

Rehabilitation of an Abandoned Open Cast Mined Area: From an Open Cast Pit to a Waste Disposal Facility - A Case Study

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ABSTRACT

In 2000 the Rustenburg Local Municipality (RLM) acknowledged that their waste disposal site was rapidly running out of airspace and that an action-plan was to be put in place to explore the possibility of developing a new waste disposal facility for the fast growing local district. The requirement was that the site had to be spacious enough to cater not only for the rapidly developing city, at the time, but also to accommodate the future airspace needs of the rapidly developing platinum industry in the area. The disposal facility was developed keeping in mind the possibility of it becoming a regional waste disposal facility in the future that was to serve more than just the RLM, but also some of the surrounding other municipalities within the Bojanala Platinum District Municipality (BPDM). Historic discussions with one of the biggest platinum mining houses in the area to explore and investigate the possible use of an ideally situated abandoned open cast mine pit needing rehabilitation and in close proximity to the centre of the city was revived.

Once the go-ahead was approved in 2001, RLM embarked on a tender process and appointed waste consultants to develop an Integrated Waste Management Strategy, which included the identification and development of a new "Regional" waste disposal facility for Rustenburg. Twelve candidate disposal sites were identified during the site selection process. Candidate sites identified were compared and evaluated in terms of their environmental, social and economic criteria. The Waterval Open Cast Site came out tops with the highest score and after much deliberation between all parties and other stakeholders the site was eventually earmarked for development. The suitability of the site was confirmed by the feasibility study conducted shortly thereafter and concluded in 2004. The total site area is approximately 120 hectares (disposal footprint 80 hectares) in size. The site is further surrounded by huge berms shielding it completely from the public eye. The mine and owner of the land in terms of their EMP is obliged to close and rehabilitate the open cast area. By developing it as a waste disposal facility to serve, not only the interest of the RLM but to provide long-term disposal capacity to the city on the one hand, but also favours the mine in that they do not have to spend huge capital costs for the closure and rehabilitation of the mining site. The arrangements between the Licence Holder, RLM, and the mine are secured in a long-term lease agreement. The Waste Management Licence was issued to RLM in 2012 after which the construction phase commenced. The site is currently under construction and is expected to be completed in July 2014 after which it will become operational.

1. INTRODUCTION

The Rustenburg Local Municipality in 2001 proposed the development of a new Waste Disposal Facility (WDF) to serve the Rustenburg area (approximate population of approximately 750 000) mainly due to the rapid growth and development of the municipality. The need for a new WDF was further supported by (a) a decline in airspace at the current municipal waste disposal site (Townlands); and (b) serious environmental and social non-compliance issues at the Townlands WDF.

1.1 Historic overview

To address the need for an environmentally and public-friendly, safe and acceptable WDF in the Municipal jurisdictional area, the municipality in 2001 called for tenders to appoint a service provider to assist them in achieving two objectives identified for their waste management division:

- The development of a Regional Waste Management Strategy (which became an Integrated Waste Management Plan) (IWMP); and
- The identification and development of a new "Regional" WDF for the municipal district.

Amendments made to the Municipal Systems Act 2000 (Act 32 of 2000) (MSA) in 2000, allocated the function of developing WDFs, previously a District Municipal function, to Local Municipal Authorities. The development of new WDFs within the Municipality therefore became a local municipal function.

After the conclusion of a competitive bid process, consultants were appointed in 2002 and commenced with the work immediately.

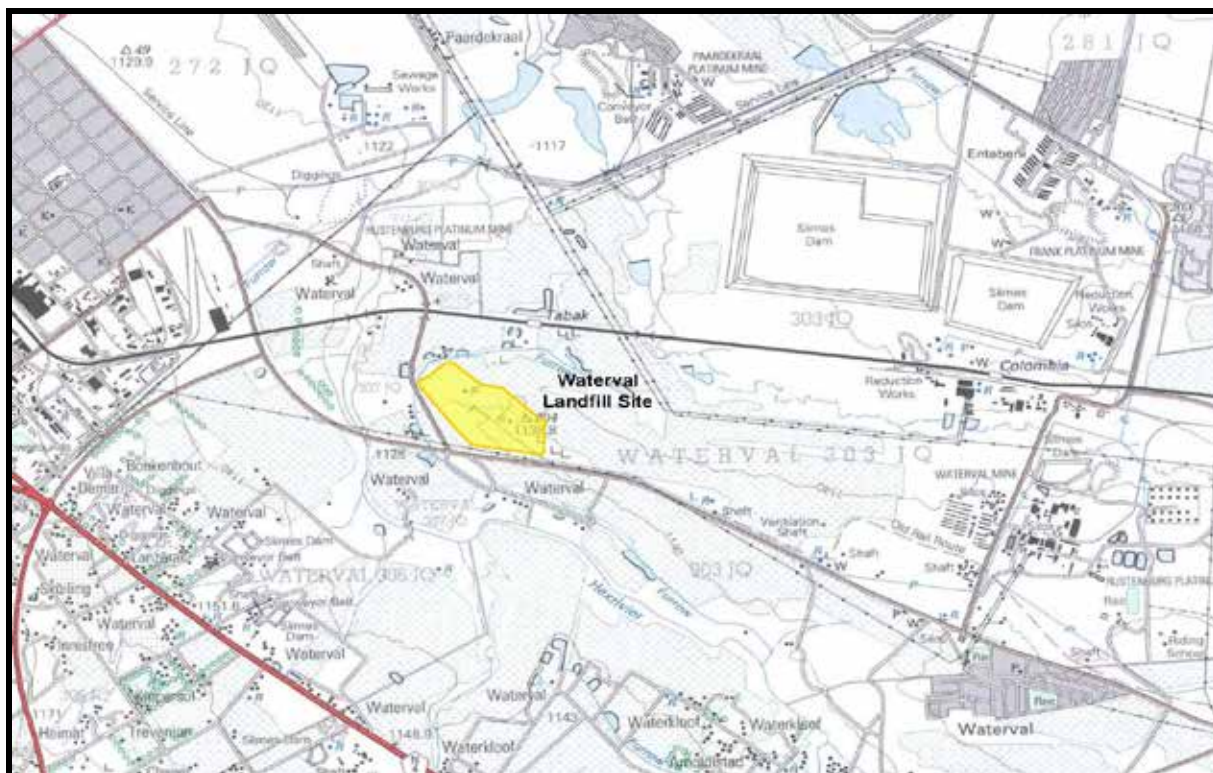


Figure 1. Location of the the Waterval WDF.

1.2 Disbanded open cast mining area

As a first step in a regional waste management strategy for the Municipality area, the technical feasibility and suitability of waste site near Waterval (Figure 1 and 2), approximately 5km outside the city that was previously investigated, had to be reviewed and confirmed. Historically the District Municipality (before 2000) investigated the possibility of converting an abandoned opencast mining area with various open pits to a WDF. Unfortunately, for unknown reasons, the project was abandoned before the legal amendments to the MSA in 2000 came into effect.



Figure 2. Aerial photo of the undeveloped site, with the Phase 1 area in the distance and Phase 2 in the foreground.

2 PRELIMINARY ASSESSMENT OF HISTORIC STUDIES

Assessing the historic project information the following approach was followed:

- Review of all studies, investigations and technical documents generated by the District Municipality prior to 2000 for the site;
- Identify gaps and additional studies that might be required to confirm the suitability of the site; and
- Make recommendations to either proceed with the site investigations of the site or to identifying and consider alternative candidate sites to the proposed Waterval site for further investigation.

The Preliminary Assessment entailed a technical evaluation and environmental feasibility of the proposed Waterval landfill site (Figure 1) with a view to subsequent detailed investigation, permitting and construction of this site as a regional WDF. Based on the historic documentation review undertaken, the Consultants concluded the following:

- The project had to be registered with the North West department of Agriculture, Conservation and Environment (NWDACE) for the Waste Management Licence (WML) licence and EIA;
- Alternative candidate sites around the city had to be identified and investigated; and
- Detailed geological and geohydrological investigations were considered necessary to rule out any potential critical issues at the Waterval site (which was already partly investigated previously).

3 AIRSPACE REQUIREMENTS

Various waste disposal scenarios and calculations done for the new regional WDF indicated that the Initial Rate of Deposition (IRD) was estimated between 137 000 and 210 000 tonnes per annum, which meant that the site would receive more than 500 tonnes per day. In terms of the Department of Water Affairs (DWA) Minimum Requirements Guideline Series (MR) the proposed facility was classified as follows:

- General waste: G;
- Large site: L; and
- Water deficit: B

On account of the climatic water balance (B) done and the nature of the waste, no significant leachate generation is expected. Based on the above, the proposed regional WDF classified as a G:L:B facility. In terms of the current National Environmental Management: Waste Act 2008, Act 59 of 2008 (NEMWA) GN R.636: Norms and Standards for the Disposal of Waste to Landfill of 23 August 2013, the site will classify as a "Class C" disposal facility.

The airspace required for a 25 year planning horizon, between 4.8 and 8.8 million m³ was required for the new WDF. To meet this estimated airspace requirement and allow for the site infrastructure, such as site offices, weighbridge, recycling and composting facilities and others, it was calculated that the size of the area required would be between 90 and 120 hectares at least. Although the potential disposal area of the Waterval site was in the order of 118 hectares (considered more than adequate for a 25-year lifespan), it was decided to look at all alternative sites in the area. Twelve alternative areas were identified of which nine were eventually selected as candidate sites for further evaluation.

4 SITE SELECTION

Candidate sites (Table 1) were added to the list using a "negative mapping" technique. These candidate sites were then plotted on to 1:50 000 topographical maps of the area and a desktop study was undertaken to evaluate and compare these sites and their surroundings (MR process).

The nine candidate sites were evaluated and appraised against environmental, technical, economic and social criteria, in order to rank them and identify the one achieving the highest score and identified as the most suitable site.

Table 1: Summary of candidate landfill sites locations, owners and land-use

Site No.	Candidate site	Site co-ordinates		Farm Name		Current land use
		Longitude	Latitude			
1	Fika Trust Site	27° 24' 30"	25° 40' 38"	HOEDSPRUIT 298 JQ		Undetermined
2	Waterval Rehabilitated site	27° 18' 30"	25° 40' 47"	WATERVAL 303 JQ		Closed & rehabilitated open cast mine
3	Waterval site	27° 18' 30"	25° 40' 47"	WATERVAL 303 JQ		Mining
4	Frank Shaft	27° 19' 55"	25° 38' 47"	KLIPGAT 281 JQ		Mining
5	Paardekraal	27° 18' 9"	25° 37' 47"	PAARDEKRAAL 279 JQ		Mining/Residential Depending on area
6	Industrial site	27° 14' 13"	25° 36' 13"	TOWNS AND TOWNLANDS 272 JQ		Agriculture
7	Boschfontein site	27° 13' 12"	25° 36' 30"	BOSCHFONTEIN 268 JQ		Mining/Agriculture
8	Shaft 16 site	27° 16' 55"	25° 32' 30"	REINKOYALSKRAAL 278JQ		Mining
9	Vlakfontein site	27° 15' 55"	25° 33' 0"	VLAKFONTEIN 276 JQ		Undetermined/Agriculture

The Waterval open cast candidate site came out tops and a decision supported by the public and authorities was taken to continue with more detailed site investigations of this site to confirm it's suitability for further development.



Figure 3: Waterval open cast mining area (Google earth, 2014)

5 LEGAL PROCESS

The project was subsequently registered with the NWDACE, now North West Department of Economic Development, Environment, Conservation and Tourism (NWDEDECT), in 2002 in terms of the previous EIA Regulations GN R.1182 and GN R.1183, September 1997, of the Environment Conservation Act, Act 73 of 1989 (ECA). Approval for the Plan of Study for Scoping was obtained and permission granted to commence with the Environmental Scoping and Public Participation processes in 2003.

The permitting process applicable at the time was followed starting with a Feasibility and Scoping Report of the preferred Waterval site. Various challenges had to be overcome during this period such as the formalisation of a lease agreement and buy-in from the DEA/NWDEDECT, DWA and Department of Mineral Resources (DMR). Meeting and co-ordinating the legal requirements of the individual departments were no easy task. The DMR requested an additional study during this time on the options available to rehabilitate the site and how it would affect the Environmental Management Plan Report (EMPR) that was in place for that mining area. The mine subsequently, in 2004, had to appoint separate consultants to undertake this study and they presented two options to the DMR in 2005:

- Option 1: Rehabilitate back to the natural environment; or
- Option 2: Development of a Waste Disposal Site at the Waterval Opencast Mine.

The DMR approved the development of a WDF as a means of ultimately rehabilitating the abandoned opencast mining area but with various conditions attached. The final EIA and WML applications were submitted at the end of 2011 and authorised in 2012. One of the DMR conditions, the amendment of the EMPR was met by the mine and approved in 2012 after the WML for the new facility was issued by the NWDEDECT.

The Municipality as the Licence Holder, is leasing the site from the Platinum mine whilst the mine retains responsibility and liabilities for the environmental issues related to the site. It is seen as a win-win relationship with the Municipality rehabilitating the open cast mining area on behalf of the mine whilst using the site as a disposal facility. The rehabilitation cost saving for the mine is quite substantial.

The abandoned opencast pits, once engineered and equipped with suitable liner systems to protect groundwater and the environment, were identified as potentially ideal "cells" for the disposal of inert waste. The existing materials on site and site configuration could also be taken advantage of in the following way:

- Stockpiles and berms were utilised as construction material where suitable; and as
- Daily cover during the operational life of the landfill.

At the end of life of the operation, it is envisaged that any remaining voids will be back-filled with available overburden, covered with a layer of topsoil and vegetated.

The site has been split into two phases, with the majority of the Phase 1 development taking place as part of the current construction contract. Phase 1 consists of a relatively small pit, which will be developed into an inert rubble disposal cell. Four large general waste cells (of which, two are being constructed under the current contract) surround the pit, as depicted in the layout plan (Figure 4 below). A significantly larger pit is located in the area set aside for Phase 2, which at a later stage could significantly increase the available airspace of the facility.

The current Phase 1 development work will see the construction of disposal facilities allowing for mainly general waste (non-hazardous waste), as well as some building rubble. It is anticipated that the site will receive between 137 000 and 210 000 tonnes of waste per annum initially and increase at a rate of 3 to 5% per annum thereafter. With the two general waste cells currently being constructed, this would equate to a capacity for between 6 and 8 years extra lifespan, depending on growth and the implementation of the recycling strategy. Should the other two large cells, which form part of Phase 1b, be constructed, the total disposal capacity will increase to provide an extra lifespan of approximately 15 to 20 years.

The WDF will serve the town of Rustenburg in the immediate future, but it is envisaged that at a later stage waste from surrounding towns may be received at the WDF once in operation. The current Municipality disposal facility can also now be closed and rehabilitated.

Although not part of the current construction contract, a materials recovery facility (MRF) funded by one of the platinum mines, as well as, a composting facility is envisaged for the near future, with space allowances having been made for this. Allowance has also been made in the design for landfill gas extraction which could

be flared initially but at a later stage may be utilised for electricity generation or as a fuel in a secondary purpose.

So, where did it all begin?

5.1 Site lay-out and engineering design

The once abandoned opencast mining area was transformed into a modern WDF, which at the same time serves to rehabilitate a previous disturbed mining area. Figure 4 below depicts the Phase 1 lay-out of the facility, currently completed and operational.

Cell 1 and 2 together provide for a capacity of approximately 680 000m³ airspace available. The lined inert rubble disposal pit adds another 90 000m³.

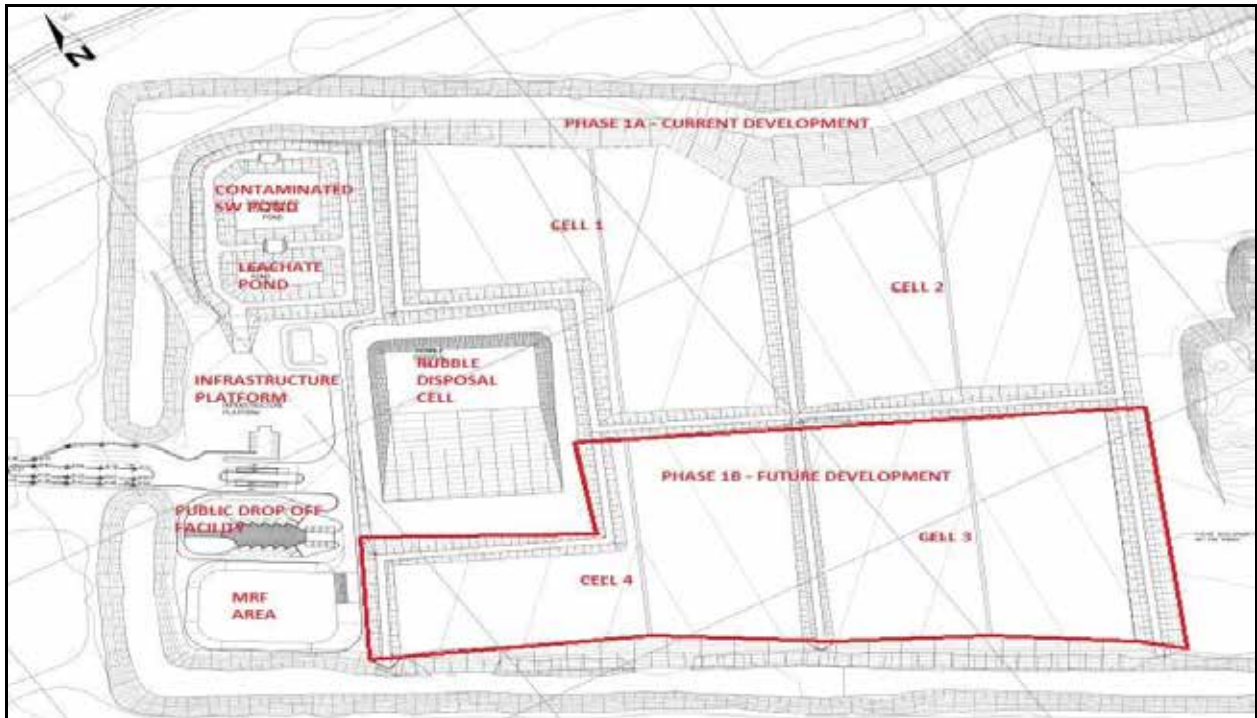


Figure 4: Phase 1a and 1b site lay out.

The liners of the cells, inert pit and ponds are all meeting the requirements of the new NEMWA GN R.636 of 13 August 2013 for a "Class C" disposal site.

6 SITE INFRASTRUCTURE

The following infrastructure had been provided for at the facility:

- Two general waste disposal cells including landfill liner and drainage systems (Phase 1a);
- A rubble disposal cell (Inert waste);
- Leachate and contaminated stormwater ponds;
- Roads;
- Water reticulation;
- Sewer systems;
- Stormwater systems;
- Ablution and canteen buildings (x 2);
- Administrations building;
- Education and training building;
- Workshop;
- Guard house;
- Taxi stop;
- Weighbridge;
- Public drop off facility;

- Fencing (2 perimeter fence lines);
- Generator;
- Vehicles wash bay; and
- Electrical reticulation and lighting (included as a separate contract).

Anticipated future developments to form part of Phase 1 include the following:

- 1 or 2 additional waste cells;
- MRF (To be financed by the mine);
- Composting facility;
- Waste-to-energy plant (Under investigation); and
- Landfill gas flaring/utilisation.



Figure 5: Undeveloped site



Figure 6: Undeveloped inert rubble pit



Figure 7: Rubble pit and cell construction



Figure 8: Compaction of cells



Figure 9: Weigh bridges and offices



Figure 10: Cell liner and base layer

7 SOCIAL IMPACT

The most significant positive impacts related to the new disposal site was the creation of approximately 100 short-term local employment opportunities during the construction phase, with an approximate R 15 million capital cost invested in the local economy of the area. The Municipality and mining house plans to further create approximately 50 to 100 permanent jobs at the facility within the next few years.

The area around the facility is earmarked for future mining of the Merensky and UG2 platinum reefs running through the surrounding area of the facility.

8 OPERATIONS

Once operational, the site Operator (a contractor is to be appointed) will rehabilitate the site in a progressive manner. The onus will also be on the Municipality, as the Licence Holder, to ensure that all operations onsite are carried out consistently to high standards and that the site is as aesthetically pleasing as possible as prescribed by the WML. For example, wind-blown litter and dust must be minimised on site and dust monitored. An operations manual for the operations of the facility has been developed and will serve as a guideline to the operator. If adhered to by the operator, the operations and maintenance of the facility as a whole will be in compliance with all legal requirements applicable. The Licence Holder must also establish a Monitoring Committee consisting of all roleplayers and specifically the local communities. The Committee must have regular meetings which must be documented and reported on.

9 CONCLUSION

The project is unique in the sense that on the one hand the owner of the abandoned open cast mining area was required to rehabilitate the site in terms of mining environmental law, whilst on the other hand the local municipality was in need of a new WDF with sufficient airspace to cater for their needs over the next 30 years at least.

The project is a win-win with the mine saving substantial rehabilitation costs and the local municipality saving the costs associated with acquiring land for a disposal facility with sufficient airspace to deal with future waste generation. Once at capacity, the waste cells will be shaped and capped and where needed rehabilitated.

The new WDF will be unique, in terms of: the additional facilities, architectural features, envisaged environmental educational and training usage and bufferzone development; as well as, its size and lifespan as a general waste facility. Increased environmental and sustainability awareness in recent years ensures that the modern landfill will never again become just another "dumpsite".

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