SITE SELECTION PROCESS FOR A REGIONAL WASTE DISPOSAL FACILITY FOR RUSTENBURG

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SUMMARY: This paper is a case study on the aspects related to the selection and permitting of a regional landfill to service the Rustenburg Municipal area. The regulatory process is discussed, and relates specifically to candidate landfill site selection, use of closed mines for landfilling and responsibility for long term environmental liability. The technical aspects of the Feasibility study and Environmental Scoping exercise have also been included.

1. INTRODUCTION

Because of the recent increase in the world demand for platinum, there has been significant development and expansion of the platinum mines in the greater Rustenburg area, being one of the richest platinum regions in the world. This rapid expansion of the mines and the consequent increase of resources and industry in the area has resulted in Rustenburg becoming the fastest growing town in South Africa. The population explosion has created an increased demand on service delivery and sound environmental disposal of waste.

To address the need for environmentally safe and publicly acceptable waste disposal facilities in the region, the Rustenburg Local Municipality (RLM) considered the development of a new regional landfill site. This decision was reinforced because the Townlands municipal landfill was then poorly operated, residential areas were being developed closer and closer to the site, the environmental integrity of the site and conditions on site were questionable and the site had already exceeded its allowable capacity in terms of its permit (Figure 1).

In 1998, preliminary investigations by consultants identified the Waterval site, belonging to the Anglo Platinum Mining Company as the ideal site for the landfill. In the development phase of its open cast mine, Anglo Platinum in consultation with the local authority, decided that the operation of the mine would be undertaken in a manner that would facilitate the closure and rehabilitation by landfill, which was seen as a win-win situation for both the mine and local authority.
A ten metre high rock berm was constructed around the site for this reason, which would be used as a screen and as cover material for the landfill. The draft Permit Application and Feasibility Study report was compiled in 2000 but was never submitted to the Department of Water Affairs and Forestry (DWAF).

Concern was expressed by the RLM that the Permit Application report was never submitted and that the technical and environmental suitability of the Waterval candidate landfill site for development as a waste disposal facility had not been confirmed. In addition, due process had not been followed in terms of the EIA Regulations (RSA 1997), where consideration of alternatives and the public participation process are vital criteria in the development of a new landfill. In terms of the National Water Act No. 36 of 1998 (RSA, 1998), the site also had to be registered as a “water use”. The DWAF requested that a more comprehensive geohydrological study be undertaken for the Waterval Site to confirm its suitability. In spite of the fact that previous work was carried out by other consultants, *Jarrod Ball & Associates* (JBA), waste management consultants, in association with Africon Engineering International and Groundwater Consulting Services (GCS), were appointed by the RLM to address the identification and permitting of a regional disposal facility. Additional investigations undertaken by JBA and associates, revealed that the site was suitable for the development as a waste disposal facility provided measures were taken to prevent leachate and polluted surface water from seeping into the ground. The DWAF consequently approved the geohydrological suitability of the site. Despite this however, the North West Department of Agriculture, Conservation and Environment (NWDACE) required that EIA Regulations be followed to the letter in order to gain acceptance and approval from all authorities.
This paper is a case study, not only to illustrate problems and issues surrounding legislative requirements and authority regulation, but to highlight relevant issues related to mine closure, environmental liability and conceptual design of the proposed landfill.

2. **REGULATORY PROCESS AND INVESTIGATIONS**

2.1 **Permitting and EIA authorisation**

As the project had not been registered with the North West Department of Agriculture, Conservation, Environment and Tourism (NWDACET) a registration application and a Plan of Study for Scoping was submitted. Two prerequisites previously overlooked, that being the investigation of alternatives (in this case, sites) and a comprehensive public participation, were included as part of the study. The Plan of Study for Scoping was approved in March 2003 and the next phase of the project, ie. the development of a draft Feasibility, Environmental Scoping and Site Identification Study (FESSIS) (Jarrod Ball & Associates, 2004) was undertaken. Various matters dealt with in this report are discussed below.

2.1.1 **Public participation process**

The public participation process involved a number of ward and councillor meetings, three public meetings, a number of stakeholder and authority meetings and the distribution of three newsletters. Newsletters were compiled to keep all interested and affected parties (I&APs) informed of the progress, which had been delayed due to the approval process. The process followed is believed to have been successful in providing I&APs and relevant stakeholders with sufficient information concerning the proposed project.

2.1.2 **Disposal need**

Because information on waste generation, collection and disposal was not available at the RLM, a weeklong weighpad survey was conducted at the Townlands municipal landfill site which gave a relatively accurate account of the types and quantities of waste disposed of at the site. Estimates of waste disposed of at the five small un-permitted sites around Rustenburg were made and information was obtained from surrounding areas, such as the mines, which currently either dispose of waste on their own landfills or stockpile it with a view to disposing of it at the new regional landfill site. The figures obtained culminated in approximate quantities which could possibly be disposed of at the new site (the best case scenario). Waste generation figures based on population size and well documented waste generation rates, gave an estimate of waste to be generated by the whole population (the worst case scenario). The information obtained as indicated above, assisted in determining the long-term waste disposal need, landfill airspace requirements and recycling and composting potential of the waste stream. Based on a 25 year planning horizon, and using the above information, between 4.8 million m$^3$ (best case) and 8.8 million m$^3$ (worst case) airspace would be required for the new regional landfill site. For this airspace requirement and allowing for infrastructure, such as site offices, weighbridge, recycling facilities, etc., a site of between 80 and 104 hectares would be required.
2.1.3 Consideration of alternatives (candidate landfill siting)

Due to the large-scale mining activities and population growth in the area, the search for appropriate sites proved to be difficult. It proved difficult to find suitable sites because much of the land is subject to mineral rights, and residential and township development is extensive. Because of the sensitive nature of the relationship which exists between the RLM and the Royal Bafokeng Administration, location of sites also excluded large tracts of land owned by the Royal Bafokeng Nation. The entire area has been impacted upon extensively by mining and industrial activities both currently, and in the past, and much of the study area was deemed suitable for the development of a waste disposal site. The identification of candidate landfill sites was limited to the central eastern and to some degree the western portion of the study area, due to the location of the waste generation centroid. Negative mapping was used as a technique to eliminate the unsuitable areas in the study area and identify others for further investigation. It makes use of overlay technology to exclude the unsuitable areas on the basis of what are termed exclusion criteria, such as those indicated below:

- Existing land use and population density.
- Topography and drainage areas of potential water pollution
- Geology and soils
- Existing and potential agricultural land use
- Identified areas of environmental sensitivity, etc.

Of twelve candidate landfill sites identified, only nine sites were considered as having the potential for development as a regional waste disposal facility. The selected candidate sites were evaluated based on Section 4.6 of the "Minimum Requirements for Waste Disposal by Landfill" (DWAF 1998) and appraised against environmental, technical, economic and social criteria, in order to rank them and identify the most suitable site(s). According to these procedures, all possible alternative sites must be considered before making a final choice. It is a DWAF Minimum Requirement and an EIA process requirement that sufficient candidate sites be identified to ensure due consideration of alternatives. This included sites put forward by the I&APs. The criteria inter-relate, as there are always economic implications when candidate sites are sub-optimal in terms of environmental and/or public acceptance characteristics. The distance of the landfill site from the waste generation area is an example of opposing economic and public acceptance criteria. While increased distance from residential areas may be more desirable to the public, there is a cost penalty associated with increased haul distances.

Through the use of a site evaluation matrix, the Waterval site was shown to be the preferred site for a waste disposal facility (Table 1). This supports the feasibility study, undertaken in 1999/2000, where from three regional sites the Waterval site was identified as being the most feasible site for waste disposal in the area. The regional DWAF office, however, had a few reservations regarding the objectivity of the ranking matrix. After further studies and re-evaluating the sites, the Waterval site achieved an even higher score and was still considered the preferred site.

Due to the vast size of the Rustenburg Local Municipal area, the development of a single regional site would not result in the entire area being serviced by one regional landfill site and therefore the addition of a second regional site or the use of transfer facilities will have to be considered in the Integrated Waste Management Strategy currently being developed.
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2.1.4 Environmental issues and concerns

In this section, the potential impacts were examined regardless of whether the landfill would be operated to the required standard or not. In reviewing likely effects of the new waste disposal facility on the receiving environment, emphasis was placed on all stages of the development of the waste disposal facility, which included the construction, operation of the landfill, and the decommissioning phase. The potential impacts on the social, health and safety, biological and natural resources, as well as the technical aspects have been briefly discussed in the report. An important underlying assumption is that the proposed landfill will be developed, operated, rehabilitated and closed in accordance with sanitary landfilling principles. A comprehensive EIA will however be undertaken when the joint Permit Application and EIA report is submitted in the next phase of the project.

A formal leasehold agreement had been entered into by the Bojanala District Municipality and Anglo Platinum when the site was first found to be feasible, so that the Municipality could permit and develop the site as a waste disposal facility. However, the issue of who would be responsible for the long-term environmental liability from either mining activities or from waste disposal, still needed to be determined and an agreement to be signed between the RLM and the mine.

2.1.5 Conceptual design

As part of the FESSIS report a conceptual landfill design was developed for the proposed Waterval site. The site layout and design had been optimised to suit the topography, the geology, the waste types and physical characteristics of the Waterval site which comprises a number of open cast quarries. To simplify the design and operation of the site, inert waste will be disposed of in the quarries at least to the original groundwater level, where after a GCL lining system will be constructed with a leachate extraction sump. Normal landfilling of all other general waste will occur above ground and within the lined quarries, with the site lined to at least G:L:B requirements. The landfill airspace afforded by the site design meets the requirement of 8.8 million m$^3$ for a site life of 25 years under the worst case scenario for waste generation and 38 years for the best. The RLM would like to optimise recycling and recovery of reusable materials and composting from their waste streams, which will also increase site life of the landfill. Provision is therefore being made at the new landfill for such initiatives. Figure 2 illustrates an aerial photo of the site overlaid by the proposed conceptual layout.

Both the Merensky and UG2 platinum bearing reefs are located within the study area. The Merensky Reef is currently being mined and the underground workings cease some 30 to 40m below the proposed waste disposal site. The mining of the UG2, located some 140m below the Merensky Reef, will cause the dewatering of the UG2 hanging wall. The entire area around the proposed waste disposal site will be therefore be further dewatered in time. Layers of chromite-pyroxenite-norite-anorthosite of the Upper Critical Zone of the Bushveld Igneous Complex constitute the underlying geology of the site. The turf clay found predominantly in this area, is difficult to work with as it has a high linear shrinkage resulting in excessive cracking. Vehicle trafficability during wet weather is also hampered by the turf.
Figure 2   Aerial photo of the site which has been overlaid by the proposed conceptual layout.
2.1.5.1 Site layout

The main entrance to the site will be located at the opening in the perimeter berm on the north-western side of the site. The majority of the facility infrastructure would be located on this side of the site. This would include the entrance facility, administration offices, ablution block, vehicle maintenance and washing facility, public disposal facility, composting facility, and provision for the possible establishment of a resource recovery facility. The landfill is to be developed in an easterly direction from the entrance facility towards the larger quarries on the eastern side of the site. Due to the large area of the site and the capital expense associated with developing the entire site, it is intended to develop the landfill in four phases. To minimize initial development costs, no waste disposal will be carried out within the western quarry, apart from inert material such as building rubble and construction spoil (eg. turf). Once this quarry is filled to above the original groundwater level with inert material, it will be lined with a GCL liner, and normal waste landfilling will continue up to the height of the perimeter berms (approximately 10m above ground level). The composting operation will be moved on top of the Phase 1 landfill, and area between the southern berm and the Phase 1 landfill will be landfilled with waste. Phase 3 will then involve extending the landfill on top of Phases 1 and 2 up to a height of about 20m above ground level.

To address storm water and contaminated water or leachate management requirements, a clean run-off pond and a leachate pond are to be established in the northern corner of the site. These ponds would serve the drainage requirements of the landfill for Phases 1 and 2, however further ponds might be required at a later stage to serve the subsequent development of the landfill in a south easterly direction.

Future phases of the landfill development will involve lining the larger eastern quarry, providing it with a leachate/contaminated water withdrawal system, and landfilling up to ground level, whereafter normal above-ground landfilling can continue. The haul road to the future landfill areas will be taken up onto the southern berm to access the future eastern landfill phases.

2.1.5.2 Gas Management

Despite the fact that the landfill is located within a water deficit area, on account of the organic content of the general waste, it is highly likely that the landfill will produce landfill gas. Since the site is to be operated according to sanitary landfilling principles with daily covering of waste, proper ventilation must be provided. This is necessary to prevent the lateral migration of gas and uncontrolled venting from the site, causing odour problems and explosion hazards in confined structures such as manholes, etc. When the final capping is applied to the landfill at various stages of completion, appropriate capping structures would be constructed over the gas chimneys to enable passive venting to continue, or to provide gas flares. Alternatively, on closure of portions of the landfill, a compost/soil/humus cover could be applied and the gas vents could be sealed off. This would force the gas to diffuse through the final cover which could promote oxidation of the methane gas to carbon dioxide and water, and the breakdown of malodorous volatile organics. Humus for the final cover soil could be provided by the proposed composting facility on the site.
2.1.6 Conceptual operating plan

As a result of the poor management and operation of the Townlands site during most of the life of the landfill, concerns were raised by a number of I&APs and communities about the proposed operation at the new proposed Waterval site. To address many of these concerns, a conceptual operating plan was developed taking all issues into consideration. It is also intended that the operation of the facility be contracted out to a specialist landfill contractor, with regular independent auditing and monitoring of the operation. The formulation of a waste monitoring committee was also suggested to form part of the FESSIS. This committee would be seen as a platform for the community to raise their concerns regarding the operation of the landfill, during its operational phase.

2.2 Regulatory Authorities' comments and concerns

Both the DWAF and the NWDACET had been kept informed of the project from the onset. However, the Department of Minerals and Energy (DME) were informed of the project during stakeholder and public meetings and were invited to attend, but had only participated in the process once the draft FESSIS had been submitted to them for comment and approval. Because of the extended authority comment period, especially for the DWAF Regional office and DME, the project was delayed by more than six months. At a meeting convened to address a number of concerns and to get deadline and comment periods set, NWDACET requested that DME play a larger role in decision making especially with regard to rehabilitation of the mine and the issue of environmental liability (short- and long-term), as no formal signed agreement existed between the various parties involved. DWAF also expressed concern regarding the possible impact of the landfill operation on the stability of the underground workings.

Official written comments from NWDACET and DWAF, after JBA had addressed the stability concerns and the site evaluation matrix respectively, indicated that the permitting and EIA phase of the project could proceed, provided legal environmental responsibility for the site was established. The DME indicated that a Mine Closure Plan (MCP), which forms part of the mine EMPR, had to be compiled which would make provision for two rehabilitation options, the first being landfilling with general waste and the second backfilling, shaping and vegetation of the site. The plan of actions agreed to by Anglo Platinum, the RLM, the DME, NWDACET, the mine’s environmental consultants and JBA included the following:

- That mine closure would be applied for the Waterval Merensky Reef Opencast Mine only. A risk assessment would be conducted and would form part of the Mine Closure Report. Two potential significant risks which require addressing are the:
  - Long-term stability of the UG2 reef underground workings
  - Return groundwater level once the underground workings (both UG2 and Merensky Reef) terminate dewatering.
- The DME will, based on the information contained in the Mine Closure Report, decide whether or not funds will be retained in order to address potential long-term environmental issues.
- The DME requires that mine closure be applied for under the provisions of the Mineral and Petroleum Resources Development Act, Act 28 of 2002 (RSA, 2002).
The contents of Regulation 60 and 62 must, inter alia, be complied with.

- It was agreed that the current lease agreement for the land, which exists between the Rustenburg Platinum Mine and the Rustenburg Local Municipality, be revised. It was agreed that the environmental liabilities could be transferred in a lease agreement. The Waterval site (surface rights) could be sold to the Municipality once the landfill is established, but Anglo Platinum retains responsibility for underground workings.
- Anglo Platinum’s environmental consultants, would compile the Mine Closure Report, with details on landfill issues compiled by JBA.
- The DME indicated that 60 working days were allocated to other departments, such as DWAF for comment. It would require approximately an additional 30 working days for the DME to issue the mine closure certificate.
- Once mine closure has been granted, the Plan of Study for EIA will be submitted to NWDACET for approval. The formal Public Participation Process and the EIA will commence once the Plan of Study for EIA has been approved. The Landfill Permitting Process will be carried out in parallel to the EIA process.
- The landfill design and development, operating and environmental monitoring plans, might be adjusted during the Landfill Permitting phase based on the findings of the EIA.

Approval to continue with the permitting phase of the project, by all of the regulatory authorities rested on the fact that the DME’s concerns had to first be addressed, that being the completion and obtaining of the mine closure certificate and the successful transfer of environmental liability for the Waterval Site. This phase of the project is intended to be finalised by September/October 2005. This additional phase has the potential to cause a delay in excess of a year, which has considerable cost, environmental and social implications to this project as well as to the continued operation of the Townlands municipal landfill.

3. CONCLUDING REMARKS

The following conclusion can be drawn from this paper:

- Mines during the development of the EMPRs, to consider mine rehabilitation options, with one alternative the possible landfilling of quarries. This has an added benefit as it creates a viable alternative to candidate landfill site selection.
- Importance of recognizing due process and involving all regulatory authorities early in the process, so as to prevent any delays in permitting and authorization, has been recognised.
- Development of the new Waterval site will represent a modern state-of-the-art waste disposal facility which will serve the regional waste needs of the greater Rustenburg area in excess of 40 years.
- The development of a regional landfill is part of the bigger Integrated Waste Management Plan for the RLM as well as the Bojanala District Municipality.
4. REFERENCES


