Integrated Water and Waste Management Plan for the Solids Removal and Treatment Facilities Upgrade at the Southern Waste Water Treatment Works, Merewent, KwaZulu-Natal

Final Report

eThekwini Water and Sanitation

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EXECUTIVE SUMMARY

The eThekwini Municipality intends to upgrade facilities at the Southern Wastewater Treatment Works (SWWTW) in order to drastically reduce the quantity of organic load to sea, thereby minimising the impact on the receiving environment. The SWWTW is located at 2 Byfield Road, Merewent, on the north-eastern bank of the Umlaas Canal, and is surrounded by residential and industrial development. The proposed development, planned within the eThekwini Metropolitan Municipality, in the KwaZulu-Natal province of South Africa and will be undertaken in two phases. The proposed upgrade will be achieved through the implementation of properly engineered techniques and installations that will convert organic waste to valuable end products such as methane rich biogas and nutrient rich resources such as compost and liquid fertilizer using anaerobic digestion technology.

Royal Haskoning DHV was appointed by eThekwini Municipality to compile an Integrated Water and Waste Management Plan (IWWMP) as required by the National Water Act, 1998 (Act 36 of 1998) for the two phases of the proposed upgrade. This IWWMP comprises of strategies put in place to ensure efficient management of water and waste in relation to the proposed upgrade. Considering that the project is an upgrade to existing structures/facilities, some of the activities related the proposed upgrade is already captured by existing procedures in place at the works. However, all water and waste-related issues and risks relevant to the construction, operational and closure phases of the proposed upgrade are identified and mitigation measures clearly set out.

This IWWMP therefore forms part of the Specialist input towards an overall current Environmental Impact Assessment (EIA) process underway.

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Abbreviations and Acronyms

AD	Anaerobic Digestion
CMS	Catchment Management Strategy
COD	Chemical Oxygen Demand
CSIR	Council for Scientific and Industrial Research
CWDP	Coastal Waters Discharge Permit
DEA	Department of Environmental Affairs
DO	Dissolved Oxygen
DSW	Durban Solid Waste
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
ESS	Eco System Survey
EWS	eThekwini Water and Sanitation
GA	General Authorization
GH	Gas Holder
HoW	Head of Works
I&APs	Interested and Affected Parties
IWRM	Integrated Water Resources Management
IWWMP	Integrated Water and Wastewater Management Plan
M & B	Mixing Building & Boiler House
MHI	Major Hazard Installation
NEM:ICMA	National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008)
NEM:WA	National Environmental Management: Waste Act (Act No. 36 of 1998) (as amended)
NWA	National Water Act (Act No. 36 of 1998)
NWRS	National Water Resource Strategy
PDS	Primary Digested Sludge
PS	Primary Sludge
PS	Primary Sludge
PST	Primary Settling Tank
RAS	Return Activated Sludge

RQOs	Resource Quality Objectives
RWQOs	Receiving Water Quality Objectives
SD	Secondary Digester
SWWTW	Southern Wastewater Treatment Works
UNEP	United Nations Environmental Programme
WAS	Waste Activated Sludge
WSDP	Water Services Development Plan
WUL(A)	Water Use Licence (Application)

1 INTRODUCTION

1.1 Activity Background

The eThekwini Municipality is mandated by the South African Government to provide social amenities, services and infrastructure to residents across eThekwini. The eThekwini Water and Sanitation is a unit of the eThekwini Municipality and is saddled with the responsibility of providing water and sanitation services to all residents. The eThekwini Municipality has been discharging sewage and selected industrial effluent streams through two deep-sea submarine outfalls (the Central and Southern Works outfalls) since about 1970.

To ensure that the environmental integrity of the receiving environment is not unacceptably compromised, the eThekwini Municipality has proposed an upgrade to the Southern Wastewater Treatment Works (SWWTW) which disposes of a large portion of its effluent (domestic and industrial) and sludge to the sea through a 4.2 km outfall. The balance is treated in a conventional activated sludge plant.

The works currently treats an average flow of 130 Ml/day from the southern areas of Jacobs, Wenthworth, Chatsworth and Umlazi. The flow contains domestic sewage – as well as industrial effluent from the Mobeni/Jacobs area. Wastewater discharged from road tankers and from sewers owned by industry also enters the works, but bypasses all treatment processes and discharges directly to the sea outfall.

Wastewater received at the head-of-works undergoes screening and degritting before being passed through primary settling tanks. Sludge from the primary settling tank is removed and degritted in hydrocyclones before being added back to the primary effluent for discharge to the sea through the ocean outfall. Scum is removed from the primary settling tanks and disposed of at the Bisasar Road landfill site, together with the collected grit and screenings.

A gravity thickener and anaerobic digesters are available but are no longer used as the discharge permit from the Department of Water Affairs allows raw sludge to be discharged to sea. The average discharge into the ocean outfall is 145 Ml/day however; the outfall has a design capacity of approximately 215 Ml/day under pump discharge.

The conventional activated sludge plant has a capacity of 48 Ml/day. The feed to this plant is domestic sewage received from the Chatsworth line. The treated effluent from the activated sludge plant undergoes tertiary treatment for industrial use. The upgrade of facilities at the SWWTW being proposed is expected to minimise the impact on the receiving environment by drastically reducing the quantity of organic load to sea, thereby preventing the impairment of the ecological functioning of the receiving environment while also safe-guarding human health.

1.2 Contact details

TABLE 1-1: CONTACT DETAILS

Area of responsibility	Contact details	
Name of company	eThekwini Municipality – Water and Sanitation	
Address	3 Prio Road, Durban, 4001	
Telephone	031 311 1111	
Fax number	031 311 8699	
Contact Persons		
Name	Keith Brackenbury	Ashley Pillay
Telephone	031 311 8657	031 311 8659
Fax number	031 311 8699	031 311 8699

1.3 Regional Setting and Location of Activity

The Southern Wastewater Treatment Works (SWWTW) is located in South Durban, Merewent on the north-eastern bank of the Umlaas Canal. The SWWTW is surrounded by a mixed development node of both residential and industrial developments. The property address is 2 Byfield Road, Merewent/Bluff located in an industrial shared residential area.

To access the Southern WWTW, take exit 8 off the M4 Southern Freeway into Duranta Road heading towards Merewent. Turn left into Basil February Road. Continue into Byfield Road which leads to the works. The close proximity is shown in Figure 1-1 below, and the wider context in the locality plan (Figure 1-2).

1.4 Property Description

The property description of the SWWTW is presented in Table 1-2 and the Title Deeds available at Appendix 1.

TABLE 1-2: PROPERTY LOCATION SUMMARY

Local Municipality	Not Applicable	
District Municipality	eThekwini Metropolitan Municipality (ETH)	
Location Co-ordinates	**Latitude (S)**	**Longitude (E)**
Corner 1	29° 57’ 14.27”	30° 58’ 27.15”
Corner 1	29° 57’ 19.32”	30° 58’ 39.92”
Corner 1	29° 57’ 30.12”	30° 58’ 09.98”
Corner 1	29° 57’ 52.81”	30° 58’ 25.86”
Corner 1	29° 57’ 31.99”	30° 58’ 22.68”
Corner 1	29° 57’ 28.65”	30° 58’ 18.80”
Centre Point	29° 57’ 28.58”	30° 58’ 21.49”

FIGURE 1-1: SITE LOCALITY

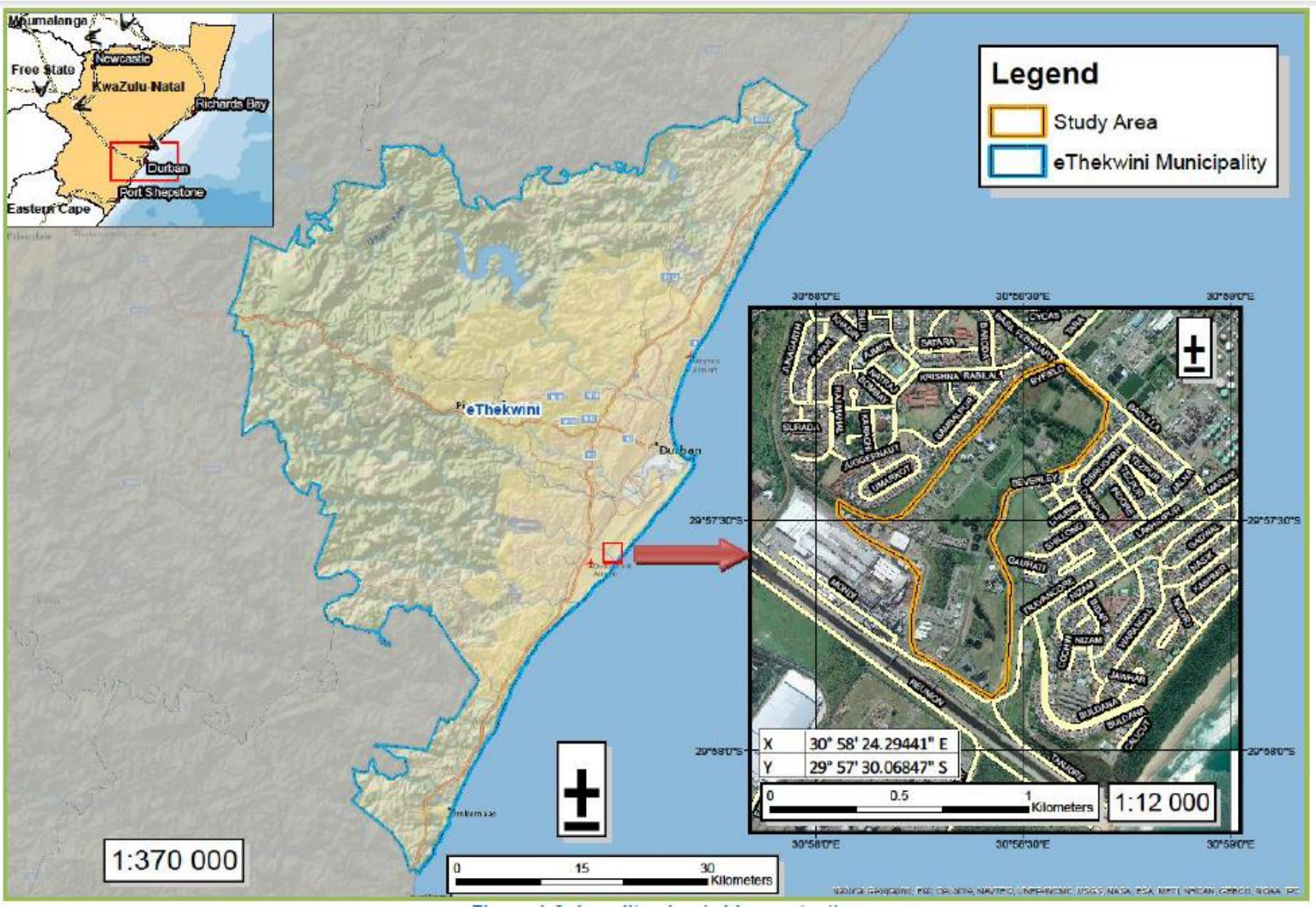

FIGURE 1-2: LOCALITY PLAN (WIDER CONTEXT)

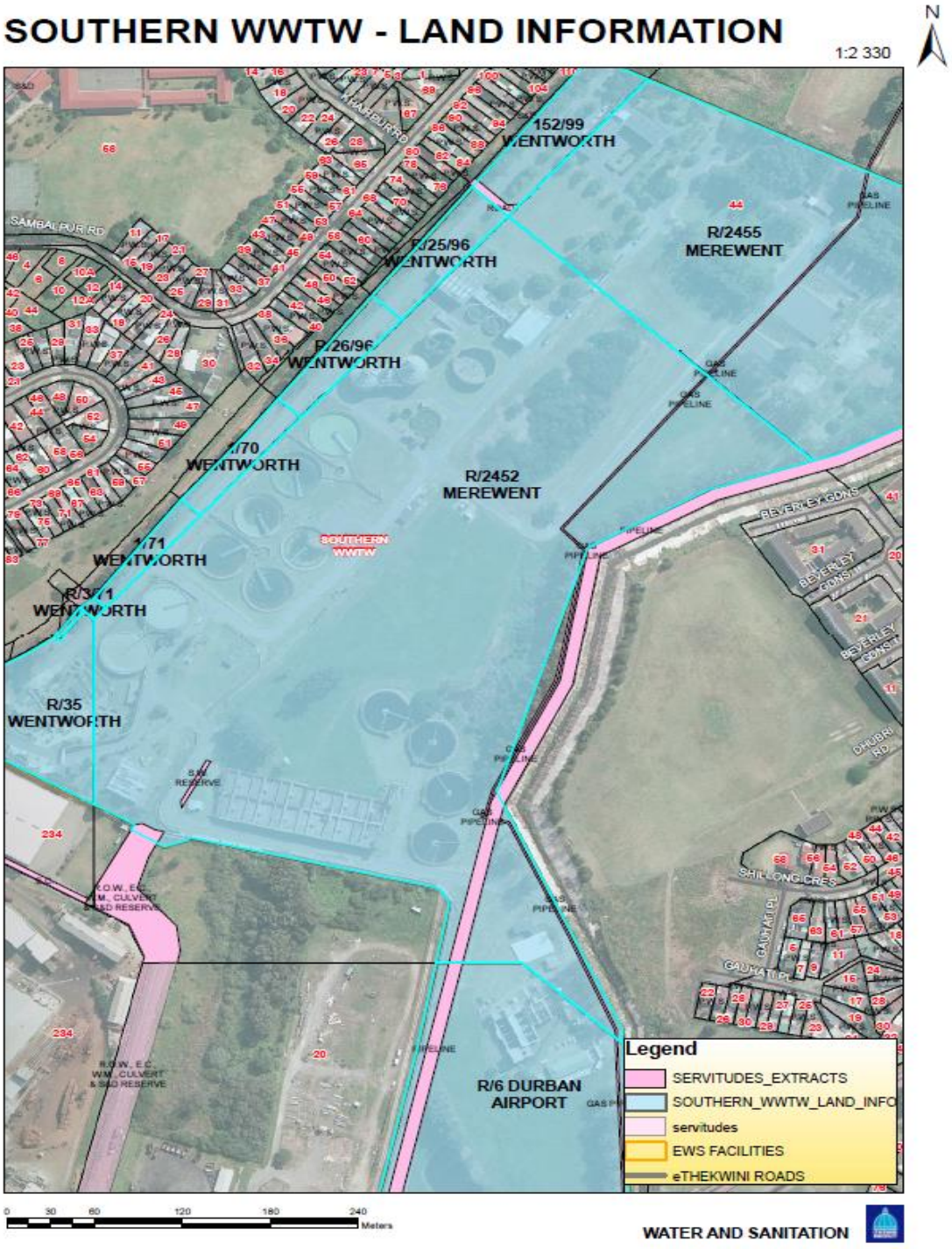

FIGURE 1-3: MAP SHEET INDICATING LOCAL LOCATION OF THE SWWTW

1.5 Purpose of IWWMP

An IWWMP considers the principles of integrated water resources management (IWRM) and is linked to the catchment management strategy or integrated water resources management strategy for the catchment under consideration. An IWWMP is therefore a simple, feasible, implementable plan for the envisaged activity; taking into account the National Water Resource Strategy (NWRS), the applicable Catchment Management Strategy (CMS) for the catchment in question, any established resource quality objectives (RQOs) and the sensitivity of the receiving water resource. It also considers up- and downstream cumulative impacts of the water use activities.

The plan is based on site specific actions that will be implemented over time, and is a living document that should be updated as the activities change.

The objectives of the IWWMP are therefore to:

- Manage the water and waste on site in support of integrated water resources management (IWRM) by:
  - identifying the potential pollution sources, and
  - setting appropriate and effective action plans for the control of these activities and associated impacts.

This IWWMP in summary presents:

- Water uses (existing lawful, previous, exemptions and general authorizations);
- Policies (safety, health, environment, water and waste);
- The environmental context (surface water, ground water, soil and land capability, climate and socio-economic environment);
- A characterization of activities (operations and methods; and waste management);
- Site characterization at facility level. The site was delineated into individual facilities for appropriate resolution on water and waste related management as well as for improved allocation of responsibility for the management of these aspects;
- Impact assessments (methodology, potential impacts and significance, risk to the environment);
- Matters requiring attention in respect of water and waste management in relation to surface water, process water, storm water, groundwater and waste;
- Performance objectives and associated measures (surface water, process water, storm water, groundwater and waste) for the attainment of the stated performance objectives;
- Environmental monitoring systems addressing process water, ground water, surface water, aquatic health, surface rehabilitation and waste, supported by data management and reporting;
- Continual improvement in terms of the above key themes forming the core of the IWWMP; and
- Operational management addressing the organizational structure, awareness training and communication on waste and water matters.

2 CONTEXTUALISATION OF ACTIVITY

2.1 Description of Activity

The SWWTW receives majority of its raw sewage effluent through three large (1,500 mm diameter) trunk sewers, i.e. the Main Southern Trunk Sewer (referred to as the Jacobs Trunk Sewer), the Wentworth Valley Trunk Sewer and the Umlaas Trunk Sewer. Other smaller diameter pipelines coming to this Works includes those from Mondi and SAPREF (each separately discharging at the inlet of this Works) and Illovo (discharging closer to the outlet of this Works). The total average daily flow to this works is in the region of 130 million litres per day and all the treated flows leaving this works is discharged directly to sea (by gravity and by pumping) through a 1,000 mm diameter, 4.2 km long sea outfall.

The Umlaas Trunk Sewer which serves the areas of Chatsworth and Umlazi discharges effluent to this Works that is predominantly domestic in origin. The discharged flow (currently in the region of 35 million litres per day) is immediately directed to a separate treatment facility where it undergoes preliminary, primary, secondary and tertiary treatment. The secondary and tertiary treatment processes are managed by a private entity (Veolia Water) who stores and sells the tertiary treated (or reclaimed) effluent to industry. All sludge generated from the treatment of this effluent is discharged to sea.

The Jacobs Trunk Sewer which serves the residential areas of Yellow Wood Park, Montclair and Woodlands and the industrial areas of Jacobs and Mobeni discharges sewage effluent that is a combination of domestic and industrial in origin. The Wentworth Valley Trunk Sewer which serves the areas of the Bluff, Wentworth, Clairwood, Bayhead and Island View discharges sewage effluent that is also a combination of domestic and industrial in

origin. The flows conveyed by these two trunk sewers (currently in the region of 95 million litres per day) combine at the main inlet works and undergo preliminary treatment only (i.e. removal of screenings and grit) before being discharged to sea.

In addition to the pipeline discharge of sewage effluent to this works, smaller volumes of effluent are also discharged by various road tankers. The effluent discharged by these road tankers also undergo preliminary treatment only before being discharged to sea.

Effluent contains a wide variety of pollutants and biological material capable of impairing the ecological configuration of the receiving environment which consequently compromises the health of humans that use or extract resources from that environment. With a significant proportion of treated wastewater being discharged into the sea, the need to ensure and maintain full compliance of chemical and biological parameters of the effluent with coastal discharge standards is of paramount importance.

Although the latest CSIR environmental report on the Durban sea outfall region (CSIR, 2014) shows that all indicators are within compliance/threshold limits or below method detection limit and possible impact of no immediate ecological effect, comparisons of certain indicators with earlier surveys however show a gradual increase in possible impact. Consequently, the eThekwini Municipality has proposed the upgrade of treatment facilities at the Southern WWTW. The proposed upgrade is to reduce the quantity of suspended solids being disposed of to sea by affording primary treatment to the combined effluent discharges from the Jacobs and Wentworth Valley Trunk Sewers. This physical treatment process (through primary settling) will result in the organic load to sea being drastically reduced. The settled solids (referred to as primary [or raw] sludge) will then be removed and stabilised through a process of anaerobic digestion, before being dewatered. According to the Scoping report (EWS, 2014: Appendix 2), the upgrade will be undertaken in 2 phases, with Phase 1 being the immediate upgrade and Phase 2 being the future upgrade. Table 2-1 provides a summary of the current situation of the SWWTW and the two phases of the proposed upgrade.

TABLE 2-1: DIFFERENT PHASES OF THE SWWTW FACILITIES UPGRADE

Phase	Description of facilities	Additional Remarks
Current Situation	*Refer to existing process flow diagram (Appendix 3)* • *Umlass effluent (35 Ml/d) to Recycling plant* • *All other effluent (95 Ml/d) to Sea Outfall* • *Existing AD plant: Decommissioned* • *Raw sludge + Secondary sludge to Sea Outfall*	Effluent from Jacobs and Wentworth trunk sewers (approx. 95 Ml/d) undergo preliminary treatment only (i.e. removal of screenings and grit) before being discharged to sea. Effluent from the Umlaas trunk sewer (approx. 35 Ml/d) undergoes preliminary, primary, secondary and tertiary treatment, before being sent to recycling plant.
Phase 1 Development	*Refer to process flow diagram (Appendix 4)* • *PST 5 & 6 to be commissioned* • *Two existing AD plants to be commissioned* • *PS from existing PST, PST 5 & 6 and two domestic PST sludge to be sent to AD plants* • *Secondary sludge to be sent to Sea Outfall* • *Two new AD plants to be built*	Upgrade will result in the primary treatment of approx. 60 Ml/d (or 63.5%) of the present combined flow (i.e. 95 Ml/d) being discharged from the Jacobs and Wentworth Valley Trunk Sewers. Sludge removed will then be combined with that currently being removed from the Umlaas effluent, currently 35Mℓ/d, before being pumped

		to the anaerobic digesters.
Phase 2 Development	*Refer to process flow diagram (Appendix 5)* • *PST Nos. 1-4 to be commissioned* • *Four new AD plants to be constructed* • *PS from PSTs 1-6 to be sent to AD plant*	

**PST – Primary Settling Tank*
** AD – Anaerobic Digester*

The options proposed for the disposal of the dewatered sludge are as follows:

- Removal off site to agriculture and/or landfill;
- Thermal drying using sludge gas and then removal off site to agriculture;
- If not thermal drying, sludge gas will be used for the generation of electricity in the region of 1MW, to be used internally on the plant; and
- Manufacture of fertilizer through a separate sludge pelletizing process using sludge gas to be established on site by a private entity (unconfirmed at this stage) and then removal off site. This option may be investigated under a separate study to be undertaken by others and does not form part of this study nor the scope of work described hereunder.

2.2 Key Related Processes and Products

2.2.1 Key refurbishment and construction activities

The aim of the proposed upgrade to the Southern WWTW is to reduce the quantity of industrial, raw sludge being disposed of through the sea outfall by developing sludge treatment infrastructure.

The following actions need to be taken as part of the upgrade:

Phase 1:

- Refurbish and bring back on line two out of six existing primary settling tanks.
- Refurbish and bring back on line existing two anaerobic primary digesters and secondary digester and construct two new primary digesters and one secondary digester, all of same capacity as existing.
- Refurbish and bring back on line existing raw sludge gravity thickener and construct a new gravity thickener of the same capacity.
- Refurbish and bring back on line existing gas holder and construct a new gas holder of the same capacity.
- Refurbish and bring back on line various existing (unused) electrical substation buildings and small pumping stations.
- Establishing a new mechanical sludge dewatering facility on site and 2 x 150,000 litres fully enclosed steel sludge storage silos.
- Provide additional effluent storage capacity of 23 million litres at existing low level pumping station and replace all old pumps with new pumps.
- Replace the last 70 m of the landline section of the sea outfall pipeline with new 2 x 1,000 m diameter pipe.

- Construct new road tanker effluent discharge bays in close proximity to the entrance of the Works.
- Install new medium voltage and low voltage electrical cables and equipment.
- Minor road works and a new access road.

Phase 2:

- Refurbish and bring back on line remaining four of the existing six primary settling tanks and construct two new primary settling tanks of the same capacity as existing.
- Construct additional anaerobic primary digesters and secondary digesters, all of the same capacity as existing.
- Construct a new raw sludge gravity thickener, of the same capacity as existing.
- Construct a new gas holder.
- Install additional mechanical sludge dewatering equipment.

2.2.2 Key stages, processes and products

A summary of the key stages and processes that will take place is presented in Table 2-2.

TABLE 2-2: KEY STAGES AND PROCESSES

Stages	Process Function	Waste Stream Generated	Waste Impact	Mitigation Measures
Preliminary Treatment	Removal of waste water constituents such as rags, sticks, grit, cans, etc which may result to maintenance and operational problems with the treatment operations, processes, and ancillary systems.	Detritus, screenings, etc.	1. Odour 2. Attraction of flies	Use of units such as manual or automatic screens, grit removable units, macerators, and grinders, etc. Solids will be captured in skips for disposal. Skips will be covered to minimize vector attraction. Screenings will be washed and dewatered to reduce odours.
Primary Settling Tanks (PST)	Assists in settling the solids in the waste water. Also involves the removal of a portion of suspended solids and organic matter from waste water.	Raw sludge	1. Odour 2. Acidification of sludge	Sludge may undergo thickening and thereafter sent to AD.
Sludge degritting	Ensures that fine grit is removed from the sludge up-front in order to prevent further problems in downstream processes such as the digestion system. Grit in digesters takes up valuable space and causes inefficient	Screenings, grit, sand	1. Odour 2. Attraction of flies	Adequate washing and classification of grit, and collection in skips for offsite disposal.

Stages	Process Function	Waste Stream Generated	Waste Impact	Mitigation Measures
	operation			
Sludge thickening	Reduces the sludge volume by removal of free sludge water, thereby promoting effective digestion. Also reduces capital and operational costs relating to the provision of sludge handling and treatment equipment	Sludge water - supernatant	1. Odour 2. Attraction of flies 3. Possible spillage if not properly managed	Regular monitoring of thickener overflows and efficient pumping to the HoW. Mechanical ventilation for odours
Anaerobic Digestion	Involves the breaking down of biodegradable material in the absence of oxygen phase	Primary Digested Sludge (PDS)	Sludge with high moisture content, high transportation costs	PDS may be dewatered, and may thereafter dried.
Dewatering	Reduces digested sludge volume and mass by removal of sludge water from interstices between sludge particles. Reduces disposal costs and increases the number of recycling options	Filtrate	1. Odour 2. Attraction of flies 3. Possible spillage if not properly managed	Regular monitoring Efficient pumping of filtrate to HoW

Table 2-3 presents the steps/processes involved in sludge processing.

TABLE 2-3: STEPS IN SLUDGE PROCESSING

Steps/Processes	Total Solids parameters
Primary Sedimentation	0.1% TS in
Raw Sludge Pumping Station	1% TS out
Raw Sludge Thickening	4% TS out
PS Digestion	3-4% TS
Secondary Digestion	3-4% TS
Sludge Dewatering	18-22% TS

Options proposed for the sludge disposal of the dewatered sludge include:

1. Removal off site to agriculture and/or landfill;
2. Thermal drying using sludge gas or pelletization and then application on land;

3. Fertilizer production to enhance productivity in the agricultural sector.

Treated effluent from the Umlaas trunk sewer is sent to the recycled water storage, while treated effluent from all other trunk sewers is discharged into the sea.

2.3 Activity Infrastructure Description

- Upgrade of primary settling tanks
- Upgrade of anaerobic digesters, secondary digesters and gas holders
- Construction of new anaerobic digesters
- Establishment of dewatering plant
- Dewatered sludge disposal facility
- Industrial effluent tanker reception bay
- Storage facilities
- Pump house (Raw and primary sludge)
- Gas pipelines (Biogas)
- Water and wastewater pipelines

2.4 Key Water Uses and Waste Streams

2.4.1 Water Uses

Water uses are defined by Section 21 of the National Water Act, 1998 (Act 36 of 1998). These water uses relate to the consumption of water, as well as activities which may affect water quality and the condition of the resource itself. They are as follows:

(a) taking water from a water resource;
(b) storing water;
(c) impeding or diverting the flow of water in a watercourse;
(d) engaging in a stream flow reduction activity contemplated in section 36;
(e) engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1);
(f) discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
(g) disposing of waste in a manner which may detrimentally impact on a water resource;
(h) disposing in any manner of water which contains waste from, or which has been heated in any industrial or power generation process;
(i) altering the bed, banks, course or characteristics of a watercourse;
(j) removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and
(k) using water for recreational purposes.

2.4.2 Waste Streams

The production waste streams comprise of effluent including sludge, all produced at various stages of the wastewater treatment process.

2.5 Organisation Structure of Activity/Company

The roles, responsibilities and authority of personnel at eThekwini Water and Sanitation will be assigned to facilitate effective environmental management. FIGURE 2-1 provides an overview of the Organisational structure that is in place for eThekwini Water and Sanitation. The organisation structure shows there are key departments under Deputy Head positions with key responsibilities for efficient treatment and disposal of wastewater. The operations department is responsible for day to day operational management and adherence to safety and to ensure that effluent discharge meets compliance requirements. The Technical department covering engineering

works together with operations to ensure sustainable technology selection and proper execution of infrastructure projects. The Manager: pollution and the environment has a particular mandate to ensure that all industry that discharges into the works conform to the trade effluent bylaw and there are routine monitoring and inspections by a team of inspectors.

2.6 Business and Corporate Policies related to the Environment

The eThekwini Municipality is committed to a business plan for the delivery of basic water and sanitation services in the eThekwini Municipal area (Appendix 6). The programme has been designed to provide an acceptable basic level of free potable water, an appropriate and sustainable sanitation service and health and hygiene education to those disadvantaged, predominantly rural and peri-urban communities, where a higher level of service is both unaffordable and inappropriate. The eThekwini Municipality also has an environmental management policy (Appendix 7), a water services development plan – WSDP (Appendix 8), and a water policy (Appendix 9). The environmental management policy is aimed at attaining sustainable development – optimising the developmental benefits gained from the environment through managing and protecting it effectively. WSDP deals specifically with the provision of services related to water and sanitation, and the associated plans and water monitoring strategies that will make it happen, while the water policy deals with water allocation and accountability.

The eThekwini Municipality is committed to an efficient trade effluent management system as provided in the sewage disposal by-law which states that, “No person shall discharge or cause or permit to be discharged into the sewage disposal system any trade effluent except with and in terms of the written permission of an authorised officer and in accordance the provisions of the law. Refer to chapter 4 of the sewage disposal by-law (Appendix 10) for details on the trade effluent management system.

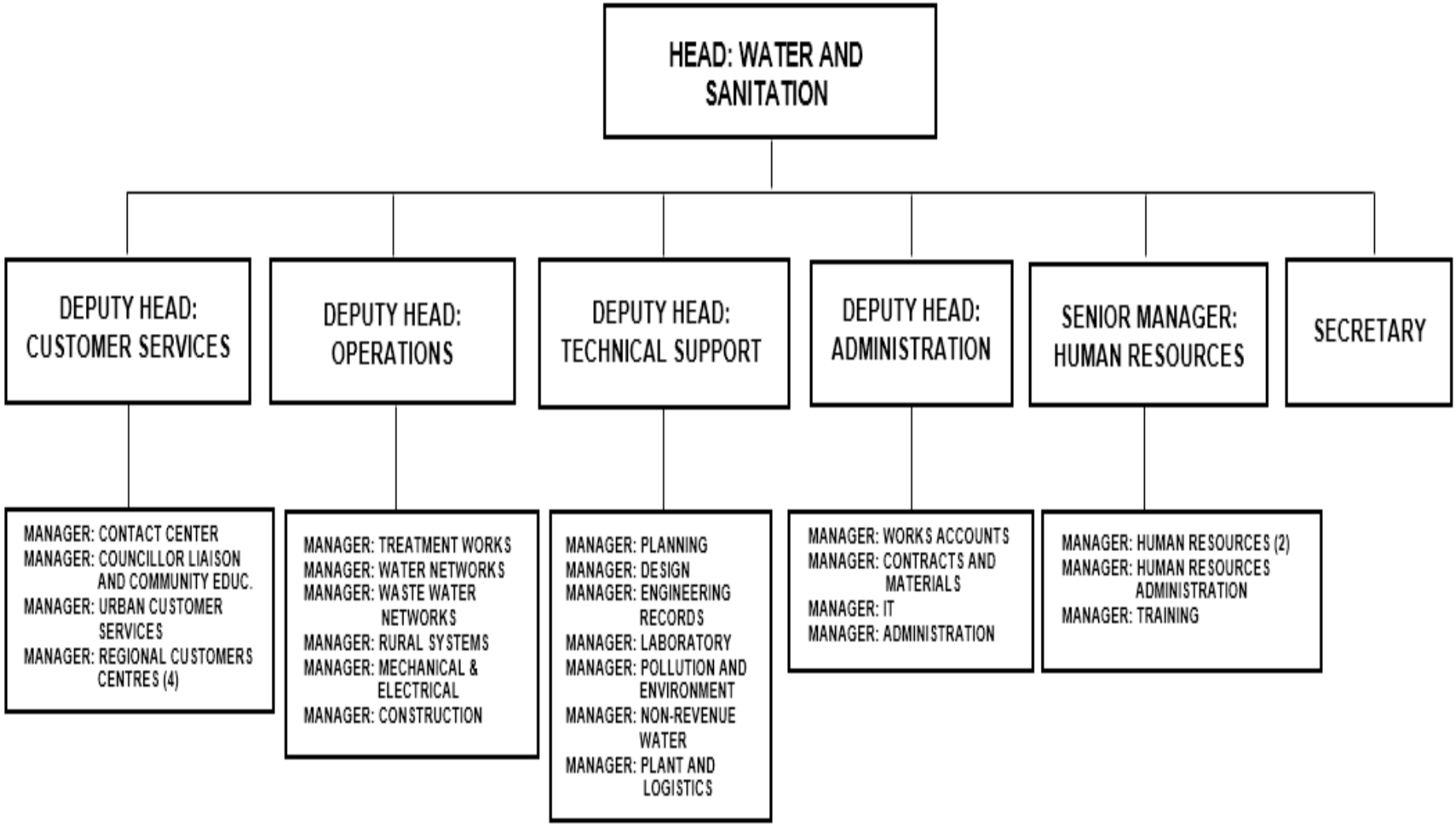

FIGURE 2-1: ORGANISATIONAL STRUCTURE

3 REGULATORY WATER AND WASTE MANAGEMENT FRAMEWORK

3.1 Summary of all Water Uses

Based on information that is currently available, the water uses associated with SWWTW have been identified, and are set out in Table 3-1 below.

TABLE 3-1: SWWTW LICENSED WATER USES

NWA Reference	Water Use	Properties in respect of which licence is issued	Description
Section 21 (h)	Disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process	Portion 6 of Durban Airport Erf 1426, Merewent Erf 2452 & 2455 Portion 152 of Wentworth Erf 99 Portion 1 & 3 of Wentworth Erf 71 Portion 25 & 26 of Wentworth Erf 96 Portion 1 of Wentworth Erf 70 Portion 3 of Wentworth Erf 19 and Wentworth	Discharge of treated effluent into the Stanvac Canal and to sea outfall. .

3.2 Existing Lawful Water Uses

3.2.1 The National Water Act (Act No. 36 of 1998) (as amended)

The SWWTW currently holds a Water Use Licence (Appendix 11). The licence is held in terms of Section 21 (h) of the Act, “for disposing in any manner of water containing waste from, or which has been heated in any industrial or power generation process.”

3.2.2 National Environmental Management: Integrated Coastal Management Act (Act No. 44 of 2008) (as amended)

In terms of the National Environmental Management: Integrated Coastal Management Act (Act No. 44 of 2008) (NEM:ICMA), anyone who wishes to discharge effluent into coastal waters must apply to the Department of environmental affairs (DEA) for a coastal waters discharge permit within 24 months of commencement of the NEM:ICMA. This is specifically if the discharge is in terms of an existing License or authorisation issued under the National Water Act (Act No. 36 of 1998) (NWA) – as is the case of the Southern Works sea outfall.

The SWWTW is required to remain compliant with the conditions of both the CWDP and the WUL as each fall within the jurisdiction of separate authorities, where the former is under the mandate of the DEA and the latter under the mandate of the DWA.

3.3 Relevant Exemptions

In terms of Section 22(1) of the NWA a person may only use water:

(a) without a licence -

i. if that water use is permissible under Schedule 1 of the NWA;

ii. if that water use is permissible as a continuation of an existing lawful use; or

iii. if that water use is permissible in terms of a general authorisation issued under Section 39.

(b) if the water use is authorised by a licence under the NWA; or

(c) if the responsible authority, namely the Chief Director: Regulation in DWA, has dispensed with a licence requirement.

Exemption has been granted to the eThekwini Municipality in terms of section 21 (4) of the Water Act, 1956 (Refer to Appendix 12) in respect of:

a.) The purification and treatment of water used for industrial purposes, including any effluent resulting from such use; and

b.) The disposal of the purified or treated water, including water recovered from any effluent.

3.4 Generally Authorised Water Uses

In terms of Section 22(1) of the NWA a person may use water without a licence if that water use is permissible in terms of a General Authorisation (GA) issued under Section 39 of the Act.

An assessment was done of the General Authorisations under the NWA, namely:

- General Authorisation No. 399, dated 26 March 2004 in terms of Sections 21 (a), (b), (e), (f) (g) and (h) water uses;
- General Authorisation No. 398, dated 26 March 2004 in terms of Section 21 (j) water use;
- General Authorisation No. 1199, dated 18 December 2009 in terms of Sections 21 (c) and (i) water uses; and
- General Authorisation No. 1198, dated 18 December 2009 in terms of Sections 21(c) and (i) for the purpose of rehabilitating a wetland for conservation purposes.

The conclusion was that there is no water uses associated with SWWTW that could be considered as General Authorisations.

3.5 New Water Uses to be Licensed

All the water uses associated with SWWTW are existing water uses, and therefore forms a part of the WUL submitted with this IWWMP. The water uses are set out in Table 3-1.

3.6 Waste Management Activities (NEMWA)

Waste is regulated under the National Environmental Management Waste Act, Act No. 59 of 2008 (NEMWA). NEMWA defines "waste" as the following: “any substance, whether or not that substance can be reduced, re-used, recycled and recovered:

(a) That is surplus, unwanted, rejected, discarded, abandoned or disposed of;
(b) That is surplus, unwanted, rejected, discarded, abandoned or disposed of;
(c) Which the generator has no further use of for (the purposes of production);
(d) That must be treated or disposed of; or
(e) That is identified as a waste by the Minister by notice in the Gazette, and includes waste generated by the mining, medical or other sector, but
    (i) A by-product is not considered waste; and
    (ii) Any portion of waste, once re-used, recycled and recovered, ceases to be waste;”

However, NEMWA does not apply to the following:

- Radioactive waste that is regulated by the Hazardous Substances Act. 1973 (Act No. 15 of 1973), the National Nuclear Regulatory Act, 1999 (Act No. 47 of 1999), and the Nuclear Energy Act, 1999 (Act No. 46 of 1999);
- Residue deposits and residue stockpiles that are regulated under the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002). Therefore the Waste Act is not applicable to the stockpiles;
- The disposal of explosives that is regulated by the Explosives Act, 2003 (Act No. 15 of 2003); or
- The disposal of animal carcasses that is regulated by the Animal Health Act, 2002 (Act No. 7 of 2002).

It is anticipated that the NEMWA waste that will be generated during the planned life of the SWWTW will include both domestic and hazardous waste.

All general household waste, garden / organic waste and salvageable items will be regarded as general waste. It is important to ensure that all hydrocarbons (e.g. used oil, diesel spillage), empty chemical containers, and oil-contaminated soil regarded as hazardous waste be recycled, reused, treated or disposed.

3.7 Waste Related Authorisations

As indicated in section 3.2 above, the SWWTW, holds both a WUL and CWDP which allows for disposal of treated effluent to sea and also its supply to industries for reuse. Domestic waste generated on-site will be transported for disposal at their registered disposal site.

3.8 Other Authorisations and Regulations

The eThekwini Municipality has been granted the following authorisations for the upgrade of facilities at the SWWTW:

- The process of submitting the Final Environmental Scoping Report & Plan of Study for EIA in support of the Environmental Impact Assessment and Waste Management Licence Application for the proposed Solids Removal and Treatment Facilities Upgrade at the SWWTW, Merewent, KwaZulu-Natal to the DEA for approval is on and is currently being finalized and in application phase.

4 PRESENT ENVIRONMENTAL SITUATION

4.1 Climate

4.1.1 Temperature and Humidity

The study area is characterised by daily average summer temperatures that ranged between 22.5 – 25.1ºC. Average winter temperatures ranged between 16.8 – 20.0ºC. Relative Humidity for the January 2009 – December 2013 monitoring period was highest during the summer months of December, January and February and lowest during the winter months. Figure 4-1 illustrates the average monthly temperature and relative humidity for the January 2008 – December 2013 monitoring period.

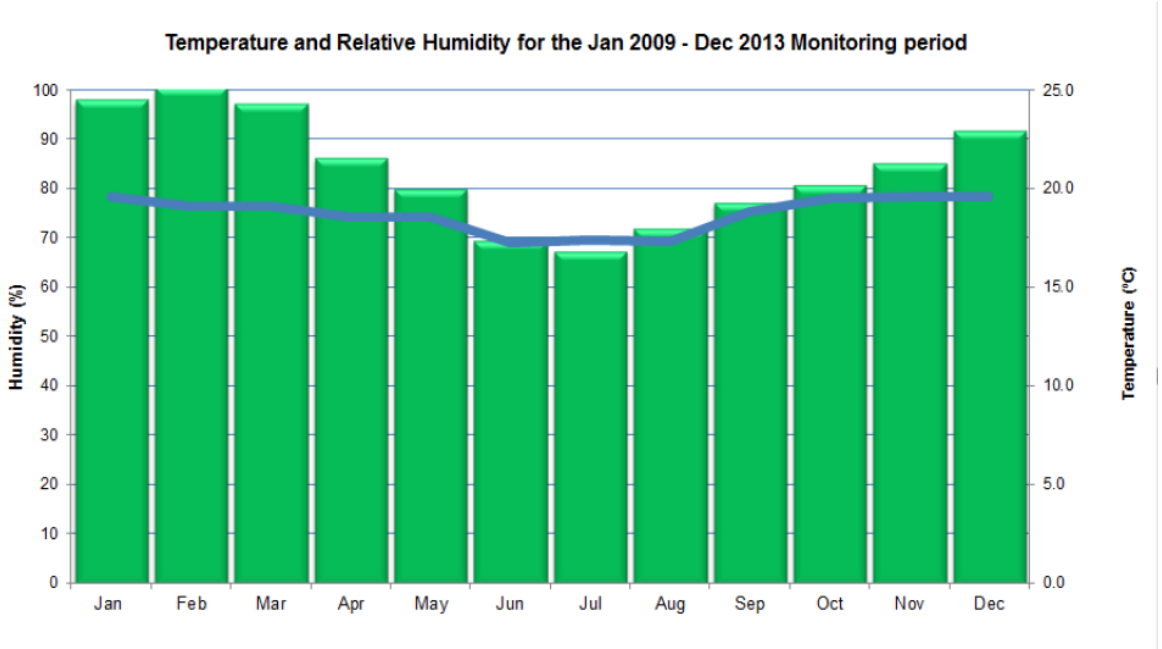

FIGURE 4-1: AVERAGE TEMPERATURE AND RELATIVE HUMIDITY FOR THE JAN 2009 – DEC 2013 MONITORING PERIOD[1]

[1] **EWS 2014**

4.1.2 Wind

According to the Environmental Scoping report, the wind rose profile (Figure 4-2) indicates that the predominant wind direction for the area under review occurs mainly from the north eastern and south western regions. Secondary winds were noted from the north western and south eastern quadrants. Figure 4-3 illustrates the wind class frequency distribution for the 2009 -2013 monitoring period. No calm winds were experienced during the monitoring period. 27.8% of the total wind speeds experienced fell within the 3.6 – 5.7 m/s wind class, while 26.7 % of the total wind speeds fell within the 2.1 – 3.6 m/s wind class. Under stable, low wind conditions, odour impact can be acute particularly from the increased exposure of the PSTs and thickener units. This can have a local social impact.

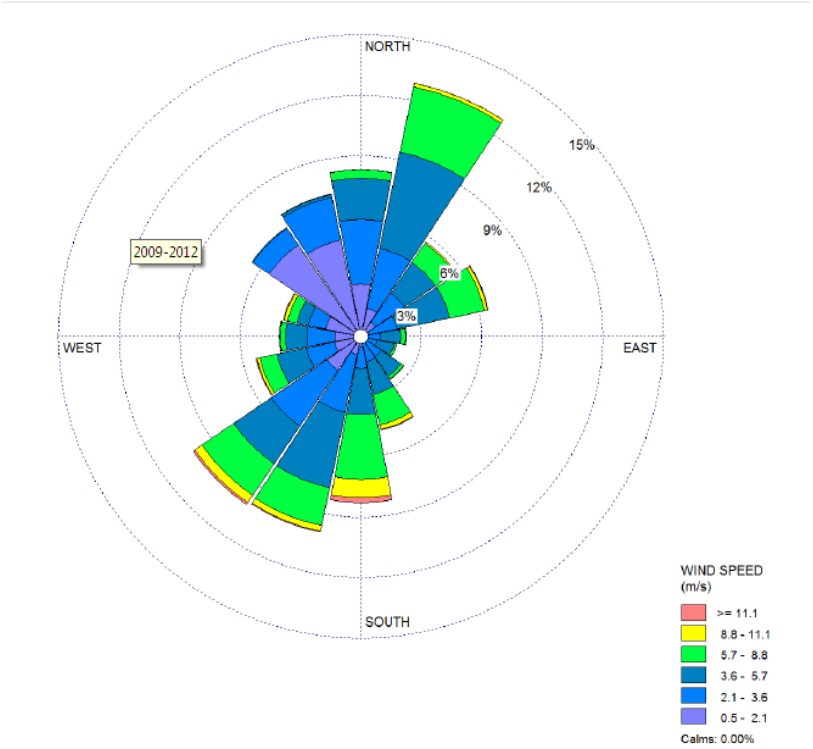

FIGURE 4-2: PERIODIC WIND ROSE FOR THE JAN 2009 – DEC 2013 MONITORING PERIOD[2]

[2] **EWS 2014**

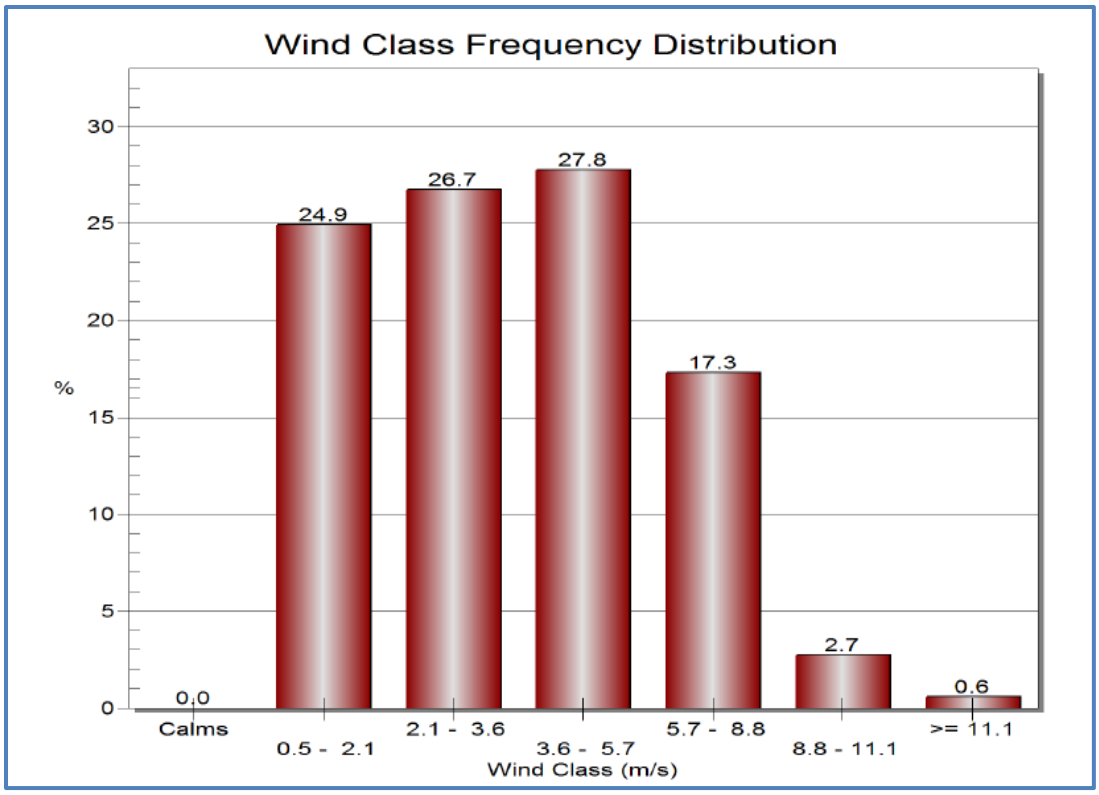

FIGURE 4-3: WIND CLASS FREQUENCY DISTRIBUTION[3]

4.1.3 Rainfall

Figure 4-4 presents a summary of the total rainfall profile for the January 2009 – December 2013 monitoring period. The spring and summer months recorded the highest rainfall with 242.26 mm and 250.76mm respectively. The winter months recorded the lowest average of precipitation with 92.24mm.

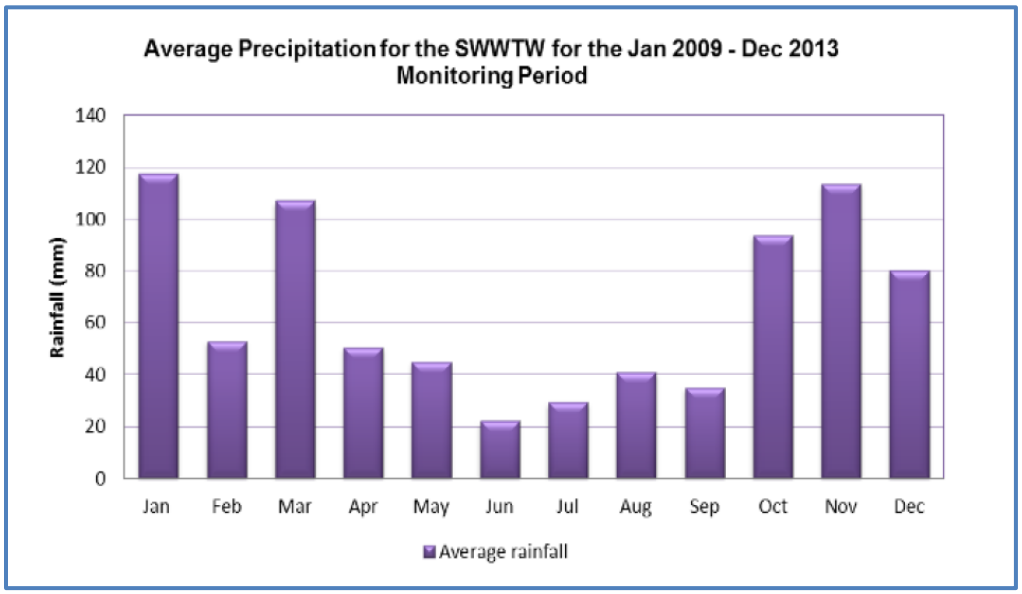

FIGURE 4-4: AVERAGE RAINFALL FOR THE JAN 2009 – DEC 2013 MONITORING PERIOD FOR THE SWWTW[4]

[3] **EWS 2014**

[4] **EWS 2014**

4.2 Surface Water

4.2.1 Water Management Area and Surface Hydrology

The SWWTW falls within the Mvoti-to-Mzimkhulu Water Management Area (WMA 11) (Figure 4-5), and the activity located in the U6 catchment. As indicated in the scoping report, the SWWTW is located within the 1:100 year floodline. This indicates that the SWWTW area is not prone to the occurrence of flood and that in the event of such, enough dilution of the effluent will take place which will drastically reduce the concentration of the effluent and thus, reducing possible contamination risks.

The works is connected either directly or indirectly to a number of surface water bodies which may require the adoption of water management measures. As shown in FIGURE 4-6, surface water bodies connected to the SWWTW include:

i. The Umlazi River
ii. The Umgeni Catchment
iii. Canals (carrying stormwater)
iv. The Coastal Zone (Sea)

FIGURE 4-5: MAP SHOWING THE MVOTI-TO-MZINKHULU WATER MANAGEMENT AREA

The SWWTW receives some of its raw sewage effluent from the Umgeni and Umlazi Catchment areas which comprise of the Umgeni and Umlazi River respectively. Although these rivers are not directly linked to the SWWTW, activities carried out within these catchments could influence the operation of the SWWTW. The eThekwini Municipality river quality reports (www.durban.gov.za) for the summer and winter periods of 2013 and 2014 indicate that the Umlazi River is of poor water quality and degraded (Refer to Appendix 13). On the other hand, the water quality of the Umgeni River can be considered to be relatively acceptable.

Proper monitoring must be done regarding overflow from the tertiary treatment of effluent to Stanvac canal. To minimize the risk of contamination associated with the discharge to the canal, analysis of water quality parameters must be frequently taken, and results found to be consistently poor should be investigated so as to determine the underlying factor and root cause of such exceedances.

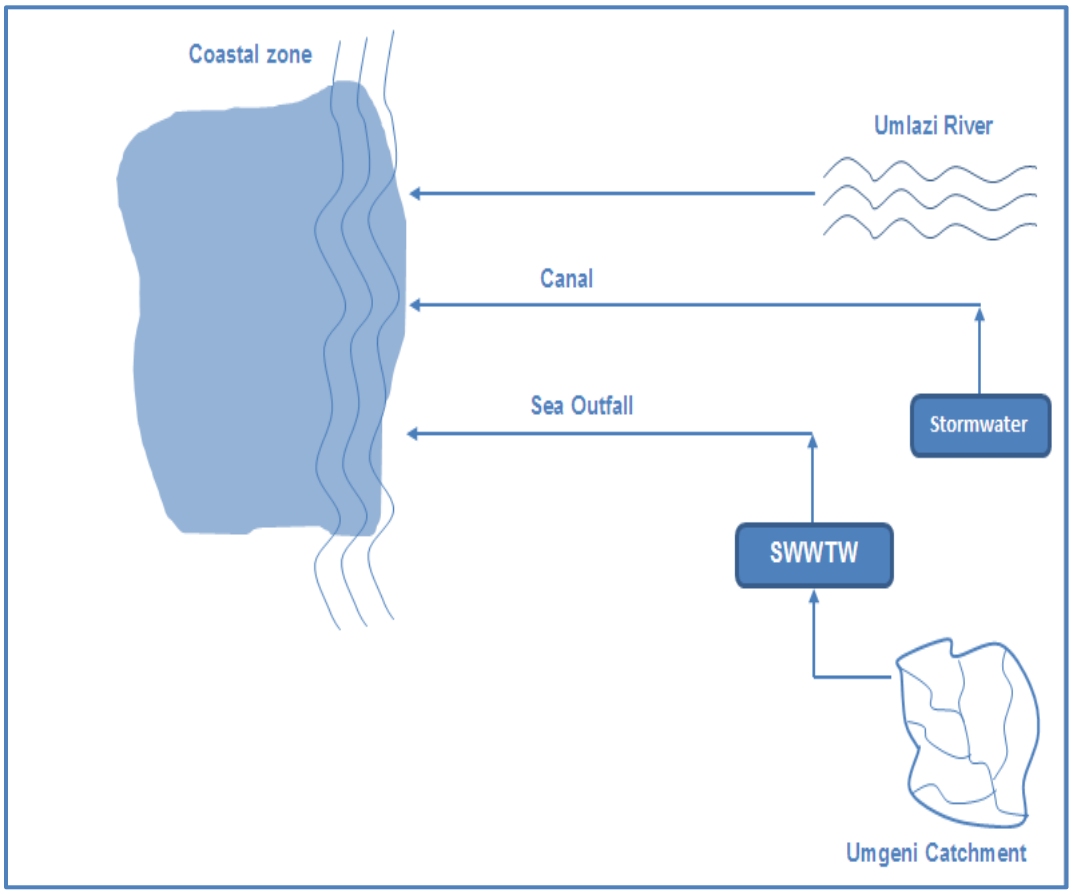

FIGURE 4-6: SURFACE WATER BODIES WITHIN THE SWWTW AREA

4.2.2 Surface Water Quality

In 2013, CSIR undertook the surface water quality assessment study under the Durban outfalls monitoring programme and this is included in the report "Sea disposal of sewage: Environmental Surveys in the Durban outfalls region)". See Appendix 14 for a detailed report.

4.2.3 Monitoring Points

THE CSIR ASSESSMENT (CSIR 2014) ENTAILED SAMPLING OF FINAL EFFLUENT FROM THE CENTRAL WORKS AND SOUTHERN WORKS WASTEWATER TREATMENT FACILITIES. WATER SAMPLES WERE COLLECTED FROM THE SURFACE, MIDDLE AND BOTTOM OF THE WATER COLUMN AT THE MARGIN OF THE ZONE OF DILUTION FOR THE TWO WORKS. THE SAMPLING DESIGN WAS CHARACTERISED BY SINGLE STATIONS AND REFERENCE SITES; BOTH SELECTED IN A REGION SITUATED BETWEEN 2000 M TO 6000 M TO THE NORTHEAST AND SOUTHWEST OF THE OUTFALL DIFFUSERS. THE SWWTW OUTFALL HAD TWO SINGLE STATIONS (SW2 AND SW5) AND FIVE REFERENCE POINTS (SS1, SS2, SN1, SN2, SN3), WHILE THE CENTRAL WORKS HAD TWO SINGLE STATIONS (CW2 AND CW5) AND FOUR REFERENCE POINTS (CN1, CS1, CS2 AND CS3). THE ZONE OF INITIAL DILUTION TAKEN FOR THE CENTRAL WORKS AND SWWTW WAS ABOUT 144 M AND 177 M RESPECTIVELY. FIGURE 4-7 PRESENTS A MAP SHOWING THE MONITORING POSITIONS, WHILE

Table 4-1 shows the variables measured in situ and in water samples collected

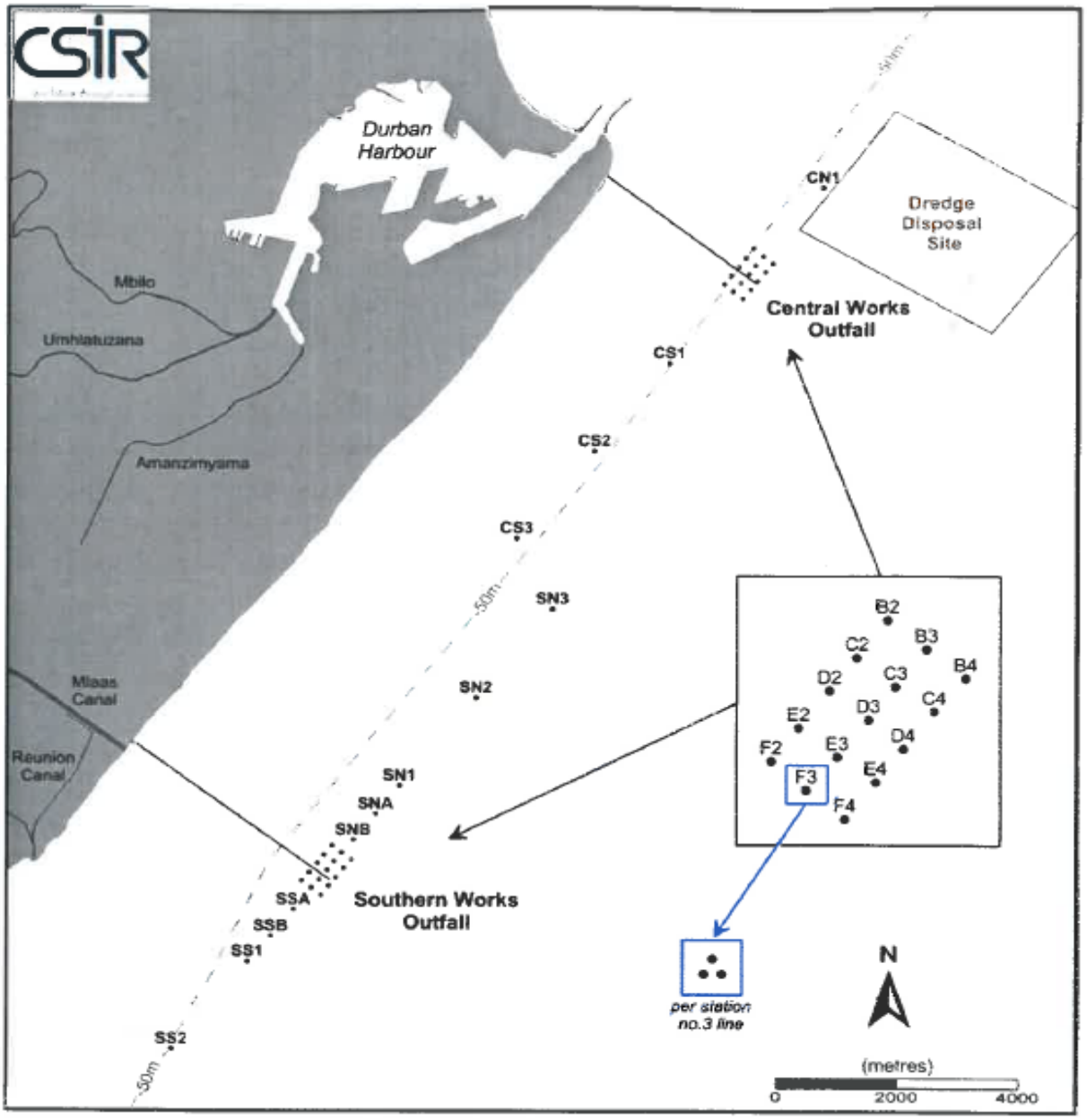

FIGURE 4-7: MAP ILLUSTRATING THE SAMPLING DESIGN FOR THE WATER QUALITY COMPONMENT OF THE 2013 SURVEY OF THE DURBAN OUTFALLS MONITORING PROGRAMME[5]

[5] **CSIR 2014**

TABLE 4-1: WATER QUALITY VARIABLES MEASURED IN SITU AND IN WATER SAMPLES FOR THE 2013 SURVEY OF THE DURBAN OUTFALLS MONITORING PROGRAMME[6]

Class	Variable (*in situ*)	Class	Variable (water sample)	Class	Variable (water sample)
Conventional	Temperature	*Conventional*	Total suspended solids	*Toxicity testing*	Sea urchin fertilization
	Salinity				
	pH	*Nutrients*	Ammonia	*Metals*	Arsenic
	Dissolved oxygen		Nitrite		Cadmium
	Turbidity		Nitrate+Nitrite		Copper
	Chlorophll-a		Orthophosphate		Chromium
			Silica		Manganese
					Mercury
		Bacteria	Faecal coliforms		Nickel
			Faecal streptococci		Lead
					Zinc

Some of the results recorded from the CSIR water quality monitoring of the SWWTW outfall are summarised hereunder.

1. Values and concentrations of the majority of physical and chemical variables were found to be compliant with the South African Water Quality Guidelines for Coastal Marine Waters (Natural Environment) (DWAF 1995.)
2. Non-compliances in pH, DO and zinc were observed at some of the sites.
3. The zinc concentration in the bottom water at one of the sites (SW5) was found to be substantially higher than concentrations at other sites, and exceeded the water quality guideline of 25 $mg.l^{-1}$.
4. Analysis of benthic macrofaunal community structure and composition provided clear evidence that the sea bed near the SWWTW outfall is enriched with particulate organic matter, characterised by lower diversity and large quantity of opportunist, pollution tolerant organisms. The chemical oxygen demand, manganese and zinc were found to be the most influential in driving biological variability at the SWWTW outfall sites.

Graphical representations of the concentrations of some variables are presented in the Appendix 15.

Table 4-2 presents an analysis of key operation data collected across different stages of wastewater treatment at the SWWTW. The COD levels, suspended solids and total solids of effluent discharged as sea outfall can be observed to be higher when compared to that of other effluent sources. The high sea outfall concentrations may be as a result of the combination of effluent from other sources resulting to a bulk increase in concentration of the SWWTW sea outfall.

TABLE 4-2: AVERAGE CONCENTRATIONS OF KEY WASTEWATER PARAMETERS AT DIFFERENT EFFLUENT SOURCES AND RECEIVING ENVIRONMENT IN 2010

Water Parameters	Raw Sewage - Chartsworth	Primary Effluent - Chartsworth	Effluent - Badulla Drive	Effluent - Jacobs Drive	Discharge - Sea Outfall
COD (mg/l)	691.10	418.35	770.98	1025.06	7011.05
pH	7.36	7.11	6.94	6.68	5.80
Settleable solids (ml/l)	15.44	1.98	17.09	32.30	23.51
Suspended solids (mg/l)	348.43	112.90	327.08	569.45	880.64
Total solids (mg/l)	985.37	714.44	1089.90	1149.55	7503.81
Zinc (µg/l)	N/A	N/A	24.46	48.28	11.17

[6] **CSIR 2014**

In summary, the impacts during the upgrade and operation of facilities are likely to be:

- Run-off from dirty areas;
- Discharge of treated effluent from the wastewater treatment works;
- Leaks from pipelines or seepage from stationary facilities such as tanker bay and low level sump
- Overflow from contaminated water bodies (dams, rivers, canals etc)
- A reduced impact on marine life due to decreased suspended solids disposed to sea.

4.2.4 Receiving Water Quality Objectives and Reserve

Interim Receiving Water Quality Objectives (RWQOs) for the SWWTW in line with the South African water quality guidelines for coastal marine waters developed by the Department of Water Affairs and Forestry in 1995. The RWQO were developed to ensure that the water quality of water resources remains fit for recognised uses and that the viability of aquatic ecosystems is maintained and protected. Appendix 16 outlines the river water quality objectives for coastal marine waters.

Table 4-3 presents averages of key constituents of effluent discharged into the sea from the SWWTW

TABLE 4-3: COMPARISON OF KEY CONSTITUENTS OF EFFLUENT DISCHARGED INTO THE SEA FROM THE SWWTW WITH RWQOS IN YEARS 2009 AND 2010

Discharge to Sea	Averages	
	2009	2010
Ammonia (free) (mg/l N)	23.15	24.32
Arsenic (ug/l)	22.11	NA[7]
Cadmium (ug/l)	5.08	0.83
Chrome (ug/l)	30.67	3.96
Copper (ug/l)	85.98	2.38
Lead (ug/l)	12.42	0.83
Mercury (ug/l)	0.29	0.00
Nickel (ug/l)	57.54	3.00
pH	5.78	5.80
Zinc (ug/l)	348.42	11.17

Legend

Compliant	
Not compliant	

4.3 Wetlands Assessment Study

As reported in the scoping report, a wetland exists around the northern portion of the study area; bordering the boundary fence (Refer to Appendix 2). At the edge of the wetland within the SWWTW is a large, mature Erythrina caffra (Coast Coral-tree). The wetland falls outside the footprint of the works, thus the proposed development will have no significant impact of on it.

[7] **Not Available**

4.4 Groundwater

The SWWTW facility upgrade will have all its systems fully enclosed to mitigate the risk of groundwater pollution. Excess flow will be contained and reticulated to sea through overflow channels.

4.5 Geotechnical Study

AECOM (Pty) Ltd was appointed by eThekwini Municipality to conduct a geotechnical investigation to determine the subsoil conditions for the proposed developments at the SWWTW (Appendix 17). The geotechnical investigation is aimed at identifying the geotechnical and geological conditions within the SWWTW area and at the sewer outfall site, highlighting any geotechnical constraints for the construction of the proposed structures.Table 4-4 summarizes the depths at which groundwater was encountered for each proposed facility.

TABLE 4-4: DEPTHS AT WHICH GROUNDWATER WAS ENCOUNTERED FOR EACH PROPOSED FACILTIY

Proposed facility	Depths at which groundwater was encountered
Tanker Bay Facility	1.7m - 2.6m in all four boreholes drilled
Sludge Drying Facility and Silos	1.0m (rest level in BH04) - 2.2m.
Primary Digesters (PD), Secondary Digester (SD), Thickener (TH), Gas Holder (GH), Mixing Building and Boiler House (M&B)	1.0m - 2.6m.
Low level Sump	1.5m - 3.0m.
Sewer Outfall Pipeline	Rest level in the borehole was at 3.2m.

4.5.1 Potential Pollution Source Identification

Groundwater is at risk of being polluted. Contamination of groundwater is majorly due to spillage, leakage, incorrect storage and handling of chemicals, oils, lubricants, fuel and other hazardous materials.

Table 4-5 provides a summary of sources and nature of groundwater pollution with corresponding mitigation measures.

TABLE 4-5: POTENTIAL GROUNDWATER POLLUTION POINTS AND MITIGATION MEASURES

Source and nature of Pollution	Mitigation measures proposed
Leachate discharging from stationary effluent leaking from treatment plants.	Ongoing and routine monitoring and reporting
Oil spillage at the tanker bay facility and seepage from low level sump	Ongoing and routine monitoring and reporting; Routine inspection, Tanker bay must be sloped and allowed to drain into the tanker discharge sump and thereafter pumped to the head of works for treatment.
Mixture of effluent and stormwater as a result of thickener overflow, secondary digester supernatant liquor, sludge grit washer/classifier overflow and filtrate	Routine inspection, construct away from water courses and sensitive areas. Setup a new SNL pump station from which effluent is pumped into the effluent channel

The causes of groundwater contamination as highlighted in Mema (2004) are majorly due to design weaknesses, overloaded capacity, residual leaks from valves and flanges as well as equipment failure.

5 ANALYSES AND CHARACTRISATION OF ACTIVITY

5.1 Site Delineation for Characterisation

- Wastewater Treatment and Surface Plant Infrastructure
- Network of water, wastewater and biogas pipelines
- Remainder of the area

5.2 Water and Waste Management

5.2.1 Process water

The treated wastewater recovered from the Umlass Trunk Sewer in the SWWTW is pumped into a recycled water storage which thereafter serves as a source of water for industries for cleaning/washing purposes. The raw wastewater from the Umlass Trunk Sewer is subjected to preliminary, primary, secondary and tertiary treatment before storage for reuse.

The raw wastewater will be treated to a quality suitable to either:

- Support cleaning and washing activities
- Inject the water for cooling of production systems/machinery

5.2.2 Water balance

Figure 5-1 presents the water balance of the SWWTW in relation to the proposed upgarde, and a summary of activities and quantity of flows within the works, targeted at achieving proper water accountability.

5.2.3 Storm Water (Clean and Dirty Water Management)

The SWWTW storm water management system is in place and fully developed (Refer to Appendix 18 for as-built drawings of existing storm water infrastructure). All possibly contaminated areas are bunded and collected drainage would be fed into the effluent channels onsite. Stormwater from roads, paved areas and building roofs are collected in a dedicated stormwater reticulation network. The storm water collected via the reticulation is fed into a box channel that runs parallel to the Stanvac channel to discharge on the shoreline. There are existing overflows from the effluent stream into the stormwater system via the overflow weirs at the low level storage dam. As part of the upgrade, the flow rate of the pumps will be increased, as well as the storage capacity in order to prevent the usage of these overflows. The area in which the tankers will park whilst discharging is sloped and drains into a dedicated system that drains into the tanker discharge sump which is then pumped to the head of works for treatment.

The need to determine the flow of effluent drained from detritus and screenings is also of importance to prevent mixture with stormwater. On the existing works, drainage from screenings washer/compactor is fed back into the channel. In the new works, the thickener overflow, secondary digester supernatant liquor, sludge grit washer/classifier overflow and filtrate are all collected in the new SNL pump station which is pumped into the effluent channel. No process stream will be diverted into the stormwater system.

Presently, AECOM is in the process of compiling a storm water management report on behalf of the eThekwini Municipality for the upgrade of facilities at the SWWTW (email correspondence 23 January 2015). Report to be forwarded to the department once it is complete.

5.2.4 Waste

Waste management at the SWWTW subscribes to the principles of sustainable waste management. This includes:

- Waste prevention - the prevention and avoidance of the production of waste at source;
- Waste reduction - the reduction of the volume or hazardous nature of the waste during production;
- Resource recovery - recycling or re-use of the waste;

- Waste treatment - the treatment of waste to reduce volume or risk to human and environmental safety and health to reduce the degree of hazard when waste is disposed of in a landfill or discharged into a water source; and
- Waste disposal - the environmentally acceptable and safe disposal or discharge of waste, (e.g. encapsulation, incineration, landfill or discharge to a water source).

5.2.5 Domestic waste

Domestic waste will include general office waste such as paper and other degradable materials. In line with current practice, waste will be removed from the SWWTW site and collected for disposal by DSW - Durban Solid Waste (the cleansing and waste unit of eThekwini Municipality) to the Shongweni Landfill site. The disposal trucks will be monitored through proper recording of weigh bill numbers and use of tracking systems.

5.2.6 Hazardous waste

Raw wastewater from the supplying trunk sewers will undergo various stages of treatment and thereafter discharged to the sea or stored for reuse as the case applies. Presently at the works, measures such as immediate clean-up and safe disposal are in place to minimize contamination from hydrocarbons (e.g. used oil, diesel spillage), empty chemical containers, and oil-contaminated soil. The SWWTW remain dedicated to the adoption of these measures.

5.3 Operational Management

5.3.1 Organizational structure

The organizational structure for SWWTW is set out in Appendix 19, and the responsibility of each member of staff is summarized below.

1. **Superintendent**

- Plans, directs, controls and supervises general operation and maintenance of the water treatment plant.
- Conducts frequent and periodic inspections of plant to detect malfunctions, initiates corrective action.
- Establishes operational schedules, ensures that building, grounds and equipment are operating properly.
- Formulates process control strategies
- Reviews records, reports, and related documentation.
- Coordinates and supervises the operations for facilities and structures under charge to ensure compliance with regulatory permitting standards.
- Reviews plans for plant upgrades, meets with consultants and contractors.

2. **Maintenance (Electromechanical)**

- Ensures that all electromechanical facilities such as water towers, reservoirs and pump stations are regularly maintained and in good working condition.
- Provides procurement advice and support
- Liaise with process controller and process engineer regarding processes or facilities that require upgrade or repairs.

3. **Process controller (Senior operator and operators)**

- Plans work schedule in conjunction with the Superintendent
- Ensures cleaning of grit canals, process changes to aerators, timeous removal of sludge, cleansing of area, changing of chlorine gas cylinders;
- Ensure timeous execution of duties;
- Ensure timeous execution of preventative maintenance;
- Ensure correct functioning of processes;

- Conducts analytical and chemical analysis to ensure process quality;
- Administrative duties, including monthly reports and timesheets;
- Daily maintenance inspections and changes to work schedule as needed.

4. Process Engineer

- Implement process operations in conformity with process designs;
- Conducts testing & evaluation of plant erections & installations;
- Provides procurement support;
- Conducts verification of mechanical & electrical installation against contractual & process design documentation, supplier documentation & site conditions;
- Managing & dealing with non-compliance issues & proposing preventative & corrective measures.

5. Works Area Manager

- Manage Wastewater Treatment Processes in compliance with the requirements;
- Directed personnel by developing Safe Operating Procedures, Process Control Plans and Operational Plans and monitor staff and unit operations performance against these plans;
- Optimization of process units;
- Compile wastewater risk abatement plans in order to identify key risks and recommend mitigation measures;
- Prepare and monitor capital and operating budgets;
- Prepare and submit reports covering process, health, safety, staff, mechanical, electrical, and finance;
- Initiate and chair disciplinary enquiries and deal with staff grievances;

5.3.2 Resources and competencies

The EWS has competent coordinator – Process Engineer, who will be responsible for the environmental management on site at SWWTW.

5.3.3 Internal and external communications

EWS initiates numerous activities to engage stakeholders at a national level, including the following:

- Stakeholder day for external stakeholders;
- One-on-one meetings with specific stakeholders on pertinent issues; and
- EWS annual report is made available to the public and covers progress in all areas of sustainability for the preceding year. The yearly study of sea outfall has been taken place for the last 40 years.

A robust stakeholder engagement is in place with respect to responsible handling/disposal of sewage to sea. Some of the questions raised by stakeholders during the latest stakeholder meetings are summarized below:

- How far do impacts extend from the outfalls?

From the results of the CSIR sea outfall survey, most of the indicators show that adverse impacts attributable to effluent discharge extends across the entire grid of sites spanning the diffuser section of the SWWTW outfalls. However, using the existing sampling design, it may be impossible to identify the precise spatial extent of adverse impacts on the seabed environment. A modification in sampling design may be necessary in the future.

- Why do seabed impacts differ between outfalls?

Going by the results of the CSIR monitoring programme, it is evident that the frequency, spatial extent and magnitude of effluent discharge induced impacts in the seabed environment around the SWWTW outfall were greater than at the Central Works. Although there are currently no supporting scientific data to provide a definitive answer in this regard, the difference has been indirectly linked to larger volume of effluent, high load contaminants and particulate organic matter in effluent discharge through the SWWTW outfall.

- Should Durban outfalls monitoring programme consider farfield effects at a greater spatial scale?

Some stakeholders have rightly asked whether the Durban outfall monitoring programme should extend beyond the study area. Stakeholders opined that accumulation of contaminants at high concentration is probable at regions beyond the study area. An investigation on the status on the receiving environment beyond the study area was recommended and is seen as critical reducing or mitigating the risks associated to ecological and human health.

5.3.4 Awareness training

All employees of SWWTW have to undergo environmental awareness and training as set out in terms of the Safety, Health, Environment and Quality Policy.

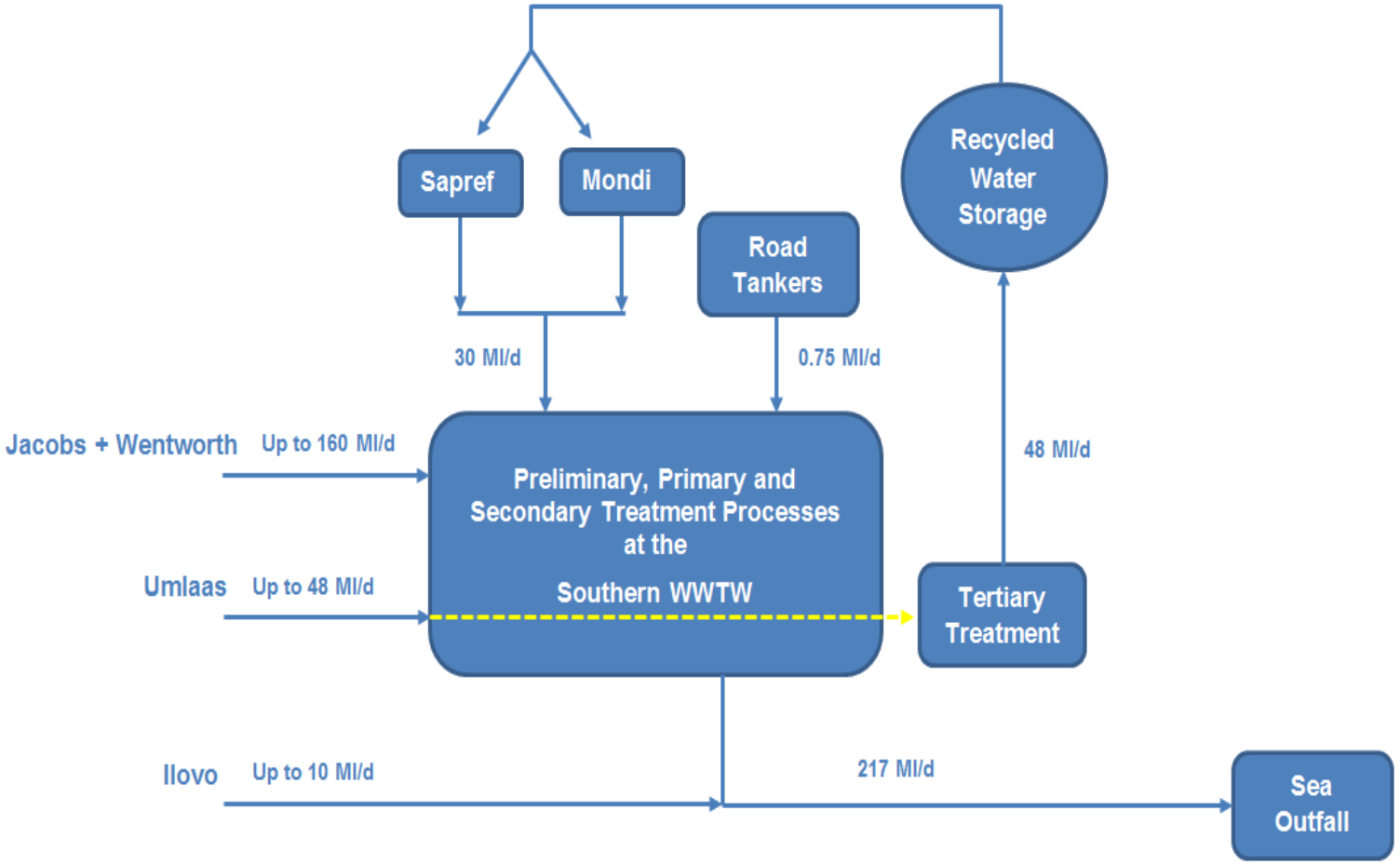

FIGURE 5-1: WATER BALANCE

5.4 Monitoring and Control

The following strategies shall be pursued under monitoring and control:

- Monitoring of change in baseline (environment) information which will include an ecosystem survey (ESS) to monitor health of ecological systems. A sea outfall survey is conducted by CSIR on annual basis to which entails sampling of final effluent from wastewater treatment facilities which includes the Southern Works. Results of the survey will be obtained and interpreted to appraise the impacts of the facilities upgrade.

5.5 Risk Assessment /Best Practice assessment

TABLE 5-1: IMPACT ASSESSMENT FOR DIFFRENT PROJECT PHASES

Risk Identified	Probability of occurrence Improbable Probable Highly probable Definite	Consequence of the impact: Nature Extent Duration Intensity	Significance ranking: Low Medium High	Management/mitigation measures
Construction Stage				
Contamination of surface during drilling with machine oils	Probable	Local short term contamination of soils and groundwater;	Low	Avoid drilling in riverine areas, Follow drilling establishment and operational protocol, Training of all staff in spill prevention and cleanup measures
Contamination of process site during construction	Probable	Local and short term	Low	Development construction stage EMP Appoint an Environmental Control Officer (ECO).
Operational Stage				
Tanker Offloading: Excessive chemical loading	Probable	Local and short term dispersion in ocean	Medium to High	Sampling of every load that is tankered Inventory control Manage within trade effluent discharge by-law requirements
Tanker spillage: ground with impact	Probable	Local, short term	Medium	Construction of bund well Spillage to be collected in a sump pump to head of works Separate stormwater and effluent spillage
Industrial Effluent: Excessive loading	Probable	Local	Medium	Ongoing monitoring and effluent quality analysis Manage within trade effluent discharge by-law requirement

Risk Identified	Probability of occurrence Improbable Probable Highly probable Definite	Consequence of the impact: Nature Extent Duration Intensity	Significance ranking: Low Medium High	Management/mitigation measures
Effluent to Sea: High zinc concentration	Highly probable	Local – dispersion/initial dilution zone	High	Ongoing monitoring of heavy metals in sea outfall discharge Sea outfall discharge monitoring to establish accumulation of effluent Reduce sludge load to sea
Sludge: High zinc concentration; high presence of pathogens and nutrients	Highly probable	Local, short term	Medium to High	Point source pollution control procedures must be in place e.g. from galvanizing industries. Monitoring and evaluation must be done on time. (UNEP, 2015). Sludge classification should be carried out before disposal or utilization.
Screenings and Detritus: Land pollution	Highly probable	Local, short term	Low to Medium	Ensure proper tracking of all loads designated for landfill
Pollution in digesters inhibiting the breakdown of biochemical process in the digesters	Probable	Local, short term	High	Ensure efficient functioning of degritting system at HoW and between settling tanks and digesters. Consider upstream monitoring of contaminants Carry out regular sampling
Pollution due to overflow of raw sludge	Probable	Local, short term	High	Regular monitoring and maintenance of pumps.
Contamination of shoreline and Umlass canal mouth by effluent during power failure, outage or load shedding	Probable	Local, short term	High	Increasing storage capacity in overflows via building of additional overflow channels, thereby limiting flow to shoreline and Umlass canal mouth
Closure Stage				
Air, land or water contamination due to non-compliance with project completion	Probable	Local, short term	Medium	Identifying any outstanding project activities, or issues. Tanks, vessels or surfaces must be well covered to avoid emissions, odour, spillage, etc.

Risk Identified	Probability of occurrence Improbable Probable Highly probable Definite	Consequence of the impact: Nature Extent Duration Intensity	Significance ranking: Low Medium High	Management/mitigation measures
criteria				

An Integrated Pollution Management Plan must be developed, if need be, in response to findings from the annual CSIR sea outfall survey. This is to mitigate the risks associated with contamination of sea and land, which could occur as a result of high concentration of heavy metal discharged in sea outfall or in sludge applied on land. The Integrated Pollution Management Plan will also allow for adoption of point source pollution control measures.

Potential risks associated with installation facilities at the SWWTW have been presented in a Major Hazard Installation (MHI) report by ISHECON in 2014 (as attached in Appendix 20), with the classification of the site as a Major Hazard Installation. Six (6) potential worst case events were modelled to determine if there are possible offsite impacts. Modelling results indicated that potential failure scenarios were all related to biogas releases, or internal explosions inside the vessels. A summary of impacts of the potential failure scenarios identified in the modelling study is presented in Table 5-2.

TABLE 5-2: THE TABLE BELOW INDICATES THE DISTANCES TO THE MHI THRESHOLDS IN COMPARISON TO THE DISTANCES OF THE SITE OF BOUNDARY SITES

No	Failure	Possible Resultant Event	Distance to MHI Threshold (m)	Distance to Site Boundary (m)	MHI
1	Primary digester internal explosion (due for example to inadequate purging during maintenance).	Explosion	57	42	Yes
2	Secondary digester internal explosion (due for example to inadequate purging during maintenance).	Explosion	55	60	No
3	Biogas holder internal explosion (due for example to inadequate purging during maintenance).	Explosion	55	90	No
4	Sludge drying building internal explosion (due to loss of containment of biogas into building and subsequent ignition thereof).	Explosion	29	28	**Marginal**
5	Biogas transfer line rupture and explosion of flammable vapours.	Delayed explosion	42	65	No
6	Biogas gas holder catastrophic rupture and explosion of flammable vapours.	Delayed explosion	110	90	Yes
		Flash fire	60	90	No

It was noted however that only the catastrophic rupture of one of the gas holders, or an internal explosion inside the digesters that are situated within 60 m of the site boundary will lead to major offsite effects. The placement of

the new processing equipment and buildings to be erected on the SWWTW site require carefully consideration in light of the analysis shown above. For the digesters it is suggested that, where possible, the new digesters be situated at least 60m from the site boundaries (limit of likely offsite fatalities), and that the new gas holders be situated at least 110 m from the site boundaries. Due to the fact that existing facilities such as the decommissioned digesters and gas holders are being re-commissioned, it is not plausible to suggest that they be moved, and while the consequences can therefore not be reduced, risk reduction methods such as hazardous area classifications to control ignition sources, maintenance and hot work procedures should be put into place. It is also important to put in a place a schedule for monitoring and routine maintenance of gas holders and digesters to prevent fire outbreak and explosions from these facilities.

5.6 Issues and responses from public consultation process

The public consultation process was undertaken as part of the EIA process.

The primary aims of the public participation process included:

- Meaningful and timeous participation of interested and affected parties (I&APs);
- Identification of issues and concerns of key stakeholders and I&APs with regards to the proposed development, i.e. focus on important issues;
- Promotion of transparency and an understanding of the proposed project and its potential environmental (social and biophysical) impacts;
- Accountability for information used for decision-making;
- Serving as a structure for liaison and communication with I&APs;
- Assisting in identifying potential environmental (social and biophysical) impacts associated with the proposed development; and
- Inclusivity (the needs, interests and values of I&APs must be considered in the decision-making process).

Issues and responses documented during the public consultation process and attendance registers are attached in Appendix 21 of this report.

5.7 Matters Requiring Attention / Problem Statement

TABLE 5-3: MATTERS REQUIRING ATTENTION WITH RESPECT TO WATER AND WASTE MANAGEMENT

Theme	Matter/Issue
Surface/storm water	Pollution of surface water
	Pollution of the sea
	Separation of effluent and clean storm water
Groundwater	Detect water levels and potential pollution
Process water	Adequate reuse of stored treated water from the Umlass Trunk Sewer
Waste	Contamination of soils/land due to incorrect disposal of hazardous waste including sludge

5.8 Assessment of Level of Confidence of Information

In general it can be stated that the extent and level of information available is adequate to support the development of the IWWMP for the upgrade of facilities at the SWWTW.

6 WATER AND WASTE MANAGEMENT

6.1 Water and Waste Management Philosophy

The eThekwini Municipality is committed to the following:

- To plan, design, construct, operate, decommission and close the proposed upgrade of facilities at the SWWTW in a responsible manner, in accordance with policies and strategies in all applicable legislative requirements;
- To minimise the impact on the receiving environment by drastically reducing the quantity of organic load to sea through the implementation of properly engineered techniques and installations that will prevent high volume of organic load to the receiving environment
- To the implementation of long term water management measures and will conduct the required monitoring during the operation phase which will inform long term water management; and
- To implement technically proven and acceptable rehabilitation measures during the construction, operational, and closure phases to ensure that at closure the project area will be free draining.

6.2 Water Management Strategies

In order to give effect to the water and waste management philosophy for upgrade of facilities at the SWWTW, the following strategies will be implemented:

Surface water

- Construct and maintain adequate storm water control measures to keep clean and dirty water separate; and
- Monitor water quality at the monitoring positions identified.

Groundwater

- Minimise the impact on groundwater resource through the design and construction of engineered barriers for potential pollution sources;
- Implement long term water management by managing groundwater levels and through the implementation of an onsite water treatment facility.

Storm water

- Separation of clean and dirty water
- Collection, containment and conveyance of both clean and dirty water in adequately sized water management infrastructure
- On-going monitoring and measurement of water quantity and quality to support the wide water balance and water management.

Waste

- Implement waste separation at source;
- Maximise recycling and reuse of waste streams;
- Dispose of waste on authorised waste disposal facilities in accordance with legal requirements;
- Implement on-going waste monitoring to inform waste management; and
- Identification and cleanup of spillage to prevent land contamination.

6.3 Performance Objectives / Goal

The following key performance objectives have been identified for the upgrade of facilities at the SWWTW.

- To minimise the impact on the receiving environment by drastically reducing the quantity of organic load to sea;
- Develop and update the water balance annually or as will be required by the IWUL;
- Contain dirty storm water;
- Prevent erosion;
- Monitor and record ambient water quality in the receiving surface water and various points on site to confirm/ assess the effectiveness of the implemented water pollution control measures;
- Assess the impact/s that project is having on local groundwater and surface water resources;
- Monitor groundwater levels; and
- Monitor the wetlands the areas.

6.4 Control and Monitoring

6.4.1 Monitoring of Change in Baseline (Environment) Information

Reports will be submitted to various government departments as required and formal institutions as requested by management objectives, conformance targets and applicable legislation and other legal requirements. All results will be made electronically available to DWA.

6.4.2 Audit and Report on Performance of Measures

The IWWMP action plan will be reviewed and updated annually or alternatively as required in terms of the WUL.

6.4.3 Audit and Report on Relevance of Action Plan

The IWWMP action plan will be reviewed and updated annually or alternatively as required in terms of the WUL.

6.5 Options analyses and motivation for implementation of preferred option

In terms of the EIA Regulations, Section 28 (1) (c) feasible alternatives are required to be considered as part of the environmental investigations. In addition, the obligation that alternatives are investigated is also a requirement of Section 24(4) of the National Environmental Management Act (Act No. 107 of 1998) (as amended). An alternative in relation to a proposed activity refers to the different means of meeting the general purpose and requirements of the activity (as defined in GNR 543 of the EIA Regulations, 2010), which may include alternatives to:

- the property on which or location where it is proposed to undertake the activity;
- the type of activity to be undertaken;
- the design or layout of the activity;
- the technology to be used in the activity;
- the operational aspects of the activity: and
- the option of not implementing the activity

6.5.1 Site Alternatives

No offsite or other site alternatives have been investigated due to the fact that the upgrades are proposed at the existing works and no additional development will encroach beyond the boundaries of the current works thereby limiting the development footprint.

6.5.2 Design Alternatives

6.5.2.1 Alternative 1 (Preferred)

The first and preferred alternative for design or layout involves the refurbishment of two old unused primary digesters, secondary digester, gas holder and thickener; as well as replicating the old structures across the road so that in total there will be four primary digesters, two secondary digesters, two gas holders and two thickeners.

6.5.2.1 Alternative 2

Alternative two involves the demolition of the existing structures (primary digesters, secondary digester and gas holder) and the construction of new structures that are approximately twice the capacity of the existing structures. In this alternative, the demolition of the existing infrastructure presents a noise issue is therefore the less favourable alternative. Furthermore, having larger structures creates a negative aesthetic impact.

Layout plan of the two aforementioned alternatives are available in the scoping report (Appendix 2).

6.6 IWWMP Action plan (priority actions and other short, medium and long term actions)

Performance Objective	Management measure	Responsible section	Timeframe
Surface water			
Contain dirty storm water	Maintain adequate storm water control measures to keep clean and dirty water separate.	Contractor	On-going during construction and operational phases
Prevent erosion	Include adequate erosion controls in the design of changes to slope conformation, linear infrastructure and points of water discharge to prevent wash down of soils into sensitive surface water areas	Contractor	On-going during construction
Minimise pollution of the surface water resource	Monitor water quality before discharging effluent	EWS	On-going during operational phase
	Interpret results against baseline results and institute remedial action as required		On-going
Groundwater			
Prevent groundwater pollution	Ensure that all its systems are fully enclosed to mitigate the risk of groundwater pollution. Excess flow must be contained and reticulated to sea through overflow channels.	AECOM and EWS	On-going during construction and operational phase
Waste			
Minimize contamination of process site during	Implement dedicated site monitoring and ensure safe disposal of hazardous waste	EWS	On-going during construction

construction	Carry out immediate clean-up of spillage and dispose safely		
Minimize effluent to Sea: Excessive heavy metals	Implement point source pollution control procedures	EWS	On-going during construction and operational phase
Prevent contamination of sandbank/surf zone	Increase storage capacity of overflows via construction of additional overflow channels; Ensure proper monitoring and strategic system management	AECOM and EWS	On-going during construction and operational phase
Prevent spillage due to overfilling of digesters	Ensure adequate upstream screening and maintenance of overflows	EWS	On-going
Prevent chemical contamination from HoW which may result to poisoning of digesters	Carry out upstream monitoring of contaminants and control of tanker discharges	EWS	On-going
Prevent Sludge Contamination	Proper monitoring and sampling; consider alternatives for backup sludge removal Carry out sludge classification/analysis	EWS	On-going monitoring during operational phase

7 CONCLUSION

The Integrated Water and Waste Management Plan (IWWMP) for the proposed upgrade of the Southern Wastewater Treatment Works has been undertaken within the context of latest environmental legislation in South Africa. The legislative underpinnings and key management strategies relate to pollution prevention, waste minimisation, adoption of the precautionary principle, integrated water and water management, cradle to grave analysis and management and all measures that are protective of water resources. The IWWMP has been backed up by ammunition of Environmental Scoping Studies, various specialist studies that have a bearing on IWWMP, and the compendium of geotechnical studies, and ground and surface water monitoring spanning several years. The proposed development has adopted a precautionary approach of ensuring opportunity for collection of baseline “no development” scenario and the upgrade of facilities in two phases.

The proposed upgrade of facilities will minimise the impact on the receiving environment by drastically reducing the quantity of organic load to sea through the implementation of properly engineered techniques and installations that will prevent high volume of organic load to the receiving environment. Undoubtedly the overall system of the wastewater works and its interaction with surface ecology and water systems needs to be well understood and scientifically management with the requisite regulatory measures in place. Ultimately the proposed upgrade can proceed as licences and permits for water usage, generation, treatment and disposal and for waste generation, treatment, containment and safe disposal are in place. Finally the emerging Environmental Management Programme (EMPr) emerging from the requirements of the IWWMP and the general environmental scoping process will enable the development to occur within a framework that is highly regulated and supported by a dynamic EMPr preventative strategy.

8 REFERENCES

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9 APPENDICES

ALL APPENDICES ARE IN A SEPARATE FILE