Western Cape Government
Environmental Affairs and Development Planning

Hazardous Waste Status Quo Report

March 2017

Executive Summary

The Waste Management Directorate of the Department of Environmental Affairs and Development Planning (DEA&DP) have conducted a status quo analysis of the management of hazardous waste in the Western Cape. The formulation of this report entailed the analysis of Integrated Pollutant and Waste Information System (IPWIS) data and data obtained from various stakeholders, during engagements with them. The results show that inorganic solid waste is the major waste type accounting for 52% of the waste that is disposed of. The major generators of this waste have also been identified. DEA&DP will engage with the major generators to assist, where possible in reducing their waste quantities. Some waste streams are challenging to deal with, particularly inorganic solid waste, organic waste and sewage sludge, which require urgent attention.

Guidelines will be formulated for e-waste management and the beneficiation of treated sewage sludge. A status quo of e-waste management within the DEA&DP will be further explored in the next financial year. These initiatives are reflected in the 2nd generation Western Cape Integrated Waste Management Plan, 2017. There are limited Waste Management Facilities (WMFs) for hazardous waste in the province and the existing waste disposal facilities are running out of airspace.

Concerns have been raised on the stringent regulations for landfills and for companies operating in the waste sector. A risk-based approach in the development of Norms and Standards for waste management facilities should be explored. DEA&DP will promote hazardous waste awareness and minimisation through their existing governance platforms and look to further expand on this through engagements with industry bodies. The limited capacity for treatment and disposal of hazardous waste management also create a conducive environment for the private to invest in this industry to provide additional treatment and disposal capacity for hazardous waste management.

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Abbreviations

BNR	Biological Nutrient Removal
BOD	Biological Oxygen Demand
CAIA	Chemical and Allied Industries Association
CFCS	Consumer-Formulated Chemical Sector
DAF	Dissolved-Air Flotation
DEA	Department of Environmental Affairs
DEA&DP	Department of Environmental Affairs and Development Planning
DoL	Department of Labour
eWASA	E-Waste Association of South Africa
HASA	Hospital Association of South Africa
HCRW	Health Care Risk Waste
IPWIS	Integrated Pollutant and Waste Information System (IPWIS)
LC	Leachable Concentration
LCT	Leachable Concentration Threshold
NEM:WA	National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)
PCB	Polychlorinated Biphenyl
PHASA	Public Health Association of South Africa (PHASA)
NORA-SA	National Oil Recycling Association of South Africa
SAEWA	South African E-Waste Alliance
SAWIS	South African Waste Information System
SBR	Sequencing Batch Reactor
TC	Total Concentration
TCT	Total Concentration Threshold

VOCs	Volatile Organic Compounds
WCED	Western Cape Education Department
WDF	Waste Disposal Facility
WMF	Waste Management Facility

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Glossary

Activated sludge treatment process: process whereby wastewater containing organic matter is aerated in an aeration basin in which micro-organisms metabolise the suspended and soluble organic matter

Anaerobic digestion: process whereby bacteria break down organic material in the absence of air, yielding a biogas containing methane.

Bioaccumulation: refers to the accumulation of substances, such as pesticides, or other chemicals in an organism.

Biological Nutrient Reduction: A biological treatment processes are used to reduce total nitrogen and phosphorus levels.

Biological Oxygen Demand: a measure of the quantity of oxygen used by microorganisms (e.g. aerobic bacteria) to oxidise organic matter.

Dissolved Air Floatation: Water treatment process that clarifies wastewater by removing suspended matter such as oil and solids.

Genotoxic waste: is highly hazardous waste that may have mutagenic, teratogenic or carcinogenic properties.

Hazardous waste: means any waste that contains organic or inorganic elements or compounds that may, owing to the inherent physical, chemical or toxicological characteristics of that waste, have a detrimental impact on health and the environment and includes hazardous substances, materials or objects within business waste, residue deposits and residue stockpiles.

Healthcare waste: is a by-product of healthcare that includes sharps, non-sharps, blood, body parts, chemicals, pharmaceuticals, medical devices and radioactive materials.

Infectious waste: waste that is suspected to contain pathogens in a sufficient concentration or quantity to cause disease in susceptible hosts. This category includes cultures and stocks of infectious agents from laboratory work; waste from surgery and autopsies on corpses with infectious diseases; waste from infected patients in isolation wards; waste that has been in contact with infected patients undergoing haemodialysis; infected animals from laboratories; sanitary waste materials and tissues (including swabs) and any other instruments or materials that have been in contact with infected persons or materials.

Pathological waste: includes all human tissues, organs, body parts, foetuses, blood and body fluids and those of infected animals. Sharp waste: Includes items that could cause cuts or puncture wounds and includes, but is not limited to, needles, hypodermic needles, scalpels and other blades, knives, infusion sets, saws, broken glass and nails, and the word ''sharp'' has a corresponding meaning.

Pasveer (Oxidation) ditch: Oval-shaped channel, in which sewage is aerated and circulated around the ditch by rotors.

Pharmaceutical waste: includes expired, unused, spilt and contaminated pharmaceutical products, drugs, vaccines and sera that are no longer required and that need to be disposed of appropriately.

Radioactive waste: includes solid, liquid and gaseous materials contaminated with radionuclides, including waste produced as a result of procedures such as in vitro analysis of body tissue and fluid, in vivo organ imaging and tumour localisation, and various investigative and therapeutic practices.

Sequencing Batch Reactor: Type of activated sludge process in which all of the treatment processes are carried out sequentially in the same tank.

Waste with heavy metals: includes, but is not limited to, mercury waste from thermometers, blood-pressure gauges, residues from dentistry; cadmium waste from discarded batteries, reinforced wood panels used in radiation proofing, and drugs containing arsenic.

1. Introduction

1.1. Background

The Department of Environmental Affairs and Development Planning (DEA&DP) in the Western Cape Provincial Government has, over the years, conducted several studies on hazardous waste management. The Situation Analysis of Hazardous Waste Management in the Western Cape Province published in September 2003, focused on providing the Department, as well as other relevant stakeholders with insight into the status of hazardous waste management in the province from the point of generation to final treatment and/or disposal. Consultative workshops with various stakeholders, interested and affected parties and the general public took place in 2004. This culminated in the development of the Hazardous Waste Management Plan for the Western Cape in 2006. Also in 2006, an Assessment for the Best Practicable Environmental Option for Managing Priority Hazardous Waste Streams was developed.

In March 2010, the Department, with funding from the Danish International Donor Agency ran a project to assist with facilitating the development of Sector Specific Industrial Waste Management Plans within the Consumer-Formulated Chemical Sector (CFCS). The main objective of this project was to facilitate and provide technical advice to the CFCS on the development of their Industry Waste Management Plans. In order to meet this objective, site assessments were done, there were engagements with representatives from targeted companies, an assessment criteria was development and the Department's generic guideline was reviewed. This culminated in the Department formulating and publishing the Industry Waste Management Plan guideline in March of 2012. This Hazardous Waste Status Quo report will provide the most up to date indication of the state of hazardous waste management in the province.

1.2. Objective

The main objective of the Hazardous Waste Status Quo assessment is to gain insight into the current state of hazardous waste management in the province. This will facilitate the identification of problematic hazardous waste types, industry sectors and treatment or disposal methods as well as enable the Department to determine how to best provide support in order to overcome challenges in the hazardous waste management sector.

1.3. Hazardous Waste Legislative Overview

1.3.1. International Conventions

The following international conventions related to hazardous waste management have been ratified by South Africa and are incorporated in national legislation:

- The Basel Convention, which addresses the need to control the transboundary movement of hazardous waste and their disposal. It sets out the categorisation of hazardous waste and the policies between member countries.
- The BAN Amendment to the Basel Convention on the Control of transboundary movements of hazardous wastes and their disposal prohibits the export of hazardous waste from a list of developed countries to developing countries.
- The Rotterdam Convention promotes shared responsibilities and enforces transparency in relation to the importation of hazardous chemicals.
- The Stockholm Convention aims to eliminate or restrict the production and use of persistent organic pollutants.
- The Montreal Protocol phases out the production of numerous substances that are responsible for ozone depletion.
- The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change, which commits its Parties by setting internationally binding emission reduction targets.

1.3.2. Legislation

National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)

According to Chapter 5 of the National Environmental Management Waste Act (NEM: WA), the National Department of Environmental Affairs (DEA) is the regulatory body for the licensing of hazardous waste management facilities. The Members of the Executive Council for environmental affairs is the licensing authorities for general waste activities. The Constitution also assigns concurrent legislative competence to national and provincial government with respect to the environment and pollution control which would include the management of hazardous waste.

National Environmental Management: Waste Amendment Act, 2014 (Act No. 26 of 2014)

According to the National Environmental Management: Waste Amendment Act, 2014 (Act No 26 of 2014) hazardous waste, means any waste that contains organic or inorganic elements or compounds that may, owing to the inherent physical, chemical or toxicological characteristics of that waste, have a detrimental impact on health and the environment and includes hazardous substances, materials or objects within the business waste, residue deposits and residue stockpiles.

Hazardous Substances Act, 1973 (Act No 15 of 1973)

This Act provides for the control of substances which may cause injury or ill-health to or death of human beings by reason of their toxic, corrosive, irritant, strongly sensitizing or flammable nature or the generation of pressure thereby in certain circumstances, and for the control of certain electronic products; to provide for the division of such substances or products into groups in relation to the degree of danger; to provide for the prohibition and control of the importation, manufacture, sale, use, operation, application, modification, disposal or dumping of such substances and products; and to provide for matters connected therewith.

Waste Classification and Management Regulations (GN. No. R. 634 of August 2013)

The purpose of these regulations is to:

- Regulate the classification and management of waste in a manner which supports and implements the provisions of the NEM:WA;
- Establish a mechanism and procedure for the listing of waste management activities that do not require a Waste Management License;
- Prescribe requirements for the disposal of waste to landfill;
- Prescribe requirements and timeframes for the management of certain wastes; and
- Prescribe general duties of waste generators, transporters and managers.

A pertinent point from the Regulations is that waste must be classified according to the South African National Standard Globally Harmonized System of Classification and Labelling of Chemicals SANS 10234:2008. This standard classifies waste according to the physical and health hazards, as well as hazards to the aquatic environment. The Regulations also state that waste must be classified within 180 days of generation and should be re-used, recycled, recovered, treated and/or disposed of within 18 months of generation. Where there have been process or activity changes, waste must be re-classified. Dilution of waste to reduce component concentration and the treatment of waste whereby it reduces the potential for re-use, recycling or recovery is prohibited.

Hazardous waste not requiring classification or assessment is as follows:

Hazardous 2 (b)

- Asbestos waste;
- PCB waste or PCB containing waste;
- Expired, spoilt or unusable hazardous products;
- General waste (excluding domestic waste) which contains hazardous waste or hazardous chemicals;
- Mixed hazardous chemical waste from analytical or academic laboratories in containers less than 100 litres; and
- Health care risk waste.

Norms & Standards for the Assessment of Waste for Landfill Disposal (GN. No. R. 635 of August 2013)

These Norms and Standards prescribe the requirements for the assessment of waste prior to disposal to landfill. The regulations state that the total and leachable concentration of elements and compounds must be used to determine the type of waste. The prescribed method for leachable concentration determination is the Australian Standard Leaching Procedure (AS 4439.1, 4439.2 and 4439.3).

The disposal requirements for hazardous waste as listed in 2 (b) is a Class A landfill. The wastes that this is applicable to are:

- Asbestos waste;
- Expired, spoilt or unusable hazardous products;
- PCBs (or rather PCB containing waste (>50ppm));
- General waste, excluding domestic waste, which contains hazardous waste or hazardous chemicals; and
- Mixed, hazardous chemical wastes from analytical laboratories and laboratories from academic institutions in containers less than 100 litres.

National Norms and Standards for the Disposal of Waste to Landfill Disposal (GN. No. R. 635 of August 2013)

These Norms and Standards determine the requirements for the disposal of waste to landfill. It covers Land Classification and Containment Barrier design, Waste Acceptance Criteria for Disposal to Landfill and Waste Disposal Restrictions. As per the regulation, once the type of waste has been determined, the disposal requirements can be determined

National Health Act, 2003 (Act No. 61 of 2003)

Section 32 of the Health Act states that metropolitan and district municipalities must ensure that appropriate municipal health services are effectively and equitably provided in their areas of jurisdiction. National and provincial government must enter into an agreement and assign to a Municipality, as contemplated in section 156 (4) of the Constitution, the following matters:

- Services to be rendered by the local municipality;
- Resources that the relevant MEC must make available;
- Performance standards which must be used to monitor services rendered by the municipality; and
- Conditions under which the agreement may be terminated.

Western Cape Health Care Waste Management Act, 2007 (Act No. 7 of 2007)

The Health Care Waste Management Act provides for the effective management (handling, storage, collection, transportation, treatment and disposal) of health care waste in order to protect communities and the environment from the risks posed by this waste as required in terms of section 24 of the Constitution.

Heath Care Waste Management Amendment Act, 2010 (Act No. 6 of 2010)

The National Department of Environmental Affairs published the NEM:WA), which necessitated minor amendments to the Western Cape Health Care Waste Management Act in respect of the terminology used and to prevent any conflict or confusion.

Western Cape Health Care Waste Management Act, 2007 (Act No. 7 of 2007): Western Cape Health Care Risk Waste Management Regulations, 2013

The Western Cape Health Care Risk Waste Management Regulations, promulgated on 15 March 2013 (HCRW regulations were developed to provide for the establishment of a health care waste manifest system that will ensure the effective management of health care waste by tracking all Health Care Risk Waste from "cradle to grave" in order to prevent illegal dumping incidents.

National Waste Information Regulations, 2012

The DEA&DP developed the Integrated Pollutant and Waste Information System (IPWIS) and thus gives effect to Section 60, 61 and 62 of NEM:WA and requires all holders of waste, including industries in the private sector, to report on their waste management practices. The NEM:WA defines a "holder of waste" to mean any one person who imports, generates, stores, accumulates, transports, processes, treats, or exports waste or disposes of waste and "industry" includes commercial activities, commercial agricultural activities, mining activities and the operation of power stations.

Waste planning requires accurate information on waste quantities disposed at and diverted from waste disposal facilities (WDFs). Comprehensive information on waste flows from each waste management facility will be reported to the National South African Waste Information System (SAWIS), via IPWIS, which will contribute to an accurate national waste balance. The National Waste Information Regulations promulgated on the 13 August 2012, regulate the reporting of waste information for the protection of the environment and the management of waste. By 2018, all specified waste management facilities that are required to collect and report to the SAWIS are to have waste quantification systems[1].

1.4. Report Structure

This Status Quo report will comprise of three chapters. Chapter 1 is the Introduction and Background to the report, which provides the necessary information, objectives and scope of the report. Chapter 2 provides key findings for the waste types that were scrutinised. Chapter 3 will use the information gained in Chapters 1 and 2 to conduct a SWOT analysis.

[1] National Waste Management Strategy, DEA(2011)

2. Key Findings of the Status Quo Assessment

2.1. Waste Information

Accurate and reliable waste information is a critical requirement to enable meaningful planning. The Integrated Pollutant and Waste Information System (IPWIS) was established in 2002 to provide accurate information on potentially harmful pollutant releases or transfers to the environment from a variety of sources, waste types, quantities of waste generated and waste management facilities (WDFs, refuse transfer stations, drop-off facilities, recycling facilities, etc.) in the Western Cape. The registration and reporting of waste information to IPWIS is mandated by the National Waste Information Regulations, 2012 and the Provincial HCRW Management Regulations, 2013. IPWIS is operational, and collects and submits the minimum required information to SAWIS as set out in section 60(1) of the NEM: WA. BizBrain is a transversal application which is used by the Department as a business intelligence tool. The information reported via IPWIS is transferred to BizBrain for analysis and to determine trends in waste generation.

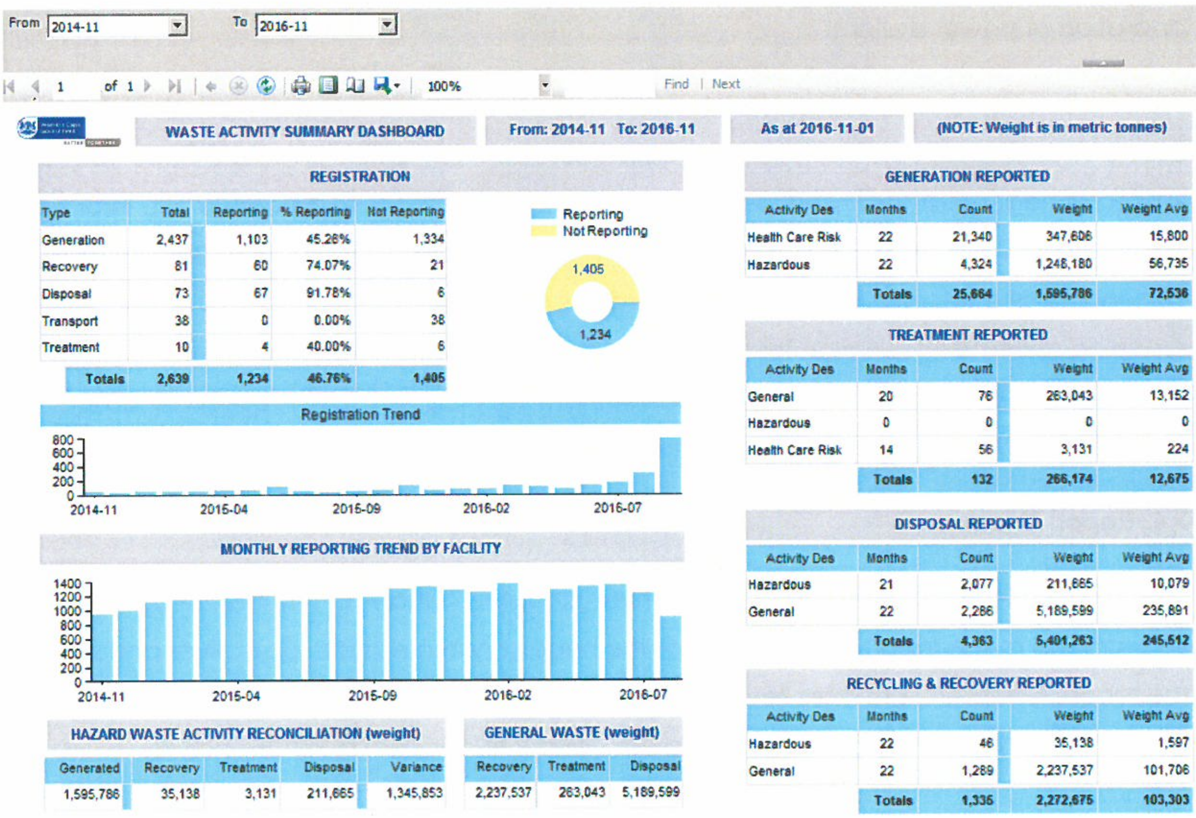

Figure 1: Overview dashboard & navigation screen

Figure 1 above, displays the Waste Activity Summary Dashboard. This provides a summary of the number of registrations, reporting status, waste generation, waste treatment, and waste disposal as well as recycling and recovery quantities reported. Quantities are displayed by mass (tonnes) and is grouped as either general or hazardous waste. More detail is provided by selecting a specific parameter, for example, registrations. Trends can be formed by selecting a timeframe for which the information is required.

2.2. Hazardous Waste Generation

Hazardous waste types and quantities were obtained from the Enviroserv Vissershok WMF and the City of Cape Town's Vissershok WMF. The Enviroserv WMF categorises hazardous waste from generators according to the National Waste Information Regulations, 2012, annexure 4. Data from other hazardous waste management facilities are currently in the process of being verified and audited. The annexure stipulates three levels of waste types with level 1 being the broader on of hazardous waste, level 2 being the major waste type and level 3 being the specific waste type. The data gained was analysed and sorted such that the quantity of each type was determined as shown in Table 1, below. Once this was done the level 2 waste types were discussed further.

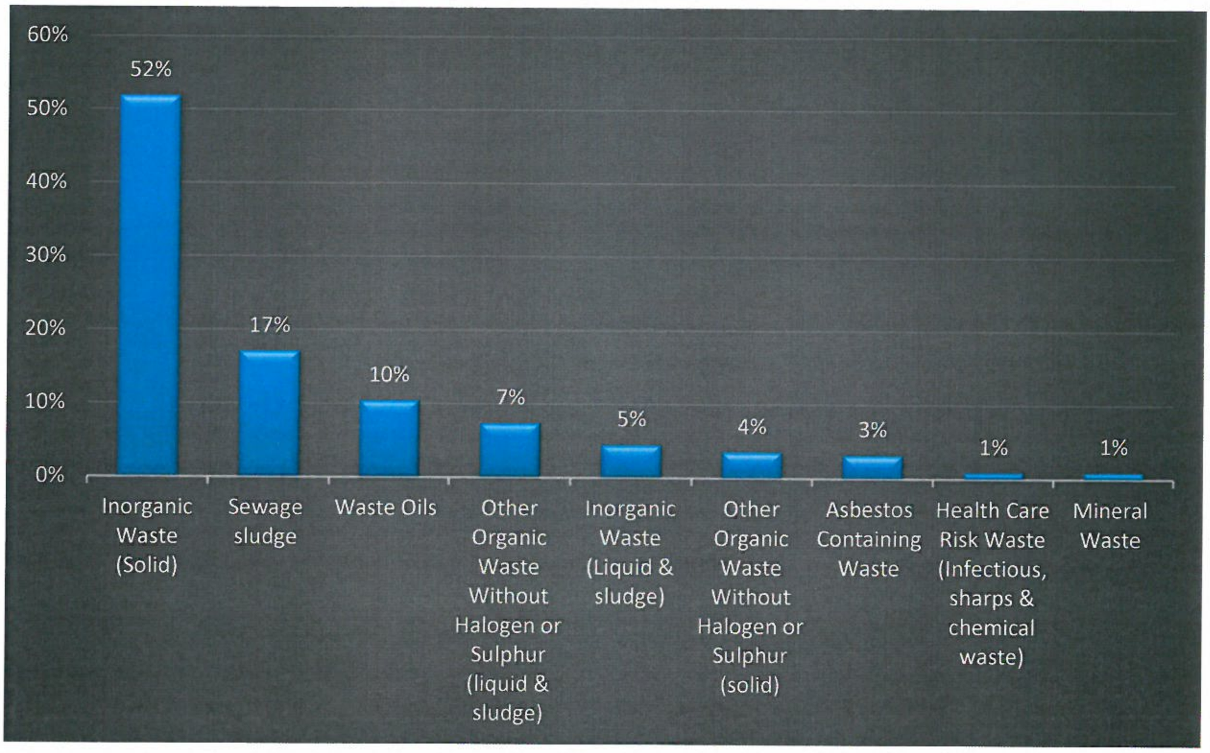

Figure 2: Vissershok hazardous waste types 2015 to 2016

Focusing on the largest waste quantities and types, the facility has treated and/or disposed of **435 160 tonnes** of hazardous waste between 2015 and 2016, this excludes household hazardous waste. The City of Cape Town's Vissershok WMF has received a total of **46 529 tonnes** of hazardous waste between 2015 and 2016, however, further detail on the types of hazardous waste is not available and data needs to be verified. The main generators of hazardous waste, as shown in figure 2, have been identified and the Department will engage with these companies/organisations.

2.2.1. Inorganic & Organic Waste

As can be seen from figure 2, inorganic and organic chemicals make up the bulk of the waste types disposed of at the Vissershok facility. The chemicals sector plays an important role in the economy as it is a key supplier and component to many other industries, such as agriculture, medicine, industrial manufacturing, energy extraction and generation, public health and disease vector control[2]. The Western Cape has 16% of the firms in the chemical sector of the country[3]. The properties and nature of some chemicals make them hazardous to both human health and the environment and as a result are highly regulated. Chemicals can affect all aspects of natural resources: atmosphere, water, soil, and biodiversity. Ozone depleting chemicals, water contamination through illegal dumping chemicals, and soil contamination through spillages and dumping as well as bioaccumulation of chemicals which also causes harm to wildlife[4].

Table 1: Sub-sectors within the chemicals sector

SIC	Sector	Sub-sectors
33100	Coke Oven Products	Commodity Organics
33200	Petroleum & Nuclear Fuels	Liquid Fuels
33400	Basic Chemicals	Commodity Organics, Primary Polymers & Rubbers, Commodity Inorganics, Fine Chemicals, Pure Functional & Specialities, Bulk Formulated Chemicals
33500	Other Chemicals	Commodity Organics, Pure Functional & Specialities, Bulk Formulated Chemicals, Pharmaceuticals, Consumer Formulated
33700	Rubber Products	Rubber Products
33800	Plastic Products	Plastic Products
SIC- Standard Industrial Classification Source: Seda, 2013		

[2] Global Environment Outlook 5, UNEP (2012)
[3] Small Enterprises Development Agency (Seda), (2013)
[4] The Global Chemical Outlook (2013)

Solid inorganic waste has been the main waste type that was received at the Vissershok waste management facility. The table below shows samples of high-volume inorganic chemicals and their principle uses.

Table 2: High-volume inorganic chemicals and their uses

Chemical (most recent year for which data are available)	Principle uses
Lime/limestone (2008)	Metallurgy, building products, environmental applications, pulp and paper
Sulphuric acid (production: 2010; consumption: 2008)	Production of phosphate fertilizer materials (53% of world consumption)
Ammonia (2010)	Production of nitrogen fertilizer (over 80% of consumption)
Sulphur (production: 2010; consumption:2008)	Sulphuric acid production
Phosphoric acid, wet process (2009)	Production of phosphate fertilizers (80-85%)
Source: Global Chemical Outlook Report, Sample High-volume Inorganic Chemicals, Page 22	

As can be concluded from the figure below, chemicals can become waste during raw material extraction, manufacturing, transport and at end of life. The responsible management of waste emanating from these processes is critical to ensuring the health and safety of people and the environment at large.

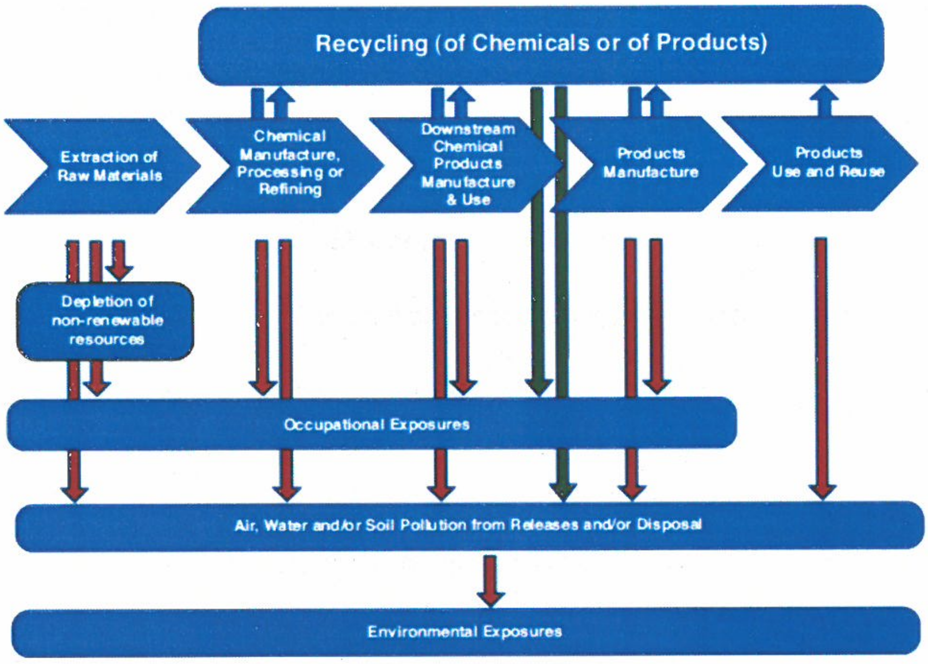

Figure 3: Life cycle of chemicals

(Source: Global Chemical Outlook Report, 2013)

Table 3: Health effects caused by exposure to certain chemicals

Category	Chemical	Health effects
Organics		
Alcohols	Methanol	Toxic if swallowed, inhaled or if in contact with skin; single exposure can damage organs; burns (flammable); neurotoxic
Olefins	Ethylene	Burns (flammable); neurotoxic
	Propylene	Burns (flammable)
	Butadiene	Carcinogenic to humans; may cause genetic defects
Aromatics	Xylenes	Harmful if inhaled, causes skin irritation on; neurotoxic
	Benzene	Carcinogenic to humans; neurotoxic; may cause genetic defects, may be fatal if swallowed and enters airways, causes damage to organs through prolonged or repeated exposure, causes eye and skin irritation on, burns (flammable)
	Toluene	Burns (flammable), may be fatal if swallowed and enters airways, causes damage to organs through prolonged or repeated exposure, causes skin irritation on; neurotoxic, including a developmental neurotoxicity
Chlorinated Compounds	Vinyl chloride monomer	Carcinogenic to humans; neurotoxic; burns (flammable)
	Trichloroethylene	Probably carcinogenic to humans; neurotoxic; suspected of causing genetic defects, causes eye and skin irritation
	Perchloroethylene	Probably carcinogenic to humans; neurotoxic

	Lindane	Neurotoxic; toxic if swallowed, harmful if in contact with skin or inhaled, may cause damage to organs through prolonged or repeated exposure, may cause harm to breast-fed children
Brominated Compounds	Polybrominated diphenyl ethers	Thyroid disorders; neurotoxic
Fluorinated compounds	Fluorinated polymers	Reproductive toxicant; possibly carcinogenic; may cause increased cholesterol
Inorganics		
Basic Inorganics	Sulphuric Acid	Carcinogenic to humans (fuming sulphuric acid); asthmagen (reactive airway dysfunction syndrome)
	Ammonia	Toxic if inhaled, causes severe skin burns and eye damage, burns (flammable), asthmagen (reactive airway dysfunction syndrome)
	Sulphur	Causes skin irritation
	Phosphoric Acid	Causes severe skin burns and eye damage
Metals	Cadmium	Carcinogenic to humans; suspected of causing genetic defects, may damage fertility or the foetus, fatal if inhaled, causes damage to organs through prolonged or repeated exposure
	Lead	Neurotoxic, including a developmental neurotoxicity; causes high blood pressure; harmful if inhaled or swallowed, may cause organ damage with prolonged or repeated exposure
	Mercury	Neurotoxic, including developmental neurotoxicity (methyl mercury) fatal if inhaled, swallowed or in contact with skin, causes organ damage with prolonged or repeated exposure
Source: Global Chemical Outlook Report, 2013		

Based on the Industry Waste Management Plans and questionnaires submitted to the Department by companies, it has been noted that hazardous waste is collected by service providers for disposal at hazardous waste management facilities. Companies operating in the chemicals sector need to identify and implement internal treatment methods for hazardous waste and where possible reuse their waste as this would decrease their disposal costs. In some cases, failed returned or expired products formed a big portion of waste that is disposed. A good example of this is demonstrated by a leading paint manufacturer operating in the Western Cape. The company has a solvent recovery plant within its premises. All resin reactors and paint mixing pots are washed after each production run using solvents or caustic water, depending on the product manufactured. Solvent waste is then poured into flow bins and taken to the solvent recovery plant. Recovered solvents are decanted into flow bins and then pumped back into the solvent storage tanks for washing of equipment.

2.2.2.Metals

The Western Cape metals and engineering sector employs approximately 10% of the national metals and engineering sector's workforce[5]. The exact number of operational companies is unknown but it is estimated that between 337 & 600 companies are active in the sector. Basic metals production in the Western Cape is dominated by primary steel production, of both long and flat steel products[6]. Hazardous waste that emanates from the metal finishing process comes from the milling and passivation processes.

Lubrication oils and greases are applied on the mill to lubricate and cool the working area. Common waste types originating from these processes are waste oils and acids. In cold reversing mills emulsion oils are applied to the mill bite to lubricate and cool the roll bite area to ensure efficient working of mills. Waste emulsion oil is separated from water and usually disposed of. Passivation Fluid is sprayed, by means of nozzles, onto the galvanized steel strip to prevent white rust on the steel. Excess passivation fluid is treated with a reducing agent to convert all hexavalent chromium compounds to trivalent chromium oxides or hydroxides which are water soluble.

The Chemical and Allied Industries Association (CAIA)

As an association that forms part of a worldwide network of chemical industry associations, CAIA seeks to promote the continuous improvement of performance in the safety, health and environmental arenas as well as to boost productivity and competitiveness of the chemical and allied industries in South Africa, thereby enhancing their sustainability. Members are mainly large and medium size companies drawn from base chemicals, fertilizers, plastics in primary form, pesticides and other agricultural products, explosives and speciality chemicals[7].

SA. Metal Finishers Association

The South African Metal Finishing Association was formed in 2005 and represents a significant proportion of the metal finishing industry in the country and membership includes electroplaters, powder coaters, anodisers and suppliers to the trade. The association provides members with access to information and assistance from a professional organisation with a powerful national network[8]. A monthly newsletter is published by the association covering the various aspects related to the sector.

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[5] Made in Africa: Western Cape Metals & Engineering, WESGRO, (2013)
[6] Metals Sector Report, WESGRO, (2014)
[7] http://www.caia.co.za/about/
[8] http://www.samfa.org.za/About_us.html

2.2.3.Waste Oils

The ROSE Foundation (Recycling Oil Saves the Environment), is a national non-profit organisation established to promote and encourage the environmentally responsible management of used oils and related waste in South Africa. Funded by the major stakeholders in the lubricants industry, to enable them to meet their environmental and extended producer responsibilities. ROSE together with a core group of stakeholders facilitated the formation of National Oil Recycling Association of South Africa (NORA-SA). NORA-SA was formed to create a body for the environmental management of the collection, transportation, storage, recycling and utilisation of used oil. The collection and recycling of used oil is a developing business in South Africa, which reduces the environmental risk, and creates employment opportunities for hundreds of collectors and allied businesses throughout the country[9].

The Department met with the ROSE Foundation to gain insight into the management of waste oils. The foundation focus their attention on oil recycling and in more recent times drum reconditioning. ROSE conducts compliance audits of drum re-conditioners for the South African Industrial Container Reconditioners Association, which was formed in January 2012. According to their records, 2 089 983 L of waste oil (wet volume) were collected in the Western Cape during 2015. Waste oil collectors buy waste oils from generators and sell to ROSE approved processors. Sources of waste are from production plants, workshops and garages, effluent and residual from drums. Waste oil from the harbour is well-handled as ships pay for waste to be disposed. Currently, municipal involvement in the oil recycling sector is minimal and oil collection receptacles issued to municipalities are not well maintained.

2.2.4.Municipal Wastewater Treatment - Sewage Sludge

The key hazardous waste types for wastewater treatment include wastewater (effluent) and sludge. Wastewater composition is approximately 99.93 percent water and 0.07 percent total dissolved and suspended solids, half of which is organic and the other half of which is inert[10]. Constituents present in domestic wastewater include microorganisms (e.g. pathogenic bacteria, viruses and worm eggs), organic materials e.g. pesticides, fats and oils), nutrients (e.g. nitrogen and phosphorus), metals (e.g. cadmium, chromium, copper, lead, mercury and nickel) and other inorganic materials (e.g. acids)[11]. Sewage sludge contains nutrients, organic matter, pathogens, metals and organic pollutants[12].

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[9] http://www.rosefoundation.org.za
[10] http://www.eolss.net/eolsssamplechapters/c06/e6-13-04-05/e6-13-04-05-txt-4.aspx#CHEMISTRY_OF_WASTEWATER_)

[11] Henze et al., 2001
[12] Harrison et al., 2006

The Green Drop Report provides quantities of wastewater entering wastewater treatment systems in each province. These quantities are indicated below for the Western Cape (Table 4). According to the table, a total flow of 836, 47ML/day was received at wastewater treatment facilities during 2013. This quantity does not however include the flows of 49 systems (approximately a 1/3 of facilities), which did not have information on their operational flows.

Table 4: Wastewater quantities entering treatment systems in the province

Ml/day	Micro size <0.5	Small size 0.5 -2	Medium size 2 -10	Large size 10 -25	Macro Size > 25	Undetermined	Total
No of WWTPs	54	48	31	10	11	4(8)	158
Total design capacity (Ml/day)	10.23	50.89	139.84	140.20	696.60	4(8)	1037.75
Total Daily Inflows (Ml/day)	3.54	25.28	95.30	84.07	628.28	49(11)	836.47

Source: Green Drop Report (2014)

Various treatment methods are used to treat wastewater and reduce the contaminants/ pollutants present in wastewater and sludge. Wastewater treatment methods can be physical/ chemical, biological or a combination thereof. A series of treatment phases can be applied and include primary treatment, secondary treatment and tertiary treatment. Primary treatment aims to remove solids from raw sewage and includes screening to trap solids as well as sedimentation by gravity to remove suspended solids present in the wastewater[13]. Primary Treatment can reduce biological oxygen demand (BOD) of incoming effluent by 20 - 30% and the total suspended solids by approximately 50 - 60%[14]. Secondary treatment processes can remove up to 90% of organic matter present in wastewater using biological treatment processes[15]. Tertiary treatment includes biological or physical-chemical treatment processes which remove contaminants not removed during primary and secondary treatment, such as nutrients, toxic materials or additional suspended solids and BOD removal[16].

[13] http://water.worldbank.org/shw-resource-guide/infrastructure/menu-technical-options/wastewater-treatment
[14] http://water.worldbank.org/shw-resource-guide/infrastructure/menu-technical-options/wastewater-treatment
[15] USEPA, 2004
[16] http://www.brighthub.com/environment/science-environmental/articles/68537.aspx

2.2.5. Asbestos

Asbestos waste disposed of at the Vissershok Hazardous Waste Management Facility can be seen as a positive as it indicates that a large quantity of asbestos waste has been disposed of in a responsible, compliant manner. Asbestos is a fibrous mineral which due to its strength and heat resistance was used in a variety of building construction materials for insulation and as a fire retardant. Asbestos was used in a wide range of manufactured goods, mostly in building materials (roofing shingles, ceiling and floor tiles, and asbestos cement products), friction products (automobile clutch, brake, and transmission parts), heat-resistant fabrics, packaging, gaskets and coatings[17]. The use of asbestos has been discontinued for most products, due to the potential health risks. Asbestos exposure occurs through inhalation or swallowing of asbestos fibres. Construction work and home renovations can be especially hazardous because many common building materials used to contain asbestos. When asbestos products start to deteriorate, microscopic fibres enter the air if disturbed through cutting, sanding or drilling[18].

The handling and management of waste asbestos is regulated by the Department of Labour (DoL). The collection and monitoring of asbestos waste requires an external authority approved by the DoL as a contractor as per Asbestos Regulations published in 2003. Asbestos waste does not require assessment or classification in terms of the Waste Classification and Management Regulations, Hazardous Waste 2 (b) and the disposal of asbestos waste requires a Class A landfill according to the Norms & Standards for the Assessment of Waste for Landfill Disposal (GN. No. R. 635 of August 2013) The Department notes that asbestos waste has been seen, during site inspections, on many landfills across the province. This has been seen mixed amongst construction and demolition waste that landfills accept.

2.3. Healthcare Risk Waste

HCRW in the Western Cape is governed by the Health Care Waste Management Act, 2007 (Act No. 7 of 2007), the Amendment Act, 2010 (Act No. 6 of 2010) and the 2013 Regulations. The legislation and regulations provide requirements for the effective management (handling, storage, collection, transportation, treatment and disposal) of healthcare waste by all individuals within the jurisdiction of the Western Cape. The Act (Act No. 7 of 2007) defines health care waste as any waste generated by or derived from medical care or research as well as any waste that has been in contact with blood, bodily fluids or tissues from humans, or infected animals from veterinary practices. HCRW is either incinerated as a means of disposal or treated through Electro Thermal Destruction. Incineration of HCRW is one of the most

[17] www.epa.gov/asbestos/learn-about-asbestos
[18] www.asbestos.com/exposure

effective means to eliminate the risks posed by health care risk waste and reduces the overall volume of the waste. There are three companies that incinerate medical waste within the province, these are, BCL Medical Waste and Solid Waste Technologies in Cape Town and Optimum Waste in George. Residual ash is then disposed of at the Vissershok Waste Hazardous Management Facility.

HCRW is mainly removed to be treated and disposed of by service providers who have to be registered on IPWIS as required in terms of the National Information Regulations, 2013. The HCRW generators are also required to register and report to the provincial IPWIS, this data is then exported to the national system, SAWIS. According to the Provincial Treasury's Socio-economic profile (2015), there are 501 public healthcare facilities in the Western Cape (Provincial Treasury, 2015). As at July 2016, 1 351 generators (includes public and private healthcare facilities) have registered with 793 reporting via the IPWIS. Health Care Risk Waste (HCRW), being a category of Hazardous waste, generated and reported has **increased by 12%** from 2015. The City of Cape Town generated 78.62% of HCRW in the Province, while the least was generated in the CKDM area.

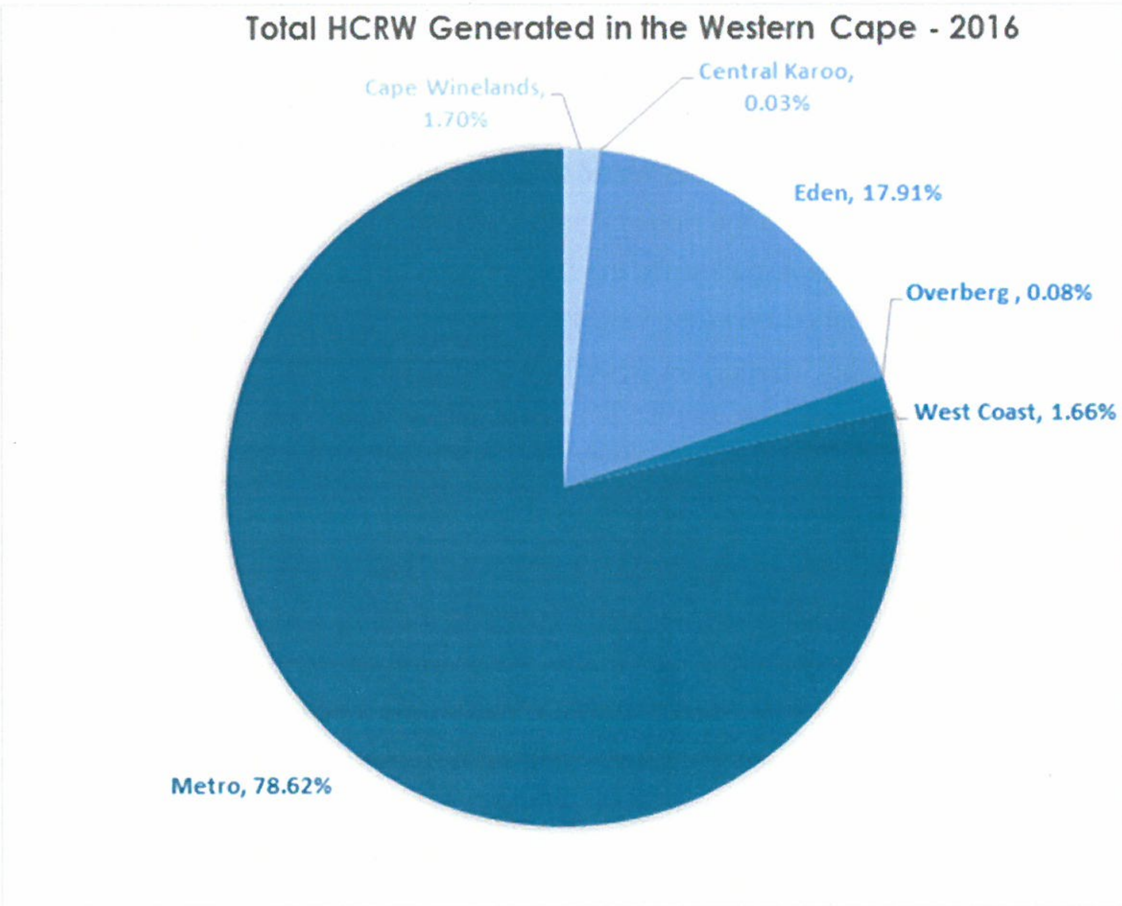

Figure 4: HCRW generated in 2016

Hospital Association of South Africa (HASA)

The industry body which represents the vast majority of South Africa's private hospitals. HASA acts as the link between private hospitals and government, other local and international healthcare stakeholders, the media and public.

Public Health Association of South Africa (PHASA)

The PHASA wants to build an association of those involved in health and health-related activities to promote greater equity in health in South Africa. PHASA advocates equitable access to the basic conditions necessary to achieve health for all South Africans as well as equitable access to effective healthcare. PHASA will work with other public health associations and related organisations and advocate on national and international issues that impact on the conditions for a healthy society.

2.4. E-Waste

E-waste is electronic equipment/ products that connect with power plugs, batteries, which have become obsolete due to, advancement in technology; changes in fashion and style trends as well as and status; nearing the end of their useful life.

Figure 5: Types of E-waste

Table 5: Environmental dangers of E-waste

E-waste Sources	E-waste Components	Environmental Hazards	Health Effects
Cathode Ray Tubes (Used TVs, Monitors, ATM, & Video Camera etc.) Batteries, PVC Cables Paints	Lead, Barium & other heavy metals	Penetrate ground water & release toxic phosphor	Anaemia, Renal Toxicity, Insomnia
Batteries, Housings (covers) & Medical Equipment	Mercury	Air emissions as well discharge into rivers of glass dust	Renal Toxicity, Muscle Tumours, Mental Retardation, Cerebral Palsy
PVC & Polymer, Paints, Printing Inks, Electrical Transformers & Capacitors	Polychlorinated Biphenyls (PCBs)	Extreme pollution from production, of toxic chemical exposure during use, hazards from fires	Suppression of immune system; Damage to the Liver, nervous and reproductive systems

Organisations

The e-Waste Association of South Africa (eWASA) was established (2008) to manage a sustainable environmentally sound e-waste management system. The eWASA is a non-profit organisation that works with manufactures, vendors and distributors of electronic and electrical goods and e-waste handlers (including re-furbishers, dismantlers and recyclers) to manage e-waste effectively.

South African E-Waste Alliance (SAEWA) is a non-profit organisation which coordinates responsible management of the entire e-waste stream. They provide a (Southern African) a safe, reliable and equitable service delivery for both commercial business clients and individual households. SAEWA aim to offer a "one stop shop" solution for e- waste. E-waste is passed through a logistics chain of the most suitable and value adding members to maximise both the recovery of "function" and "material" in a cradle-to-cradle based waste management system.

The Department met with SAEWA to get a better understanding on the current state of e-waste management in the Western Cape. From a generation point of view, the United Nations generation data in South Africa is estimated to be between 0.30 to 2 million tonnes of e-waste with a conservative estimate 0.35 to 0.36 million tonnes using a 26% growth rate to do projections. There is however no data specific to the Western Cape. One area of concern is the lack of compliance with stringent regulations. Few recyclers are over the regulated threshold (treating of more than 500 kg of hazardous waste per day) and are required to have a waste license as processing of e-waste is a listed activity. Considering that 95% of e-waste recycling is informal and generally consist of 2-3 people along with the high cost of attaining a waste license, it is no surprise that there are licensed e-waste processors in the Western Cape because all of them are operating just under the licensing threshold. There are certain processors in the country that use sophisticated smelters as well the wet leaching process to separate valuables. From a market point of view, printed circuit boards are valuable and there are some companies processing nationally however, most valuables are sent abroad and hence, as a country, we are not getting the benefits. The Department plans to conducts a status quo on e-waste in the province in the 2017/18 financial year to gain more insight into this waste stream.

2.5. Schools and Tertiary institutions

Schools

Key hazardous waste types at secondary schools include expired chemicals, waste from laboratory experiments, fluorescent tubes, asbestos and electronic waste. This section will however focus only on the chemical aspect of hazardous waste generate at schools as the latter three waste types have already been discussed.

A meeting was conducted with Donald Francis of the Western Cape Education Department (WCED) on 18 July 2016 in order to obtain more information regarding chemical waste management at schools in the province. It was indicated that in 2012, the WCED commenced a pilot project, which entailed the removal of some of the waste chemicals by a waste service provider at government owned secondary schools. The pilot project was initiated in the Metro North WCED District (figure 8). Owing to financial constraints, only a small portion of chemicals meeting certain criteria were removed (estimated at 25%) and not all of the schools in the district participated. The removal of known and unknown chemicals were based on the following criteria:

- The chemical is contaminated or it has melted/ solidified;
- The container is broken/ contents are leaking/ lid is cracked;
- There is evidence of a chemical reaction on the outside of the container;
- Other (evaluated at head office); and
- It should be noted that due to financial constraints, expired chemicals did not form part of the criteria for removal.

Following the success of the pilot schools chemical removal project in the Metro North District, the project was also carried out in the Metro South WCED District in 2015. A tender process is currently underway for the removal of chemical waste from schools in the Metro Central WCED District (as at July 2016).

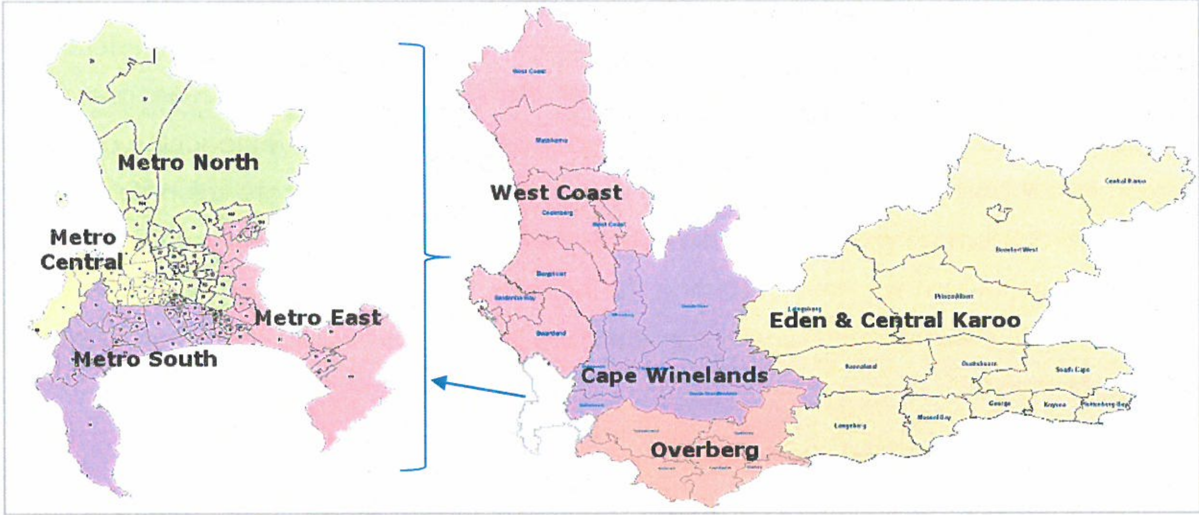

Figure 6: WCED School Districts

Source: adapted from WCED (undated)

Tertiary Institutions

A questionnaire was distributed to the four major tertiary institutions in the Western Cape in order to obtain information about the generation and management of hazardous waste. Three of the institutions responded and the information provided is displayed below for bio-hazardous, chemical and radio-active waste:

Bio-hazardous waste:

Bio-hazardous waste includes waste from infectious animals; bulk human blood products; microbiological waste; pathological waste; sharps; hazardous products of recombinant DNA bio-technology and genetic manipulation (Stellenbosch University, 2010). The source of bio-hazardous waste is from the Health Sciences, Science and Engineering faculties. The cost of removing and treating this waste type was indicated to be R56 668 for one of the universities (3263.48kg per month - average taken from 2011 up to and including 2015) and R42 353 (average over 4 months) for another university. Bio-hazardous waste is removed by service providers at various intervals depending on the arrangement with the university i.e. either every second day, weekly or monthly. Waste that is removed is incinerated and disposed of at Vissershok Hazardous Waste Management Facility. One of the institutions indicated that as part of their waste minimisation strategy, unused and out of date plastic ware was recycled.

Chemical waste:

Chemical waste includes flammable solvents (e.g. acetone, alcohols, acetonitrile); leachate toxic materials (e.g. heavy metals, pesticides); corrosives (e.g. hydrochloric acid, potassium hydroxide pellets); reactives such as oxidizers, cyanides, sulphides, explosives, unstable materials and water-reactive materials (e.g. sodium metal, benzoyl peroxide); toxic materials including mutagenic, carcinogenic, acute or chronic toxicity materials (e.g. chloroform, ethidium bromide); PCBs (>50 ppm concentration) and non-returnable gas cylinders (Stellenbosch University, 2010). The sources of chemical waste includes the Health Sciences, Science and Engineering faculties. One of the universities indicated that a total of 3291.12L of chemical waste is disposed of per month on average at a cost of R65 362.04 per month (average taken from 2011 up to and including 2015). Another institution indicated that they dispose of approximately 175L of chemical waste on a monthly basis, however calculating the overall cost of disposal of chemical waste at this institution was not available since each laboratory manages its own hazardous waste disposal budget. Removal of chemical waste from universities ranges from monthly to six (6) monthly basis, depending on the particular university's arrangement with the service provider. Chemical waste is disposed of at Vissershok Hazardous Waste Management Facility with one of the treatment methods being encapsulation.

One of the institutions indicated that they are considering using safer alternatives and that some solvents are being recovered as part of their internal waste minimisation strategy. Off-site the recycling of oil is also taking place. Issues highlighted with managing this waste type include high costs, lack of alternatives to landfill in the province and changes to the requirements for disposal at WDFs. A particular institution also highlighted that there was a large backlog of chemicals that were used by researchers who have since left, these are often not labelled, making disposal challenging.

Radio-active waste:

Radioactive waste is generated by the Science and Health Science Faculties. Radio-active waste is grouped into high, low and intermediate levels. Low and intermediate level waste includes items that have come into contact with some radiation (Stellenbosch University, 2010). High level waste includes mostly spent fuel from reactors (IAEA, undated). Radio-active waste is generally found in low quantities at institutions, with one of the institutions disposing of 5kg of radioactive sharps on a monthly basis. Another institution indicated that it is hard to ascertain how much radio-active waste is being generated since sealed sources are seldom removed and disposed of. The South African Nuclear Energy Corporation SOC Ltd (NECSA) did however remove some of the waste in 2015 at no cost. Radio-active waste with a short half–life is stored until decayed and no longer radio-active, where after it is disposed of as hazardous chemical waste. The university is planning the removal of low-level radio-active waste to be disposed of at Vaalputs radioactive WDF in the Northern Cape. The large distance to the Vaalputs WDF makes disposal of this waste costly. One of the institutions indicated that they intend to move away from radioactive to fluorescence methods to reduce the generation of this waste type.

2.6. Tanneries

A tannery is where animal skins and hides are processed to produce leather which is durable and less susceptible to decomposition. The animal hides and skins are recovered from slaughterhouses and farms (livestock) and to a lesser extent from wild animals and reptiles.

Tanning hide into leather involves a process which permanently alters the protein structure of animal skin and it can be performed with vegetable or mineral methods as well as chrome. The leather manufacturing process is divided into four main categories:

- Pre-tanning operations (hide and skin storage as well as beamhouse operations);
- Tanning (tanyard operations);
- Post-tanning (wet- finishing operations); and
- Finishing operations.

Due to the chemicals used in the production processes, contaminants are found at each category in the form of solids, liquids and gasses. Chromium (Cr), sulphur, oils and noxious gas (methane, ammonia, and hydrogen sulphide) are the elements of liquid, gas and solid waste of tannery industries. The hair-removing process results in organic loads (measured as biochemical oxygen demand (BOD) and COD) and sulphide; and the chrome tanning method results in Cr (III) contamination. The Water Research Commission (WRC: 145 TT 44/90, 1989) also identifies chromium contamination and high chemical oxygen demand as the typical problems associated with tannery effluents, which pose risks to the environment and human health. Some tanneries may produce large amounts of solid waste contaminated with chromium such as hide scraps, skins, and excess fats.

3. Hazardous Waste Treatment

3.1. Physical methods

This refers to processes which enable different waste components to be separated or isolated for re-use or appropriate treatment or disposal. Physical treatment methods are generally simple and low cost, however the selection of a suitable process is dependent on the characteristics and physical form of the waste. The following are examples of physical treatment options:

- Filtration/ Centrifuging/ Distillation/ Reverse Osmosis/ Ion Exchange and flocculation - these phase separation processes are used to separate hazardous and non-hazardous components, e.g. metals in wastewater, neutralised acids and alkalis containing suspended metal hydroxides.
- Encapsulation - this method stabilises the hazardous waste and then incorporates it within a solid matrix such as cement concrete. This treatment method is a short-term solution as it is being phased out and will be prohibited as of 2021 according to the National Norms and Standards for the Disposal of Waste to Landfill Disposal (GN. No. R. 635 of August 2013).

3.2. Chemical methods

These methods refer to the treatment methods that are used to affect the complete breakdown of hazardous waste into non-toxic gases or, more frequently, to modify the chemical properties of the waste, for example, neutralisation of acidity or alkalinity. The following are examples of chemical treatment options:

- Neutralisation – involves the reaction of waste with an alkali or acid to obtain a neutral pH, for e.g. the addition of sulphuric acid to an alkaline waste or calcium carbonate to an acidic waste.
- Oxidation – is the reaction of waste with an oxidising agent, for e.g. the reaction of cyanide with sodium hypochlorite to produce carbon dioxide and nitrogen.
- Reduction – is the reaction of an inorganic waste with a reducing agent to a less hazardous compound, for e.g. the reduction of hexavalent chromium to the less hazardous trivalent chromium using ferrous sulphate.
- Hydrolysis – involves the decomposition of hazardous organic compounds, for e.g. certain pesticides with sodium hydroxide (caustic soda).
- Precipitation – is a reaction in which heavy metals are formed from a solution, for e.g. the use of lime, sodium hydroxide or sodium carbonate to precipitate metal ions.

3.3. Physico-chemical Treatment

Physico-chemical treatment is used to treat hazardous liquid, solid and sludge waste. The principal physico-chemical treatment operations are material conversion (e.g. neutralisation, oxidation and reduction) and material separation (e.g. filtration, sedimentation, distillation and ion exchange). Physico-chemical treatment plants can use many processes, some processes being common to several treatments. Physico-chemical processes are a useful way of concentrating certain hazardous wastes or transforming them into less problematic compounds (for further disposal or recycling).

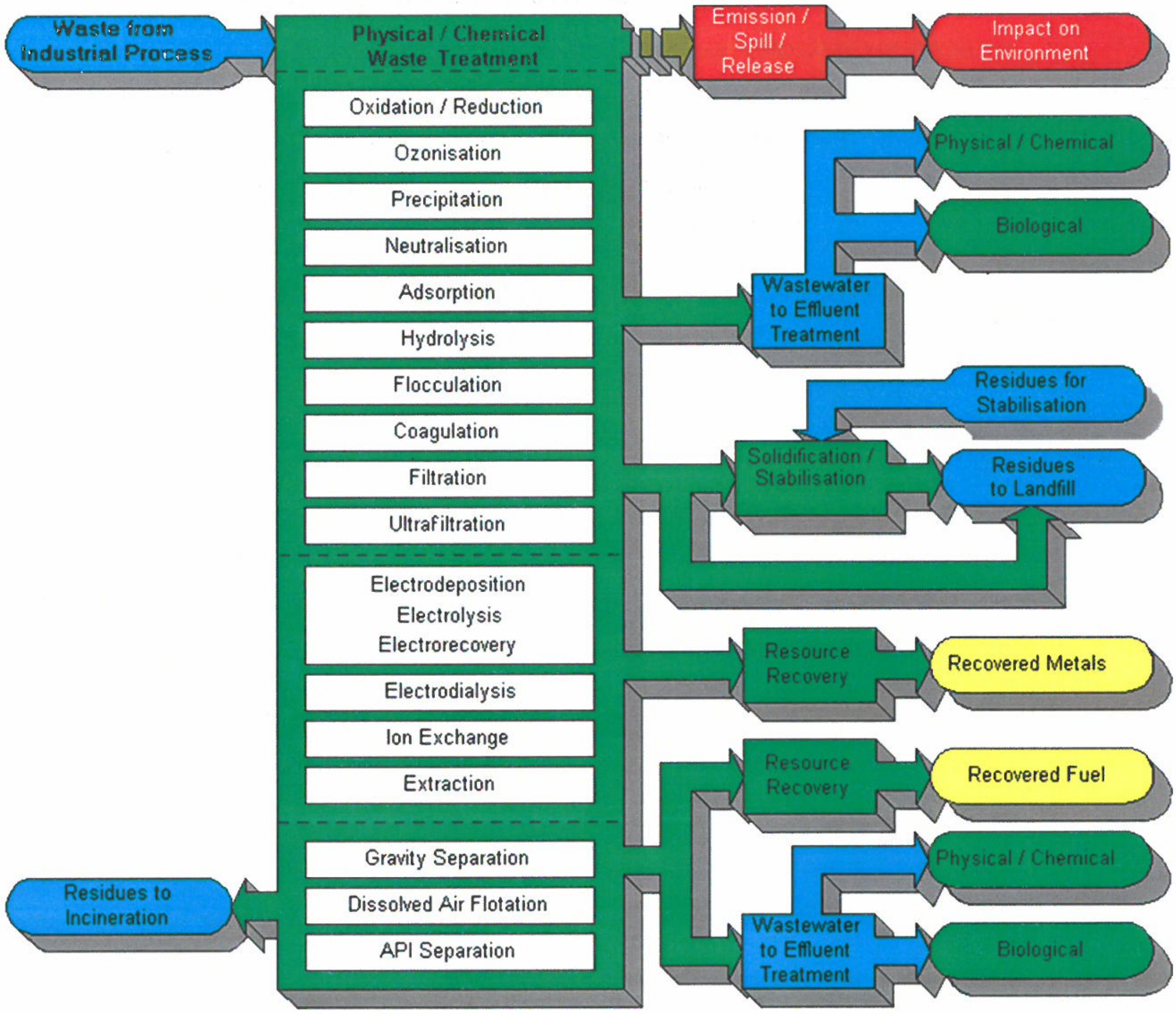

Figure 7: Physical/Chemical Waste Treatment Processes

(Source: UNEP- Training Resource Pack for hazardous waste management in developing economies)

3.4. Biological Treatment

Biological treatment, commonly referred to as bioremediation, is a process whereby waste materials are biologically degraded under controlled conditions. Using this treatment, bacteria is introduced into an environment where oxygen is present (aerobic) or oxygen-free (anaerobic). This is generally used for aqueous solutions containing organic contaminants and a more prominent treatment method when land or water pollution has taken place. In order for this treatment method to be used the following must be considered:

- Type of the organic contaminant must be able to be degraded by microbial action;
- Concentration of contaminant must not be in the extremes, if too low, concentrations may not support microbial growth whilst too high concentration may kill off the bacteria;
- Inhibitors and inorganics will inhibit microbial growth;
- Acclimatisation of microbes with waste is necessary; and
- Reaction times required for the treatment.

Some biological treatment methods/ technologies are:

- Bioventing/ Biosparging – is the process of increasing oxygen supply to soil.
- Land farming – is the introduction of bacteria to contaminated soil to remove oil products.
- Activated Sludge – where bacteria are cultivated in the treatment process, in the presence of oxygen, to break down organic matter into carbon dioxide, water, and other inorganic compounds. It is generally used for sewage or industrial wastewater.
- Bioleaching – is the use of bacteria on heavy metals in contaminated soil.
- Anaerobic ponds - are deep treatment ponds that exclude oxygen and encourage the growth of bacteria, which break down effluent[19]. The driving force behind the treatment is sedimentation[20]. Helminths (parasitic worms) settle to the bottom and bacteria and viruses are removed by attaching to settling solids. Bacteria and viruses also experience die-off as a result of loss of food or predation.[21]

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19 http://stabilizationponds.sdsu.edu/
20 Butler et al., 2015
21 Butler et al., 2015

- Anaerobic digestion –where bacteria are cultivated in an oxygen-free treatment process to break down organic matter into carbon dioxide and methane. It is used for organic waste and non-aromatic hydro carbons.

3.5. Thermal Treatment

These are processes where heat is applied to waste in order remove, break down or treat hazardous waste. Some examples of these are:

- Thermal desorption – where waste is heated to a temperature whereby the contaminants are evaporated and then condensed in order to be treated further or destroyed.
- Incineration/ co-incineration - is a high-temperature dry oxidation process that reduces organic and combustible waste to inorganic, incombustible matter and results in a very significant reduction of waste volume and weight.
- Electro Thermal Deactivation – is the use radio waves to destroy living cells and pathogens. It is used for HCRW such as, general medical waste, theatre waste and sharps.

3.6. Comparison of Treatment Methods

The type of treatment method and process selected is dependent on a number of factors, such as the concentration of the hazardous component(s), quantity of hazardous materials, physical form of hazardous waste (liquid, solid or mixture) as well as the operational costs of the treatment process. Table 7 below depicts an adapted table from the Technologies and Management Strategies for Hazardous Waste Control by the Office of Technology Assessment, USA.

Table 6: Technologies and Management Strategies for Hazardous Waste Control

Technology	Type of waste	Applications/Industry
Gravity settling	Slurries which separate phase solids	Pre-treatment in industrial wastewater process (Waste Water)
Filtration	Aqueous solutions with finely divided solids	Tannery water (Abattoirs/Meat)
Flotation	Finely divided solids	Oil/water waste, paper waste, mineral industry
Flocculation	Aqueous solutions with finely divided solids	Refinery, paper waste, mine industry

Distillation	Organic liquids	Solvent separations, chemical & petroleum industry
Evaporation	Organic/inorganic aqueous streams, slurries & sludge	Metal plating waste
Ultrafiltration	Heavy metal aqueous solutions	Metal coating
Carbon/resin absorption	Organic/inorganic aqueous solutions with low concentrations	Phenols (Chemicals)
Solvent extraction	Organic liquids, phenols, acids	Recovery of dyes (Chemicals)
Precipitation	Lime slurries	Metal plating waste water treatment
Reduction	Metals. Mercury in dilute streams	Chrome-plating solutions and tanning operations (Metals)
Dechlorination	PCB-contaminated oils	Transformer oils (Energy generation)
Thermal oxidation	Chlorinated organic liquids	Recovery of sulphur, HCL (Chemicals)

4. Waste Disposal

According to the National Standard for the Disposal of Waste to Landfill, 2013 there is waste that is currently, or will be prohibited from landfill disposal. Table 8 below shows some of the hazardous waste and their respective compliance timeframes:

Table 7: Waste prohibited or restricted from landfill disposal

Waste Prohibited or Restricted for Disposal	**Timeframe**
Waste which, in the conditions of a landfill, is explosive, corrosive, oxidizing (according to SANS 10234 or SANS10228).	Immediate - 2013
Waste with a pH value of <6 or >12	
Flammable waste with a closed cup flashpoint lower than 61°C	
Waste compressed gases (according to SANS 10234 or SANS 10228).	
Untreated Healthcare Risk Waste (HCRW).	
Infectious animal carcasses and animal waste	
Whole Waste tyres	
Lead acid batteries	Immediate- 2014
Hazardous waste Electric and Electronic Equipment (WEEE) – Lamps.	3 years - 2016

Re-usable, recoverable or recyclable used lubricating mineral oils, as well as oil filters	4 years- 2017
Re-usable, recoverable or recyclable used or spent solvents.	5 years - 2018
PCB containing wastes (>50 mg/kg or 50 ppm).	
Hazardous waste Electric and Electronic Equipment (WEEE) – Other.	8 years - 2021
Hazardous waste with a calorific value of: (i) > 25 MJ/kg. (ii) > 20 MJ/kg. (iii) > 10 MJ/kg. (iv) > 6% TOC	 4 years - 2017 6 years - 2019 12 years - 2025 15 years- 2028

Hazardous Waste classified in terms of the Minimum Requirements 1998 may be accepted and disposed of as set out in the table below for a period not exceeding three (3) years after the date of coming into operation of the regulations (August 2016.)

Table 8: Disposal requirements as per Minimum requirements (1998)

Waste	Disposal Requirements
Hazardous Waste- Hazard Rating 1 or 2	Class A or HH
Hazardous Waste- Hazard Rating 3 or 4	Class A or Hh
Hazardous Waste- Delisted	Class B or GLB +
General Waste	Class B or G S/M/L B-/B+

In order to dispose of hazardous waste at a landfill, the Norms and Standards for the Assessment of Waste for Landfill Disposal, 2013 must be followed. These Norms and Standards prescribe the requirements for the assessment of waste prior disposal to landfill. The regulation states that the total and leachable concentration of elements and compounds must be used to determine the type of waste. The following four step method can be used determine the type of waste:

- Identify chemicals in waste by means of analysis, at an accredited laboratory;
- Analyse to determine the Total Concentration (TC)and Leachable Concentration (LC);
- Compare TC & LC to organic, inorganic and metal leachable concentration threshold (LCT) limits;

  Depending on where actual concentrations fall as compared to threshold limits, the type of waste is determined as per the table below.

Table 9: Determining waste types for landfill disposal

Type of Waste	Element or Chemical Substance Concentration
Type 0	LC > LCT3 OR TC > TCT2
Type 1	LCT2 < LC ≤ LCT3 OR TCT1 < TC ≤ TCT2
Type 2	LC T1 < LC ≤ LCT2 AND TC ≤ TCT1
Type 3	LCT0 < LC ≤ LCT1 AND TC ≤ TCT1
Type 4	LC ≤ LCT0 AND TC ≤ TCT0 for metal ions and inorganic anions AND all chemical substances are below the total concentration limits provided for organics and pesticides listed.

After the concentration threshold limits have been determined, the National Standard for the Disposal of Waste to Landfill (R 636) must be followed. As per the regulation, the disposal requirements can be determined according to the following table:

Table 10: Disposal requirements for Hazardous Waste types

Waste Risk Level	Disposal Requirements
Type 0: Very High Risk	Disposal NOT ALLOWED. The waste must be treated first and then re-tested to determine the risk profile for disposal.
Type 1: Moderate Risk	Disposal only allowed at a landfill whit a Class A or Hh/HH containment barrier design.
Type 2: Moderate Risk	Disposal only allowed at a landfill with a Class B or GLB+ containment barrier design (or Class A).
Type 3: Low Risk	Disposal only allowed at a landfill with a Class C or GLB+ containment barrier design (or Class B or A).
Type 4: Inert Waste	Disposal allowed at a landfill with a Class D or GSB+ containment barrier design.
Non-hazardous Waste (Pre-classified)	Disposal only allowed at a landfill with a Class B or G S /M/L B-/B + containment barrier design.

The Vissershok waste management facilities in Cape Town, managed by Enviroserv and WasteMan and the municipality respectively, and a facility at PetroSA in Eden District, are the only sites commercially used for hazardous waste disposal in the Western Cape. The PetroSA waste disposal facility serves the PetroSA operations located in Moss Industria (Mossel Bay) for hazardous waste but also has a facility that caters for the greater Eden area with regards to general waste disposal. Seven chemical treatment technologies, including dechlorination, electrolysis, hydrolysis, neutralisation, oxidation, precipitation and reduction, are present in the province. Biological treatment technologies are not commonly used in the Western Cape, however when applied, they are used for the treatment of organic effluents and spills[22]. Based on engagements with management of the Enviroserv Vissershok WMF, it is estimated that there is 10 years of remaining airspace, considering this facility deals with the bulk of the hazardous waste in the province, this is a very short timeframe. The facility is currently being expanded to increase its disposal capacity. The CoCT Vissershok South site provides an estimated 15 million additional m3 of airspace (current plus future expansion) which can be developed to accept medium to low grade hazardous waste.

Below is a list of the operational facilities which can be used, depending on the waste type:

Table 11: Waste Facilities in the Western Cape

Name/Area	Type of facility	Old	New
City of Cape Town Vissershok	WDF	H:h	Class A
Enviroserv/ Averda Vissershok	WMF	H:H	Class A
PetroSA Mossel Bay	WMF	H:H	Class A

5. SWOT Analysis

Using the information gained, a strength, weaknesses, opportunities and threats (SWOT) analysis was conducted. The main purpose of a SWOT analysis is to identify positive and negative factors in each category and how it would affect the current situation. This will be a useful tool in summarising the state of hazardous waste management and facilitate the formulation of goals and strategies. It is important when using this tool to specify what the situation is. In this case the situation is, the state of hazardous waste in the Wertern Cape. Internal environment is defined as the state of hazardous waste management witin the province and external is factors like international treaties , national legislation, state of economy etc.

[22] State of Environment Outlook Report for the Western Cape Province, Waste Management Chapter (2013)

Internal	**Strengths** • Availability of information on IPWIS & BizBrain • Quality and detail of Enviroserv's Vissershok reported data • Private and Government corporation on acceptance on HW from generators, depending on their registration • ROSE foundation used oil collection • Compliant asbestos disposal • HCRW reporting has improved	**Weaknesses** • Low level & accuracy of reporting throughout the HW value chain • Limited airspace remaining at Class A landfills • Management of household hazardous waste • No representative and/or regulated body for chemical HW • Lack of understanding and awareness of regulations by all stakeholders • Treatment options for sewage sludge • Complexity of e-waste stream, no accurate quantities • Over regulation of certain technologies (e.g. composting, e-waste) • Lack of enforcement ito Disposal of Waste to Landfill (R 636) • Lack of resources at provincial level to deal with HW
External	**Opportunities** • Improve communication between national and DEA&DP wrt hazardous waste into our borders • Use WG platform to advocate for change in regulations • Industry Waste Management Plans for larger generators of HW • Limited facilities for HCRW treatment • Industry plan for E-waste, representative PRO • Use of WISP, RAG for further engagement	**Threats** • New risk averse national regulations on landfill liner requirements • Limited supporting infrastructure for testing of materials (labs etc.) • Large quantities of Inorganic & organic waste needing treatment/disposal • Asbestos contamination of C&D waste • Poor management of HW at schools (funding, prioritising) • Lack of compliance ito Disposal of Waste to Landfill (R 636) • Limited HW treatment options within the province • Limited airspace available at all HW facilities.

6. Conclusion

As with most waste related matters, information is key. One cannot determine the status quo of hazardous waste management without having meaningful information. Whilst IPWIS provides a platform for the reporting of hazardous waste, the system is only as good as the information that is reported. With low levels of consistent and accurate reporting, credible and accurate information is a challenge.

Steady progress has been made in this regard especially with HCRW but this has to be expanded to other hazardous waste types. The analysis of the data reported thus far has enabled DEA&DP to identify the waste types that are most frequently treated and/or disposed and to also identify the major generators of these waste types. The shortage of hazardous WMFs in the province and the decrease in available airspace is a major concern and every effort must be made to minimise waste to landfill, according to the waste hierarchy.

Strict regulations limit the ability of some companies to operate in a compliant and sustainable manner within the waste economy. There are existing platforms that DEA&DP will use to promote hazardous waste awareness and minimisation. Some waste streams are particularly challenging, the large quantities of firstly inorganic solid waste and secondly sewage sludge require attention.

E-waste management within the province will be further explored in the 2017/18 financial year. The DEA&DP will work closely with Green Cape, the National Cleaner Production Centre and other government institutions to maximise support to hazardous waste generators by looking at suitable alternatives.

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www.samfa.org.za/About_us.html

www.rosefoundation.org.za

www.eolss.net/eolsssamplechapters/c06/e6-13-04-05/e6-13-04-05-txt-4.aspx#CHEMISTRY_OF_WASTEWATER_)

water.worldbank.org/shw-resource-guide/infrastructure/menu-technical-options/wastewater-treatment

www.brighthub.com/environment/science-environmental/articles/68537.aspx

www.epa.gov/asbestos/learn-about-asbestos

www.asbestos.com/exposure

http://stabilizationponds.sdsu.edu/

SIGN-OFF

I hereby approve the Hazardous Waste Status Quo Report

Eddie Hanekom

Director: Waste Management

Date: 28-03-2017