PUBLIC MEETING: BACKGROUND INFORMATION DOCUMENT

The Storage and Treatment of Health Care Risk Waste using a Converter and a Boiler that Generates Steam for an Autoclave in Seshego, Polokwane

Project Reference Numbers:
Storage (Basic Assessment) - 12/9/11/L599/5
Treatment (Scoping EIA) - 12/9/11/L600/5

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DOCUMENT CONTROL SHEET

DOCUMENT: The Storage and Treatment of Health Care Risk Waste using a Converter and a Boiler that Generates Steam for an Autoclave in Seshego, Polokwane

REVISION	PREPARED BY	REVIEWED AND APPROVED BY
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SIGNED:		
DATE:		

REVISION	PREPARED BY	REVIEWED BY	APPROVED BY

GLOSSARY OF TERMS

Disposal
The burial, deposit, discharge, abandoning, placing or release of any waste into, or onto, any land.

Generators
Organisations and their associated personnel (including for example, owners, staff and board members) as follows:

- Acupuncturists and other similar premises where alternative medicine is practised;
- Ambulance and special emergency service depots;
- Clinics for medical, dental or similar purposes;
- Dental hospitals, surgeries and laboratories;
- Funeral undertakers and morticians;
- General practitioner clinics;
- Health centres;
- Hospitals;
- Medical research institutions;
- Pathological and microbiological laboratories;
- Pharmaceutical manufacturers and pharmacies;
- Residential and dedicated nursing homes;
- Specialist medical practitioners ;
- Tattooists, body piercers; and
- Veterinary hospitals, surgeries, clinics, laboratories and pet shops.

Hazardous Waste
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.

Health Care General Waste (HCGW)
Means the non-hazardous component of waste generated by a generator and can include liquids, but excludes the following:

- health care risk waste; and
- isolation waste.

Health Care Risk Waste (HCRW)
Means waste capable of producing any disease and includes but is not limited to the following:

- laboratory waste;
- pathological waste;
- isolation waste;
- genotoxic waste;
- infectious liquids and infectious waste: all kinds of waste likely to contain pathogenic microorganisms;
- sharps waste: needles, sharps and pricking objects that may cause injury as well as infection;
- chemical waste; and
- pharmaceutical waste.

Health Care Waste (HCW)
Means health care general waste and health care risk waste.

Incineration
Any dedicated method, technique or process to convert waste to flue gases and residues by means of thermal oxidation.

Infectious waste
Discarded materials from health-care activities on humans or animals which have the potential of transmitting infectious agents to humans. These include discarded materials or equipment from the diagnosis, treatment and prevention of disease, assessment of health status or identification purposes, that have been in contact with blood and its derivatives, tissues, tissue fluids, or wastes from infection isolation
wards.

Interested and Affected Parties (I&APs)
Includes –
(a) any person, group of persons or organisation interested in or affected by an activity; and
(b) any organ of state that may have jurisdiction over any aspect of the activity;

Non-combustion
Any method, technique or process for microbial inactivation or for otherwise altering the biological, chemical or physical characteristic of health care risk waste so as to sterilize such health care risk waste by any means of technology which does not constitute incineration.

Pathological (otherwise known as anatomical) waste includes the following:

- deceased animals or animal parts infected with zoonotic diseases;
- human and animal tissues, organs, body parts, blood, fluid blood products and body fluids;
- containers or equipment containing blood that is fluid or blood from animals known or suspected to be infected with any zoonotic disease; and
- human foetuses; but excludes teeth, hair, and animal carcasses generated by the public;

Treatment
Any method, technique or process that is designed to (i) change the physical, biological or chemical character or composition of healthcare risk waste, or (ii) remove, separate, concentrate or recover a hazardous or toxic component of healthcare risk waste, or (iii) destroy or reduce the toxicity of healthcare risk waste, in order to minimise the impact of the waste on the environment prior to further use or disposal.

Waste Management Hierarchy
The Waste Management Hierarchy reflects the different waste management options (reduction, re-use, recycling, recovery, treatment/destruction, and disposal) that should all form part of an integrated waste management system.

EXPERTISE AND DETAILS OF THE PERSON WHO PREPARED THIS BACKGROUND INFORMATION DOCUMENT FOR THE PUBLIC MEETING

An independent environmental impact assessment consultant has an important role to play in preparing environmental documents for environmental authorities and the public. In order to undertake an Environmental Impact Assessment (EIA), the appointed consultant should have the following experience, qualifications and experience:

- Report writing skills that can be verified through examples of the auditor's written work.
- Proven written and communication skills.
- Experience in environment, health and safety conformance compliance.
- At least a first degree in an area related to the area of study, together with an appropriate length of recent professional experience in the field.
- Be registered with a professional body and or approved by a government authority.

This document was prepared by Chantel Minnaar (six yrs experience) and was approved by the EAP and Managing Member, Lorraine Hodge. Academically Chantel has a Masters in Biomedical Technology and has successfully completed courses in Environmental Management Systems and Environmental Aspects and Impacts. Chantel is also a course developer in occupational health, safety and environmental courses.

STATEMENT OF INDEPENDENCE AND CAPACITY

The EIA consultant, Lorraine Hodge, has been actively involved in the environmental, health and safety field since 1991 and has undertaken the environmental impact assessment process as well as public participation processes centering on waste management projects.

Academically Lorraine has a PhD in Applied Community Science.

Lorraine is registered with the Southern African Institute for Occupational Hygiene and is a member of the Waste Management Institute of southern Africa.

Lorraine is contracted by the University of South Africa to supervise postgraduate students in the fields of environmental science, health and safety and has also been appointed as an external examiner. The appointed EAP feels confident that the EIA process, required is within her knowledge, skills and understanding of the waste management sector, and that she has the ability to objectively undertake this task for Buhle Waste (Pty) Ltd.

SIGNED:…… **DATE:……..**

1. INTRODUCTION

Hindoc was contracted by the applicant Buhle Waste (Pty) Ltd to undertake two Waste Management Licenses:

1. **The Transport of Hazardous Waste and the Storage thereof in Seshego, Polokwane**
   Basic Assessment Procedures Applies - Reference Number: 12/9/11/L599/5

2. **The Treatment of Hazardous Waste in Seshego, Polokwane**
   Scoping and Environmental Impact Assessment Procedures Applies - Reference Number: 12/9/11/L600/5

The public meeting deals with the Storage and Transport (Basic Assessment) and the Treatment (Scoping EIA) of health care risk waste (HCRW). The Basic Assessment process will run parallel with the Scoping EIA process as the proposed projects take place on the same premise. The processes fall under different listed activities and are required to be followed by the Department of Environmental Affairs (DEA).

Tables 1 and 2 lists the activities of the National Environmental Management: Waste Act 2008 (No. 59 of 2008) that the proposed projects fall under:

Table 1: Basic Assessment Listed Activities

INDICATE THE NO. & DATE OF THE RELEVANT NOTICE:	ACTIVITY NUMBERS (AS LISTED IN THE WASTE MANAGEMENT ACTIVITY LIST) :	DESCRIBE EACH LISTED ACTIVITY:
Notice 113 of Dec 2010	Category A (2)	Storage of Hazardous Waste: Buhle Waste (Pty) Ltd will be storing hazardous waste in an enclosed warehouse facility in Seshego in excess of 80m^3
Notice 113 of Dec 2010	Category A (18)	The construction of facilities for the storage of hazardous waste.

Table 2: Scoping EIA Listed Activities

INDICATE THE NO. & DATE OF THE RELEVANT NOTICE:	ACTIVITY NUMBERS (AS LISTED IN THE WASTE MANAGEMENT ACTIVITY LIST) :	DESCRIBE EACH LISTED ACTIVITY:
Notice 113 of Dec 2010	Category B (5)	Buhle Waste (Pty) Ltd proposes the treatment of hazardous waste using a converter and autoclave unit at Seshego industrial site with a capacity to treat in excess ·of I ton of hazardous waste per day.
Notice 113 of Dec 2010	Category B (8)	Buhle Waste (Pty) Ltd proposes the treatment of Health Care Risk Waste (general infectious waste, sharps, anatomical waste and pharmaceutical waste) using a converter and autoclave unit.
Notice 113 of Dec 2010	Category B (11)	Buhle Waste (Pty) Ltd proposes the construction of the converter and autoclave plant at Seshego industrial site for the treatment of Health Care Risk Waste (general infectious waste, sharps, anatomical waste and pharmaceutical waste)

THE NEED OF THE PROPOSED PROJECTS

Due to the increased population growth and urban and industrial development in Polokwane, Limpopo, there is an increased demand for waste service provision in terms of storage and collection facilities and services, handling and transportation, treatment and ultimately disposal services and facilities.
(www.environment.gov.za/.../Chapter%209%20**Waste**%20Management.pdf)

A lack of HCRW storage and treatment facilities together with the continuous increase of HCRW generation could result in the HCRW being disposed of illegally and in turn cause severe environmental pollution. A report published on 31 August 2007 by the Department of Economic Development, Environment and Tourism (Limpopo Provincial Government) made known that the Department discovered an illegal dumping site into an illegal medical waste disposal site. Medical waste is classified as hazardous waste in terms of Environment Conservation Act, which is not allowed to be disposed at any waste site but only in the prescribed site which is Holfontein in Johannesburg. Environmental reports on the state of Limpopo reveal that it consists of an estimated 5.2 to 5.4 million people served by more than 50 hospitals or major medical centers and clinics. The major health problems are Tuberculosis, HIV/AIDS, sexually transmitted disease, upper respiratory tract infections, diarrhea, bilharzia and malaria and other conditions which increase the pressure for the demand of waste service.
(www.**environment**.gov.za/soer/reports/limpopo.html) Currently HCRW is collected at the health care facilities and then transported to Gauteng for treatment and disposal.

The proposed storage and treatment facility is located in the industrial area of Seshego at No 52, Freedom Drive, Zone 6, Polokwane, Limpopo Province. HCRW is proposed to be treated using a converter and autoclave units. These technologies are further discussed.

2. RELEVANT LEGISLATION

Relevant statutes in South Africa that applies to the proposed projects are listed below:

- Constitution of the Republic of South Africa, Act 108 of 1996
- The Environment Conservation Act (Act 73 of 1989) in Section 20 defines the role of DWAF in permitting waste treatment facilities. In turn, DWAF has given effect to its responsibility for the permitting of waste disposal facilities through the formulation of the "Minimum Requirements" Series of documents that state the requirements, standards and procedures that apply in the permitting of waste disposal facilities. However, the Minimum Requirements do not deal with health care risk wastes adequately and a draft policy was produced by DWAF to issue permits for incinerators and alternative waste disposal technologies
- Hazardous Substances Act 15 of 1973
- National Environmental Management Act 107 of 1998 (NEMA)
- Environmental Impact Assessment Regulations (June 2010), R. 543
- National Environmental Management: Waste Act 59 of 2008 (NEMWA)
- Waste Management Activities (December 2010) in accordance with 20(b) of NEMWA
- National Nuclear Regulator Act 47 of 1999
- National Road Traffic Act 93 of 1996
- National Water Act 36 of 1998
- Nuclear Energy Act 46 of 1999
- Occupational Health and Safety Act (OHSA) 85 of 1993
- The National Environmental Management Act: Air Quality Management Act
- National Building Regulations and Building Standards Act 103 of 1977
- The National Waste Management Strategy, 2000
- Draft HCRW Management Policy and HCW Management Regulations

3. DESCRIPTION OF THE PROJECT

Buhle Waste (Pty) Ltd has made a Waste Management License application to the DEA authorities for the collection of HCRW from generators in Polokwane, Limpopo, the storage thereof and treatment of using an autoclave and converter units in the Seshego industrial domain.

THE AUTOCLAVE

Steam Sterilization such as autoclaves is an efficient wet thermal disinfection process. They are commonly used for highly infectious waste, such as microbial cultures or sharps. Minimum contact times and temperatures will depend on several factors such as the moisture content of the waste and ease of penetration of the steam. Research has shown that effective inactivation of all vegetative microorganisms and most bacterial spores in a small amount of waste (about 5–8kg) requires a 60-minute cycle at 121℃ (minimum) and 1 bar (100kPa); this allows for full steam penetration of the waste material. By increasing steam, the pressure and temperature inactivates microorganisms in shorter time periods.

AUTOCLAVE OPERATING CYCLE

A typical operating cycle for an autoclave involves the following:

- **Waste collection**: A waste cart is lined with special plastic liners or large autoclavable bags to prevent waste from sticking to the container. Red bags are then placed in the lined container.
- **Pre-heating of the autoclave**. Steam is introduced into the outside jacket of the autoclave.
- **Waste loading:** The waste carts are loaded into the autoclave. Periodically, chemical or biological indicators are placed in the middle of the waste load in the autoclave to monitor disinfection. The charging door is closed, sealing the chamber.
- **Air evacuation:** Air is removed from the autoclave through pre-vacuuming as explained above.
- **Steam treatment:** Steam is introduced into the autoclave chamber until the required temperature is reached. Additional steam is automatically fed into the chamber to maintain the temperature for a set time period.
- **Steam discharge:** Steam is vented from the autoclave chamber, usually through a condenser, to reduce the pressure and temperature. A post-vacuum cycle is used to remove residual steam.
- **Unloading:** Usually, additional time is provided to allow the waste to cool down, after which the treated waste is removed and the indicator strips, are removed and evaluated.
- **Shredding:** After treatment, the autoclave bins are removed from the autoclave using a forklift and transported to the shredding station. Shredded material discharges to a leak-proof skip container which is placed below the discharge point of the shredder. There is no change of state of the waste in the autoclaving process. The material is merely sterilised using live steam at a moderately high pressure. Blood and serum wastes clot or coagulate as the proteins denature at high temperature and any free moisture, that might have been present in the incoming waste, will be blended during the shredding of the sterilised waste. The treated waste is stored in a bulk container and covered with a reinforced plastic cover before being hauled to the approved landfill. Spare containers are available to facilitate efficient processing cycles and allow sufficient slack time in the system so that the haulage of processed sterile HCRW to the landfill does not constrain the processing cycle.
- **Validation of Sterility:** Spore testing is carried out to evaluate the sterility of the process by introducing test phials with the waste into the autoclave. Only spore testing is accepted in developed countries as proof of the effectiveness of the process and the level of sterility achieved. This is due to the fact that the selected organisms, *Bacillus subtilis* and *Bacillus stearothermophilus* are among the more resistant aerobic spore forming bacteria known to microbiologists whereas the species listed in the DWAF guideline are all easily killed at 70℃. Thus the species list suggested by DWAF which included *Escherichia coli, Streptococcus faecalis, Proteus vulgaris,* other *Proteus sp, Klebsiella aerogans, Alcaligenes faecalis, Micrococcus spp, Staphylococcus aureus, Staphylococcus*

albus, Pseudomonas aeruginosa, candida albicans and an assortment of viruses such as Hepatitis B, HIV and cell material containing HIV infected cells will not be used. At the end of the cycle, the phials containing test organisms are recovered from the load. The soybean-casein digest broth medium is incubated for 48 hours at 30℃ for *Bacillus subtilis* and 55℃ for *Bacillus stearothermophilus*. The media are examined for turbidity as a sign of bacterial growth. Any growth should be sub-cultured to identify the organism either as the test micro-organism or as an environmental contaminant due to poor aseptic technique.

Waste is loaded into carts lined with hessian or plastic to facilitate unloading. Once the waste carts have been placed in the autoclave the vacuum system is started to evacuate air from the vessel ensuring that steam can be introduced without a blanketing effect. Steam is introduced until the desired temperature in the vessel is attained. The vessel is then held at temperature for the required time to achieve sterilisation. Waste is removed by wheeling the cart from the autoclave vessel. The State and Territorial Association on Alternative Treatment Technologies (STAATT) met in 1994 to develop consensus criteria for medical waste treatment efficacy. Level III was selected as the recommended minimum criteria by STAATT. A 10^6 reduction (or a 10^6 kill) is equivalent to a one millionth survival probability in a microbial population or a 99.9999% reduction of the given micro-organism as a result of the treatment process. The autoclave achieves this (Log 6 – 8).

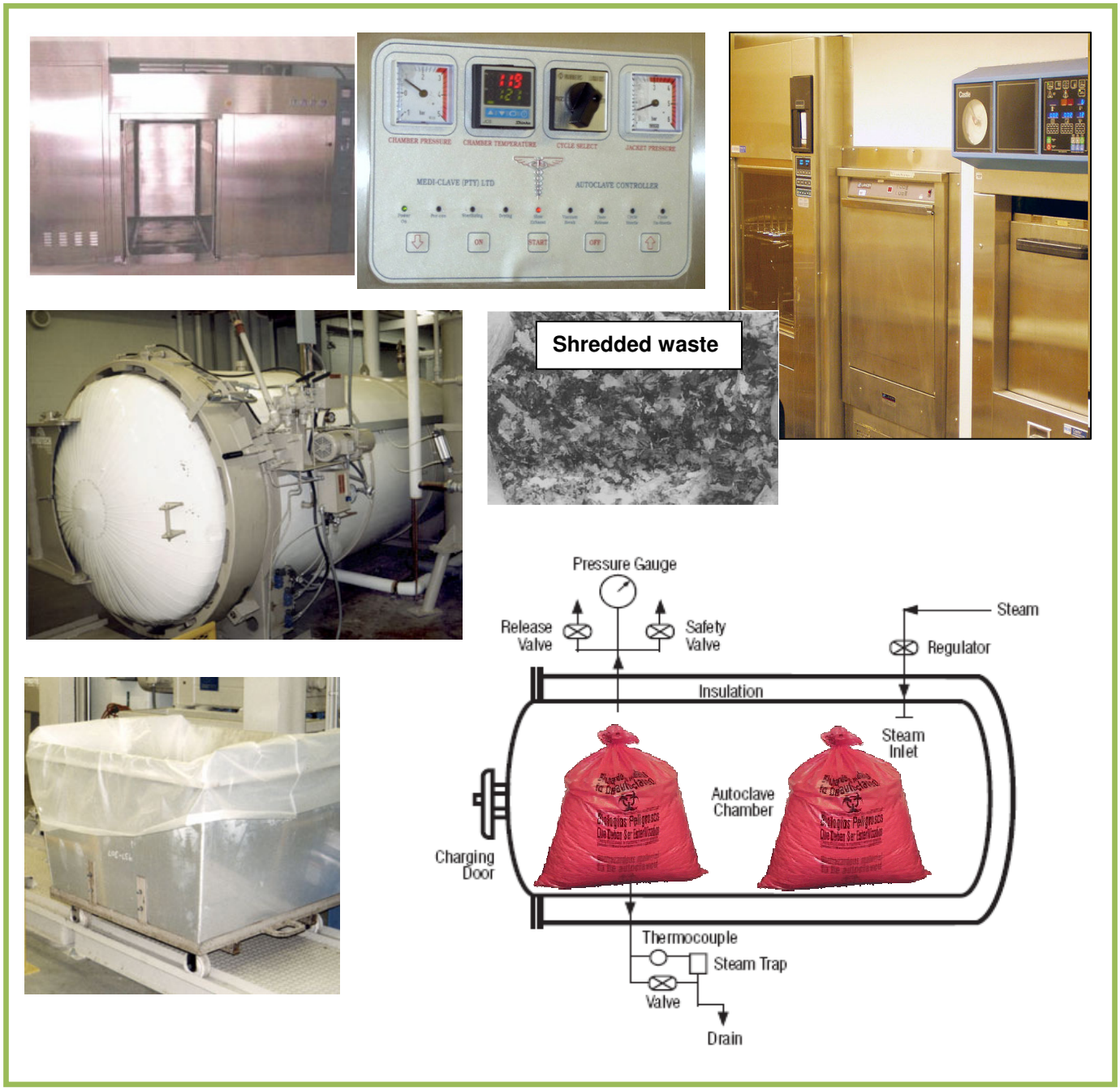


Figure 1: Photos depicting examples of autoclaves, their accessories and end products

Suitable treatment and disposal technologies according to the different categories of HCRW are presented in the Table 3 below. The waste categories that are allowed to be treated using an autoclave are highlighted.

Table 3: Type of HCRW that can be treated using an Autoclave unit

Waste category	Rotary kiln	Two chambers pyrolytic incineration	Single chamber incineration	Wet thermal treatment	Chemical disinfection	Microwave irradiation	Sanitary landfill
Non-risk HCRW	N/A	N/A	N/A	**N/A**	N/A	N/A	N/A
Human anatomical waste	YES	YES	YES	**NO**	NO	NO	NO
Waste sharps	YES	YES	YES	**YES**	YES	YES	**YES** for small quantities **with encapsulation**
Hazardous Pharmaceutical waste	YES	NO Small amount only	NO	**NO**	NO	NO	NO **YES** for small quantities **with inertization**
Cytotoxic pharmaceutical waste	YES	NO **YES** for modern ones	NO	**NO**	NO	NO	NO **YES** for small quantities **with inertization**
Infectious waste	YES	YES	YES	**YES**	YES	YES	YES
Highly infectious waste	YES	YES	YES	**YES**	YES	YES	NO **YES** only after pre-treatment
Other hazardous waste	YES	NO	NO	**NO**	NO	NO	NO **YES** if specially designed
Radioactive health-care waste	NO	NO	NO	**NO**	NO	NO	YES Specially designed

THE CONVERTER

Incinerators are the main method of treating clinical and other bio-hazardous waste. This method has proven to be both costly and ineffective in dealing with this waste stream. Medical waste incinerators emit a wide range of pollutants besides dioxins and furans and also generate highly contaminated ash that is potentially hazardous to human health. It is scientifically acknowledged that these pollutants can have serious negative effects on the health of incineration plant personnel, the general public and the environment. Although incineration is still widely used, non-incineration technologies are winning an increasing amount of support. The chosen non-incineration technology is the Converter (related to the autoclave), simply because it converts and sterilizes entire bio-hazardous waste into a useful granular fuel or fertiliser. The Converter plant is a fully automated and totally sealed system. The Converter provides treatment sterility with any level of bacterial charge, bearing in mind that sterility is not the only disinfections end result. There is also a reduction of waste volume and a reduction in weight as with the autoclaved and shredded waste. This makes the output material easier to handle and transport. The Converter plant output is dry and therefore not fermentable. It contains no odour and suitable for long storage and is easy to transport without any danger of spillage. The treated waste no longer contains pricking or sharp parts, and it can be even hand held without any risk and without having to pack it in airtight or watertight containers. Clinical Waste Solutions (CWS) in Botswana treats clinical waste using the Converter Technology. The converter sterilizers are also used in several hospitals and waste treatment facilities, including Italy, Romania, China, Brazil, Turkey, Russia, Cuba and Canada, who have approval from the Minister of Environment (http://www.tradeboss.com/default.cgi/action/viewproducts/productid/81337/productname/Converter/).

Operating Principle

The Converter is designed to treat hospital waste at high temperatures (155°C) in presence of water in both the liquid state and saturated vapour using a unique operating mode. This method allows the Converter to obtain the sterilising temperature and wet conditions without the use of high pressure. Figure 2 shows the process cycle of the Converter.

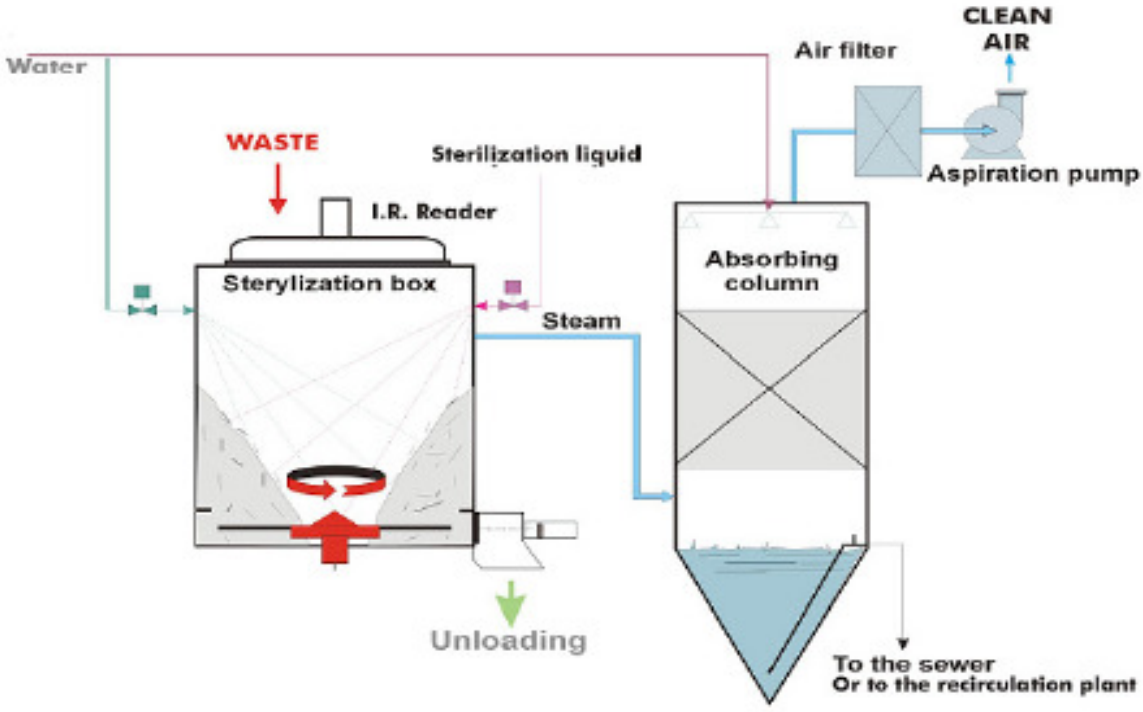


Figure 2: Process cycle of the Converter

Converter Operating Cycle

- The Converter machine is composed essentially of a cell with an internal rotor.
- The cycle begins when the closed packages containing the waste are loaded into the chamber.
- After loading the bags containing the waste, the chamber is sealed and the sturdy rotor equipped with blades located at the bottom of the chamber, starts to turn. The waste is immediately crushed as the rotor reaches speeds in excess of 1,500 R.P.M and the mass is simultaneously heated up.
- During the cycle, water is injected into the chamber in a controlled manner. The water comes into close contact with the surface of the hot material and evaporates, simulating the effect of "wet heat" sterilisation, without the need of any increase in pressure.
- Due to the waste being finely ground and mixed by the blades on the rotor, each portion of the waste is subjected to the same conditions: presence of liquid water and high temperatures determined in real time through the measurement of the infra-red emission of the material.
- At the end of the cycle, the mass is then cooled to about 100℃ through a further controlled injection of water (which completely evaporates) and the dry material obtained from the treatment is automatically discharged by centrifugal force.

What can the Converter Treat?

Most highly hazardous hospitals waste such as:

- **Infectious waste:** laboratory cultures, waste from isolation wards, excreta, materials in contact with infected patient, waste suspected to contain pathogens.
- **Pathological waste:** body parts, blood, fetuses, other body fluids, human tissues.
- **Sharps:** needles, infusion sets, knives, blades, glass.
- **Low level radioactive waste:** unused liquids from radiotherapy, glassware, absorbent paper, urine.

Microbial Inactivation Efficacy

The main purpose for the treatment technology is to decontaminate waste by destroying pathogens. Due to the unique sterilization properties of the converter, the bacterial reduction surpasses international standards at a level of 1×10^{45} in bacterial reduction factor. This proves that the product received from the converter after sterilization is of no harm, and will not cause any public health issues.

Advantages

The advantages of the Converter in comparison with other techniques are:

- Sterility and not only disinfection effects
- Sterility with any level of bacterial charge
- No limits for bacterial concentration level in the waste
- Reduction of waste volume to about 70% average
- Reduction in weight equal to the waste moisture content (30% average), with a saving on eventual disposal operations of treated material
- No release of polluting liquids from the process
- No release of odours and vapours
- A dry product is the final result, therefore non-fermentable, with a very light odour, suitable for long storage and transportable without dripping

- No sharp or pricking items are present in the treated product and can be handled without risk or packaging into air or watertight containers
- Useful in producing energy as the product has a high heating power
- Treatment occurs under a vacuum system, therefore no risk of aerosols being released into the environment
- No prior treatment process required before treatment by the Converter
- High level of safety in case of failure
- Easily manageable emergency system in case of failure
- No certifications or periodic checks, as needed for pressure vessels
- No need of concrete works (foundations)
- Easily transferable mono-block equipment
- No problems of electromagnetic compatibility

Converter technology is an environmentally-friendly alternative to other traditional means of waste disposal that include incineration, plasma arc, and landfill disposal in that waste conversion results in a small carbon footprint and avoids polluting emissions into the atmosphere.

ESTIMATED WASTE QUANTITIES AND TYPE TO BE TREATED

The following Table lists the waste types and quantities that will be treated using the Converter and Autoclave:

Table 4: Waste types and quantities that will be treated using the Converter and Autoclave

TYPES OF WASTE	MAIN SOURCE (NAME OF COMPANY)	QUANTITIES		ON-SITE RECOVERY REUSE RECYCLING TREATMENT OR DISPOSAL	OFFSITE RECOVERY REUSE RECYCLING TREATMENT OR DISPOSAL	OFFSITE DISPOSAL
		TONS/ MONTH	M^3/ MONTH	method & location	method location and contractor details	
General Infectious	Hospitals, medical clinics and other health facilities	101.365		Converter and Autoclave in Seshego, Polokwane		Disposal at Rietfontein in Gauteng
Sharps	Hospitals, medical clinics and other health facilities	10.016		Converter and Autoclave in Seshego, Polokwane		Disposal at Rietfontein in Gauteng
Anatomical	Hospitals, medical clinics and other health facilities	5.363		Converter and Autoclave in Seshego, Polokwane		Disposal at Rietfontein in Gauteng
Pharmaceutical	Hospitals, medical clinics and other health facilities	1.197		Converter and Autoclave in Seshego, Polokwane		Disposal at Rietfontein in Gauteng

FLOW DIAGRAM OF THE PROPOSED PROJECT ACTIVITIES

The following Figure depicts a flow diagram of the proposed project activities with the inputs, outputs and potential emissions.

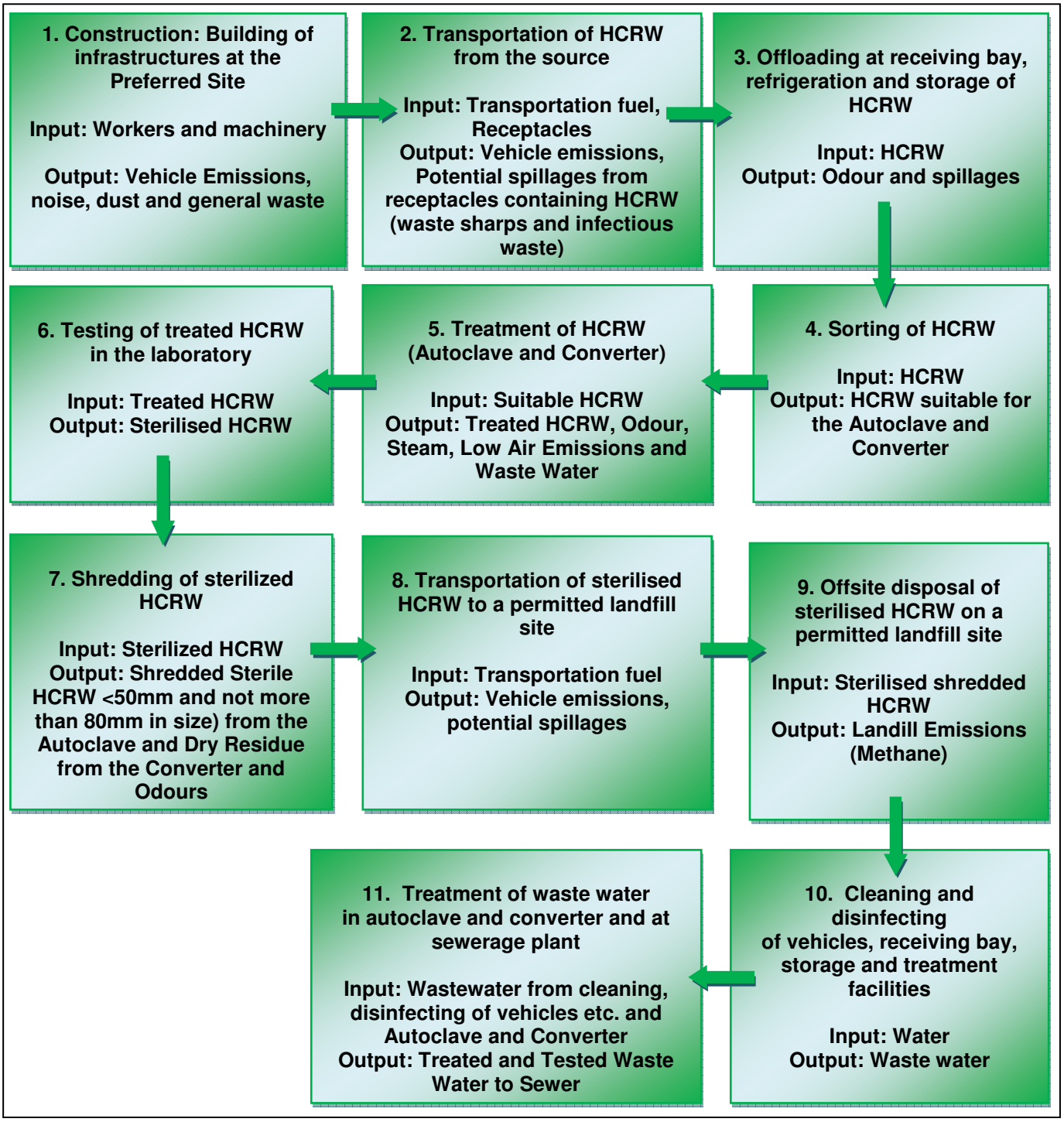


Figure 3: A flow diagram of the proposed project activities with the inputs, outputs and potential emissions

4. DESCRIPTION OF THE SITE AND SURROUNDING AREA

PREFERRED SITE

The proposed site to be used for the storage and treatment of HCRW is situated at Seshego – No 52, Freedom Drive, Zone 6, Polokwane, Limpopo Province, in an area zoned industrial.

ALTERNATIVE SITES

The applicant is currently renting the premise and the enclosed warehouse building has suitable space for storage and for the treatment units.

The Seshego, Freedom Road Site affords the advantage of an environment that does not pose undue and difficult to control health and safety risks for Buhle Waste (Pty) Ltd employees and is able to accommodate both activities, namely, the storage and treatment of HCRW.

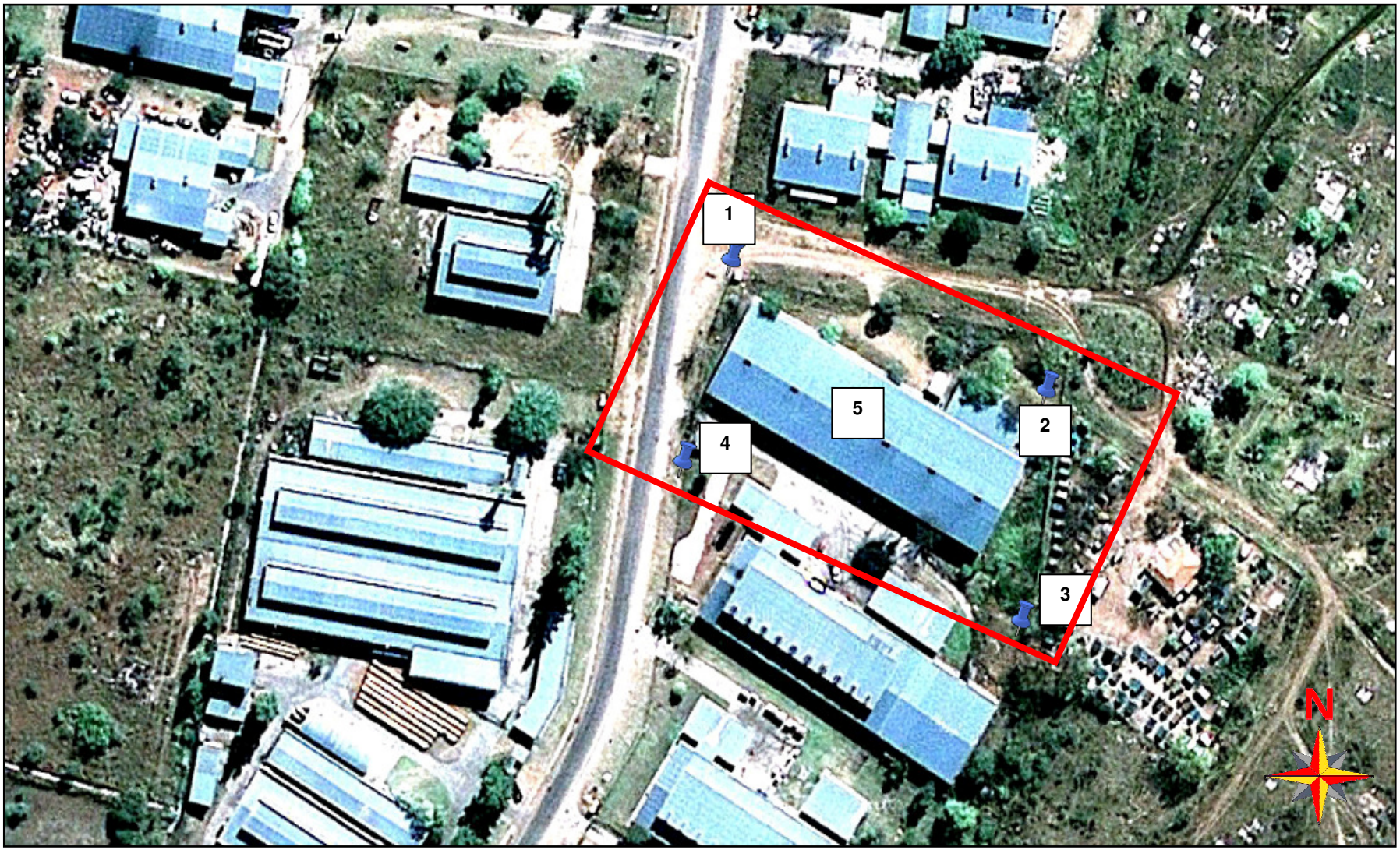
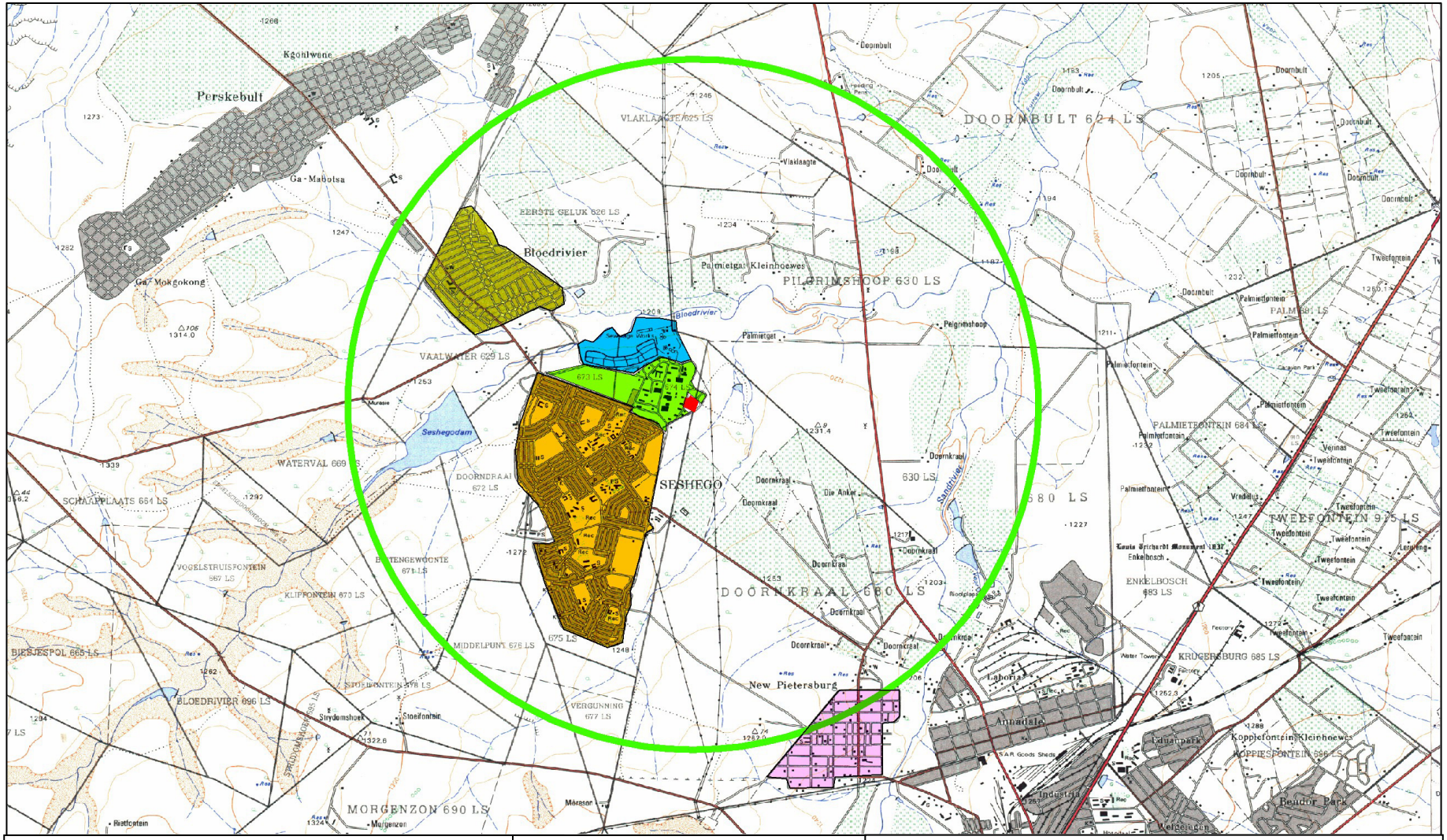


Figure 4: Aerial Map indicating the external and center points of the preferred site situated in Seshego Industrial

Buhle Waste Limpopo **Erf No: 8057/18** **52/12 Freedom Drive, Seshego**	**Co-Ordinates** **Latitude: S23° 50' 12.1"** **Longitude: E29° 24' 11.1"**	**Key** **Buhle Waste Site**

Figure 5: Aerial Map indicating the surrounding environment situated in Seshego Industrial



Buhle Waste Limpopo
Erf No: 8057/18
52/12 Freedom Drive, Seshego

Co-Ordinates
Latitude: S23° 50' 12.1"
Longitude: E29° 24' 11.1"

Key

- Buhle Waste Site
- Residential
- Seshego Industrial
- Residential
- Seshego residential
- Sewage Works
- Bloedrivier
- New Polokwane
- 5 km Buffer Zone

Figure 6: The surrounding environment situated in Seshego Industrial

5. INFRASTRUCTURE REQUIRED TO SERVICE THE PROJECT

SERVICE PROVIDERS FOR THE SITE

- Electricity = ESKOM
- Water = Magalies Water and Lepelle Northern Water Boards are the main Water Services Providers in Limpopo that supplies the municipalities: Capricorn District Municipality
- Sewage = Capricorn Wastewater Treatment Works
- Solid waste = A permitted waste disposal company

6. ESTIMATES OF WASTES EXPECTED FROM THE PROJECT

SOLID WASTE AND DISPOSAL

- Contaminated worker overalls and other personal protective equipment
- Residual waste produced as a result of the treatment processes

Waste will be divided into that which is hazardous and that which is general. Hazardous waste which poses a threat to public health and safety, or to the environment, such as corrosive, flammable, poisonous, infectious or other dangerous substances will be disposed of according to the "Minimum Requirements for Waste Disposal".

LIQUIDS AND DISPOSAL

No effluent will be produced by this project, only wastewater which will be treated in the Converter and Autoclave and tested before being discharged into the sewer. The water released by the Converter machine is colourless, odourless, with a small quantity of cellulose and polythene fibres. The drain water contains some mg/litre of active chlorine, which is immediately eliminated as soon as the discharge of the machine comes in contact with the sludge in the sewers.

GASEOUS AND PARTICULATE EMISSIONS TO THE ATMOSPHERE

The **Autoclave** has odour but not toxic and can be managed implementing odour management controls. Large autoclaves may require a boiler with stack emissions that will be subject to control. Hazardous chemicals should not be autoclaved as it could cause hazardous vapours. Analyses of emissions from autoclave loads of regulated medical waste indicated that a low amount of volatile organic compounds are released during sterilization and the area requires adequate general ventilation. Dioxins that are formed during incineration do not pose a problem in autoclaves. The sterilized and shredded waste will be stored in closed containers under roof.

The **Converter** sterilising unit is designed to operate under a constant light vacuum, so in the unlikely case of a faulty seal, at worst, airflow can only move from the outside towards the inside. This leaves zero possibility of a leakage of dangerous gaseous mixtures into the outside environment. The fumes of the machine are treated in an absorbing wet column with water; it then passes through a filter charged with activated coal and through a DOP 99,999% absolute filter and then through the final aspirator, which keeps the whole machine under a light vacuum.

A dry product is the final result, therefore non-fermentable, with a very light odour, suitable for long storage and transportable without dripping. The sterilized dry residue product will be stored in closed containers under roof. There is no release of polluting liquids, toxins, odours, or vapours from the process.

HAZARDOUS SUBSTANCES PRODUCED OR UTILIZED

The residue arising from the autoclave and converter units will be analysed, de-listed and disposed at a GLB $^{+}$ landfill site.

7. EXPECTED USE OF NATURAL RESOURCES

Water: The amount of water will depend on the size of the Autoclave and Converter units. Typically a hydroclave which is a similar technology uses approximately 700-1820 litres of water per batch cycle for treating 9120kg.

Electricity: Electricity will be used for the converter and steam will be generated from a boiler for the autoclave. The amount of electricity will depend on the size of the Autoclave and Converter units. A back-up generator will be onsite to run the plant in the event of electricity shortages. Typically a hydroclave which is a similar technology uses approximately 30kW per batch for treating 9120kg.

8. ALTERNATIVE TECHNOLOGIES FOR THE TREATMENT OF HCRW

HCRW is the combination of health care general waste (like municipal solid waste for example packaging materials) and HCRW which is the hazardous component of HCW generated by health care facilities such as infectious waste. HCRW is a broad term used to include sharps, tissues, swabs, gloves and all waste contaminated with blood and body fluids, but excludes radioactive and chemically hazardous waste. HCRW is classified as hazardous waste because it has the potential, even in low concentrations, to have a significant adverse effect on public health and the environment due to its inherent toxicological, chemical and physical properties. HCRW falls under risk category 6 of toxic and infectious properties. Infectious waste is further classified as a hazard rating 1 (extreme hazardous waste) and must therefore be treated prior to landfill disposal.

The choice of technology for HCRW treatment and disposal should always be driven with the objective of minimizing negative impacts on health and the environment. Several technologies exist to treat or dispose of HCRW. They include:1) Incineration in rotary kilns or double chamber incinerators; 2) Burning in single chamber incinerators; 3) Wet thermal treatment (autoclaving); 4) Chemical disinfection; 5) Microwave irradiation; 6) Sanitary landfill, including inertization and encapsulation. Not all these technologies can be used for the treatment or the disposal of all categories of HCRW.

Incineration is the burning of waste under controlled conditions in order to treat the waste. The main concern with incineration is the gaseous emissions. Burning of chlorinated plastics (mainly PVC) can give rise to dioxins and furans. Incinerators can also emit particulate matter, heavy metals (mercury, lead, and cadmium), acid gases (hydrogen chloride, sulphur dioxide, nitrogen oxides) and other combustion by-products such as carbon monoxide. The ash from incinerators is also considered to be toxic. As alternatives to incineration, four main processes are used to disinfect infectious waste. They are thermal, chemical, irradiative and biological.

Thermal processes rely on heat to destroy the pathogens. The low-heat thermal processes (operating below 180 ℃) utilise moist or dry heat and do not involve combustion. These include hydroclaves, autoclaves, advanced autoclaves and microwave/radio frequency heating units.

Microwave technology is another low heat process that uses microwave energy to generate steam from the water in the waste to provide the moist heat necessary for disinfection. Microwave technology has been approved and commercial scale units are operating in Europe and the United States. Microwave disinfection is appropriate for the treatment of microbiology laboratory waste. However, there is some disagreement as to its suitability for treating human blood, body fluid waste and waste sharps. It is generally considered effective for viruses although there is some debate about this. It is not suitable for treating large quantities of infected metal (such as needles from inoculation campaigns). It is not appropriate for human and animal anatomical waste or hazardous chemicals. Microwave technology is more complex than hydroclave/autoclaving from an operational and maintenance point of view. The microwave generator employs high voltages and specialised electronics. Health risks from microwave leakage can also be a problem if the units are not well engineered and maintained. The capital and operating costs of microwave disinfection are higher than for hydroclave/autoclaving.

Chemical processes involve disinfectants to destroy pathogens, or chemicals to decompose the waste, or agents to encapsulate the waste. The use of chlorine disinfectants (in the form of bleach or chlorine dioxide) has raised concerns about the possible formation of chlorinated by-products in the wastewater. Non-chlorinated chemical systems include those that use lime powder, lime slurries or peracetic acid. The problem with these processes is the potential human health and environmental risk. Sterilisation can also be achieved through the use of high concentrations of a gas such as ethylene oxide and formaldehyde. However, there is now evidence that both ethylene oxide and formaldehyde are probable human carcinogens. Ethylene oxide is also highly flammable and reactive, and requires special permits for storage on site. Systems that use heated alkali to digest tissues, pathological waste and animal carcasses have been found to be effective in also destroying chemotherapy agents as well as prion diseases such as mad cow disease. The capital cost of chemical disinfection is moderate and the operating costs about the same as autoclaving.

Irradiation involves the use of ionising radiation such as ultraviolet or gamma radiation to destroy microorganisms. Irradiative processes for healthcare waste are still in the development stage and the costs of sterilising by irradiation

are high and require extensive protective equipment and highly trained operating personnel. There is also the problem of disposal of the radioactive source.

Biological processes use enzymes or micro-organisms to decompose organic matter. As with the irradiation process, these processes are still in the development or demonstration stage.

The following table gives examples of alternative methods for the treatment of HCRW:

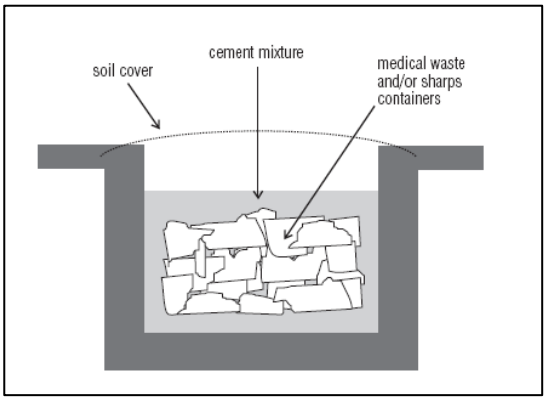
Table 5: Examples of alternative methods for the treatment of HCRW.

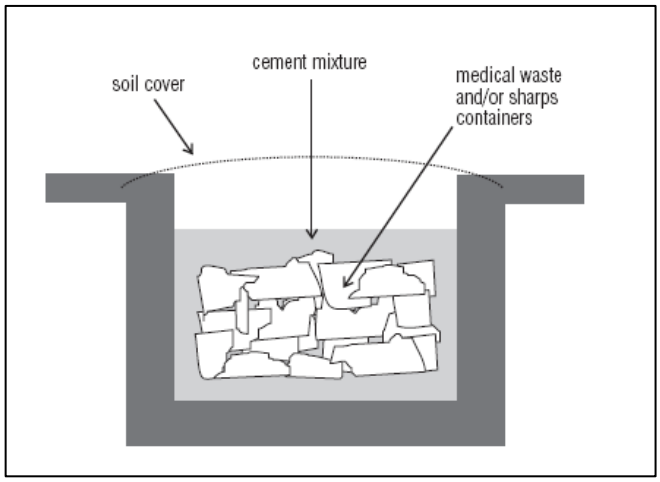
Description of technology	Aspects	Impacts	Cost	Where used
Incineration: Incineration is the burning of waste at high temperatures. Waste is fed into the first chamber and is exposed to lower (800-900^0) temperatures under oxygen starved conditions causing pyrolysis. The pyrolysis gases pass into the second chamber where they burn at a higher temperatures (1000-1050 ^{0}C)resulting in the formation of carbon dioxide and water	Ash produced requires landfill disposal Gases produced require scrubbing	Soil contamination Air emissions with possible soil and water contamination Cost implications: Expensive to operate Health impacts: concern that incineration results in dioxin and mercury pollution	Medium R2-3 million rand	This method is used in South Africa and many other countries Incineration is one of the most common methods for treating HCRW
Description of technology	**Aspects**	**Impacts**	**Cost**	**Where used**
Plasma arc technology/plasma pyrolysis: Reduces materials to their elemental components by means of extremely high temperature plasma. The process essentially uses electrical energy to heat plasma gases to super-hot temperatures to melt and decompose material into molten slag and gases. The extreme heat vaporises organic material.	A solid residue is produced as a by-product which requires disposal A gas stream consisting of basic molecular components is produced Requires a lot of electrical energy Requires high quality operators	Air emissions with possible soil and water contamination Cost implications: Expensive to operate	High +/- 9.5 Million rand	Not used in South Africa. Available in the USA
Description of technology	**Aspects**	**Impacts**	**Cost**	**Where used**
Chemical Treatment: Gaseous chemicals (ozone, chlorine, formaldehyde, ethylene oxide and propylene) can be used to treat HCRW	Storage of chemicals and risk to personnel whilst handling chemicals Gaseous chemicals destroyed in a flare or filtered to prevent toxic emissions	Health impacts Safety impacts Air emissions Waste water disposal Soil contamination Water quality impacts	Low to medium	Used in the USA in limited applications for rural clinics

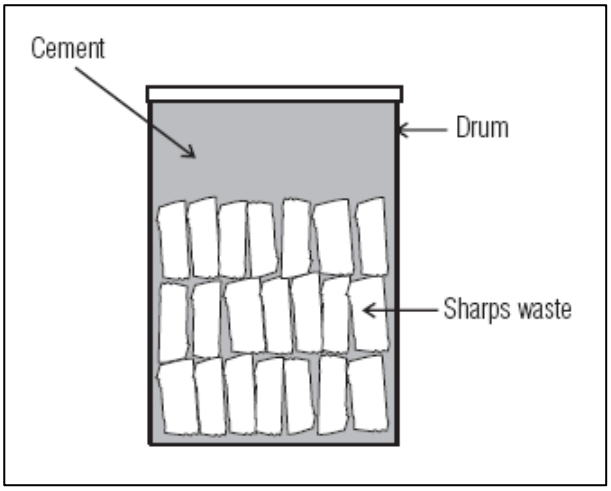
Description of technology	Aspects	Impacts	Cost	Where used
	Treated waste requires disposal to landfill			
Description of technology	**Aspects**	**Impacts**	**Cost**	**Where used**
Steam Sterilization: Incorporates exposure to a sanitizing agent under negative air pressure (HEPA) High Efficiency Particulate Air) filtration. Shredding is often included. Operating temperatures are maintained between 96-115^{0}C.	Dry sterilized waste requires landfill disposal This technology often uses a sanitizing chemical such as sodium Hypochlorite	Soil contamination Water quality impacts	Medium 3.5 Million Rand	Used in a number of countries but losing ground to autoclave based plants
Description of technology	**Aspects**	**Impacts**	**Cost**	**Where used**
Microwaving: The microwave process uses radiant energy to heat moisture within the waste to heat water that is then sprayed onto waste. Microwaving kills infectious agents through heat and pressure. A shredding mechanism is often combined with the microwave process to reduce the volume of waste to be treated. Waste is heated to between 95-100^{0}C and maintained at this temperature for a period of time. Metal wastes cannot be treated with this technology	No emissions are created or chemicals Final produce requires disposal by landfill	Soil contamination and water quality impacts Cost implications Sorting implication to remove metals	High	A limited number of plants in the USA
Description of technology	**Aspects**	**Impacts**	**Cost**	**Where used**
Reverse Polymerisation: Reverse polymerisation destroys and sterilizes all infectious biological and anatomical waste along with needles and sharps. Microwave energy breaks down inter-molecular bonds to cause reverse polymerization. Operating at between 150-250^{0}C, microwave reduces HCRW to carbon residue	Sterilised carbon can be disposed of in a general landfill site Off gases consist of low volume hydrocarbons High capital and operating costs	Soil contamination Water quality impacts Air emissions Cost implications	Very high	A few plants in the USA

THE LOW COST ALTERNATIVE METHODS

Cement Encasing:
This method involves sealing the accumulated waste in a cement encasing under the ground and covering the top with soil.

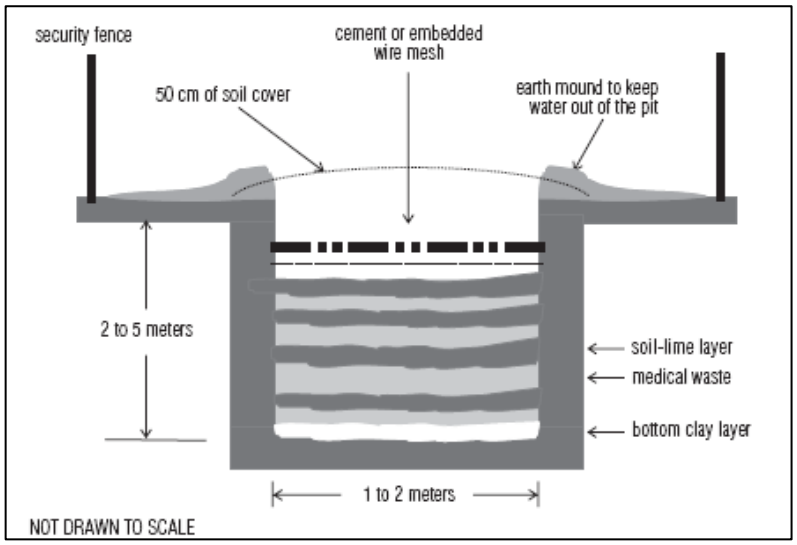






Encapsulation with Immobilizing Materials:

Encapsulation involves placing waste in drums or plastic containers, sealing them with cement or other immobilizing material, and burying them in a local landfill.



Waste Burial Pit with Concrete Cover:

This method involves burying waste in deep pits with a clay layer or geomembrane liner at the bottom to protect groundwater, adding a soil-lime mixture as a disinfectant between layers of waste, sealing the top with a cement mixture, and covering with soil.

The following table lists the various methods suitable for different HCRW categories:

Table 6: Disposal and treatment methods suitable for different categories of HCRW.

Technology or method	Infectious waste	Anatomical waste	Sharps	Pharmaceutical waste	Cytotoxic waste	Chemical waste	Radioactive waste
Rotary kiln	Yes	Yes	Yes	Yes	Yes	Yes	Low level infectious waste
Pyrolytic incinerator	Yes	Yes	Yes	Small quantities	No	Small quantities	Low level infectious waste
Single chamber incinerator	Yes	Yes	Yes	No	No	No	No
Drum or brick incinerator	Yes	Yes	Yes	No	No	No	No
Chemical disinfection	Yes	No	Yes	No	No	No	No
Wet thermal treatment	Yes	No	Yes	No	No	No	No
Microwave irradiation	Yes	No	Yes	No	No	No	No
Encapsulation	No	No	Yes	Yes	Small quantities	Small quantities	No
Safe burial	Yes	Yes	Yes	Small quantities	No	Small quantities	No
Sanitary landfill	Yes	No	No	Small quantities	No	No	No
Discharge to sewer	No	No	No	Small quantities	No	No	Low-level liquid waste
Intertization	No	No	No	Yes	Yes	No	No

(World Health Organization, 1999)

9. THE EIA PROCESS AND THE WAY FORWARD

The Tables below details the flow of the EIA process for a Basic Assessment and Scoping EIA that will be followed for the proposed projects.

The EIA phases still to be completed are listed in the Table below, together with the time frames for comment:

Table 7: Process flow for a Basic Assessment

Phase	Tasks
Completed Phases and Tasks	
Waste Management License Application	Made application to DEA
Notices send to potential Interested and Affected Parties (I&Aps)	Notices were sent to the neighbours surrounding the site, NGOs and the Environmental Authorities
Public Meeting and Background Information Document (BID)	A public meeting was held and BIDs were drafted and submitted to the registered I&APs.
To be Completed	
Draft Basic Assessment Report (BAR) and Environmental Management Programme (EMP)	Consider all comments and representations received from I&APs following the public participation process and prepare a draft BAR and EMP.
Submission of draft BAR and EMP to competent authorities and I&APs	The draft BAR and EMP will be submitted to the competent authorities and I&APs for a comment period of 40 days.
Specialist Studies	Specialist studies may be required from the competent authorities.
Final Basic Assessment Report (BAR) and Environmental Management Programme (EMP)	Consider all comments and representations received from the competent authorities and I&APs on the draft BAR and EMP.
Submission of final BAR and EMP to competent authorities and I&APs	The final BAR and EMP will be submitted to the competent authorities and I&APs for a comment period of 60 days.
Notification of outcome of the application	Once a decision has been reached by the Environmental Authorities and the EAP has been notified of the decision, by the issue of a Letter, I&APs will be notified of the decision within the timeframes stipulated by the competent authority.
Appeals	The applicant and I&APs may appeal the decision of the competent authority. A person affected by the decision and who wishes to appeal against the decision, must lodge a notice of intention to appeal with the Minister, MEC, or delegated organ of state within 10 days after that person has been notified in terms of the regulations of the decision.

Table 8: Process flow for a Scoping EIA

Phase	Tasks
Completed Phases and Tasks	
Waste Management License Application	Made application to DEA
Notices send to potential Interested and Affected Parties (I&APs)	Notices were sent to the neighbours surrounding the site, NGOs and the Environmental Authorities
Public Meeting and Background Information Document (BID)	A public meeting was held and BIDs were drafted and submitted to the registered I&APs.
To be Completed	
Draft Scoping Report (SR)	Consider all comments and representations received from I&APs following the public participation process and

Phase	Tasks
	prepare a draft SR.
Submission of Draft SR to competent authorities and I&APs	The draft SR will be submitted to the competent authorities and I&APs for a comment period of 40 days.
Final SR	The final SR will be prepared.
Submission of Final SR to competent authorities and I&APs	The final SR will be submitted to the competent authorities and I&APs for a comment period of 40 days.
	The EAP will compile a plan of study for EIA which will be submitted simultaneously to I&APs and environmental authorities, together with the Final Scoping Report. The Plan of Study for Environmental Impact Assessment will include the need for specialist studies.
The EAP will await the decision of the Environmental Authority	If the environmental authority notifies the EAP to proceed with the tasks contemplated in the Plan of Study for Environmental Impact Assessment, the EAP will proceed with the tasks, including the public participation process for environmental impact assessment.
Commission specialists and undertake investigations	If a need for specialist studies was identified in the Scoping phase, the EAP will identify the specialists required and appoint the necessary specialists to undertake the studies.
Draft Environmental Impact Report (EIR) and EMP	The Draft EIR and EMP will be prepared and submitted to I&APs and competent authorities for comment period of 40 days.
Undertake the second public participation process	Hold a second public meeting with I&APs.
Final EIR and EMP	Prepare the final EIR and EMP and submit to I&APs and authorities for a comment period of 60 days.
Notification of outcome of the application	Once a decision has been reached by the Environmental Authorities and the EAP has been notified of the decision, by the issue of a Letter, I&APs will be notified of the decision within the timeframes stipulated by the competent authority.
Appeals	The applicant and I&APs may appeal the decision of the competent authority. A person affected by the decision and who wishes to appeal against the decision, must lodge a notice of intention to appeal with the Minister, MEC, or delegated organ of state within 10 days after that person has been notified in terms of the regulations of the decision.

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Clinical Waste Solutions (CWS) is a company based in Botswana that treats clinical waste using the Converter Technology.
Contact:
Tel (+267) 316 5286
Fax (+267) 316 5289
E-mail: cws@botsnet.bw

The following website is a youtube video where the converter is used to treat clinical waste.
http://www.youtube.com/watch?v=HRWIeuFeBXk

Converter available at:
http://www.tradeboss.com/default.cgi/action/viewproducts/productid/81337/productname/Converter/)

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