anne bindoff CONSULTANCY

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MOTIVATION IN SUPPORT OF THE APPLICATION TO EXCLUDE BOILER ASH WASTE FROM THE DEFINITION OF WASTE

for

GLEDHOW SUGAR COMPANY (PTY) LTD

by

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DETAILS OF THE SPECIALIST

Name of Company: Anne Bindoff Consultancy.
Name: Anne Bindoff: Director/Owner.
Qualifications: MSc (Eng – Enviro) UKZN, BSc (Chem and App Chem) UKZN, HED UNISA. RMPASA and Plant Science Consultants Association (PSCA) attendance for GHS training.
Professional Affiliations: RPMASA, IWMSA, PSCA.
Professional Registration: SACNASP: application pending
Company Specialities: Environmental Management, specialising in Waste Management, Hazardous Waste, Legal aspects, GHS: UN Standards Safety Data Sheet Compilations for Hazardous chemicals, Agri-Remedies (New standards) and fertilizers (New standards).

Experience:

- **Regulatory DAEA/EDTEA:** Pollution and Waste Management: Acting Assistant Manager ILembe DM 2006 - 2009.
- **Corporate: SAPPI Mandeni:** 2009 – 2013: Environmental Specialist: SHEQ systems, landfill site management, waste management, legal compliance for permits licences, waste classifications, water permits, waste permits, etc.
- **Own Business: Anne Bindoff Consultancy: As above**
  Clients:
  - **Sappi Mandeni:** Hazardous waste removal.
  - **INDIFLORA: Brookdale Assessment Centre** - Rehabilitation: Waste removal for legal compliance.
  - **Aquasol:** SDS and labels, HCA and DALRD new requirements.
  - **NCP Chlorchem**: Waste assessment.
  - **Intellichem:** Tremcards supply.
  - **IFF:** Tremcards supply.
  - **SAPREF:** Tremcards supply.
  - **Bowisolve:** Legal requirements for road transportation of waste/Hazardous waste.
  - **Andermatt Madumbi:** Agri-remedies SDS assessments and advisory.
  - **RPMASA:** GHS training for Safety Data Sheets.
  - **IWMSA:** Hazardous waste management training.
  - **ECOGUARD:** Agri-remedies SDS compilations – new requirements and advisory.
  - **Aquasolve:** Supply of Safety Data Sheets: Fertilizers, new agricultural standards as per Dept of Labour HCA requirements.
  - **Dow/Corteva:** SDS advisory and tremcards supply.
  - **BPL**: Tremcards Supply.
  - **WALLACE AND GREEN ENVIRONMENTAL SPECIALISTS**: Waste Specialist
    - Motivation in support of the removal of Sumitomo Mill waste ash and rubber compound from definition of waste.
    - Motivation in support of the removal of various waste streams from Illovo mills: Eston, Noodsberg, Gledhow mills.
    - Motivation in support of the removal of various waste streams from Umfolozi Sugar Mill.

1. INTRODUCTION

The Gledhow Sugar Company (GSC) first commenced operation at the current site in 1912. The original owners of the mill were CG Smith, F Reynolds, W Pearce and the Crookes brothers. Later, Illovo Sugar Limited took ownership, and between 2004 and 2009 Ushukela Milling. The Gledhow Sugar Company (Pty) Ltd was founded on the 10th September 2009 on the acquisition of the Gledhow Sugar Mill at Stanger, KwaZulu Natal, by a consortium of four shareholders:

- Ushukela Milling (Pty) Ltd (34.9%)
- Illovo Sugar Limited (30%)
- The Gledhow Growers' Share Trust (25.1%)
- Sappi (10%)

Gledhow Sugar (henceforth referred to as “the mill”) has the philosophy of empowering the local community and expanding the company to reach new heights. (ref: https://www.gledhowsugar.com/about). This is in line too with Illovo Sugar (South Africa) (Pty) Ltd, as an invested, long-term contributor to South Africa’s economy, committed to partnering for the continuing transformation of its agricultural and sugar production sectors. The mill is located in the small village of Gledhow near the small town of Stanger within the Kwadukuza local municipality, Ilembe District municipality, within KwaZulu-Natal province.

Figure 1: Google Earth photo of the Gledhow Sugar Company in Kwadukuza: KZN;
showing the mill’s ash storage site (pin locations A - D) and the mill to be surrounded by:

- small residential dwellings, mixed socio-economic dwellings housing,
- the SAPPI Fine Paper Mill,
- sugar cane,
- closely located to the town of Stanger with an approximate town population of approximately 59,900 people. (ref: https://south-africa.places-in-the-world.com/1001814-place-gledhow.html.)
- The 2011 census gives the unemployment rate to be 30,6%, with the youth unemployment of 37,2%.

Figure 1: Google Earth photo of the Gledhow Sugar Company in Kwadukuza: KZN. (Screen shot from GOOGLE EARTH)

Table 1: GPS co-ordinates of the ash storage location in the GSC mill site.

Table 1: GPS co-ordinates of the ash storage location in the GSC mill site

GPS CO-ORDINATES AT CORNERS OF WASTE GENERATING FACILITY (i.e., BOILER ASH)	Pin Locations	LATITUDE			LONGITUDE		
	A	29	21	51.29	31	17	16.10
	B	29	21	52.03	31	17	15.60
	C	29	21	51.23	31	17	13.78
	D	29	21	50.53	31	17	14.31

"The Gledhow mill in KwaDukuza crushes sugar for more than 245 growers who produce more than 1.1-million tonnes of sugar cane a year. SA Canegrowers, an industry organisation, says this amounts to 6% of the industry's total output. These growers employ more than 3,400 workers from surrounding communities." (ref: https://www.businesslive.co.za/bd/national/2023-03-22-kzn-sugarcane-farmers-worry-as-another-mill-enters-business-rescue/#:~:text=The%20Gledhow%20mill%20in%20KwaDukuza,of%20the%20industry%27s%20total%20output. *)*

There are two particularly important factors that have also been considered in drafting this report while considering the issues:

- Currently the mill is undergoing a business rescue process which the Board of Directors of Gledhow Sugar Company Proprietary Limited announced to voluntarily

commence business rescue proceedings on 10th March 2023. The company has been facing significant challenges in recent years, including the forced closure of its factory due to social unrest in KwaZulu-Natal in July 2021 and catastrophic flood damage to its machinery and infrastructure in April 2022 amongst other challenges being faced. This report considers these circumstances with the motivation to encourage beneficiation of the waste streams to enhance the performance of the mill for waste streams to be managed to maximize the benefit to the mill by reducing costs, increasing efficiencies and compliance to the environmental laws of the land.

- A site inspection was conducted by the Environmental Management Inspectors (EMI) on the 26th October 2022. There were findings from the inspection where the mill was found to have "failed to adhere to the provisions of the environmental law in respect of the activities taking place on site." (refer to Attachment 6: S31L NEMA PCN Gledhow Sugar.). A compliance notice has been issued to the mill with requirements to comply to.

This report serves as a basis for the application to remove the ash from the definition of waste as per the NEM:WA legal requirement and is compiled as the basis for the risk assessment and the risk management plan. This is done to manage the boiler ash waste stream as a beneficiated product for health and safety.

This report fulfils the requirements as set out in the legislative framework given in Section 2 below.

2. LEGISLATIVE FRAMEWORK

2.1. Acts:

- The Constitution of the Republic of South Africa, Act 108 of 1996.
- National Environmental Management Act (NEMA): Act No 107, 1998. 27 November 1998. (NEMA)
- National Environmental Management: Waste Act. (NEM:WA) No. 59 of 2008.
- The National Environmental Management: Waste Amendment Act (NEM:WAA), 2014 (Act No 26 of 2014).
- National Environmental Management: Waste Act (59/2008): National Waste Management Strategy, 2020 (NWMS).
- National Road Traffic Act (RTA), No. 93 of 1996.
- Occupational Health and Safety Act (**OHSA)** no: 85 of 1993.

2.2. National Norms and Standards. Listed Activities and other relevant documents

- NEM:WA Regulation 331 National Norms and Standards for the Remediation of Contaminated Land and Soil Quality. 2013
- The Framework for the Management of Contaminated Land, Department of Environmental Affairs (DEA), May 2010
- National Norms and Standards for the Storage of Waste. 2013.
- NEM:WA (Act 59 of 2008) Government Notices (23 August 2013):
    - R.634 Waste classification and Management Regulations

- R.635 National norms and standards for the assessment of waste for landfill disposal
- R.636 National norms and standards for disposal of waste to landfill

- National Environmental Management: Waste Act (59/2008): Regulations regarding the exclusion of a waste stream or a portion of a waste stream from the definition of waste (18 July 2018)
- **SANS 10234 (2019)(2nd ed):** Globally Harmonized System (GHS) of Classification and Labelling of Chemicals
- **GHS:** UN Standards Purple Book 9th ed

3. GLEDHOW SUGAR COMPANY CONTACT DETAILS

Name: Gledhow Sugar Company (Pty) Ltd
Physical address:1 Gledhow Mill Road, KwaDukuza, 4450
Postal Address: PO Box 55, KwaDukuza, 4450, South Africa

Contact person:
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Portfolio: SHERQ Manager
General Mill Contact no: +27 32 437 4400
Tel: +27 32 437 4502 | **Mobile:** +27 82 904 1645
Email: CSithole@Gledhow.co.za

4. ILLOVO INTEGRATED MANAGEMENT SYSTEM

As part of the mill operations, the Illovo Integrated Management System which includes the SHERQ Management Systems has been adopted for best practice in the industry and is adhered to by all its sugar mills. In relation to environmental responsibility, the following is an extract from Illovo's Code of Conduct and Business Ethics (see Attachment 1a: Illovo Group Code of Conduct and Business Ethics).

4.1. Environmental management

Excerpts from the Illovo Group Environmental Management document are given as follows:

- Illovo supports and encourages operating, manufacturing, farming and agricultural practices and production systems that are sustainable.
- As an environmentally sensitive business, Illovo supports a precautionary approach to environmental challenges and is committed to promoting environmental responsibility and encouraging the development and diffusion of environmentally friendly technologies in our operations.
- Suppliers should adopt a precautionary approach to environmental challenges and continually strive towards improving the efficiency and sustainability of their operations, including water conservation programmes, initiatives to promote greater environmental responsibility and encourage the development and diffusion of environmentally friendly technologies.

- The following aspects of environmental management will be included in the assessments of Suppliers:-
    - they should be aware of, and be able to demonstrate compliance with all current environmental legislation that may affect their activities;
    - they should conduct an environmental review of all aspects of their products and services.
- Any enforcement, improvement or prohibition notices served on a Supplier within the last three years by any competent authority must be disclosed and will be reviewed.

Illovo has developed its own Integrated Risk Management System (IIRMS) to ensure that the standards to which the business conforms are unified under a single platform, guiding and measuring compliance.

IIRMS guidelines have been developed from best practices in the Illovo Group, and from best practice in their industry where necessary. IIRMS assists in the management of environmental risks at Illovo and ensures that these standards are implemented by the whole group.

Many of the Illovo Group sugar factories already operate to high environmental standards through a circular economy model where outputs such as molasses, vinasse, condensed mollasses solids (CMS), bagasse, bagash/boiler ash, and filter cake are turned into co-products; such as energy feedstock, fertiliser, soil conditioning nematodes and bioethanol. This is aligned to the circular economy, meaning that, as much as possible, we eliminate waste, and re-use resources, putting them back into the process.

Gledhow Sugar Company (GSC) has its own inhouse specific management systems protocols: refer to Attachment 1b: Waste Management Plan.

5. FACILITY WASTE GENERATING PROCESS

Refer to Attachment 2: SCHEMATIC- Sugar production Process flow chart showing ash generation. This illustrates the overall process flow diagram of the mill to produce sugar and the accompanying waste streams: bagasse and ash. It must be noted that for the purpose of this report and application for waste exclusion, a brief overview of the main processes that generate the waste streams have been discussed below.

5.1. Brief overview

The purpose of this section is to satisfy the legal requirement for the description of the components that make up the ash waste stream.

5.2. Waste stream- boiler ash

Pea coal is burnt in 3 boilers with rotating grates and the resultant ash is transferred into a holding bin. Ash is loaded with a front end loader into trucks and taken to the end-users.

Boiler ash is the waste stream relevant to this waste exclusion application, as it is to be used in blockmaking by the local community for empowering them for business opportunities and for employment of others. A further use would be to use the ash in the construction industry.

5.3. Process description to produce sugar

The following section describes the entire sugar milling processes briefly to produce raw sugar. This gives the overall view for the various waste stream generated.

Figure 2: Process description to make sugar: Gledhow Sugar Company is the process description obtained from the Gledhow Sugar Company website on the link: https://www.gledhowsugar.com/process.

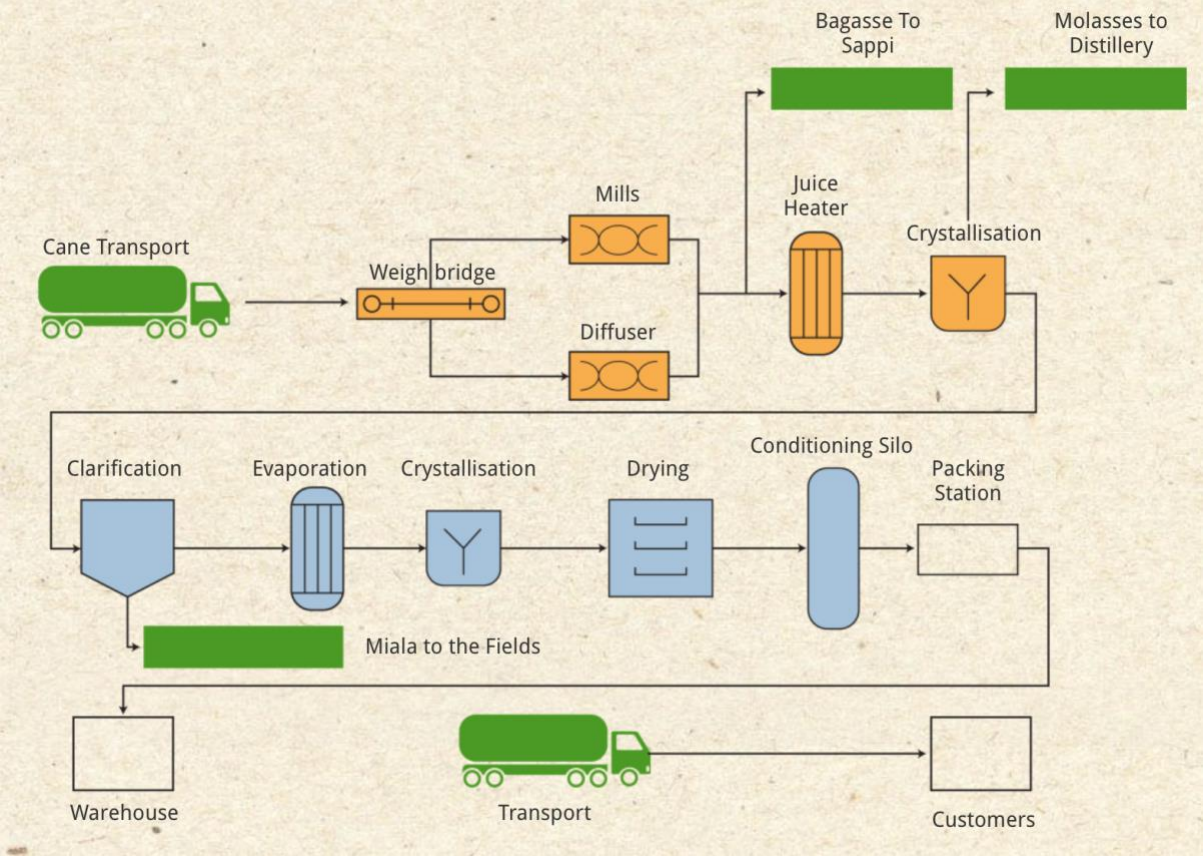

Figure 2: Process description to make sugar: Gledhow Sugar Company.

5.3.1. Delivery

Cane is delivered to the mill in articulated vehicles, called Hilos, to where it is spilled onto the feed table for direct processing. The factory processes approximately 300 tons of cane per hour.

5.3.2. Juice Extraction

Cane entering the factory is first prepared by chopping with 3 sets of Cane Knives, and a Shredder which reduces it to a fine consistency. It then passes into either the Mill or Diffuser where approximately 98% of the sucrose is extracted and sent for processing.

The spent cane, called Bagasse, is then sent to the Depithing Plant for processing prior to being sent to the SAPPI mill to be made into paper products. No bagasse is burnt in the boilers yet. A cogeneration project is being proposed, where a potential fuel may be bagasse.

5.3.3. Raw Sugar Process

The juice leaving the Extraction Process contains various impurities, including soil, and has to be clarified prior to processing. Clarification is done by heating the juice, adding:

- Milk-of-lime,
- Flocculant,
- Allowing the resulting mud (Miala) to settle out in large decanting vessels called Clarifiers.

The juice, now free of mud is returned to the process. The thin, clear juice is then concentrated into a heavy syrup in Evaporators.

Sugar is made in Vacuum Pans by growing small grains of sugar to a required size by introducing syrup into the pan in controlled temperature conditions. When the boiling cycle is complete, the resultant product, Massecuite (sugar crystals suspended in molasses), is struck into the Crystallizers where the crystal continues to grow.

The Sugar Crystals are separated from the Molasses by spinning the Massecuite in a perforated spinning basket (Centrifugals) which retains the crystal but allows the Molasses to drain off.

The Molasses is processed further to recover sugar and the final exhausted molasses (Final Molasses) is stored in bulk tanks, prior to sale for the manufacture of ethanol. The Raw Sugar is melted and sent on for further processing in the refinery to remove the colour components in the sugar.

The refined sugar process will not be described here as it is not relevant for the purposes of this report.

5.4. Waste and Effluent streams

Solid waste from the cane juice clarifier is sent to the Oliver mud filters and the waste after the Oliver filters is called filter cake.

All the effluent liquid and boiler liquid waste is pumped to the ash dam, the sedimentation of this is the sludge.

5.4.1. Waste streams generated - a schematic.

Figure 3: SCHEMATIC- Sugar Production Process Flow Chart Showing Ash and Bagasse Generation below shows the schematic process to produce the boiler ash waste stream. This schematic diagram together with the main process diagram given above: Figure 2: Process description to make sugar: Gledhow Sugar Company describes the waste stream generation in the mill.

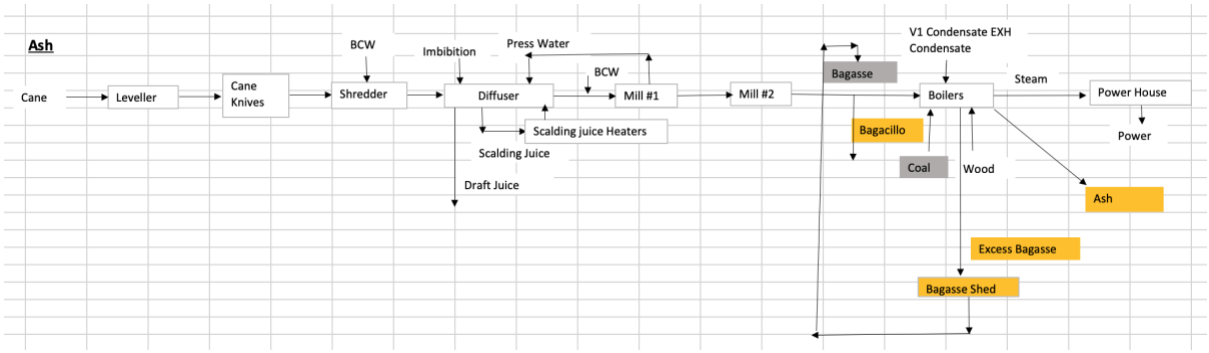

Figure 3: SCHEMATIC- Sugar Production Process Flow Chart Showing Ash and Bagasse Generation

Currently pea coal is burnt in 3 boilers with rotating grates and the burnt ash is transferred into a holding bin and then it is loaded with GSC Front-end loader into trucks to be taken to the recipients for blockmaking. The construction company would engage with the GSC about the collection systems to be implemented.

The following citation is a reflection of the source of bottom and and the uses thereof, from Singh, M., Siddique, R., March 2013. (Website: https://www.sciencedirect.com/science/article/abs/pii/S0921344912002200.)
"Coal bottom ash (CBA) is formed in coal furnaces. It is made from agglomerated ash particles that are too large to be carried in the flue gases and fall through open grates to an ash hopper at the bottom of the furnace. Bottom ash is mainly comprised of fused coarser ash particles. These particles are quite porous and look like volcanic lava. Bottom ash forms up to 25% of the total ash while the fly ash forms the remaining 75%. One of the most common uses for bottom ash is as structural fill.

Published literature shown that there is a strongly possibility of coal bottom ash being used as substitute/replacement of fine aggregate (sand). Its use in concrete becomes more significant and important in view of the fact that sources of natural sand as fine aggregates are getting depleted gradually, and it is of prime importance that substitute of sand be explored."

"Bottom ash has the appearance and particle size distribution similar to that of natural fine aggregate i.e. river sand. Because of these properties it attracted to be used as sand replacement in concrete. Recently research works have been focused on usage of bottom ash as partial sand replacement in concrete. The published research data indicate that bottom ash is a viable material as sand replacement in concrete. Therefore its suitability as sand replacement material in concrete and the ways in which bottom ash affects the fresh, hardened as well as durability properties of concrete has been critically evaluated in this review.

Bottom ash can be beneficially utilized in a variety of manufacturing and construction applications. At present in America, coal bottom ash is predominantly used for the following applications:

- Road base and sub-base
- Structural fill

- Backfill
- Drainage media
- Aggregate for concrete, asphalt and masonry
- Abrasives/traction
- Manufactured soil products

Published literature shown that there is a strongly possibility of coal bottom ash being used as substitute/replacement of fine aggregate (sand). Its use in concrete becomes more significant and important in view of the fact that sources of natural sand as fine aggregates are getting depleted gradually, and it is of prime importance that substitute of sand be explored."

The use of fly ash also has a multitude of uses, described in a number of research papers. The following citation from the website: https://civilwale.com/fly-ash/#:~:text=Fly%20ash%20is%20also%20used%20for%20embankment%20construction%2C%20it%20has,of%20fly%20ash%20in%20embankments. The different uses are given for construction purposes as a specific portland cement, clay bricks, as a few examples of many available.

The key factors would be their chemical, physical and mechanical properties to determine their use. For the purposes of this report, the focus would be on the use that would not impact the environment by exposure to soils, surface and ground water by long term leaching potential. The requirement would be for the construction use to ensure this would not happen. This would require that the construction company in the use of ash in its civils projects, to bind the ash into medium that would reduce significantly the possibility of polluting the environment.

5.5. Boiler stack particulate capture method

The particulates which go through the stacks with the hot air are collected in scrubbers. This is called fly ash. All the effluent liquid and boiler liquid waste is pumped to the ash dam, the sedimentation of this is the sludge.

5.6. Waste recipients

Poor socio economically, low and no income community.

5.7. Waste generated

For 2021/2022, the waste generated was as follows:
Ash: 120 tpd av.
Filter cake: 190 tpd av.
Sludge: Last year Gledhow Sugar Company (GSC) removed about 8000 tons after 10 + years. (A statistical estimate of 800 tons of sludge generated per annum).

5.8. Waste Removed

Ash: Clients take all ash off site to make concrete blocks. However, ash would become available for the construction industry as well.

Filter Cake: The growers take all filter cake to their fields as a soil enhancer / fertilizer.
Sludge: This sludge is only removed by dredging after a few years and all the dry sludge is taken by growers to their fields as fertilizer.

6. CONSEQUENCES OF NOT RECYCLING OR REUSING THE ASH PRODUCED

The only recourse for ash if it is not reused or recycled is to dispose to landfill. Landfilling is the option chosen by many to dispose of waste as the most convenient option. Unfortunately landfilling as a waste management practice contributes to high airspace use. This leads to very costly sourcing and development requirement for more landfill space. So, in line with the NEM:WA: National Waste Management Strategy (NWMS - 2020); the focus is on amongst others to divert waste from landfilling and to implement the circular economy principles to beneficiate the waste as a resource in a safe and responsible manner.

Should the ash not be permitted to be used for blockmaking or for use in construction :

- That percentage which is used to make up the materials for the concrete formulation:
  - Sand + ash + cement + water, where the ash replaces the sand used by a convenient percentage,

  becomes
  - Sand + cement + water.

Sand is obtained by sandwinning practices from river beds, a disruptive process to the ecology of the rivers.

- Opportunities to earn an income for those with no or low income:
  - youth,
  - women and
  - entrepreneurs in general

- The users of this waste stream require the ash to create income generating opportunities for themselves at no cost to themselves, only the cost of the other materials including less sand required. Hence if this waste stream is not allowed to be beneficiated, the opportunities may be lost due to the cost of buying the extra sand, and income generation would be missed. This would lead to other means of income in the underdeveloped area to be sourced, by redirecting the unemployed from the potential to give them dignity to earn income themselves with honest labour towards commiting crime.
- Construction companies too would require more sand from the river sand mining source. The ash does also add to the chemical makeup of the concrete medium, hence more chemicals would be required by the construction company to modify the concrete for its purpose.

- The requirement of Gledhow Sugar Company to dispose of the ash to a permitted and properly managed landfill site costs the company in terms of:
  - Landfilling fees; unless there is no charge for potential cover material,

- Fuel which is changing and generally increasing monthly in 2023,
- Driver salaries,
- Truck fees and maintenance.

6.1. Benefits of reuse and recycling

6.1.1. Intended use of ash

The ash will be used as a medium to include into the sand, cement and water mix to make concrete blocks. The same will apply to construction projects.

6.1.2. Benefits of Reuse and recycling

The benefits of reusing and recycling the ash aligns with the objectives of the South African National Waste Management Strategy (NWMS) - 2020 and are also aligned with the Sustainable Development Goals (SDG) 2030. Examples of the relevant SDG's:

- **SDG 3**: To avoid/minimize waste related environmental factors that prevent ill-health and disease.
- **SDG 8**: Promoting the waste management sector as a key contributor to overall economic growth and development.
- **SDG 9**: Use of natural resources to improve people's standard of living without damaging the environment.
- **SDG 12**: Through: ensuring production patterns, implementing initiative that reduce waste, promote re-cycling, re-use.

The NWMS 2020 strategy is directing South Africa to a future with zero waste in landfills. This will be achieved through eight strategic goals, two of which are relevant for this report namely:

- **Goal 1:** Promote waste minimisation, re-use, recycling and recovery of waste. Focuses on implementing the waste management hierarchy, and with the ultimate aim of diverting waste from landfill.
- **Goal 8:** Establish effective compliance with and enforcement of the Waste Act. Ensures that everyone adheres to the regulatory requirements for waste management, and builds a culture of compliance.

The re-use of the ash benefits:

- GSC by the cost savings of diverting these waste streams from landfilling.
- It promotes independence within the disadvantaged community by being able to generate an income by making concrete blocks,
- to sell to their community and,
- also enabling them to employ people within the community.
- Business creation and thus job creation.
- Replacement of sand with a renewable resource: ash in construction businesses.
- Ash contributes to desired affects on the concrete characteristics through the chemical nature by adding to the physical, and mechanical nature of the item being made.

By correct management of the waste, the potentially hazardous components will be managed to minimize any hazards presented.

To be able to benefit from this opportunity, the ash will need to be characterised to understand the chemical and physical nature of the waste stream. It is then assessed for landfilling using the standard criteria and classified by Globally Harmonised Standards (GHS) aligned to the United Nattions standard for health and environmental risk. tUnderstanding these characteristics of the ash will help to minimumise the risk for use for the purpose of making concrete blocks and use in the construction industry. The following section describes this process and the results describe the nature of the waste.

7. METHODOLOGY USED TO ASSESS THE CHEMICAL/HAZARDOUS NATURE OF THE WASTE TO BE EXCLUDED.

7.1. Rationale

Research work has been done for the use of the various ashes within the civils and building industry. There are promising results that this may be successful with proper understanding of the chemical makeup of the ash. This section focuses on the chemical makeup of the ash pre-beneficiation and the potential hazards and risks on health and the environment together with any possible physical risk these pose in its proposed application.

The perception by some stakeholders is that ash is a hazardous waste and needs to be rejected outright from beneficial use. To be able to properly address the perception, measures must be put in place on how it is to be managed. The risk assessment and a risk management plan can be formulated to minimise any harm to people and the environment.

7.2. Characterisation of the waste ash

The waste sample taken at the GSC was received at Talbot and Talbot accredited laboratories on 17th September 2021, and testing commenced on the same day. It was tested using the **NEM:WA Norms and standards Regulations** for assessment and classification of waste. See:

- Attachment 3a: Certificate of Analysis,
- Attachment 3b: Waste Assessment and Classification, and
- Attachment 3c: Safety Data Sheet - SDS.

This gives:

- the chemical composition from a prescribed list,
- the assessment of the waste for
    - waste type
    - the landfill class
- the GHS classification for any hazards from
    - the physical nature of the waste with any risks associated with it,
    - any risk to health, and
    - any risk to the environment.

The second approach is to determine the hazard thresholds of the chemicals in soils and hence the effect on the environment and the health of the community. The following was used:

- **The Framework for Contaminated Land Rehabilitation (DEA- May 2010) guideline** was used, and compared with the Total Concentration values (TC) obtained as well as the Leachable Concentration (LC) results from the laboratory analyses obtained.

The ash is then managed appropriately using the mitigation/management provided from the identified risks.

7.3. Results

Note: refer to:

- Attachment 3a: Certificate of Analysis,
- Attachment 3b: Waste Assessment and Classification and
- Attachment 3c: Safety Data Sheet - SDS.

for the full details of the analyses and assessments.

7.3.1. Waste assessment to landfill

- GN 636 S5(1)(q)(ii): Current Prohibition/Restriction from Disposal: None.
- GN R636 S5 (1)(r)(iv): Future Prohibition/Restriction from Disposal: None.
- GN R635 S7, the waste is chemically assessed as a Type 1 waste, which is High risk. Class A Landfill (H:H, H:h)

7.3.2. GHS Classification and Hazard Management

IMPORTANT NOTE: refer to the attachment 3c, Safety Data Sheet (SDS) for full details referred to in this report.

- pH - 9.8.
- Moisture, not given. assumed to be ≤ 40%, as no restriction nor prohibition given.
- Physical appearance: Dark grey, granular solid.

Table 2: Summary of ash GHS hazard classification

Classification in accordance with SANS 10234:2019:	
Physical	Not classified
Health: H315: Cat 2: Skin irritation.	Causes skin irritation
H318: Cat 1: Serious eye damage.	Causes serious eye damage
Environment	Not classified
Overall classification:	**HAZARDOUS - HEALTH**

7.4. Hazards not otherwise classified:

Primary Health Hazards: In the event that the waste is utilised in a manner that results in significant dust generation, potential health hazards may arise from dust exposure via inhalation, eye contact and skin contact.

Eye contact: Dust may mechanically irritate the eyes, resulting in redness or watering.

Skin contact: Direct contact with dust particles can cause skin irritation.

Inhalation (acute): May cause irritation to the respiratory tract, chest pain.
Inhalation (chronic): Repeated inhalation of dust containing respirable crystalline silica is associated with silicosis, lung cancer and autoimmune disorders. Long term exposure to Aluminium oxide dust can lead to lung damage, while long term exposure to Iron Oxide dust can lead to pneumoconiosis (siderosis).
Ingestion: May cause gastrointestinal irritation.

Additional information: In the event of dust exposure, potential health hazards may arise via inhalation, eye contact and skin contact. Repeated inhalation of dust containing respirable crystalline silica is associated with silicosis, lung cancer and autoimmune disorders. Long term exposure to Aluminium oxide dust can lead to lung damage, while long term exposure to Iron Oxide dust can lead to pneumoconiosis (siderosis).

7.5. Composition or information on ingredients in ash

Table 3: Composition of ash.

Ingredient(s) - Metal oxides	[C/I/SA] %	GHS Classification (Regulation)
Silicon dioxide (SiO_2). -	34,53%[NS]	-
Aluminium oxide (Al_2O_3). -	15,01%[NS]	-
Calcium oxide (CaO). -	2.43%[NS]	H315 H318
Iron oxide (Fe_2O_3). -	2,67%[NS]	-
Potassium oxide (K_2O). -	0,33%[NS]	H315 H318
Phosphorous pentoxide	0.46%[NS]	H315 H318
(P_2O_5).-	0,60%[NS]	-
Titanium dioxide (TiO_2). -	0.43%[NS]	-
Magnesium oxide (MgO). -	0,49%[NS]	H315 H318
Sulphur Trioxide (SO_3). -		

Notes to above table: [C] Constituent component; [I] Impurity; [SA] Stabilising Additive; [NS] Not Specified; [O]

Additional Notes:
Elemental oxides were used to represent chemical composition and assessed for GHS.
H315: Causes skin irritation.
H318: Causes serious eye damage.

7.6. Hazards identification

Health hazards:
Uses advised against:
WASTE: if a commercial product residue, not intended for original use. KEEP AWAY FROM clothing. DO NOT eat, drink or smoke when using this product. AVOID release to the environment. Collect spillage.

7.6.1. Precautionary measures

Prevention:

- KEEP AWAY FROM clothing.
- AVOID breathing dust, fume, gas, mist, vapours, spray.
- DO NOT get in eyes, on skin, or on clothing.
- Wash skin thoroughly after handling.
- DO NOT eat, drink or smoke when using this product.
- AVOID release to the environment.
- Wear protective gloves, protective clothing, eye protection, face protection.

Responses:

- IMMEDIATELY call a POISON CENTRE or doctor / physician.
- Get medical advice / attention if you feel unwell.
- Fight fire with normal precautions from a reasonable distance.
- Collect spillage.
- IF SWALLOWED: Call a POISON CENTRE or doctor/physician if you feel unwell.
- IF ON SKIN: Wash with plenty of water.
- IF INHALED: Call a POISON CENTRE or doctor/physician if you feel unwell.
- IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
- If exposed or concerned: Call a POISON CENTRE or doctor/physician.
- Take off contaminated clothing and wash it before reuse.

7.6.2. First-aid measures

- **Immediate actions:** IMMEDIATELY call a POISON CENTRE or doctor / physician. If exposed or concerned: Call a POISON CENTRE or doctor/physician.

- **Actions to be avoided:** DO NOT eat, drink or smoke when using this product. AVOID release to the environment.

- **Inhalation:** AVOID breathing dust, fume, gas, mist, vapours, spray. IF INHALED: Call a POISON CENTRE or doctor/physician if you feel unwell. Take off contaminated clothing and wash it before reuse.

- **Skin Contact:** KEEP AWAY FROM clothing. DO NOT get in eyes, on skin, or on clothing. Wash skin thoroughly after handling. Wear protective gloves, protective clothing, eye protection, face protection. IF ON SKIN: Wash with plenty of water.

- **Eye Contact:** DO NOT get in eyes, on skin, or on clothing. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

- **Ingestion:** DO NOT get in eyes, on skin, or on clothing. IF SWALLOWED: Call a POISON CENTRE or doctor /physician if you feel unwell.

Protection of first-aiders and notes for attending physicians

- **Physician notes:** Get medical advice / attention if you feel unwell.

7.6.3. Fire Fighting

- **Protection of fire-fighters:** KEEP AWAY FROM clothing. AVOID breathing dust, fume, gas, mist, vapours, spray. Fight fire with normal precautions from a reasonable distance.

7.6.4. Accidental release measures

- **Personal precautions, PPE:** Wear protective gloves, protective clothing, eye protection, face protection. KEEP AWAY FROM CLOTHING

- **Environmental precautions:** AVOID release to the environment. Collect spillage.

7.6.5. Safe Handling and Storage

- **Safe handling:** DO NOT get in eyes, on skin, or on clothing. DO NOT eat, drink or smoke when using this product. AVOID release to the environment. Wear protective gloves, protective clothing, eye protection, face protection.

- **Additional information:** Eating, drinking and smoking in work areas is prohibited. Remove contaminated clothing and protective equipment, and wash hands after use and before entering eating areas.

7.6.6. Exposure controls and personal protection

- **Engineering controls:** Activities that generate dust require the use of general ventilation and/or wet suppression methods to maintain exposure.

- **PPE:**
  - **Respiratory:** Use **respiratory protection** approved under appropriate government standards

  - **Hand/Arm:** Handle with **gloves** approved under appropriate government standards.

  - **Eye/Face:** Face shield and safety glasses. Use equipment for **eye protection** tested and approved under appropriate government standards.

  - **Skin/Body:** Wear protective **clothing**

  - **Hygiene:** Handle in accordance with good hygiene and safety practice. Wash hands before and after handling.

  - **Special conditions posing a hazard**

- In the event of dust generation, potential health hazards may arise. Activities that generate dust (e.g. grinding, crushing, etc) should be avoided.

7.6.7. Stability and reactivity

- No data available.

7.6.8. Disposal

- **Landfill Class (RSA) (subject to treatment):** Type 1 Waste: Class A Landfill (H:H / H:h) per: GN R635 (7)(2)(b) - strictly subject to treatment due to GN R636 (5)(1) prohibited disposal: see above
- **Safe, environmentally preferred disposal:** Dispose of contents/container to an approved facility in accordance with all applicable regulations and landfill requirements per this safety data sheet's Section 13.
- **Additional information:** Do not fly tip. Do not dispose into sewer, stormwater, or environment. Do not burn unless by means of compliant incineration practices.

8. CHEMICAL AND TECHNICAL SPECIFICATIONS – PRE-BENEFICIATION

(Chemical analysis: Interpretation of results in terms of leachability potential, contamination of soils)

8.1. Introduction

Prior to being used in the manufacture of concrete blocks or use in construction, the ash chemical composition, risks and the hazards it presents is shown In the laboratory analyses results. The basis of the leachability test of the ash was in anticipation of the environment within the landfill body containing putrescible waste and hence low pH conditions (pH of 5). Low pH conditions are conducive to easier leaching out of metallic components of the salts. However, the ash will be used in the manufacture of concrete blocks, and in construction projects, so, the components of the ash will be bound in the structures made once the concrete mix has dried. The concrete structures subjection to leaching will be largely limited due to this nature of the concrete once set. However, the storage of the ash on site may affect the environment to some degree should the toxic components spill out of the storage containment area. Management systems of the ash will be required generally, but principally at the storage stage due to potential for multiple exposures to humans and environmental health. The chemical and hazardous nature of the ash is given in the analyses conducted on the ash. Refer to:

- Attachment 3a: Certificate of Analysis,
- Attachment 3b: Waste Assessment and Classification and
- Attachment 3c: Safety Data Sheet - SDS.

Total concentrations for the elements within the ash were determined as per NEM:WA - National norms and standards for the assessment of waste for landfill disposal. The quantitative results present the hazard risk to all stakeholders when exposed directly to the ash. These exposures have been given toxicity values. The GHS classification for the hazard of ash is presented in Table 2: Summary of ash GHS hazard classification.

The results for the Total Concentration (TC) and the Leachability Concentration (LC) are presented in Table 4: LC and TC laboratory results for the GSC ash. These values were used for the Framework for the Management of Contaminated Land database of the Soil Screening values. The Soil Screening Values (SSV) are the soil quality values, expressed as mass of contaminant per mass of soil, that are:

For SSV1: protective of both human health and ecotoxicological risk for multi-exposure pathways, inclusive of contaminant migration to the water resource. Soil Screening Values 1 are applicable to all land-uses, and thus represent an 'acceptable-risk' situation, with no adverse effects on human health and the aquatic environment.
For SSV2: that are protective of risk to human health in the absence of a water resource. Soil Screening Values 2 are land-use specific and have been calculated for three key land-uses namely, standard residential, informal residential settlements and commercial/industrial land-uses.

This approach was followed because GSC has the intention of beneficiating the ash waste stream by supplying the local community the ash to use to make concrete blocks and to construction companies. The ash will be used to replace some of the sand being used in concrete mix. The ash will be:

- loaded at the mill,
- transported to the users site,
- offloaded,
- stored, and
- worked with to manufacture the blocks, or the particular item being constructed,

so information is needed on the potential risks to the people and to the environment to manage this material for safety.

8.2. Laboratory results

Table 4: LC and TC laboratory results for the GSC ash.

Chemical	**LC. (mgX/l)**	**TC. (mgX/kg)**
Antimony	<0,05	<5
Arsenic	<0,08	<8
Barium	0,56	**162**
Boron	<0,16	<16
Cadmium	<0,17	<17
Chromium Cr^{+3}	<0,16	471
Hexavalent Chromium	0,005	0,044
Cobalt	<0,17	<17
Copper	<0,17	<17
Lead	**1,28**	<8

Chemical	LC. (mgX/l)	TC. (mgX/kg)
Manganese	0,44	43
Mercury	0,0032	**1,08**
Molybdenum	<0,31	<31
Nickel	<0,18	<18
Selenium	**<0,63**	**<63**
Vanadium	<0,02	13
Zinc	0,26	3,66

Chloride	4,24	-
Cyanide (Total)	<0,01	<10
Flouride	<0,06	1,3
Nitrate	0,25	-
Sulphate	17,4	-
TDS	**1145**	-

Note: Bold analytical results exceed at least the lowest applicable concentration threshold per Appendix 1 of the T and T analytical report. for the assessment of waste to landfill.

8.3. Total concentration and leachable concentration of components in ash as a characterisation of the hazard nature of the ash.

The GHS classification for the hazards that the ash would pose in terms of its physical nature, health and environmental hazards were made based on the oxides of each component for hazardous risk. The ash was determined to be hazardous to human health considering the different routes of exposure. The risks presented to human health if exposed were:

- skin irritation and
- serious damage to the eyes

There was no risk to the environment as assessed by the GHS method. These health hazards are mitigated using the management measures as outlined in the Safety Data Sheet to protect human health.

The waste is CHEMICALLY assessed as high hazard (Type 1) when assessed for landfill.

There is thus a need to be aware of the effect of these components in the ash on the receiving environment. The following are the sources of information for the possible effects that may be encountered to assess the risk of these components:

- Department of Environmental Affairs: Framework For the Management of Contaminated Land. May 2010.
- Department of Environmental Affairs, Government Notices.

- R. 634: National Environmental Management: Waste Act (59/2008): Waste Classification and Management Regulations.
- R. 635: National norms and standards for the assessment of waste for landfill disposal.
- R. 636: National norms and standards for disposal of waste to landfill.

8.4. Soil Screening Values as a basis for developing risk assessment and risk management plans.

The remediation of contaminated land is being used as a base from which to determine the effects on the environment and related stakeholders.

This work is used to show the values used to assess the risk to the affected areas when the ash is applied to the fields.
This approach will be a useful tool to manage the use of the ash in the environment of the block making operation and on the construction site.

TABLE 5: Summary of the TC and LC values when compared to the soil screening values for protection of water resources. Metals only; shows the soil screening values required to achieve DWA Water Quality Guidelines levels for aquatic ecosystems protection and domestic water use. (Framework for the Management of Contaminated Land. 2010. p 33).

Table 5: Summary of the TC and LC values when compared to the soil screening values for protection of water resources. Metals only. (Note, the highlighted numbers from these thresholds represent exceedances of the components in their total concentration and/or their leachable concentrations. NO leachable components were exceeded)

Parameter	**SSV1**	**SSV2**	**SSV2**	**SSV2**	**Protection of water Resource**	
	All Land-Uses Protective of the Water Resource (mg/kg)	**Informal Residential (mg/kg)**	**Standard Residential (mg/kg)**	**Commercial/ Industrial (mg/kg)**	**Protection of Human Health (Drinking water usage) (mg/kg)**	**Protection of Ecosystem Health (mg/kg)**
Metals and metalloids						
Antimony	-	-	-	-		-
Arsenic	**5,8**	23	48	150	**5,8**	580
Barium	-	-	-	-	-	-
Boron	-	-	-	-	-	-
Cadmium	**7,5**	**15**	32	260	**7,5**	37
Chromium Cr^{+3}	46000	46000	96000	790000	N/A	N/A
Hexavalent Chromium	6,5	6,5	13	40	19	260
Cobalt	300	300	630	5000	-	22000

Parameter	SSV1	SSV2	SSV2	SSV2	Protection of water Resource	
	All Land-Uses Protective of the Water Resource (mg/kg)	**Informal Residential (mg/kg)**	**Standard Residential (mg/kg)**	**Commercial/ Industrial (mg/kg)**	**Protection of Human Health (Drinking water usage) (mg/kg)**	**Protection of Ecosystem Health (mg/kg)**
Metals and metalloids						
Copper	**16**	1100	2300	19000	200	**16**
Lead	20	110	230	1900	20	100
Manganese	740	740	1500	12000	10000	36000
Mercury	**0.93**	**0,93**	**1**	4,5	**1**	4,1
Molybdenum	-	-	-	-	-	-
Nickel	91	620	1200	10000	91	1400
Selenium	-	-	-	-	-	-
Vanadium	150	150	320	2600	2000	-
Zinc	240	9200	19000	150000	3700	240

Note: Bold analytical results exceed at least the lowest applicable concentration threshold per for SSV guidelines.

Two tiers of Soil Screening Value have been defined as follows:

- **Soil Screening Value (SSV) 1** represents the lowest value calculated for each parameter from both the Human Health and Water Resource Protection pathways calculations as detailed under the preceding sections. SSV1 values are not land-use specific.
- **Soil Screening Value (SSV) 2** represents the land-use specific soil value calculated following the methods as detailed under the preceding sections. SSV2 values are land-use specific and are appropriate for screening level site assessment in cases where protection of water resource is not an applicable pathway for consideration.

Interpretation: The indication here is that the total concentration values presented some exceedances, but no leachable components were exceeded. Hence caution needs to be exercised in exposure of the material to people in all residential areas through water sources and the ecosystem. The use needs to be protective of people and the environment, away from water sources.

Using the assessments for human and environmental health in the GHS classification, the ash is hazardous for human use, however can be mitigated by correct procedures outlined in the SDS to follow.

8.5. Long term stability and functionality

The SDS indicated that there were no issues with the stability and reactivity of the ash, other than to avoid dust generation. However the ash is moist and must be kept moist to prevent dust formation.
The ash being inorganic will have long term stability and hence its functionality will remain stable.
There is not data for incompatible materials for ash however general care is needed when handling it.

8.6. Reactivity with environmental factors

The following section gives an indication of the responses of the receptors to the concentrations of the exceeded components in the ash in leachate. The system in total remains stable under natural environmental conditions.

8.7. Leaching potential showing long term stability and functionality, reactivity with environmental factors.

The leachability testing is done as per requirement for waste management at a landfill site. The sample was subjected to an Australian Standard Leaching Procedure (ASLP2 Acetate pH 5.0 (P/NP)) as per National Environmental Management Waste Act 59 2008, for the National norms and Standard for the assessment for waste for landfill disposal. The resultant leachate was analysed for various components. However, the requirement is for the ash to be used in the concrete aggregate to manufacture concrete blocks and construction projects. The stored ash may be exposed to rain water intermittently. Rain is only slightly acidic (pH 5,6). This may affect the solubilities of the chemical compounds resulting in a possibly lower leachability than the acidic leachability test solution at pH 5,0 submerged over 24 hours. However, the leachability given would be a conservative approach to what may be presented to the environment. The possibility of the lower pH conditions may be reached if organic materials would be allowed to decompose under anaerobic conditions resulting in an acidic environment. The leachable components from the leachability testing were not exceeded in the SSV1 and SSV2 test thresholds. However, caution is needed because of the potential to leach out lead and selenium. There were some total concentration exceedances for barium, mercury and selenium. This implies that the ash would need management to reduce any potential impacts. However, there were no environmental concerns and human risks would be to eyes, and skin. These can be managed.

9. CHEMICAL AND TECHNICAL SPECIFICATIONS – POST-BENEFICIATION

The overall outcome of the various guidelines used was that the ash is a low risk waste stream to be used in the intended applications. The blocks once manufactured and dried will encase all the components within the dried block as will the ash componenets in the construction projects. Even if there was rain, the leaching out of the components in a harmful concentration is minimal because of the surface area presented to the elements.

9.1. Intended users of the waste stream

The intended use of the waste boiler ash is for concrete blockmaking and to be used as a substitution to sand in the construction industry. The waste stream will be used by low or no income communities and in the construction industry.

9.2. Long term stability and functionality

The concrete blocks and structures remain stable throughout their useful life.

9.3. Reactivity with environmental factors

No adverse reactivity nor instability were noted in the SDS report.

10. IDENTIFICATION OF POTENTIAL RISKS AND THE MANAGEMENT THEREOF

Refer to: Attachment 4: Risk Assessment Ash GSC and Attachment 5**:** Risk management plan for GSC boiler ash.

11. REFERENCES

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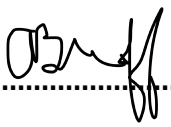
7. DEA. (May 2010). *Framework for the Management of Contaminated Land.* Pretoria: Deptartment of Environmental Affairs.

12. DECLARATION BY SPECIALIST – ANNE BINDOFF

All information and instructions provided in this report in respect of the Risk Assessment and Risk Mitigations/Management Plan substance is given in terms of the provisions of the National Environmental Management: Waste Act (59/2008): Regulations regarding the exclusion of a waste stream or a portion of a waste stream from the definition of waste. Information and data is based on available information given by Gledhow Sugar Company and is the best information available through general research based on this information as at the date of this report. It is presented in good faith, to be correct.

Name: Anne Bindoff

Signature: .....  ..... **Date:** 28th June 2023.....