MRF – Business Case

"You cannot be on time when you do not know what the time is"

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Foreword

This advice report is written for my dissertation at the University of Applied Science Utrecht. I did research for the Breede River Winelands Municipality to support them in achieving their goals for sustainable way of waste management.

This report could have never been successful without the help of the following people.

I want to thank Breede River Winelands Municipality for giving me the opportunity to work on this project and especially Celeste Matthys and Dirk Steyn for helping me to gather information and receive data, support and feedback.

From the University of Applied Science Utrecht, I want to give thanks to Liesbeth Hoeberichts and particularly Jan Mol for their feedback and guidance during my research.

I want to thank Frits van Aggelen and Joop van Tubergen for their expertise within waste management and giving me feedback and advice for my report.

In addition, I want to express my thanks to Jana Zarembová for visiting and supporting me during my stay in South Africa and reviewing my report.

Last but not least, I want to give thanks to my parents for supporting me during all my abroad activities and making it possible to experience this challenge.

Max Kranendijk

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Management summary

This advice report is a continuation of previous research done by students of the University of Applied Science Utrecht. In 2007, a group of students started to work on a project to improve waste management for the Breede River Winelands Municipality (BRWM). This project was founded due a collaboration of the BRWM with Waste Management South Africa (WaMaSa), an organization which provides information and knowledge for municipalities about waste management.

The BRWM has already received different advice reports with a lot of suggestions and recommendations how to improve the recycle process but there was still no actual plan of dealing with the obtained information. The main objective for this report was to translate all the available information into a real business case including the private enterprise, which will run the Materials Recovery Facility (MRF) in Ashton.

In order to achieve this objective, the following main research question was formed: *What is the most effective way, in order to gain the highest recyclable waste throughput, to run the MRF in Ashton and what consequences will this have for the financial aspects indicated in costs and profits?*

Research was done on previous information and adapted to the current situation, which was checked and discussed with experts within waste management.

The BRWM contains respectively high quality waste, which makes it suitable for recycling. Currently, only 2.5% of the household waste is recycled at the landfill by scavengers. In the following five years, this should be increased to approximately 31%. This increase can be achieved with the introduction of an MRF, which will create 21 new jobs, four transfer stations, the introduction of separating at source and buy-back centres. 26% of the total waste will be recycled by 2013. Currently, the prognosis is that the landfill will reach its limits by the end of 2013. In the year 2011, the MRF should be capable of making profits when separation at source is implemented. The prognosis for the break-even point is when 1505 kg are recovered from the business and household waste. These results are outcomes from calculations done in this research and based on assumptions by experts. Therefore, it is important to recalculate these figures when the MRF is operational and figures can be updated to the actual situation. With updated information, strict targets can be generated and the expectations of the MRF can be verified.

The answer on the main research question is that the MRF needs an accurate monitoring system in order to adapt its process towards the incoming waste and a trial and error process will lead to an efficient separating method within the MRF. This process needs to be continuously measured with the following Key Performance Indicators:

- The recovered recyclables meeting the requirements set by the buyer
- Incoming waste and outgoing recyclables are correctly monitored
- The MRF's use of its full capacity
- Full use of employees capacity
- Incoming waste containing worth full recyclables
- Citizens awareness of recycling

Beside the main research question, there is a second part of this advice report, which concerns the overall process of waste management in the BRWM and the previous research. The previous research struggled with inaccurate data, which resulted in incorrect prognosis. In order to prevent this in the future, data collection is required. The BRWM kept on receiving advice and in the meanwhile no action was taken. Strategies cannot be valuable if they are not based on true facts like the following comparison demonstrates: *"You cannot be on time when you do not know what the time is".* It is not possible to make a valuable decision on unreliable information. Therefore, data collection is essential. Recycling is a business based on *knowledge* and meeting the *quality requirements of the buyer*.

With this advice report, the business case of the MRF is created. It is important for the BRMW to frequently update this business case when more information is available.

Table of content

1. Introduction

In this chapter, the setup of this advice report will be explained. The following subchapters will be described; background information, project definition, objective, problem definition, definitions, restrictions and essential preconditions, research structure and the reader. This will clarify which aspects the focus will be put on, which parts will be omitted and what the results of this advice report will be.

1.1 Background information

The Breede River Winelands Municipality (BRWM) in South Africa is currently working on decreasing the amount of waste. The main reason for this is that the landfill in Ashton is reaching its limits. In order to reduce the amount of waste, the BRWM is building an Materials Recovery Facility[1] (MRF) in Ashton next to the current landfill. This new MRF will improve and extend the amount of recyclables, therefore, the amounts of waste towards the landfill will decrease. According to the prognosis, the MRF should be operating in September. The whole business case is not initiated yet. The main objective is to set up this business case.

Beside this 'practical issue', there is also an environmental reason. The Government of South Africa wants to achieve a zero waste management in 2022 (Polokwane Declaration 2001)[2]. In order to achieve the desired situation, recycling is a must.

In 2007, a group of students from the University of Applied Science Utrecht, started to work for the BRWM. They started with a project to improve waste management for the BRWM. This project was founded due a collaboration of the BRWM with Waste Management South Africa (WaMaSa), an organization which provides information and knowledge for municipalities about waste management. In total four delegations, on the average of five people, have been working approximately for five months on this project. The BRWM received a lot of information and recommendations. For instance, the amount and different kinds of waste were measured. With these calculations, they advised to build a recycle facility in order to increase the amount of waste. The outcome was that a 'clean MRF[3]' would suit the best in the BRWM area.

At the moment, there is no solid plan available for the MRF and furthermore, there are barely financial figures known. This advice report will support the BRWM with a solid and structured plan of a working MRF and will give them the possibility to calculate the operating costs and the amount of waste that can be recycled.

1.2 Project definition

As already mentioned at the 'background information', the BRWM is already working on a waste recycling improvement plan. To give a clear overview of all the existing subparts, the 'Effect Cause Effect' diagram will be used. This model will explain which causes effect this plan. Currently, the whole 'waste recycling improvement project' consists of three main phases. In figure 1, these phases are drawn and explained afterwards.

[1] More information about what an MRF is and how it works can be found in Chapter 2
[2] Appendix I The Polokwane Declaration on Waste Management
[3] Explanation of a clean MRF can be found in chapter 2

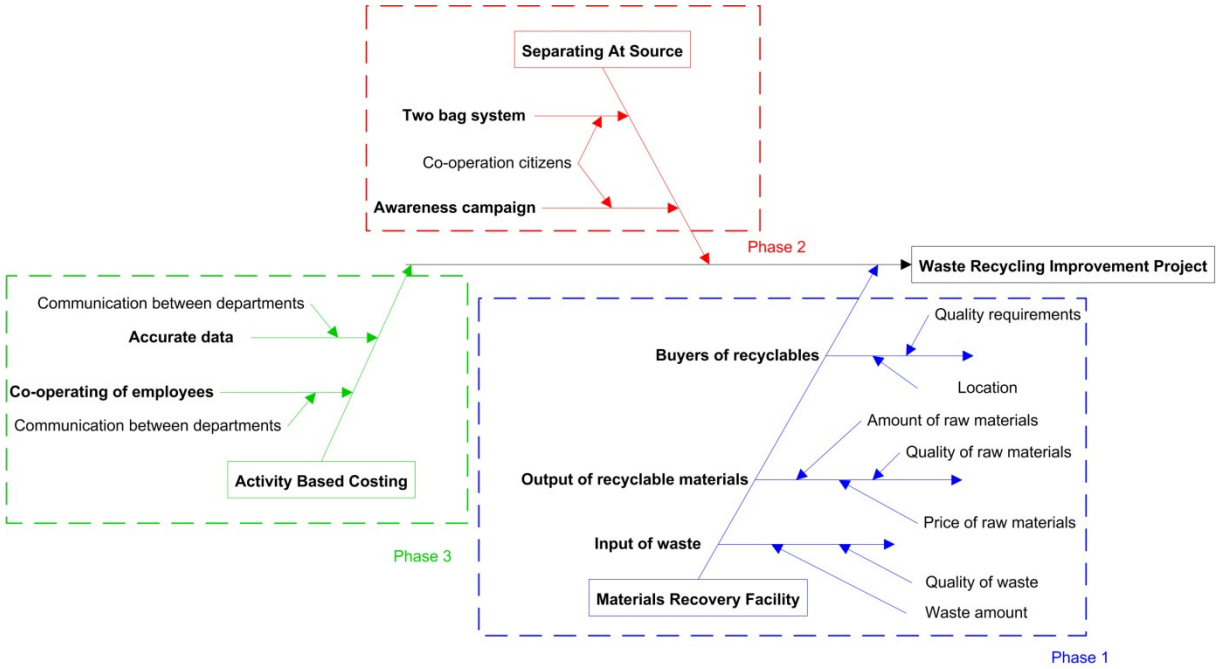


Figure 1: Effect Cause Effect diagram

Phase 1: Materials Recovery Facility

The first phase is the use of a Materials Recovery Facility, a location where it is possible to collect, separate and prepare waste for recyclable use. More detailed information about an MRF can be found in Chapter 2. This MRF will reduce the volume and amount of waste which normally goes to the landfill. It will replace the old situation where pickers[4] took the recyclables out of the landfill. The amounts and the quality of the waste throughput will have the most significant influence on the 'success' of the MRF. This advice report will mainly focus on phase one. All the detailed information about this phase is described further on. In order to operate the MRF efficiently, the quality of the waste input is important. In order to improve the quality of waste, 'separating at source' will be implemented and explained in phase two.

Phase 2: Separating at source

When the MRF starts operating; the BRWM will begin with separating at source in phase two which will be introduced with two methods. In the first one, the citizens will be supplied with two bags; a clear bag for recyclable waste and a black bag for non-recyclable waste. These bags will be provided with flyers which will explain how to use the bags and separate the waste. The second method is an awareness campaign to convince the people to actually recycle. With different kinds of advertisement such as handing out flyers, the BRWM will try to persuade the citizens to start recycling. There will be different plans per area consisting of three main divisions; business waste, household waste high income and low income. A fellow student, Kim Kaak is working on this part.

Phase 3: Activity Based Costing

In phase three, the BRWM wants to start with 'Activity Based Costing'[5]. At the moment, the budgeting of the BRWM is quite limited as there is a desire to have better insight in the information of their exact costs of the different departments. The municipality of Rhenen in the Netherlands has been training the BRWM how to implement Activity Based Costing or a similar way of budgeting. With better insight in the financial information about their departments, the estimation of exact costs and calculation of the fees for waste collection for the citizens can be set.

[4] People who look for recyclables in refuse bags at a dumpsite
[5] A method to allocate costs to products and services

1.3 Objective

The BRWM has already received different advice reports with a lot of suggestions and recommendations how to improve the recycle process but there is still no actual plan of dealing with the obtained information. The main objective for the BRWM is to have clear information about 'how to run the MRF' with all the additional information. To achieve it, the following information will be created:

- Translate all the available information into a real business case including the private enterprise which will run the MRF in Ashton.

In this business case the following points will be included:

- Overview of the costs involved in running the MRF.
- Insight in the information about the profits that can be made by a private entrepreneur.
- Amount of input and output of waste and recyclable materials.
- Systematic Lay-out Planning of the MRF.
- Scenarios on future situations.
- Risk management.

After obtaining all the information, the BRWM will get a better 'picture' of the whole working MRF and will be able to help to run the MRF as effective as possible. Besides, a better insight in the information about the financial consequences can be gained, which will result in making better prognosis for the financial plans in the future and the amount of possible recyclables at the MRF. The objectives which the BRWM sets for the long and short term can be found in section 4.1.

1.4 Problem definition

In the 'Project definition', the different parts are explained which include the entire 'Waste Recycling Improvement Project'. The rest of the report will be focused on the MRF. At the moment, an MRF is being built in Asthon by the BRWM, which will be finished by the end of July 2009. A training, of approximately three weeks, for the employees will follow. Afterwards the MRF will be operational. The operating plan is based on other MRFs, but there is no actual business case. Most of the information is based on estimated figures so far. The main task is to run this MRF as effective as possible, with more workers than in the current situation, in order to create new jobs. There is a complicated balance between effective and efficient in this case; effective in the meaning of high throughput and job creation and efficient in the meaning of operating costs. Nevertheless, the main focus is on waste reducing, which falls under effectiveness. When all issues are combined, the following main research question can be stated:

> ***What is the most effective way, in order to gain the highest recyclable waste throughput, to run the MRF in Ashton and what consequences will this have for the financial aspects indicated in costs and profits?***

In order to give an answer on the main research question, the following four sub questions need be answered:

1. What is an MRF and what are the requirements for the BRWM?

2. What kind and what amount of waste is currently produced?

3. What are the costs and profits of the MRF based on the calculated amounts of waste?

4. How should the MRF be implemented?

The following chapters will answer these sub questions and the main research question will be answered in the conclusion.

1.5 Definitions

In this section, the most important definitions[6] are explained concerning the 'problem definition'.

Business Case: A type of decision-making tool used to determine the effects a particular decision will have on profitability. A business case should show how the decision will alter cash flows over a period of time, and how costs and revenue will change.

Effective: Aiming for result in order to realise a set objective.

Efficient: To achieve a set objective with a minimum use of resources e.g. time or money in relation to the norm.

Throughput: Output relative to input; the amount passing through a system from input to output.

Materials Recovery Facility (MRF): A waste processing facility, accepting deliveries from WCV (Waste Collection Vehicles), as a mixed solid waste stream (otherwise known as residual waste or black bag waste) or from separated (dry) waste in clear bags.

1.6 Restrictions and essential preconditions

Some of the figures used are based on research which was done by previous students, consultants or the BRWM. Due the amount of fixed time available, which is five months, it is not possible to recalculate all the figures. Therefore, there is a possibility that some of the figures will not be entirely accurate. Furthermore, some of the figures might need to be estimated because they are not calculated or measured yet. When this is the case this will be stated and justified.

1.7 Research structure

The research is done in a qualitative way. Most of the information is gained by the previous research and adapted to this advice report as mentioned before. Information is checked and discussed with experts within waste management. In figure 2, the structure of the report is drawn. It illustrates the tools used for research and the route towards the end of this advice report. This model is based on an approach used by change management[7].

[6] Based on definitions from online sources which can be found in the references
[7] Kleijn, H. and Rorink, F. (2005), *Verander-management*, Amsterdam: Pearson Education Benelux bv

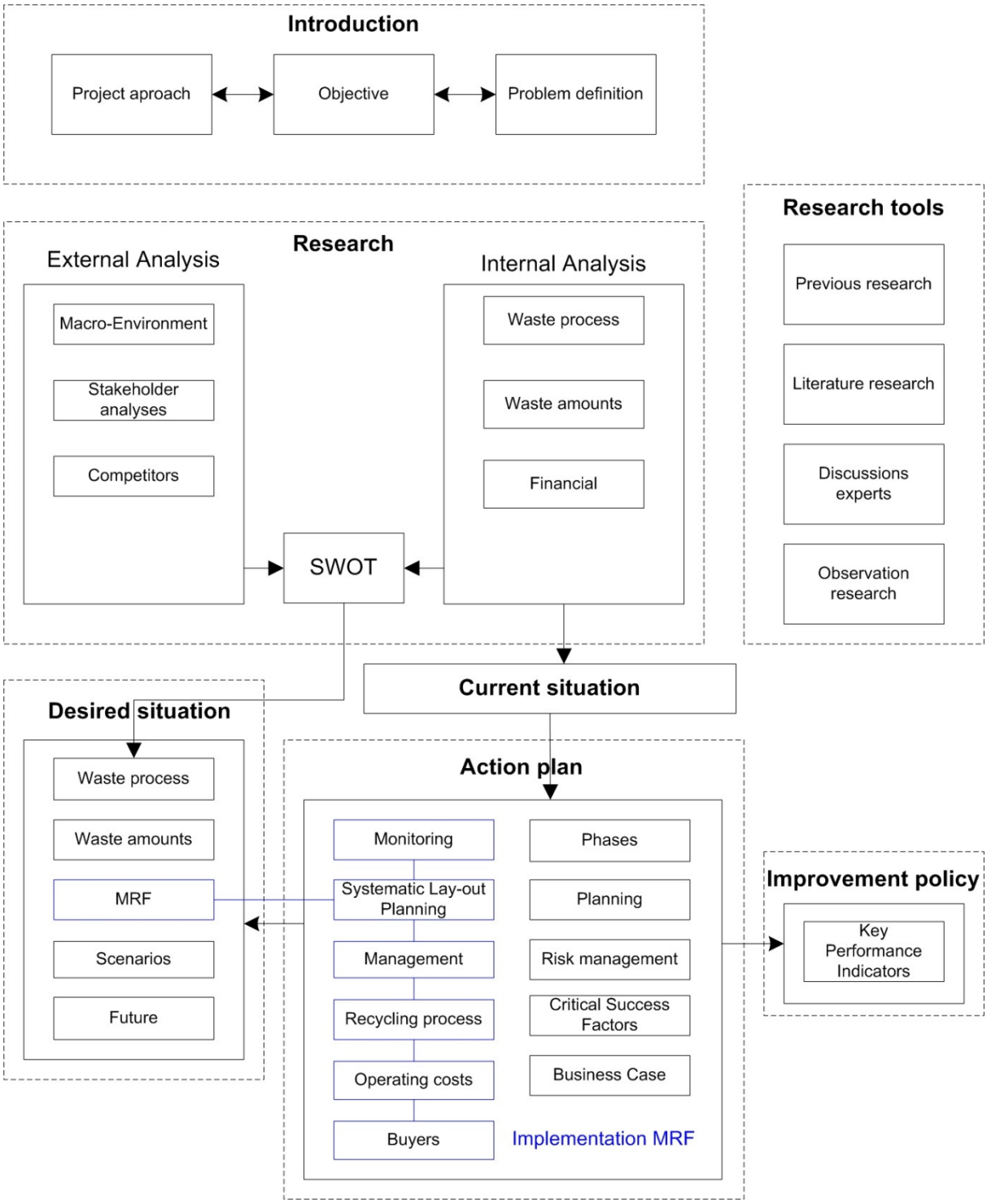


Figure 2: Research structure

1.8 Reader

In the first chapter, the introduction of the report is described. Chapter two explains what an MRF is and which different types there are. In chapter three, the current situation of waste management in the BRWM is explained. Chapter four describes the desired situation of waste management in the BRWM including the predicted waste amounts and future predictions. In chapter five, the action plan is given how to get to the desired situation and is especially focussed on the MRF. Chapter six discusses the conclusions about this research and recommendations are given for the future.

2. Materials Recovery Facility (MRF)

A Materials Recovery Facility is a location where the recyclable materials are collected, separated and prepared for use of the intermediate trader or end consumer. MRFs can be high and low technology facilities; depending on the use of machines, equipment and amount of employees. Within MRFs there are different separating methods used. Separating can be done (semi) automatically and/or manually; depending on the type of incoming waste and requirements of the buyer, a waste method is chosen for recycling. There are two different types of MRFs, a dirty MRF and a clean MRF. The differences are explained in the next sections. The basic procedure of an MRF is drawn in figure 3.

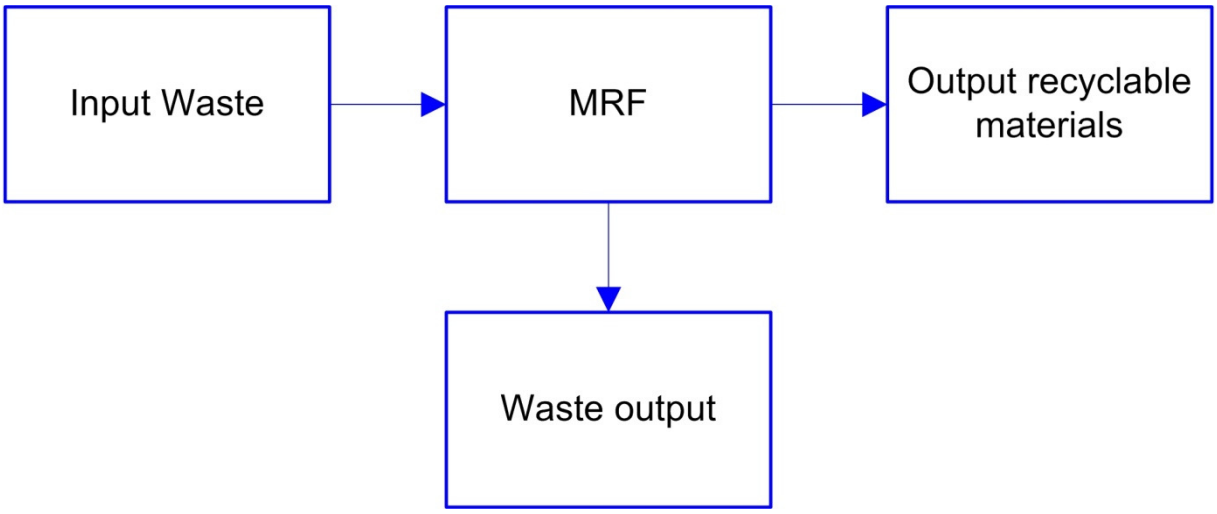


Figure 3: Procedure of MRF

2.1 Dirty MRF

A dirty MRF means that the amount of waste towards the MRF is unsorted. Meaning that all the waste is mixed together (also called residual waste). These are mostly the black household bags, which are collected and then sent straight to the MRF. A dirty MRF is a basic way to separate waste and mostly manually managed in South Africa, which means that people open the bags with their hands or other equipment and just sort out the recyclables in different containers before they get baled. Because the waste is mixed, possible recyclables get wet and unsuitable for recycling. In the Western countries, an amount of waste is also used for biological treatment. So far, this is not possible for the BRWM, therefore, no detailed report about this technology will be provided.

A dirty MRF with only manual sorting recovers around 5 – 15% of the amount of incoming waste. With more advanced technology, the percentage can be more than 70%. This depends of course on the quality of the incoming waste and the required quality of the recycled waste components.

The following features are applicable for a dirty MRF, which is mostly used in South Africa with only manual sorting.

Strengths	**Weakness**
Extract additional recyclables from residual waste streams	Low quality of recyclable output
Lower capital costs	Dirty work environment
Potential work opportunities	Potential dust

2.2 Clean MRF

Basically, the main difference between a dirty and a clean MRF is that the household waste input is separated at source to receive ‘dry waste’. Recyclable materials are put in a clear bag and usually separated from the other waste, which is located in black bags. A Clean MRF is mostly (semi) automatically managed, which means the waste is carried over a conveyer belt and separated by machines or by hand. There are a lot of advanced machines to separate waste automatically, but the

BRWM does not have the resources to invest in such machines which are used in big recycle companies in the Western countries. Therefore, no detailed analysis about these kinds of machines and methods will follow. Besides that, the amounts and quality of the waste is not high enough to make such an advanced method profitable.

A clean MRF recovers around 80 – 97% of the amount of incoming waste. This high rate is generated because almost all the incoming waste is recyclable as a result of the separating at source. Differences in the amount of percentage are still there because of the participation level of the citizens to separate their waste and the accuracy of the MRF recycling process. The non-recyclables go directly to the landfill.

Strengths	**Weakness**
Efficient waste process	Profit more independent of raw material prices
High quality of recyclable output	Storage risks (e.g. fire and theft)
Potential work opportunities	

2.3 Requirements BRWM

The MRF in Ashton will be built on the requirements of a combination of a clean and dirty MRF, due the future implementation of separation at source. After the introduction of the MRF, only mixed waste will be separated. During the years, separation at source will be implemented. At that time, mixed waste from profitable areas and separated waste will be handled. The MRF will change at the same time from a dirty MRF towards a clean MRF, where only separated waste will be sorted and will recycle household and business waste.

3. Current Situation

In this chapter, the current situation of waste management in the BRWM is described, what the waste amounts are, what kind of recycling there is at the moment and an overview of the costs is given. The focus is aimed on recycling. A more detailed analysis about the BRWM itself is done by Kim Kaak and can be found in *Skoon en netjies hergebruik, A guide to social and organisational change for recycling (Kaak, K. 2009)*.

3.1 Internal analysis

In this section, the situation of waste management within the BRWM is described. The situation of waste collection and handling is explained and figures about amounts, composition and recycling will be mentioned.

3.1.1 Waste collection

The BRWM consists of five different towns: Ashton, Robertson, Bonnievale, McGregor and Montagu including rural areas. All the produced waste goes to one landfill in Ashton. Figure 4 presents an overview of different waste types, the destination of the waste and the way of handling.

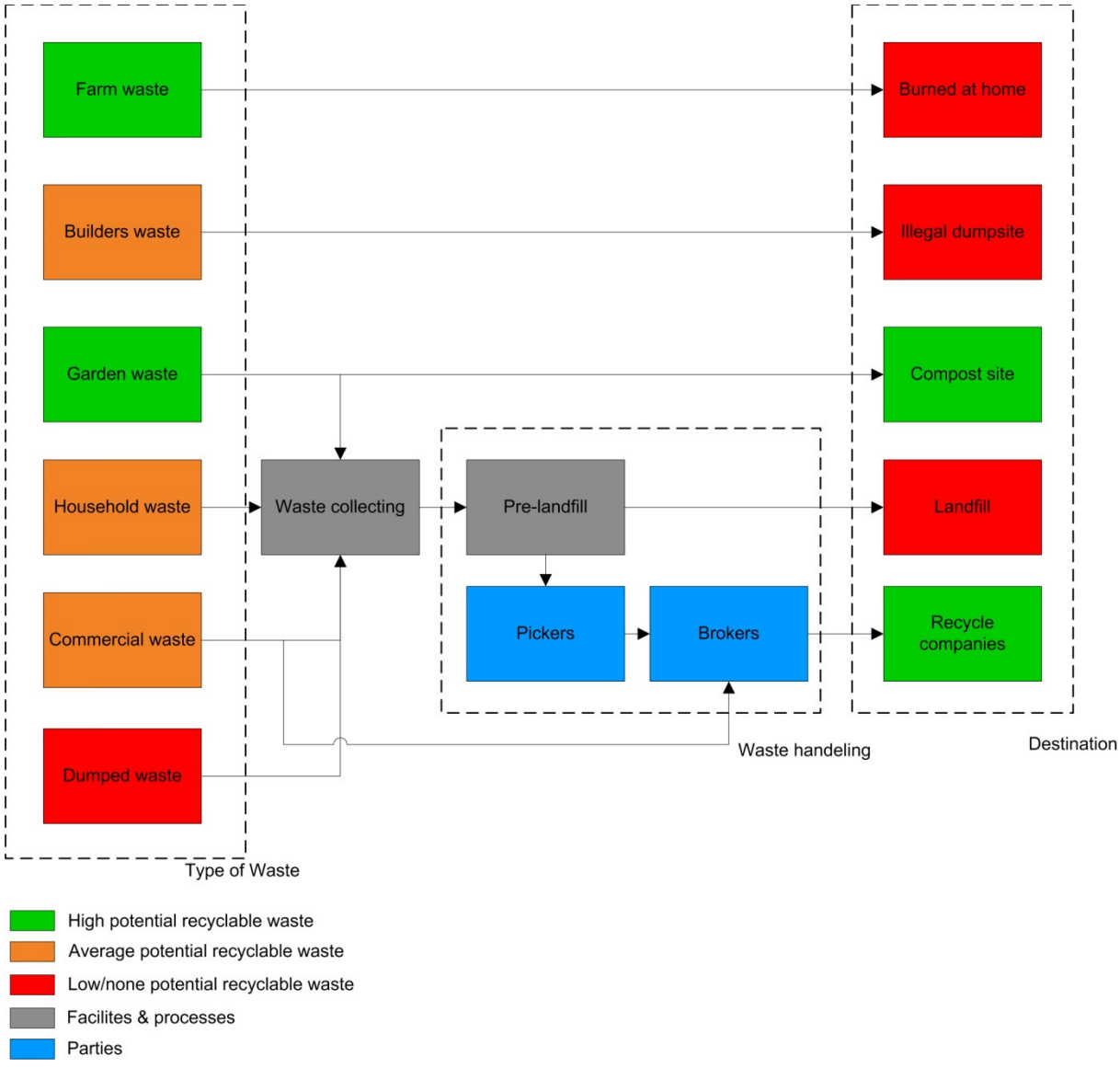


Figure 4: Waste collection current situation

Different types of waste:

- (Wine)Farm waste - burning own waste on the fields.
- Builders waste - dumping at allocated dumpsites, which is in fact illegal but tolerated by the BRWM because there are no suitable places yet.
- Garden waste - brought to the compost site in Robertson or mixed with the household waste.
- Household waste - collected by the BRWM and brought to the pre-landfill.
- Commercial waste - collected by the BRWM and brokers collect the recyclables themselves.
- Dumped waste - collected by the BRWM and brought to the pre-landfill.

Waste handling:

- Pre-landfill is an area at the landfill where the collected bags are unloaded.
- Pickers are the people who look for recyclables in refuse bags at a dumpsite and sell it then to the brokers or they work for a broker on salary base.
- Brokers are the people who buy recyclables from pickers and collect from companies. They sell the recyclables to recycle companies.

Destination:

- Burned at home: (wine)farms burn the waste at the fields, which is officially not allowed but tolerated by the BRWM.
- Illegal dumpsite: these are allocated places by the municipality in each town, where builders' rubble is dumped.
- Compost site: farms and citizens bring the green waste to the composting site at Robertson.
- Landfill: After the pickers looked through the waste bags, the waste is brought to the landfill.
- Recycle companies: Companies which buy the recyclables gained from the MRF.

3.1.2 Waste amounts

At the moment, there is a waste production in the BRWM of 110 ton[8] per working day. This is an amount of 29040 (110 * 22 * 12) tons per year. The previous research (Grooten, D., ed al, A, *Waste problem or opportunity*, 2008) was done about the composition of the waste in BRWM and the waste producers were divided in three different categories:

Low income (25%)
High income (45%)
Commercial (30%)

These categories are based on the producers of waste and their origin and divided according to their quality and composition of waste.

A sample was done of approximately 384 kg per category over the five different towns in the BRWM. In total there was a sample of 1152 kg. These samples gave the following result, which is shown in table 1.

[8] Based on an interview, 24 April 2009 with Dirk Steyn, project supervisor and manager of Environmental Services (west) of the BRWM

Recyclable	Low income	High income	Commercial	Total %	Total KG
White paper	1,44%	1,54%	3,63%	2,14%	2356,20
Common mix	3,00%	4,02%	5,52%	4,22%	4636,50
Cardboard	2,09%	2,01%	3,63%	2,52%	2767,60
Newspaper	2,74%	2,24%	2,33%	2,39%	2631,20
Magazines	0,39%	0,47%	0,73%	0,53%	580,80
Glass	5,87%	9,09%	10,32%	8,65%	9519,40
HDPE	3,79%	3,66%	3,49%	3,64%	4005,65
LDPE	4,05%	3,19%	3,20%	3,41%	3748,80
PS	1,04%	0,83%	1,45%	1,07%	1175,35
PET	2,88%	3,54%	2,48%	3,06%	3362,70
Metal	4,18%	5,43%	5,09%	5,02%	5517,05
Green waste	3,26%	11,93%	10,32%	9,28%	10207,45
Electronic waste	0,13%	0,09%	0,12%	0,11%	119,90
Non recyclable	65,14%	51,96%	47,69%	53,97%	59371,40
	100,00%	100,00%	100,00%	100,00%	110000,00

Table 1: Composition of waste

This leads to a recyclable amount which is shown in table 2.

Amount of total waste	Percentage	Weight in KG
Recyclable	46,03%	50628,60
Non-Recyclable	53,97%	59371,40

Table 2: Amount of recyclable waste

The amounts shown in table 1 are going to the landfill at the moment and get checked by the pickers. There is also an amount of recyclables taken out by the brokers before the waste is collected by the BRWM. Brokers collect around 2 tons of recyclable material per day, which is an amount of 1320 (2*22*12) tons per year. Samples were taken of waste which is already checked by brokers. Therefore, the actual amount of recyclable (commercial) waste is even higher because the brokers collect mainly from commercial waste.

3.1.3 Waste recycling

The waste collection is already described in section 3.3.1. In this section, the focus will be put on the recycling part, how that is done at the moment. The brokers are the only ones who sell recyclables to the recycle companies. The BRWM just collects the waste and brings it to the landfill. Pickers try to find recyclables in the unloaded black bags at the pre-landfill and sell them to the brokers. Beside these recyclables from the pickers, they collect recyclables at companies themselves and in some cases from schools, households and farms.

In this situation, it is really difficult to have accurate figures about the percentage of recycling. At the moment, it is assumed that an amount of 2,5 % is recovered from the waste amount by the pickers. This assumption is based on experience which Dirk Steyn[9] has within the business.

3.1.4 Landfill

In table 3, there is an overview of the generated waste per year, the amount which is reduced by the pickers and the total amount of waste which goes to the landfill.

[9] Dirk Steyn, project supervisor and manager of Environmental Services (west) of the BRWM

Waste group	Produced (ton)	Reduced by pickers (ton)	Total to landfill (ton)
Household/Business waste (59%)	*17028*	*724*	16304
Low income (25%)	*4257*	426	3831
High income (45%)	*7663*	106	7556
Business waste (30%)	*5108*	192	4917
Garden waste (25%)	7260	0	7260
Abattoir waste (9%)	2752	0	2752
Builders waste (7%)	2000	0	2000
Total	**29040**	**724**	**28316**

Table 3: Waste amount per year to the landfill

3.1.5 Financial analysis

At the moment, the costs in environmental services are separated in the following categories:

- Waste collection
- Cleaning of the streets
- Waste treatments
- Pest control
- Waste policies

Since the BRWM does not use ABC costing or any other method to allocate the costs to the activities, they do not know exactly how much everything costs. The previous research (Grooten, D., ed al, *Waste problem or opportunity*, 2008) demonstrates a balance for the environmental services 2007-2008, which is illustrated in figure 5.

Actual balance budget 2007-2008 of Environmental Services

Cost	Rand	Benefits	Rand
Salaries	4.984.214,74	**Dumping at landfill site**	507.841,77
Repairs	856.068,39	**Collection fees**	9.937.312,47
Capital costs	12.152,67	**Sold Compost**	79.512,84
Contribution to funds	828.349,03	**Dumping at compost site**	1.068,53
General cost:		**Subsidy IOT PA West Cape**	1.250.012,14
Fuel and oils	1.030.306,36		
Machinery rent	21.003,95	**Other benefits**	10.840,45
Composting activities	72.641,37		
Rehabilitation	289.070,50		
Security utilities	97.593,10		
Waste bins	11.106,80		
Black bags	263.267,01		
Depreciation	1.143.686,62		
Other costs	351.630,65		
Subtotal	**9.961.091,19**	**Subtotal**	**11.786.588,20**
Surplus	1.825.497,01		
Total	**11.786.588,20**	**Total**	**11.786.588,20**

Figure 5: Actual balance budget 2007-2008 of Environmental Services

Every year, the BRWM receives a budget based on last year's budget. This budget needs to be spent the next year completely. Therefore, it is not possible to save money for a big purchase. Currently, big investments are done by financing in phases. Using this method often causes delays.

Stating the exact costs will be a research on itself and in consultation with Frits van Aggelen[10] it is decided to omit this part. The BRWM will implement ABC in the near future, which forces them to start allocating their costs. As said before, this will be done in cooperation with the municipality of Rhenen, The Netherlands.

[10] Owner and founder of WaMaSa and this waste project

3.2 External Analysis

In this section, the outside influences on waste management for the BRWM will be described. It will be clarified which parties and factors influence the waste management process out of the capabilities of the BRWM.

3.2.1 Stakeholder analysis

A 'stakeholder analysis' is used to identify the groups and individuals, who are likely to be affected by the activities or project, in this case waste management. With a power/interest matrix, it is possible to classify the stakeholders' relation to the power they hold and the extent to which they are likely to show their interest to the strategies of the organisation.

Table 4 shows an overview of the most important stakeholders within the BRWM waste management. These groups are selected from a previous stakeholder analysis[11] and now combined in a power/interest matrix that can be found in figure 6.

Stakeholders	**Expectations**	
	Power	**Interest**
Abattoirs	- Rules set by BRWM	- Awaiting recycling opportunities
Low income citizens	- Low quality of waste	- No priority for a clean environment
Pickers	- Licence and opportunity to collect in hands of BRWM	- Recyclables collecting is their income
Brokers	- Opportunity to collect in hands of BRWM	- Recyclables collecting is their income
Wineries	- Waste has low value	- Awaiting for new opportunities of waste treatment
High income citizens	- High quality of waste - Responsible for success separating at source	- Awareness of a clean environment
Businesses	- High quality of waste	- Recycling is profitable/ discount for fees
Government	- Forces BRWM to recycle (Polokwane Declaration)	- Not interested in the method, only in the objectives
Buyers	- Price of raw materials control amount and what to recycle	- As long as they get enough recyclables of required quality
BRWM management	- Control waste management	- Clean environment - Achieve objectives

Table 4: Stakeholder analysis

[11] Gvozdenovic, E., Giacobbi, A., Smeets, N., *Stakeholder analyse, 2008*

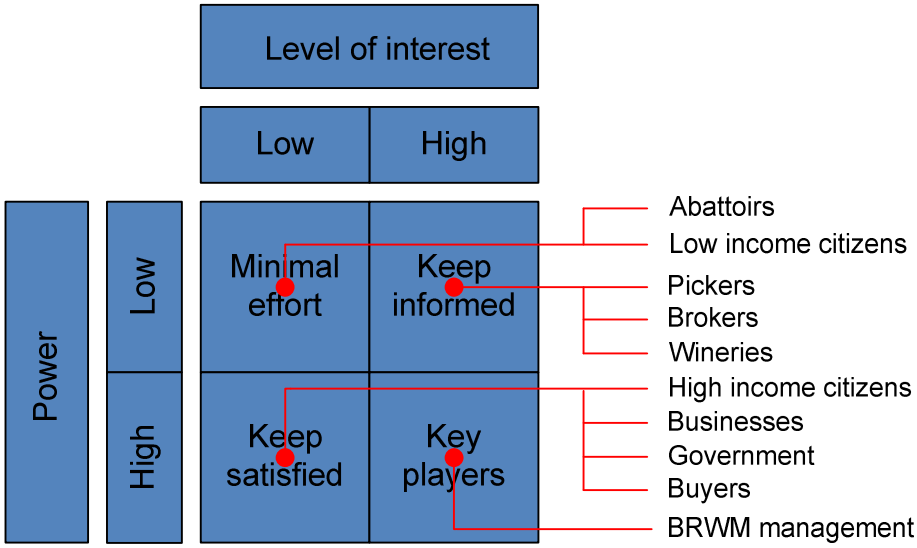


Figure 6: Stakeholder power/interest matrix

Interests are mainly driven by financial reasons or visual benefits. Parties are interested in waste recycling when it is beneficial for them. For the higher income areas for example, visible results of a cleaner environment are a good trigger to persuade them to separate their waste. They want to know what will happen with their separated waste and what benefits it has in terms of figures of reduced waste towards the landfill. These are all facts used for the awareness campaign.

On the other hand, the 'power side' is driven by the producers of quality waste and the parties which buy the recyclables. At the moment, only recyclables with value are collected. In the future, a structuralized procedure and recycling as much as possible is desired. How to trigger the stakeholders is described in detail in *Skoon en netjies hergebruik, A guide to social and organisational change for recycling (*Kaak, K., (2009).

3.2.2 PESTEL

A 'PESTEL model' is used to analyse which factors in the macro-environment affect the managers decisions within an organization. This model divides the factors in six different groups. In figure 7, the six groups are described and the way of their influence to the competitive force is explained. In general, there is not a lot of entrepreneurial thinking in a municipality, but these factors help to make the right decisions and make the BRWM aware of possible influences and changes of waste recycling in the future.

Figure 7: PESTEL model

Political factors

The Polokwane Declaration on Waste Management means a reduction of respectively 25% to 50% of waste generation and disposal and a plan for zero waste by 2022. These targets force the BRWM to start recycling. In the future, there might be new targets or desirables pushed by the government, which will force the BRWM to adapt their waste management procedure.

Recycling is a major topic worldwide. There is more pressure from the Western world to start or improve this process. In South Africa there are special funds and initiatives to help municipalities with recycling. For example, they have the 'cleanest town' competition in the Western Cape. The winner gets rewarded with a grant.

Economic factors

Economic factors mainly influence the amount of waste. If the economic situation is better, people will buy more luxurious goods and food, which go together with more waste.

The economic situation also affects the price of raw materials. In bad times, the prices will go down which makes it sometimes unprofitable to recycle some of the materials. This is an issue of last year when the prices of raw materials dropped.

The financial crisis is a hot topic. Expectations were that production and consumption will reduce, but so far the waste amount is still increasing. Nowadays, the waste generation is growing with an amount of 7 % in the Western Cape[12].

Social factors:

Social factors have a big influence on waste management. If people do not support recycling, there is no way to start with it. It is important to convince people to start to recycle and explain the benefits of it. At the moment, there is a lot of illegal dumping because of the economic reasons and the social ones as well. If people barely have enough money to live, there is obviously no desire to recycle for them. This is the reason of a need for specific awareness.

[12] Based on an interview with Bertie Laurens (Appendix V)

Another important factor is the demographic growth, shown in table 5. At the moment, there is a stable population growth projected[13]. The growth of population will lead mostly in a growth of produced waste as well.

Category	2005	2010	2015
High income, low density	3113	4829	6313
Middle income, middle density	14814	21085	29331
Low income, high density	57824	78126	86477
Informal and traditional settlements	5520	6883	7668

Table 5: Projected population and growth estimate

Technological factors:
If the amounts and quality of waste increase, it might be profitable to use more advanced machines to get more recyclable materials out of the waste. There are a lot of improvement opportunities in the future, but in this state the BRWM is not ready for it. Currently, the amounts of produced waste is too little to invest in more advanced machines. When the recycling process is successfully operating, a new research about new ways of recycling can be done.

Beside the efficient and money issue, there is also a social issue. New technologies mean that people might be replaced for machines and lose their jobs. Innovation has to be done with three important factors; increase recyclable amount, increase efficiency and job creation.

Environmental factors:
The BRWM is located in a tourist wine area. In order to keep tourism, a clean environment is important. Illegal dumping and dirty streets have a bad influence for the tourism sector.

Environment is a big issue worldwide, as said before with political factors, there is a pressure from outside Africa.

Legal factors:
At the moment, there are some illegal activities concerning the waste treatment. For instance, illegal dumping and abattoir waste dumping on prohibited places and unhealthy working conditions. Today, this is still tolerated, but in the future these activities need to be prevented and dealt with.

Nowadays, a big issue is the working conditions of the pickers on the landfill. They do not correspond with the 'Basic conditions of employment'[14] according to the safety regulations. If the pickers start working for the MRF, these facts need to be taken into consideration.

Key drivers for change
Key drivers for change are the factors which have the biggest influence on the BRWM for waste management. It forces the BRWM to adapt their decisions to the changing environment. At the moment, the key drivers for change are the influences from political issues. The BRWM has to start recycling to reduce the amount of waste to meet their set of objectives for the future.

Summarizing this section, there are a lot of parties involved positively, some more than others with the improvement of waste management. The main issue is how to satisfy all these parties with the available budget .There are two groups of drivers which force recycling; one group by law jurisdiction and set targets for the future (Polokwane Declaration) and the second group in needs of a cleaner environment and/or financial benefits. A successful strategy satisfies these parties within the capabilities of the BRWM.

[13] Integrated solid waste management plan, MBB CONSULTING SERVICES (SOUTH) (PTY) LTD Stellenbosch, 2006
[14] http://www.labour.gov.za/legislation/acts/basic-conditions-of-employment/basic-conditions-of-employment-act-and-amendments

3.2.3 Comparable waste management

In this section, waste treatments comparable with the new plans for the BRWM situation will be discussed to acquire data about their experience. The first one is the MRF in Malmesbury[15]. One of the oldest MRFs in the Western Cape and a good example for BRWM because of the experience they have. The MRF is owned by a private entrepreneur. A conveyor belt is used for separating, which is shown in illustration 1. Only waste from high income areas is going through this MRF. Waste from low income areas is not profitable enough. The MRF is not profitable and the main purpose is landfill airspace saving and job creation. In the list below, the main facts about this MRF are summarized, more detailed information can be found in appendix V.

Illustration 1: Conveyor belt in MRF Malmesbury

Malmesbury MRF facts:

- Input of 70 tons per day (2400 per month)
- 33% in volume of landfill airspace saving
- 23 employees in total
- 9 females at the conveyor belt
- Separated materials:
  - Tins
  - Paper (mixed, news and office)
  - Metal
  - Plastics (HDPE, DLPE, PS, PET)
  - Glass

Illustation 2: MRF with manual separating

The second situation is the transfer station in Hermanus[16] with an MRF next to it, which is privately owned as well. It is the most successful transfer station in the Western Cape. Hermanus won already prizes for the cleanest town, due successfully operating waste treatment. Besides that, it is a famous tourist place which has a big budget for their waste management. It is one of the towns which has been using separating at source already for a few years and put a lot of effort in the awareness of the citizens. Waste is separated in clear bags for recyclables and non-recyclables in black bags.

For the lower incomes they use 'Swop Shops', people can exchange recyclables for toothpaste, toilet paper etc. Non-separated waste is brought to the transfer station and then moved to the MRF where the waste is separated manually which is shown in illustration 2. Separated waste from clear bags goes directly to the MRF. After the recyclables are separated, they get baled and stored for transport. Baled recyclables are shown in illustration 3.

Illustration 3: Example of baled recyclables

[15] Detailed information can be found in appendix V Minutes MRF Malmesbury, Swartland
[16] Detailed information can be found in appendix V Minutes Hermanus Transfer Station and MRF

3.3 SWOT analysis

A 'SWOT analysis' is a tool which helps to indentify the strengths, weaknesses, opportunities, and threats of a company. Strengths and weaknesses are internal factors (section 3.1), which create or destroy value and opportunities and threats are external factors (section 3.2), which create or destroy value. Combining these factors, four different strategies can be created in a 'confrontation matrix', which is shown in figure 8. These strategies are:

- Attack; strengths used to utilize a specific opportunity.
- Defend; strengths used to fend off a specific threat.
- Strengthen; improve threats to utilize a specific opportunity.
- Neutralize; improve threats to neutralize a specific threat.

In this case, this tool will be used to identify the 'features' of waste management in the BRWM and mainly focus on the introduction of the MRF.

		External	
		Opportunities • Organic waste separation • Abattoir waste recycling • Waste amount is increasing • Glass bins • Subsidy • Innovation projects	**Threats** • Decrease price of raw materials • Increase of transport costs • Brokers • New strict environmental rules • Theft
Internal	**Strengths** • High quality of waste • Support Rhenen municipality • Low waste taxes • Cleanest town award	**SO strategy (attack)** • MRF operational as soon as possible • Start separating at source when MRF is operational	**ST strategy (defend)** • Increase storage and sell amounts in bigger lots • Legislation on permits for controlled collection recyclables
	Weaknesses • Dependent of cooperation of citizens • Far distance from Cape Town • Low budget • Inaccurate data	**WO strategy (strengthen)** • Research new recycle opportunities within BRWM • Awareness campaign • Acquire waste data	**WT strategy (neutralize)** • Research for reuse of recyclables within the area • Acquire new landfill space

Figure 8: Confrontation matrix

Currently, the BRWM is performing the 'SO strategy', implementing an MRF which is almost finished and then separating at source will be introduced. This strategy needs to be supported with the 'WO strategy' to strengthen the internal weaknesses for improvement of the success of the MRF.

The 'ST strategy' and 'WT strategy' will be applicable when the MRF does not meet its expectations because set targets are not achieved or when the MRF is unprofitable in terms operating costs or benefits.

The BRWM is forced to act as soon as possible to start recycling, which is currently happening with introducing the MRF. However, it is important to strengthen the internal weaknesses, only then the MRF can be successful. Concluding, this results in performing the 'SO strategy' in combination with the 'WO strategy'.

4. Desired Situation

This chapter elaborates on the explanation of what the desired situation should look like for waste management in the BRWM within five years time and what kind of consequences this will have for the amounts of waste, costs and utilisation of the MRF. The desired situation is adapted to the current available information, based on an earlier research called 'Integrated solid waste management plan' (IWMP)[17]. A lot of plans are depending on each other, as a result of that there are a lot of fluctuations in the desired situation. E.g. separating at source can only be introduced when the MRF is operational. Besides, a scenario is worked out to create a prognosis for the future concerning waste amounts.

4.1 Objectives

In March 2001, the BRWM Council hired external consultants to investigate waste minimization facilities to serve the greater 'BRWM area' as well as the drafting of the IWMP in compliance with the National Waste Management Strategy (NWMS)[18].

Based on this research, the BRWM has set the following objectives for the next 10 years divided in short term and long term:

Short term objectives (0-5 years)

- Finishing the construction of the MRF and make it operative.
- Identification of a new landfill site and development of such site need to be concluded in order for the new site to be ready to receive waste when the Ashton site is closed.
- Construction of transfer stations, except in Bonnievale; where the new landfill will be placed.

Long term objectives (5-10 years)

- 95 % of the green waste is recycled
- 40 % of all waste is recovered or recycled
- 40 % of the citizens cooperate with separating at source

With the introduction of the MRF a more organised recycling process will be set up.

4.2 Waste collection process

The main objective for the municipality is to increase the amount of recyclables and to decrease the amount of waste towards the landfill. Two things are needed for that, separated waste at source and a facility to sort out the recyclables. The new situation is drawn in two figures because the waste streams are divided into a business and household waste. This is done to keep the drawing better organized.

[17] Integrated solid waste management plan, 2006, MBB CONSULTING SERVICES (SOUTH) (PTY) LTD Stellenbosch
[18] Appendix II National Waste Management Strategy

4.2.1 Business waste collection

In figure 9, it is shown how the business waste is collected and handled. On the next page the descriptions of the parties and facilities are described.

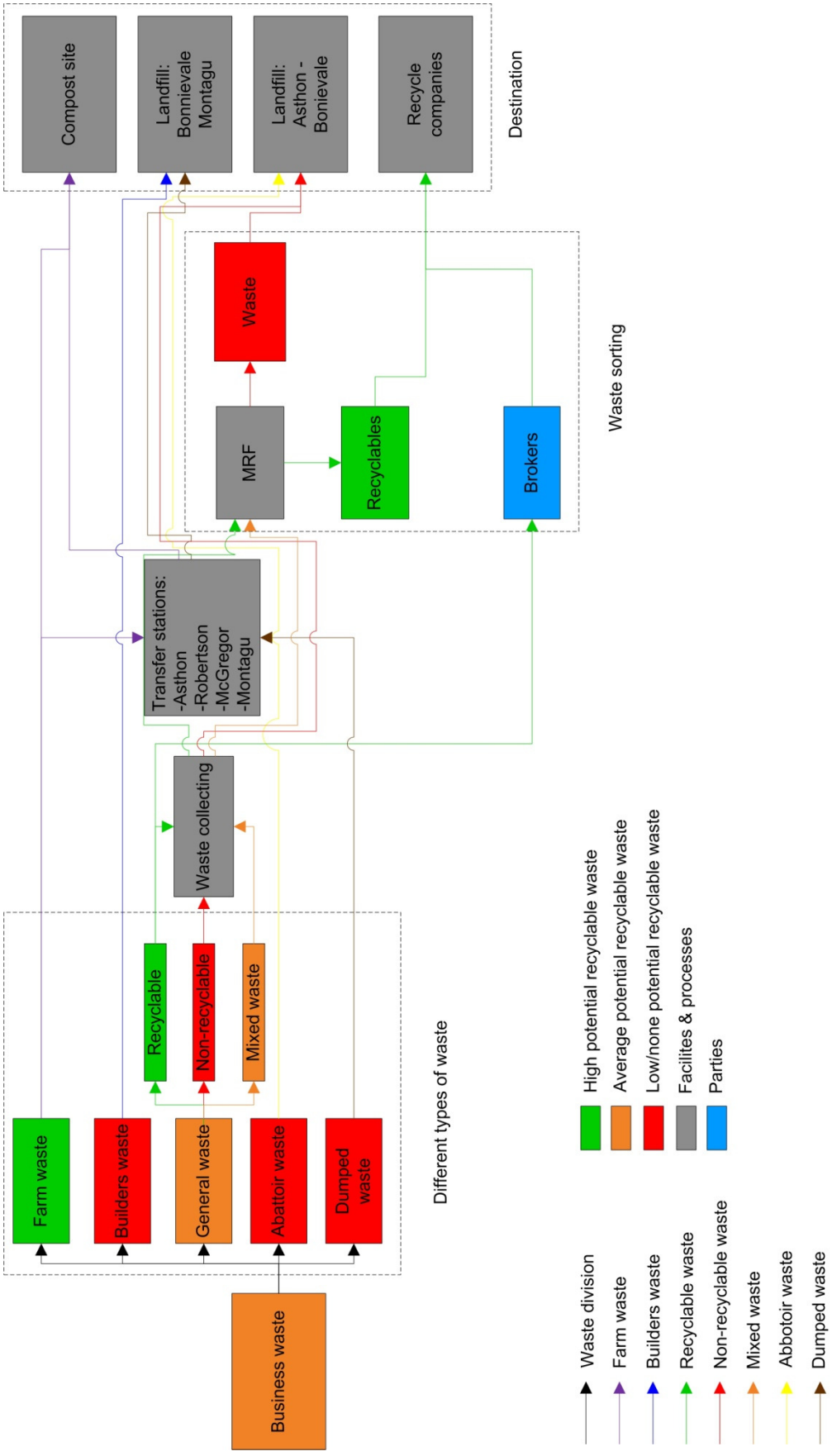


Figure 9: Business waste collection desired situation

Business waste:

- (Wine)Farm waste: waste is brought to the composting site by themselves or via a transfer station.
- Builders waste: In order to fill up two old landfills, builders waste is put on the layer of the landfills in Bonnievale and Montagu. There is also a 'big hole' in Robertson in a remote area which causes problems during heavy rain. This will be filled as well. After that all the waste will go to the new landfill set between Bonnievale and Ashton.
- Garden waste: is brought to the compost site in Robertson or via a transfer station.
- Abattoir waste: is brought directly to the landfill.
- Dumped waste: illegal dumped waste is collected and brought to the landfill

Facilities:

- Transfer station: A facility where waste is stored temporarily to make it ready for transport to the MRF or landfill. In the BRWM situation is waste per town and surroundings collected and brought to the different transfer stations. Transfer stations are built in Ashton, Robertson, McGregor and Montagu.
- MRF: Materials recycling facility, more information can be found in section 4.3.

Parties:

- Brokers: they work on the same way as in the current situation. Only they cannot collect anymore from pickers because they are replaced by the MRF.

Destination:

- Compost site: farms bring the green waste to the composting site at Robertson or green waste from the transfer stations is brought there.
- Landfill Bonnievale & Montagu: two old landfills, where the top layer is filled with builders waste.
- Illegal dumpsite: these are allocated places by the municipality in each town, where builders rubble is dumped.
- Landfill: After the pickers looked through the waste bags, the waste is brought to the landfill.
- Recycle companies: They buy the recyclables from the brokers and the MRF owner.

4.2.2 Household waste collection

In figure 10, it is shown how the household waste is collected and handled. On the next page the descriptions of the new parties and facilities are described.

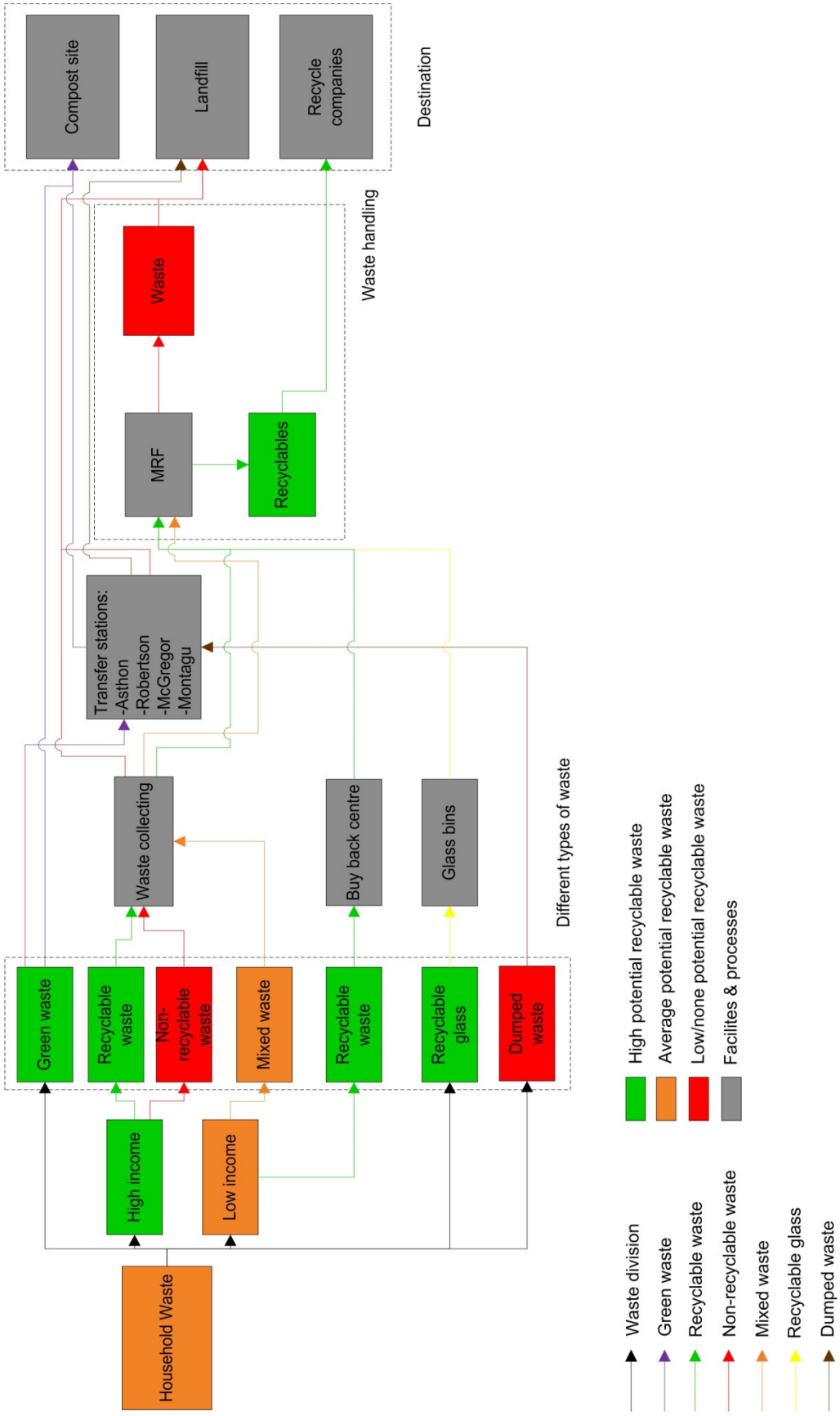


Figure 10: Household waste collection desired situation

Household waste:

- Green waste: is brought to the compost site in Robertson or via a transfer station.
- High income:
  - Recyclable waste: Recyclables are put in clear bags, which are collected by the municipality and brought to the MRF.
  - Non-recyclable waste: Non-recyclables are put in black bags, which are collected and brought to the landfill via transfer stations.
- Low income (mixed waste):
  - Waste is unsorted meaning there are still recyclables in. The next years will tell if its profitable to bring low income waste to the MRF.
  - Recyclable waste: people will collect it and bring it to 'buy back centres'.
- Recyclable glass: People can bring their recyclable glass to glass bins.
- Dumped waste: illegal dumped waste is collected and brought to the landfill

Facilities:

- Transfer station: A facility where waste is stored temporally to make it ready for transport to the MRF or landfill. In the BRWM situation is waste per town and surroundings collected and brought to the different transfer stations. Transfer stations are build in Ashton, Robertson, McGregor and Montagu.
- MRF: Materials recycling facility, more information can be found in section 4.3.
- Buy back centre: People, mostly from low income areas collect recyclables and bring them to 'buy back centre' where they can get food and products in change for recyclables. Recyclables are brought to the MRF for further handling.
- Glass bins: On certain points in the towns glass bins are placed. They will be emptied by the municipality and brought to the MRF.

Destination:

- Compost site: citizens bring their green waste to the composting site at Robertson or green waste from the transfer stations is brought there.
- Landfill: After the pickers looked through the waste bags, the waste is brought to the landfill.
- Recycle companies: They buy the recyclables from the MRF owner.

4.2.3 Transport

The transfer stations are built to decrease the transport costs. In every town, Ashton, Robertson, McGregor and Montagu a transfer station will be built. Except for Bonnievale because the MRF will be moved there when the landfill in Asthon reaches it limits. Local waste from every town is collected at each transfer station and recyclables are brought towards the MRF. Non-recyclable waste is directly dumped at the landfill and compost waste is brought to the composter in Robertson. In figure 11, the new transport system is demonstrated[19].

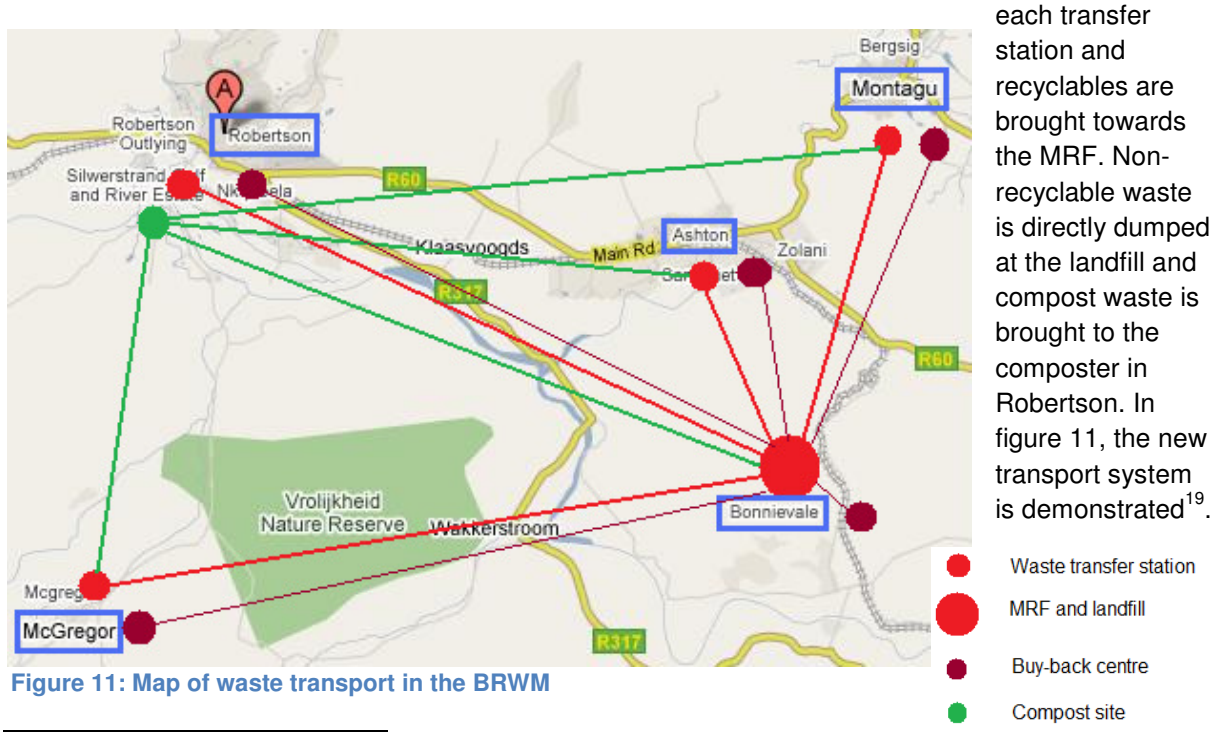


Figure 11: Map of waste transport in the BRWM

[19] Aarden, T and van de Bunt, P. (2009), *Final Report. Design of a transfer station in Robertson*

4.3 MRF

In five years' time, the MRF will be efficient and fully operational. The aim is to create a clean MRF, but this is depending on the support of the citizens, otherwise it will be one between a dirty and a clean MRF. The target is to have all the high income areas supplied with the separated at source system. Only separated at source waste will be sorted at the MRF. There will be only waste coming from lower income, which contains mixed waste when it is profitable to recycle. During the first five years it will become clear from which areas it is beneficial to send the waste through the MRF. If it would not be profitable in sense of waste amount decreasing it will be send directly to the landfill. More detailed information about the implementation of the MRF can be found in section 5.2.

4.4 Waste amounts

It is difficult to predict the amounts of waste for the future in the BRWM. The current amounts are based on experience and assumptions of experts[20]. Within the next years, incoming waste to the landfill site is measured with a vehicle weigh scale at the MRF and the outgoing recyclables are known as well. This will make it possible to calculate the exact amounts of produced waste which is going to the landfill. For now, the predicted amounts will be calculated on for the next five years. Currently, there is a waste grow rate of 7% in tons in the Western Cape. The composition is not known, that is why it is not sure if the business waste or household waste is growing. Further research needs to be done to clarify this. In order to make further calculations about waste towards the landfill, recycling and possible profits for the MRF, detailed information about the waste composition and amount in five years will be portrayed.

4.4.1 Composition

It is not easy to make assumptions about the composition of the waste in five years since there are only figures known of the current situation. Experts[21] predict the quality of waste (packing material) will increase. The amounts and composition of waste can only be precisely forecasted if there is a research led on this issue. Afterwards, the figures will be used for calculating the amounts of recyclables.

It is important that waste samples will be taken every six months in the same way as the previous group did[22]. The saying 'Knowledge is power' is typically applicable for waste recycling as there is a need to adapt the waste recycling treatment on the waste input. Without knowing the amount and composition of the waste it is not possible to set up the recycling process as efficient as possible.

4.4.2 Amount

As mentioned above, there is a waste growth of 7% in tons in the Western Cape. At the moment, there are no figures of the composition changes for the future. For calculating the amounts for the next five years, the 7% growth will be used, which is shown in table 6.

Year	Waste amount (ton)	Grow rate (%)
2009	29040	7%
2010	31073	7%
2011	33248	7%
2012	35575	7%
2013	38066	7%

Table 6: Waste grow rate

4.5 Future scenario

A desired situation is a set of objectives which are aimed for within a set period of time. In the BRWM situation, the objectives are set for a period of ten years. To acquire these objectives, different plans are made for the following years. The desired situation in this case is only described for the following five years so the future scenario as well.

[20] E.g. Dirk Steyn: BRWM Manager of Environmental Services (west)
[21] Appendix V Minutes
[22] Grooten, D., Habieb, F., Jansen, L., Keverling Buisman, P. and Veldhuizen, A, *Waste problem or oppertunity*, 2008

A word of caution:

As the word prediction stand for 'based on assumptions', the result can never be taken for granted. It is even more difficult when a lot of figures are based on assumptions which are being calculated with. This is why the outcomes cannot be used for making decision; it only helps to make prognosis for the future because changes in the assumed figures have a huge impact on the predicted result.

In this thesis, future calculations about recycled waste amounts and waste towards the landfill will be led. With these figures, it is possible to assume when the landfill in Asthon reaches its limit. This is useful because the MRF will be moved towards the new landfill when the old one is full.

Scenarios are often used to design different situations about possible future outcomes. Often the following scenarios are used:

- Best case scenario
- Worst case scenario
- Predicted scenario

In this case only the predicted scenario will be designed. There are too many uncertainties to make an adequate design for the other two scenarios. Besides, future calculations can be done more adequately in the future when new tools will be used and implemented, which are explained in section 5.2.

The amount of waste towards the landfill depends on the amount of recycled waste which depends on the following circumstances and used as variables in table 7: Waste recycling:

- Waste growth: Grow rate of waste per year. In this scenario, the same waste growth will be used because this one is stable comparing to the figures of previous years.
- Waste composition: The different materials within the waste.
- Waste recycled, depending on:
    - Participation factor: Amount of waste that is actually separated by the citizens. This factor is based on experience and participation figures in other places within the Western Cape[23].
    - Theft factor: Amount of recyclables that gets stolen before collection.
    - MRF lost factor: Amount of recyclables unable to recover at the MRF.

In table 7, the calculation for the following five years are shown.

An explanation of the terms used in table 7 is given below.

X-axis calculation factors:

- Waste amount (ton): Amount of waste indicated in tons (weight).
- Waste amount (%): Amount of waste indicated in percentage of weight.
- Waste grow rate (%): Waste grow rate per year in percentage.
- Recyclable (%): Amount of waste that is recyclable per group in percentage.
- Theft factor (%): Amount of recyclables stolen before collection indicated in percentage.
- Lost factor (%): Amount of recyclables unable to recover at the MRF indicated in percentage.
- Participation factor (%): Amount of waste that is actually separated by the citizens indicated in percentage.
- Recycle rate (%): Amount of waste recycled per group indicated in percentage.
- Waste recycled (%): Amount of waste recycled per group indicated in percentage of total produced waste.
- Waste recycled (ton): Amount of waste recycled per group indicated in tons (weight).
- Waste to landfill (ton): Amount of waste dumped at the landfill in tons (weight).

[23] Interview with Bertie Laurens and Johan van Tag

Y-axis groups:

- Household/Business waste: Amount of household and business waste divided in:
    - Low income: Waste from low income areas.
        - Buy back centre: % indicates how much percentage of the total area is making use of the buy-back centre.
    - High income: Waste from high income areas.
        - Separating at source: % indicates how much percentage of the total area is integrated in the separating at source method.
        - Non participating: % indicates how much percentage of the total area is not integrated in the separating at source method.
    - Business waste: Waste from business.
- Garden waste: Amount of garden waste which is not added with the household waste.
- Abattoir waste: Amount of abattoir waste from butchers and business.
- Builders waste: Amount of builders waste.

Year	Type	Waste amount (ton)	Waste amount (%)	Waste grow rate (%)	Recyclable (%)	Theft factor (%)	Lost factor (%)	Participation factor (%)	Recycle rate (%)	Waste recycled (%)	Waste recycled (ton)	Waste to landfill (ton)
2009	Household/Business waste (59%)	17028		7%	47%							12371
	Low income (25%)	*4257*	*14,66%*	7%	31%	x	*95%*	x	2%	0%	67	4190
	High income (45%)	*7663*	*26,39%*	7%	36%	x	*90%*	x	4%	1%	276	7387
	Business waste (30%)	*5108*	*17,59%*	7%	42%	x	*85%*	x	6%	1%	321	4788
	Garden waste (25%)	7260	*25,00%*	7%	55%	x	x	x	55%	14%	3993	3267
	Abattoir waste (9%)	2752	*9,48%*	7%	0%	x	x	x	0%	0%	0	2752
	Builders waste (7%)	2000	*6,89%*	7%	0%	x	x	x	0%	0%	0	2000
Total		**29040**	**100,00%**							**16%**	**4657**	**24383**
2010	Household/Business waste (59%)	18220		7%	47%							12104
	Low income (25%)	*4555*	*14,66%*	7%	31%	*x*	*90%*	x	3%	0%	143	4412
	High income (45%)	*8199*	*26,39%*	7%	36%	*x*	*x*	x	x	4%	465	7734
	Separation at source (10%)	*820*	*2,64%*	7%	*36%*	*0%*	*25%*	30%	8%	2%	66	753
	Non participating (90%)	*7379*	*23,75%*	7%	*36%*	*x*	*85%*	x	5%	1%	399	6980
	Business waste (30%)	*5466*	*17,59%*	7%	*42%*	*x*	*80%*	x	8%	1%	458	5008
	Garden waste (25%)	7768	*25,00%*	7%	*65%*	x	x	x	65%	16%	5049	2719
	Abattoir waste (9%)	2945	*9,48%*	7%	*0%*	x	x	x	0%	0%	0	2945
	Builders waste (7%)	2140	*6,89%*	7%	*0%*	x	x	x	0%	0%	0	2140
Total		**31073**	**100,00%**							**22%**	**6116**	**24957**
2011	Household/Business waste (59%)	19495		7%	47%							11646
	Low income (25%)	*4874*	*14,66%*	7%	31%	*x*	*90%*	x	3%	0%	153	4720
	High income (45%)	*8773*	*26,39%*	7%	36%	*x*	*x*	x	x	3%	850	7923
	Separation at source (60%)	*5264*	*15,83%*	7%	*36%*	*0%*	*10%*	35%	11%	2%	597	4667
	Non participating (40%)	*3509*	*10,55%*	7%	*36%*	*x*	*80%*	x	7%	1%	253	3256
	Business waste (30%)	*5849*	*17,59%*	7%	*42%*	*x*	*75%*	x	10%	2%	612	5236
	Garden waste (25%)	8312	*25,00%*	7%	*70%*	x	x	x	75%	19%	6234	2078
	Abattoir waste (9%)	3151	*9,48%*	7%	*0%*	x	x	x	0%	0%	0	3151
	Builders waste (7%)	2290	*6,89%*	7%	*0%*	x	x	x	0%	0%	0	2290
Total		**33248**	**100,00%**							**24%**	**7850**	**25398**
2012	Household/Business waste (59%)	20860		7%	47%							11596
	Low income (25%)	*5215*	*14,66%*	7%	31%	*x*	*x*	x	x	1%	295	4920
	Buy back centre (20%)	*5215*	*14,66%*	7%	*31%*	*0%*	*10%*	20%	6%	1%	295	4920
	High income (45%)	*9387*	*26,39%*	7%	36%	*x*	*x*	x	x	3%	1217	8170
	Separation at source (100%)	*9387*	*26,39%*	7%	*36%*	*0%*	*10%*	40%	13%	3%	1217	8170
	Non participating (0%)	*0*	*0,00%*	7%	*36%*	*x*	*75%*	x	9%	0%	0	0
	Business waste (30%)	*6258*	*17,59%*	7%	*42%*	*x*	*70%*	x	13%	2%	786	5472
	Garden waste (25%)	8894	*25,00%*	7%	*75%*	x	x	x	75%	19%	6670	2223
	Abattoir waste (9%)	3371	*9,48%*	7%	*0%*	x	x	x	0%	0%	0	3371
	Builders waste (7%)	2450	*6,89%*	7%	*0%*	x	x	x	0%	0%	0	2450
Total		**35575**	**100,00%**							**25%**	**9264**	**26606**
2013	Household/Business waste (59%)	22320		7%	47%							11931
	Low income (25%)	*5580*	*14,66%*	7%	31%	*x*	*x*	x	x	1%	316	5264
	Buy back centre (40%)	*5580*	*14,66%*	7%	*31%*	*0%*	*10%*	20%	6%	1%	316	5264
	High income (45%)	*10044*	*26,39%*	7%	36%	*x*	*x*	x	x	3%	1302	8742
	Separation at source (100%)	*10044*	*26,39%*	7%	*36%*	*0%*	*10%*	40%	13%	3%	1302	8742
	Non participating (0%)	*0*	*0,00%*	7%	*36%*	*x*	*75%*	x	9%	0%	0	0
	Business waste (30%)	*6696*	*17,59%*	7%	*42%*	*x*	*70%*	x	13%	2%	841	5855
	Garden waste (25%)	9516	*25,00%*	7%	*60%*	x	x	x	80%	20%	7613	1903
	Abattoir waste (9%)	3607	*9,48%*	7%	*0%*	x	x	x	0%	0%	0	3607
	Builders waste (7%)	2622	*6,89%*	7%	*0%*	x	x	x	0%	0%	0	2622
Total		**38066**	**100,00%**							**26%**	**10389**	**27993**

Table 7: Estimated amounts of recycled waste

In table 7, the generated waste per year is calculated. With these figures, it is possible to calculate how much space is added to the landfill every year. Table 8 shows when the landfill reaches its limits.

For calculating from mass (in ton or kg) to volume (kg/m3) the following variables are used:

- Kg/m3 after dumping: The volume the waste generates when it is dumped on the landfill.
- Kg/m3 after compacting: The volume after the waste is compacted
- Kg/m3 after years: Because of subsiding of the waste, the mass per volume increases.

M3 calculation: The multiply factor to change from ton (mass) to m3 (volume) has a big influence on calculating the space left on the landfill. For now, these figures are based on interviews with waste expert in South Africa and the Netherlands and might differ to the actual figure, since they are not measured yet in the BRWM area.

The outcome of this calculation is presented in table 8 on the following page. With these calculations the landfill will be full by the end of 2013. In the past, earlier forecasts were made about this. Some of them assumed the landfill would already be full last year. Previous wrong forecasts, indicated that it is difficult to predict when the landfill reaches its limits because there are many factors which influence actual volume on the landfill. The main reason for this scenario is to show what can be calculated if these figures are actually known and what benefits this gives to choice of strategies and objectives for the future. The previous research was done with outdated figures, which resulted in running behind the current matters. In the future, strategies should be made on actual figures in order to produce proper forecasts. As written before, how to achieve this will be discussed in detail in section 5.2.

Year	Type	Dumped amount (kg)	Kg/m3 after dumping	Kg/m3 after compacting	Kg/m3 after years	m3 after dumping	m3 after years
2009							
	Household/Business waste (59%)						
	Low income (25%)	4190016	230	700	1100	18217	3809
	High income (45%)	7386593	230	700	1100	32116	6715
	Business waste (30%)	4787567	200	700	1000	23938	4788
	Garden waste (25%)	3267000	400	600	1500	8168	2178
	Abattoir waste (9%)	2752000	400	600	1500	6880	1835
	Builders waste (7%)	2000000	660	850	1280	3030	1563
Total		**24383176**				**92349**	**20887**
Space left	June 2009 => 96887						86444
2010							
	Household/Business waste (59%)						
	Low income (25%)	4411644	230	700	1100	19181	4011
	High income (45%)						
	Separation at source (10%)	753450	230	700	1100	3276	685
	Non participating (90%)	6980392	230	700	1100	30350	6346
	Business waste (30%)	5008266	200	700	1100	25041	4553
	Garden waste (25%)	2718870	400	600	1500	6797	1813
	Abattoir waste (9%)	2944640	400	600	1500	7362	1963
	Builders waste (7%)	2140000	660	850	1280	3242	1672
Total		**24957262**				**95249**	**21042**
Space left	January 2010 86444						65402
2011							
	Household/Business waste (59%)						
	Low income (25%)	4720460	230	700	1100	20524	4291
	High income (45%)						
	Separation at source (60%)	4666506	230	700	1100	20289	4242
	Non participating (40%)	3256364	230	700	1100	14158	2960
	Business waste (30%)	5236404	200	700	1100	26182	4760
	Garden waste (25%)	2077994	400	600	1500	5195	1385
	Abattoir waste (9%)	3150765	400	600	1500	7877	2101
	Builders waste (7%)	2289800	660	850	1280	3469	1789
Total		**25398292**				**97694**	**21529**
Space left	January 2011 => 65402						43873
2012							
	Household/Business waste (59%)						
	Low income (25%)						
	Buy back center (10%)	4919599	230	700	1100	21390	4472
	High income (45%)						
	Separation at source (100%)	8169782	230	700	1100	35521	7427
	Non participating (0%)						
	Business waste (30%)	5471941	200	700	1100	27360	4974
	Garden waste (25%)	2223453	400	600	1500	5559	1482
	Abattoir waste (9%)	3371318	400	600	1500	8428	2248
	Builders waste (7%)	2450086	660	850	1280	3712	1914
Total		**26606179**				**101969**	**22518**
Space left	January 2012 => 43873						21355
2013							
	Household/Business waste (59%)						
	Low income (25%)						
	Buy back center (10%)	5263971	230	700	1100	22887	4785
	High income (45%)						
	Separation at source (100%)	8741666	230	700	1100	38007	7947
	Non participating (0%)						
	Business waste (30%)	5854977	200	700	1100	29275	5323
	Garden waste (25%)	1903276	400	600	1500	4758	1269
	Abattoir waste (9%)	3607311	400	600	1500	9018	2405
	Builders waste (7%)	2621592	660	850	1280	3972	2048
Total		**27992792**				**107918**	**23777**
Space left	January 2013 => 21355	**Landfill full by the end of 2013**					-2422

Table 8: Prognosis for landfill figures

4.6 Long term future

In the future situation, the plans for the following five years are described. There might be a possibility that some of them will be delayed and will be implemented in a later state, but these plans will not be discussed. This section will focus on issues and possibilities for the future and are summarized below.

Abattoir waste handling: At the moment, there is no proper treatment for abattoir waste. It is dumped at the landfill, which is illegal, since the landfill in Asthon does not have a valid permit for abattoir dumping[24]. Unsuitable abattoir handling is dangerous for public health. Besides, a proper treatment will contribute in waste decrease. One of the possibilities is to make animal nutrition from the abattoir waste.

Chemical waste: This waste is mixed with the normal waste. The main reason for this is that it is too expensive to separate this kind of waste for suitable treatment. E.g. Batteries are mixed in household waste and end up at the landfill. Projects in schools and supermarkets can trigger people to hand in their chemical waste and separate it from the normal waste by rewarding participating people via a lottery. This is also done in Cape Town. In this way, it can be stored separately from the household waste and wait for new ways of treatment. Wasteplan[25] is planning research for possibilities for chemical waste treatment within the Western Cape.

Organic waste separating at source: Organic waste contains a big amount of non-recyclable waste and is one of the main threats for recyclables. When separating at source is implemented and working successfully, further on separating can be introduced.

Integrate brokers in the process: In the current situation there is recycling on a small scale. Private companies and parties collect valuable recyclables and sell them to buyers. For the BRWM it does not matter who recycles, as long as it decreases the amount of waste towards the landfill. In the future, a more organised waste management is demanded; this should also include the brokers. Their waste is not only valuable for the MRF, but when it is also collected by the BRWM; it creates more structure and information about the total waste. Fluctuations in the price of raw materials affect which materials are recycled now and differ constantly. With full control, the process is easier to monitor and can be operated efficiently.

Outsource opportunities: The BRWM is fully responsible for their waste management and no other parties are included. Different parts can be done by specialized companies e.g. cleaning of the streets, waste collection, waste handling (MRF) and even only parts of the recycling like green waste. When the short term objectives are implemented, research needs to be done on these possibilities.

[24] Grooten, D., Habieb, F., Jansen, L., Keverling Buisman, P. and Veldhuizen, A, *Annexure by final report*, 2008
[25] Largest on-site waste management company in the Western Cape

5. Action Plan

In this chapter, the phases of how to achieve the desired situation are explained. This will be done in four main phases, which are described in section 5.1. Because this report is focused on the MRF business case, all the details will be presented and are summarized in section 5.7. The implementation of the MRF can be found in section 5.2.

5.1 Phases

The desired situation is stretched over a period of five years and consists of a few phases. In the introduction of the report, three phases concerning the whole recycling project were mentioned. Within the following years, the input of the MRF will change due some changes in the waste collection. This chapter will clarify how the waste collection and handling will change during these phases in the BRWM.

5.1.1 Phase 1: Introduction of the MRF

Currently, the prognosis is that the MRF will be finished by the end of July 2009. Soon, a tender will be available for running the MRF, which will be done by a private entrepreneur. The MRF will replace the work which is currently done by the pickers. All the employees will start with a three week training in order to gain the knowledge to work successfully in the MRF. The implementation of this MRF is explained in chapter 5.2.

5.1.2 Phase 2: Separating at source

At the time the MRF is operational and working successfully, a pilot will start in Montagu with a two bag system. This pilot means that people will be informed about the use of two bags via flyers and marketing, which is a part of the awareness campaign[26]. People will have two bags, one with recyclable waste and one with non-recyclable waste. The BRWM will collect the waste and bring it to the MRF. Separating the recyclable waste from the non-recyclable waste will decrease the lost factor of the recyclable waste. Recyclables stay dry (apart from people who do not co-operate) and will not mix with wet and dirty waste, like abattoir or green waste.

With the feedback of this separating process in Montagu, the rest of the BRWM will be supplied with two bags in order to increase the quality of recyclables all over the BRWM. Collection will be separated in two shifts, one for recyclables and one for non-recyclables.

Next to separation at source for high come areas, a ‘buy back centre’ will be created for low income areas. When successful, more ‘buy back centres’ will be built.

5.1.3 Phase 3: Use of a transfer station

In the next phase, the transfer stations are added to the waste procedure. Basically, they do not change the procedure. They make the waste collection and separating more organised and offer the citizens and companies more options to get rid of their waste. Transfer stations will be built in McGregor, Robertson, Montagu and Ashton from 2010, every year one. The MRF will be moved later on near Bonnievale. No transfer station needs to be built there. Waste in that region will be brought directly to the MRF or landfill.

5.1.4 Phase 4: Move of MRF to new landfill

In the last phase, the MRF will move to a new location between Bonnievale and Asthon, at the new landfill site. When the landfill in Ashton is full, the MRF will be disassembled and rebuilt at the new location.

Depending on the implementation of the first 3 phases, extra recycle methods are introduced as described in section 4.6 like glass bins and organic waste separation.

[26] Kaak, K., ‘Skoon en netjies hergebruik, *A guide to social and organisational change for recycling*, 2009

5.2 Implementation MRF

The whole construction plan is already approved by the BRWM and executed by Akura[27]. This means that the MRF is already designed and currently being built. Aspects like management, sorting order and storage are still adjustable and will be discussed in this chapter. The main purpose of this section is to explain how to run the MRF as efficient as possible within the BRWM needs. Besides that, figures about the involved costs and revenues are calculated.

5.2.1 Monitoring

A lot of information is unknown at the moment. Decisions are made on assumptions and experience. In order to make decisions on facts, this information is needed.

The simple saying 'Knowledge is power' is typically applicable on waste management as mentioned before in section 4.4.1. If the figures of the kind of incoming waste is not known, it is impossible to process it efficiently because the facilities need to be adapted to the kind of waste which comes in. Therefore, the BRWM needs to start measuring the following points frequently:

- Quantity incoming waste
- Composition of waste
- Source of waste
- Amount of recyclables recovered
- Participation of citizens separating at source (household survey)

At the landfill location, all the incoming waste needs to be measured daily with the weight scale, resulting in the knowledge of the above mentioned points. All the information should be kept in an excel spreadsheet and updated every day. Only then it is possible to make adequate calculations about current waste amounts, profits and waste development in composition, amount and source. Development per area or waste producer will be clear, likewise differences per season.

This information ends the struggling of the past years, incorrect calculations and forecasts e.g. "The current Ashton disposal site will reach capacity within the next 12 to 18 months" according to Mbb consulting services 2006 (page 38). A small amount of monitor work can make a big difference in the future with accurate targeting of the changes in waste and help to prevent wrong prognosis and recommendations.

5.2.2 Systematic Lay-out Planning

In this section, the Systematic Lay-out Planning (SLP) is illustrated and explained. A SLP is used for redesigning a warehouse or creating a new one. The MRF is already designed and built by Akura including the lay-out. Therefore, this section will not go into many details, but will zoom into some specific procedures and features of the separating process within the MRF. The SLP of the MRF is illustrated in figure 12. The scale division might not be 100% accurate, but the main purpose is to clarify the separating procedure in the MRF and the flow chart of the materials.

[27] Akura, manufacturing engineering company (Pty) Ltd

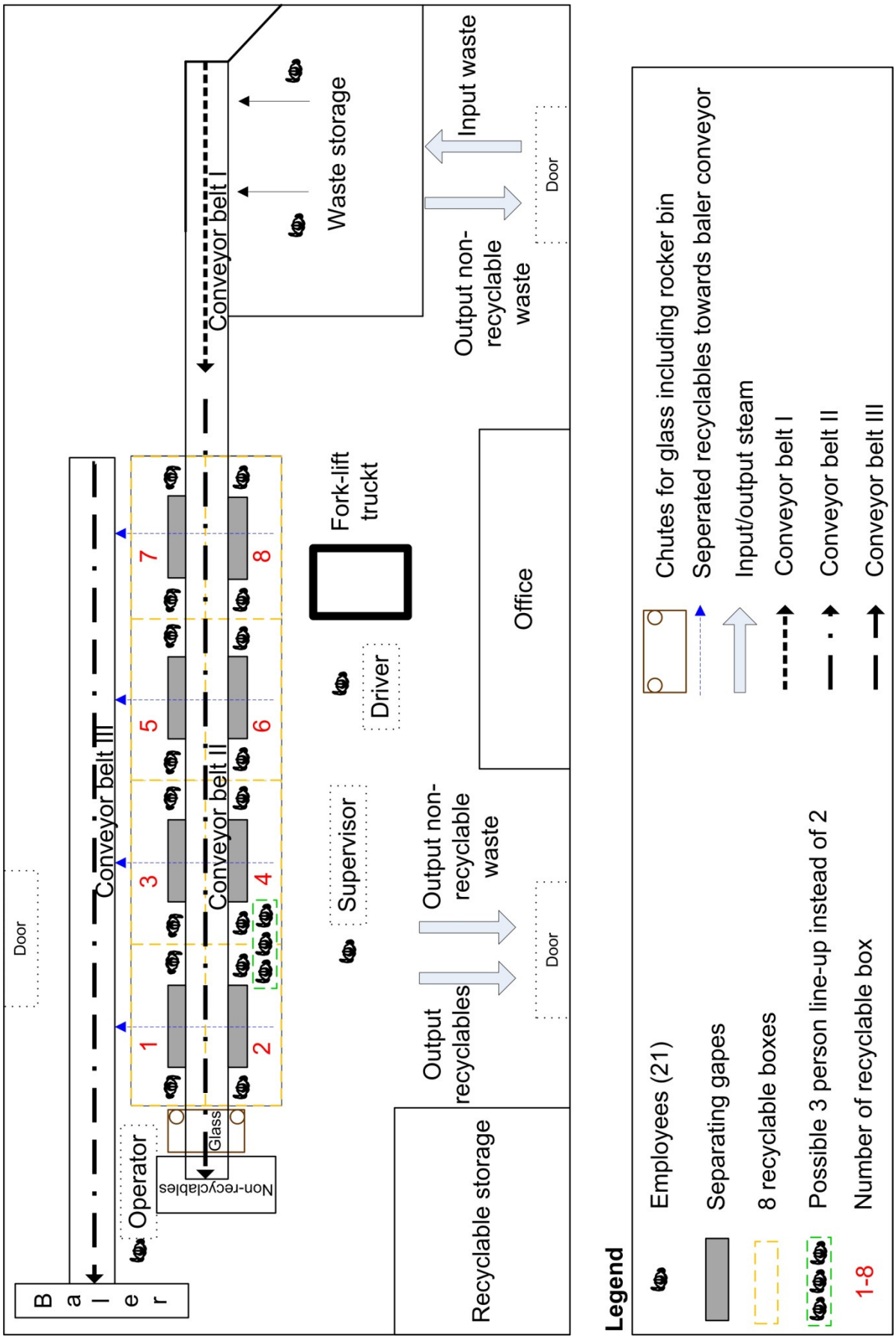


Figure 12: System Lay-out Planning

Figure 12 illustrates 21 employees currently planned to work in the MRF. Sixteen employees are planned to work at the conveyor belt. This can be increased with six persons, who can separate light materials in a bag behind them as shown with the green marking. The MRF contains eight boxes (partly shown in figure 12 and illustration 4) and two chutes for glass (shown in illustration 6) at the end of the conveyor belt. It is possible to recyclable nine different materials with this setup.

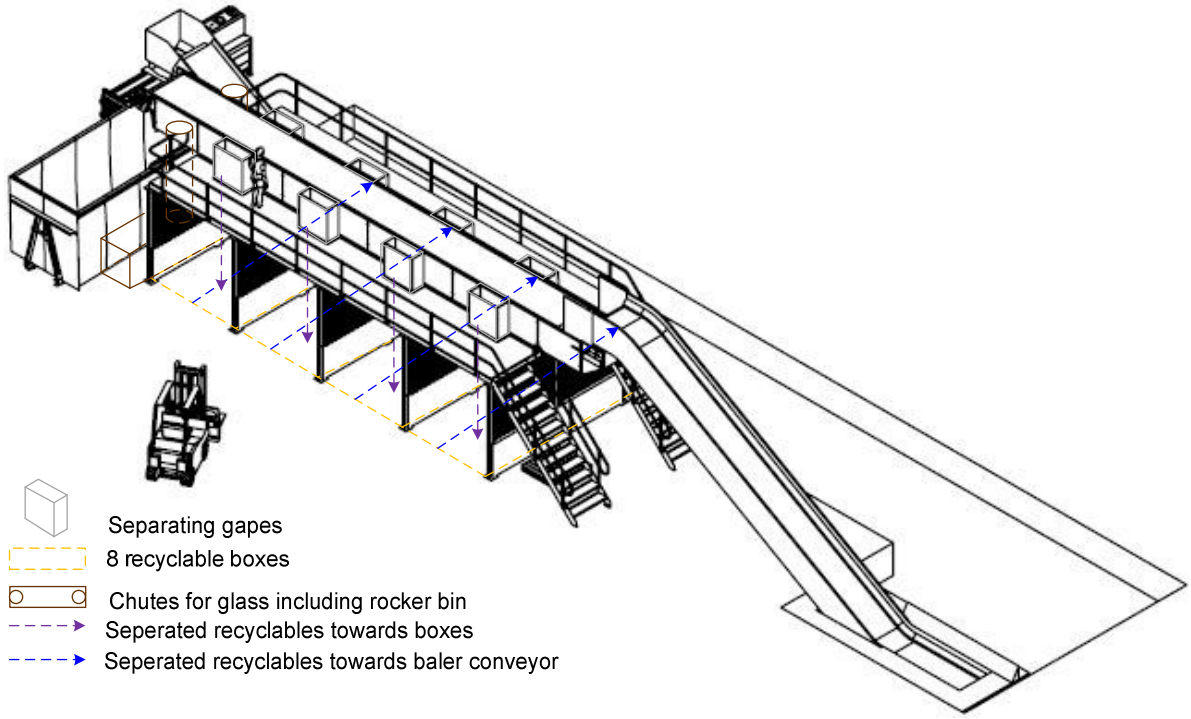


Figure 13: 3d model of the separating part

Illustration 4: Separating boxes without partition

Illustration 5: Chutes for glass

The description in the legend of previous figures is applicable for the two illustrations above.

To empty the even box numbers, the uneven number in front needs to be emptied first. This procedure is done with a shovel (shown in illustration 6) used by a fork-lift truck, which moves the recyclables towards the 'baler conveyor' after the partition is temporary removed between the two boxes. More information about the separating order and process is described in section 5.2.4. After the recyclables are baled, they are stored outside the MRF. Only paper is stored inside.

Illustration 6: Shovel for pushing recyclables

5.2.3 Management

An MRF does not require an intricate management because it is not a complicated business. Still there are some aspects to take into account. The success of an MRF depends on the input quality of waste and the separation of the waste within the MRF. In order to separate the waste efficiently in the MRF, a trained and motivated personal is required. Comparing with other MRFs, females were always working at the conveyor belt performing the separation work because of their better hand-eye coordination. Separation work is quite a boring task. Triggers and variation should be created to keep the employees motivated and focussed on their work. Léon de Caluwé[28] invented a guide to change organisations with a five colour changing method. Normally, this model is used for changing organisations, but the 'red thinking' suits perfectly for triggering the MRF employees. Red thinking is associated with rewarding, motivating and stimulating of the employees. Besides, an atmosphere as good as possible is created. These are actually the key factors how to trigger the employees. Bonuses can be provided after reaching a set target in amounts of generated recyclables. Targets should be set when the capabilities of the MRF are known and the recycling process is working as desired. Because of this, too easy or impossible targets will be avoided. Targets should be adapted when waste quality increases e.g. introduction of separation at source.

5.2.4 Recycling process

This section concerned with the process flows from the incoming waste until the outgoing recyclables and disposals. Extra attention is paid to the separation part.

In figure 9 and 10 (chapter 4), it is already explained how the process will be from collection to the landfill. Now, the focus is aimed at the processes around the MRF. Waste is brought directly or via transfer stations to the MRF in Ashton. Trucks are weighted at the weight bridge to gain exact figures of the incoming waste as explained in chapter 5.2.1.

Waste is unloaded in the MRF as indicated in the SLP in figure 11. Two workers open the incoming waste bags and decide if it is worth to recycle. If not, the waste is dumped at the non-recyclables. Waste is pushed towards 'conveyor belt I', which is set on a 'high speed' to spread out the waste over the belt. 'Conveyor belt I' moves the waste towards 'conveyor belt II', a 'slower belt' where the waste is separated by hand picking. The intention is to put sixteen employees at the conveyor belt. Each person can recover an average of 60 kg of recyclables per hour, which is 480 (60 * 8) kg per day. With sixteen persons this is 7680 kg per day, which is approximately 2000 (7680 * 22 * 12) ton per year[29].

The best sorting order is a big issue and different methods are used e.g. first the valuable materials or rather first the biggest materials. To create the best sorting order for the MRF in Ashton a 'trial and error'[30] procedure would be best applicable. Trial and error is a learning experience which offers more solutions to a certain experiment, in this case finding the best sorting order. Each 'error' is feedback to formulate a new 'trial'. The big advantage is that the sorting order can easily be changed and adjusted to different incoming waste, which differs because of source and season.

Separated recyclables are collected in boxes and when full, moved towards 'conveyor III', which moves the recyclables to the baler, controlled by the operator. When the recyclables are baled, they get stored inside and outside at the storage areas with a fork-lift truck. Tins, glass and plastics do not need to be covered; rain does not influence the quality of the recyclables. Paper will be stored inside because rain will decrease the quality. Disposals from the MRF are brought to the landfill and compacted with a compactor at location.

[28] Dutch professor who is specialized in learning and change routes
[29] Appendix V Minutes Akura Manufacturing Engineering Company. (Pty) Ltd
[30] http://www.stevepavlina.com/blog/2005/09/trial-and-error-ego-and-awareness/

5.2.5 Operating costs and profits

In this chapter, a closer look to the costs and possible profits is made to create a better view of the profitability of the MRF. Table 9 shoes the estimated costs for running the MRF with the planned use of sixteen employees at the conveyor belt. These costs will hardly fluctuate during the years; which means they are granted as fixed costs.

Type	Amount	Cost per year
Staff		
Salary		
Workers	18	864000
Operator	1	54000
Drivers	1	60000
Supervisor	1	72000
Insurance		875
Clothes		3360
Building		
Depreciation		45020
Maintenance		5000
Storage		0
Electricity		19200
Machines		
Maintenance		10000
Depreciation		37500
Insurance		48000
Vehicles	1	
Insurance		875
Fuel		15000
Total		**1234830**

Table 9: Estimated operating costs MRF

With the figures used from sections 3.1 and 4.5, it is possible to make assumptions about the possible revenues of the collected recyclables. These revenues assumptions are very flexible because of the unstable market for recyclables. Therefore, updating the financial calculations is very important. The full calculations about profits from recyclables can be found in appendix IV. In Table 10, the total revenues are displayed for the following five years.

Year	2009	2010	2011	2012	2013
Income MRF	533952	865194	1316284	1885162	2017123
Costs MRF	1234830	1234830	1234830	1234830	1234830
Profit (Rand)	-700878	-369636	81454	650332	782293

Table 10: Profits for the following 5 years

Table 1 and diagram 1 show that the MRF should be profitable in the year of 2011, when approximately 1515 kg[31] of recycles is recovered. These profits are based on assumptions and definitely need to be verified after the MRF is running and figures can be updated to the actual information and experience. The calculated profits are based on the generated recyclables from table 11.

Year	2009	2010	2011	2012	2013
Low income	67	143	153	295	316
High income	276	465	850	1217	1302
Business waste	321	458	612	786	841
Total (ton)	664	1066	1616	2299	2460

Table 11: amount of generated recyclables for the following 5 years.

[31] Calculated with appendix IV, based on assumptions due the number of flexible variables

Diagram 1 demonstrates the break-even point, indicated in income and costs, meaning that the operating costs are exactly the same as the acquired income.

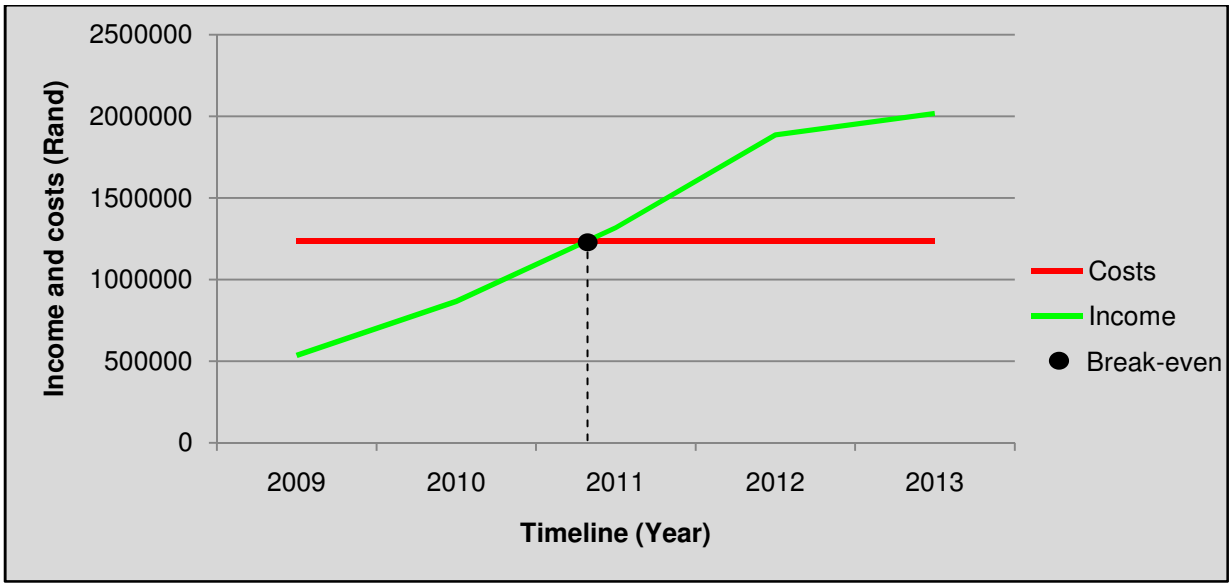


Diagram 1: Break-even point

In section 5.4, it is calculated that one person can recover 60 kg of recyclables per hour, which is around 126 ton (60 * 8 * * 22 * 12) per year. Analysing table 11 indicates that in 2009 and 2010 an overcapacity is used of employees working at the conveyor belt is used. Because of inefficiency, a buffer of manpower should be used, which still means that in the beginning there are not sixteen employees needed at the conveyor belt.

In consultation with the owner of the MRF, this issue should be discussed. The BRWM could stand surety for debts in the first years, when the targets that were set are achieved in numbers of recycled waste, to secure extra jobs in the beginning as well. These targets should be set within the first months when more information is known about actual recycle figures.

Summarizing this section, the previous tables and diagram indicated that the MRF is capable of making profits in 2011. There are many external factors which influence the revenues. Thus, it is important to update the figures on monthly basis.

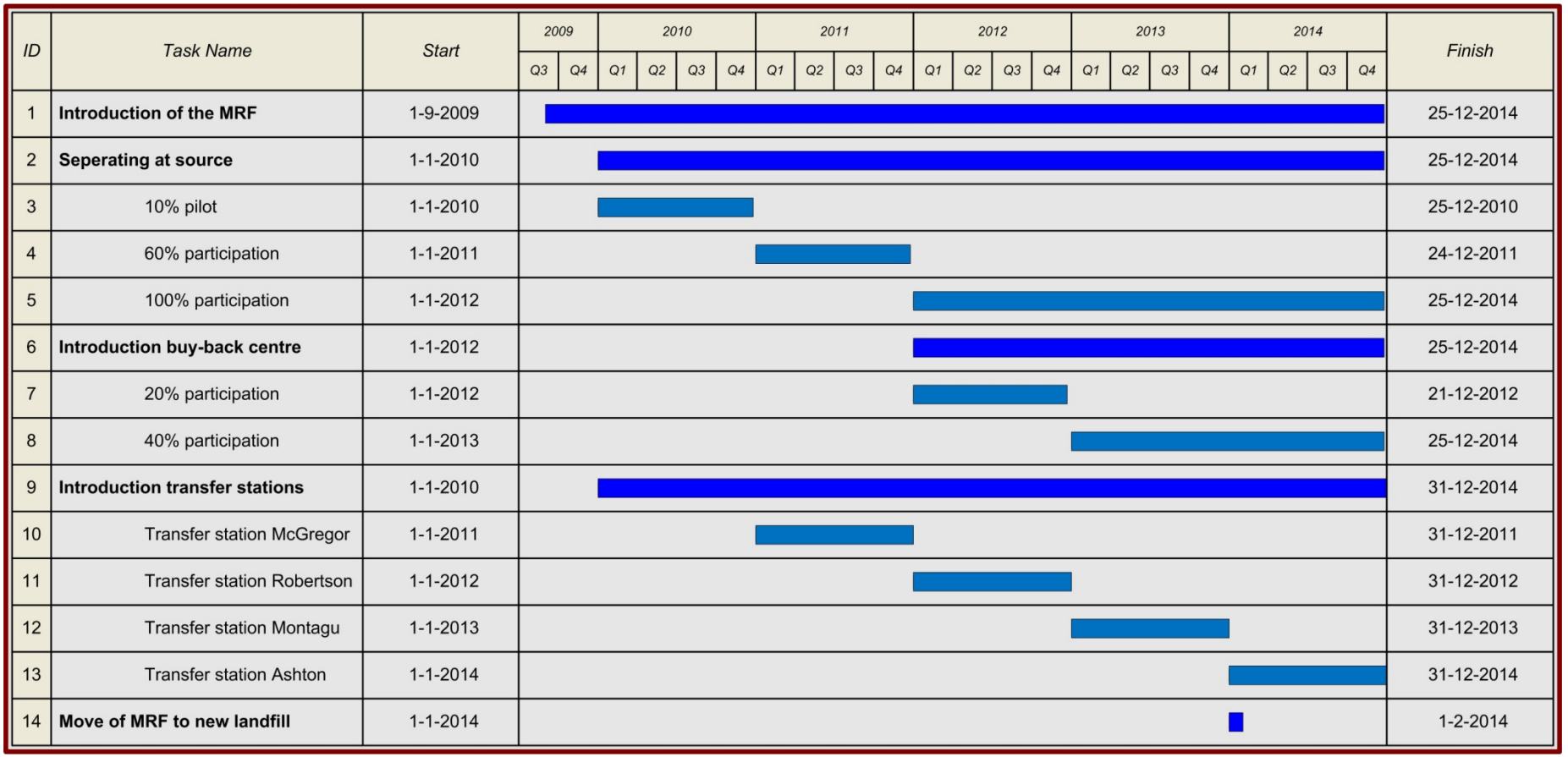
5.2.6 Buyers

The buyers have a big influence on the MRF and must not be underrated. Buyers set the requirements for recyclables and therefore decide what to recycle and the method that should be used in order to meet the required quality. A difficulty in the recycling industry is the price fluctuation of raw materials. This means that within a few weeks some of the recyclables might not worth to recycle anymore. Therefore, buyers avoid long term contracts. Private companies are aiming for profits; therefore, unprofitable recyclables will not be taken out. The BRWM has to decide within their budgets and targets if they can effort to pay for recycling unprofitable materials in order to reduce the amount of waste.

5.3 Planning

Figure 14 presents the planning processes for the phases described in section 5.1. As written before, some of the phases depend on each other. Therefore, delays or complications of a certain phase will negatively influence a later phase and change the planning. Another issue is that the required budget is not always available and plans need to be postponed. Important is that this planning needs to be updated when delays or complications take place. Thus the planning in this state cannot be taken for granted.

Figure 14: Planning action plan



ID	Task Name	Start	Finish
1	**Introduction of the MRF**	1-9-2009	25-12-2014
2	**Seperating at source**	1-1-2010	25-12-2014
3	10% pilot	1-1-2010	25-12-2010
4	60% participation	1-1-2011	24-12-2011
5	100% participation	1-1-2012	25-12-2014
6	**Introduction buy-back centre**	1-1-2012	25-12-2014
7	20% participation	1-1-2012	21-12-2012
8	40% participation	1-1-2013	25-12-2014
9	**Introduction transfer stations**	1-1-2010	31-12-2014
10	Transfer station McGregor	1-1-2011	31-12-2011
11	Transfer station Robertson	1-1-2012	31-12-2012
12	Transfer station Montagu	1-1-2013	31-12-2013
13	Transfer station Ashton	1-1-2014	31-12-2014
14	**Move of MRF to new landfill**	1-1-2014	1-2-2014

5.4 Risk management

The possible risks that can occur will be described in this section as well as which actions should be taken to prevent or reduce the chance from happening. Some of the factors are directly copied from figure 7, which presents the prognosis of recycled waste. In table 12, the risks are shown which negatively influence the success of the MRF. The risk influences are ordered from large to low impact.

Risk Management					
#	**Description**	**Change**	**Consequence**	**Risk**	**Measure**
1	Low participation rate	3	5	15	- Awareness campaign - Monthly updates about recycled figures
2	High MRF lost factor	3	3	9	- Reward achieved targets for separated recyclables - Trial and error improvement policy
3	Drop price of raw materials	2	4	8	- Acquire local use of recyclables
4	Waste grow rate is bigger	1	4	4	- Increase MRF capacity
5	High theft factor	1	2	2	- Use of marked bags
	Legend: 1 – very small, 2 - small, 3 - average, 4 - big, 5 – very big				

Table 12: Risk management

Some of the measures are a part of future plans, but might be overlooked again when they are not successful e.g. the awareness campaign. When the desired participation is not reached, different marketing approaches need to be taken.

5.5 Key Performance Indicators (KPIs)

Key Performance Indicators (KPIs) are measures or metrics used to help an organisation to evaluate how successful a process, product or service is. When evaluating these indicators in a structured way, improved plans for the whole process can be made. KPIs support continuous learning and help to adjust the process when needed.

In order to run the MRF efficiently, the following list of KPIs should be used to value:

- The recovered recyclables meeting the requirements set by the buyer
- Incoming waste and outgoing recyclables are correctly monitored
- The MRF's use of its full capacity
- Full use of employees capacity
- Incoming waste containing worth full recyclables
- Citizens awareness of recycling

Measuring these indicators will prove if action needs to be taken to prevent inefficiency, incorrectness or mistakes. These KPIs help to control the whole process (input, throughput and output of waste handling).

5.6 Critical Success Factors (CSFs)

"Critical Success Factors (CSFs) are the critical factors or activities required for ensuring the success of your business"[32]. There are many different definitions used for CSFs. In this report, the following definition is used: "CSF is a business term for an element which is necessary for an organization or project to achieve its mission"[31]. These factors are called critical because failing of one factor will lead to failure of the whole business.

[32] http://rapidbi.com/created/criticalsuccessfactors.html

Based on previous information, a list of CSFs is created in order to run this MRF successful:

- Frequent and accurate monitoring of waste
- Extensive trial and error use
- Entrepreneurial method of management
- Short term separating at source implementation
- Awareness campaign
- Continuous adaption to the changing environment via the use of KPIs

5.7 Business Case

In this section, the right of existence is discussed of the MRF, the business case. There are many different definitions about what a business case stands for. The following definition is used in this research:

> *A business case is a project management tool to capture the reasoning for initiating a project or task. It should show the decision will alter cash flows over a period of time, and how costs and revenue will change. Specific attention is paid to internal rate of return, cash flow and payback period.*[33]

This whole chapter described the implementation, features and requirements of the MRF and what the exact benefits are in relation to the costs. Section 5.2.5 described the financial future for the MRF. Based on assumptions, it is calculated that the MRF can be profitable in 2011, but delays in future implementation plans and negative factors e.g. low participation rate and a drop of price of low materials could threaten the profits and loss can occur. However, profits should not only be seen in the lucrativeness of the MRF itself. For the BRWM, 'the profits' must be achieved in different terms as well, like saving landfill and transport costs, job opportunities, saving valuable disposal space at the landfill site, encouraging voluntary participation, awareness and pride.

Summarizing these benefits, the following results will be achieved:

- 21 new jobs created
- 31% of household and business waste is recycled in 2013
- 26% of total waste is recycled in 2013
- Structured and improved waste handling

An important notice is that these results are based on calculations which are partly acquired via assumptions. Therefore, it is important to recalculate these figures when the MRF is operational and figures can be updated to the actual situation. With updated information, strict targets can be generated and the expectations of the MRF can be measured.

[33] Based on definitions from online sources which can be found in the references

6. Conclusion / Recommendations

In this research, all the available information gathered by the previous research is translated into a real business case for the Materials Recovery Facility (MRF) in Asthon. The research can be divided in two parts; the first one describes the MRF business case as planned and in the second part, the overall process of waste management in the BRWM and the previous research are portrayed. In order to have a successfully operating MRF, more external information is needed. Therefore, extra attention for the overall process of waste management is required.

In chapter one, the following main research question was formulated: "*What is the most effective way, in order to gain the highest recyclable waste throughput, to run the MRF in Ashton and what consequences will this have for the financial aspects indicated in costs and profits?".* To give a clear answer to this question, four sub questions are answered within this research: *1. What is an MRF and what are the requirements for the BRWM? 2. What kind and what amount of waste is currently produced? 3. What are the costs and profits of the MRF based on the calculated amounts of waste? 4. How should the MRF be implemented?*

The first sub question, "*What is an MRF and what are the requirements for the BRWM?",* was answered in chapter two. A Materials Recovery Facility is a location where the recyclable materials are collected, separated and prepared for use of the intermediate trader or end consumer. The BRWM requires an MRF which handles (dirty) mixed waste and later on separated (at source) waste.

Sub question two, "*What kind and what amount of waste will come towards the MRF?",* was answered in chapter three. In table 1 and 7, the waste amounts and composition towards the MRF were calculated. These figures were partly based on assumptions. The MRF will separate household (low and high income areas) and business waste. Compost waste will be brought to the composting site in Robertson and builders waste and abattoirs will be brought directly to the landfill.

The third sub question, "*What are the costs and profits of the MRF based on the calculated amounts of waste?",* was answered in combination of chapter four and five. The first two years the MRF will be unprofitable because of the low quality of waste and the (inefficient) initiation phase. In the year 2011, the MRF should be capable of making profits when separation at source is implemented. For the next five years this is in 2009 and 2010 a loss of respectively 700878 and 369636 rand and for 2011, 2012 and 2013 a profit of 81454, 650332 and 782293 rand. Currently, the prognosis for the break-even point is when 1505 kg are recovered from the business and household waste. Profits must not only be seen in financial terms, but also in *saving landfill and transport costs, job opportunities, saving valuable disposal space at the landfill site, encouraging voluntary participation, awareness and pride.* Calculations were partly based on assumptions; therefore, they cannot be taken for granted. In order to improve the accuracy of the calculations, frequent monitoring needs to be implemented.

The last sub question, "*How should the MRF be implemented?* ", was answered in chapter five. An implementation procedure of an MRF is a period of 'trial and error'. This means, there is no best plan on forehand. Continuous trials will lead to the most effective sorting order within the MRFs capabilities. Different factors influence the best sorting order, like buyers' requirements and the quality and composition of incoming waste. In order to run the MRF successfully, a list of Key Performance Indicators (KPIs) and Critical Success Factors (CSFs) is created.

KPIs:

- The recovered recyclables meeting the requirements set by the buyer
- Incoming waste and outgoing recyclables are correctly monitored
- The MRFs use of its full capacity
- Full use of employees capacity
- Incoming waste containing worth full recyclables
- Citizens awareness of recycling

CSFs:

- Frequent and accurate monitoring of waste
- Extensive trial and error use
- Entrepreneurial method of management
- Short term separating at source implementation
- Awareness campaign
- Continuous adaption to the changing environment via the use of KPIs

The main objective of this research was to give an answer on the main research question: "*What is the most effective way, in order to gain the highest recyclable waste throughput to run the MRF in Ashton and what consequences will this have for the financial aspects indicated in costs and profit?".* There are two main aspects to answer this question. The first aspect is a '*trial and error'* procedure. An MRF should continually adapt to its input, especially in the beginning. There is no best sorting order; successful sorting is a combination of available resources and the input of waste. The second aspect is *knowledge.* Waste management is a business where knowledge is needed in order to be successful. E.g. recycling low quality waste via an MRF will not be profitable and efficient. Thus, it is necessary to know the answers to the following questions: "Where does the waste come from? What is the composition? How will it develop? What are the quality requirements of the buyers?". This information will be obtained with accurate monitoring. With this information, it is possible to send the right waste towards the MRF and adapt the sorting order to the kind of waste in order to gain the desired recyclables. The MRF is easily adjustable in changing the sorting order to the different kinds of incoming waste.

The introduction of this chapter described a second part of this research about the overall process of waste management in the BRWM and the previous research. After becoming more familiar with the problems the BRWM have to struggle with, some issues kept on coming back in advice reports. The main returning problem was *inadequate data.* This resulted in false prognosis about the space left on the landfill and future implementations. Another issue was that some pieces of advice contained plans which were not within the financial capabilities of the BRWM. Consultants and students produced different advice and recommendations, but most of them were based on assumptions. The BRWM kept on receiving advice and in the meanwhile no action was taken. Strategies cannot be valuable if they are not based on true facts, like the following comparison: *"You cannot be on time when you do not know what the time is".* It is not possible to make a valuable decision on unreliable information. Therefore, data collection is essential. Only then, a strategy for the future can be determined. Recycling is a business based on *knowledge* and meeting the *quality requirements of the buyer*.

With this advice report, the business case of the MRF is created. It is important for the BRMW to frequently update this business case when more information is available.

Recommendations for further research

This research made a start with more accurate calculations about financial figures and waste streams towards the landfill; unfortunately, there is still a lack of accurate figures. With new and more exact information, it is possible to refine these calculations and use it for new strategies in the near future. Therefore, further research is required:

- When the MRF is operating, the following uncertainties need to be recalculated:
  - Waste streams towards the landfill.
  - Profits earned with generated recyclables.
  - Exact volume density increasing by compacter.
  - Composition of waste.
- Participating rate separating at source citizens once introduced.
- Integration of brokers with the BRWM recycling process.
- Abattoir waste recycling.
- Electronic waste collection (e.g. school/supermarket projects).
- Implement/review an accurate monitoring system for acquiring accurate data.
- Outsource possibilities.

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Experts

University of applied Sciences Utrecht

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Waste experts

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Appendices

Appendix I Polokwane Declaration

The Polokwane Declaration on Waste Management

POLOKWANE, NORTHERN PROVINCE, SOUTH AFRICA
26-28 SEPTEMBER 2001

1. Preamble:

WE THE REPRESENTATIVES of government at national, provincial and local level; civil society and business community,

PARTICIPATING in the first National Waste Summit, hosted by Department of Environmental Affairs and Tourism and held in Pietersburg, September 26-28, 2001

RECOGNIZING that waste Management is a priority for all South Africans, and the need for urgent action to reduce, reuse, and recycle waste in order to protect the environment;

FURTHER RECOGNIZING that we can achieve the vision and the goal contained in this declaration, namely,

Vision

To implement a waste management system which contributes to sustainable development and a measurable improvement in the quality of life, by harnessing the energy and commitment of all South Africans for the effective reduction of waste.

Goal

Reduce waste generation and disposal by 50% and 25% respectively by 2012 and develop a plan for ZERO WASTE by 2022.

REAFFIRM our commitment to the Integrated Pollution and Waste Management Policy, the National Waste Management Strategy and the principles of waste minimization, reuse, and recycling for sustainable development.

RECOMMIT ourselves to the objectives of the integrated pollution and waste management policy.

EMPHASIZE the essential role of efficient management of waste in sustainable development and the protection of human health and the environment.

ACKNOWLEDGE the responsibility as South Africans to work together in our shared vision for zero waste by 2022 based on an implementation and evaluation approach.

SHARE grave concern about environmental degradation, which has significant economic and social impact.

DETERMINED to undertake initiatives that will promote appropriate and efficient use of natural resources, and to protect the people of South Africa and the environment.

2. Do hereby declare that government, business and civil society need to join in common efforts toward the accomplishment of the goal for reduction of waste generation and disposal by 50% and 25% respectively by 2012 and engage in the following actions:

(1) Prioritization of Waste Management.

(2) Implementation of the National Waste Management Strategy.

(3) Development and implementation of a Legislative and Regulatory Framework to promote waste avoidance, prevention, reduction, re-use and recycle.

(4) Provision of efficient and effective collection and disposal facilities.

(5) Establishment and enforcement of targets for waste reduction and recycling.

(6) Setting benchmarks towards achieving the 2012 target.

(7) Disseminate information on the status and trends on waste reduction in the country.

(8) Introduce mandatory waste audit processes.

(9) Explore the use of economic instruments to support waste management initiatives.

(10) Develop and provide the public with educative resources necessary to allow participation in the waste elimination process on an informed basis.

(11) Develop Intergovernmental Capacity.

(12) Develop Waste Information and Monitoring Systems.

(13) Establish systems that ensure that physical and financial responsibility for waste is borne by the product producers.

(14) Effectively manage waste disposal/reprocessing facilities, thereby avoiding the need to establish new, or expand existing facilities.

(15) Promote employment and economic empowerment opportunities, in particular in Small, Medium and Micro Enterprises, through increased product reuse and material recycling.

(16) Promote clean technology and clean production.

2.1 While acknowledging the progress made so far, we the participants, agree that much still remains to be done in order to accomplish the objectives of the white paper, and to build on progress to date to meet those objectives.

We therefore commit ourselves as:

2.1.1 National, Provincial and Local Government

(1) To develop and implement a comprehensive legislative and regulatory framework by June 2002.

(2) Implement the NWMS.

(3) To build capacity within all spheres of government.

(4) Promote strong intergovernmental coordination and cooperation.

(5) To develop an Information Management System by April 2002.

(6) Explore and support appropriate economic instruments to support the NWMS.

(7) To set up a Multi Stakeholder forum consisting of national, provincial, local government, business and civil society.

(8) Promote and Implement sustainable poverty relief projects.

(9) To provide comprehensive waste management services.

(10) To explore the establishment of a National Waste Fund.

(11) To develop compliance monitoring mechanism.

(12) To develop comprehensive communication strategies including mounting campaigns.

2.1.2 Civil Society

(1) Build capacity including community to community empowerment and raise environmental awareness.

(2) Develop skills in advocacy and lobbying.

(3) Streamline administration services that deliver effective environmental waste management services.

(4) Participate actively in regulatory mechanisms through monitoring and contributing in effective management of disposal sites.

(5) Promote and support waste reduction, re-use and recycling.

(6) Promote and Participate in safe and healthy waste recovery methods.

(7) Collaborate with government and relevant stakeholders.

(8) Actively engage in Public Private Partnerships to mobilize resources to implement innovative waste management programmes.

2.1.3 Business Community

(1) Representatives from business commit themselves to a process of engagement with government and civil society with a view of agreeing to a range of joint ventures, which would showcase the potential of partnership between government and business to achieve sustainable waste management.

(2) Utilize cleaner production technologies and methods of production.

(3) Comply with legislation, regulation and standards.

(4) Meet waste reduction targets and in addition make voluntary commitments to exceed the targets.

(5) Strengthen relationship between government, business to business and civil society by improving and promoting transparency.

(6) Manufacture more safer environmentally friendly products.

(7) Contribute towards improved networking and information sharing.

(8) Engage in programmes that promote responsible advertisement and labeling of products.

(9) Promotion of sustainable Public & Private Partnership in order to improve Waste Management service delivery. The Partnerships will be based on shared responsibility, social responsibility, accountability, competency, reliable service provision and compliance with norms and standards.

(10) Promotion of recycling opportunities which are sustainable and engage in activities that will grow the recycling industry by 30% by 2012.

THIS JOINT DECLARATION IS PREMISED ON THE PATRIOTISM WHICH ALL SOUTH AFRICANS OUGHT TO EMBRACE.

ADOPTED AT THE FIRST NATIONAL WASTE SUMMIT 26-28 SEPTEMBER 2001.

PARTIES

1. GOVERNMENT OF SOUTH AFRICA REPRESENTED BY THE DEPUTY MINISTER REJOICE MABUDAFHASI, DEPUTY MINISTER OF ENVIRONMENTAL AFFAIRS AND TOURISM

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2. BUSINESS COMMUNITY REPRESENTED BY JOHN DES LIGNERIS

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3. CIVIL SOCIETY REPRESENTED BY MS MASANA E. MOTUBATSE

Appendix II National Waste Management Strategy

National Waste Management Strategy (NWMS)

The ultimate aim of the NWMS is to implement a co-coordinated integrated waste management system to ensure “cradle to grave” management of waste.
The Table below summarizes in broad terms the key elements of the historical waste management approach compared to the strategic objective of the NWMS:

HISTORICAL WASTE MANAGEMENT APPROACH	STRATEGIC OBJECTIVES FOR INTEGRATED WASTE MANAGEMENT
Limited focus on control mechanisms	Focus on sustainable environmental protection
Inadequate waste collection services	Adequate waste collection services for all
Adverse effect on the environment and public health	Sustainable protection of the environment and public health
Fragmented approach with single media focus	Consolidated multimedia approach
Conflict of interests	Transparency in conflict resolution
Insufficient information Integrated	Waste Information System
Inadequate environmental planning	Holistic integrated environmental planning and capabilities
Inadequate R&D programmes	Focused investigations that take cognisance of cross-cutting implications
Fragmented regulatory approach	Integrated regulatory approach
Regulations inadequately enforced	Enforcement facilitated
Full waste management costs not realized	Polluter Pays Principle and total cost accounting

Further issues addressed in the NWMS with regards to integrated waste management initiatives are:
• Integrated waste management planning, regulations and guidelines;
• Waste information system;
• Waste minimisation;
• Recycling;
• Waste collection and transportation;
• Waste treatment; and
• Waste disposal.

Implementing instruments being considered include:
• Institutional development;
• Capacity building;
• Legislative requirements;
• Funding; and
• Public participation and partnerships, education and awareness.

Appendix III Five ways of thinking about change

Five ways of thinking about change

In the following table is described how to trigger and satisfy employees during a change within a company.

	Things/people will change if you
Yellow thinking	- Can unite the interests of the important players - Can compel people to accept (common) points of view/opinions - Can create win-win situations/can form coalitions - Demonstrate the advantages of certain ideas (in terms of power, status, influence) - Get everyone on the same wavelength - Can bring people into a negotiating process
Blue thinking	- Formulate a clear result/goal beforehand - Lay down a concrete plan with clear steps from A to B - Monitor the steps well and adjust accordingly - Keep everything as stable and controlled as possible - Can reduce complexity as much as possible
Red thinking	- Stimulate people in the right way, for example, by inducements (or penalties) - Employ advanced HRM tools for rewards, motivation, promotions, status - Give people something in return for what they give the organisation (barter) - Manage expectations and create a good atmosphere - Make things attractive for people
Green thinking	- Make people aware of new insights/own shortcomings - Are able to motivate people to see new things/to learn/to be capable of ... - Are able to create suitable (collective) learning situations - Allow the learning process to be owned by the people involved and geared toward their own goals
White thinking	- Start from people's drives, strengths, and "natural inclinations" - Add meaning to what people are going through - Are able to diagnose complexity and understand its dynamics - Give free rein to people's energy and remove possible obstacles - Make use of symbols and rituals

Appendix IV Calculations profit recyclables

Calculations profit recyclables

Year	Type	Percentage (%)	Recyclables (ton)	Price per ton	Profit (ton)
2009	**Recyclables Low income**		67		
	Glass	18,65%	12	290	3623
	Paper common mix	14,11%	9	350	3308
	Newspaper / Magazines	9,95%	7	400	2665
	Cardboard	6,64%	4	650	2892
	Metal	13,28%	9	800	7118
	HDPE	12,04%	8	2000	16134
	LDPE	12,87%	9	800	6896
	PS	3,30%	2	1500	3320
	PET	9,15%	6	2300	14099
Total		100,00%	**67**		**60055**
	Recyclables High income		276		
	Glass	25,24%	70	290	20199
	Paper common mix	15,44%	43	350	14911
	Newspaper / Magazines	7,52%	21	400	8306
	Cardboard	5,58%	15	650	10011
	Metal	15,07%	42	800	33286
	HDPE	10,16%	28	2000	56090
	LDPE	8,86%	24	800	19555
	PS	2,30%	6	1500	9540
	PET	9,83%	27	2300	62389
Total		100,00%	**276**		**234289**
	Recyclables Business waste		321		
	Glass	24,65%	79	290	22933
	Paper common mix	21,85%	70	350	24539
	Newspaper / Magazines	7,31%	23	400	9379
	Cardboard	8,67%	28	650	18080
	Metal	12,16%	39	800	31202
	HDPE	8,34%	27	2000	53485
	LDPE	7,64%	25	800	19616
	PS	3,46%	11	1500	16666
	PET	5,92%	19	2300	43707
Total		100,00%	**321**		**239608**
Total profit					**533952**

Table 12: Profit recyclables 2009

Year	Type	Percentage (%)	Recyclables (ton)	Price per ton	Profit (ton)
2010					
	Recyclables Low income		143		
	Glass	18,65%	27	290	7754
	Paper common mix	14,11%	20	350	7078
	Newspaper / Magazines	9,95%	14	400	5703
	Cardboard	6,64%	10	650	6188
	Metal	13,28%	19	800	15232
	HDPE	12,04%	17	2000	34527
	LDPE	12,87%	18	800	14758
	PS	3,30%	5	1500	7106
	PET	9,15%	13	2300	30172
Total		100,00%	**143**		**128518**
	Recyclables High income		465		
	Glass	25,24%	117	290	34041
	Paper common mix	15,44%	72	350	25129
	Newspaper / Magazines	7,52%	35	400	13998
	Cardboard	5,58%	26	650	16871
	Metal	15,07%	70	800	56096
	HDPE	10,16%	47	2000	94526
	LDPE	8,86%	41	800	32955
	PS	2,30%	11	1500	16077
	PET	9,83%	46	2300	105141
Total		100,00%	**465**		**394835**
	Recyclables Business waste		458		
	Glass	24,65%	113	290	32717
	Paper common mix	21,85%	100	350	35010
	Newspaper / Magazines	7,31%	33	400	13381
	Cardboard	8,67%	40	650	25794
	Metal	12,16%	56	800	44515
	HDPE	8,34%	38	2000	76305
	LDPE	7,64%	35	800	27986
	PS	3,46%	16	1500	23777
	PET	5,92%	27	2300	62356
Total		100,00%	**458**		**341841**
Total profit					**865194**

Table 13: Profit recyclables 2010

Year	Type	Percentage (%)	Recyclables (ton)	Price per ton	Profit (ton)
2011	**Recyclables Low income**		153		
	Glass	18,65%	29	290	8297
	Paper common mix	14,11%	22	350	7574
	Newspaper / Magazines	9,95%	15	400	6102
	Cardboard	6,64%	10	650	6621
	Metal	13,28%	20	800	16298
	HDPE	12,04%	18	2000	36944
	LDPE	12,87%	20	800	15791
	PS	3,30%	5	1500	7603
	PET	9,15%	14	2300	32284
Total		100,00%	**153**		**137514**
	Recyclables High income		850		
	Glass	25,24%	215	290	62210
	Paper common mix	15,44%	131	350	45924
	Newspaper / Magazines	7,52%	64	400	25581
	Cardboard	5,58%	47	650	30832
	Metal	15,07%	128	800	102515
	HDPE	10,16%	86	2000	172746
	LDPE	8,86%	75	800	60225
	PS	2,30%	20	1500	29381
	PET	9,83%	84	2300	192144
Total		100,00%	**850**		**721558**
	Recyclables Business waste		612		
	Glass	24,65%	151	290	43759
	Paper common mix	21,85%	134	350	46825
	Newspaper / Magazines	7,31%	45	400	17897
	Cardboard	8,67%	53	650	34499
	Metal	12,16%	74	800	59539
	HDPE	8,34%	51	2000	102058
	LDPE	7,64%	47	800	37431
	PS	3,46%	21	1500	31802
	PET	5,92%	36	2300	83401
Total		100,00%	**612**		**457212**
Total profit					**1316284**

Table 14: Profit recyclables 2011

Year	Type	Percentage (%)	Recyclables (ton)	Price per ton	Profit (ton)
2012	**Recyclables Low income**		295		
	Glass	18,65%	55	290	15980
	Paper common mix	14,11%	42	350	14587
	Newspaper / Magazines	9,95%	29	400	11753
	Cardboard	6,64%	20	650	12752
	Metal	13,28%	39	800	31390
	HDPE	12,04%	36	2000	71153
	LDPE	12,87%	38	800	30414
	PS	3,30%	10	1500	14644
	PET	9,15%	27	2300	62180
Total		100,00%	**295**		**264853**
	Recyclables High income		1217		
	Glass	25,24%	307	290	89082
	Paper common mix	15,44%	188	350	65762
	Newspaper / Magazines	7,52%	92	400	36632
	Cardboard	5,58%	68	650	44151
	Metal	15,07%	183	800	146798
	HDPE	10,16%	124	2000	247367
	LDPE	8,86%	108	800	86240
	PS	2,30%	28	1500	42073
	PET	9,83%	120	2300	275145
Total		100,00%	**1217**		**1033249**
	Recyclables Business waste		786		
	Glass	24,65%	194	290	56187
	Paper common mix	21,85%	172	350	60124
	Newspaper / Magazines	7,31%	57	400	22979
	Cardboard	8,67%	68	650	44297
	Metal	12,16%	96	800	76448
	HDPE	8,34%	66	2000	131043
	LDPE	7,64%	60	800	48062
	PS	3,46%	27	1500	40834
	PET	5,92%	47	2300	107087
Total		100,00%	**786**		**587060**
Total profit					**1885162**

Table 15: Profit recyclables 2012

Year	Type	Percentage (%)	Recyclables (ton)	Price per ton	Profit (ton)
2013	**Recyclables Low income**		316		
	Glass	18,65%	59	290	17098
	Paper common mix	14,11%	45	350	15609
	Newspaper / Magazines	9,95%	31	400	12575
	Cardboard	6,64%	21	650	13645
	Metal	13,28%	42	800	33588
	HDPE	12,04%	38	2000	76134
	LDPE	12,87%	41	800	32543
	PS	3,30%	10	1500	15669
	PET	9,15%	29	2300	66532
Total		100,00%	**316**		**283392**
	Recyclables High income		1302		
	Glass	25,24%	329	290	95318
	Paper common mix	15,44%	201	350	70365
	Newspaper / Magazines	7,52%	98	400	39196
	Cardboard	5,58%	73	650	47241
	Metal	15,07%	196	800	157074
	HDPE	10,16%	132	2000	264682
	LDPE	8,86%	115	800	92277
	PS	2,30%	30	1500	45018
	PET	9,83%	128	2300	294405
Total		100,00%	**1302**		**1105576**
	Recyclables Business waste		841		
	Glass	24,65%	207	290	60120
	Paper common mix	21,85%	184	350	64333
	Newspaper / Magazines	7,31%	61	400	24588
	Cardboard	8,67%	73	650	47398
	Metal	12,16%	102	800	81799
	HDPE	8,34%	70	2000	140216
	LDPE	7,64%	64	800	51426
	PS	3,46%	29	1500	43692
	PET	5,92%	50	2300	114583
Total		100,00%	**841**		**628154**
Total profit					**2017123**

Table 16: Profit recyclables 2013

Appendix V Minutes

Minutes MRF Malmesbury, Swartland

Date: 12th of March 2009
Time: 12.30 – 14.00
Place: Malmesbury
Attendance: Thijs Aarden, Pim van de Bunt, Kim Kaak, Max Kranendijk

Introduction

The MRF in Malmesbury is one of the oldest MRF's in the Western Cape and therefore, a good example to visit. The MRF is run by the municipality and the manager of the MRF is Hein Baumgarten. He gave us a tour in the MRF.

About Malmesbury MRF

All the waste of the municipality arrives at the Malmesbury MRF. The municipality exists of 11 villages, where Malmesbury is by far the biggest. The MRF is not profitable. This isn't the main purpose anyway. The main purpose is to save airspace on the landfill and to create jobs.

Summary

Process

The compactor enters the site and gets weighted. Depending on where the waste comes from, it goes into the MRF. Each day 70 tons of waste enters the MRF. That is 2400 tons of waste each month and 33% of this waste (volume wise) gets recycled. This results in 800 m^3 per month of saved airspace.

After the waste is weighted it enters the MRF. In the MRF it gets dumped at a general dumping depot. This is a space of approximately 375 m^2. The black bags are ripped open here and put on the conveyor belt. After that the pickers can sort out the waste. On the sides of the conveyor belt there are several bags, where they can put the different materials in. After all the waste is separated, all the waste is compressed into bales. A normal truck has the capacity of 72 bales.

Only the waste of the high income area and the business waste goes to the MRF. The waste of the low income goes straight to the landfill. Commercial is therefore by far the most valuable. If there is a lot of abattoir waste in the compactor, then the waste doesn't enter the MRF. The man at the entry decides on that.

There are a total of 23 people working on the MRF, inclusive the landfill. There are 9 female pickers working next to the conveyor belt.

They separate the following into different bags:

- Tin
- Paper
- Metal
- Plastic
- Glass

Plastic is further separated in:

- High quality plastics
- Low quality plastics
- Hard plastic, like crates
- PET bottles, like coke bottles

Paper is further separated in :

- Mixed paper
- News paper
- Office paper

It doesn't matter if the compressed bales of waste get wet. In fact, it's profitable since the bales of waste get heavier and the buyers pay the MRF by the weight of the bales.

It is possible to wash the waste and it's profitable if you have big quantities of waste. The waste is lighter after washing so the yield is lower. Therefore, the prices of washed waste is higher.

Building

The building exists of a steel construction. It likes quite a lot like the MRF in Ashton. The sides are covered with IBR cladding

Detail

- Split level floors
- No ventilation units on the roof
- Weighbridge at the entrance of the site
- Steel construction
- Bricks up to 700 mm above ground. After that, the sites are finished with cladding.
- No isolation in the roof
- Big overhead doors

Minutes Hermanus Transfer Station and MRF

Date: 13th of March 2009
Time: 11.00 – 15.00
Place: Hermanus
Attendance: Thijs Aarden, Pim van de Bunt, Max Kranendijk

Introduction

The transfer station of Hermanus is one of the biggest and most successful running transfer station in the Western Cape. In order to get a good impression of how a good transfer station looks like, we visited this transfer station. We met Johan van Tag, the manager of the transfer station, at the transfer station.

About Hermanus transfer station

The Hermanus transfer station is collecting the waste of approximately 35000 inhabitants.

Summary

Domestic waste

In Hermanus they have been separating at source for a few years now. All the waste is separated at the homes and collected in 2 different bags: 1 bag for recyclables and 1 bag for non-recyclables. This municipality has also placed glass bins all around the town. They are used the same way as in The Netherlands. They are also separating in the low income area, but on a different way. The low income area is close by the transfer station. The people from this area come and bring their own waste to the transfer station and get paid per kg waste. Their waste is mostly glass and bottles.

In Hermanus they have build special 'Swop Shops'. At these shops, they can buy products with recyclable waste. For example, they can buy toothpaste, toilet paper or soap. These shops are build for children, but they mostly get used by adults. Important fact is that the shop doesn't sell products that are already sold in local shops, this creates unpleasant competition.

Business waste

These recyclables are collected every day by private companies. The non-recyclables of the business waste is brought by the companies themselves. At the transfer station their waste can be dumped in containers. Each month companies get free tokens, so they can bring their waste for free. When a company needs more tokens, they have to buy them at the transfer station.

Process in Transfer station

Non-recyclable waste gets dumped in containers. These containers are checked out by pickers at a later stage. After that, the waste goes to the MRF.
The separated waste, of companies and households, is going straight to the MRF. In here, a second separation is done. After the waste is separated, the waste is getting compressed to smaller bales. This saves a lot of space. Since there is separation at source, the waste is not dirty. Therefore, washing the waste is not needed.

Awareness

This is done by involving the people with pollution problem. People were putting effort into it, it was complete new for them, but they did cooperate. Involving people with the problem was done by putting articles in the newspapers, but the best way of informing is to actually go to the people and tell them what to do. This needs to be done frequently in order to remind the people of the problem.
In the high income area, they gave the people a flyer and a different waste bag.

Return

In Hermanus they have a kind of PPS-construction: the municipality is collecting the waste and brings the recyclables to the MRF. A private company runs the MRF and sells the waste to recycle companies.

Building

The only different compared with the building in Malmesbury is that the terrain with the transfer station and MRF consists of multiple buildings. There is also lighting outside, giving it a secured feeling.

Facts

- There are specials bins for chemical waste, like batteries, flammables, hazardous waste etc.
- Each month 2000-2500 tons of waste comes at the transfer station. There is one person at the transfer station who is coordinating all the incoming waste to the right containers.
- There are 40 people working at the MRF and the transfer station. They get paid approximately 200 rand a day.
- A big problem for the BRWM is the distance to Cape Town. The cost of the transport can become high of this.
- Metal is the best material to sell, the price of this material is the highest at the moment.

Minutes Waste Plan

Date: 16th of April 2009
Time: 09.00 – 11.00
Place: Durbanville
Attendance: Thijs Aarden, Pim van de Bunt, Max Kranendijk

Introduction

The director of Waste Plan is Mr. Bertie Lourens. He is the manager of an MRF, which he runs in the area. He is a well known men in the waste recycling world and lot of people refer to him.

About Waste Plan

Waste Plan is a waste management company that specializes in the reduction , recycling, removal and reporting of waste generated in the manufacturing and retail sectors as well as municipal residential areas. Their main focus is on removals reduction and to minimize waste to the landfill. Waste plan has future plans to develop workshops in which they will research the possibilities or recycling methods used in Europe, in order to improve the situation in South Africa.

Interview questions

- Are there ways to calculate the volumes of waste, when you only have the weight of the waste?
- Are there long terms contracts between the MRF and the recycling companies?
- Is the amount of waste growing because of the economical growth? How fast is it growing?
- Do you have statistics of waste and relevant counts that are useable for the MRF that they are building in Ashton?

Bertie Lourens knows a lot about waste and recycling. He is also one of the few who is updating his recycling results and therefore we were able to compare our counts with his and fill in the missing parts of our counts.

Interview

When you have separation at source, 2 bags will be collected. Before the compactor comes to pick up the recycle bag, people will steal the bags. About 10% of all recycle bags are stolen before they can be picked up by the compactor.

There need to be 1 buy-back centre in each town, to prevent people from dumping waste illegal. These buy-back centre are mend for the poorer people, so that they have a small income out of it.

Municipalities have poor communication with the local community and don't know well how to motivate people. Therefore, you need to outsource, in order to be successful. Make use of facts and keep the message short; people don't like to be bothered with long messages.

Bertie Lourens told us that he is busy researching the possibilities of recycling organic waste. Organic waste is by far the biggest sector of non-recyclables and organic waste can be used to generate power. He is convinced that if there is a way to recycle organic waste, each MRF will have a standard rate of 30% recyclables of the total waste.

Facts

- On average, each household produced 11.54 kg/house/month in 2008.
- On average, each household produced 14.54 kg/house/month in 2009.
- The recycle participation rate is 67% in 2008.
- Waste generation growth of 7% last year in Cape Town.
- There is only a small impact on the amount of waste due to the financial crisis.
- Of all the recyclables you collect, 10% gets lost. This 10% is either contaminated or it doesn't get filtered out at the MRF.
- You can combine tin and metal in 1 bin.

- By crushing the glass, you can make bins 2.5-5 times more heavy.
- Bertie Lourens get R 0.50/kg, we will probably receive R 0.30-0.35/kg.
- There are no long-term contracts with recycle companies, the prices are too unstable for that.
- In Industrial waste you find the most recyclables, therefore, it is profitable to collect the waste from them.

Minutes Akura Manufacturing Engineering Company. (Pty) Ltd

Date: 26th of June 2009
Time: 11.00 – 12.00
Place: Ashton
Attendance: Max Kranendijk

Introduction

To gain more information about the MRF in Ashton I planned a meeting with the Installation team of Akura in Ashton. Some of the workers have already more than twenty years of experience within the business. Andre van Heever guided me through the MRF and explained me how the throughput will be in the future by going through all the steps..

Akura Manufacturing Engineering Company. (Pty) Ltd

Akura manufactures custom made equipments from machines until whole facilities like in Ashton.

Summary

The MRF has three doors, only two are used for in and output. Number three is used for ventilation. Waste is brought in and stored in front of the conveyor belt. Bags are opened and pushed to the belt. When waste is 'too dirty' it will be put directly in the waste skip. At the conveyor belt there is space for sixteen workers at the 'sorting gapes'. If needed it is possible to put six extra people at the belt, but they need to use separate bags for sorting. An average person can handle 70 kg per hour when working sufficient, but an average of 60 kg is used. With a quick calculation 7680 kg (60*16*8) per day can be recovered. There are eight 'sorting gapes', so 8 different materials can be sorted. Plus glass which is sorted at the end of the belt. The best sorting order is a continues discussing between experts. Some say you need to get out the biggest pieces first and other say first the most valuable. In the end it depends often on the composition of waste and the kind of MRF. Trial and error is the best method to find the best sorting order. First start with getting out the easiest recyclables like cardboard, white paper, PET, glass and tin. Later this can be expanded with more materials.

Facts

- Maximal of 10% can be recovered from mixed (non separated) waste.
- For the first years for separated waste it will be around 30%.
- An experienced MRF in Cape Town recovers 40% from separated waste.
- Maintenance cost are low:
    - First year 750 rand.
    - Every next year 2400 rand.
    - Big parts like blades cost 7000 rand.
    - Rest of the cost are fuel for truck and lubricating oil.
    - Similar MRFs are operating fine without big maintenance for more than twenty years.