DRAFT FOR DISCUSSION

BEEFCOR ABATTOIR

CONCEPT PAPER
INTERIM REPORT ON EFFLUENT AND WASTE HANDLING SYSTEMS AT BEEFCOR-OKAHANDJA

April 2024

BURMEISTER & PARTNERS (PTY) LTD
CONSULTING ENGINEERS
PO Box 1496
WINDHOEK
NAMIBIA
Corner of Andimba Toivo Ya Toivo & Van Zyl Streets,
Suiderhof, Windhoek, Namibia
Tel: +264 61 379 000

DOCUMENT TRANSMITTAL CONTROL

Version	Date	Prep	Check	Approved	Description of Revision
00	29.04.2024	HB	HB	HB	1st Issue

DOCUMENT REFERENCE: W1538/ BEEFCOR/Concept Paper on Effluent & Waste Handling Systems/Reports

APPROVED DISTRIBUTION LIST

This document is cleared for distribution to the following persons: -

- BEEFCOR MANAGEMENT
- OKAHANDJA MUNICIPALITY
- MINISTRY OF AGRICULTURE, WATER AND LAND REFORM
- DIRECTORATE VETERINARY SERVICES

CONFIDENTIALITY

All recipients of this document are to note that the information contained herein forms part of an ongoing and continuous design development process and should be regarded as confidential at this stage.

TABLE OF CONTENTS

List of Tables

List of Figures

ANNEXURE A: TREATED EFFLUENT DISCHARGE STANDARDS

1. INTRODUCTION

BEEFCOR MEAT SUPPLIERS (PTY) LTD is one of two exporting abattoirs and meat value addition facilities in Namibia. BEEFCOR is exporting deboned beef to Europe with a future expansion to China. BEEFCOR abattoir and meat processing plant is situated in Okahandja, central Namibia.

BEEFCOR appointed Burmeister and Partners Consulting Engineers on 13 March 2024 to develop a new integrated waste management system. This interim report follows the initial investigation process and aims to provide feedback of findings to date. More elaborate future reports will be published. The purpose of this Report is twofold :-

a. to present interim findings and to discuss possible further solutions with the Client and the Okahandja Municipality
b. to submit an interim progress report to the Competent Authority to demonstrate what has been done to date and to allow further constructive engagement

2. ENGINEER'S TERMS OF REFERENCE

The Engineer's terms of reference are reflected in the letter abstract below.

BEEFCOR
MEAT SUPPLIERS (PTY) LTD

Reg. nr.: 2013/0345
VAT Reg: 0613974-015

PUTTING NAMIBIAN BEEF ON THE MAP

Ms Ndiyakupi Nghituwamata

The Executive Director

Ministry of Agriculture, Water and Land Reform

Government Office Park

Private Bag 13193

Windhoek

13 March 2024

RE: APPOINTMENT OF PROFESSIONAL ENGINEER OR INCORPORATED ENGINEER REGISTERED IN TERMS OF THE ENGINEERING PROFESSIONS ACT 1986 (ACT 18 OF 1986).

The Infrastructure, Town Planning & Technical Services Department, Okahandja Municipality

I, **Beefcor Meat Suppliers Pty Ltd**, duly represented by Mr Jurgens Twyman have appointed **Burmeister & Partners (Pty) Ltd**, duly represented by Mr Hendrik Boshoff (Professional Registration No. **PE 97005)** to undertake the **PLANNING, DESIGN** of the:

- **NEW EFFLUENT TREATMENT WORKS FOR BEEFCOR ABATTOIR, AND**
- **SOLID WASTE HANDLING SYSTEMS (WHERE APPLICABLE)**
- **ADVICE AS TO SURVEYS, LABORATORY TESTS AND OTHER TESTS OF SPECIALISED NATURE.**

and the inspection of this work during the construction in order to check compliance with the approved design, such appointment being effective from **13 March 2024**.

The above-named person has accepted the appointment and has undertaken to accept responsibility for providing the Okahandja Municipality, simultaneously with the submission of the infrastructure plans, with such drawings, details, and particulars as he/she may require in terms of the Local Authorities Act 1992 (Act 23 of 1992) and to render the new infrastructure

BEEFCOR
MEAT SUPPLIERS (PTY) LTD

Reg. nr.: 2013/0345
VAT Reg: 0613974-015

PUTTING NAMIBIAN BEEF ON THE MAP

safe and in compliance with the relevant environmental standards and legislation. The Engineering Services shall be carried out strictly as per Engineering Professions Act of 1986, as amended.

In so far as such drawings, details and particulars may refer to work of Mechanical, Civil, Structural and Electrical nature, such person has further undertaken to immediately inform the Okahandja Municipality Infrastructure, Town Planning & Technical Services if it appears that any structural work is being carried out in a manner, which may endanger the strength, stability or serviceability of the building or any adjoining building or structure.

Should the above appointment be terminated before construction of the wastewater plant and associated solid waste facilities are completed, I undertake to inform the Okahandja Municipality accordingly and provide the name, registration number and acceptance of the substitute duly registered professional or incorporated engineer.

Signed:

For and on behalf of Owner .... Date: **13 March 2024**

Engineer .... Date: **13 March 2024**

126 Andimba Toivo Ya Toivo Str.
Suiderhof
Tel: +264-61-379000
Fax: +264-61-379001
P.O. Box 1496
WINDHOEK
NAMIBIA
BURMEISTER & PARTNERS (PTY) LTD
CONSULTING ENGINEERING

Figure 1 : Engineer’s Terms of Reference

3. STRUCTURE OUTLAY OF THIS REPORT

This report is composed as follows:-

- Locality of plant
- Historical Context
- Socio – economic Impact of BEEFCOR on the Town of Okahandja
- Waste Profile of Red Meat Abattoirs
- The Legal Framework
- The Abattoir Circular Economy
- Tried and Tested Treatment and Mitigation Options
- Further Tests and Design Work Required

4. LOCALITY

The key plan indicates the general location of the BEEFCOR plant (red square) in relation to the town of Okahandja as well as the proximity to the Okahandja Municipal Wastewater Treatment Works (WWTW) (blue circle).

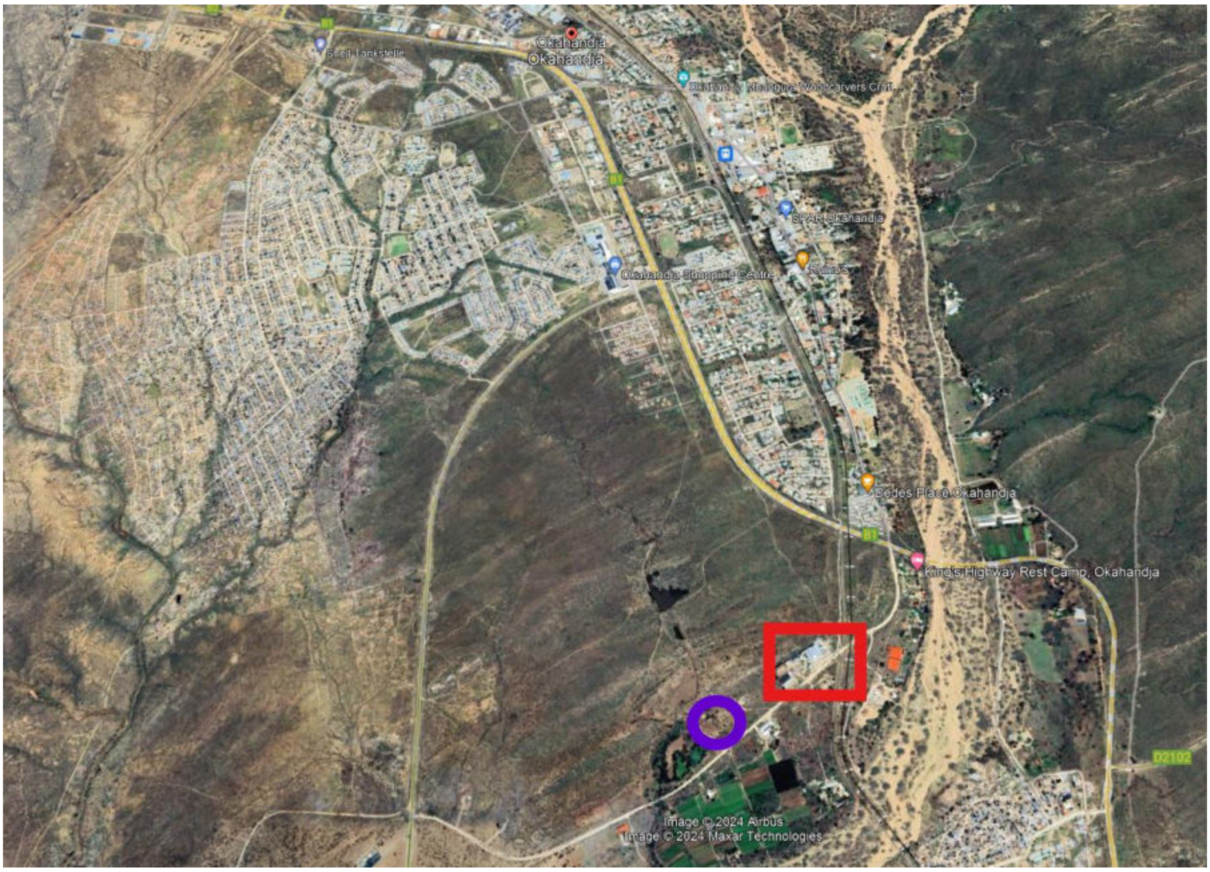


Figure 2 : Locality Map (BEEFCOR Plant and Municipal Wastewater Treatment Works)

Figure 3 depicts the offset (buffer distances) from the plant to the rest of town and the municipal WWTW. It can be seen that the existing WWTW is ideally located (more than 500 meters) from residential developments.

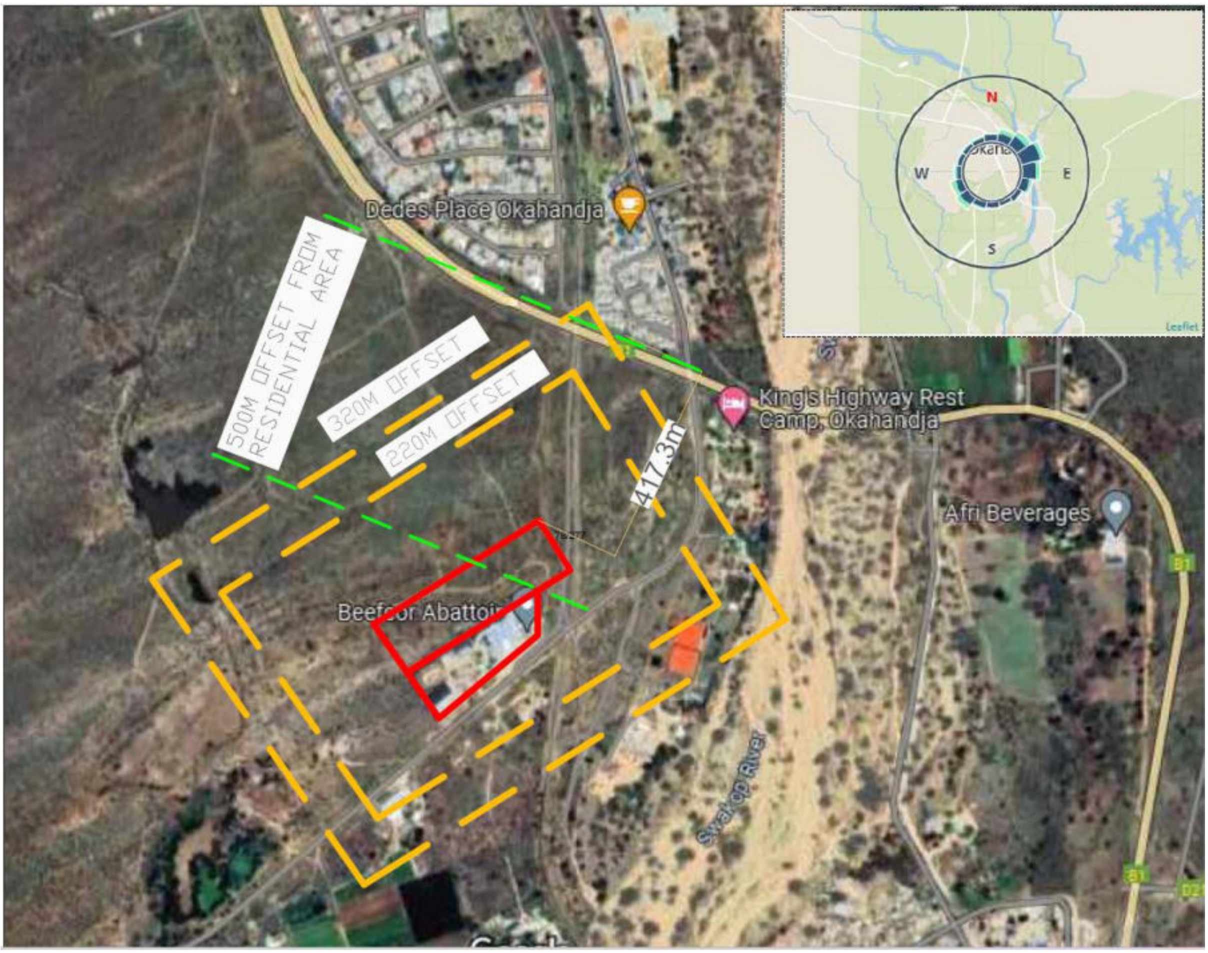


Figure 3 : Typical Buffer Distances between BEEFCOR Plant and Urban Areas

*Figure 4 : Location of Okahandja WWTW and Swakoppoort Dam Catchment Area*depicts that the existing Okahandja Municipality WWTW is situated in the catchment area of the Swakoppoort Dam that is utilised as one of the main water sources for the central region. Water discharged from the effluent treatment Works need to comply with Special Standards (not general standards) as laid down by the Department of Water Affairs (DWA).

Figure 4 : Location of Okahandja WWTW and Swakoppoort Dam Catchment Area

5. BACKGROUND & CONTEXT

5.1 HOCHFELD / BEEFCOR VERTICALLY INTEGRATED MEAT VALUE CHAIN

Waste management and effluent treatment at any abattoir do not exist in isolation. In order to understand how the waste handling and effluent proposals are fitting into a bigger context, it may be helpful to outline the vertically integrated BEEFCOR meat value chains. BEEFCOR and its sister companies operates a classic integrated meat value chain, which comprises of:-

- Hochveld Auction Kraals
- Hochveld Feedlot
- Hochveld Grain and Fodder Production
- Maize Milling
- BEEFCOR Export Abattoir

The beneficial forward and backward linkages among the different business units are therefore self-explanatory. The value chain ensures that:-

- the exodus of weaners supply on the hoof to South Africa is curbed and value addition is retained in Namibia[1].
- the problematic marketing seasonality of typical free-range cattle availability is buffered by means of the feedlot.
- the challenges pertaining to late season cattle conditioning is overcome by means of the scientific approach to feed lotting and animal nutrition.
- the scarcity of livestock feed is locally substituted (not imported)
- grain is locally produced and by-products from grain production is used as cattle feed.

It is against this background that an expanded and integrated waste management plan is proposed.

Disclaimer: BEEFCOR is to a large extent not competing with Meatco for cattle supply as its main focus is on procuring weaners and other non-slaughter ready cattle from producers for fattening in the feedlot. Meatco has seized operations in all their feedlots and thus only procures slaughter-ready cattle from Producers.

5.2 BEEFCOR SCALE OF OPERATIONS

The scale of daily beef production affects the generated waste. Table reflects the current and future production targets.

Current Slaughter Capacity	160 bovines per day
Future Target Slaughter Capacity	250 bovines per day

Table 1: BEEFCOR Slaughter Capacities (Current and Future)

[1] In excess of 150,000 weaners are exported to South Africa on an annual basis. Without BEEFCOR and its feedlot this number will increase.

5.3 SOCIO-ECONOMIC IMPACT OF BEEFCOR ON THE TOWN OF OKAHANDJA

When assessing waste treatment, it is important to point out that waste generation on any industry does not stand in isolation. Waste should be seen as an opportunity and should be seen against the wider positive impact of the entire meat value chain and thus a nett positive socio-economic impact. The impact of BEEFCOR's operations on the local town is multifold, e.g.:-

- Accrued direct investment over the last >10 years in the town.
- Attracting at least 50,000 slaughter-ready cattle to the town of Okahandja to be processed and value- added (the absence of BEEFCOR will effectively mean that these cattle will be slaughtered in other cities and towns of Namibia)
- Processing some 50,000 cattle per annum (14,000 tons of export quality red meat per annum)
- Further value addition of some 5000 tons of specialized meat products using BEEFCOR's own tried and tested developed specialised recipes.
- Curbing the transport of weaners on the hoof to South Africa by procuring weaners locally (up to 40,000 retained annually)
- Marketing products on the shelves of Europe proudly produced and packaged in the town of Okahandja.
- Job creation.
- Skills Transfer to local citizens.
- Continuous skills development and training to local citizens.
- New Technology imports.
- Import of new specialized professional skills.
- Housing to some employees.
- Rates and Taxes paid to local Authorities.
- Providing much needed protein to the local community (food security)
- Provided hygiene slaughter practices (under strict supervision of Directorate of Veterinary Services (DVS)
- Investment in renewal energy (curbing the carbon footprint of the town)
- Technical and Financial Collaborations with local Municipality over a period of >10 years.
- Direct CSR (Corporate Social Responsibility) donations in cash and kind.

BEEFCOR is privately owned enterprise which utilised own funds and resources to set up this prestigious operation. Zero demand is made on the taxpayer, and it directly speaks to the achievement of the Namibian Government's Vision 2030 in terms of realizing Industrialization.

It should be evident that the BEEFCOR plant in Okahandja is a beacon of success that can be imitated by other industrialists who are interested to invest in the town of Okahandja.

With the well publicized high (youth) unemployment rate, it should therefore be self-evident that it is not only the responsibility, but also the duty of statutory authorities to collaborate with BEEFCOR to make the enterprise financially sustainable over the long term (**without** compromising on environmental impacts and relevant legislation)

5.4 WASTE TREATMENT STREAMS CHART

The waste streams at BEEFCOR are presented in 6.

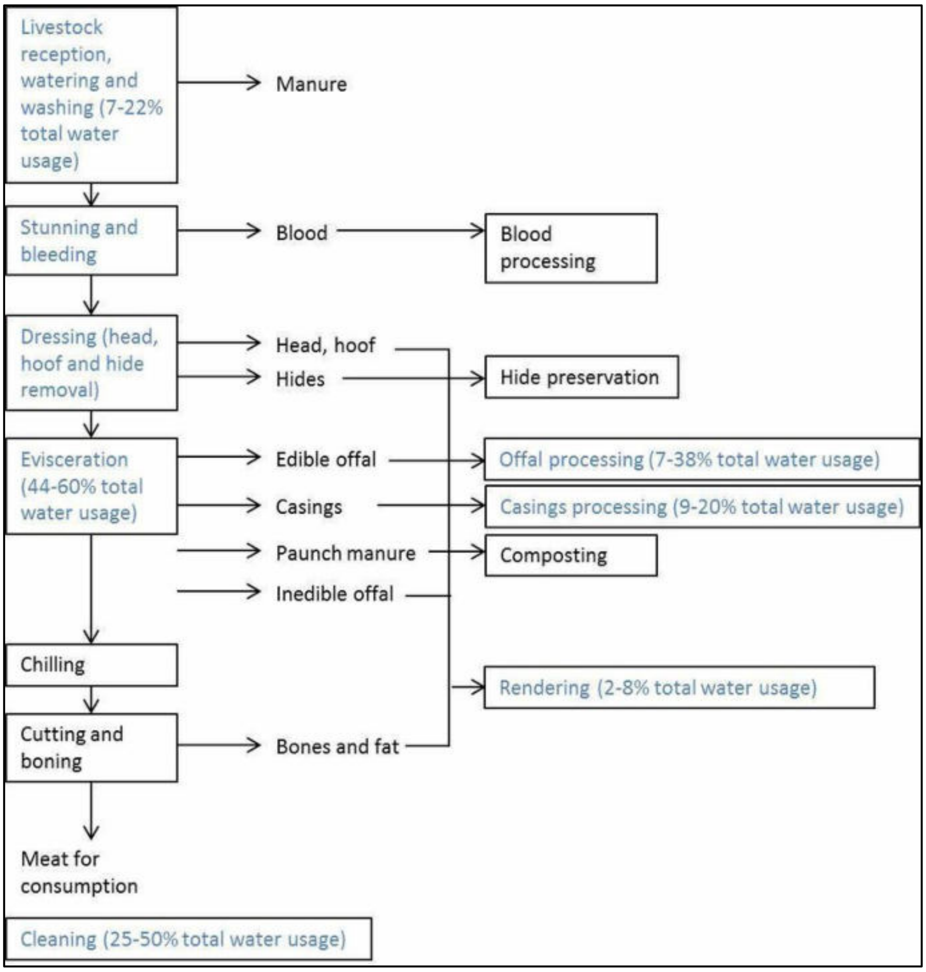


Figure 5 : Waste Stream Flow Chart

Table 2: Summary List of Waste Streams generated at BEEFCORsummary of waste streams generated at BEEFCOR.

WASTE STREAM	CURRENT TREATMENT / MITIGATION	INTERVENTIONS REQUIRED
Manure (from lairages)	Used as organic fertilizer	No risks identified
Blood	Captured and separated from rest of effluent streams Processed, treated and composted – used as high value organic fertilizer	New value addition process proposed – see chapters below
Skins	Sold to leather industry	No risks identified

Paunch (cattle stomach content)	Used as organic fertilizer	No risks identified
Condemned material	Strictly controlled and supervised Fed to vultures for tourism industry	New value addition process proposed – see chapters below
Municipal Refuse (paper, plastic etc)	Discharged at approved municipal landfill / waste site	No risks identified
Domestic sewerage stream (origin human)	Discharged in into municipal sewerage network (treated by municipality)	Municipal Wastewater Treatment Works are not meeting special standards – need to be upgraded
Process effluent (origin plant wash water)	Discharged into municipal sewerage network	New value addition process proposed – see chapters below
Horns	Discharged at approved municipal landfill / waste site	Remain as is
Gall stones	Sold to Market	Remain as is

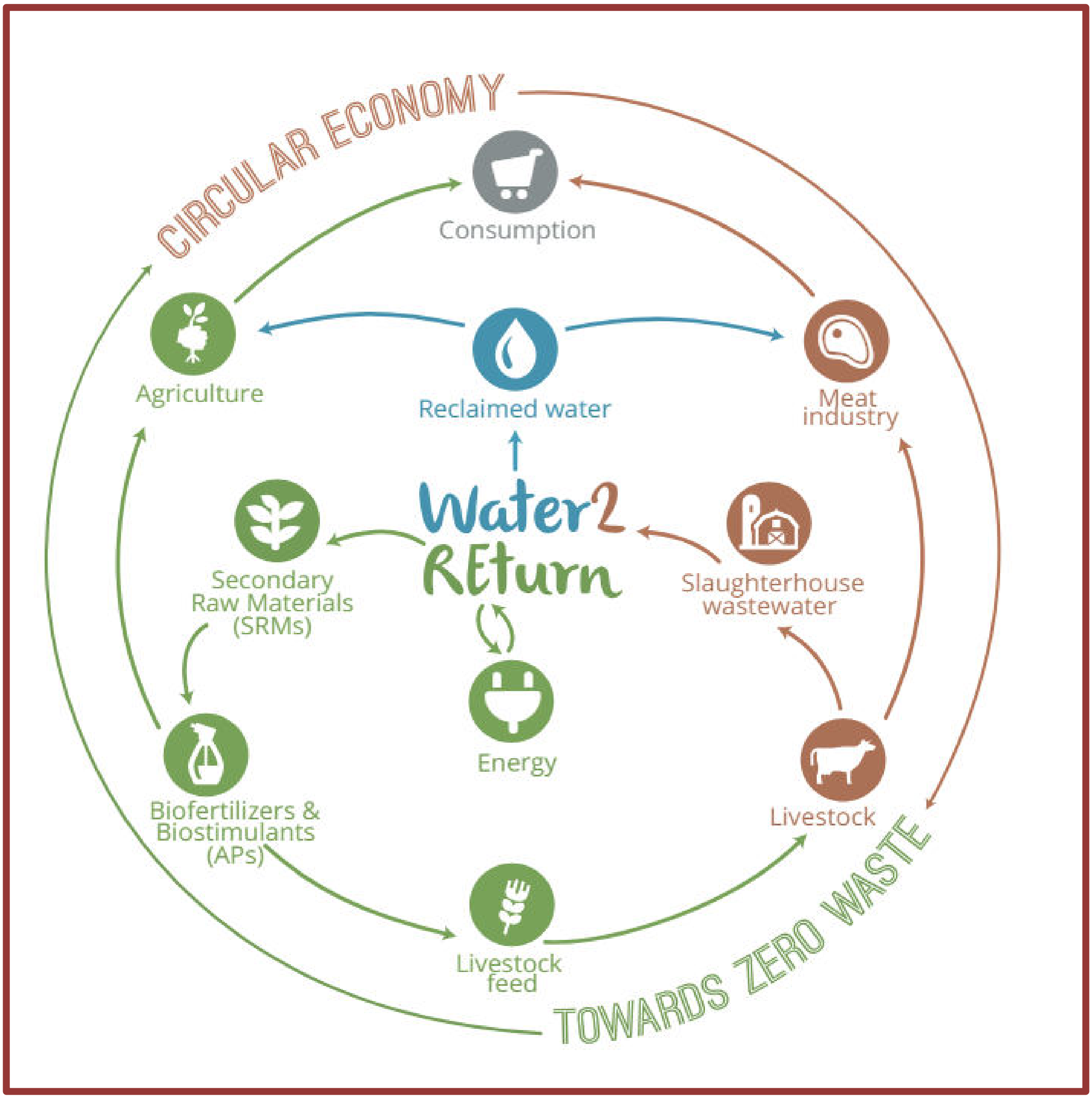
Table 2: Summary List of Waste Streams generated at BEEFCOR

5.5 DESIRED APPROACH: WASTE CIRCULAR ECONOMY

All processes of an abattoir (including waste management), as any other enterprise, needs to be economically and environmentally sustainable for the business to remain competitive and keep trading. BEEFCOR has attained export status to the European Union and to Norway. The international beef industry is extremely competitive and thus require local Namibian abattoirs to produce meat products at internationally competitive rates. This implies for example that excessive energy, water and waste treatment costs can cause a private abattoir and meat value addition enterprise to close down, as it may not be able to offer products at fluctuating international competitive pricing.

A privately owned Abattoir such as BEEFCOR has to comply with all regulations but is not sustained through taxpayer subsidies. In addition, international customers and international country-specific regulations compel exporters of meat products to adopt strict environmental compliance policies, failure which may lead to the cancelling of export contracts. These economic realities, force abattoir operators to adopt value added yet cost effective waste management operations to remain financially and environmentally sustainable.

Error! Reference source not found.aims to demonstrate the abattoir circular economy graphically.



Source: Waste2Return

Figure 6 : Abattoir Circular Economy

In the Namibian context, the circular economy in the abattoir industry implies that amongst others the following sustainability principles should be considered:-

- Wastewater should be safely and responsibly recycled / reused as it stands against the context of water scarcity as well as high water costs (risking economical sustainability of abattoir businesses)
- Waste streams contain valuable nutrients that should be rekindled, recycled, and recovered (as opposed to only treated as a "waste headache")
- Cyclical scarcity of fodder for livestock, necessitate the intensive crop production of replacement feeds (in lieu of seasonal natural grazing) – importing and transporting of protein and energy feeds

into Namibia is not economically feasible and new ways must be found maximise local production of feeds.

- Escalating prices for fertiliser imports into Namibia force producers to revert to locally available (organic) bio-fertilisers to support the production of fodder.
- *"Cradle – to – grave "waste* impact accountability principle (this means that in future punitive measures will be taken against BEEFCOR by their international customers / importers, if for example it is established that the municipal wastewater treatment is found to be malfunctioning (discharging partially treated effluent into environment). This effectively makes BEEFCOR also responsible to ensure that downstream entities handle waste streams diligently.
- Due to the well publicized water scarcity in Okahandja, a new holistic tactic on re-use of effluent waste management should be pursued.

We propose an integrated solution for slaughterhouse wastewater treatment and nutrient recovery, as well as for the recovery of valuable nutrients with a high market value in the agriculture sector.

6. THE LEGAL FRAME FRAMEWORK

6.1 NATIONAL LEGISLATION

All waste handling and wastewater solutions shall strictly conform to the following statutory requirements:-

- Water Resources Management Act 11 (Regulations published in 2023)
- Local Authority Act
- Environmental Management Act

BEEFCOR is currently in process of carrying out an environmental impact assessment with the aim to obtain an ECC.

Table 3: Summary of Impacts of the Regulations (Water Resources Management Act 11) on BEEFCORprovides a non-exhaustive summary of the key points as contained in the Regulations of the Water Resources Management Act 11. The Regulations are new in Namibia and directly impacts the planning, design, testing and application processes to be followed.

ACT STIPULATION	IMPACTS ON BEEFCOR
66. (1) A person who intends to apply for a licence under section 72 of the Act must apply to the Executive Director on a form approved by the Minister which form is obtainable from the offices or official website of the Ministry.	Any new and existing wastewater treatment facility must receive a license from the MAWLR. This applies to BEEFCOR as well as the Okahandja Municipality. BEEFCOR should request a copy of the license of the existing Municipality WWTW to ascertain if any conditions exist.
67. Effluent discharged must comply with the water quality standards set out in Annexure 11.	The treated effluent shall comply with the Act. This applies to both BEEFCOR if a new wastewater

	treatment facility is constructed as well as the Okahandja Municipality. The effluent discharge from the existing Okahandja Municipal WWTW must be tested.
69. Subject to any conditions prescribed under these regulations or imposed by the Minister, treated wastewater may be used for the re-use applications contemplated in Annexure 2, namely for purposes of: - (b) agricultural re-use, as specified in Table 2.2 (c) landscape irrigation, as specified in Table 2.3; or (d) aquaculture, as specified in Table 2.4	This requirement applies to both BEEFCOR and the Okahandja Municipality (as long as discharge meets the specifics of the Regulation)
5. A person who intends to treat wastewater with the intention of re-using the water must, subject to the purpose of use of the water, adhere to the treatment levels specified in Annexure 2 as follows: - (a) for purposes of mining and industrial re-use as set out in Table 2.1 (b) for purposes of agricultural re-use as set out in Table 2.2 (c) for purposes of landscape irrigation as set out in Table 2.3; and	This requirement applies to both BEEFCOR and the Okahandja Municipality (as long as discharge meets the specifics of the Regulation)
Application fee for transfer of licence to discharge effluent or construct or operate wastewater treatment facility or waste disposal site. 71. (1) A licence holder who intends to transfer a licence to discharge effluent or construct or operate wastewater treatment facility or waste disposal site must apply to the Executive Director in the manner contemplated in regulation 66 (1).	This clause stipulates that should the Municipality transfer the license of the existing WWTW to BEEFCOR, an application for the transfer of the license needs to be made to MAWLR.
110. The following use of a wetland or a dam is considered to be harmful and is prohibited: -- (d) the storage of animal manure or other fertilizers in or near the watercourse or within a 100 metres distance from the active stream (e) any wastewater storage along a watercourse or within a 100 metres distance from the active stream, and	

Requirements for persons engaged for operating waterworks used for supplying water for domestic, commercial, industrial or agricultural use. 9. (1) An owner of existing waterworks or new waterworks which are still under construction and will be put into operation must, within 30 days of the commencement of these regulations: - (a) employ a person as a process controller to be in charge of the waterworks; and (b) employ the number and class of operators specified in Annexure 4 to operate the waterworks subject to the classification of the waterworks concerned, the minimum number of employees, including unskilled labourers, on site as set out in Annexure 5. (2) An owner of waterworks must keep an updated register of all operators and employees, including their qualifications, who are employed at the waterworks.	If effluent water is re-used for agricultural use, the operational personnel must conform Annexure 4 of the Act.

Table 3: Summary of Impacts of the Regulations (Water Resources Management Act 11) on BEEFCOR

6.2 OKAHANDJA TOWN STATUTORY REQUIREMENTS

The letter from the Office of the CEO of Okahandja Municipality dated August 2015 stipulates the local municipal requirements pertaining to effluent. Letter included for ease of reference.

MUNICIPALITY OF OKAHANDJA

Tel:+264 62 505 100
Fax:+264 62 501 746
email:okahandja@okahandja.org.na
65 Martin Neib Avenue

Office of the CEO
PO Box 15
Okahandja

Enquiries: Julia K. Hukununa

24 August 2015

Mr. F. G du Rand
BeefCor Meat Suppliers (Pty) Ltd
South plot 205
Okahandja

SUBJECT: PERMISSION GRANTED TO DISCHARGE TRADE EFFLUENT INTO MUNICIPAL SEWERS

The discharge of trade effluent into Council's sewers is allowed under the following conditions as per Chapter 5, Industrial Effluent Sewerage and Drainage Regulations, Regulation 42 and 43.

a) The trade effluent must receive preliminary treatment before discharge into the sewers of Council;
-will render it harmless to the health of men working on the sewers,
-or harmless to the materials of which the sewers are constructed, and to the plant and equipment at the sewerage purification works, and
b) The trade effluent should also be of such a nature as not to interfere or be likely to interfere with the free flow of the contents of the sewers or the process of treatment and disposal at the sewerage purification works.

2. Trade effluent discharged into Municipal Sewers shall be according to the Trade effluent requirements and Standards.

3. Continual Improvement of pretreatment plant is required as the slaughter capacity increases.

4. Ad-hock inspections and sampling shall be done by Council, and laboratory fees shall be payable by BeefCor Meat Suppliers.

It is an offence if non-conforming trade effluent is allowed to pass through Council sewers.

Permission maybe withdrawn anytime without prior notice by the issuer if regulations are not complied with.

I hope you find this in order and appropriate.

....

Beren Kauhouje
Acting Chief Executive Officer

OKAHANDJA MUNICIPALITY
2015 -08- 24
PO Box 15 Okahandja
Tel: (062) 505100 Fax: (062) 501746
65 Martin Neib Avenue
Office of the Chief Executive Officer

Figure 7 : Letter from the Office of the CEO of Okahandja Municipality

6.3 BEEFCOR'S COMMITMENT

BEEFCOR Management expressed to our Office a firm commitment to responsibly comply with all statutory and legal requirements.

7. ASSESSMENT OF SOLID WASTE TREATMENT OPTIONS

7.1 (MUNICIPAL) REFUSE

General office waste can be continued to be disposed at the approved municipal site. The Client may consider implementing recycling and segregation of different categories of solid wastes – this is however not compulsory and would only be a voluntary decision (e.g. to reduce carbon and waste footprint).

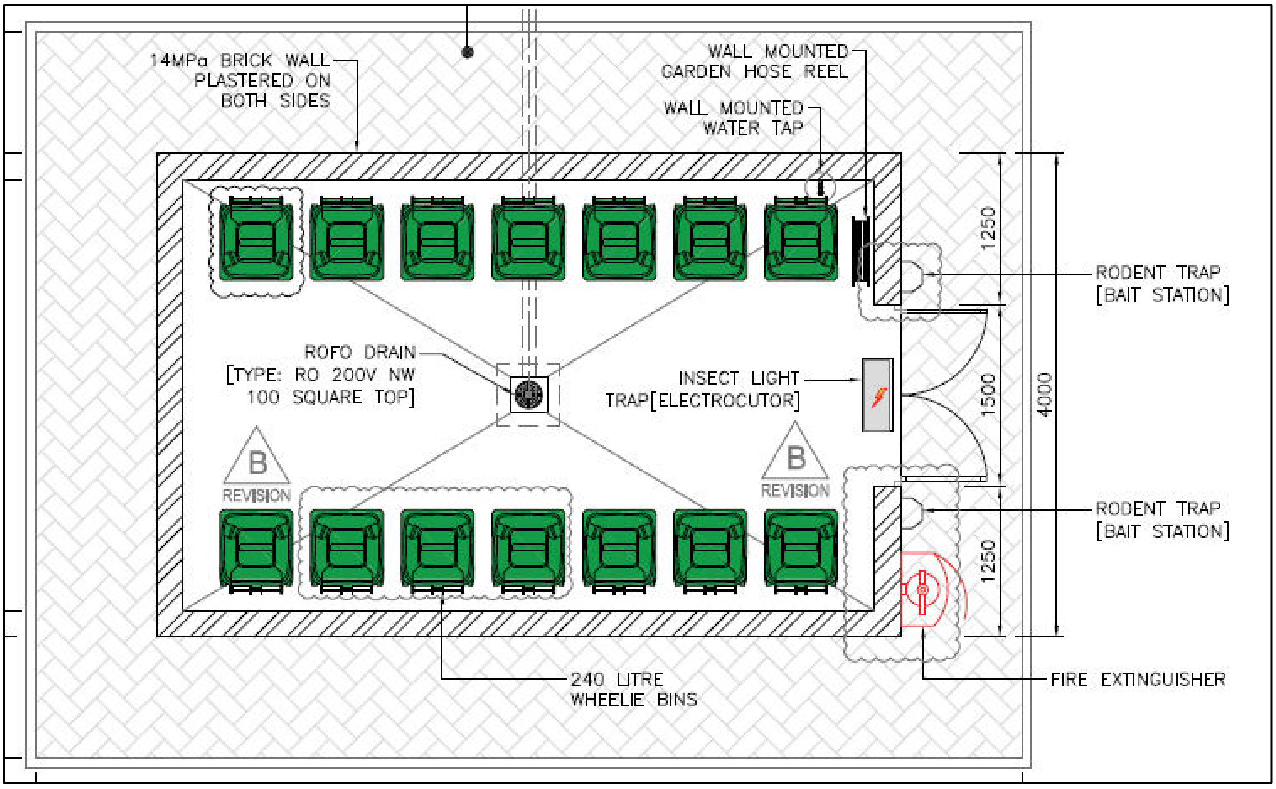


Figure 8 : Typical Abattoir Refuse Yard allowing recycling[i]

7.2 MANURE

Manure (droppings) collected at the lairages and the wash bay is regarded as organic waste. Manure can be used as biofertilizer either in raw format, or as part of composting process. On site manure storage should be avoided as it attracts environmental stressors such as insects and run-off during the rainy season can cause underground water contamination. If manure is stored for longer periods before tilting into land, it needs to be stored under roof or on manure slabs to mitigate environmental pollution risks.

Lairages are washed on a daily basis. It makes financial sense to clean lairages first as a dry run (picking up manure manually with scoop shovels) and then use untreated wash water. This two-step process should reduce water consumption for cleaning of lairages.

It is further recommended to investigate the feasibility of using (partly) brackish borehole water for the cleaning of lairages and wash bays to eliminate the use of expensive chlorinated potable water for the lairages.

This exercise falls outside the scope of this report but is suggested because it may reduce operational cost and further reduce the demand on scarce national water resource.

7.3 CONDEMNED / HIGH RISK WASTE MATERIAL

Condemned /high risk material arise from:-

a) condemned products (not healthy for human and livestock consumption)
b) high risk material such as tonsils and spinal cord[2]
c) floor droppings and collections in floor drains

These product residues need to be safely destroyed under strict control and documented.

The daily production of these products was roughly estimated as follows:-

- Maximum daily production **4 tons per day**[3].
- Average daily production 2 tons per day (own estimate)

Disclaimer: the maximum daily production rate of 4 tons requires further assessment, as it appears high. If the production can be reduced, the burden and costs on waste will be lowered.

It is suggested that a diesel fire Incinerator be installed to incinerate condemned /high risk product under strict control of the competent Authority.

The incineration process generates the following waste materials:-

- Air borne Emissions (incl. CO_2) – a minimum stack height of 12 meters in urban areas is recommended to mitigate pollution risks.
- Ash- can be safely disposed of at the approved municipal landfill since remaining residue is sterilised and neutralised.

[2] *Further discussions needed with Competent Authority regarding the potential processing alternatives pertaining to this material for the local market.*
[3] *Source: BEEFCOR Dr Gadha 23.04.2024*

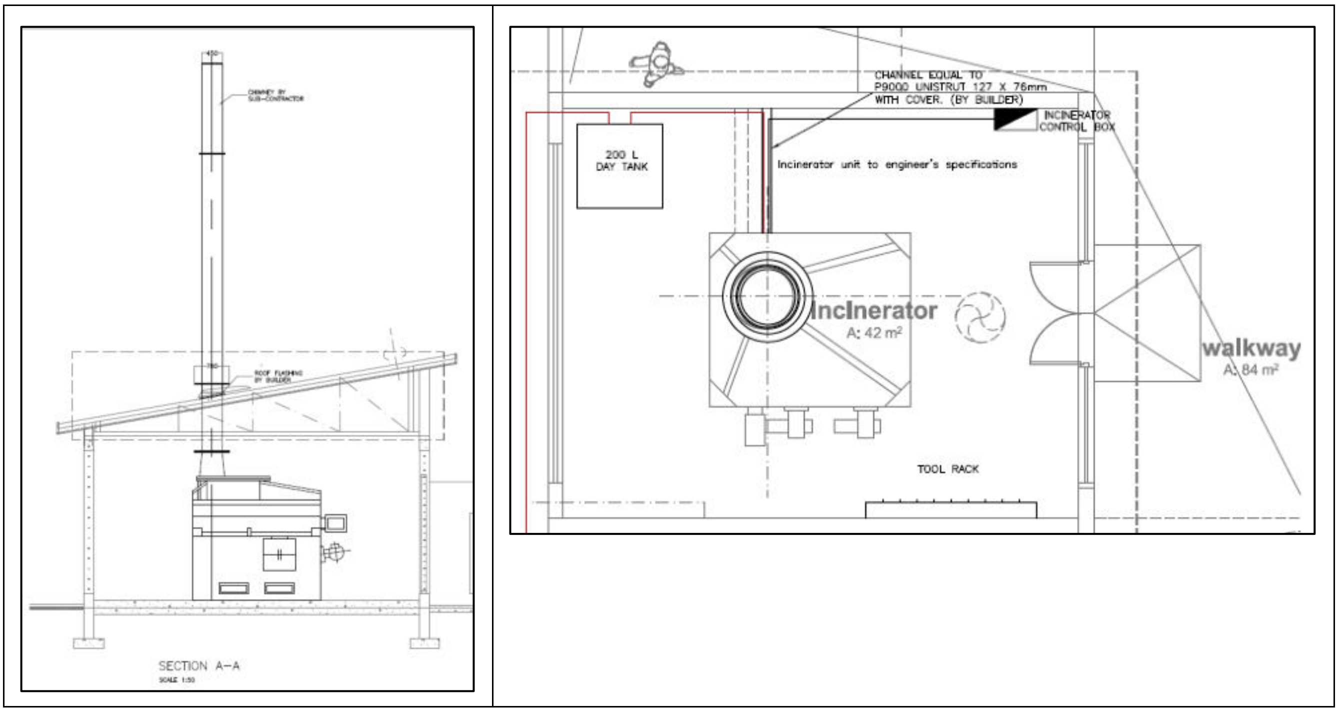


Figure 9 : Typical Incinerator

8. ASSESSMENT OF WASTE LIQUIDS TREATMENT OPTIONS

8.1 ESTIMATED WASTE LIQUID METRICS

The following BEEFCOR waste liquid metrics are considered (for comment and scrutiny).

OPERATIONAL PARAMETER	METRIC	REMARKS
Future Design Slaughter Capacity	250 LSU per day[4]	
Average Carcass Size Dressed Weight	288 kg	Own research
Blood per LSU	15 liter per LSU	Average
Design Wastewater (sewerage + effluent)	1500 liter per LSU	80% of Water Consumption @ 1800 liter per LSU[5]
Daily Blood production	3,750 liter per day	
Staff Sewerage	56 kl per day (15%)	140 liter per person x 400 staff members
Process Water Based Effluent Combined	319 kl per day (85%)	Excluding Blood
Daily Total Water based Wastewater Production	375 kl per day (100%)	Excluding Blood
Note: Water conservation will reduce volume effluent, which is the least expensive form of "effluent treatment"		

Table 4: Liquid Metrics

[4] *Source | B Swanepoel - BEEFCOR*
[5] *Source | J Twyman - BEEFCOR*

8.2 WASTE LIQUID STREAM CATEGORIES

For the purposes of this report, abattoir waste liquid streams are split into three (3) main categories:-

- CATEGORY 1: Domestic Sewerage
- CATEGORY 2: Process Effluents (paunch, various types of washwater and brine)
- CATEGORY 3: Blood

Category 1 (domestic sewerage) and 2 (process effluents) waste streams are currently discharged into the municipal sewerage network and piped towards the municipal WWTW.

Blood is collected and dispatched separately (not disposed in the municipal sewerage network) – blood handling is addressed under a separate heading in this report.

At BEEFCOR, there are multiple parallel connections to the municipal sewerage network. This is mainly due to the orientation and the placement of the different buildings relative to the street-run municipal sewerage pipe. **Error! Reference source not found.**depicts the existing connections onto the municipal sewerage network. [6]

The following adjustments will be made to the existing sewerage pipe network:-

- Sewerage and process effluents will be split (segregated) [7]
- Pre-treatment to be expanded (refer to headings in this report)

[6] *Source | BEEFCOR Own Records 22.04.2024.*
[7] *In accordance with Meat Safety Act of 2000 (South Africa)*

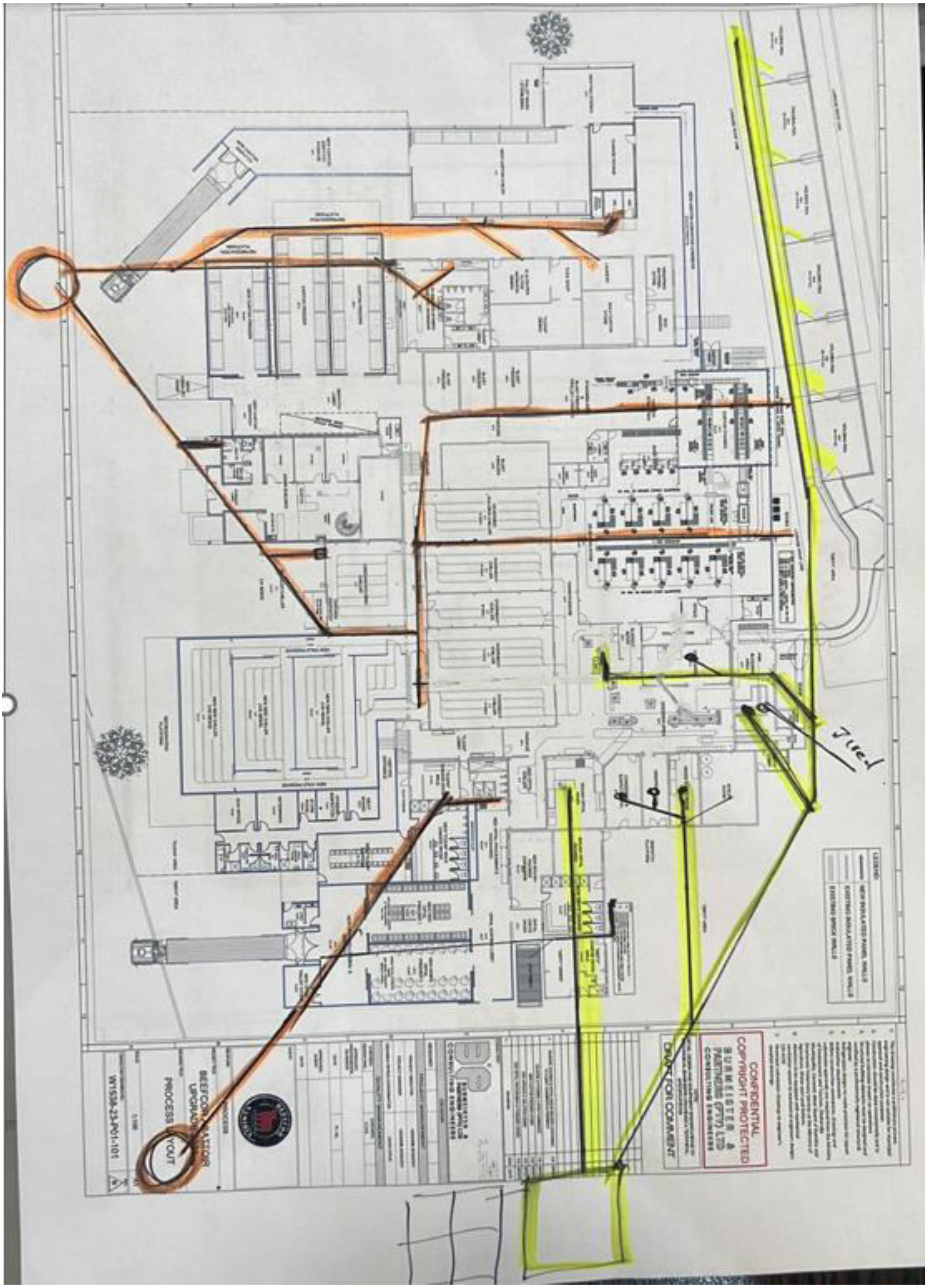


Figure 10 : As-built Sewerage and Effluent Network at BEEFCOR Plant

8.3 EXPECTED ORGANIC LOADING ARISING FROM PROCESS EFFLUENT

Effluent parameters for abattoirs tend to have a spectrum of variance depending in how abattoirs are designed and whether they are effectively operated. Below are typical guideline values selected to be within internationally reported ranges, and represent the higher limits of regional targeted ranges as reported in *Water and Wastewater Management in the Red Meat Industry* (Steffen, Robertsen and Kirsten Inc. Consulting Engineers, 1989) compiled for the Water Research Commission of South Africa.

PARAMETER	UNIT	DESIGN VALUE	RANGE	REFERENCES
COD	mg/ℓ	3500	1 400-14 000 mg/ℓ 3 540 mg/ℓ	(European Commission, May 2005) (Steffen, Robertsen and Kirsten Inc. Consulting Engineers, 1989)
BOD	mg/ℓ	2500	650 – 10 100 mg/ℓ 1590 – 2350 mg/ℓ	(European Commission, May 2005) (Verheijen, Wiersema, & Hulshoff Pol, 1996)
Suspended Solids	mg/ℓ	1500	330- 1450 mg/ℓ	(Steffen, Robertsen and Kirsten Inc. Consulting Engineers, 1989)
Total Nitrogen (TKN)	mg/ℓ	120	65-670 mg/ℓ 46-111 mg/ℓ	(European Commission, May 2005) (Steffen, Robertsen and Kirsten Inc. Consulting Engineers, 1989)
Phosphates	mg/ℓ	60	9 – 94 mg/ℓ	(European Commission, May 2005)

Table 5: Expected Loading of Abattoir Effluent

8.4 BEEFCOR PROCESS EFFLUENT TREATMENT OPTIONS

8.4.1 OVERVIEW OF ABATTOIR EFFLIUENT TREATMENT

Any efficient abattoir process effluent treatment regime consists of three (3) distinct stages:-[8]

- STAGE 1 : Pre-treatment (where solids, fats, grease, proteins etc are removed)
- STAGE 2 : Final Treatment (different options exist at BEEFCOR – discussed below)
- STAGE 3 (OPTIONAL[9]) : Recycling for water re-use (fodder irrigation)

The paragraphs below aim to develop these stages into different options.

[8] *Burmeister | Own Research*
[9] *Not a statutory requirement, but rather an economical decision*

8.4.2 ABATTOIR EFFLUENT MANAGEMENT REQUIREMENTS

In any discussion regarding abattoir effluent treatment and wastewater treatment in general the following considerations should be kept in mind:-

- Strict control over water consumption is by far the most effective method of "treatment" as this discipline ensures the generation of lower volumes of effluent. No "end of the pipe" solution can yield better results.
- *"Cradle-to-Grave"* principle: since BEEFCOR is exporting, they are also accountable for outsourced / downstream processes having environmental impacts, but handled by other entities (e.g. if sewerage treatment at the municipal treatment works is polluting the environment, it can be flagged by an EU audit as a non-compliance in future)
- The establishment of proper storm water drainage and the prevention of storm water infiltration into the internal sewer system is another key factor that reduce effluent stream quantities during the rainy season.
- The sensitivity of the site and surrounding areas to odours must be determined. Odour treatment is considered over and above normal wastewater treatment.
- The operator of the abattoir should possess the required annual operating budget and the necessary skills to operate and maintain the treatment system to ensure its uninterruptible effectiveness.
- Wastewater treatment in general generates additional solid waste that must be disposed of, often at extra cost if not used.
- Disinfection of floors and other surfaces for sanitation purposes should be controlled. Good management and the correct selection and use of chemicals are essential.
- The use of salt for the disinfection of floors should be strongly opposed. Using salt to preserve skins should be done under strict supervision to minimise the amount of salt entering the effluent.
- Blood, proteins, grease, fats, and other foreign solids should not enter effluent streams as it will negate further downstream treatment options.
- Sewerage and process effluents should be segregated at the plant.

Effluent reduction options (some of these options are already implemented at BEEFCOR):-

- Lairage cleaning protocol to include a 2-stage process, i.e. first dry clean and then wash.
- Handwash basins to be throttled to allow only the minimum amount of water to flow per cycle.
- Sterilisers to be adjusted to allow the minimum volume flow without compromising plant hygiene.
- Floor washing using foam-based chemicals tend to utilise less water than conventional methods.
- Truck wash to first include a dry clean stage and then using high pressure WAP machines.
- Consideration to allow only showering in the morning and not after work.

Water consumption and effluent reduction can only be achieved by having a metering plan to allow a daily water mass balance. Metering water consumption at different sections of the plant identify trends early on and allowing management to intervene to reduce water use.

8.4.3 *STAGE 1: PRE-TREATMENT PROCESS TREATMENT TRAIN*

Irrespective the selected final treatment regime for BEEFCOR, a functional and environmentally safe pre-treatment process train an absolute requirement to ensure that a downstream main treatment process is not compromised.

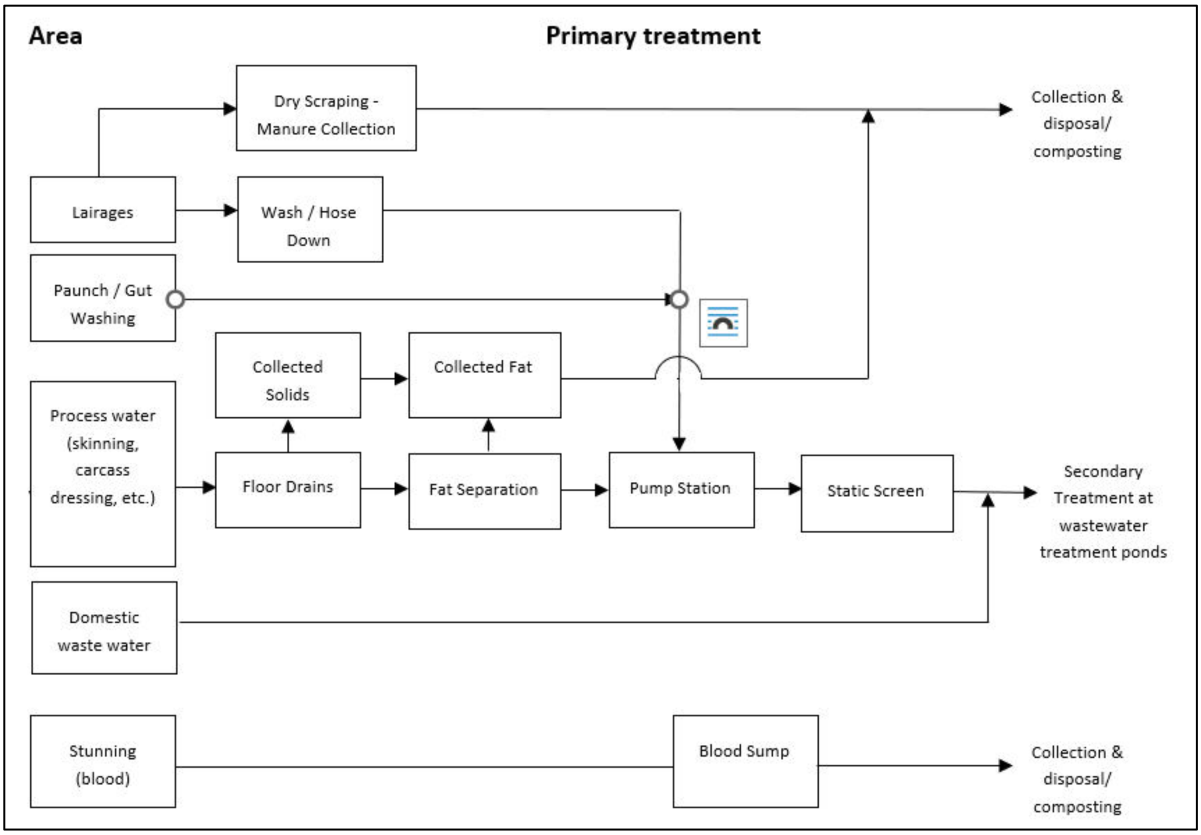


Figure 11 : Minimum Pre-treatment Required at BEEFCOR

<u>The Importance of Floor Drain Screening</u>

The first step in cleaning process water is by screening at the floor drains in the process areas. Typical "Rofo" or "Herbisch" type floor drains, which are currently also installed at the abattoir and are locally distributed, should be installed in the new process area floors. These floor drains have integral grit sieves and sludge traps which are easy to clean on a daily basis. Dropped solids, proteins and pieces of fat collect in the sieve baskets in floor drains and these are cleaned daily and disposed of with the other solid wastes.

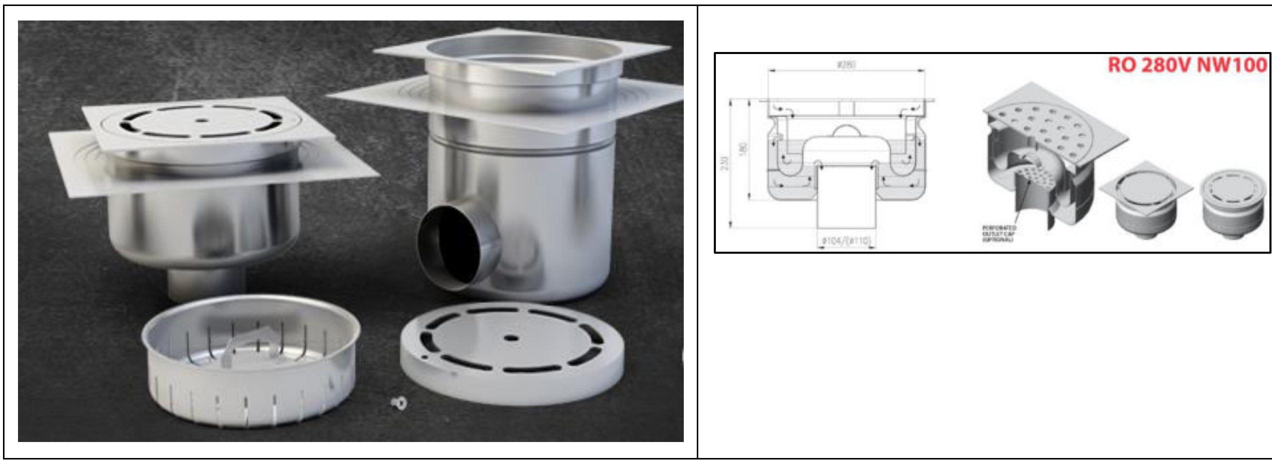


Figure 12 : Floor Drain Examples (already employed at BEEFCOR)

<u>Grease Trap</u>

All the wastewater from the floor drains and also collected from the rest of the abattoir process train (but excluding paunch content) will be conveyed to an appropriately designed fat trap (grease separator). The fat trap can either be prefabricated or a custom designed and built fat trap. In either case the fat trap should be adequately sized to have sufficient retention time to effectively allow the wastewater to cool and to allow the fat to separate from the water and float to the top of the tank. As a minimum design standard SANS 10252:2 requirements should be met for flow through the fat traps. But it is recommended that at least 30-60 minutes of retention time be allowed for in the fat trap according to (Wang, Hung, Lo, & Yapijakis, 2005). Fat particles and grease are detrimental to sewerage piping systems as it causes bacterial growth and secondly it hampers final effluent treatment processes. It is a municipal bylaw that all grease and fats (and oils) should be allowed to enter municipal systems.

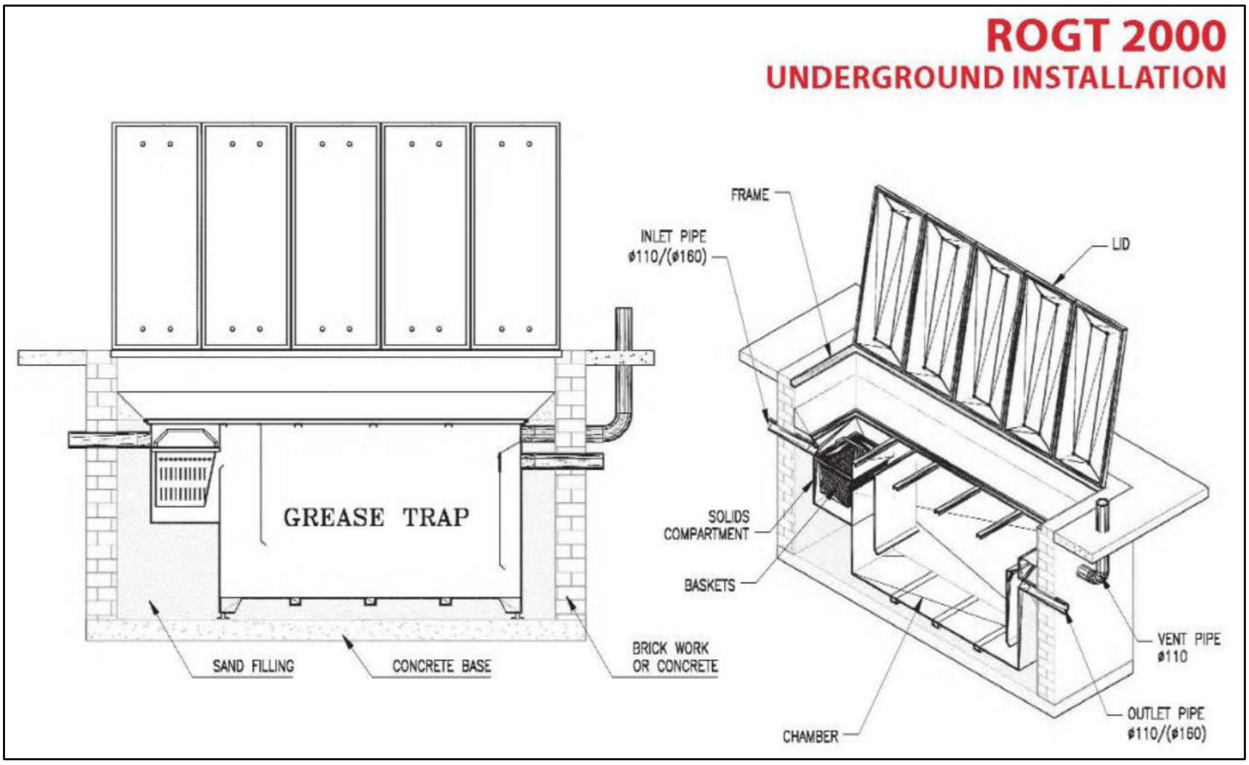


Figure 13 : Typical Example of Grease Traps (new required at BEEFCOR)

Final Screening of Process Effluent

All the lairage effluent, as well as the effluent from the offal area and the process water that passed through the fat trap will be collected in a centralised pump sump. From the pump sump the combined wastewater will be pumped via a single sewer rising main and passed through a static screen. The screen type will typically be a static wedge screen with 1-3mm screen size as shown in the figure below. These screens are designed to allow easy cleaning, and will screen out the overwhelming majority of hair, some fats, tissue, meat scraps, paunch and gross solids, which will reduce the organic loading of the wastewater. The screened effluent will then be directly discharged to the outfall sewer system.

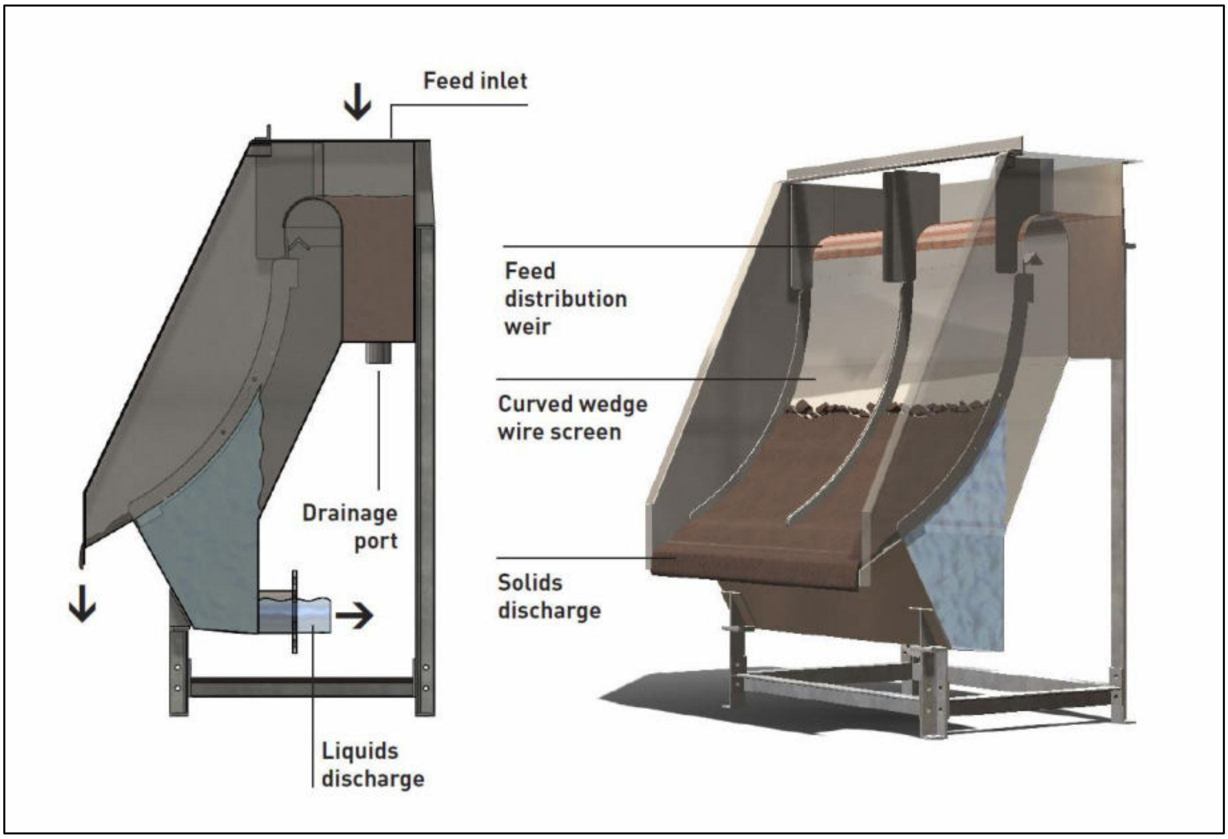


Figure 14 : Typical Example of Particle Static Screen (new required [10]at BEEFCOR)

The screenings collected from all the different screening processes together with the sludge generated by the fat and grit traps must be incinerated and/or disposed of according to the correct prescribed procedures for the land filling of hazardous and organic waste or disposed of at a designated appropriate landfill facility. Where relevant all solid waste material should be appropriately dewatered to facilitate transport.

Mitigation of Vector Attraction

The screening and collection area surrounding the static screens will be covered to avoid vector attraction in the form of rodents, house flies, mosquitoes, etc. and associated breeding. A typical example of a covered

[10] *Static screen shown. Mechanised rotary and other screens also possible.*

screen is shown in the figure below of a similar installation at Outapi Abattoir. All other on-site treatment areas and conveyance systems are closed piped systems.

Figure 15 : Insect Proof Cage around Screen

<u>Odour Mitigation</u>

Wastewater pre-treatment has a risk of introducing new odours at the plant. The recommended techniques for minimising odour emissions from the following abattoir areas are given by the GDARD Manual for Abattoir Waste Management (Department of Agriculture and Rural Development- Gauteng Provincial Government, 2009):

<u>Abattoir processing areas:-</u>

- All sewage drainage pipes to be equipped with water seals by means of traps and as per the SANS 10252:2 design specifications (South African Bureau of Standards, 1993) [done already]
- The blood sump where the blood waste stream will be collected will be sealed with double seal manhole covers, and the blood will be removed daily [done already]
- Paunch contents to be removed daily [done already]
- The process area will be washed and sterilised daily under veterinary supervision [done already]
- Operator to use airtight bags and bins [done already]
- Enclosed conveying and filling systems, which will be part of the detail design of the abattoir [to be confirmed]
- Good housekeeping. This will generally include daily removal and processing of solid wastes by the operator [done already]

Lairages:-

- Odours from manure and urine can greatly be reduced by daily cleaning:-
  - Dry sweeping of manure and removing the manure in sealed holding bins for further processing.
  - After dry sweeping the lairages, they should be washed by using low volume high pressure sprays.
- Manure should be collected daily.
- Animal holding time in lairages should be kept as short as possible, without compromising veterinary regulations.

Stormwater Designs

Everything possible should be done to prevent storm water from entering the sewer system. Stormwater increases the burden (and operational demands) on wastewater conveyance and treatment systems. We are not aware of any stormwater entering sewerage systems at BEEFCOR, but new pre-treatment designs should cater for this principle. It can be explained as follows:-

If all the premises in the town of Okahandja allows stormwater to enter sewerage systems, it will cause a substantial hydraulic overflow on municipal systems.

8.4.4 STAGE 2: MAIN PROCESS EFFLUENT TREATMENT OPTIONS

The main treatment options available to BEEFCOR and the Okahandja Municipality are as follows:-

- Option 1: Upgrade existing municipal treatment system and institute a fail-safe operational management.
- Design and build a "stand alone" BEEFCOR effluent treatment system with biological treatment final stage in the form of irrigation in respect of fodder production.

Sewerage emanating from BEEFCOR is allowed to enter the municipal treatment system. (Sewerage and process effluent should be segregated). Table below provides a qualitative assessment of the two options to determine the choice.

Assessment Criteria	**Option 1:** Upgrade Municipal Wastewater Treatment System	**Option 2:** Construct new Stand Alone BEEFCOR Effluent Treatment Plant
Capital Costs	+++	++
Combined Operational Costs	+++	+
Duplication of Operations	+++	+
Operational Risks	++	+
Combined Energy Costs	++	+
Energy costs for BEEFCOR only	+	++
Future institutional risks to BEEFCOR	+	+++
Option to Irrigate / recycle	++	++

Table 6: Qualitative Assessment

It would appear that the most feasible solution from a combined BEEFCOR / Municipality economic perspective seems to be upgrade the existing municipal WWTW.

BEEFCOR and the Municipality needs to enter into an agreement to mitigate institutional risks and to outline the capital contributions.

8.4.5 *STAGE 2: TYPES OF MAIN TREATMENT TECHNOLOGIES (PRELIMINARY)*

Typical treatment of abattoir wastewater can be subdivided into three categories as follows:-

- **Primary Treatment:** Screening, fat separation, flow equalisation, dissolved air flotation, chemical flocculation/coagulation and flotation, sedimentation.
- **Secondary treatment:** Biological treatment in the form of anaerobic digestion or aerobic activated sludge systems, extended aeration systems, lagoons, etc.
- **Tertiary Treatment:** Filtration including the use of membranes, disinfection.

The table below gives an indication of the ability of each type of treatment to remove the contaminants in the wastewater as listed above. Note that the blank cells indicate that the treatment cannot remove the relevant wastewater contaminant.

EMISSION TYPE TECHNOLOGY	TOTAL SUSPENDED SOLIDS	ORGANICS	OILS/FATS/ GREASE	NITRATES/ AMMONIA	PHOSPHORUS
Primary Treatment					
Mechanical screening	Yes	Yes			
Fat separation	Yes	Yes	Yes	Yes	Yes
Equalisation/balance tanks					
Dissolved air flotation Dispersion flotation Mechanical flotation	Yes Yes Yes	Yes	Yes		
Coagulation/flocculation/precipitation		Yes	Yes	Yes	Yes
Sedimentation/filtration/flotation		Yes	Yes		
Secondary Treatment					
Anaerobic treatment		Yes			
Activated sludge/aeration lagoons	Yes	Yes		Yes	Yes
Extended aeration		Yes		Yes	
Nitrification/denitrification				Yes	
Tertiary Treatment					
Filtration/coagulation/precipitation	Yes	Yes	Yes	Yes	Yes

Table 7: Summary of technologies for treating slaughterhouse wastewater effluents.
[Adapted from German TWG Members, 2001]

It is a requisite to take a laboratory sample at the existing wastewater treatment works to determine the most feasible upgrade option. The laboratory results will lead our design decision making.

It is also necessary to calculate or measure the daily sewerage volume intake arising from the town of Okahandja. Further consultations are necessary with the Municipality to:-

i. gauge their openness to a combined treatment operation.
ii. obtain the as-built network plans connecting to the WWTW in order to calculate the volume flow.
iii. future growth forecast of town.

8.4.6 HIGH-LEVEL ASSESSMENT OF MUNICIPAL WWTW

A visual inspection of the Okahandja WWTW was taking place in April 2024 by our Office. The Works consists of:-

- Inlet Works (bypassed at date of inspection)
- Aeration Sumps (functional)
- Sludge Settler (functional)
- Sludge Drying Slabs (adapted to be utilised as small ponds)
- Sludge Extraction System (not operational)
- Area perimeter correctly fenced off (in fulfilment of security and safety provisions of the Act)
- A bypass pipeline is currently being constructed to bypass the Aeration Sumps (this detail must be confirmed as it appears to be illegal)

It is our visual interpretation that the effluent overflowing from the WWTW will not be according to DWA special standards (to be confirmed with a laboratory test).

The WWTW is some 600 meters away from the Swakop River and hence does not contravene the provisions of the Act.

Figure 16 : Okahandja WWTW Proximity of Swakop River

It is proposed to utilise the unused area for other pond systems. (Design currently being prepared Burmeister & Partners) The following inputs are needed from the Municipality:-

- Influent Parameters (to be tested)
- Influent Volumes (either through calculation based on number of erven or measurement)
- Soil Contamination Samples

Figure 17 : Okahandja Municipality WWTW Open Area identified for Additional Pond Systems and Sludge Drying

The effluent from the WWTW is currently used by a private irrigation Operator to produce crops. We have not inspected the type of crops, but the use of the WWTW effluent for crop production seems to be in contravention of the Act under the following provisions.

- Part of the Irrigation Scheme seems to be closer than 100 meters from the edge of the river.
- The current effluent is not suitable for irrigation of edible crops.

Figure 18 : Current Irrigation situated within 100 meters from Edge of Swakop River (to be confirmed)

8.4.7 STAGE 3: RECYCLING / RE-USE OF WASTEWATER

Recycling and re-use options available for wastewater recycling are:-

- Irrigation and fodder production
- Reverse Osmosis (RO) for re-use of water in low-risk areas in abattoir

Through consultations with BEEFCOR it was understood that a full Reverse Osmosis plant will not be considered at this stage because the use of RO water for food processing is outright prohibited under Namibian Law. The Regulations will have to be amended by the Minister under a special dispensation before ANY recycled water can be re-used for food processing plants.

ANNEXURE 2
(Regulations 5, 68(2) and 69)

RE-USE APPLICATIONS FOR DIFFERENT TREATMENTS

Table 2.1: Mining and Industrial Re-use

Application in	Primary and Secondary Ponds	OD – Oxidation Ponds with 40 day maturation pond retention time	Primary and Secondary Treatment, not adhering to General Standard	Primary and Secondary Treatment, adhering to General Standard	Primary, Secondary and Tertiary Treatment*, adhering to Special Standard
1. Food Processing	Not permissible	Not permissible	Not permissible	Not permissible	Not permissible

Figure 19 : Abstract from Water Resources Act Regulations Prohibiting RO Treatment for Food Processing

The proposed recycling of wastewater is proposed to take place at the existing Okahandja WWTW plant. The reasons for a combined upgraded plant are as follows:-

- Existing Okahandja WWTW is non – compliant with the latest Act and needs to be upgraded in any event.
- Creating two “smaller” wastewater treatment facilities in close proximity to one another, i.e. a new BEEFCOR Owned WWTW + the new upgraded Okahandja WWTW is not as economically viable as a combined upgraded WWTW (lower treatment cost per m3 treated)
- BEEFCOR is subject to the “cradle to grave” principle in terms of wastewater treatment and therefore needs to ensure that the Okahandja WWTW is also legally complaint.
- Permitting approvals will be less tedious at the existing (upgraded) Okahandja Municipality WWTW since it is an existing plant.
- BEEFCOR is already sponsoring operational personnel at the Okahandja WWTW and might as well just continue with this arrangement to ensure full compliance at all times.
- The basic infrastructure at the Okahandja WWTW is in place and expansion will be less expensive than to develop everything from new (for BEEFCOR’s own plant)
- It reduces the environmental risk to have one WWTW than having two.

It is proposed to use a similar design as what was used at Chalmar Beef Abattoir Wastewater Treatment Plant in Bapsfontein South Africa, with the potential addition of sterilisation to comply with DWA Special Standards. Note that groundwater at Bapsfontein is very shallow and special care needed to be taken to prevent groundwater pollution. This plant has been operation for more than 20-years and fodder is produced for their own feedlot, by using the treated effluent and composting of blood and other bio-waste. Refer to *Figure 20 : Case Study: Recycling and Re-use of Abattoir Effluent Chalmar Beef Bapsfontein, South Africa*

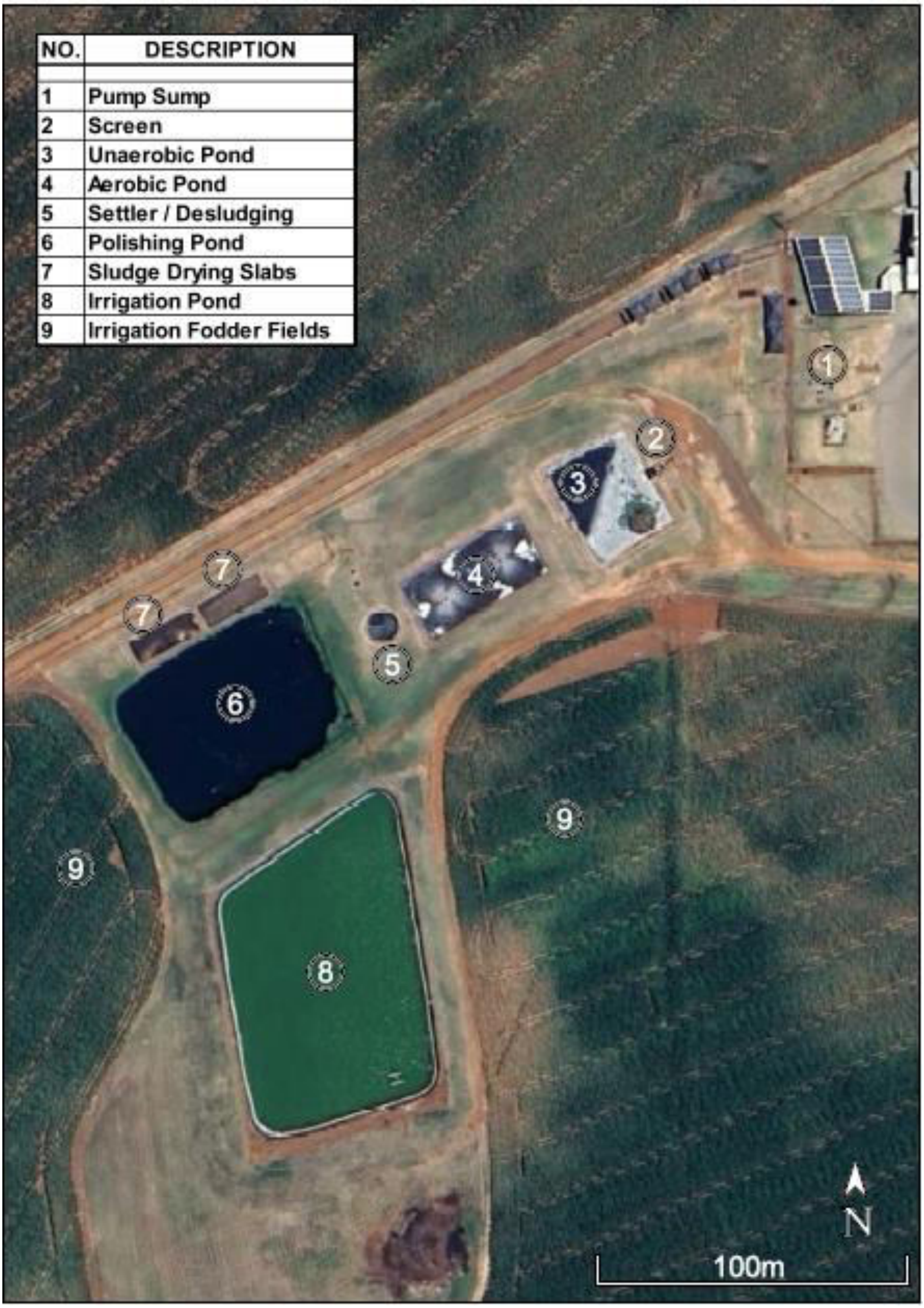


Figure 20 : Case Study: Recycling and Re-use of Abattoir Effluent Chalmar Beef Bapsfontein, South Africa

Several open / unused areas exist where fodder production can be safely practiced further away from the Swakop River. For every 1 ML of re-used treated effluent, an area of approximately 9 ha of fodder production is approximated. [9 ha = 300-meter x 300 meter] A further consultation with the Municipality is needed to explore this option in more detail.

Figure 21 : Approximate Areas identified for Potential Fodder Production

*Figure 22 : Irrigation Potential*depicts the mechanisms of using irrigation as a final step in sewerage and effluent treatment. The objective would be to maximise the water and nutrients taken up by plants and prevent drainage to groundwater and losses in run off. In the case of BEEFCOR no livestock will be kept on the fodder production field as all harvesting will be transported back to the feedlot in Hochveld (by using empty trucks returning after delivering cattle to the abattoir).

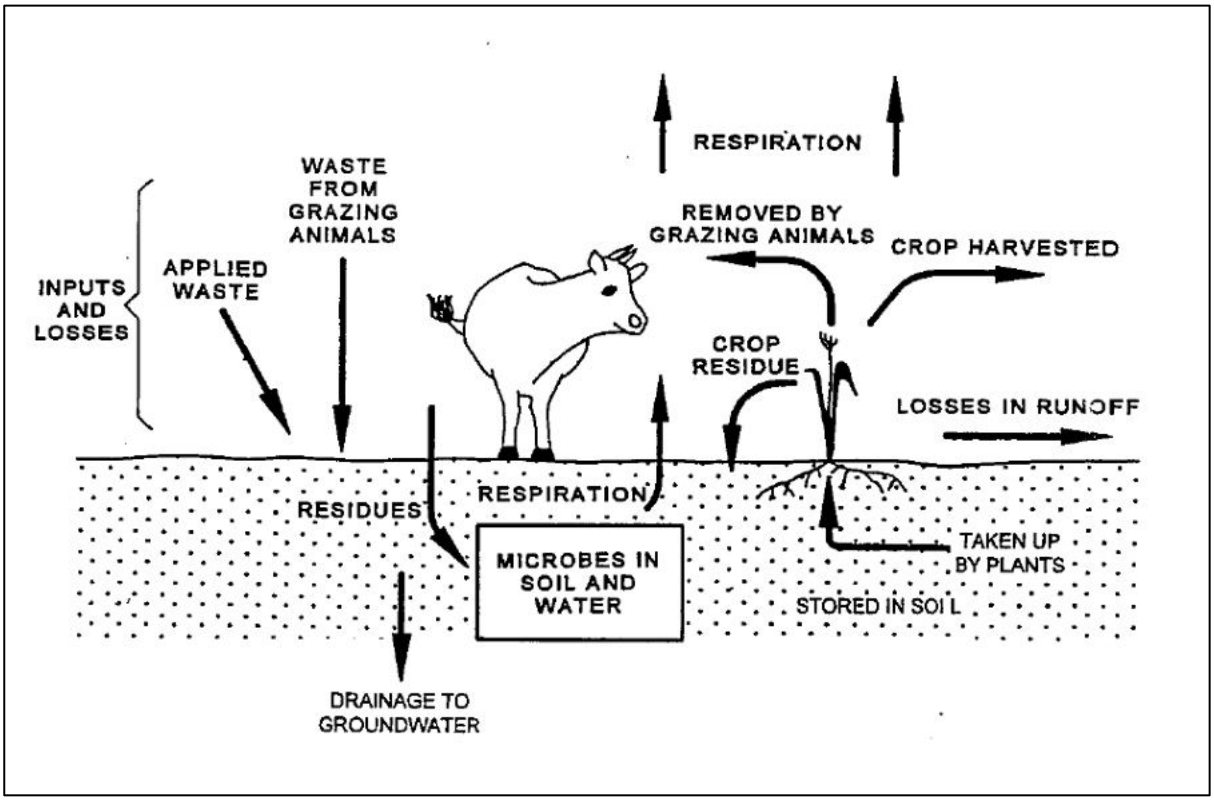


Figure 22 : Irrigation Potential

Figure 23 : Proposed layout for the wastewater treatment plant

Figure 23 Depicts the usage of a similar design to that of Chalmar Beef and a new composting plant.

8.4.8 *BLOOD*

Of all waste products, the waste in the form of blood has the highest polluting value. Blood itself has a very high BOD: 150 000 – 200 000 mg/l, the extreme value being 405 000 mg/l. Furthermore, the bulk of the pollution in the form of nutrients (Nitrogen and Phosphorus) also originates in blood. In order to drastically reduce the waste load, it is generally recommended that as much of the blood as is possible be collected and kept separate for processing or transporting away from the site.

Blood is currently correctly captured in a blood through inside the bleeding area and piped to a blood storage tank outside the plant. Blood can either be composted, or treated with special enzymes before being used as biofertilizer. It is not environmentally safe to use blood in raw format as bio-fertilizer. When composting, the blood can be treated with a biological product, and immediately applied to a compost pile. The liquid blood is used to moisten compost piles and provide essential nutrients and thus improving the quality of the compost pile.

9. RECOMMENDATIONS & ACTION PLAN

The following immediate recommendations and action plan is proposed.

Stage	Activity	Responsibility / Actioned By	Remarks
1	**Pre-FEED****		
	Laboratory Tests / Sampling		
	Beefcor effluent sample	Beefcor	
	Okahandja Municipality WWTW Influent Sample	Burmeister	
	Okahandja Municipality WWTW Effluent Sample	Burmeister	
	Soil Tests (to determine suitable soil)	Burmeister	
	Drawings and Information Required		
	Population served by Municipal WWTW	Okahandja Mun	Present / Future
	As-built drawings of Okahandja Sewerage Network	Okahandja Mun	
	As-built drawings of Okahandja WWTW	Okahandja Mun	
	Preparing Beefcor As-built Sewerage Network Drawing on AutoCAD	Burmeister	
2	**FEED****		
	Prepare Detail Drawings signed off by Professional Engineer	Burmeister	
3	**PROCUREMENT**	**Burmeister / Beefcor**	Procuring construction services
4	**CONSTRUCTION**		
	Construction Works	Contractors	
	Construction supervision by Professional Engineer	Burmeister	Signing off by Engineer
5	**TESTING AND COMMISSIONING**		
5.1	Testing and Commissioning Report by Professional Engineer (signing off on operational compliance)	Burmeister	Submittal to DWA
5.2	Assistance with Re-Application of WWTW Permit	Burmeister Okahandja Mun	

ANNEXURE A:

TREATED EFFLUENT DISCHARGE STANDARDS

Effluent to be discharged or disposed of in areas with potential for drinking water source contamination; international rivers and dams and in water management and other areas				
			Special Standard	General Standard
DETERMINANTS	**UNIT**	**FORMAT**	**95 percentile requirements**	
PHYSICAL REQUIREMENTS				
Temperature	° C		Not more than 10P^{0P}C higher than the recipient water body	
Turbidity	NTU		< 5	< 12
PH			6,5-9,5	6,5-9,5
Colour	mg/litre Pt		< 10	< 15
Smell			No offensive smell	
Electric conductivity 25 °C	mS/m		< 75 mS/m above the intake potable water quality	
Total Dissolved Solids	mg/litre		< 500 mg/litre above the intake potable water quality	
Total Suspended Solids	mg/litre		< 25	< 100
Dissolved oxygen	% saturation		>75	>75
Radioactivity	Units		below ambient water quality of the recipient water body	
ORGANIC REQUIREMENTS				
Biological Oxygen Demand	mg/litre	BOD	< 10	< 30
Chemical Oxygen Demand	mg/litre	COD	< 45	< 100
Detergents (soap)	mg/litre		< 0.2	< 3
Fat, oil & grease, individual	mg/litre	FOG	nil	< 2.5
Phenolic compounds	mg/litre	as phenol	< 0.01	< 0.10
Aldehyde	µg/litre		< 50	< 100
Adsorbable Organic Halogen	µg/litre	AOX	< 50	< 100
INORGANIC MACRO DETERMINANTS				
Ammonia (NHB$_{4B}$ – N)	mg/litre	N	< 1	< 10
Nitrate (NOB$_{3B}$- N)	mg/litre	N	< 15	< 20
Nitrite (NOB$_{2B}$- N)	mg/litre	N	< 2	< 3
Total Kjeldahl Nitrogen (TKN)	mg/litre	N	< 18	< 33
Chloride	mg/litre	Cl	< 40 mg/litre above the intake potable water quality	< 70 mg/litre above the intake potable water quality

Effluent to be discharged or disposed of in areas with potential for drinking water source contamination; international rivers and dams and in water management and other areas				
			Special Standard	General Standard
DETERMINANTS	**UNIT**	**FORMAT**	**95 percentile requirements**	
Sodium	mg/litre	N	< 50 mg/litre above the intake potable water quality	<90 mg/litre above the intake potable water quality
Sulphate	mg/litre	SOB_{4B}	< 20 mg/litre above the intake potable water quality	< 40 mg/litre above the intake potable water quality
Sulphide	mg/litre	S	< 0.05	< 0.5
Fluoride	mg/litre	F	1,0	2,0
Cyanide (Free)	µg/litre	CN	< 30	< 100
Cyanide (recoverable)	µg/litre	CN	< 70	< 200
Soluble Ortho phosphate	mg/litre	P	< 0.2	3,0
Zinc*	mg/litre	Zn	1	5

Effluent to be discharged or disposed of in areas with potential for drinking water source contamination; international rivers and dams and in water management and other areas				
			Special Standard	General Standard
DETERMINANTS	**UNIT**	**FORMAT**	**95 percentile requirements**	
INORGANIC MICRO DETERMINANTS				
Aluminium	µg/litre	Al	< 25	< 200
Antimony	µg/litre	Sb	< 5	< 50
Arsenic	µg/litre	As	< 50	< 150
Barium	µg/litre	Ba	< 50	< 200
Boron	µg/litre	B	< 500	< 1000
Cadmium*	µg/litre	Cd	< 5	< 50
Chromium, (hexavalent)	µg/litre	Cr	< 10	< 50
Chromium, Total*	µg/litre	Cr	< 50	< 1000
Copper*	µg/litre	Cu	< 500	< 2000
Iron	µg/litre	Fe	< 200	< 1000
Lead*	µg/litre	Pb	< 10	< 100
Manganese	µg/litre	Mn	< 100	< 400
Mercury*	µg/litre	Hg	< 1	< 2
Nickel	µg/litre	Ni	< 100	< 300
Selenium	µg/litre	Se	< 10	< 50
Strontium*	µg/litre	Sr	< 100	< 100
Thallium	µg/litre	Ti	< 5	< 10
Tin*	µg/litre	Sn	< 100	< 400
Titanium	µg/litre	Ti	< 100	< 300
Uranium*	µg/litre	U	< 15	< 500

Effluent to be discharged or disposed of in areas with potential for drinking water source contamination; international rivers and dams and in water management and other areas				
			Special Standard	**General Standard**
*Total for Heavy Metals (Sum of Cd,Cr,Cu,Hg, Peri-Urban Development Board	µg/litre	Cd,Cr,Cu, Hg & Pb	< 200	< 500
UNSPECIFIED COMPOUNDS FROM ANTHROPOGENIC ACTIVITIES				
Agricultural chemical compounds	µg/litre		Any in-/organic compound recognized as an agro-chemical is to be avoided or reduced as far as possible. Maximum acceptable contaminant levels will be site specific, dependent on chemical usage and based the water quality of the recipient water body	
Industrial and mining chemical compounds, including unlisted metals and persistent organic pollutants	µg/litre		Any in-/ organic compound recognized as an industrial chemical including unlisted metals is to be avoided or reduced as far as possible. Maximum acceptable contaminant levels will be site specific dependent on chemical usage and based the water quality of the recipient water body	
Endocrine Disruptive Compounds (EDC)	µg/litre		Any chemical compound that is suspected of having endocrine disruptive effects is to be avoided as far as is possible. Maximum acceptable contaminant levels will be site specific dependent on chemical usage and based the water quality of the recipient water body.	
Hydrocarbons (Benzene, Ethyl Benzene, Toluene and Xylene	µg/litre		Below detection level	Below detection level
Organo-metallic compounds: methyl mercury, tributyl tin (TBT), etc.	µg/litre		Below detection level	Below detection level
DISINFECTION				
Residual chlorine	mg/litre		< 0.1 Dependent on recipient water body	< 0.3 Dependent on recipient water body

Effluent to be discharged or disposed of in areas with potential for drinking water source contamination; international rivers and dams and in water management and other areas				
			Special Standard	General Standard
DETERMINANTS	**UNIT**	**FORMAT**		
BIOLOGICAL REQUIREMENTS (Algae and parasites)				
Further treatment of the effluent is dependent on: 1. the water quality of the recipient water body if any 2. the distance from any point of potable water abstraction 3. an acceptable maximum contaminant level downstream of the point of discharge 4. the exposure to human and animal consumption downstream of the point of discharge 5. any re-use option that may be implemented..				
MICROBIOLOGY				
Further treatment of the effluent is dependent on: 1. the water quality of the recipient water body if any 2. the distance from any point of potable water abstraction 3. an acceptable maximum contaminant level downstream of the point of discharge 4. the exposure to human and animal consumption downstream of the point of discharge 5. any water re-use option that may be implemented.				

[i] *Burmeister*