TABLE OF CONTENTS

1. INTRODUCTION

1.1. Project Background

1.1.1 Project Summary

The Maltese Government is committed to close down the Maghtab landfill by 1st May 2004. Malta agreed to this commitment, to avoid having the Maghtab and Qortin landfills subject to the stringent conditions of the landfill directive (1999/31/EC) with the associated risks of failure in compliance.

The preferred site for the establishment of a long term engineering landfill is Ghallis, situated to the west of the Maghtab landfill. Due to the extensive works involved in the proposed extraction of minerals prior to the development of the landfill, it was decided that an interim solution be considered.

Two closed hard stone quarries were identified and a PDS was prepared for the restoration of both quarries. The EIA is in progress but due to the sensitivity of this locality, the process may take longer than expected. Thus, WasteServ Malta Ltd (WSM Ltd) still needs to be provided with an acceptable site for the proper management of waste following the closure o Maghtab, on the 1st of May 2004. During recent years an investigation and study into Maghtab, Qortin and Wied Fulija landfills has been carried out to develop environmentally sound strategies for their rehabilitation. This was achieved by an investigation of the waste masses, measurement and monitoring of aerial emissions, sea and groundwater quality and temperature profiles. This culminated in the characterization of each site by the development of site-specific conceptual models. From the results obtained, it was identified that Zone C of Maghtab had a very low temperature and can be considered as inert/stabilised waste. Appendix A shows the distinctive areas of the Maghtab Landfill as considered in the site Investigation.

In July 2003, inert waste was diverted away from Maghtab to rehabilitate the closed private quarries. The material required for the daily cover to operate the Maghtab Landfill was extracted from Zone C. The shifting of this waste created some void space in the Maghab landfill, which can be reused.

Under this proposed Storage Facility at Ta' Zwejra, Maghtab, WSM Ltd proposes to construct the necessary infrastructure and operate a temporary storage facility for Municipal Solid Waste with a combined leachate recirculation and gas recovery system. It is planned that this proposed project would have a lifetime of three years.

1.1.2 Policy Context

Existing national policies relating directly to waste management and landfills are contained in the following:

- *Structure Plan (1990 – 2010) for the Maltese Islands* published in 1992 by the Planning Authority (PA).
- *Waste Management Policy for the Maltese Islands* published and subsequently adopted in 1998 by the Ministry of Foreign Affairs and the Environment
- *Space for Waste: The Waste Management Subject Plan* published by the PA in October 2001 and awaiting Cabinet Approval

- *A solid Waste Management Strategy for the Maltese Islands* published by the Ministry for the Environment and approved by Government in October 2001.

Waste Management Policy for the Maltese Islands

The *Waste Management Policy for the Maltese Islands* was published for public consultation in 1997 and subsequently adopted in 1998 by the Consultative Board for the Environment of the former Ministry of Foreign Affairs and the Environment. The Policy document provides an overview of the waste management situation on the Islands and sets out the key principles that should form the basis of a sound waste management strategy for the future. The Policy acknowledged that the legislative and regulatory framework of the European Union will exercise significant influence upon the development of waste management plans for the Islands, since most European countries adopt these as the basis for their legal and policy framework.

Waste Management Subject Plan

The *Waste Management Subject Plan* was published by the PA in October 2001 and provides strategic direction and context to the Government and the private sector (in accordance with the timescale of the approved Structure Plan) in waste management issues up to 2010.

A number of strategic waste management, development control and environmental policies have been set within the Plan, focusing on the key principles of waste management. In all there are some 29 strategic waste management policies and some 9 development control and environmental related policies.

Solid Waste Management Strategy for the Maltese Islands

Following adoption of the Waste Management Policy, the *Solid Waste Management Plan for Malta* was issued by the Ministry for the Environment as a consultation draft in January 2000. The main purpose of the Plan was to identify possible strategies and systems for the management of waste that utilize the latest technologies and conform to the current situation within the EU. The *Solid Waste management Strategy for the Maltese Islands* followed on from, and was intended to complement and build upon, the *Solid Waste Management Plan for Malta*. This strategy was formally ratified by Government in October 2001 and forms the main basis of the Government's approach towards developing a sustainable waste management system. The Solid Waste Management Strategy proposes a series of key objectives relating to this Project. Principally, these are to close down the Maghtab and Qortin landfill sites and bring these sites, together with the closed landfill at Wied Fulija, back into beneficial use.

1.2 Details of the Developer

1.2.1 Background

WSM Ltd is a private company in accordance with the Companies Act 1995 and is wholly owned by Government through Malta Government Investments Limited and Malta Investment Management Company Limited. WSM Ltd's main business objectives are to:

- organise, manage and operate integrated systems for waste management, including integrated systems for minimisation, collection, transport, sorting, reuse, utilisation, recycling, treatment and disposal of solid waste and hazardous waste; organise, manage and operate integrated systems for export of waste to destinations outside the Maltese Islands;

- organise, manage and operate integrated systems for waste management in accordance with the Laws of Malta and the waste management policy and plan of the Government of Malta while observing internationally recognised waste management principles;

- organise, manage and operate integrated systems for waste management for other types of waste as may be decided by the Government of Malta or the Ministry responsible for the infrastructure relating to the management of waste.

- to assist in and supervise the implementation of waste management policies as developed from time to time by the Government of Malta.

1.2.2 Experience

WSM Ltd is currently managing the public waste management facilities and the contract with a **Private entity (Package 1)** for the public disposal and recycling of the inert wastes generated in the Maltese Islands. WSM Ltd is also finalizing the contracts for the establishment and management of the new public waste disposal and treatment facilities for the other waste streams.

The new waste management facilities are being planned and developed through the following main tender packages:

Package 2A – the contract for the construction and operation of engineered landfills, a facility for temporary storage of waste, pre-treatment and transfer/ export of hazardous waste, a transfer station in Gozo and transport between facilities. Tenders for this package have been issued and are being negotiated;

Package 2B – the contract for the upgrading of the existing composting plant and Materials Recovery Facility (MRF) at Sant' Antnin. This package is proposed for funding via the European Union's Cohesion Fund available during the period 2004-2006. The project is included in Malta's Project Pipeline and funds from the EU will be available for successful applications from 1st January 2004. Technical Assistance to identify state-of-the-art technology for this project is currently on-going under the 2003 EU Pre-Accession Programme.

Package 2C – source segregation and separation collection is proposed for funding via the European Union's Structural fund. The Solid Waste Management Strategy for the Maltese Islands considers the source segregation of the Municipal Solid Waste as a main task and that it is essential to produce compost of good quality. This entails the establishment of Civic Amenity Sites, Bring-In Sites and separate collection system to be coupled with an intense information and education campaign. Currently there are two on-going pilot projects rendering encouraging results of captured and recovered waste fractions. The system shall be extended to all the local authorities by the end of 2006, when the upgraded composting and material recovery facilities will be in operation. The gradual introduction of the Producer Responsibility Schemes shall also contribute to avoid the contamination of biodegradable waste stream and recover a higher fraction of dry recyclables. Technical Assistance for the operation of this project under the 2003 EU Pre-Accession Programme through a Framework is currently on-going; and

Package 2D – for thermal treatment of special waste as detailed in the strategy.

2. PROJECT JUSTIFICATION

2.1 The Project Objectives

The principle driving force behind this proposed project for this short-term waste storage facility are to:

- Proceed with the planned immediate closure, rehabilitation and restoration of existing waste dumpsites, in particular the Maghtab waste disposal site, and thereby end current uncontrolled dumping practices, environmental nuisances and the potential risks to human health;
- To provide WSM Ltd with the required time to develop a long term controlled engineered landfill and associated waste processing and treatment facilities at Ghallis
- Provide a short-term environmentally sound storage facility for non-hazardous and non-inert waste.
- Enable Malta to achieve the necessary compliance with the requirements of local and foreign legislation relating to waste management within the required timeframes.

2.2 The Need for the Project

2.2.1 Introduction

According to the Landfill Directive 1999/31/EC, the EU Commission does not classify the

'*storage of waste prior to recovery or treatment for a period less than three years*' as a landfilling operation.

Since the current landfill has to be closed by ***end of April 2004,*** (a programme of rehabilitation document is included in Appendix B), this project will be a transitional solution for the management of non-hazardous and non-inert waste generated on Malta and Gozo, until another waste management facility has been set in place for the long-term management of waste.

This project will be managed in three phases over a period of three years, as follows.

- This project will cater for the storage of the non-hazardous and non-inert waste generated in Malta between May 2004 and May 2005, according to **Schedule 6, R13 of the Legal Notice 337 of 2001**. No waste will be accepted in this facility after 1st May 2005.
- During the second and third year of the project the waste will be treated in situ at this temporary storage facility to achieve accelerated stabilization of waste according to **Schedule 6, R10 of Legal Notice 337 of 2001**. The treatment process should enhance the biological degradation that will facilitate the further treatment and mechanical separation upon extraction. During the treatment process, gas will be generated which can be used as a fuel to generate energy, according to **Schedule 6, R9 of Legal Notice 337 of 2001**.

2.2.2 Existing On-Site Conditions

The footprint area of this temporary storage facility shall be that covered in Zone C of Appendix A, having total available area of some 40,000m^2. WSM Ltd is considering the establishment of this storage in stages, each having a floor area of approximately 15,000m^2. Subject to the allowable and possible height and level of the area, the available waste storage volume of this site is estimated to be approximately 250,000m^3 of non-inert and non-hazardous waste.

The area involves some minor excavations to ensure a gradual natural slope of at least 1:50 for the collection of leachates produced from the stored waste. An inspection chamber is currently being built on the boundry between the existing Maghtab landfill and the adjacent area where this storage facility is being proposed. This chamber is essential to ensure that no cross contamination is taking place between the two sites. A person can walk through this enclosed chamber to monitor whether there are traces of leachates trespassing from either site. In case that there is evidence of leachate contamination, this leachate liquid may be managed through the access provided which may also be utilized for ground investigation.

2.3 Project Viability

This project will be developed by WSM Ltd who shall be responsible to build and operate this temporary storage facility. The costs / charges for providing and operating the requirements of this project will be met in the first instances by Government as represented by this Company.

However, as foreseen in the Solid Waste Management Strategy for the Maltese Islands, Government also intends to introduce a system for recovering the full costs of providing and operating public waste management facilities from waste producers, specifically by:

- Increasing progressively charges for the use of public waste management facilities by private / commercial organizations over a transitional period until they have reached levels that recover the full costs of their provision and operation; and
- Phasing in charges for the provision of MSW management services

Prior to this being implemented, WSM Ltd and Government is committed to conduct a detailed evaluation and consultation process with all stakeholders on the final decision regarding the mechanism for charging for waste management facilities and services. Currently, the proposed change in rate to 75 cents per tonne is being considered by the stakeholders. It is also being considered that this will be increased to Lm1.08 per tonne by the end of November. This follows the same pattern adopted from the disposal of construction and demolition waste.

Table 1 Estimated costs for the Storage Facility

Construction		
Surface Preparation		97609
Construction Materials		207329
Equipment		74181
Design and Monitoring		75500
Total		454619

Operation					
	Qty	Rate	Number of hours/day	Number of days	Operating costs
Human Resource	4	2.5	8	365	29200
Bulldozer		11.5	10	365	41975
compactor		30	10	365	109500
monitoring	1	2.5	4	270	2700
Total					183375

Treatment					
Mechanical Separation	250000	0.65			162500
Shifting of material	250000	0.44			110000
Total					272500

Rehabilitation					
	Qty	Rate			
Construction & Demolition Waste	250000	1.18			-295000
Trees	3750	15			56250
Bulldozer	150	11.5			1725
					-237025

Total Cost of Storage	910494
Cost / Tonne (LM)	**2.69**

2.4 Project Timetable

In accordance with the Strategy, it is essential for this project to be in place and to therefore have an area fully engineered and operational by **1st of May, 2004**.

It is planned that the whole area shall be subdivided into three sections (cells) of approximately equal volumes, as shown in Appendix C. Once the first section is filled, all the necessary piping connections are laid. The waste is capped followed with recirculation of leachates. In the meanwhile, the filling of the second phase is commenced. Once the space for this phase is exhausted, the incoming waste is stored in section C and treatment of Phase B is commenced. When the three cells are exhausted and capped, constant and continuous leachate recirculation is maintained until the third quarter of 2006.

A detailed time schedule for the management of the whole temporary storage facility together with a layout of the three sections is attached in Appendix C.

3. PROJECT DESCRIPTION: TEMPORARY WASTE STORAGE FACILITY

3.1 Project Components

This project will comprise the temporary storage for the Municipal Solid Waste generated on the Maltese Islands during a period of 12 months in an area measuring some 15,000m^2. The storage of this waste shall be followed by an intensive waste treatment programme with a duration of 2 years. Research has shown that the decomposition of readily and moderately decomposable organic waste constituents can be accelerated into stabilized waste by the recirculation of leachates.

3.2 General Design Criteria

3.2.1 The Construction of the Site

The construction of this temporary waste storage/treatment facility, which is situated in the original footprint of Maghtab Landfill, mainly involves the removal of the waste classified as inert. The area is to be lined to enable for the collection and recirculation of leachates that may be generated by the fresh waste.

The concept of the proposed storing and treatment can be described in the following phases of development:

1) Storing with leachate circulation
2) Capping and aeration
3) Gas collection
4) Removal/treatment/recovery of stabilized waste

The engineering works for the construction of the facility incorporate the following elements:

- Excavation of site to achieve formation level
- Construction of containment bunds
- Trimming and shaping of engineered fill to create formation surfaces;
- Installation of a 500mm thick foundation layer of maximum permeability of 1 x 10^{-7} m/s
- Supply and installation of a geosynthetic clay liner
- Supply and installation of a 2mm thick textured HDPE geomembrane liner
- Supply and installation of non-woven puncture-resistant geotextile protector
- Supply and installation of a leachate drainage system and collection points

All geo-synthetic materials to be deployed are approved for use in geomechanical engineering. They are ISO certified and manufactured by the well-known Company, *NAUE Fasertechnik* from Germany. All phases of installation will be done by a certified installer and monitored by Quality/Assurance team.

3.2.2 Waste Treatment Phase

As stated previously, the primary goal of this project will be to store for three years, the Municipal Solid Waste generated in Malta between May 2004 and May 2005. During the second and third year of the project the waste will be treated *in situ* at this temporary storage facility to achieve accelerated stabilization of waste.

Research has shown readily and moderately decompostable organic waste constituents can be stabilized faster through controlled microbiological processes. Adding moisture is the key method because moisture content is probably the most important factor that enhances biodegradation within the storage area. Both laboratory and field scale research indicates that addition of moisture accelerates degradation of waste. Moisture availability is a key factor in sustaining the microbiological treatment. Typical moisture content of municipal solid waste in conventional landfills is approximately 20%. Minimum moisture content of 40% is necessary for the facility to operate as expected. The addition of water increases the microbial activities, which in turn increases the gas generation. In addition to gas generation, the following phenomena are also observed;

- The humuslike material generated due to the microbial activities filters some salts and metals from leachate.
- The organic constituent in leachate decreases significantly.
- The increase of pH leads to increase in metal concentration in leachate.

Both laboratory and field-scale research indicates that about 60% of minicipal solid waste is cellulose and hemicellulose, which accounts for about 90% of methane generation potential. Three groups of anaerobic bacteria decompose the cellulose and other polymers to produce methane. The first group consists of hydrolytic and fermentative microorganisms. These microorganism hydrolyze carbohydrates, fats, protein, and so on to form soluble sugars, amino acids, carboxylic acids, and glycerol. These chemicals are subsequently converted to form short-chain carboxylic acids, carbon dioxide, hydrogen, and acetate. The second group of microorganisms consists of obligate proton-reducing acetogens. These microorganisms convert the first-stage chemicals to acetate, carbon dioxide and hydrogen. The third group of microorganisms are methanogens, which convert the hydrogen, carbon dioxide, and acetate to methane.

The treatment proposed for this temporary storage facility will include, among other things, the addition of moisture to the solid waste to create environmentally favorable conditions for micro-organisms responsible for waste decomposition. At a minimum, leachate is recirculated and injected back in the waste to stimulate the natural biodegradation process. However, leachate alone is usually not available in sufficient quantity to sustain the biological degradation. Water or other non-toxic or non-hazardous liquids, including wastewater and storm water are suitable amendments to supplement leachate (depending on climatic conditions and regulatory approval). Maintaining the moisture content at the right level will enhance the microbiological process and accelerate the decomposition and stabilization of waste. The fact that the normal ambient temperature in Malta is relatively high could enhance the biodegradation process. Expressed as a volume per mass of solid waste, the range of liquid addition to reach field capacity is 113.65m^3 – 227.3m^3 per 1,000 tons of solid waste (Reinhardt and Ham, 1974).

Three different options for treating the stored waste are briefly detailed hereunder. In all three cases, the circulation of leachate is an indispensable process for the fast stabilization of waste.

- The first solution would be where moisture is added to the waste mass in the form of recirculated leachate and other liquid sources to maintain the moisture content at a determined optimal moisture level. Biodegradation occurs in the absence of oxygen (anaerobically) and produces a gas similar in composition to landfill gas, primarily methane, which can be captured to minimize greenhouse gas emissions and used for energy project.
- The second option would be to remove the leachate from the bottom layer, piped to liquids storage tanks, and recirculated into the storage area in a controlled manner. Air is also injected into the waste mass, using vertical or horizontal wells, to promote aerobic activity and accelerate waste stabilization. Gases similar in composition to LFG that will be generated from this process could also be captured and used for energy recovery. This is the preferred option because stabilization of waste may be achieved within the required timeframe.
- The third alternative treatment would be to accelerate the waste degradation by employing a sequential aerobic-anaerobic treatment to rapidly degrade organics in the upper sections of the storage facility followed by gas collection from lower sections.

3.3 The Storage Facility during its Treatment

Once closed, methanogenic conditions within the cell are optimized by the recirculation of leachate, which will maintain the moisture content of the deposited waste at the optimal level. Adding moisture after waste placement will accelerate the biodegradation process and control the onset of rapid gas generation. This recirculation process can be achieved by installing a piping network in horizontal buried trenches or vertical wells, which offer advantages of minimum exposure pathways, good all-weather performance, and favorably aesthetics. Thus, these two alternative solutions are preferred.

Once the waste being stored is closely monitored and maintained constantly at the right moisture content, the following is expected to be observed;

- Fast decomposition and biological stabilization of waste mass ;
- Early stabilization decreases long-term environmental risk and reduces postclosure costs;
- Reduced leachate contamination due to the recirculation of leachates;
- The waste mass settles more and faster leading to 15-30% gain in air space during active storage life;
- The recirculation of leachate will significantly increase the gases similar in composition to LFG which when captured, can be directed to the equipment that will be available on site for the treatment of the old Maghtab Landfill.

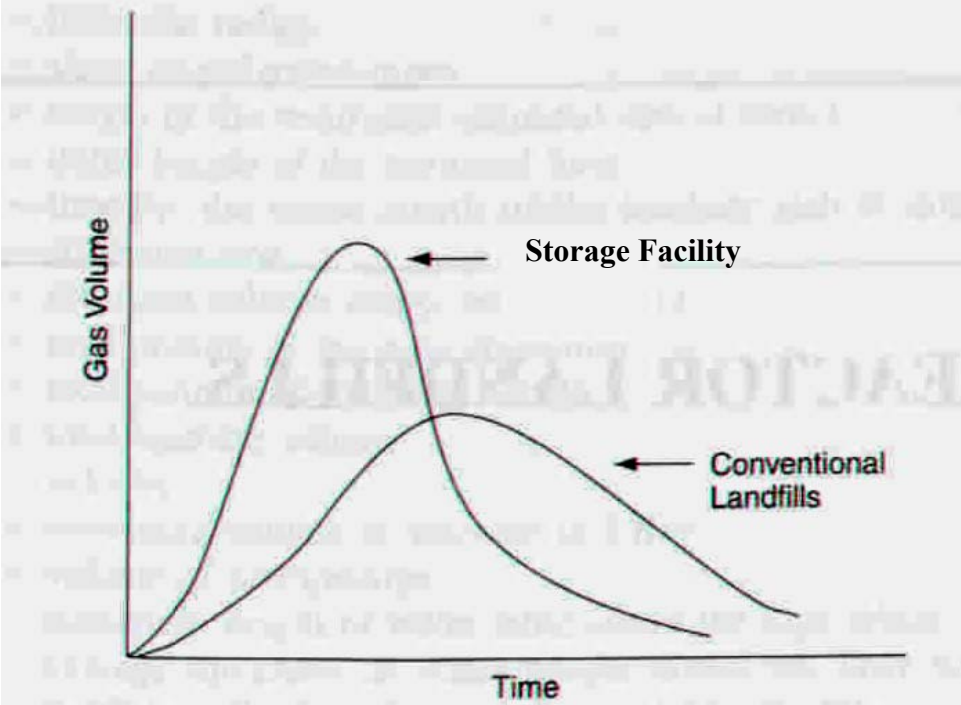
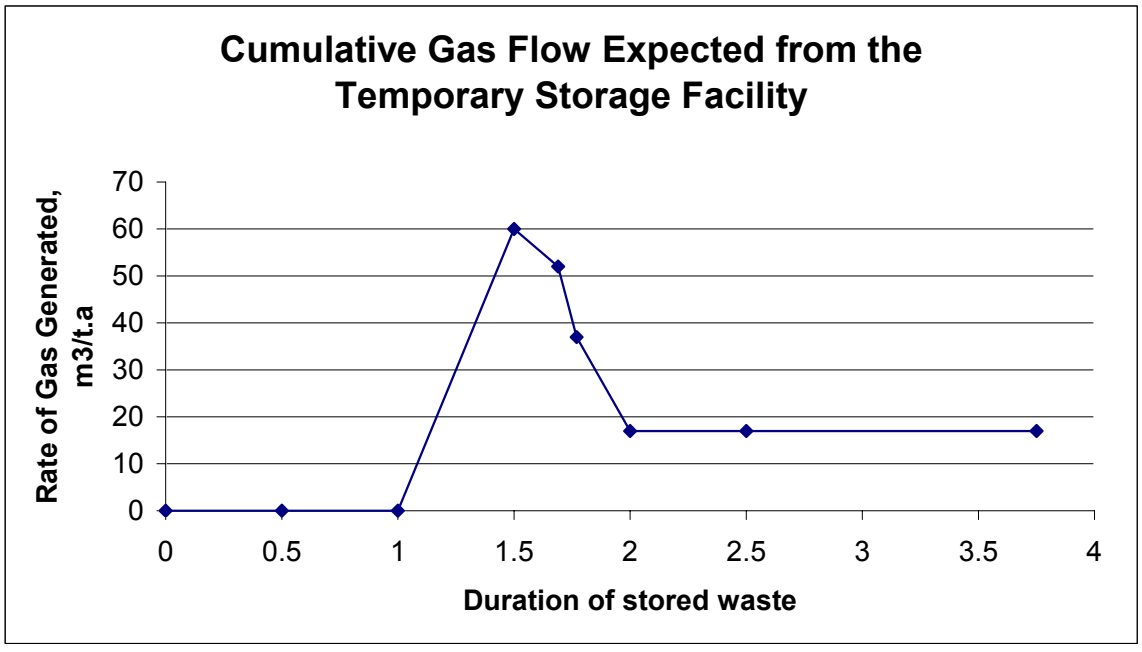


Figure 2 Comparison of gas generation rates between a conventional landfill and the storage facility

3.3.1 Amount of Waste Deposited

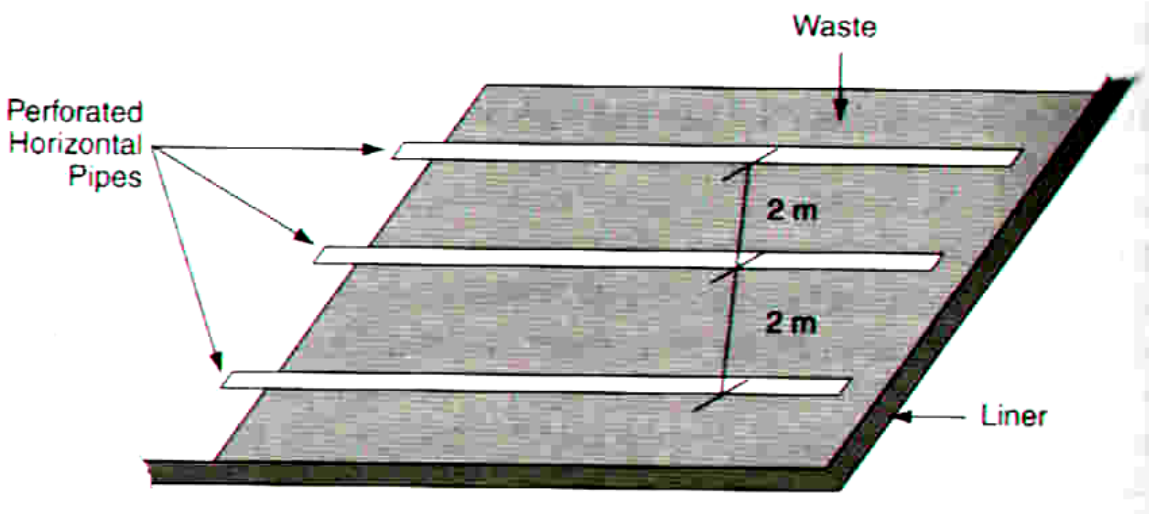
Table 1 Amount of MSW Deposited at Maghtab

Waste Generated in Malta (Tonnes)			
	Jan-Dec 2002	Jan-Dec 2003	Projected Jan-Dec 2004
Non-Inert & Non-hazardous waste	250,423.48	258,261.88	266, 000



As could be seen in Figure 1, keeping the Municipal Solid Waste at the right moisture level and monitoring all variables that may affect the methanogenic conditions, a maximum flow rate of approximately 60m^3 /t.a of gas could be generated from one tonne of waste after just 1 ½ years of being stored. This means that assuming the total projected tonnage of waste that will be generated in Malta during 2004 amounts to 266,000 tonnes (from the projected value shown in table 1), by storing all this Municipal Solid Waste produced in 1 year, it is expected that approximately 8,400,000m^3 of gas can be collected during the second year of its storage phase.

Since the density of waste will vary with the height of deposited waste, the lower portions will have a higher density when compared to the upper regions of the storage cell. For this reason, the waste permeability may inhibit leachate flow at the lower region of the storage facility. To avoid such problems, circulation of leachate will be carried out at intermediate levels to obtain homogeneous moisture content in all the storage facility.



3.3.2 Gas Extraction System

The collection of gaseous emissions will require

- The installation of gas wells and wellhead access chambers;
- The installation of wellheads onto the gas wells;
- In addition to the wells, steel abstraction pipes may be laid into shallow trenches and covered;
- The installation of steel connecting pipework;
- The installation of manifolds and blockwork chambers;
- The installation of MDPE gas mains;
- The connection of the manifolds to the gas mains;
- The installation of gas mains connecting the manifolds to a gas plant that is being built as part of the Aerial Emissions Control for the Maghtab Landfill rehabilitation project, attached in Appendix B.

To efficiently control gas and avoid odour problems, the gas extraction system will require installation of large diametric pipes. The gas pipes, blowers and related equipment will be installed early in its operational life to collect efficiently the gas produced from the storage. The gas collected from this storage facility will be added to the gas being collected from the rehabilitation process of the Maghtab landfill and utilized/flared according to the quantities produced.

3.3.3 Final Waste Storage Treatment

It is expected that by the recirculation of leachates and extraction of gases similar in composition to LFG generated due to this treatment process, within three years, the stored waste is expected to be transformed into stabilized waste.

Following the leachate recirculation treatment, the waste will be extracted gradually in layers and mechanically separated by size using a mobile rotating screen (sieve). The large, non-stabilised fraction will be disposed in another permanent waste facility. The stabilized waste will be used as a landfill capping.

To ensure complete stabilization, the waste shall be subjected to an aerobic treatment prior to extraction and filtration. The stored waste shall be treated in layers of 3.5 meters depth for a faster odour stabilization.

a. Principles of the in-situ treatment

Odour emissions are largely due to the anaerobic state of the waste. The opening of the Storage Facility may result in some release of gases and thus causes odour problems, which are due to the anaerobic state of the stored material. The odour emissions depend more on the stored material and on the water content than on the "age" of the stored material. In order to excavate the waste from the storage facility, it is absolutely necessary to solve the odour emission problem.

Biological methods, such as biofilters and bioscrubbers, have been widely used in different applications for odor control, especially in Europe. In a biofilter, the microbes use the offensive organics as a food source, converting them to carbon dioxide and water vapor. Advancements in engineered biofilters have reduced the size and cost significantly, making them a sustainable and economical technology for odor sources such as sewage lift stations and treatments.

b. Process description for the Procedure of Excavation

A safe way to excavate waste with odour control is to transform the biological climate inside the waste storage facility. The activity of anaerobic bacteria, which are responsible for offensive smells, is stopped by blowing air into the waste. At the same time, the foul-smelling mixture of gas and air is drawn off the stored waste and cleaned in a biofilter.

Supply air is passed through the biofilter before it is blown into the stored waste. In the biofilter, it is heated and enriched with aerobic bacteria, which, when blown into the waste, it encourages the creation of an aerobic atmosphere and at the same time stop the recreation of an anaerobic condition.

The water contents of the treated storage area and the biofilter are equal. The water from the waste is needed to keep the biofilter wet. Because of the high temperature inside the biofilter, this water evaporates and is, in the form of steam, recirculated back to the storage facility. Excess water is collected in special water collection systems.

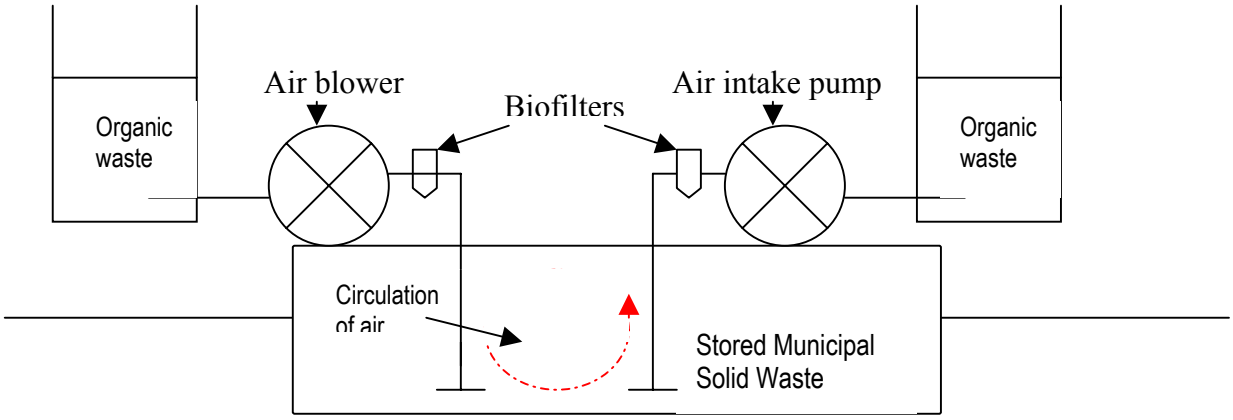


Figure 3 The Principle of the Odour Stabilisation System

One of the problems connected to odour stabilisation is the need to keep constant water content. Since the Storage Facility has no leakage drain, it is very wet inside. While the gas/air mixture is being drawn off, water is drawn off as well and condenses in the piping system. The direction of the airflow is reversed every hour to avoid water blocking the pipes.

To supply the waste material with enough air, vertical perforated pipes are forced into the storage facility in a grid-like array, at intervals of approximately 5 to 6 meters. The hourly reversion of the airflow prevents channelisation inside the buried material and facilitates a continuous aeration of the excavation area.

c. Installation and operation of the Odour Stabilisation System

Steel perforated pipes are forced into the waste by means of mechanical vibration. The holes of each pipe are cleaned with the aid of compressed air from a mobile unit, which is connected to the units by a flexible pipe. The connections are intended to provide easy assemble and dismantling of the system. The complete installation of one pipe can take 10 to 15 minutes.

After the installation of all the units and connecting pipes, the aeration process is started. On the 1st day, high peaks of methane are likely to be measured by the control instruments. As from the 2nd day, the change from an anaerobe to an aerobe atmosphere inside the storage facility is significant and the levels of methane in the waste air decrease to a normal rate. The treatment is continued to a number of days until optimum results are recorded. The normal treatment period does not exceed 6 days.

d. Advantages

Advantages of this Odour Stabilisation System include;

- Gases are extracted with a constant pressure.
- The stored waste is aerated and ventilated with a constant pressure of 0.3 bar.
- No special drilling equipment is necessary and no gap after the drilling between the perforated pipes and the waste has to be filled up with gravel and sealed on the surface. It is easy and cheap and no emissions endanger the staff.
- This treatment procedure uses natural air instead of oxygen, which makes this process a biological one.
- Aerobisation is carried out over a short timeframe. Stabilized waste can be obtained after 4 to 6 days followed by excavation.

e. Measuring technique

Continuous measurements of the exhaust gases, parameter: CH_4 , O_2 and CO_2
Limits for a successful aerobisation:

CH_4:	< 1	Vol%
CO_2:	< 0,5	Vol%
O2:	> 17,0	Vol%

In order to start excavating the waste, the limits for the emissions on the excavating surface have to be approximately:

Methane CH_4:	< 1,5 %
Sulphur hydroxide H2S:	< 5 ppm
Carbon monoxide CO:	< 30 ppm

When the results of energy extraction and leachate treatment prove to be beneficial as estimated, a decision shall be taken on the future utilization of this site.

3.3.4 Variables that Need to be Closely Monitored

a. Moisture
As stated above, moisture content is the single most important factor that promotes the accelerated decomposition. The success of this temporary waste treatment facility relies on maintaining optimal moisture content near field capacity (**approximately 35 to 65%**) and adds liquid when it is necessary to maintain that percentage.

The volume of liquid to be added to maintain the moisture content of the waste at an average of 40%, depends on the initial moisture content of the waste mass.

The actual volume of liquid to be added is

$$V = M_p AT$$

where M_p = additional percentage of moisture
V = volume of Liquid, L^3
A = Area of waste mass, L^2
T = thickness of the waste mass, L

This equation assumes a homogenous waste mass. However, in reality the waste mass is heterogeneous. A large material such as wood logs, daily cover and so on impedes uniform flow. The suction head due to unsaturated condition in a landfill prevents downward movement of liquid. The suction head or negative potential causes the liquid to move from an area of less negative potential to the adjacent area with higher negative potential until the waste mass reaches field capacity. Since the heterogeneity of the waste mass causes

channeling, the waste mass is not wetted uniformly. Theoretical estimation regarding additional liquid volume requirements is influenced by:

- Actual moisture content
- Heterogeneity
- Compaction
- Accuracy of the predictive model

Since moisture is a critical factor in the operation of the storage facility, it has to be monitored on site. Waste samples should be collected at well-defined horizontal and vertical locations regularly during storage. Waste samples should be collected at 30.5 grid points on the surface at 3m vertical intervals every week for 4 consecutive weeks. If the moisture content values stabilize within the 4-week period, then the sampling frequency may be reduced to once every month.

b. Landfill Gas Emissions
The recirculation of the leachate will produce a high rate of gases similar in composition to landfill gas (LFG) such as methane gas. The quality and quantity will have to be closely monitored.

c. Leachate Head on the Liner
Monitoring the depth of leachate on the liner is a primary requisite to monitor the operation of the storage facility. Control of head on the liner requires the ability to maintain a properly designed leachate collection system, monitor head on the liner, store of leachate outside the dedicated storage area, and remove leachates at rates two to three times the rate of normal leachate generation. This criterion is being achieved by the appropriate design and specifications of bottom liner slopes, drainage layer flow distances, and hydraulic conductivity of the leachate drainage layer.

d. Temperature
The ambient temperature of Malta may offer the opportunity to maintain the favorably methanogenic conditions to accelerate the biodegradation process of the stored waste in order to produce inert waste, with optimum extraction of the gases similar in composition to LFG.

To measure the Leachate head, transducers shall be used. Pressure measurements are taken using a standard differential voltage signal calibrated over a gage pressure range of 0 to 1.5m. The cables from each transducer are connected to a datalogger and relay multiplexer. The datalogger interprets electrical signals emitted by the transducers and stores them.

3.3.5 The Storage Facility During its Rehabilitation

From May 2007, when all the stored waste will be removed from the storage facility, the land will be refilled with construction & demolition (inert) waste. The lining that will be used for the storage facility will not be removed since this will not cause any adverse effects for the rehabilitation of the site. A topsoil layer will be added on top of the inert waste and the whole area will be planted with trees. A financial estimate of the rehabilitation phase could be seen in table 1.

4. PRELIMINARY CONCLUSION

This working plan proposes and describes a Project that is crucial for the on-going development of a more sustainable system for managing wastes on the Maltese Islands. The Project is also indispensable if Malta is eventually to achieve compliance with European policies and legislation relating to wastes management, both in context of the closure and subsequent rehabilitation of former waste disposal site and new planned sites.

A series of other initiatives are being undertaken by Government to increase the amounts of waste that is recovered and recycled, including the introduction of separate collection of Municipal Solid Waste and upgrading and expansion of the existing Sant Antnin composting plant which is due to become operational by the end of 2006. Whilst the various waste avoidance, re-use, recovery and recycling measures will reduce substantially the volume of waste that needs to be treated and disposed of, the need for a storage facility for the Municipal Solid Waste requiring treatment and final disposal for a period of at least one year, is a *must* for the Maltese Islands in the current circumstances.

This storage facility is to be constructed with the highest safety precautions to guarantee that during the waste storage period, the surrounding environment is protected and no harm will be added to the natural habitat, including the sea and the water aquifer zone. All by-products of this storage facility will have to be contained specifically in this area only. This will be achieved by proper management of this facility to the best available technology and the engineering lining as detailed in Appendix C.

Appendix A

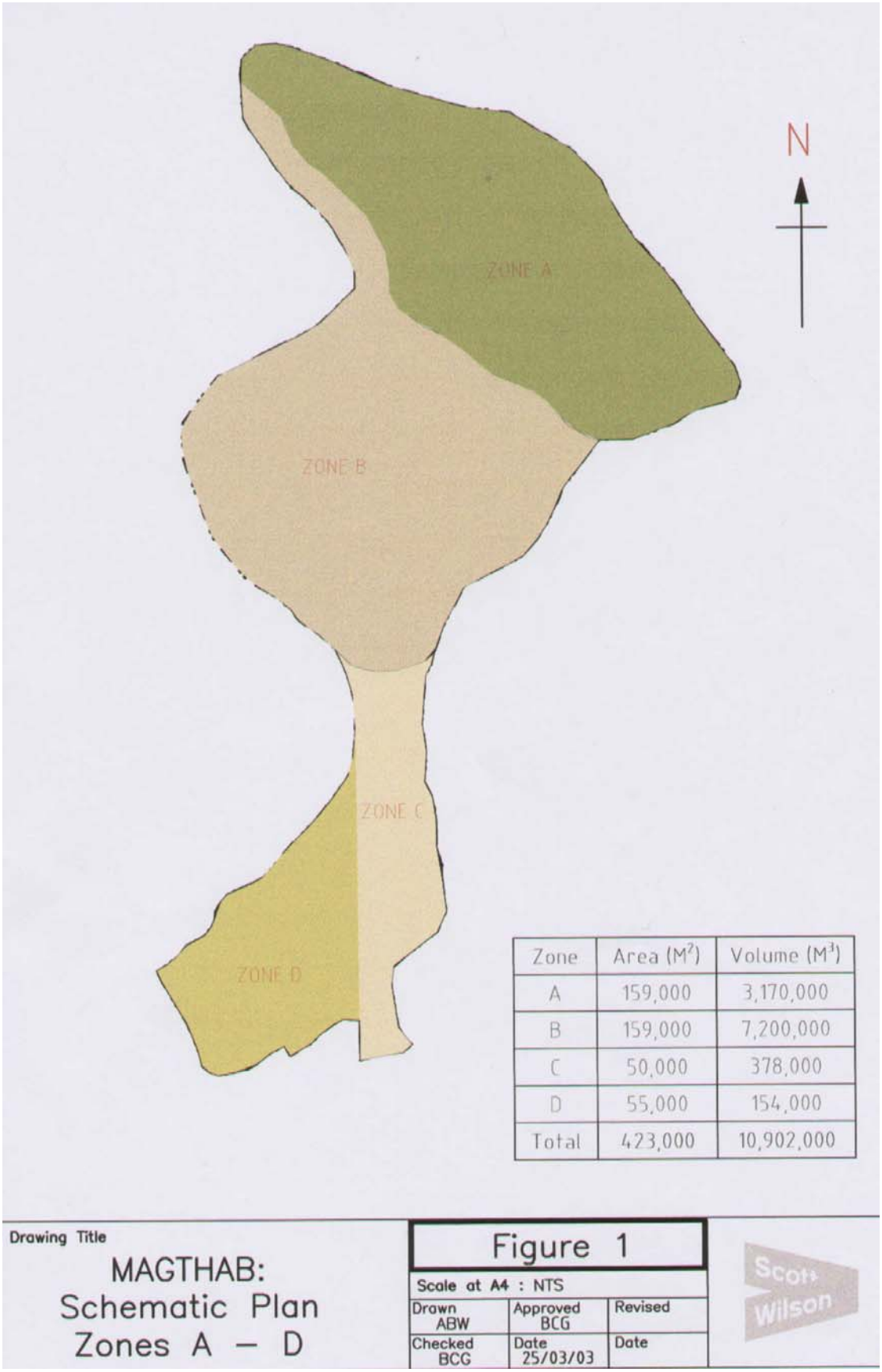
SELECTED SITE

Ta' Zwejra Maghtab Temporary Storage Facility

As stated in the 'Development of Rehabilitation Strategies Maghtab, Qortin and Wied Fulija Landfills' Stage III final report, prepared by Scott Wilson, the Maghtab Landfill was subdivided into four Zones.

- Zone A is the northern, seaward face;
- Zone B is the main bulk of the central section of the landfill;
- Zone C is the southern spur nearest to the reception area; and
- Zone D is the formerly restored area to the west of the reception area, now handed back to the original owners and used for agricultural purposes

Analysing Zone A and Zone B, it was found that both zones mainly constituted of non inert waste and was not advised to carry out any excavation works in these zones. Analysing Zone C resulted that this zone had a very low temperature and can be considered, as inert/stabilised waste that could be suitable for early restoration.



Zone	Area (M^2)	Volume (M^3)
A	159,000	3,170,000
B	159,000	7,200,000
C	50,000	378,000
D	55,000	154,000
Total	423,000	10,902,000

Drawing Title

MAGTHAB:
Schematic Plan
Zones A – D

Figure 1

Scale at A4 : NTS

Drawn	Approved	Revised
ABW	BCG	
Checked	Date	Date
BCG	25/03/03	

Scott Wilson

Appendix B

AERIAL EMISSIONS CONTROL FOR MAGHTAB, QORTIN AND WIED FULIJA LANDFILLS

Project Description Statement

Government of Malta

Ministry for Resources and Infrastructure

WasteServ Malta Ltd

AERIAL EMISSIONS CONTROL FOR MAGHTAB, QORTIN AND WIED FULIJA LANDFILLS

Project Description Statement

Working Draft 02

Phoenix Building
Old Railway Track
Sta Venera
Malta

September 2003

TABLE OF CONTENTS

Introduction

Project Background

1.1.1 Project Summary

Over the past year an investigation and study into Maghtab, Qortin and Wied Fulija landfills in order to develop environmentally sound strategies for their rehabilitation has been carried out. This was achieved by an investigation of the waste masses, measurement and monitoring of aerial emissions, sea and groundwater quality and temperature profiles. This culminated in the characterisation of each site by the development of site-specific conceptual models. These were used to assess the impact that each landfill is having on the surrounding environment currently and potentially in the future should there be no intervention. This process identified key risks that require mitigation for each site.

The results of this study have been developed into recommendations for rehabilitation. These recommendations have defined a number of immediate and longer-term actions that will be implemented in a number of sequential and partially overlapping phases.

This document is a Project Description Statement (PDS) for the implementation of environmental control and initial rehabilitation of Maghtab, Qortin and Wied Fulija landfills (the 'Project'). Comprehensive restoration strategies have been developed that will involve the progressive rehabilitation of each site. Due to the nature of the proposed works (environmental control, waste recontouring, landscaping / planting etc) it will take many years to achieve full restoration. As the first phase, the installation of an aerial emission management system and a minimum amount of associated earthworks to create access and working platforms is to be undertaken. This Project Description Statement covers this initial phase.

It is intended that the Project will be designed to a high specification including conformance with European Union (EU) policy on waste management and good gas management practice. This Project seeks to:

- establish short and long-term measures to minimise the aerial impact of the landfills;
- close and commence restoration of the landfills as stipulated in the *Solid Waste Management Strategy*.

1.1.2 Policy Context

Existing national policies relating directly to waste management and landfills are contained in the following:

- *Structure Plan (1990 – 2010) for the Maltese Islands* published in 1992 by the Planning Authority (PA).
- *Waste Management Policy for the Maltese Islands* published and subsequently adopted in 1998 by the Ministry of Foreign Affairs and the Environment.
- *Space for Waste: The Waste Management Subject Plan* published by the PA in October 2001 and awaiting Cabinet Approval.
- *A Solid Waste Management Strategy for the Maltese Islands* published by the Ministry for the Environment and approved by Government in October 2001.

Waste Management Policy for the Maltese Islands

The *Waste Management Policy for the Maltese Islands* was published for public consultation in 1997 and subsequently adopted in 1998 by the Consultative Board for the Environment of the former Ministry of Foreign Affairs and the Environment. The Policy document provides an overview of the

waste management situation on the Islands and sets out the key principles that should form the basis of a sound waste management strategy for the future. The Policy acknowledged that the legislative and regulatory framework of the European Union will exercise significant influence upon the development of waste management plans for the Islands, since most European countries adopt these as the basis for their legal and policy framework. Malta will become a member of the EU in May 2004. The Government is thus fully committed to EU environmental policies and legislation and is in the process of transposing these into national legislation.

Waste Management Subject Plan

The *Waste Management Subject Plan* was published by the PA in October 2001 and provides strategic direction and context to the Government and the private sector (in accordance with the timescale of the approved Structure Plan) in waste management issues up to 2010.

A number of strategic waste management, development control and environmental policies have been set within the Plan, focusing on the key principles of waste management. In all there are some 29 strategic waste management policies and some 9 development control and environmental related policies.

Solid Waste Management Strategy for the Maltese Islands

Following adoption of the Waste Management Policy, the *Solid Waste Management Plan for Malta* was issued by the Ministry for the Environment as a consultation draft in January 2000. The main purpose of the Plan was to identify possible strategies and systems for the management of waste that utilise the latest technologies and conform to the current situation within the EU. The *Solid Waste Management Strategy for the Maltese Islands* followed on from, and was intended to complement and build upon, the *Solid Waste Management Plan for Malta*. This Strategy was formally ratified by Government in October 2001 and forms the main basis of the Government's approach towards developing a sustainable waste management system. The Solid Waste Management Strategy proposed a series of key objectives relating to this Project. Principally, these are to close down the Maghtab and Qortin landfill sites and bring these sites, together with the closed landfill at Wied Fulija, back into beneficial use.

PDS Contents

An overview of the contents of this PDS, cross-referenced to the relevant clauses in the PDS Guidelines (Appendix A), is presented in **Table 1**.

Table 2: Overview of PDS Contents

Section	Description	Reference to PDS Guidelines
1	**Background**	
1.1	Project Background	A2
1.2	Overview of PDS Contents	
1.3	Details of the Developer	A1
2	**Project Justification**	
2.1	The Project Objectives	A2
2.2	The Need for the Project	A3, A6, A7, A9, A10
2.3	Project Viability	A5
2.4	Project Timetable	A4

Section	Description	Reference to PDS Guidelines
3	**Project Description**	
3.1	Project Components	A8
3.2	General Design Principles	A11, A12, A13, A14
3.3	Summary of Mitigation Measures	A15
4	**Preliminary Conclusions**	
5	**Appendices**	A6, A8

Details of the Developer

1.1.3 Background

The Ministry for Resources and Infrastructure (MRI) seeks to provide a comprehensive quality service to Government in the design and implementation of infrastructure works and projects. These activities provide the necessary means for ensuring an adequate service to the community and the infrastructure required for an efficient economy. The role of the Ministry extends further in that it must ensure that any development is carried out in harmony with the environment.

The newly formed semi-autonomous WasteServ Malta Ltd (WSM Ltd) is a private company in accordance with the Companies Act 1995 and is wholly owned by Government through Malta Government Investments Limited and Malta Investment Management Company Limited. WSM Ltd's main business objectives are to:

- organise, manage and operate integrated systems for waste management, including integrated systems for minimisation, collection, transport, sorting, reuse, utilisation, recycling, treatment and disposal of solid waste and hazardous waste; organise, manage and operate integrated systems for export of waste to destinations outside the Maltese Islands;

- organise, manage and operate integrated systems for waste management in accordance with the Laws of Malta and the waste management policy and plan of the Government of Malta while observing internationally recognised waste management principles;

- organise, manage and operate integrated systems for waste management for other types of waste as may be decided by the Government of Malta or the Ministry responsible for the infrastructure relating to the management of waste.

- to assist in and supervise the implementation of waste management policies as developed from time to time by the Government of Malta.

Project Justification

The Project Objectives

- Closure and initial phase of the rehabilitation of Maghtab, Qortin and Wied Fulija landfills;
- Introduce the environmental measures necessary in order to enable the landfills to be fully rehabilitated and brought back to beneficial use at a future date;
- Immediate minimisation of the aerial impacts of the landfills on nearby receptors;
- Ensure compliance with all national and EU legislation, particularly with regard to waste management and environmental control;
- Utilisation of appropriate European Union funding already identified for landfill rehabilitation.

The Need for the Project

1.1.4 Introduction

The solid waste disposal sites at Maghtab, Qortin and Wied Fulija were developed at a time when the full environmental impacts of such operations were not known. As a result, the Maltese Islands are left with a legacy of landfill sites that have no systems in place for the proper control of landfill leachate or gas and the presence of fires is common. A concern has arisen over the potential human health and environmental impacts of these sites and the need to raise the environmental standards associated with the management of wastes in Malta. Movement has been made towards this with the implementation of *A Solid Waste Management Strategy for the Maltese Islands* (October 2001) and the letting of contracts for the appropriate management of wastes. This current project is being executed in line with this overall strategy and involves the control of aerial emissions and initial rehabilitation of the three largest landfills.

This Project will establish the initial phase of the rehabilitation of the sites. It is expected that this will be progressively followed over a number of years with further phase in this process. Future phases will include recontouring of the waste (as required for particular end-use requirements) and the establishment of a vegetative cover). Decommissioning of the environmental control systems including the aerial emissions control plant and equipment will also be undertaken once the waste masses have stabilised some time in the future. Following the implementation of the complete restoration, it is anticipated that the sites could, in the future, serve a number of afteruses.

1.1.5 Existing On-Site Conditions

Maghtab

The footprint area of the landfill is currently around 40 hectares although the area of land owned by the Government is larger, at around 60 ha. The main waste filling area forms a complex shape with wastes rising steeply from natural ground level in benches to a flat upper plateau around 6 hectares in area. The maximum thickness of waste over the buried valley is around 70 metres. This is likely to increase as the landfill continues to receive waste up until its projected closure during 2004.

Qortin

The current landfill footprint occupies an area of around 3.5 hectares. The shape of the landfill at the present time is a flat-topped mound with very steep side slopes (approaching 1v:1h) with a summit plateau approximately 1.5 hectares in area. On the seaward side, the

base of the waste encroaches to within 2 or 3 m of the cliffs at the edge of the limestone plateau. The maximum depth of waste is around 17 metres.

Wied Fulija

The landfill site is situated on the south coast of the island of Malta in the hamlet of Wied Fulija approximately 1½ kilometres south of the town of Zurrieq. The site comprises two separate bodies of waste on the eastern and western sides of the Wied Il-Hallelin. The seaward side of the site lies within 10-25 m of a cliff edge, where there is a sheer drop of around 100 m to the sea. The top of the waste is up to 25 m above the surrounding natural ground level on the seaward side but is thinner (around 10 m) on the landward side. The total footprint is in the region of 6.5 hectares. Both the eastern and the western halves are steep sided, benched and flat-topped. The top area of the western side is approximately 0.9 hectares, and the eastern side about 1.5 hectares

1.1.6 Surrounding Site Conditions

Figures 1, 2 and 3 show the location of the three sites.

Maghtab

The site was developed on areas of garigue and some former agricultural land. Before waste disposal operations began, the natural topography of the area was a valley lying between two low ridges; the general slope of the land was towards the sea. Currently, the valley is entirely buried and the ridges form the land surfaces at the base of the western (Il-Ghallis ta' Gewwa) and eastern (Ta' Hammud) sides of the landfill.

Current landuse on the former ridges is predominantly agricultural although fields adjacent to the landfill are disused on the northeastern and southern sides of the site. An area of garigue is present at Xaghret Franklin to the west of the site, whilst in the north, the site is encroaching on a small area of garigue at Il-Ghoqod beyond which lies the main coast road from Swieqi to St Paul's Bay.

Qortin

The site was developed on the high level (around 100-110 mASL) garigue limestone plateau of Ghajn Damma and areas of garigue remain on the plateau to the west. A small private dwelling has been built on the highest point of the plateau immediately to the west of the landfill. The limestone plateau to the south and east consists of rubble walled fields. Although the fields immediately adjacent to the landfill are disused, the remainder are currently in agricultural use.

The limestone plateau terminates to the north and west with a cliff face around 10-15 m high below which are steep clay slopes (*Rdum*) descending to the sea at Marsalforn and the coastline to the east where limestone again outcrops at sea level.

Wied Fulija

The landfill was mainly founded on rock although some of the waste has been placed on the agricultural fields that surround the site as the landfill has grown. The valley beneath the two land-raises generally follows the route of the Wied but contains a limited thickness of waste. The surrounding area is predominantly agricultural with some animal husbandry.

1.1.7 Current Operation of the Sites

The Maghtab landfill site is the only operational landfill site on the island of Malta authorised to take non-inert waste. It has been in operation since 1977 and has taken most of Malta's waste since the closure of Wied Fulija in 1996. Prior to 1997 no detailed records were kept of the quantity and type

of wastes deposited. However since this time a weighbridge has been installed and records have been made of all wastes deposited. It is due to close at the end of April 2004.

Qortin landfill has been in operation as a landfill since 1968. It currently takes all the non-inert waste from Gozo and like Maghtab is due to close at the end of April 2004.

Unlike the other two sites, the landfill at Wied Fulija is no longer active. It commenced operations in 1979 and ceased to accept waste from 1996. The only activity that now takes place there is the temporary storage of material for recycling (such as glass) and the storage of compost from the San Antnin Composting Plant.

1.1.8 Development of Strategies for Rehabilitation

An investigation of the waste masses, measurement and monitoring of aerial emissions, sea and groundwater quality and temperature profiles enabled the characterisation of each site by the development of site-specific conceptual models. These were used to assess the impact that each landfill is having on the surrounding environment currently and potentially in the future should there be no intervention. This process identified key risks that require mitigation for each site.

The sites have a number of uncontrolled fires and waste is predominantly degrading in aerobic conditions although locally anaerobic decay is also occurring. Because of this, typical landfill gas (especially methane) concentrations are low, and carbon monoxide concentrations and gas temperatures are relatively high. In addition, other gases and emissions associated with waste combustion are being released to atmosphere in an uncontrolled manner. The aerial emissions management system is designed to collect these high temperature gases for destruction before release into the atmosphere.

Project Viability

Capital funding for this project has been identified as part of the monetary sum made available through European Union structural funding. The installation works will be undertaken under one or more contracts let in accordance with European Union requirements. After completion of the handover period responsibility for managing the system will rest with the Developer.

Project Timetable

The installation and commissioning of the aerial emissions management systems will be carried out in a number of stages for Maghtab and Wied Fulija, and in a single stage at Qortin. The works will commence as soon as practicable. It is anticipated that work will start at Wied Fulija early in 2004 with works at Maghtab and Qortin commencing as soon as these sites are closed, in May 2004. The contract works, commissioning, training and handover periods are expected to last some 18 months in total, which will enable subsequent phases of the rehabilitation to progress.

Full restoration of these sites, which will include establishment of vegetation and development of afteruses, will take place when the emissions from the site are under control.

Project Description

1.2 Project Components

1.2.1 Summary

The Project will involve:

- Installation of environmental monitoring systems;
- Procurement of monitoring equipment;
- Recontouring the waste within the site boundaries to form access tracks and level working platforms;
- Probing / drilling into the waste for well installation;
- Construction of a secure compounds to house gas management plant;
- Installation of pumps and associated pipework (gas collection system);
- Installation of gas treatment plant;
- Operation and maintenance of installed systems;

1.3 General Design

1.3.1 Principal Design Criteria

The criteria on which the design was developed predominantly are a result of the landfills study findings described in Section 1.1.8. Potential environmental and health impacts and risk reduction goals led to the selection of specific treatment plant for this Project.

Selected systems will be utilised to extract gases from within the waste masses and destroy the harmful components before venting to atmosphere. Operated effectively these systems will minimise harmful substances venting to atmosphere and accelerate the process of returning the sites to beneficial afteruses.

Other design elements are based on legislative requirements and industry best practise. Health and safety aspects (including the construction, operation and maintenance elements) have been given full consideration.

1.3.2 Key Legislative Requirements

There are a number of significant European Union Directives that are relevant to this Project. Some of these have already been transposed into Maltese regulations and others will follow shortly: Those of particular relevance include:

- 1999/31/EC Directive relating to the landfilling of waste;
- 1999/30/EC Directive relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air;
- 2000/69/EC Directive relating to limit values for benzene and carbon monoxide in ambient air.

1.3.3 Other General Design Principles

Other general design principles to be applied to the planning and design of the Project include:

- Achieving improved environmental performance in the short, medium and long term;
- Addressing the most significant hazards (particularly those with health and safety implications) immediately;
- Ensuring that no (significant) environmental deterioration is caused during restoration works;
- Ensuring that restoration works are confined within existing site boundaries with no significant demand for large tracts of adjacent land as temporary or permanent working areas or for long term storage / disposal unless essential for environmental control;
- Utilising proven or readily (locally) available technologies;
- Minimising the disturbance of waste by careful siting of access routes, working platforms and wells;
- Preventing an increased impact on the environment by limiting the excavation into waste to those areas required for long-term slope stability;
- Minimising the area of restoration works to the minimum required for an efficient aerial emissions management system to operate and other works required for longer-term safety measures;
- Constructing the works in a phased manner to ensure efficiency of the installed system;
- Minimising the amount of material brought into the sites where at all possible;
- Stabilising steep slopes by cut / fill operations, only where essential and practicable; and
- Ensuring the works will integrate with the long-term rehabilitation options selected for each site.

1.3.4 Aerial Emissions Management System

The system at each site will comprise a number of steel wells connected at the surface with steel pipe to a number of manifolds. These shall be connected to the gas abstraction pumps and management plant located in a secure compound via MDPE gas mains. The gas treatment plant will comprise high temperature flares for burning the higher concentrations of methane gas and noncatalytic oxidation equipment i.e. a VOC thermal oxidiser ('Vocsi Box' or similar) for the destruction of VOCs in low concentrations of methane. The final stage would comprise an activated carbon filter to remove any residual trace gases. Figure 8 is a process diagram to show the anticipated configuration of these systems.

<u>Gas Collection and Delivery</u>

The collection of gases and emission will require:

- The installation of gas wells (probably 'impact' wells that do not require drilling) and wellhead access chambers;
- The installation of wellheads onto the gas wells;

- The installation of steel connecting pipework;
- The installation of manifolds and blockwork chambers;
- The installation of MDPE gas mains (including drainage for condensate);
- The connection of the manifolds to the gas mains;
- The installation of gas mains connecting the manifolds to a gas plant.

Gas Treatment

Abstracted gasses will be treated in a compound constructed at each site. The plant will comprise:

- Condensate collection
- Pumps and regulators
- High temperature gas flares
- Noncatalytic oxidation equipment
- Activated carbon filters for exhaust gases

The small volume of spent carbon produced by the filtration process will be disposed of to landfill.

Figure 7 shows an example of a VOC thermal oxidiser (in this case a Vocsi Box) and a typical gas treatment compound with an open sided shelter.

Staged Approach

It is likely that the works may be let in two contracts: one covering Maghtab and Wied Fulija and the other Qortin.

In order to confirm the design assumptions, to optimise the funding programme and to adhere to the site closure programme, the works will be installed in stages.

The initial stage will be to install environmental monitoring systems and equipment in order to obtain background data and to carry out the monitoring described in Section 1.3.5.

The Maghtab and Wied Fulija landfill sites will be developed in a number of stages. The first stage will involve installation of wells and pumps, the construction of the gas extraction plant compound and certain treatment plant. This will be commissioned and operated. The results from the initial stage will be assessed and any design and construction modifications made prior to the installation of subsequent stages.

Subsequent stages will involve operation and maintenance of the equipment installed during earlier phase one and construction of further wells and treatment plant

The restoration of Qortin landfill will be conducted in one stage.

There is likely to be some earthworks and movement of waste to create suitable working platforms and access routes, but none of this waste will leave the sites.

Access Arrangements

Existing site infrastructure will be used where at all possible. Access arrangements for construction traffic will be the same as during the operational period of the landfills. Vehicle compounds and storage of materials and machinery will take place within the site boundaries.

Figures 4, 5 and 6 show the probable location of the compound at each of the sites; these will be screened by landscaping bunds. Services to the compounds will be provided including water, telecommunications and electricity as a minimum.

1.3.5 Environmental and Health & Safety Monitoring

Long term environmental monitoring will be conducted (partly utilising some of the instruments installed as part of earlier works). Initially, before commissioning of the systems, this will concentrate on gathering baseline data on air and groundwater quality. Subsequently this information will be used to direct the operations and to assess their performance.

The key environmental media to be monitored are considered to be:

- Aerial emissions associated with the operation of the emissions control system;
- Aerial emissions associated with the earthworks required to install the emissions control system;
- Monitoring of changes in groundwater quality as the emissions control system is implemented.

On-site Emissions Monitoring

Emissions from the treatment plant will be measured to monitor effectiveness. Records of:

- particulate matter;
- volatile organic compounds;
- sulphur dioxide;
- nitrogen oxides; and
- dioxins.

will be undertaken.

Off-site ambient Air Monitoring

Off-site ambient air monitoring at all three sites will be undertaken. Primarily monitoring will be for total respirable particulates (mass per unit volume). Collated filters containing collected particulate matter will be periodically analysed for the presence of toxic metals in dust. The particulate monitoring semi-volatile organic compounds in air will be collected.

Meteorological data will be collected at all three sites using meteorological stations attached to downwind particulate monitors.

The ambient air monitors will be located in secure fenced compounds with a concrete base and either be powered by solar/wind/battery power (if in remote locations) or by mains electricity supply (if located close to services). The ambient air monitors will be capable of storing operational data on-board. Users will be able to access logged information either directly through a user interface or remotely using a modem.

Protective Monitoring of Personnel

Personal protective monitoring will be required during earthworks to ensure the health and safety of site operatives. In particular personal monitoring for the following will be required:

- VOCs (using photo-ionisation detectors or equivalent); and
- respirable dust.

To minimise risk of uncontrolled exposure of hot and combusting waste materials, monitoring of proposed excavation areas will be required using hand-held infra-red detectors and surface temperature probes.

Groundwater

Groundwater monitoring boreholes have already been installed around the site as part of the investigation works (Section 1.1.8). These should be suitable for long term monitoring although some rehabilitation of some of the wells may be required. In addition to these wells there are a number of private groundwater abstractions around the site and these should also be sampled and the waters tested at the same frequency as the monitoring boreholes.

It is proposed that the monitoring regime include sampling and analysis for a range of water quality parameters (including ammonia, major ions, pH and conductivity), metals in saline waters, volatile organic compounds and organotins.

Equipment

As part of this Project sufficient and appropriate environmental and personal monitoring equipment, as well as GPS surveying equipment, necessary for the short and longer term management of these systems will be provided.

1.3.6 Commissioning, Operation, Maintenance and Training

After the installation of the aerial emissions management system each will be commissioned and the period of operation will commence. The plant and equipment installed will be operated and maintained until the emissions from the sites no longer present an adverse impact on the surrounding environement. The emissions and equipment will be continuously monitored throughout this period to determine the efficacy of the installed system, which will be maintained and modified to ensure optimum performance.

During the initial operation/handover period the developer's maintenance staff will be instructed as to the purpose, function and operation of the new installations. This will take the form of several formal and informal training sessions held throughout the operational period and 'shadowing' of the contractor's staff. The outcome of this training will be the transfer of responsibility for the operation and maintenance from the works contractor to the developer. It will also be necessary for the contractor to train staff of developer to continue the long term environmental monitoring.

1.3.7 Health and Safety

The works contractor will be required to develop a Site Health and Safety Manual for the works covering the following:

- Health and safety policy;
- Site safety rules;

- Procedures for controlling contractors / sub-contractors;
- Use of PPE;
- Safe working practices e.g. for working in confined spaces or potentially dangerous areas;
- Procedures for investigating and reporting accidents and other safety-related incidents;
- Training in safety aspects of site operation; and
- Procedures for controlling off site migration of potentially harmful emissions.

1.3.8 Resource Requirements

Table 2 outlines the main elements of equipment that will be installed on the sites along with an rough estimate of quantities.

Table 2

Item	Unit	Quantity
6m deep boreholes with well casing	No.	600
Galvanised Steel Wellheads	No.	600
BSP galvanised steel pipe for connecting pipework	Metre	60,000
Manifolds	No.	25
Pipe for gas main	Metre	15,000
Fenced compound	No.	3
High temperature gas flare	No.	3
Activated carbon filters	No.	2
VOC thermal oxidiser	No.	4
Monitoring/surveying equipment etc.		

The number of staff likely to be employed on the Project will be 20-30 people during the construction phases and approximately 2-4 during the operational/hand-over phase.

1.4 Summary of Mitigation Measures (Construction and Operational Phases)

The installation of the aerial emissions management system is designed to reduce the environmental impact of the landfills, however, in order to minimise any impacts the construction or operation may cause, procedures will be adopted to eliminate nuisances from:

- Vehicle traffic;
- Litter;
- Odours;
- Noise;
- Birds;
- Vermin, insects and other pests;
- Fires/smoke; and
- Dust.

1.4.1 Traffic Impacts

All three sites have previously been operating as landfills resulting a number of vehicular movements per day. Construction traffic for establishment of the aerial emissions control will use

existing routes and accesses to the sites. Total construction vehicle movements to and from the site will be limited as it is anticipated that, apart from the delivery of plant and equipment all vehicles working on site will remain on site for the duration of the works. Hence, apart from at Wied Fulija traffic volumes will be significantly less than presently. Where necessary traffic will be routed away from more sensitive areas. Figures 4, 5 and 6 indicate the access points for each of the sites.

1.4.2 Litter Control

Litter control will be given a high priority, particularly when any excavations into the waste are necessary. On particularly windy days construction works will cease until the wind has abated.

Movable screens or nets will be positioned near the working areas to control wind blown litter if required.

1.4.3 Odour Control and Aerial Emission

The very nature of this Project is intended to minimise the impacts caused by aerial emissions from the sites. In addition control measures during the construction and operational phases will be adopted.

Odours from the landfills will be reduced by good site management during excavations into the waste and the drilling of wells. The principal means of minimising these will include:

- the provision of adequate cover;
- rapid deposition of malodorous wastes, using covered trenches where necessary;
- rapid burial of excavated wastes and the closure of such excavations.

1.4.4 Noise Control

Vehicles or equipment visiting or in use on the site will conform to Maltese standards in relation to noise performance. Special attention will be given to fitting sound reduction equipment to power tools, machines and fixed plant. When necessary acoustic screens will be used in the proximity of all noise-generating equipment.

The imposition of on-site speed limits will reduce noise of vehicles accessing the site. The effective maintenance of site equipment will also be necessary to reduce noise.

1.4.5 Pest Control

The cessation of tipping at the landfills will go a long way to control pests on the site. There is a possibility the any excavation into the wastes may exacerbate a problem that already exists. The immediate cover of excavated or moved waste will be the most effective means of pest control. Regular site inspection will indicate the prevalence of pests which can be dealt with should a problem arise. The most consistently effective measure is the good site management and proper covering of all exposed waste as quickly as possible.

An assessment into the control of rodents on the landfills has been carried out with a view to the implementation of recommendations upon closure of Maghtab. It is not anticipated that the construction of the aerial emissions control system will impact on the rodent control works in any way.

1.4.6 Dust Control

The deposition of mud on the public highway by construction traffic will be minimal as it is unlikely that site vehicles will leave site often during the works; there is no intention for material to be removed from site. Where construction traffic has to leave site the deposition of mud on the adjacent roads will be limited by the use of wheel wash facilities installed at Maghtab and Qortin. Mud control will be part of the routine site inspection program

Damping down of site access roads, using water sprays will mitigate the emission of dusts. As a minimum all haul roads and working surfaces where vehicular movements occur will be sprayed with water daily, or more frequently when there are unusually high vehicular movements or the weather conditions are windy.

Preliminary Conclusions

This Project seeks to reduce the impact on the surrounding environment of the Maghtab, Qortin and Wied Fulija landfills, in particular with regard to their aerial emissions. This is to be done by adopting an approach based on providing necessary environmental and safety control.

Previous studies of these landfills have identified a number of adverse impacts that are considered to require positive intervention. In particular, aerial emissions of gases, dusts and smoke from the sites (largely as a result of subterranean combustion) are considered to present the most immediate and significant environmental impacts. Other significant impacts relate to the contaminated nature of some of the waste materials and the size, shape and location of the sites. This Project addresses all of the immediate impacts and is the first phase in a comprehensive restoration scheme to return the sites to beneficial use.

All the sites present significant challenges to the successful implementation of remedial strategies. It is considered that workable rehabilitation strategies for each site will require the use of a number of passive or active control techniques combined and operated over a period of time to effectively mitigate the identified impacts.

In general, the basic environmental controls proposed relate to management of aerial emissions by installing gas collections systems linked to flares and other treatment plant. Some waste recontouring will be required to allow access to all parts of the sites to install the control systems. At some time in the future, when the environmental impacts are reduced and it is considered safe, the sites will be fully rehabilitated. This would involve recontouring and the placement of soils and landscape planting, which could take many years to become established.

An extensive environmental monitoring scheme will be conducted at the same time as construction works in order to identify and rectify any problems at an early stage. In addition, every effort will be taken to ensure there are no adverse impacts on the surrounding environment, site workers and nearby residents caused by the construction of this control system. It is considered that due to the nature and former use of each of these sites, that any impacts will be of a significantly lower magnitude than at present or when the sites were operational.

APPENDIX A

Project Description Statement Guidelines

In order to set out the Terms of Reference for the EIA, a detailed Project Description Statement is required. This should take the form of a mini report taking into consideration the following issues:

A.1 Details of the person/s wishing to carry out the development;

A.2 An explanation of the nature of the opportunities and problems being addressed by the development and of its general economic, social and environmental objectives;

A.3 A description of the general strategy employed and of the production processes and operational methods to be used and any alternative methods considered, in reaching the social, environmental and economic objectives of the development;

A.4 An indication of the proposed timing of the project and why this timing was preferred;

A.5 An indication of whether the project is economically viable;

A.6 The location of the proposed development with site boundaries clearly shown on a map;

A.7 A brief indication of the alternative uses and locations considered, including suitable alternative locations and sites for the proposed development and alternative uses or arrangement of land uses, on the proposed site;

A.8 A description of the physical characteristics including size, scale, design and phasing of the development using models, photographs, diagrams, plans and maps where appropriate;

A.9 A description of present land uses and environmental characteristics of the site;

A.10 A brief description of surrounding land uses, their nature, their extent and their environmental characteristics;

A.11 A description of the services, water, foul water sewers, surface water drainage, including storm water drainage and energy sources available on site;

A.12 Estimates of the number of persons to be employed with estimates for each phase of the development;

A.13 The nature and quantities of raw materials to be used and wastes generated during construction and operation; the proposed method of storage or handling of materials and wastes and machinery needed during both the construction and the operational phases;

A.14 Access arrangements, parking requirements and parking arrangements on and off the site, during both construction and operation;

A.15 Proposals for mitigating the negative effects of the development.

APPENDIX B

Figures

Appendix C

TIME SCHEDULE FOR THE MANAGEMENT OF THE TEMPORARY FACILITY

Time Schedule for the Management of the Temp

	Year 2004/2005												Year 20					
	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Section A	**Filling Process**				**Capping and Leachates re**													
Section B					**Filling Process**				**Capping and Le**									
Section C									**Filling Process**				**Cappi**					