WARWICK ZERO WASTE PROJECT

Cost-Benefit Analysis of the Early Morning Market Composting Pilot Project at the Durban Botanic Gardens

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Acronyms

Abbreviations	Description
BCR	Benefit-cost ratio
BSU	Business Support, Markets, Tourism and Agri-Business Unit (eThekwini Municipality)
CAP	Climate Action Plan
CBA	Cost-benefit analysis
CO_2e	Carbon dioxide equivalent
CPI	Consumer price index (i.e., inflation)
CSW	Cleansing and Solid Waste Unit (eThekwini Municipality)
DUT	Durban University of Technology
EMM	Early Morning
GAIA	Global Alliance for Incineration Alternatives
GHG	Greenhouse gas
MSW	Municipal Solid Waste
NPV	Net present value
PRC	Parks, Recreation and Culture Unit (eThekwini Municipality)
QS	Quantity surveyors
SAPIA	South African Petroleum Industry Association
SARB	South African Reserve Bank
SARS	South African Revenue Service
SSA	Sub-Saharan Africa
UFC	Urban Futures Centre (Durban University of Technology)
WZW	Warwick Zero Waste

Executive Summary

Globally the waste sector is a significant contributor to greenhouse gas (GHG) emissions. One of the more significant impacts of landfilling organic waste is its contribution to methane gas, which, over a 20-year lifespan, has over 82.5 times the warming potential of carbon dioxide (GAIA, 2022). According to the State of the Waste Report, an estimated 6.5 million tonnes of food and garden waste was generated in South Africa in 2017 (DEA, 2018), much of which is sent to landfill. In addition to the emission of methane and other GHGs, landfills also generate multiple negative public health impacts and other externalities (Goa, 2017; Scarlat, 2015). It is also a costly management approach requiring increasingly scarce land and airspace in urban areas. Due to these negative impacts, global focus has shifted urgently towards more sustainable, alternative approaches to managing organic waste.

Municipalities can derive numerous benefits from diverting organic waste into alternative treatment methods, such as small-scale, decentralised composting and anaerobic digestion (to produce biogas). This cost-benefit analysis (CBA) report was commissioned to determine if there is a net benefit or cost to the eThekwini Municipality from diverting food and garden waste from landfill into a small-scale compost production operation. The CBA was done on a working pilot that diverts organic waste (majority fruits and vegetables) from the municipal-run Early Morning Market (EMM) in Warwick Junction, and composts this along with garden waste at the city's Botanic Gardens. This pilot forms part of the Warwick Zero Waste (WZW) project that works with informal workers to develop and action zero-waste solutions for the city of Durban. Given the success of the pilot, significant potential exists to scale-up and divert all the food waste from the EMM into a full-scale composting operation.

Drawing on research data collected over 3 years (2021-2023), this report illustrates the feasibility of a small municipal-run decentralised model that composts organic waste within a 2km radius from where it is discarded. The data used within this CBA includes a baseline assessment and waste categorisation study undertaken in the EMM. The study estimated that 398 tonnes of waste is generated at the market per year and is being sent to landfill. Of this, 84.1% was classified as organic or as food waste (i.e., fruit and vegetables). As part of the pilot, some of this waste was then incrementally diverted for composting, eventually ensuring a steady flow of organic feedstock from the market, and from the gardens, to produce a high-quality, rich compost for use by the city's Parks, Recreation and Culture Department. Data has been captured throughout the pilot process on volumes, feedstock inputs and compost outputs, as well as technical data on the air temperature and humidity, soil moisture content and temperature, and level of rainfall, etc.

In order to develop a CBA for the diversion of the entire 398 tonnes of food waste, all the costs and benefits of the composting pilot were identified for three scenarios and quantified for the status quo (i.e., sending all food waste to landfill) and for the alternative (i.e., diverting food waste to produce compost), and these costs and benefits were then projected over a 10-year period. The costs were then subtracted from the benefits to calculate either the net benefit or net cost, which is then discounted using an appropriate rate to determine the net present value (NPV). Lastly, a sensitivity analysis was done to test the impact of some key variables on the NPV in each of the three scenarios presented.

Ultimately, the CBA model indicates that due to the substantial costs associated with sending waste to landfill in the eThekwini Municipality (incurred from limited landfill space, long transportation distances, etc.) and the savings generated from diverting waste and creating compost, this project creates a net positive benefit to the municipality. An NPV of over R1 indicates that the project is worth pursuing, and this CBA shows an NPV of R5 992 793, R1 989 756 and R1 156 640 respectively across the three scenarios developed over 10 years.

Additionally, there are numerous other positive impacts that are created through this project, such as creation of new, green employment opportunities, GHG emission reductions from compost production (especially methane), reduced transport costs, and the reinvestment of savings for the city's Business Support Unit (BSU) into EMM infrastructure, which will help improve the working conditions for market traders and vendors.

As a recommendation from this study, scaling up of the current WZW pilot project should be supported by the eThekwini Municipality. Further to this, it is highly likely that other projects of a similar nature would be equally as viable within the municipality, and as such, expansion of this concept to other fresh produce markets should be investigated. Ultimately this CBA indicates that municipal-run, small-scale decentralised composting sites hold potential to create local level jobs across the city, meet Climate Action Plan goals through reducing methane and other negative externalities created from landfilling, and produce rich compost for growing plants and food in the city.

1 Introduction

1.1 Background

The Warwick Zero Waste (WZW) project started in early 2021 and is being implemented by groundWork, the Durban University of Technology's (DUT) Urban Futures Centre (UFC), and Asiye eTafuleni. The aim of the project is to co-create a zero-waste case study, focussing on the informal markets in Durban's Warwick Junction. The goal is to create an "easy to replicate, zero waste to landfill case study for large informal markets commonly found in Africa".

Within the first year of the project, research and data collection was done to identify pilot projects. One such project identified was to undertake a baseline assessment of the Business Support Unit's (BSU)[1] Early Morning Market (EMM) to collect data on the types and volumes of waste being generated. Firstly, a survey was completed with 166 traders which identified information such as that 78% of the products sold were organics (fruit, vegetables, etc.), that 88% of traders were not sorting their waste, and that 92% of the waste goes into the allocated wheelie bins in the market. These bins were being collected by the Cleansing and Solid Waste Unit (CSW) and send to landfill. In order to get more refined data on this waste, the WZW team undertook a waste categorisation assessment where bins were weighed over a period of 16 days, following which a more granular waste audit process was done on 10 of the bins each day. Using this data, it was estimated that on average, 398 tonnes of waste was generated at the EMM per year that was being sent to landfill, with 84.1% of it being organic waste (i.e., fruit and vegetables).

Given that the aim of the project is to identify zero waste to landfill solutions, the next step for the WZW team was to identify potential opportunities to divert this waste from landfill. Using a 2km radius, the Durban Botanic Gardens (which is only 1.5km from the EMM,) was identified as a potential location which could be considered for a composting pilot site.

Figure 1: Images from the waste categorisation assessment

[1] In this report, Business Support Unit (BSU) is used to represent the full name of the unit, namely, Business Support, Tourism, Markets and Agri-Business Unit

After securing support from the Parks, Recreation and Culture (PRC) Department for the use of the Botanic Gardens site, the phase 1 pilot process was initiated between 28 June and 8 November 2022. During this initial phase, one 240 litre wheelie bin of food waste was collected from the EMM per week and combined with green and brown garden waste from the Botanic Gardens to create 16 compost heaps. Thereafter, on 21 November 2022, the team initiated phase 2, a scale up of the pilot, whereby a 1-ton bakkie was used to collect EMM waste to create a single large compost windrow at the Botanic Gardens. Based on learnings from the first two phases, phase 3 was initiated on 15 March 2023, which involved the collection of food waste twice a week and the construction of 12 windrows, along with relevant drainage to capture leachate run-off. Compost is produced and matured in rotation over a 3-month period. Figure 2 provides a snapshot of the 3 phases.

Figure 2: Timeframes of each phase

Phase 1
28 Jun - 8 Nov 2022
- 1 x 240l wheelie bin
- 1 per week
- 16 compost heaps

Phase 2
21 Nov 2022
- 1 ton bakkie
- Once off
- Single windrow

Phase 3
15 Mar 2023 - present
- 4 ton truck
- 2 per week
- 12 windrows

Throughout all of these phases, research was conducted on the composition of each compost heap. On a weekly basis, technical data was collected on the air temperature and humidity, soil moisture content and temperature, and level of rainfall, etc. Additionally, the quality of the compost was assessed through sending samples for full nutrient testing and microbial analysis, while the team also conducted a series of pot trials on compost samples to compare the growth rates of different species of plants in the project compost, as compared to other commercial compost varieties. The tests show that the project compost is rich in nutrients and full of diverse life, and that plants grown in this compost outperform the growth of plants cultivated in the commercial compost samples the team tested against.

Figure 3: Phase 1 - pilot compost heaps being tested by a WZW team member

Figure 4: Phase 2 - the WZW team after setting up the first scaled-up windrow

Figure 5: Phase 3 - setting up 12 windrows

Given the success of the initial pilot project in creating a high-quality compost product, the WZW team identified that significant potential exists to scale-up even further and divert a more substantial amount of food waste from the EMM into the production of compost. However, to do this would require the support and buy-in from various municipal departments, and the viability of the proposed project would need to first be determined. As such, the WZW team approached Lumec to undertake a cost-benefit analysis (CBA) which would identify both the economic and environmental costs and benefits of the pilot project and determine the viability if all food waste from the EMM is diverted into a full-scale composting operation.

1.2 Context and rationale

1.2.1 Organic waste as a challenge

Within Sub-Saharan Africa (SSA), the organic fraction of municipal solid waste comprises between 43% (Kaza, 2018) and 57% (UNEP, 2018) of total municipal solid waste (MSW) generated. This is significantly greater than any other waste stream. In South Africa, organic waste contributes almost 20 million tonnes, or 35% of total general waste generated (DEA, 2018) – this includes garden waste, food waste, and wood waste.

Most organic waste, along with other waste streams, is either openly dumped and burned (69% of total waste in SSA) or sent to landfill (24% of solid waste in SSA) (Kaza, 2018). In South Africa, an estimated 6.5 million tonnes of food and garden waste were generated in 2017 (DEA, 2018), and most of this is being sent to landfill.

Landfilling of waste has several disadvantages including large land requirements, greenhouse gas emissions (especially methane), surface and ground water contamination, air and soil pollution, and other impacts such as noise and odours for surrounding populations (Goa, 2017; Scarlat, 2015). One of the more significant impacts of landfilling waste (particularly organic waste), is its contribution to methane gas. The waste sector contributes approximately 20% of total methane emissions globally, making it the third-largest source of methane emissions (GAIA, 2022). According to GAIA (2022), methane is short-lived and extremely potent, and over a 20-year lifespan, has over 82.5 times the warming potential of carbon dioxide (CO_2).

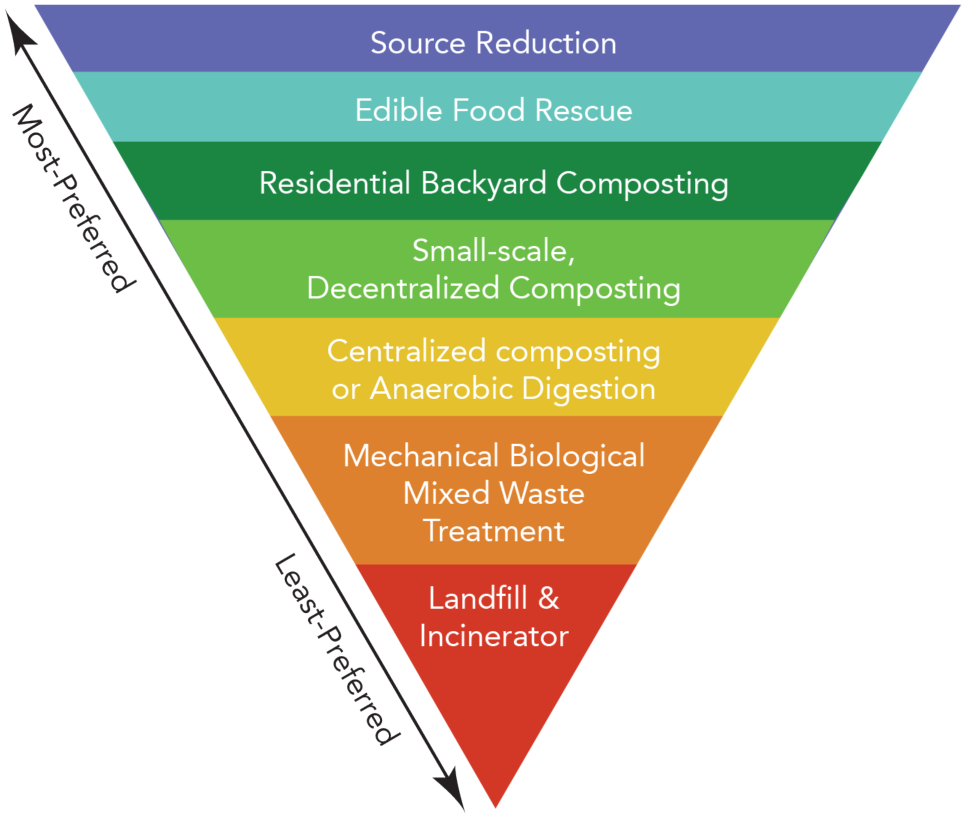
Municipal solid waste contributes to the majority of waste sector emissions (GAIA, 2022). Within South Africa, it was estimated that the waste sector generated 23 Mt of greenhouse gasses (both methane and carbon dioxide emissions), measured in Carbon Dioxide Equivalent (CO_2e) in 2020, with solid waste disposal contributing 79.2% of this (DFFE, 2022).

1.2.2 Managing organic waste

Due to the negative impacts caused by the current MSW system, particularly methane created through landfilling of organic waste, global focus has shifted towards more sustainable, alternative approaches towards managing MSW. Municipalities in South Africa have a responsibility for MSW management, and there are numerous benefits for them in diverting organic waste into alternative treatment methods such as composting and anaerobic digestion (i.e., the production of biogas). Firstly, this will assist municipalities in attempting to meet national waste reduction and organic waste diversion targets. Secondly, this provides potential economic benefits such as reduced expenditure on transporting and landfilling waste and the creation of additional revenue streams from power, biofuels, compost, and other products (Usmani, 2021).

The following image presents the hierarchy for managing food and other organic waste. As with all other types of waste, prevention is the most preferred option. Where food waste cannot be prevented and is still edible, it should be recovered for human consumption. Where not edible, this can be channelled into local livestock farming operations as animal feed. Should neither of these options be suitable, the next most preferred option could be residential backyard composting, or if not generated by residents, then channelled into small-scale decentralised composting operations. Thereafter, the next most preferred option would be centralised composting or anaerobic digestion, followed by mechanical biological treatment. Finally, and only if no other options are available, food and other organic waste should either be incinerated or sent to landfill.

Figure 6: Hierarchy for reducing and recycling food scarps and other food scraps and other organic discards



Source: Institute for local Self-Reliance (2014)

Given the urgent warnings from scientific panels on the need to rapidly reduce harmful greenhouse gas (GHG) emissions to slow global warming, these last two technical processes for managing organic waste (i.e., landfilling and incineration) are no longer viable or responsible solutions. The C40 Leadership Group indicates that for cities in the global south that do not have good waste separation, MSW comprises high levels of food waste, which renders incineration one of the least efficient ways to produce energy compared to renewable sources (C40, 2019). It is also more expensive, as additional fuel needs to be added, and creates air pollution, and as such, they indicate that incineration is "among the worst approaches cities can take to achieve both waste reduction and energy goals" (C40, 2019).

Within the context of the food waste being generated by the EMM, the most applicable option is to consider **small-scale, decentralised composting**; this is both since the food waste generated is not fit for human consumption, and that the EMM is located within central Durban which is far from outlying areas where small-scale livestock farmers are based. Additionally, the other organic waste (garden waste) being sent to landfill by Durban Botanic Gardens is required as part of the composting process, and since this cannot be used for human or animal feed, composting would be the most preferred management option for this waste.

1.2.3 Policy Framework

Within South Africa, there are several strategic plans and relevant legislative requirements that support the diversion of organic waste from landfill into alternative technologies. Of importance are:

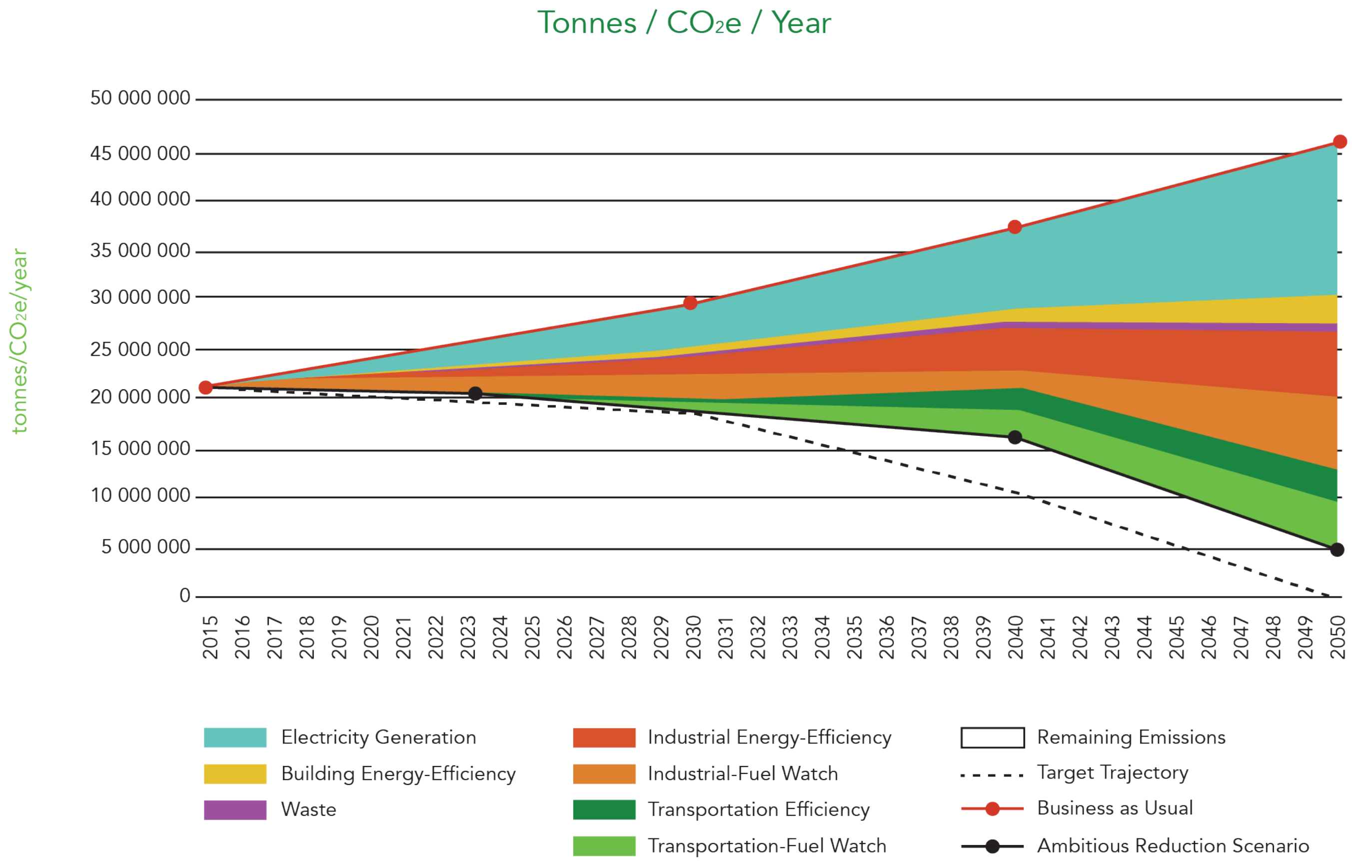
- National Environmental Management: Waste Act (2008),
- National Norms and Standards for Disposal of Waste to Landfill (2013),
- National Organic Composting Strategy (2013),
- National Waste Management Strategy (2020),
- National Norms and Standards for Organic Waste Composting (2021), and
- National Norms and Standards for Treatment of Organic Waste (2022).

The latter two are particularly important as they establish regulations that both reduce the restrictions for a range of organic waste treatment options and reduce regulatory barriers for compost producers that process more than 10 tonnes of organic waste per day (GreenCape, 2022).

The Norms and Standards for Disposal of Waste to Landfill (2013) were developed to place restrictions on a range of waste streams going to landfill. The Norms and Standards specified that in 5-years' time (by 2018), 25% of garden waste was to be diverted from a baseline at a particular landfill, and that in 10-years' time (by 2023), that would increase to 50% of garden waste (DEA, 2013). In addition, within pillar 1 of the National Waste Management Strategy 2020, minimisation of waste to landfill, specifically organic waste, as well as prevention of food waste, are focus areas (DFFE, 2020). A key intervention in addressing this is to divert organic waste from landfill through composting and recovery of energy (DFFE, 2020).

Within the context of the eThekwini Municipality, it was the first African city to complete a Paris-aligned Climate Action Plan (CAP) in collaboration with the C40 Leadership Group. In their plan, the city sets out ambitious emissions reduction targets of 40% by 2030 and 80% by 2050. The figure below depicts the current emissions by sector as well as the business-as-usual and ambitious reduction targets.

Figure 7: eThekwini Municipality's GHG Emissions Reduction Trajectory



Source: eThekwini Municipality' Climate Action Plan (2019)

In relation to waste management, the city intends on diverting waste disposed at landfill sites by 90% by 2050 through reuse, recycle, recovery and re-engineering. Additionally, by 2030, eThekwini plans to achieve a 50% increase in locally produced food and reduce the volume of good quality leftover food waste by 80% (eThekwini Municipality, 2019). To increase local food production, there will be a focus on promoting small-scale community farming cooperatives and community gardens in residential parks. To achieve a reduction in food waste, the city intends on promoting circular economic activities through supporting local entrepreneurs in developing composting systems to make use of food waste from residents and businesses (eThekwini Municipality, 2019). While efforts to support local entrepreneurship for small-scale composting are laudable, it is important to recognise that small-scale composting is not on its own a financially viable business proposition. Currently, and in the foreseeable future, as societies start to restructure waste management in response to climate and social protection goals, local and national governments will continue to hold responsibility for managing organic waste. Given that many municipalities are already carrying the high costs of sending organic waste to landfill, this report indicates how shifting to a municipal run small-scale, decentralised composting model brings substantive and much needed savings to the municipal coffers. As is outlined below, rather than looking to an unlikely profit generation solution, local government can move towards a municipal savings model to meet their Climate Action Plan goals.

1.3 Goal and Scope

With the above context and rationale in mind, the goal of this CBA is **'to evaluate the costs and benefits of diverting food and garden waste from landfill into compost production to determine if there is a net benefit or cost to the eThekwini Municipality'**. The results of the CBA will be used by policymakers both within and outside the eThekwini Municipality to better understand the potential for diverting MSW into composting operations.

The specific scope of work that was carried out to achieve this goal is outlined below:

- Review all research reports and databases and capture relevant information and data.
- Create a list of output indicators to identify specific information requirements.
- Identify gaps in current data and engage with stakeholders to plug data gaps.
- Develop a cost-benefit analysis model over a 10-year period and determine net cost/benefits, net present value (NPV), and benefit-cost ratio (BCR).
- Develop a sensitivity analysis for the most significant variables.
- Present the results of the CBA model to a range of stakeholders to gain input.
- Plug any final information gaps and finalise the CBA model.
- Develop a report that captures the process and results (this report).

1.4 Definitions

The following key definitions are applied to this research:

- **Food waste** in the context of this research relates only to waste of fruit and vegetables, which is generated as part of the retail process from traders at the Early Morning Market.
- **Composting** refers to 'open windrow composting', which is an aerobic method of composting organic waste in rows which are regularly turned to oxygenate the organic waste and speed up the decomposition process.

2 Methodology

2.1 CBA Methodology

Cost-benefit analysis is a common economic assessment tool. A CBA includes all the benefits and costs of a project to determine the net value of performing the project, which is calculated by subtracting the sum of the costs from the sum of the benefits (Christensen, 2010). CBA is an important tool in evaluating public investment decision making (Kocher, 2018) and is a well suited methodology for the WZW project as it considers both the economic and environmental costs and benefits, unlike other economic assessment tools such as the Cost-Effectiveness Assessment and Life-Cycle Cost assessment.

CBA compares the costs and benefits to the whole of society, and only when the benefits outweigh the costs, should the proposed activities be undertaken. This is done by determining the net value over a defined time-period to arrive at the net present value (NPV). The formula used is:

$$(\text{NPV}\ (i, N)) = \sum_{t=0}^{N} \frac{R_t}{(1+i)^t}$$

Where N is the total number of periods, i is the discount rate, t is time and Rt is the net cash flow at time t. Once calculated, a positive NPV indicates that the project should processed while a negative NPV indicates that the project should not proceed.

2.2 Approach to the CBA

A CBA model was developed within Microsoft Excel to collate and analyse all the data collected. The approach utilised to develop the model was as follows:

1. Unpack the current status quo and identify alternatives.
2. Develop a list of all monetary and non-monetary costs and benefits and other tangible and intangible outcomes (output indicators).
3. Quantify the costs and benefits (input indicators) using market prices from both primary and secondary research. This comprised the following:
    a. Gather all existing data collected from the WZW baseline study on volumes of food waste generated from the EMM.
    b. Gather all existing data on the composting pilot project around inputs (food waste, green and brown garden waste) and the outputs (compost produced).
    c. Engage with BSU, CSW and PRC to gather data and refine assumptions where data was missing and/or needed to be confirmed.
    d. Undertake desktop research to gather data on operational and capital expenditure requirements.
    e. Calculate the value, volume, etc., of all input indicators including:
        i. the volume of other feedstock inputs required (i.e., garden waste per tonne of food waste, etc.)
        ii. the expenses required to operate a composting facility of this size (i.e., operational costs)
        iii. the capital requirements (i.e., equipment and machinery requirements)
    f. Project all benefits and costs over a 10-year period.
4. Select a discount rate and calculate the net present value and cost-benefit ratio.
5. Undertake a sensitivity analysis to test the impact of changes in key variables on the NPV.

2.3 Limitations to the CBA

The composting project is currently in its final pilot phase. As such, data utilised around feedstock volumes and compost outputs are based on tests undertaken during the pilot phases, rather than being based on a full-scale composting operation. In addition, most operational expenditure items are determined using both the current pilot project requirements and an estimate of the requirements to scale-up to full production and using relevant market prices. However, given the length of time over which the pilot project has been implemented (over 14 months at present), the WZW team has been able to collect a range of detailed data, which allows for comparative analysis to be done on the data to ensure greater accuracy and confidence.

Another limitation relates to the fact that currently, there is no monetary value available to quantify the cost of methane emissions in South Africa. Therefore, it is not possible to quantify the total economic value of the reduced environmental impact of this project. This was however done for CO_2 emissions, so to some extent, the environmental impact has been measured.

3 Costs and Benefits

3.1 Status quo and alternative

Currently, all food waste from the EMM and garden waste from the Botanic Gardens is being removed by CSW, transported on a 19,6km round trip to the Electron Road Transfer Station, and then a further 66kms round trip to the Buffelsdraai Landfill. Associated with this is the cost of waste removal for the EMM and the Botanic Gardens, the landfill and airspace costs for CSW (which includes transport costs), and the GHG emissions from waste at landfill. Landfill and airspace costs account for all the capital and operational costs associated with operating and maintaining landfills for the Cleansing and Solid Waste Unit. The alternative is to divert food waste from the EMM to the Botanic Gardens, where it will be combined with green and brown garden waste from the Botanic Gardens' maintenance activities, to produce compost. This reduces the need to transport both the food and garden waste to landfill, along with all the associated transport, landfill, and airspace costs, and reduces GHG emissions substantially.

3.2 Identification of costs and benefits

Based on the status quo and alternative presented above, all the costs and benefits of each option are presented in Table 1.

Table 1: Costs and benefits of each of the options

Status Quo (i.e., Landfill)		Alternative (i.e., Diversion)	
Costs	Benefits	Costs	Benefits
Cost of waste removal service from EMM for BSU Cost of waste removal service from Botanic Gardens for PRC Landfilling cost for CSW for waste removed from EMM and Botanic Gardens Landfill airspace cost for CSW for waste removed from EMM and Botanic Gardens Cost of CO_2 emissions from waste at landfill External cost of landfill activities	No Benefits	Cost of transporting waste from EMM to Botanic Gardens Cost of producing compost at Botanic Gardens	Saving of cost of waste removal from the EMM for BSU Saving of cost of waste removal from Botanic Gardens for PRC Saving of landfill cost for CSW Saving of landfill airspace cost for CSW Saving of CO_2 emission cost from waste at landfill Saving by avoiding external costs of landfill activities Saving on cost of purchasing compost at Botanic Gardens Revenue from sale of excess compost
Not included			
Methane gas emissions from waste as landfill			Reduction in methane emissions from waste diverted from landfill

Within the status quo, there are no benefits accrued to the city; the current waste management activities utilise resources and accrue costs to the municipality. The costs for the status quo are removal of waste from EMM and Botanic Gardens, the landfill and airspace costs for CSW of disposing of this waste to landfill, the cost of CO_2 emissions released at landfill, and the external costs of landfill activities. The revenue for CSW from waste removal activities (from EMM and Botanic Gardens) could be viewed as a benefit, however, these resources can be reallocated to other areas since the broader waste management network is under-resourced.

The costs of the alternative are the cost of transporting food waste from EMM to the Botanic Gardens and the costs (both capital and operational) of the compost production process. The benefits are significant and include savings to both EMM and Botanic Gardens for the reduced CSW waste removal service, landfill, and airspace savings to CSW due to less waste being sent to landfill, savings from CO_2 emissions and external costs (from sending waste at landfill), the compost savings for Botanic Gardens, and the revenue generated from the sale of additional compost produced.

The cost of methane emissions in the status quo, and benefits of methane emissions avoided in the alterative, are excluded from the model as there is currently no price for methane emissions in South Africa. However, given the Global Methane Pledge which aims to reduce global methane emissions by 30% in 2030 from 2020 levels, it is expected that pressure will be placed on South Africa to take action to reduce emissions towards its Nationally Determined Contribution. Inclusion of the price of methane emissions in this model would make the status quo less viable, and the alternative more viable.

3.3 Assumptions

In development of the model, several assumptions were made. These are listed below:

- The CBA model considers financial flows within the eThekwini Municipality, i.e., the net savings and costs to the city as a whole and not per department/unit.
- CBA model has been developed for a full 'scaling-up' of the pilot composting project - a key assumption is that all food waste from the EMM will be diverted into the composting operation.
- The 2022 food waste baseline volume (334 tonnes) is used from 2023-2032 (i.e., there is no growth in food waste).
- Only direct costs of producing compost are included - costs such as communications, marketing, etc., are already accounted for in existing PRC budgets.
- Capital investment costs are included for a truck, woodchipper and chainsaw.
- Human resources required to maintain the operation are 1 supervisor and 3 labourers.
- Sufficient land is available to undertake composting of all the food waste at the Durban Botanic Gardens.
- No rental is paid as this land is the property of the eThekwini Municipality. The same would apply to composting facilities on other municipally owned sites.
- The composting production requires an improved separation process at the Early Morning Market to ensure that plastics (which comprise 10% of total waste generated) are removed.
- Given that the current waste management system in eThekwini is constrained, the loss of revenue for CSW of the waste management service to EMM and Botanic Gardens is offset by the value gained through additional capacity created by not having to provide that waste removal service any longer.
- The CBA uses constant 2023 prices, with no monetary inflation applied between 2023 and 2032.

3.4 Scenarios

Three scenarios were developed as part of the CBA. These are below:

Scenario	Description
Scenario 1: No building	Within this scenario, no physical building structure will be constructed for the composting operations. As with many composing facilities of a similar scale, the composting will occur in the open with channels to capture leachate runoff only.
Scenario 2: Painted steel structure	Within this scenario, a concrete base will be constructed with a painted steel frame and roof structure.
Scenario 3: Galvanised steel structure	Within this scenario, a concrete base will be constructed with a galvanised steel frame and roof structure.

3.5 Machinery and equipment costs

The machinery and equipment cost requirements are presented in the table below, along with the variables that are used to determine the repayment schedule. The total cost requirement is approximately R597,000 to be repaid over 5 years.

Table 2: Capital cost requirements and variables

Machinery and equipment	Capital cost
Truck	R346,956.52
Wood chipper	R245,000.00
Chainsaw	R5,000.00
Total	**R596,956.52**

Number of years	5
Interest Rate	11.75%
Principal	R596,956.52
Payment	R13,203.68

The depreciation and interest repayable are summarised in the table below. The detailed breakdown of the repayment schedule is provided in Annexure 1.

Table 3: Depreciation and interest repayable over the 5-year period

Year	2023	2024	2025	2026	2027
Depreciation	R119,391.30	R119,391.30	R119,391.30	R119,391.30	R119,391.30
Interest	R65,228.29	R53,665.89	R40,669.30	R26,060.63	R9,639.91

3.6 Building (construction) costs

The cost of construction of the two building structures (scenario 2 and 3) are indicated below. Scenario 2, which is the painted steel structure, is approximately R5 million while the cost of the galvanised steel structure is R6,4 million. The detailed construction cost repayment schedules are provided in Annexure 2.

	Scenario 2	Scenario 3
Total cost	R4,936,413.35	R6,436,812.94
Number of years	10	10
Interest Rate	11.75%	11.75%
Principal	R4,936,413.35	R6,436,812.94
Payment	R70,111.61	R91,421.71

3.7 Input indicators

The detailed input indicators used as part of the CBA model are provided within Annexure 3. This table provides the indicators, unit and value per indicator, and the source of data. The specific notes relating to how each indicator is calculated are provided within the CBA model sheet.

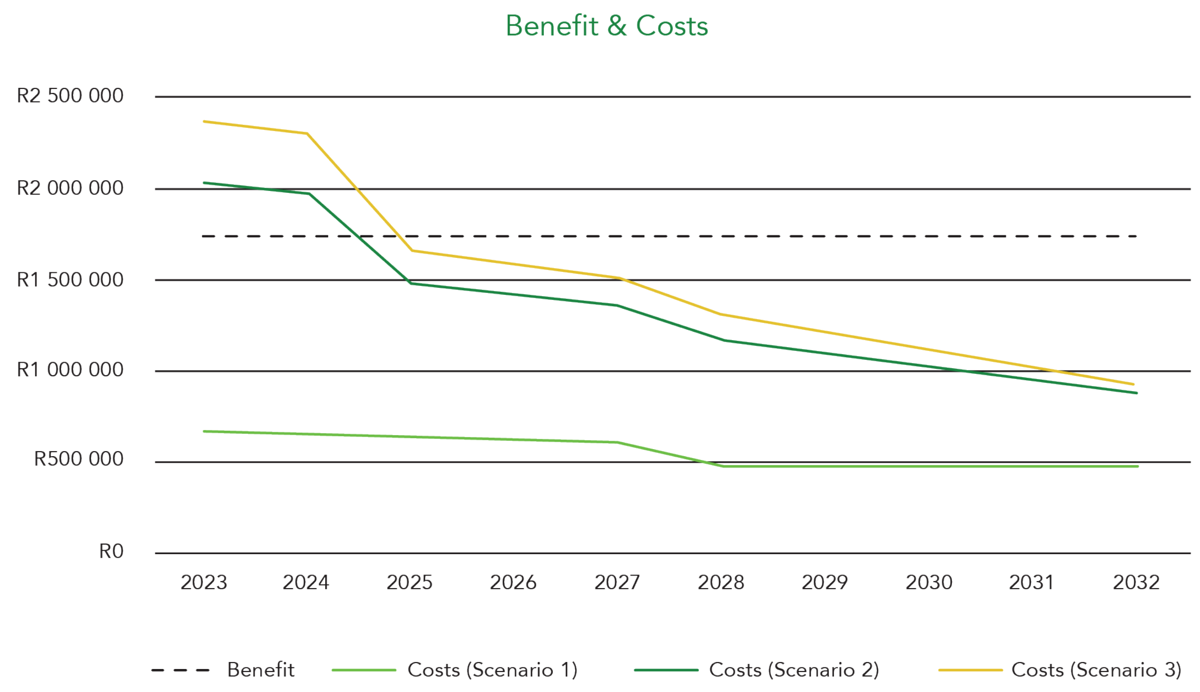
Findings of the CBA

3.8 Benefits and costs

All the benefits and costs were then projected over a 10-year period. Annexure 4 provides the detailed breakdown of each of the benefits and costs, which are totalled and provided across the 10-year period within the graph below.

The benefits, which are constant from 2023-2032 since the model is a real-growth model, are R1,73 million per year, totalling R17,3 million over the 10-year period. For scenario 1, costs are R664,000 in 2023 and decline to R480,000 in 2032. For scenario 2, costs start at just over R2 million in 2023 and reduce to R876,000 in 2032, while for scenario 3, costs are R2,36 million in 2023 and decline to R921,000 in 2032. In all scenarios, the costs decline as the interest repayments reduce over the time period.

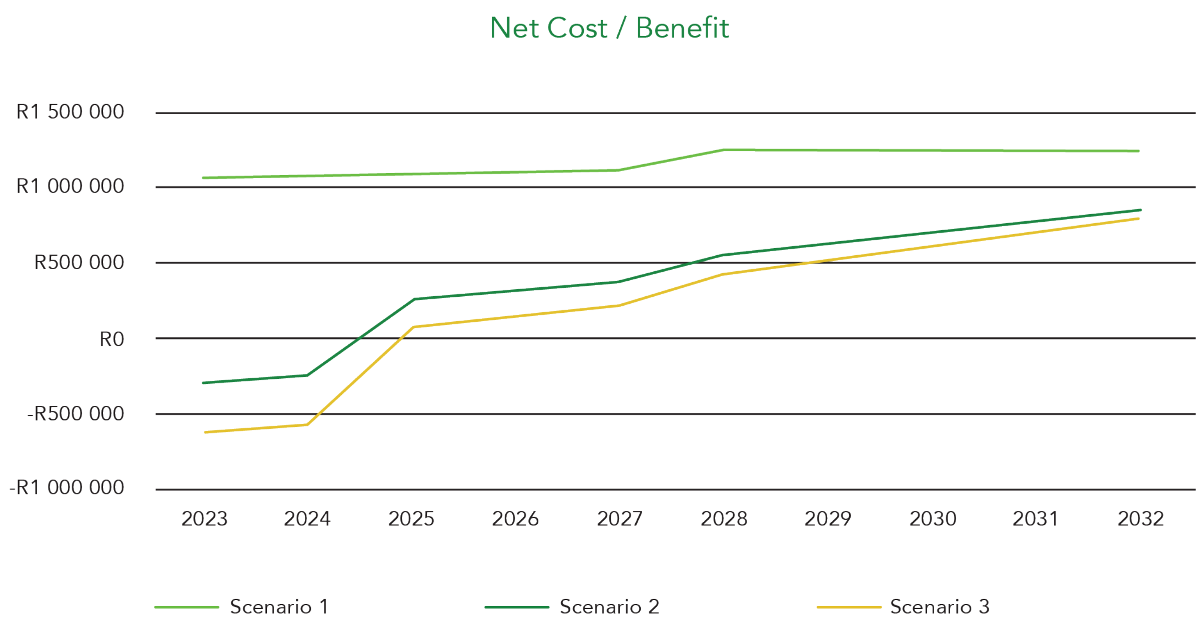
Figure 8: Benefits and costs (2023-2032)



3.9 Net benefits/costs

The net cost/benefit is then calculated for the period 2023-2032 by subtracting the costs from the benefits. In all scenarios, there is a cumulative net benefit to the city. However, since the costs are substantially lower in scenario 1, the cumulative net benefit is R11,7 million over the 10-year period. In scenario 2, the cumulative net benefit is R3,8 million while in scenario 3 it is R2,3 million over the 10-year period. The figure below depicts the net benefit per scenario per year.

Figure 9: Net cost/benefit (2023-2032)



3.10 Net present value and cost-benefit ratio

Finally, the net present value and cost-benefit ratios are calculated. Where the NPV is greater than R1, this indicates that the project is viable and will generate a greater net value than investing in an alternative project at the current market interest rate. The same applies to a CBR of more than 1.

Table 4: Results of the CBA model

Cost-benefit analysis	Scenario 1	Scenario 2	Scenario 3
Net present value (NPV) Sum of present value of future benefits - sum of present value of future costs	R5,992,793	R1,989,756	R1,156,640
Benefit-cost ratio (BCR) Sum of present value of future benefits / sum of present value of future costs	3.10	1.29	1.15

As indicated above, the project presents an overall net benefit to the city across all scenarios. Within scenario 1, where no investment is made into a physical structure, the NPV is greatest at almost R6 million and a BCR of 3.1. Within scenario 2 and scenario 3, even when investment is made into a physical structure, the NPV is R1,9 million and R1,15 million respectively, with BCRs of 1.29 and 1.15.

This indicates that scaling up the current pilot composting production is viable and would be an overall benefit to the city even when purchasing new, dedicated capital equipment and investing in a physical composting facility structure.

3.11 Sensitivity Analysis

A sensitivity analysis was conducted to test the impact of some key CBA model variables on the NPV of each of the scenarios. This is done to ensure that should there be any significant changes to the selected variables, the anticipated impact on the NPV of the project can be understood. The variables selected are those which currently have the largest contribution to either the costs or benefits within the model, and which are the most likely to substantially impact on the NPV of the project.

Table 5: Sensitivity analysis for selected key variables

Discount rate	Scenario 1	Scenario 2	Scenario 3
5%	R7,195,296	R2,389,017	R1,388,729
6.9%	**R5,992,793**	**R1,989,756**	**R1,156,640**
8%	R5,428,804	R1,802,498	R1,047,787
10%	R4,518,714	R1,500,325	R872,135

Landfill cost per tonne	Scenario 1	Scenario 2	Scenario 3
R1300	**R5,992,793**	**R1,989,756**	**R1,156,640**
R1000	R5,229,050	R1,226,014	R392,897
R800	R4,719,889	R716,852	-R116,264

Sale price of excess compost	Scenario 1	Scenario 2	Scenario 3
R433	**R5,992,793**	**R1,989,756**	**R1,156,640**
R300	R5,487,540	R1,484,503	R651,387
R200	R5,108,600	R1,105,564	R272,447

Cost of EMM waste removal service	Scenario 1	Scenario 2	Scenario 3
R35,000	**R5,992,793**	**R1,989,756**	**R1,156,640**
R20,000	R5,217,056	R1,214,019	R380,902
R15,000	R4,958,924	R955,887	R122,771

Interest rate	Scenario 1	Scenario 2	Scenario 3
11.75%	**R5,992,793**	**R1,989,756**	**R1,156,640**
13.00%	R5,351,517	R1,572,565	R767,177
15.00%	R4,476,122	R1,031,838	R272,943

It is clear from the analysis that the project is only marginally impacted by large changes in the key variables selected.

- Even at an extremely high real discount rate of 10%, the NPV across all scenarios is still positive.
- A decline in the cost of sending waste to landfill is the only change that makes the NPV from scenario 3 negative. However this this highly unlikely as the cost of sending waste to landfill (R1300) is even considered to be too low at present.
- Should the price of compost decline by more than half, this will reduce the revenue that can be generated through the sale of excess compost, but not to the extent that the project is no longer viable.
- If the cost of the CSW waste removal service is reduced by more than half, thereby reducing the savings for EMM and Botanic Gardens, this would reduce the NPV but the overall the project would still be viable in all scenarios.
- Finally, should the interest rate increase to an unlikely rate of 15%, even then the project would still be considered viable across all scenarios.

4 Conclusion

4.1 Summary of Key Findings

The study utilises a CBA model to determine the net value of the composting project, considering the quantifiable costs and benefits. Due to the substantial costs associated with sending waste to landfill in eThekwini (limited landfill space, long distances, etc.) and the savings generated from diverting waste and creating compost, the study has indicated that this project creates a net positive benefit to the eThekwini Municipality across all scenarios. Additionally, there are numerous other positive impacts that are created through this project. These impacts, along with specific outcomes, are presented in the table below.

Table 6: Impacts and outcome from the WZW Project

Impact	Outcome
Financial impact for the city	• Savings on waste disposal to EMM and Botanic Gardens • Savings on compost purchase for PRC • Savings on landfill and airspace costs for CSW
Employment impacts	• Creation of new, green employment opportunities for the city (in this case study, an estimated 4 jobs for every 400 tonnes of organic waste diverted)
Economic impacts	• Locates viable and green economic activities within communities which can address spatial and other inequalities.
Climate and environmental impact	• GHG emission reductions from compost production (especially methane) and reduced transport distances • Production of compost to replenish soil and support local food production
Impact on traders	• Reinvestment of savings for BSU into EMM infrastructure toward improved working conditions for market traders and vendors. • Increased education about the impact of food waste and climate change
Institutional impacts	• Successful transversal partnership model within the municipality • Creation of a strong, circular economy model for replication to create a patchwork of small, closed loops across the city.
Educational impacts	• Creation of training opportunities for students • Creation of broad awareness and education around food waste

Other than the financial impacts in terms of savings for various city departments, there are impacts such as the creation of new green jobs, better working conditions for informal traders, positive environmental and climate impacts, education and awareness creation, and stronger institutional partnerships.

The results of the research indicate that the project has the potential to create positive economic value within the city, as well as contributing towards climate change mitigation, employment creation, improved working conditions for informal traders, better awareness and education, and transversal governance ambitions.

4.2 Recommendations

4.2.1 Current WZW pilot project

Scaling up of the current WZW pilot project should be supported by the eThekwini Municipality. Operational relationships currently exist between the relevant departments (and WZW team), and these should continue with the aim of optimising current processes. Departmental and WZW representatives must continue to promote the project and advocate for greater support from the city. This will include engagement with relevant city leadership to ensure that support and buy-in can be secured at the highest level.

To scale the project from the current pilot level to full diversion of food waste from the EMM, some initial capital will be required. As such, a project plan will need to be developed to outline the approach to be taken, the key stakeholders and their roles and responsibilities, institutional requirements, an operational structure, budget, and timeframes.

4.2.2 Other potential projects

Based on the results of the analysis, it is highly likely that other projects of a similar nature would be equally as viable within eThekwini. Expansion of this concept to other fresh produce markets in the city will have an even greater impact, and allow the Parks, Recreation and Culture and Business Support units to be leading contributors towards addressing the city's climate action plan targets. Additionally, the benefits of reduced landfill space will allow CSW to reallocate their over-capacitated city fleet towards greater priority areas, and ensure cost savings across the board.

To action this, an assessment needs to be undertaken to identify all fresh produce markets within the eThekwini Municipality and nearby parks and public open spaces within a 2km radius. Thereafter, the relevant operational managers can engage to identify the potential for such a project to be implemented, and arrangements can be made to initiate a pilot. Again however, this would require buy-in from city leadership to ensure that operational processes are not hindered. The WZW team can, with support from Business Support, assist in determining the city-wide impact if this project is implemented throughout the municipality, which would assist to further motivate for support and funding. Based on an understanding of the volumes of food waste at the municipal level, other opportunities could be explored such as small-scale anaerobic digestion (to provide biogas to food vendors as fresh produce markets).

5 Annexures

Annexure 1: Detailed machinery and equipment repayment schedule

Period	Month	Balance	Interest	Principal Paid	New Balance
0					R596,956.52
1	January 2023	R596,956.52	R5,845.20	R7,358.48	R589,598.05
2	February 2023	R589,598.05	R5,773.15	R7,430.53	R582,167.52
3	March 2023	R582,167.52	R5,700.39	R7,503.29	R574,664.23
4	April 2023	R574,664.23	R5,626.92	R7,576.76	R567,087.48
5	May 2023	R567,087.48	R5,552.73	R7,650.94	R559,436.53
6	June 2023	R559,436.53	R5,477.82	R7,725.86	R551,710.67
7	July 2023	R551,710.67	R5,402.17	R7,801.51	R543,909.16
8	August 2023	R543,909.16	R5,325.78	R7,877.90	R536,031.26
9	September 2023	R536,031.26	R5,248.64	R7,955.04	R528,076.23
10	October 2023	R528,076.23	R5,170.75	R8,032.93	R520,043.30
11	November 2023	R520,043.30	R5,092.09	R8,111.59	R511,931.71
12	December 2023	R511,931.71	R5,012.66	R8,191.01	R503,740.70
13	January 2024	R503,740.70	R4,932.46	R8,271.21	R495,469.49
14	February 2024	R495,469.49	R4,851.47	R8,352.20	R487,117.28
15	March 2024	R487,117.28	R4,769.69	R8,433.99	R478,683.30
16	April 2024	R478,683.30	R4,687.11	R8,516.57	R470,166.73
17	May 2024	R470,166.73	R4,603.72	R8,599.96	R461,566.77
18	June 2024	R461,566.77	R4,519.51	R8,684.17	R452,882.60
19	July 2024	R452,882.60	R4,434.48	R8,769.20	R444,113.40
20	August 2024	R444,113.40	R4,348.61	R8,855.07	R435,258.33
21	September 2024	R435,258.33	R4,261.90	R8,941.77	R426,316.56
22	October 2024	R426,316.56	R4,174.35	R9,029.33	R417,287.24
23	November 2024	R417,287.24	R4,085.94	R9,117.74	R408,169.50
24	December 2024	R408,169.50	R3,996.66	R9,207.02	R398,962.48
25	January 2025	R398,962.48	R3,906.51	R9,297.17	R389,665.31
26	February 2025	R389,665.31	R3,815.47	R9,388.20	R380,277.11
27	March 2025	R380,277.11	R3,723.55	R9,480.13	R370,796.98
28	April 2025	R370,796.98	R3,630.72	R9,572.96	R361,224.03
29	May 2025	R361,224.03	R3,536.99	R9,666.69	R351,557.34
30	June 2025	R351,557.34	R3,442.33	R9,761.34	R341,795.99
31	July 2025	R341,795.99	R3,346.75	R9,856.92	R331,939.07
32	August 2025	R331,939.07	R3,250.24	R9,953.44	R321,985.63
33	September 2025	R321,985.63	R3,152.78	R10,050.90	R311,934.73
34	October 2025	R311,934.73	R3,054.36	R10,149.32	R301,785.41
35	November 2025	R301,785.41	R2,954.98	R10,248.69	R291,536.72

Period	Month	Balance	Interest	Principal Paid	New Balance
36	December 2025	R291,536.72	R2,854.63	R10,349.05	R281,187.68
37	January 2026	R281,187.68	R2,753.30	R10,450.38	R270,737.30
38	February 2026	R270,737.30	R2,650.97	R10,552.71	R260,184.59
39	March 2026	R260,184.59	R2,547.64	R10,656.04	R249,528.55
40	April 2026	R249,528.55	R2,443.30	R10,760.38	R238,768.18
41	May 2026	R238,768.18	R2,337.94	R10,865.74	R227,902.44
42	June 2026	R227,902.44	R2,231.54	R10,972.13	R216,930.31
43	July 2026	R216,930.31	R2,124.11	R11,079.57	R205,850.74
44	August 2026	R205,850.74	R2,015.62	R11,188.05	R194,662.69
45	September 2026	R194,662.69	R1,906.07	R11,297.60	R183,365.08
46	October 2026	R183,365.08	R1,795.45	R11,408.23	R171,956.86
47	November 2026	R171,956.86	R1,683.74	R11,519.93	R160,436.93
48	December 2026	R160,436.93	R1,570.94	R11,632.73	R148,804.20
49	January 2027	R148,804.20	R1,457.04	R11,746.63	R137,057.56
50	February 2027	R137,057.56	R1,342.02	R11,861.65	R125,195.91
51	March 2027	R125,195.91	R1,225.88	R11,977.80	R113,218.11
52	April 2027	R113,218.11	R1,108.59	R12,095.08	R101,123.03
53	May 2027	R101,123.03	R990.16	R12,213.51	R88,909.51
54	June 2027	R88,909.51	R870.57	R12,333.10	R76,576.41
55	July 2027	R76,576.41	R749.81	R12,453.87	R64,122.54
56	August 2027	R64,122.54	R627.87	R12,575.81	R51,546.74
57	September 2027	R51,546.74	R504.73	R12,698.95	R38,847.79
58	October 2027	R38,847.79	R380.38	R12,823.29	R26,024.50
59	November 2027	R26,024.50	R254.82	R12,948.85	R13,075.64
60	December 2027	R13,075.64	R128.03	R13,075.64	R0.00
			R195,264.03	R596,956.52	

Annexure 2: Detailed construction cost repayment schedules

Scenario 2 – Painted steel frame structure

Period	Month	Balance	Interest	Principal Paid	New Balance
0					R4,936,413.35
1	January 2023	R4,936,413.35	R48,335.71	R21,775.90	R4,914,637.45
2	February 2023	R4,914,637.45	R48,122.49	R21,989.12	R4,892,648.33
3	March 2023	R4,892,648.33	R47,907.18	R22,204.43	R4,870,443.90
4	April 2023	R4,870,443.90	R47,689.76	R22,421.85	R4,848,022.05
5	May 2023	R4,848,022.05	R47,470.22	R22,641.40	R4,825,380.66
6	June 2023	R4,825,380.66	R47,248.52	R22,863.09	R4,802,517.56
7	July 2023	R4,802,517.56	R47,024.65	R23,086.96	R4,779,430.60
8	August 2023	R4,779,430.60	R46,798.59	R23,313.02	R4,756,117.58
9	September 2023	R4,756,117.58	R46,570.32	R23,541.29	R4,732,576.29
10	October 2023	R4,732,576.29	R46,339.81	R23,771.80	R4,708,804.49
11	November 2023	R4,708,804.49	R46,107.04	R24,004.57	R4,684,799.92
12	December 2023	R4,684,799.92	R45,872.00	R24,239.61	R4,660,560.31
13	January 2024	R4,660,560.31	R45,634.65	R24,476.96	R4,636,083.35
14	February 2024	R4,636,083.35	R45,394.98	R24,716.63	R4,611,366.72
15	March 2024	R4,611,366.72	R45,152.97	R24,958.65	R4,586,408.07
16	April 2024	R4,586,408.07	R44,908.58	R25,203.03	R4,561,205.04
17	May 2024	R4,561,205.04	R44,661.80	R25,449.81	R4,535,755.23
18	June 2024	R4,535,755.23	R44,412.60	R25,699.01	R4,510,056.22
19	July 2024	R4,510,056.22	R44,160.97	R25,950.64	R4,484,105.57
20	August 2024	R4,484,105.57	R43,906.87	R26,204.74	R4,457,900.83
21	September 2024	R4,457,900.83	R43,650.28	R26,461.33	R4,431,439.50
22	October 2024	R4,431,439.50	R43,391.18	R26,720.43	R4,404,719.06
23	November 2024	R4,404,719.06	R43,129.54	R26,982.07	R4,377,736.99
24	December 2024	R4,377,736.99	R42,865.34	R27,246.27	R4,350,490.72
25	January 2025	R4,350,490.72	R42,598.55	R27,513.06	R4,322,977.66
26	February 2025	R4,322,977.66	R42,329.16	R27,782.46	R4,295,195.21
27	March 2025	R4,295,195.21	R42,057.12	R28,054.49	R4,267,140.72
28	April 2025	R4,267,140.72	R41,782.42	R28,329.19	R4,238,811.52
29	May 2025	R4,238,811.52	R41,505.03	R28,606.58	R4,210,204.94
30	June 2025	R4,210,204.94	R41,224.92	R28,886.69	R4,181,318.25
31	July 2025	R4,181,318.25	R40,942.07	R29,169.54	R4,152,148.72
32	August 2025	R4,152,148.72	R40,656.46	R29,455.16	R4,122,693.56
33	September 2025	R4,122,693.56	R40,368.04	R29,743.57	R4,092,949.99
34	October 2025	R4,092,949.99	R40,076.80	R30,034.81	R4,062,915.18
35	November 2025	R4,062,915.18	R39,782.71	R30,328.90	R4,032,586.28
36	December 2025	R4,032,586.28	R39,485.74	R30,625.87	R4,001,960.41

Period	Month	Balance	Interest	Principal Paid	New Balance
37	January 2026	R4,001,960.41	R39,185.86	R30,925.75	R3,971,034.66
38	February 2026	R3,971,034.66	R38,883.05	R31,228.56	R3,939,806.09
39	March 2026	R3,939,806.09	R38,577.27	R31,534.34	R3,908,271.75
40	April 2026	R3,908,271.75	R38,268.49	R31,843.12	R3,876,428.63
41	May 2026	R3,876,428.63	R37,956.70	R32,154.91	R3,844,273.72
42	June 2026	R3,844,273.72	R37,641.85	R32,469.77	R3,811,803.95
43	July 2026	R3,811,803.95	R37,323.91	R32,787.70	R3,779,016.25
44	August 2026	R3,779,016.25	R37,002.87	R33,108.74	R3,745,907.51
45	September 2026	R3,745,907.51	R36,678.68	R33,432.93	R3,712,474.58
46	October 2026	R3,712,474.58	R36,351.31	R33,760.30	R3,678,714.28
47	November 2026	R3,678,714.28	R36,020.74	R34,090.87	R3,644,623.41
48	December 2026	R3,644,623.41	R35,686.94	R34,424.67	R3,610,198.73
49	January 2027	R3,610,198.73	R35,349.86	R34,761.75	R3,575,436.99
50	February 2027	R3,575,436.99	R35,009.49	R35,102.12	R3,540,334.86
51	March 2027	R3,540,334.86	R34,665.78	R35,445.83	R3,504,889.03
52	April 2027	R3,504,889.03	R34,318.71	R35,792.91	R3,469,096.12
53	May 2027	R3,469,096.12	R33,968.23	R36,143.38	R3,432,952.74
54	June 2027	R3,432,952.74	R33,614.33	R36,497.28	R3,396,455.46
55	July 2027	R3,396,455.46	R33,256.96	R36,854.65	R3,359,600.81
56	August 2027	R3,359,600.81	R32,896.09	R37,215.52	R3,322,385.29
57	September 2027	R3,322,385.29	R32,531.69	R37,579.92	R3,284,805.36
58	October 2027	R3,284,805.36	R32,163.72	R37,947.89	R3,246,857.47
59	November 2027	R3,246,857.47	R31,792.15	R38,319.47	R3,208,538.00
60	December 2027	R3,208,538.00	R31,416.93	R38,694.68	R3,169,843.33
61	January 2028	R3,169,843.33	R31,038.05	R39,073.56	R3,130,769.76
62	February 2028	R3,130,769.76	R30,655.45	R39,456.16	R3,091,313.61
63	March 2028	R3,091,313.61	R30,269.11	R39,842.50	R3,051,471.11
64	April 2028	R3,051,471.11	R29,878.99	R40,232.62	R3,011,238.48
65	May 2028	R3,011,238.48	R29,485.04	R40,626.57	R2,970,611.92
66	June 2028	R2,970,611.92	R29,087.24	R41,024.37	R2,929,587.54
67	July 2028	R2,929,587.54	R28,685.54	R41,426.07	R2,888,161.48
68	August 2028	R2,888,161.48	R28,279.91	R41,831.70	R2,846,329.78
69	September 2028	R2,846,329.78	R27,870.31	R42,241.30	R2,804,088.48
70	October 2028	R2,804,088.48	R27,456.70	R42,654.91	R2,761,433.57
71	November 2028	R2,761,433.57	R27,039.04	R43,072.57	R2,718,360.99
72	December 2028	R2,718,360.99	R26,617.28	R43,494.33	R2,674,866.67
73	January 2029	R2,674,866.67	R26,191.40	R43,920.21	R2,630,946.46
74	February 2029	R2,630,946.46	R25,761.35	R44,350.26	R2,586,596.20
75	March 2029	R2,586,596.20	R25,327.09	R44,784.52	R2,541,811.67

Period	Month	Balance	Interest	Principal Paid	New Balance
76	April 2029	R2,541,811.67	R24,888.57	R45,223.04	R2,496,588.63
77	May 2029	R2,496,588.63	R24,445.76	R45,665.85	R2,450,922.78
78	June 2029	R2,450,922.78	R23,998.62	R46,112.99	R2,404,809.79
79	July 2029	R2,404,809.79	R23,547.10	R46,564.52	R2,358,245.28
80	August 2029	R2,358,245.28	R23,091.15	R47,020.46	R2,311,224.82
81	September 2029	R2,311,224.82	R22,630.74	R47,480.87	R2,263,743.95
82	October 2029	R2,263,743.95	R22,165.83	R47,945.79	R2,215,798.16
83	November 2029	R2,215,798.16	R21,696.36	R48,415.25	R2,167,382.91
84	December 2029	R2,167,382.91	R21,222.29	R48,889.32	R2,118,493.59
85	January 2030	R2,118,493.59	R20,743.58	R49,368.03	R2,069,125.56
86	February 2030	R2,069,125.56	R20,260.19	R49,851.42	R2,019,274.13
87	March 2030	R2,019,274.13	R19,772.06	R50,339.55	R1,968,934.58
88	April 2030	R1,968,934.58	R19,279.15	R50,832.46	R1,918,102.12
89	May 2030	R1,918,102.12	R18,781.42	R51,330.20	R1,866,771.92
90	June 2030	R1,866,771.92	R18,278.81	R51,832.80	R1,814,939.12
91	July 2030	R1,814,939.12	R17,771.28	R52,340.33	R1,762,598.79
92	August 2030	R1,762,598.79	R17,258.78	R52,852.83	R1,709,745.96
93	September 2030	R1,709,745.96	R16,741.26	R53,370.35	R1,656,375.61
94	October 2030	R1,656,375.61	R16,218.68	R53,892.93	R1,602,482.67
95	November 2030	R1,602,482.67	R15,690.98	R54,420.64	R1,548,062.04
96	December 2030	R1,548,062.04	R15,158.11	R54,953.50	R1,493,108.53
97	January 2031	R1,493,108.53	R14,620.02	R55,491.59	R1,437,616.94
98	February 2031	R1,437,616.94	R14,076.67	R56,034.95	R1,381,581.99
99	March 2031	R1,381,581.99	R13,527.99	R56,583.62	R1,324,998.37
100	April 2031	R1,324,998.37	R12,973.94	R57,137.67	R1,267,860.70
101	May 2031	R1,267,860.70	R12,414.47	R57,697.14	R1,210,163.56
102	June 2031	R1,210,163.56	R11,849.52	R58,262.09	R1,151,901.47
103	July 2031	R1,151,901.47	R11,279.04	R58,832.58	R1,093,068.89
104	August 2031	R1,093,068.89	R10,702.97	R59,408.65	R1,033,660.25
105	September 2031	R1,033,660.25	R10,121.26	R59,990.36	R973,669.89
106	October 2031	R973,669.89	R9,533.85	R60,577.76	R913,092.13
107	November 2031	R913,092.13	R8,940.69	R61,170.92	R851,921.21
108	December 2031	R851,921.21	R8,341.73	R61,769.88	R790,151.33
109	January 2032	R790,151.33	R7,736.90	R62,374.71	R727,776.61
110	February 2032	R727,776.61	R7,126.15	R62,985.47	R664,791.15
111	March 2032	R664,791.15	R6,509.41	R63,602.20	R601,188.95
112	April 2032	R601,188.95	R5,886.64	R64,224.97	R536,963.98
113	May 2032	R536,963.98	R5,257.77	R64,853.84	R472,110.14
114	June 2032	R472,110.14	R4,622.75	R65,488.87	R406,621.27

Period	Month	Balance	Interest	Principal Paid	New Balance
115	July 2032	R406,621.27	R3,981.50	R66,130.11	R340,491.16
116	August 2032	R340,491.16	R3,333.98	R66,777.64	R273,713.53
117	September 2032	R273,713.53	R2,680.11	R67,431.50	R206,282.03
118	October 2032	R206,282.03	R2,019.84	R68,091.77	R138,190.26
119	November 2032	R138,190.26	R1,353.11	R68,758.50	R69,431.76
120	December 2032	R69,431.76	R679.85	R69,431.76	R0.00
			R3,476,980.07	R4,936,413.35	

Scenario 3 – Galvanised steel frame structure

Period	Month	Balance	Interest	Principal Paid	New Balance
0					R6,436,812.94
1	January 2023	R6,436,812.94	R63,027.13	R28,394.58	R6,408,418.36
2	February 2023	R6,408,418.36	R62,749.10	R28,672.61	R6,379,745.75
3	March 2023	R6,379,745.75	R62,468.34	R28,953.36	R6,350,792.39
4	April 2023	R6,350,792.39	R62,184.84	R29,236.86	R6,321,555.52
5	May 2023	R6,321,555.52	R61,898.56	R29,523.14	R6,292,032.38
6	June 2023	R6,292,032.38	R61,609.48	R29,812.22	R6,262,220.16
7	July 2023	R6,262,220.16	R61,317.57	R30,104.13	R6,232,116.03
8	August 2023	R6,232,116.03	R61,022.80	R30,398.90	R6,201,717.12
9	September 2023	R6,201,717.12	R60,725.15	R30,696.56	R6,171,020.56
10	October 2023	R6,171,020.56	R60,424.58	R30,997.13	R6,140,023.43
11	November 2023	R6,140,023.43	R60,121.06	R31,300.64	R6,108,722.79
12	December 2023	R6,108,722.79	R59,814.58	R31,607.13	R6,077,115.66
13	January 2024	R6,077,115.66	R59,505.09	R31,916.62	R6,045,199.05
14	February 2024	R6,045,199.05	R59,192.57	R32,229.13	R6,012,969.92
15	March 2024	R6,012,969.92	R58,877.00	R32,544.71	R5,980,425.21
16	April 2024	R5,980,425.21	R58,558.33	R32,863.38	R5,947,561.83
17	May 2024	R5,947,561.83	R58,236.54	R33,185.16	R5,914,376.67
18	June 2024	R5,914,376.67	R57,911.60	R33,510.10	R5,880,866.57
19	July 2024	R5,880,866.57	R57,583.49	R33,838.22	R5,847,028.34
20	August 2024	R5,847,028.34	R57,252.15	R34,169.55	R5,812,858.79
21	September 2024	R5,812,858.79	R56,917.58	R34,504.13	R5,778,354.66
22	October 2024	R5,778,354.66	R56,579.72	R34,841.98	R5,743,512.68
23	November 2024	R5,743,512.68	R56,238.56	R35,183.14	R5,708,329.53
24	December 2024	R5,708,329.53	R55,894.06	R35,527.65	R5,672,801.89
25	January 2025	R5,672,801.89	R55,546.19	R35,875.52	R5,636,926.37
26	February 2025	R5,636,926.37	R55,194.90	R36,226.80	R5,600,699.56
27	March 2025	R5,600,699.56	R54,840.18	R36,581.52	R5,564,118.04

28	April 2025	R5,564,118.04	R54,481.99	R36,939.72	R5,527,178.32
29	May 2025	R5,527,178.32	R54,120.29	R37,301.42	R5,489,876.91
30	June 2025	R5,489,876.91	R53,755.04	R37,666.66	R5,452,210.24
31	July 2025	R5,452,210.24	R53,386.23	R38,035.48	R5,414,174.76
32	August 2025	R5,414,174.76	R53,013.79	R38,407.91	R5,375,766.85
33	September 2025	R5,375,766.85	R52,637.72	R38,783.99	R5,336,982.86
34	October 2025	R5,336,982.86	R52,257.96	R39,163.75	R5,297,819.11
35	November 2025	R5,297,819.11	R51,874.48	R39,547.23	R5,258,271.89
36	December 2025	R5,258,271.89	R51,487.25	R39,934.46	R5,218,337.43
37	January 2026	R5,218,337.43	R51,096.22	R40,325.49	R5,178,011.94
38	February 2026	R5,178,011.94	R50,701.37	R40,720.34	R5,137,291.60
39	March 2026	R5,137,291.60	R50,302.65	R41,119.06	R5,096,172.54
40	April 2026	R5,096,172.54	R49,900.02	R41,521.68	R5,054,650.86
41	May 2026	R5,054,650.86	R49,493.46	R41,928.25	R5,012,722.61
42	June 2026	R5,012,722.61	R49,082.91	R42,338.80	R4,970,383.81
43	July 2026	R4,970,383.81	R48,668.34	R42,753.36	R4,927,630.45
44	August 2026	R4,927,630.45	R48,249.71	R43,171.99	R4,884,458.46
45	September 2026	R4,884,458.46	R47,826.99	R43,594.72	R4,840,863.74
46	October 2026	R4,840,863.74	R47,400.12	R44,021.58	R4,796,842.16
47	November 2026	R4,796,842.16	R46,969.08	R44,452.63	R4,752,389.53
48	December 2026	R4,752,389.53	R46,533.81	R44,887.89	R4,707,501.64
49	January 2027	R4,707,501.64	R46,094.29	R45,327.42	R4,662,174.22
50	February 2027	R4,662,174.22	R45,650.46	R45,771.25	R4,616,402.97
51	March 2027	R4,616,402.97	R45,202.28	R46,219.43	R4,570,183.54
52	April 2027	R4,570,183.54	R44,749.71	R46,671.99	R4,523,511.55
53	May 2027	R4,523,511.55	R44,292.72	R47,128.99	R4,476,382.56
54	June 2027	R4,476,382.56	R43,831.25	R47,590.46	R4,428,792.10
55	July 2027	R4,428,792.10	R43,365.26	R48,056.45	R4,380,735.65
56	August 2027	R4,380,735.65	R42,894.70	R48,527.00	R4,332,208.65
57	September 2027	R4,332,208.65	R42,419.54	R49,002.16	R4,283,206.48
58	October 2027	R4,283,206.48	R41,939.73	R49,481.98	R4,233,724.51
59	November 2027	R4,233,724.51	R41,455.22	R49,966.49	R4,183,758.02
60	December 2027	R4,183,758.02	R40,965.96	R50,455.74	R4,133,302.28
61	January 2028	R4,133,302.28	R40,471.92	R50,949.79	R4,082,352.49
62	February 2028	R4,082,352.49	R39,973.03	R51,448.67	R4,030,903.82
63	March 2028	R4,030,903.82	R39,469.27	R51,952.44	R3,978,951.38
64	April 2028	R3,978,951.38	R38,960.57	R52,461.14	R3,926,490.24
65	May 2028	R3,926,490.24	R38,446.88	R52,974.82	R3,873,515.42
66	June 2028	R3,873,515.42	R37,928.17	R53,493.53	R3,820,021.88
67	July 2028	R3,820,021.88	R37,404.38	R54,017.33	R3,766,004.56

68	August 2028	R3,766,004.56	R36,875.46	R54,546.24	R3,711,458.31
69	September 2028	R3,711,458.31	R36,341.36	R55,080.34	R3,656,377.97
70	October 2028	R3,656,377.97	R35,802.03	R55,619.67	R3,600,758.30
71	November 2028	R3,600,758.30	R35,257.42	R56,164.28	R3,544,594.02
72	December 2028	R3,544,594.02	R34,707.48	R56,714.22	R3,487,879.79
73	January 2029	R3,487,879.79	R34,152.16	R57,269.55	R3,430,610.24
74	February 2029	R3,430,610.24	R33,591.39	R57,830.31	R3,372,779.93
75	March 2029	R3,372,779.93	R33,025.14	R58,396.57	R3,314,383.36
76	April 2029	R3,314,383.36	R32,453.34	R58,968.37	R3,255,414.99
77	May 2029	R3,255,414.99	R31,875.94	R59,545.77	R3,195,869.22
78	June 2029	R3,195,869.22	R31,292.89	R60,128.82	R3,135,740.40
79	July 2029	R3,135,740.40	R30,704.12	R60,717.58	R3,075,022.82
80	August 2029	R3,075,022.82	R30,109.60	R61,312.11	R3,013,710.71
81	September 2029	R3,013,710.71	R29,509.25	R61,912.46	R2,951,798.26
82	October 2029	R2,951,798.26	R28,903.02	R62,518.68	R2,889,279.58
83	November 2029	R2,889,279.58	R28,290.86	R63,130.84	R2,826,148.73
84	December 2029	R2,826,148.73	R27,672.71	R63,749.00	R2,762,399.73
85	January 2030	R2,762,399.73	R27,048.50	R64,373.21	R2,698,026.52
86	February 2030	R2,698,026.52	R26,418.18	R65,003.53	R2,633,023.00
87	March 2030	R2,633,023.00	R25,781.68	R65,640.02	R2,567,382.97
88	April 2030	R2,567,382.97	R25,138.96	R66,282.75	R2,501,100.22
89	May 2030	R2,501,100.22	R24,489.94	R66,931.77	R2,434,168.46
90	June 2030	R2,434,168.46	R23,834.57	R67,587.14	R2,366,581.32
91	July 2030	R2,366,581.32	R23,172.78	R68,248.93	R2,298,332.39
92	August 2030	R2,298,332.39	R22,504.50	R68,917.20	R2,229,415.19
93	September 2030	R2,229,415.19	R21,829.69	R69,592.02	R2,159,823.17
94	October 2030	R2,159,823.17	R21,148.27	R70,273.44	R2,089,549.73
95	November 2030	R2,089,549.73	R20,460.17	R70,961.53	R2,018,588.20
96	December 2030	R2,018,588.20	R19,765.34	R71,656.36	R1,946,931.84
97	January 2031	R1,946,931.84	R19,063.71	R72,358.00	R1,874,573.84
98	February 2031	R1,874,573.84	R18,355.20	R73,066.50	R1,801,507.34
99	March 2031	R1,801,507.34	R17,639.76	R73,781.95	R1,727,725.39
100	April 2031	R1,727,725.39	R16,917.31	R74,504.40	R1,653,220.99
101	May 2031	R1,653,220.99	R16,187.79	R75,233.92	R1,577,987.08
102	June 2031	R1,577,987.08	R15,451.12	R75,970.58	R1,502,016.49
103	July 2031	R1,502,016.49	R14,707.24	R76,714.46	R1,425,302.03
104	August 2031	R1,425,302.03	R13,956.08	R77,465.62	R1,347,836.41
105	September 2031	R1,347,836.41	R13,197.56	R78,224.14	R1,269,612.27
106	October 2031	R1,269,612.27	R12,431.62	R78,990.09	R1,190,622.18
107	November 2031	R1,190,622.18	R11,658.18	R79,763.53	R1,110,858.65

108	December 2031	R1,110,858.65	R10,877.16	R80,544.55	R1,030,314.10
109	January 2032	R1,030,314.10	R10,088.49	R81,333.21	R948,980.89
110	February 2032	R948,980.89	R9,292.10	R82,129.60	R866,851.29
111	March 2032	R866,851.29	R8,487.92	R82,933.79	R783,917.50
112	April 2032	R783,917.50	R7,675.86	R83,745.85	R700,171.65
113	May 2032	R700,171.65	R6,855.85	R84,565.86	R615,605.79
114	June 2032	R615,605.79	R6,027.81	R85,393.90	R530,211.89
115	July 2032	R530,211.89	R5,191.66	R86,230.05	R443,981.85
116	August 2032	R443,981.85	R4,347.32	R87,074.38	R356,907.46
117	September 2032	R356,907.46	R3,494.72	R87,926.99	R268,980.48
118	October 2032	R268,980.48	R2,633.77	R88,787.94	R180,192.54
119	November 2032	R180,192.54	R1,764.39	R89,657.32	R90,535.22
120	December 2032	R90,535.22	R886.49	R90,535.22	R0.00
			R4,533,791.79	R6,436,812.94	

Annexure 3: Detailed Input Indicators

Input indicators	Unit	Value	Source
Indicators for waste diversion			
Tonnes of garden waste currently sent to landfill per month	Tonnes	120.0	PRC
Cost of garden waste removal service per tonne	Rand/tonne	100.0	PRC
Cost of garden waste removal per skip per month	Rand	2,858.7	PRC
Value of waste removal service for Botanic Gardens per month (garden waste)	**Rands**	**R4,217**	
Value of waste removal service at EMM per month (total)	Rand	R35,026	BSU
Value of waste removal service at EMM per month (food waste)	**Rand**	**R29,471**	
Tonnes of organic (food) waste diverted from landfill per month	Tonnes	27.9	UFC
Tonnes of garden waste diverted from landfill per month	Tonnes	13.6	PRC
Total tonnes of waste diverted from landfill per month	Tonnes	41.5	UFC/PRC
Cost per tonne to landfill waste	Rand/tonne	R1,300	CSW
Value of saving on landfill costs	**Rand**	**R53,939**	
Savings in landfill airspace	Rand/tonne	R474	CSW
Value of saving on airspace costs	**Rand**	**R19,667**	

Input indicators	Unit	Value	Source
External cost of landfilling (2011)	Rand	110.6	Nahman, 2011
Saving of external costs of landfill per month	**Rand**	**R4,589**	
Amount of CO_2e avoided per month	Kilograms	16,596.5	GAIA
Amount of CO_2e avoided per month	Tonnes	16.6	
Carbon Tax	Rand/tonne	144.0	SARS
Value of CO_2e avoided per month	**Rands**	**R2,390**	
Amount of CH4 avoided per month	Kilograms	5,581.3	GAIA
Amount of CH4 avoided per month	Tonnes	5.6	
Parameters for compost production			
Food waste contribution (baseline = 344 tonnes)	Percentage	100.0%	UFC
Brown garden waste contribution as percentage of food waste	Percentage	19.5%	UFC
Green garden waste contribution as percentage of food waste	Percentage	29.2%	UFC
Compost contribution as percentage of food waste	Percentage	36.7%	UFC
Reduction factor (percentage of total organic waste to compost)	Percentage	71.1%	UFC
Value to produce compost (all costs of operations as per operational costs below)	Rand	N/A	N/A
Volume of compost produced per month	Tonnes	36.8	UFC
Volume of compost produced per month (effective total less compost retained)	Tonnes	26.5	
Value to purchase current compost	Rand/cubic metre	R433	PRC
Volumes of compost purchased per month by Botanic Gardens	Cubic metres	3.0	PRC
Value of compost purchase per month (current)	**Rand**	**1,300.0**	PRC
Volumes of compost required per month	Cubic metres	5.0	PRC
Value of compost purchase per month (optimal)	Rand	2,166.7	PRC
Cost of sale per kilogram of compost	Rand/cubic metre	R433	PRC
Total compost produced in cubic metres per month	Cubic metres	64	Lumec
Sale of excess compost	**Rands**	**R25,462**	

Input indicators	Unit	Value	Source
Operational Costs per Month			
Depreciation / recoupment of capital outlays	Rands	As per capital cost requirements	Lumec
Interest repayment	Rands		Lumec
Insurance	Rands	R1,913	PSG
Maintenance (equipment)	Rands	R2,487	Lumec (5%)
Maintenance (building)	Rands	R20,568	Lumec (5%)
Fuel costs	Rands	R12,903	Lumec
Water (variable cost)	Rands	R82	eThekwini
Water (fixed cost)	Rands	R397	eThekwini
PPE	Rands	R375	PRC
Tools and equipment	Rands	R458	PRC
Human Resource Costs			
Supervisor	Rands	R10,000	PRC
Labourer	Rands	R3,780	PRC
Capital costs			
Truck	Rands	R346,957	Lumec
Wood chipper	Rands	R245,000	Tomcat Chippers
Chainsaw	Rands	R5,000	PRC
Construction costs			
Building cost – Scenario 1	Rands	R4,936,413	DUT QS
Professional fees - Scenario 1 (paid over first 2 years)	Rands	R896,453	DUT QS
Building cost - Scenario 2	Rands	R6,436,813	DUT QS
Professional fees - Scenario 2 (paid over first 2 years)	Rands	R1,168,925	DUT QS

Input indicators	Unit	Value	Source
Fuel consumption			
Truck fuel consumption	Litres per 100km	8.5	JAC Motors
Truck kilometres per month	Kilometres	252.0	Lumec
Truck litres used per month	Litres	21.4	Lumec
Truck fuel cost per month	**Rands**	**R520**	Lumec
Chipper fuel consumption	Litres per hour	2.5	Green Corridors
Chipper operational hours per month	Hours	84.0	Lumec
Chipper litres used per month	Litres	210.0	Lumec
Chipper fuel cost per month	**Rands**	**R5,242**	Lumec
Water usage per ton of compost per month	Litres	40.0	Parks
Total water usage per month	Litres	1,660	Lumec
Water usage cost per month	Rands	R82	Lumec
Resource prices			
Average price of diesel per litre	Rands/litre	R24.29	SAPIA
Water cost per kilolitre 2022/2023	Rands/litre	R49.7	eThekwini
Fixed monthly cost 2022/2023	Rands	R396.9	eThekwini
Other assumptions			
Prime lending rate	Percentage	11.75%	SARB
Inflation rate (CPI)	Percentage	4.5%	StatsSA
Discount rate (Real rate of return)	Percentage	6.9%	Lumec
Operational days per month	Days	21.0	Lumec
Cost of maintenance of machinery and buildings (annual)	Percentage	5.0%	Lumec
EMM food waste diversion	Percentage	84.1%	UFC
Time period for present value of money	Years	10.0	Lumec

Annexure 4: Total benefits and costs

Scenario 1	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	Total
EMM saving on waste removal	R353,651	R353,651	R353,651	R353,651	R353,651	R353,651	R353,651	R353,651	R353,651	R353,651	R3,536,505
PRC saving on waste removal	R50,606	R50,606	R50,606	R50,606	R50,606	R50,606	R50,606	R50,606	R50,606	R50,606	R506,059
CSW saving on landfill costs	R647,264	R647,264	R647,264	R647,264	R647,264	R647,264	R647,264	R647,264	R647,264	R647,264	R6,472,640
CSW saving on airspace costs	R236,002	R236,002	R236,002	R236,002	R236,002	R236,002	R236,002	R236,002	R236,002	R236,002	R2,360,024
PRC saving on compost purchase	R15,600	R15,600	R15,600	R15,600	R15,600	R15,600	R15,600	R15,600	R15,600	R15,600	R156,000
Value of CO_2e avoided	R28,679	R28,679	R28,679	R28,679	R28,679	R28,679	R28,679	R28,679	R28,679	R28,679	R286,788
Saving of external costs of landfill	R93,379	R93,379	R93,379	R93,379	R93,379	R93,379	R93,379	R93,379	R93,379	R93,379	R933,791
Sale of excess compost	R305,548	R305,548	R305,548	R305,548	R305,548	R305,548	R305,548	R305,548	R305,548	R305,548	R3,055,476
Total Benefits	**R1,730,728**	**R1,730,728**	**R1,730,728**	**R1,730,728**	**R1,730,728**	**R1,730,728**	**R1,730,728**	**R1,730,728**	**R1,730,728**	**R1,730,728**	**R17,307,283**

Scenario 1	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	Total
Depreciation / recoupment of capital outlays	R119,391	R119,391	R119,391	R119,391	R119,391	R0	R0	R0	R0	R0	R596,957
Interest	R65,228	R53,666	R40,669	R26,061	R9,640	R0	R0	R0	R0	R0	R195,264
Insurance	R22,950	R22,950	R22,950	R22,950	R22,950	R22,950	R22,950	R22,950	R22,950	R22,950	R229,500
Maintenance (equipment)	R29,848	R29,848	R29,848	R29,848	R29,848	R29,848	R29,848	R29,848	R29,848	R29,848	R298,478
Fuel costs	R154,838	R154,838	R154,838	R154,838	R154,838	R154,838	R154,838	R154,838	R154,838	R154,838	R1,548,378
Water (variable cost)	R990	R990	R990	R990	R990	R990	R990	R990	R990	R990	R9,898
Water (fixed cost)	R4,763	R4,763	R4,763	R4,763	R4,763	R4,763	R4,763	R4,763	R4,763	R4,763	R47,628
PPE	R4,500	R4,500	R4,500	R4,500	R4,500	R4,500	R4,500	R4,500	R4,500	R4,500	R45,000
Tools and equipment	R5,500	R5,500	R5,500	R5,500	R5,500	R5,500	R5,500	R5,500	R5,500	R5,500	R55,000
Human resource costs	R256,080	R256,080	R256,080	R256,080	R256,080	R256,080	R256,080	R256,080	R256,080	R256,080	R2,560,800
Total Costs	**R664,088**	**R652,525**	**R639,529**	**R624,920**	**R608,499**	**R479,468**	**R479,468**	**R479,468**	**R479,468**	**R479,468**	**R5,586,903**

Scenario 2	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	Total
EMM saving on waste removal	R353,651	R353,651	R353,651	R353,651	R353,651	R353,651	R353,651	R353,651	R353,651	R353,651	R3,536,505
PRC saving on waste removal	R50,606	R50,606	R50,606	R50,606	R50,606	R50,606	R50,606	R50,606	R50,606	R50,606	R506,059
CSW saving on landfill costs	R647,264	R647,264	R647,264	R647,264	R647,264	R647,264	R647,264	R647,264	R647,264	R647,264	R6,472,640
CSW saving on airspace costs	R236,002	R236,002	R236,002	R236,002	R236,002	R236,002	R236,002	R236,002	R236,002	R236,002	R2,360,024
PRC saving on compost purchase	R15,600	R15,600	R15,600	R15,600	R15,600	R15,600	R15,600	R15,600	R15,600	R15,600	R156,000
Value of CO_2e avoided	R28,679	R28,679	R28,679	R28,679	R28,679	R28,679	R28,679	R28,679	R28,679	R28,679	R286,788
Saving of external costs of landfill	R93,379	R93,379	R93,379	R93,379	R93,379	R93,379	R93,379	R93,379	R93,379	R93,379	R933,791
Sale of excess compost	R305,548	R305,548	R305,548	R305,548	R305,548	R305,548	R305,548	R305,548	R305,548	R305,548	R3,055,476
Total Benefits	**R1,730,728**	**R1,730,728**	**R1,730,728**	**R1,730,728**	**R1,730,728**	**R1,730,728**	**R1,730,728**	**R1,730,728**	**R1,730,728**	**R1,730,728**	**R17,307,283**

Scenario 2	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	Total
Depreciation / recoupment of capital outlays	R218,120	R218,120	R218,120	R218,120	R218,120	R98,728	R98,728	R98,728	R98,728	R98,728	R1,584,239
Interest	R630,715	R584,936	R533,478	R475,638	R410,624	R346,363	R284,966	R215,954	R138,382	R51,188	R3,672,244
Professional fees	R448,226	R448,226	R0.00	R0.00	R0.00	R0.00	R0.00	R0.00	R0.00	R0.00	R896,453
Insurance	R22,950	R22,950	R22,950	R22,950	R22,950	R22,950	R22,950	R22,950	R22,950	R22,950	R229,500
Maintenance (equipment)	R29,848	R29,848	R29,848	R29,848	R29,848	R29,848	R29,848	R29,848	R29,848	R29,848	R298,478
Maintenance (building)	R246,821	R246,821	R246,821	R246,821	R246,821	R246,821	R246,821	R246,821	R246,821	R246,821	R2,468,207
Fuel costs	R154,838	R154,838	R154,838	R154,838	R154,838	R154,838	R154,838	R154,838	R154,838	R154,838	R1,548,378
Water (variable cost)	R990	R990	R990	R990	R990	R990	R990	R990	R990	R990	R9,898
Water (fixed cost)	R4,763	R4,763	R4,763	R4,763	R4,763	R4,763	R4,763	R4,763	R4,763	R4,763	R47,628
PPE	R4,500	R4,500	R4,500	R4,500	R4,500	R4,500	R4,500	R4,500	R4,500	R4,500	R45,000
Tools and equipment	R5,500	R5,500	R5,500	R5,500	R5,500	R5,500	R5,500	R5,500	R5,500	R5,500	R55,000
Human resource costs	R256,080	R256,080	R256,080	R256,080	R256,080	R256,080	R256,080	R256,080	R256,080	R256,080	R2,560,800
Total Costs	**R2,023,349**	**R1,977,570**	**R1,477,887**	**R1,420,047**	**R1,355,032**	**R1,171,380**	**R1,109,983**	**R1,040,971**	**R963,399**	**R876,205**	**R13,415,825**

Scenario 3	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	Total
EMM saving on waste removal	R353,651	R353,651	R353,651	R353,651	R353,651	R353,651	R353,651	R353,651	R353,651	R353,651	R3,536,505
PRC saving on waste removal	R50,606	R50,606	R50,606	R50,606	R50,606	R50,606	R50,606	R50,606	R50,606	R50,606	R506,059
CSW saving on landfill costs	R647,264	R647,264	R647,264	R647,264	R647,264	R647,264	R647,264	R647,264	R647,264	R647,264	R6,472,640
CSW saving on airspace costs	R236,002	R236,002	R236,002	R236,002	R236,002	R236,002	R236,002	R236,002	R236,002	R236,002	R2,360,024
PRC saving on compost purchase	R15,600	R15,600	R15,600	R15,600	R15,600	R15,600	R15,600	R15,600	R15,600	R15,600	R156,000
Value of CO_2 avoided	R28,679	R28,679	R28,679	R28,679	R28,679	R28,679	R28,679	R28,679	R28,679	R28,679	R286,788
Saving of external costs of landfill	R93,379	R93,379	R93,379	R93,379	R93,379	R93,379	R93,379	R93,379	R93,379	R93,379	R933,791
Sale of excess compost	R305,548	R305,548	R305,548	R305,548	R305,548	R305,548	R305,548	R305,548	R305,548	R305,548	R3,055,476
Total Benefits	**R1,730,728**	**R1,730,728**	**R1,730,728**	**R1,730,728**	**R1,730,728**	**R1,730,728**	**R1,730,728**	**R1,730,728**	**R1,730,728**	**R1,730,728**	**R17,307,283**

Scenario 3	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	Total
Depreciation / recoupment of capital outlays	R248,128	R248,128	R248,128	R248,128	R248,128	R128,736	R128,736	R128,736	R128,736	R128,736	R1,884,319
Interest	R802,591	R746,413	R683,265	R612,285	R532,501	R451,638	R371,580	R281,593	R180,443	R66,746	R4,729,056
Professional fees	R584,463	R584,463	R0	R0	R0	R0	R0	R0	R0	R0	R1,168,925
Insurance	R22,950	R22,950	R22,950	R22,950	R22,950	R22,950	R22,950	R22,950	R22,950	R22,950	R229,500
Maintenance (equipment)	R29,848	R29,848	R29,848	R29,848	R29,848	R29,848	R29,848	R29,848	R29,848	R29,848	R298,478
Maintenance (building)	R246,821	R246,821	R246,821	R246,821	R246,821	R246,821	R246,821	R246,821	R246,821	R246,821	R2,468,207
Fuel costs	R154,838	R154,838	R154,838	R154,838	R154,838	R154,838	R154,838	R154,838	R154,838	R154,838	R1,548,378
Water (variable cost)	R990	R990	R990	R990	R990	R990	R990	R990	R990	R990	R9,898
Water (fixed cost)	R4,763	R4,763	R4,763	R4,763	R4,763	R4,763	R4,763	R4,763	R4,763	R4,763	R47,628
PPE	R4,500	R4,500	R4,500	R4,500	R4,500	R4,500	R4,500	R4,500	R4,500	R4,500	R45,000
Tools and equipment	R5,500	R5,500	R5,500	R5,500	R5,500	R5,500	R5,500	R5,500	R5,500	R5,500	R55,000
Human resource costs	R256,080	R256,080	R256,080	R256,080	R256,080	R256,080	R256,080	R256,080	R256,080	R256,080	R2,560,800
Total Costs	**R2,361,471**	**R2,305,292**	**R1,657,682**	**R1,586,702**	**R1,506,918**	**R1,306,663**	**R1,226,606**	**R1,136,618**	**R1,035,468**	**R921,772**	**R15,045,189**

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