anne bindoff CONSULTANCY

Reg no: 2014/011805/07

MOTIVATION IN SUPPORT OF THE APPLICATION TO EXCLUDE BAGASSE WASTE FROM THE DEFINITION OF WASTE

for

UMFOLOZI SUGAR MILL (Pty Ltd)

by

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August 2023

Revision 3.

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Details of the specialist

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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.
      - Umfolozi mill.

1. INTRODUCTION

(https://www.umfolozisugarmill.co.za)

Umfolozi Sugar Mill (Pty) Ltd (here-after referred to as USM) is situated in Matubatuba, Zululand, Northern Kwazulu Natal. It is a leading producer of high-quality very high polarity (VHP) brown sugar, which is sold in the Southern African Customs Union (SACU) and to various cross-border regional markets.

Refer to Figure 2: Google earth view of the Umfolozi Sugar Mill and the location of the 2 bagasse storage areas relative to the mill.

Figure 3: Google earth view of the Umfolozi Sugar Mill (Source: Google Earth, 2023) and the location of the 2 bagasse storage areas

Some of the residential area can be seen relative to the mill and the bagasse storage areas. Table 1 provides details on the GPS coordinates of the 2 bagase storage areas.

Table 1: GPS coordinates of the 2 bagasse storage areas

REFERENCE	LATITUDE			LONGITUDE		
Bagasse Storage Area A (Red polygon)						
A	28°	26’	38.73” S	32°	11’	6.01” E
B	28°	26’	40.02” S	32°	11’	5.06” E
C	28°	26’	41.42” S	32°	11’	6.62” E
D	28°	26’	40.04” S	32°	11’	7.37” E
Bagasse Storage Area B (Yellow polygon)						
A	28°	26’	30.48” S	32°	11’	7.19” E
B	28°	26’	33.99” S	32°	11’	6.30” E
C	28°	26’	36.68” S	32°	11’	9.15” E
D	28°	26’	32.03” S	32°	11’	11.89” E

2. LEGISLATIVE FRAMEWORK

2.1. Acts:

- The Constitution of the Republic of South Africa, Act 108 of 1996.
- Dept Of Water Affairs (DWA):
  - National Water Act (NWA): (Act 36 of 1998)
  - Water Quality Guidelines. 1996. Various.
  - Guidelines for the Utilisation and Disposal of Wastewater Sludge. Vol 1 - 5.
- 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.
- **WHO:** Guidelines for Drinking-water Quality. FIRST ADDENDUM TO THIRD EDITION. Volume 1. Recommendations (3rd ed.)

3. CONTACT DETAILS OF THE USM

Applicant:	Umfolozi Sugar Mill (Pty) Ltd
Trading name (if any):	Umfolozi Sugar Mill Environmental Technologist
Contact person:	Yolande Sajiwan

Physical address:	Corner of Mill and Club Lane, Riverview, Mtubatuba, 3935		
Postal address:	Private Bag X12, Mtubatuba		
Postal code:	3930		
Telephone:	035 550 7700	Cell:	083 571 7206
E-mail:	YSajiwan@usm.co.za	Fax:	-

4. USM MILL INTEGRATED MANAGEMENT SYSTEM PROFILE

Declarations in the USM SHEQ&FS policy:

Commitment:

"USM is committed to sustainability; this relates to our compliance mission odf "DO NO HARM" by protecting:

- Staff, visitors and contractors, by supplying a safe environment,
- Our environment,
- Our assets and our plant.

through the implementation of the Integrated Management System (IMS) with clear objectives:

- To prevent injuries to all people on site, by preventing our pollution and reducing water and energy consupltion.

4.1. Vision, mission and values

The following is an extract of the vision and mission of the USM:

- "To sustain customers with quality products and service
- To sustain growers with fair and transparent interactions
- To sustain employees with a safe and high-spirited environment
- To sustain surrounding communities through job creation and poverty alleviation initiatives."

4.2. Compliance

"Our compliance management system is under-pinned by our belief in causing no harm to people, the environment, consumers and our assets.

We have adopted an integrated approach to compliance and follow an effective management system that ensures sustainability that is not people dependant, with clear accountabilities and responsibilities in our Documentation, Record-keeping, Working conditions and the State of our physical space, the working environment, company culture, Behaviour and Actions.

We sustain our compliance system with continuous auditing and inspection at different levels."

The commitment to compliance is indicated in the listed documentation undergirded by the Sheq Policy. The following documents are listed for the records for compliance to best practice in this industry at the USM:

- USM Code of Conduct and Business Ethics (Attachment 1).
- Occupational Health and Safety Certificate (NOSA 4 Star) (Attachment 2).
- Waste Management Licence (Attachment 3).
- Water Use Licence (Attachment 4).
- SHEQ FS Policy (Attachment 5).

4.3. Corporate social investment

"USM is situated in a deeply rural, poverty-stricken district of KwaZulu-Natal. We need to be in tune with the needs of our community and be able to lend a hand where we can. USM actively participates in our local community by enhancing and developing the skills of disadvantaged community members and contributing to the upliftment of the broader area.

5. FACILITY WASTE GENERATING PROCESS

The production process is the place where the waste streams at each stage of the sugar production process are generated. The following sections describe the process very briefly.

5.1. Production process description

Refer to: https://www.umfolozisugarmill.co.za/mill.html

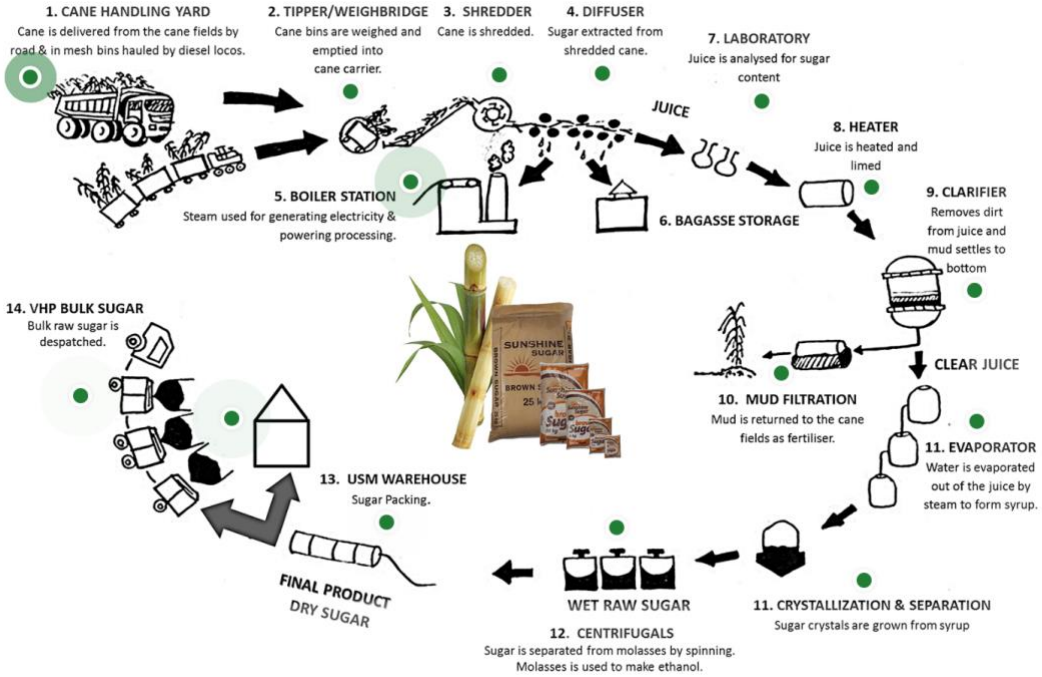

Figure 4: The USM production process

Refer to Figure 5: showing the USM production process. The link provides a useful visual reflection of the process as the link gives photographs of the activity. The process flow is important to understand to understand the inputs for the bagasse waste generated (sugar cane) and where the waste is generated in the process.

Approximately 1.3 million tons of sugar cane is crushed in an average year with "normal" climatic conditions over a 36 week milling season. 65% of the sugar cane is produced on the Umfolozi flats and delivered on the narrow gauge railway. Between 4% and 10% is delivered by Small Scale Growers, some of which is delivered on the narrow gauge railway and the balance by road.

The cane is weighed over a weighbridge and then tipped onto a conveyor/carrier to a shredder.

5.2. Bagasse waste generation:

The shredded cane is then transferred to a diffuser where the sugar juice is extracted with hot water. The fibre is then squeezed to remove as much moisture as possible leaving a dry fibrous solid which is the bagasse. The bagasse is then either sent to:

- the boilers to be used as fuel to generate heat and steam for the process of sugar extraction; OR
- Sent to the bagasse storage areas (see Figures 1, 5a and 5b).

The other waste stream generation processes are described as follows: The juice is sent for purification to remove by flocculating the non-sucrose components by heat and lime addition with other additives for optimal separation. This is then sent to the clarifier. The clarified overflow is taken to evaporators to crystallise out the sucrose, and the underflow/sludge is sent to the mud filter where the mud is concentrated to produce the filter cake.

The bagasse currently is used as a biofuel in the boilers to produce steam. The fly ash from the wet scrubber technology is used for PM abatement in the USM boilers and the bottom bagasse produced are quenched to cool down and a slurry is formed. This is combined with the filter cake to produce smuts which is then stored in licenced temporary storage dams.

The schematic in figure 3 below gives the overview of the process where the waste streams are formed. Figure 4: below shows the smuts storage dam.

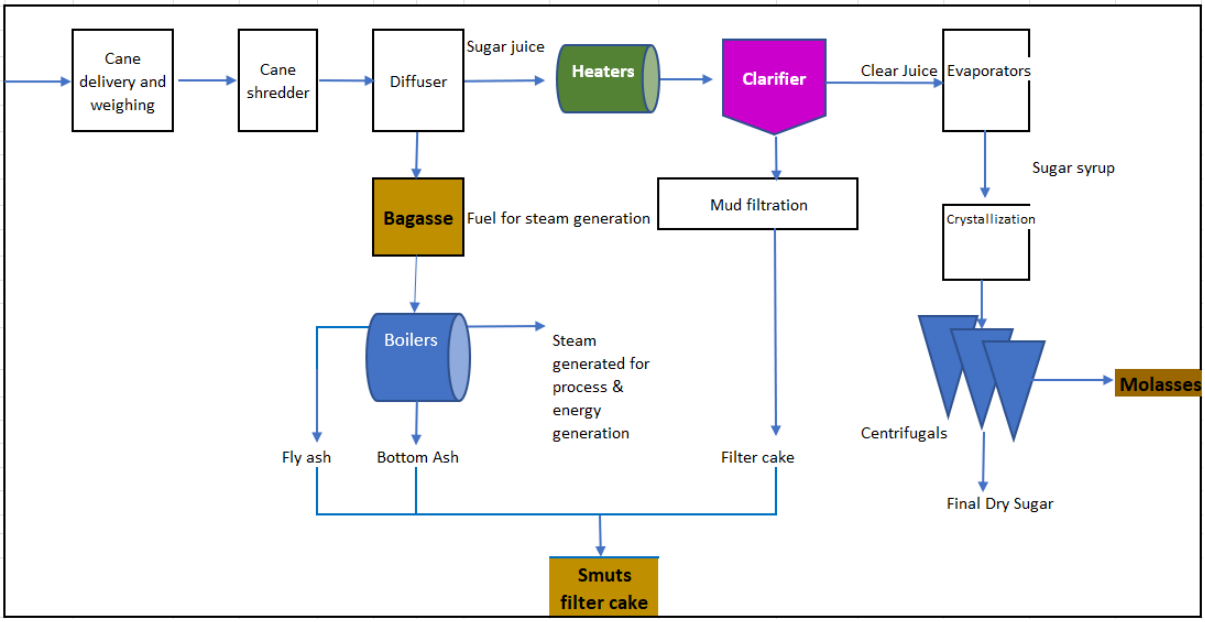

Figure 6: Schematic process flow diagram showing bagasse, boiler ash, filter cake smuts and molasses production

Figure 7: Smuts storage dam. Decommissioned dam made accessible to farmers

Figure 8a: Bagasse storage facility

Figure 5b: Bagasse storage facility

5.3. Water abstraction for sugar processing

Figure 6 below shows the process for purifying river water for suitability to feed into the sugar processing plant for appropriate uses.

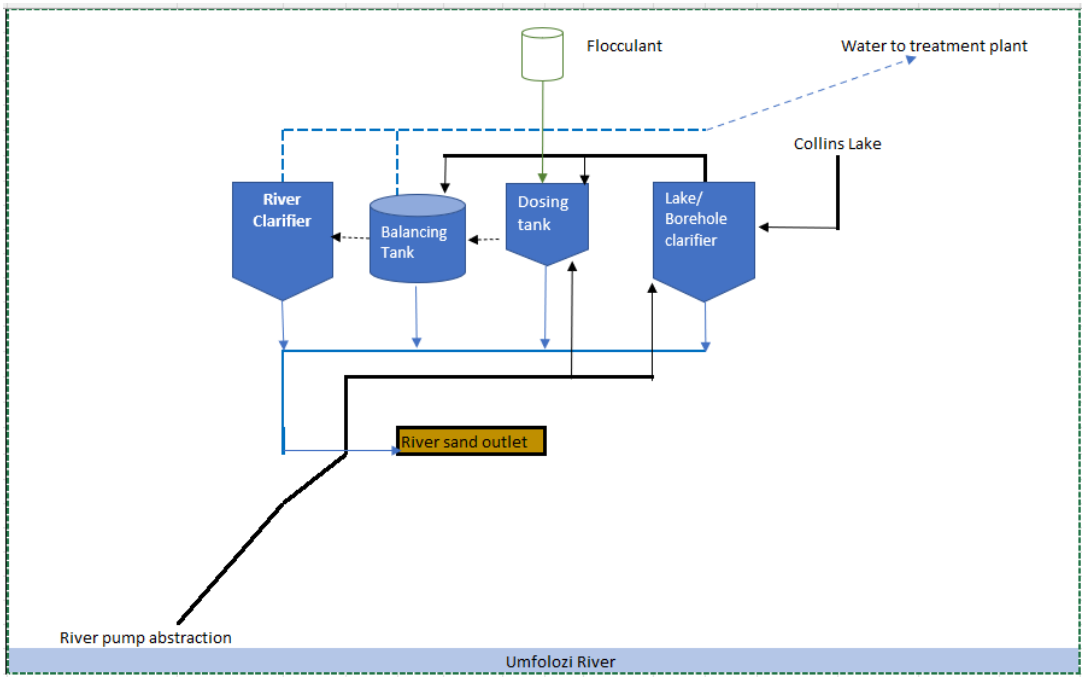

Figure 9: shows the process for purifying river water for suitability to feed into the sugar processing plant for appropriate uses

Water is abstracted from the Umfolozi River to use in the abstraction of sugar from sugar cane. This water needs to be processed to be deemed suitable for among others; steam generation in the boilers, for the diffusers to dissolve out the sugars from the sugar cane, and for general use around the mill. The process is shown in the schematic of Figure 6 above. The treatment process generates a sandy sludge with the river sand from the raw river water. The reuse of this sandy sludge would be used for blockmaking to suit the needs of the local community for generating their own income.

5.4. Waste effluent treatment works

The processes also include treatment of the waste streams. The schematic is shown **in Figure 7 Effluent Treatment Plant.**

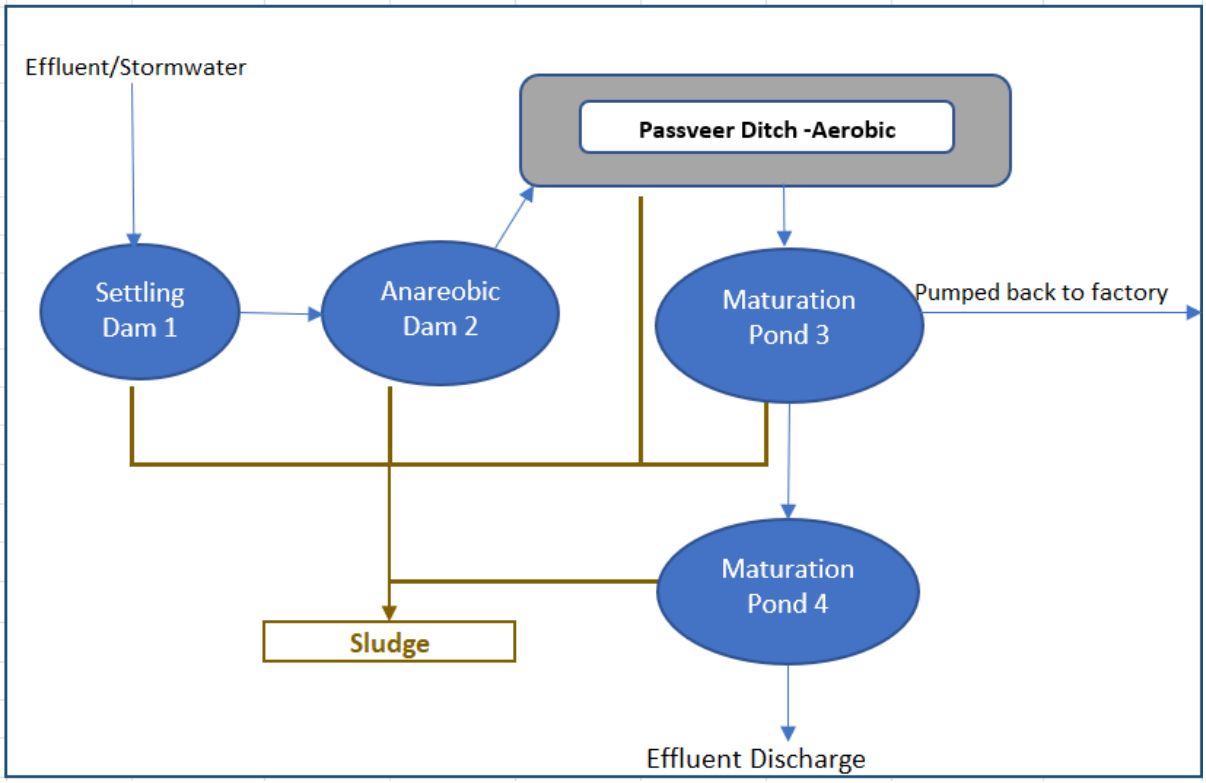

Figure 10: Effluent Treatment Plant

All of the processes in producing sugar involve producing spills of solids like sugar cane fibre, stalks etc and liquids like sugar juice, process water, and other liquids as run-off within the plant. The solid waste is swept up into containers, and put back into the processing system. This liquid effluent stream is collected together with any stormwater run-off into an effluent treatment works. The processes must be run to best practice to minimise these solid and liquid effluent flows.

The liquid effluent which would be rich in sugars and other sugar cane based organic and inorganic materials needs to be treated to reduce the chemical oxygen demand (COD) of the effluent to acceptable levels before discharging into the natural water sources. The following describes this process.

The primary effluent from the mill is captured into settling dam (1). The underflow collects the solids as a sludge, and the overflow is taken to the anaerobic dam (2). The organics are reduced in an anaerobic process where the underflow sludge is combined together. with the settling dame sludge. The overflow is taken to the PASSVEER DITCH where the effluent is agitated mechanically to aerobic conditions. The sludge is combined with the other sludge streams. The liquid overflow is take to the maturation pond (3) to polish off the reduction of organics processes. This liquid is pumped back to the sugar processing or to the next

maturation pond (4) to take the COD levels down to acceptable levels for effluent discharge. The sludge streams are combined here, and are used for soil enhancing.

5.5. Waste bagasse generated and beneficiated.

- Approximate bagasse produced: ± 40,000 tons/month.
- Bagasse removed by farmers is taken approximately 2% of monthly production.

The information obtained from these sections gives a good background for the raw materials inputs that generates the bagasse waste stream (and others). The socio-economic needs and the geographic area into which the material is intended to be used is described briefly in section 4.3. The following section will build onto this by presenting some work that has been done on bagasse to assess the advantage in using this waste stream as a soil enhancer. Following on from this the bagasse will be described in this context.

6. BAGASSE

6.1. Introduction

Bagasse is a very useful solid waste stream from the sugar cane sugar extraction process. As can be seen from the process flow schematic (figures 2 and 3), bagasse is a waste stream generated from the diffuser where the sugar juice is extracted from the shredded cane and then the excess moisture is squeezed out. The chemical composition of bagasse will be presented later in this report. It is made up of the cellulose and hemicellulose fibres, water, and minor inorganic and organic components. The moisture content is generally between 45 and 55% on a wet basis. (https://www.celignis.com/feedstock.php?value=13.). Currently it is being used as a biofuel in the boilers to generate steam and power. The future intention is to look at additional uses for papermaking.

The following gives a brief overview of the beneficiation streams for bagasse.

6.2. Agricultural need for soils enrichment with suitable fertilizers

The fuel used to fire the boilers at the USM is bagasse, with coal being used should bagasse not be a suitable resource occasionally; example being firing up the boilers after a shut, should the bagasse be too wet. Bagasse however is the primary source of fuel. There are other uses which will be looked at for their advantages to Umfolozi mill.

Some studies have been done on the effectiveness of bagasse as a soil nutrient source for growing sugar cane. The following papers are cited in support of this.

- **Bagasse: a potential organic soil amendment used in sugarcane production**

(Ref: Jehangir H. et. al. (**https://edis.ifas.ufl.edu/publication/ss690**))
Paper 1 describes the benefits of bagasse as a soil enhancer. The conclusion will be cited as the summary of this paper's findings:

- **Conclusion**

Bagasse appears to be a good sustainable organic soil amendment that can be applied on mineral soils locally where it is being generated. A 2-inch application of bagasse and a 4-inch application of bagasse with extra N showed significant yield response in sugarcane. In addition, numerous agronomic benefits of bagasse application include low pH, low bulk density, high water-holding capacity, and high organic matter content. Nutrient composition of bagasse is typically high, yet it can be variable. As an amendment, bagasse could supplement sandy soils with major and micronutrients. Due to the high organic matter content and the high C:N ratio, some of the N and P fertilizer applied during crop production can potentially become immobilized. Ultimately, the timing and rate of bagasse application would depend on the soil and crop types. Currently, there are no recommendations in place for sugarcane growers on utilizing bagasse on mineral (sandy) soils. This would be a good starting point if they want to sustainably incorporate their bagasse stockpiles back into the sugarcane production cycle.

6.3. Bagasse as a use for biofuels

(ref: Pan, S. et. al. 15 November 2022, Science Direct (https://doi.org/10.1016/j.indcrop.2022.115684.))

The bagasse waste stream is already being used as a direct fuel for the existing boilers to generate steam and heat for the process of extracting sugar from the sugar cane. However, there are other biofuel options that are available. A brief citation from the abstract from the reference paper is given:

6.3.1. Abstract

"This review aims to present the current status and challenges in the conversion of SCB into biofuels like biohydrogen, biomethane, biomethanol, bioethanol, and biobutanol. The major economic and environmental perspectives are also discussed to assess the economics and eco-friendliness of SCB as the feedstocks for biofuel production"

6.4. Bagasse as a use for paper making

Paper making is a very old industry with the use of cellulose fibres from various sources. Currently wood from extensive forestry is the most common method of supplying fibre to paper mills to process into paper for all purposes from packaging to printing. However, forestry is deemed to be one responsible factor in deforestation. Hence the use of alternative source of fibre which are readily available is deemed an advantage for preserving natural areas as carbon sinks with the unique ecosystems they support.

7. RECYCLING OR REUSING THE BAGASSE PRODUCED

7.1. Consequences of not recycling or reusing the bagasse produced

The only recourse for the disposal of the bagasse is to landfill if not recycled or reused.

In 2017 - 51% of approximately 19 million tons of organic waste was disposed of into landfill. The amount of bagasse generated within the country from the +/- 22 million tons of sugarcane crushed is approximately 3,3 million tons of dry bagasse (ref: https://researchspace.ukzn.ac.za/handle/10413/155.), of which 1/3 is surplus to the factory.

Hence there is a lot of bagasse that would potentially be disposed of into the landfill site if not beneficiated by reusing and recycling.

Unfortunately landfilling is a waste management process that uses up airspace thus causing a very costly sourcing and development requirement for more landfill development. 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 in a responsible manner: - to beneficiate the waste as a resource stream for other operations.

The negative aspect to the removal of the bagasse to a permitted and properly managed landfill site which does have space available costs:

- the company:
  - Landfilling fees; unless they don't charge for potential cover material,
  - Fuel which is changing and generally increasing monthly in 2023,
  - Driver salaries,
  - Truck fees and maintenance.
  - distances may be large to the nearest legally licenced and well managed landfill site.
  - A cost incurred that would reduce the budget for employment of staff as well as reduction of budget, even if it is small to do much needed maintenance.
  - Additional cost to purchace coal to burn in the boilers.

- farmers
  - The loss of good nutrient off from the sugarcane farm soils and the need for farmers to supplement this with commercial fertilizers.
    - Currently fetilizers have increased in price,
    - Fertilizers are becoming scarce.
  - A cost incurred that would reduce the budget for employment of staff as well as reduction of budget, even if it is small to do much needed maintenance or field development, etc.

7.2. Benefits of reuse and recycling

The objectives of the NWMS - 2020, are aligned with the Sustainable Development Goals:

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 National Waste Management Strategy (NWMS) 2020 is directing South Africa to a future with zero waste in landfills. This will be achieved through eight strategic goals, three 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 bagasse benefits USM by the cost savings of diverting these waste streams from landfilling. The cost savings involved promotes:

- job creation by employment of people within the:
  - agricultural sector, by preserving the soils which is being degraded on a large scale in the area (section 4.9)
  - potential alternative biofuel production processes,
  - paper making processes
- will be realised by the farmer by not having to buy commercial fertilizer.

To be able to benefit from this opportunity, the bagasse will need to be characterised for minimum risk from the use of the micro nutrients to be available for the crops and not to be an environmental hazard. The following section describes this process and the results of the nature of the waste.

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

8.1. Rationale

The methodology adopted was as per 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.

Using this method the classification of waste was done using the laboratory analyses results. The laboratory results can also be used to determine the GHS classification for human, and environmental risk. Then a risk assessment done with the mitigation plans.

8.2. Characterisation of the waste

The waste bagasse was sampled by SRK Consulting from the Bagasse Storage Area (BSA). This was sent off for chemical analyses.

The first approach will be to identify the components within the bagasse waste using the standardised testing protocols. These will be described as follows:

The waste bagasse sample was received by ELEMENT Materials Technology UK on 18th July 2019, an ISO 17025 accredited laboratory under UKAS (4225), or Elements Materials Technology (SA) which is an ISO 17025 accredited under SANAS (T0729) or a subcontractor laboratory. It was tested for its chemical composition, the classification of the waste for any hazards, and for assessment for waste type and landfill class using the **NEM:WA Norms and standards Regulations** for assessment and classification of waste. See Attachment 6 SRK report for analysis and waste assessment for bagasse & smuts Emergency Pond & Molasses The second approach is to determine the hazard thresholds of the chemicals on the soils and water quality hence what would the effect on the environment and the health of the community would be. 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 analytical results are then examined to determine what, if any, risks there are to people and to the environment, and what the hazards are if any. The bagasse is then managed appropriately using the mitigation/management provided with the identified risks. The engagement of an agronomist is key to the correct management of the bagasse application onto the soils to ensure the soil ecosystem is well looked after to avoid salinity build up, pH imbalances, leaching of toxic components and other potential problems.

8.3. Results

Note: refer to:

- **Attachment 6a:** SRK report for analysis and waste assessment for bagasse & smuts Emergency Pond & Molasses Waste assessment. (done in September 2019.)
- **Attachment 6b:** Safety data sheet (SDS) for bagasse. (Compiled on 12 June 2023)

There are minor differences which do affect the waste assessment. These will be given in the sections following.

8.4. Waste assessment to landfill

- **SRK:**

(ref: Based on GN R635 (7)(2): The waste is chemically assessed as a **Type 4 waste**, which is an **inert waste**, and to be disposed of at a **Class D Landfill** (General B^-).

- **Talbot and Talbot SDS:**
  - **Current disposal prohibition/restrictions:**
    - **Type 0, Prohibited Waste** - GN R636:
      - (5)(1)(b): Waste with a pH value of <6 or >12. **Analytical pH value of: 5.7.**
      - (1)(q)(ii) Waste with a moisture content >40% or that liberates moisture under pressure in landfill conditions, and which has not been stabilised by treatment. **Analytical value of: 47 %.**
  - **Future disposal prohibition/restrictions:**
    - Future Prohibited Waste - GN R636:
      - (5)(1)(r)(iv) >6% Total Organic Carbon (TOC). **Non-hazardous waste with analytical value of: 87 %**. (**Prohibited from: Aug 2028**)
  - **Landfill Class (RSA) (subject to treatment):**

- **Type 3 Waste: Class C Landfill (GLB+)** -: GN R635:
  - (7)(2)(d) - **strictly subject to treatment due to GN R636 (5)(1) prohibited disposal: see above**

8.5. GHS Classification and Hazard Management

Not classified as hazardous for GHS hazards based on available information.

8.5.1. Hazards not otherwise classified

Primary Health Hazards: The primary health hazard posed by this product is thought to be exposure to dust via inhalation and eye routes.
Human health hazards - acute
Inhalation: Cellulose dust may aggravate pre-existing respiratory conditions or allergies. Excessive dust concentrations may cause unpleasant deposit or obstruction in the nasal passages.
Eye contact: Dust may mechanically irritate the eyes, resulting in redness or watering.
Human health hazards - chronic
Cellulose dust is a biologically inert dust that has little or no effect on the lungs and does not produce significant organic disease or toxic effect when allowable exposure limits are met.
Note: The waste may contain traces of crystalline silica dust. Repeated inhalation of dust containing respirable crystalline silica is associated with silicosis, lung cancer and autoimmune disorders.
Physical hazards: Activities that result in significant amounts of dust generation may present a combustion hazard.

8.6. Precautionary measures

8.6.1. Prevention:

- KEEP AWAY FROM clothing.
- AVOID breathing dust. fume, gas, mist, vapours, spray.
- 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.

8.6.2. Responses:

- 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 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.

8.6.3. First-aid measures:

- **Immediate actions:** 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.
- **First Aid Measures**
  - **Inhalation:** AVOID breathing dust, fumes, gas, mist, vapours, spray. IF INHALED: Call a POISON CENTRE or doctor/physician if you feel unwell.
  - **Skin Contact:** Keep away from clothing. DO NOT get in eyes, on skin or clothing.. Wear protective gloves, protective clothing, eye protection, face protection.
  - **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.

Anticipated effects and symptoms summaries
Acute effects: Not specified due to classification; apply reasonable care.
Delayed effects: Not specified due to classification; apply reasonable care.
Symptoms/effects: Not specified due to classification; apply reasonable care.

8.6.4. Fire Fighting:

Fire and explosion hazards: Avoid generating dust; sufficient concentrations of fine dust dispersed in air, and in the presence of an ignition source is a potential hazard.

Unusual fire explosion hazards: Depending on airborne concentration, moisture content, particle diameter, surface area and exposure to an ignition source, airborne cellulose dust may ignite and burn with explosive force in a contained area

Extinguishing media and methods: Not specified due to classification; apply reasonable care.

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.

Clean-up: Contain and collect as any solid. Avoid actions that cause dust to become airborne. Do not breathe dust, and do not allow large quantities of dust or wetted material to contact eyes.

8.6.5. Accidental release measures:

Personal precautions, protective equipment, and emergency procedures: : KEEP AWAY FROM clothing. Wear protective gloves, protective clothing, eye protection, face protection.
Environmental precautions: AVOID release to the environment. Collect spillage.

8.6.6. 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.

Safe storage: Keep in a dry place away from heat, sparks, open flames, hot surfaces and other sources of ignition.

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.

8.6.7. Engineered controls:

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

PPE:

Respiratory: In case of exposure to high dust levels, use a respirator approved under appropriate government standards.
Eye/Face: In case of exposure to high dust levels, use goggles or safety glasses approved under appropriate government standards.
Skin/Body: Handle in accordance with good hygiene and safety practices. Clean up areaswhere cellulose dust settles to avoid excessive accumulation of this combustible material. Minimize compressed air blowdown or other practices that generate high airborne-dust concentrations.
Hand / arm: Handle with gloves approved under appropriate government standards
Special conditions posing a hazard
Avoid dust generation.
KEEP AWAY FROM clothing.

8.6.8. Stability and reactivity

Conditions to avoid: Keep away from heat, sparks, open flames and hot surfaces.

8.6.9. Disposal considerations

Refer to disposal restricions and prohibitions given in section 8.4 above.

Safe, environmentally preferred disposal: Dispose of contents/container to an approved facility in accordance with all applicable regulations and landfill requirements per the bagasse 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.

9. CHEMICAL AND TECHNICAL SPECIFICATIONS – PRE-BENEFICIATION

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

9.1. Introduction

The chemical composition of the bagasse for risk based application to the fields is shown In the laboratory analyses results represented by the Total Concentration (TC) and Leachability Concentration (LC) of the various components. The basis of the leachability test on the bagasse was done with deionised water. pH 7. The leachate results given would be a very rough indication of the POST-BENEFICIATION state of the bagasse in the soils when applied in the sugarcane fields. The complexity of the interaction of the bagasse with the soils and microflora and the plants are not reflected in these results other than in the health and robustness of the plants. The background research work given in the different uses of bagasse indicate good uses in the beneficiation processes: Soil enhancer, papermaking as well as in biofuels. It is anticipated that the research has been done by the sugar industry to anticipate the usefulness of the waste stream.

(Refer to Attachment 6a (SRK Analysis, Waste Assessment Report)
Total concentrations for the bagasse 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 bagasse. These exposures have been given toxicity values.
The results for the Total Concentration (TC) and the Leachability Concentration (LC) are presented in Table 2. These 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 USM has the intention of beneficiating the bagasse waste stream by application to land as a fertilizer, use as a biofuel and in papermaking. Hence this provides a valuable tool to assess the risks and the management of the activity and material in the specific beneficiation activity.

9.2. Laboratory results

Table 2: LC and TC laboratory results for the USM Bagasse

Chemical	**TC** (mgX/kg)	**LC** (mgX/L)
Antimony	<1	<0,002

Chemical	TC (mgX/kg)	LC (mgX/L)
Arsenic	<0,5	<0,0025
Barium	6	0,61
Boron	9,67	0,23
Cadmium	<0,1	0,0005
Chromium Cr^{+3}	6,6	0,0035
Hexavalent Chromium	<0,3	<0,006
Cobalt	<0,5	0,002
Copper	4	0,009
Lead	<5	0,005
Manganese	30	0,161
Mercury	<0,1	<0,001
Molybdenum	<0,1	<0,002
Nickel	1	0,002
Selenium	<1	<0,003
Vanadium	2	0,0056
Zinc	8	0,477

Chloride	N/A	8
Cyanide (Total)	<0,5	<0,01
Fluoride	NDP	NDP
Nitrate	N/A	<0,05
Sulphate	N/A	4,2
TDS	N/A	608

9.3. Total concentration and leachable concentration of components in bagasse as a characterisation of the hazard components

The TC and LC concentrations are representative of the components in the bagasse as metal cations and non-metal anions. The assessment for the hazards were made based on the experience of bagasse waste stream.

- Thus the waste is classified as inert TYPE 4 waste (SRK), or chemical assessment to be type 3 waste from the SDS from Talbot and Talbot, which classifies the waste as type 3 waste.

- Disposal to a Class D Landfill site (SRK) or a class C landfill site (Talbot and Talbot SDS)
- HOWEVER, there are restrictons/prohibitions to disposal current and future. Hence the overall assessment of the waste is a TYPE 0 waste which cannot be disposed of at a landfill site unless treated and reassessed.
- The risks presented to human health were presented as eye irritation. There was no GHS hazard according to the information available.
- There was no risk to the environment

The bagasse is proposed to be used as:

- a soil enhancer on farm fields,
- pulp for papermaking,
- to produce biofuel as a direct fuel source to the boilers.

There is thus a need to be aware of the effect of these components within the bagasse on the receiving environment; the soil, natural water bodies, the aquatic environment, livestock which may encounter these components as well as in the manufacturing production processes. These are the sources of information for the possible effects that will be used to obtain information 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.

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

There were no exceedances on the SSV1 and SSV2 thresholds for contaminated soils. Thus the bagasse can be used on soils as a fertilizer. There is no risk to human health nor human settlements nor to water sources. However, any run-off to natural water sources is NOT good agricultural practice due to loss of valuable materials and the cost that was incurred in bringing the bagasse to site and spreading the bagasse. Table 3 gives the threshold values for SSV1 and SSV2. Table 2 gives the laboratory results.

Table 3: Soil Screening Values 1 and 2

Parameter	**SSV1 All Land-Uses Protective of the Water Resource** (mg/kg)	**Informal Residential** (mg/kg)	**SSV2 Standard Residential** (mg/kg)	**Commercial/ Industrial** (mg/kg)
Metals and metalloids				
Antimony	-	-	-	-

Parameter	SSV1 All Land-Uses Protective of the Water Resource (mg/kg)	Informal Residential (mg/kg)	SSV2 Standard Residential (mg/kg)	Commercial/ Industrial (mg/kg)
Arsenic	5,8	23	48	150
Barium	-	-	-	-
Boron	-	-	-	-
Cadmium	7,5	15	32	260
Chromium Cr^{+3}	46000	46000	96000	790000
Hexavalent Chr	6,5	6,5	13	40
Cobalt	300	300	630	5000
Copper	16	1100	2300	19000
Lead	20	110	230	1900
Manganese	740	740	1500	12000
Mercury	0.93	0,93	1,0	4,5
Molybdenum	-	-	-	-
Nickel	91	620	1200	10000
Selenium	-	-	-	-
Vanadium	150	150	320	2600
Zinc	240	9200	19000	150000
Cyanide	14	620	1200	10000

Anions	SSL (mg/kg)
Chlorides	12 000
Fluorides	30
Nitrate/Nitrite	120
Sulphates	4000

9.5. Long term stability and functionality

The bagasse being organic will have long term stability and hence it will remain stable and consistent in all the beneficiation avenues being proposed.

Leachability is minimal as reflected in the chemical analyses. There are no known environmental incompatibilities with bagasse.

9.6. Reactivity with environmental factors

The bagasse is a dried organic material hence care must be taken with any sparks and fire near bulk storage areas and in bulk transportation. No other environmental factor will affect bagasse.

10. CHEMICAL AND TECHNICAL SPECIFICATIONS – POST-BENEFICIATION

The post beneficiation chemical and technical specifications for the:

- Use as a soil enhancer: the research work done on bagasse shows the integration of the bagasse into the soils facilitated by the microbes in the soils. These then facilitate

the uptake of any minerals into the plants, enhance the soil quality, and add water absorption qualities to the soils, among other benefits.

- Paper making: these technical and chemical specifications have not been determined yet at the time of this report. However, in paper making the fibre itself will be processed appropriately to the specifications required for the type of paper to be made.
- Biofuels: The type of biofuel other than for direct fuel to the boilers is not determined as yet. However, the research work gives possible biofuels as cited in Pan, S et. al. November 2022, - biohydrogen, biomethane, biomethanol, bioethanol, and biobutanol.

The overall outcome of the bagasse analysis is that it is an low risk/inert waste to be used in the intended beneficiation fields.

11. INTENDED USERS OF THE WASTE STREAM.

The intended use of the waste bagasse is for:

- biofuel in USM boilers and
- for small scale sugar cane growers for application to the soils as a soil enhancer..
- Pulp for papermaking.

12. IDENTIFICATION OF POTENTIAL RISKS AND THE MANAGEMENT THEREOF

USM has a well-established SHEQ system which incorporates:

- Established environmental management plan:
- Waste management plan in draft.

Refer to attachments 7 Showing the risks and assessment for bagasse and Attachment 8: Showing the management plan to minimise each risk

13. REFERENCES

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14. 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 Umfolozi Sugar Mill 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:** 11th August 2023 .....