated Desktop Study, Field hydrocensus and sampling for the Durban Solid Waste Shongweni Landfill Site. Prepared for eThekwini Municipality. 17 February 2020.

General Authorisation (GA) in terms of Section 39 of the National Water Act No. 36 of 1998 for Water Uses as defined in Section 21 (C) or Section 21 (I), (as contained in Government Gazette No. 40229, 26 August 2016).

Thekwini Geocivils cc 2001. Geotechnical Investigation Report for the proposed New Landfill Site in DMA Western Zone Shongweni.

Strategic Planning Resources 2010 Shongweni Local Area Plan, Regional Socio-economic Assessment. June 2010. Prepared for Linda Masinga & Associates.

WSP Proposed Shongweni Landfill Draft Environmental Management Programme March 2016.

15 APPENDICES

The following list of Appendices is relevant to this application:

Appendix	Description	Included
1	Certified copy of ID of applicant and company registration certificate	Yes
2	Copy of property's title deed where water use occurs	Yes
3	Lease Agreements and certified copy of ID of landowner	N/A (land owned by applicant)
4	Copy of Property Zoning Documents where water use occurs	Yes
5	Clearance letter from the Department of Rural Development and Land Reform	Yes
6	Proof of BBBEE Status	N/A (Government Department)
7	Licence application forms	No hard copy forms, only online forms completed on e-WULAAs
8	1:50 000 topographic map / 1:10 000 map	Yes
9	Master Layout Plan	Yes
10	Alternatives Report and map	Yes
11	Environmental Impact Assessment (EIA) Report	Yes
12	Environmental Authorisation (RoD)	Yes
13	Environmental Management Plan (EMP)	Yes
14	Wetland Assessment Report & Hydropedological Assessment Report	N/A (no wetlands)
15	Geotechnical Studies	Yes
16	Aquatic Assessment	Yes
17	Geohydrological Study	Yes
18	Hydrological Study	Yes
19	Water Supply and Demand Analysis + Water Balance	Yes
20	Method Statements	Yes
21	Stormwater Management Plan	Yes
22	Civil designs	Yes
23	Monitoring programme for surface and groundwater, and biomonitoring	Yes
24	Contingency Plan	Yes
25	Public Participation	Yes
26	Financial provision	Yes
27	Mining Permit, Prospecting Right, Signed Social and Labour Plan	N/A (no mining)
28	Exemption from GN 704	N/A (no mining)
29	Service Level Agreements	Yes
30	Existing Authorisations/Licenses (Waste Management License)	Yes