Ghallis Non Hazardous Landfill

Landfill Optimisation of Void Space Assessment

WasteServ Malta Limited

WasteServ Malta Ltd

SLR Ref:403.00585.00026
Version No: 1
April 2016

CONTENTS

DRAWINGS

1.0 INTRODUCTION

SLR Consulting Limited (SLR) was instructed by WasteServ Malta Limited (WasteServ) to undertake an assessment of how to optimise the potential remaining void space at the Ghallis Non Hazardous Waste landfill. WasteServ has been operating the facility since 2007 and the objective of the work is to assess options on how the void space can be increased from the scheme currently planned.

The ongoing development of the landfill follows the principals set out in the Environmental Impact Assessment for the site[1] with the landfill void created by the phased extraction of in-situ limestone deposits. Each landfill cell is then shaped in preparation for the installation of a lining system. The lining system design incorporates a 500mm thick foundation layer on the base and side slopes of the disposal area overlain by a Geosynthetic Clay Liner (GCL) and a 2.0mm thick High Density Polyethylene (HDPE) geomembrane. For each constructed landfill cell a gravel drainage blanket placed on a protection geotextile allows the free drainage of leachate to a sump and vertical chamber from where it can be extracted.

Following completion of waste infilling at the site a capping and restoration system will be installed. To date no areas have been capped and restored. The detailed design for the system is yet to be finalised. The concept presented in the Environmental Impact Assessment assumed the capping and restoration system to comprise (bottom to top) of a 300mm thick stabilisation layer overlain by a 1 mm thick geomembrane, a geocomposite drainage layer, a 300mm protection later and 1m of restoration soils.

This report presents part of the work defined under WasteServ Contract WSM 62/2015 dated 16th July 2015 following submittal of the SLR proposal P403/4168 dated 17th February 2015. Specifically the report looks at how the void space at the site could be modified considering the following:

- by increasing the height of the final restoration contours;
- by increasing the footprint of the landfill beyond the currently proposed scheme;
- by improved waste compaction; and
- by altering the containment design at the perimeter slopes (vertical lining system).

Drawing No.1 shows a general layout of the site. This shows the landfill area that has currently been developed and the various activities at the site.

[1] WasteServ Malta Limited. Waste Management Facility at Ghallis Ta Gewwa, Naxxar. Environmental Statement. SLR Consulting Limited, December 2005

2.0 EXSITING PHASING PHILOSPOHY

As part of the same contract as detailed above, SLR produced a report in September 2015 called landfill Phasing and Construction programming reference 403.00585.00026 dated September 2015.

This report looked at the phasing of cell construction and waste infilling up to completion of the site. This was on the basis of further development in accordance with an overall landfill footprint and final restoration contours as provided by WasteServ. We assume the footprint and restoration contour information is taken from the scheme 'approved' under the site permit regulated by the Malta Environment and Planning Authority (MEPA).

The output from the report was a series of programmes and quantities which detailed the phasing of ongoing rock excavation, landfill cell construction and waste infilling up to the end of the life. At the time of the report the remaining waste void space left at the site was calculated at approximately 1.35 million m^3. A number of programmes were produced on various scenarios depending on different assumptions for the annual waste filling rate.

Section 3 of this report looks at the options to increase the overall void of 1.35 million m^3 under the 'approved' scheme.

3.0 OPTIONS TO INCREASE VOID SPACE

The following provides a brief description of the concepts considered for increasing the voidspace. The voidspace calculations are discussed in Section 4.

Figure 1, below, presents a schematic section through the design of the Ghallis Landfill. As shown a proportion of the landfill has been developed and filled with waste, adjacent to Maghtab Landfill. As the site develops the remaining area will be quarried and lined with a composite lining system to contain the waste.

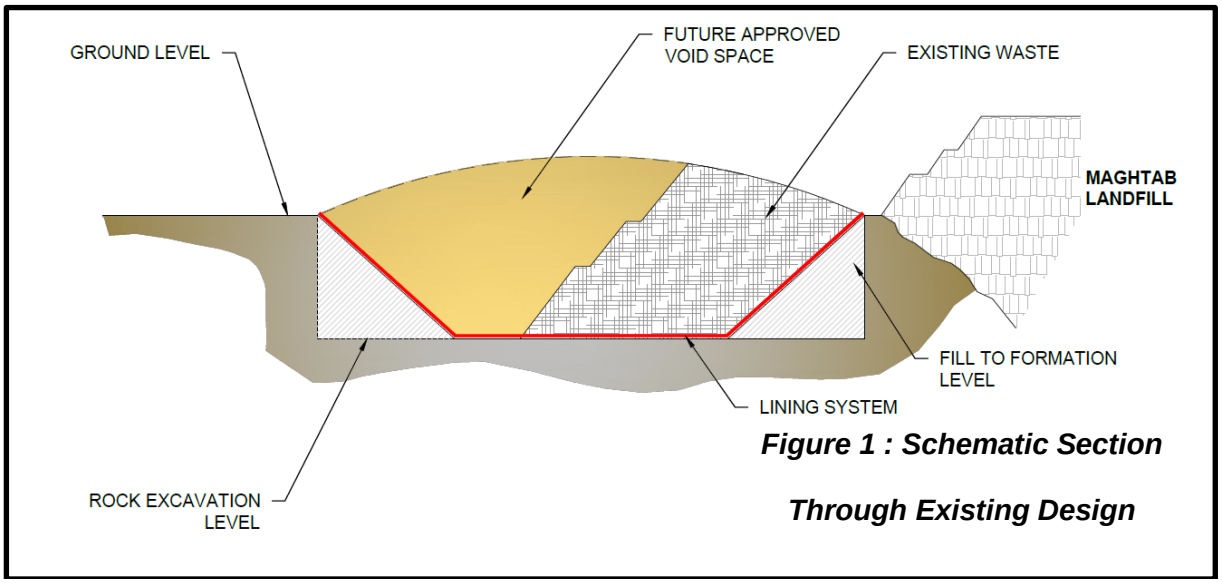

Figure 1 : Schematic Section Through Existing Design

3.1 Increase Restoration Levels

The current restoration design for the site comprises relatively steep slopes (max. 1 V in 2H) extending from the perimeter of the landfill footprint to an elevation of approximately 60maOD at which point the gradient flattens off to a maximum elevation of 65maOD as shown on Drawing No. 2. The void space of the landfill may be increased by simply raising the restoration levels, as shown in Figure 2 below. The maximum level of the “approved” scheme is 65maOD and for the purposes this conceptual design this has been increased to 72maOD

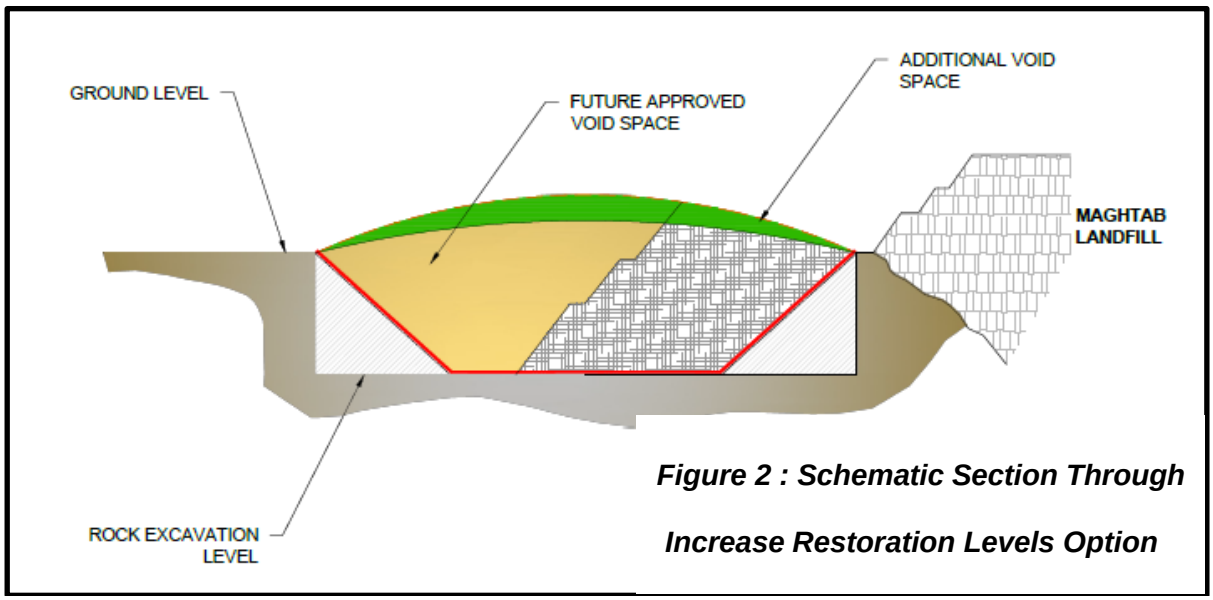

Figure 2 : Schematic Section Through Increase Restoration Levels Option

Increasing the restoration levels will require both planning permission and permitting issues to be addressed. It is the lowest cost option since the increase in engineering costs is minimal. One possible issue with this option is the level of protection provided by the geotextile protector to the geomembrane at increased vertical loads, which will need to be addressed as part of the detailed design process. The main regulatory issue would be the potential to reassess visual impact at the site.

3.2 Vertical Lining System

The current lining system to the side slopes in installed on a 1V in 2H slope. The slope is formed by the excavation of the in situ rock to a sub-vertical face and then back filling with crushed rock to achieve the required gradient. An increase in the void space may be achieved by steepening the gradient of the side slopes from 1V in 2H to sub-vertical, see Figure 3.

Figure 3 : Schematic Section Through Vertical Lining System Option

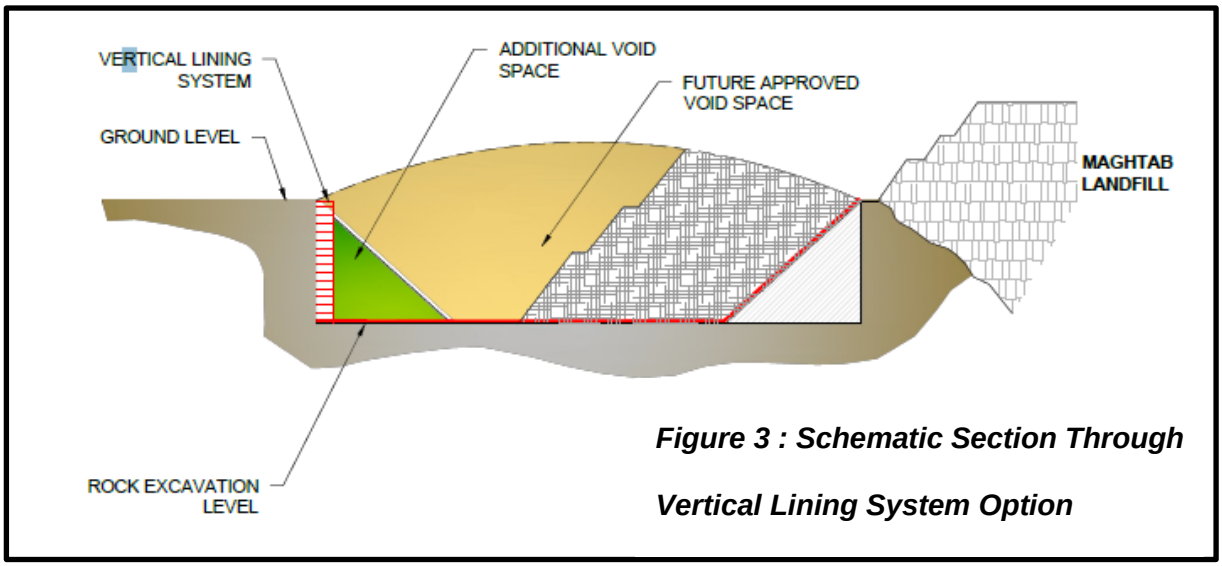

Figure 3 : Schematic Section Through Vertical Lining System Option

There are a number of construction techniques available which can be used to line a sub-vertical quarry face (70^{o}). However, these lining systems are expensive (in excess of €100/m^2) and time consuming to construct and in order to be economically viable the increase in the volume of airspace released must be significant Hence, vertical lining systems are generally only used in very deep steep sided quarries, where significant backfilling of the quarry would be required to engineer a surface on which to install the lining system.

At Ghallis the increase in void space using a vertical lining system would be relatively small since the quarry is only 20m deep. In addition to this remaining length of the perimeter, over which the vertical system is to be installed, is relatively short at around 100m and a tie in detail would be required between existing and vertical systems, further reducing the possible void gain. On the basis of the length of steep wall available and the depth of the quarry, the area of steep wall would be 2,000m^2 and the increase in waste void would be in the order of 21,000m^2. Given that the cost of the vertical lining system would be in excess of €200,000, it is therefore not considered to be a viable option and has not been considered further in Section 4.

3.3 Increase Landfill Footprint

Increasing the footprint of the landfill will naturally increase the void space at Ghallis and there are a number of ways in which this can be achieved. Increasing the footprint will require both planning permission and permitting issues to be addressed.

3.3.1 Expand Quarry to Northwest

Extending the excavation of rock to the north west of the current site boundary is the only direction in which the quarry can be expanded, as the site is constrained by the coastal road to the north, recycling facility to the south/southwest and Maghtab to the east, see Figure 4. Rock would be excavated and perimeter slopes formed in a similar manner to that currently undertaken on site. The increase in void space is a result of the additional rock excavation and the higher restoration levels that can be achieved.

Whilst this option gives the largest increase in capacity, it will require the road into the Mechanical and Biological Treatment (MBT) facility to be moved. Another consideration with this option is the programming of the extraction of rock, as it may not be possible to extract the rock in time to provide a sufficient area to be lined which will ensure continuity of void space.

The cost associated with expanding the quarry, i.e. moving access road, rock excavation, increased basal liner area and capping area, will be outweighed by the increased value of the void space. It should be noted that if there is not an outlet for the excavated excess stone then a cost may be associated with the disposal of this material.

Figure 4 : Schematic Section Through Expand Quarry to Northwest Option

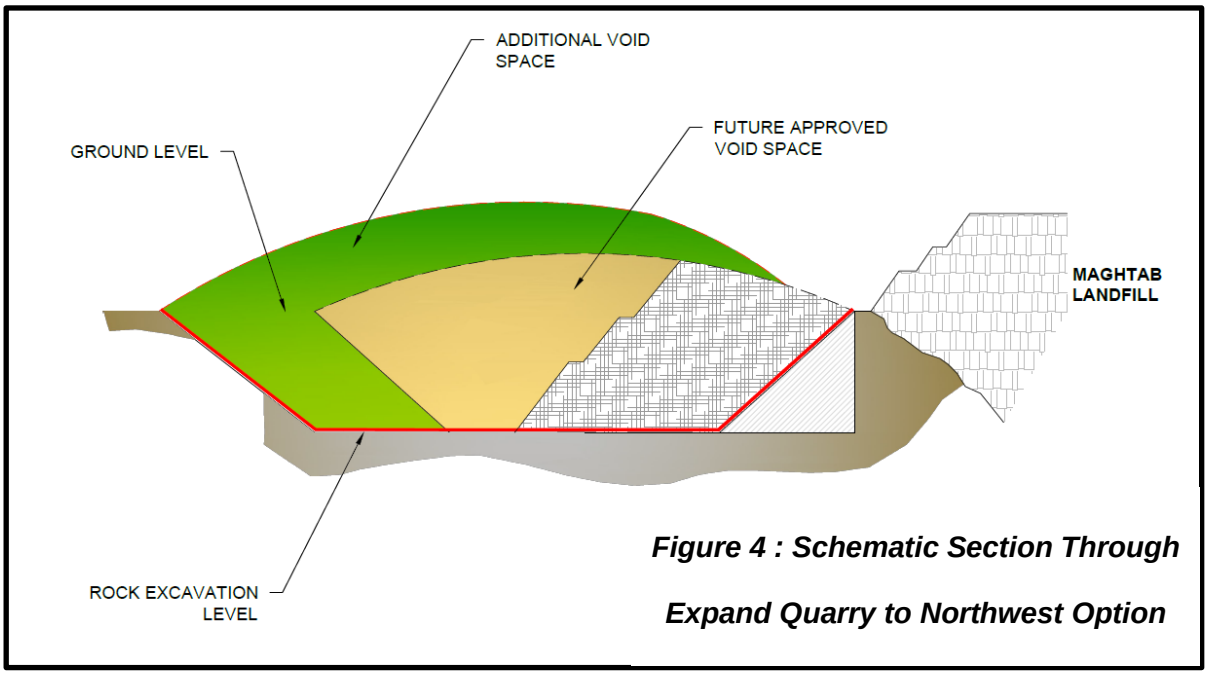

Figure 4 : Schematic Section Through Expand Quarry to Northwest Option

3.3.2 Construct Perimeter Bund

An alternative to extracting additional rock from the north western boundary is to construct a perimeter bund which effectively extends the side slope lining system allowing for a higher restoration level to be achieved, as shown on Figure 5. This bund could also extend along

the southern boundary, between the landfill and the recycling facility, up to the access road that runs between Maghtab and Ghallis.

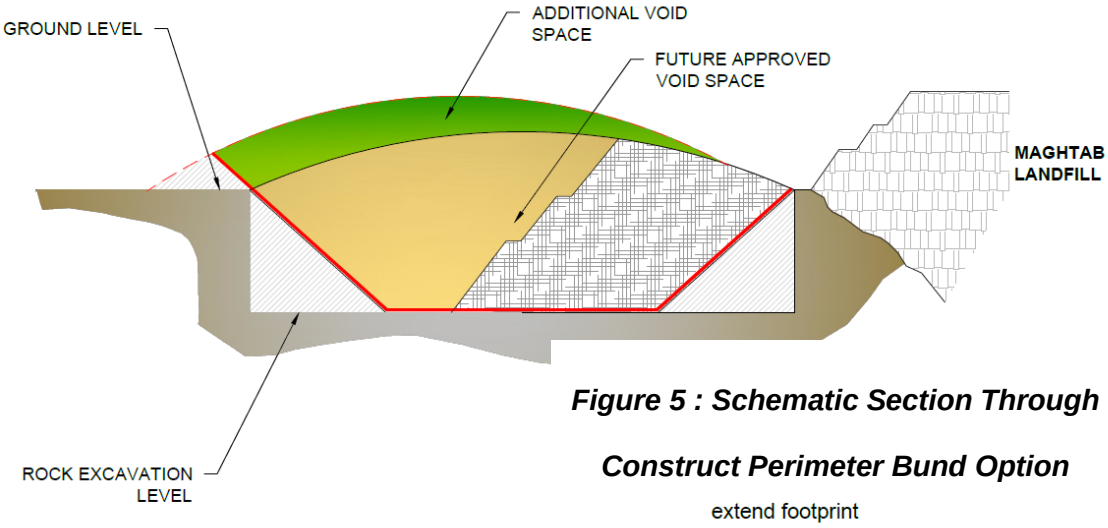

Figure 5 : Schematic Section Through Construct Perimeter Bund Option

The bund would be constructed to form a 1V in 2H slope upon which the lining system would be installed and a 5m wide crest, which will allow the lining system to be anchored and provide access. The slope of the outside face of the bund would vary along its length but would not exceed 1V in 2H.

Similarly to extending the quarry, the construction of the bund would require the access road to the recycling facility to be moved, however, the excavation of rock would not be an issue and rock excavated to form the side slopes could be used to form the bund.

The cost associated with expanding the footprint in this manner, i.e. moving access road, bund construction, increased basal liner area and capping area, will be outweighed by the increased value of the void space.

3.3.3 Overtipping Against Maghtab

Overtipping against Maghtab Landfill along the eastern boundary of Ghallis will also increase the air space by increasing the maximum height of the landfill and allowing the upper plateau of the landform to be elongate to the east.

The basal lining system from Ghallis landfill would have to extend over the existing waste slopes of Maghtab. Such lining systems are referred to as Piggyback Lining Systems. Such lining systems have to take into account the compressible nature of the underlying waste and will therefore require careful and potentially complex geotechnical design. The concept for Piggybacking over Maghtab is shown on Figure 6.

The actual increase in the void space will be determined by how high up the waste slope of Maghtab the over tipping may extend. This will be determined by a number of factors, namely; the condition of the underlying waste, the presence of landfill gas and leachate infrastructure, and maximum strain which the piggy back lining system can withstand. It should be noted that at the time of the planning permission in 2005 there was a commitment to keep Mahgtab and Ghallis as two separate sites with no connection.

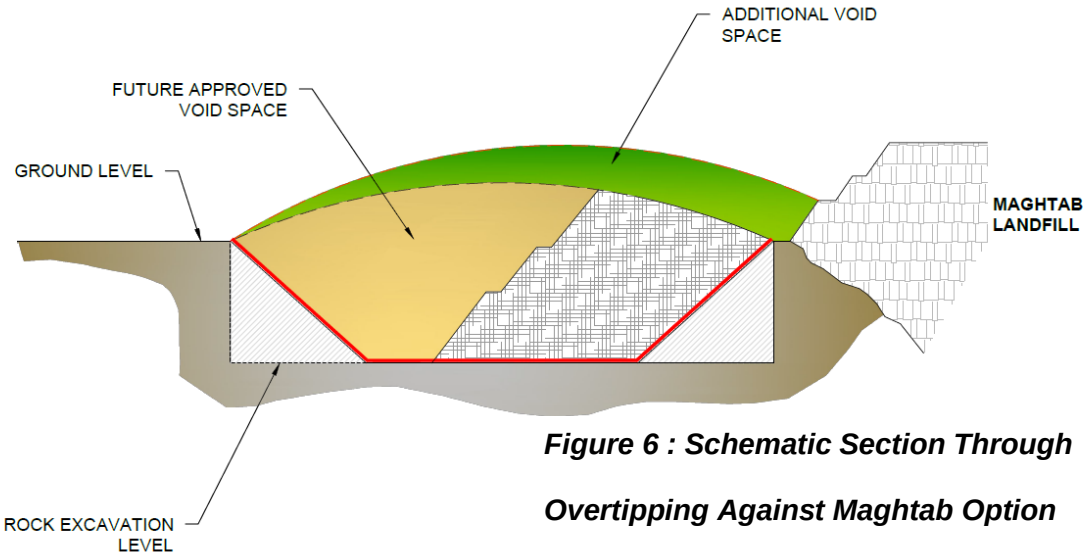

Figure 6 : Schematic Section Through Overtipping Against Maghtab Option

The cost associated with overtipping Maghtab will only be outweighed if the increase in void space is significant, due to the high cost of the piggyback lining system and changes to the gas infrastructure on Maghtab.

3.4 Utilise Existing Void in Hazardous Waste Landfill

The hazardous waste landfill at Ghallis was developed for the disposal of non-recyclable hazardous waste and to date has been partially lined. As the hazardous landfill has not been used to date for its intended purpose it could be re-permitted as a non-hazardous facility.

WasteServ have provided SLR with a topographical survey of the currnt void along with a restoration profile. Using this information the hazardous landfill provides a void of 155,700m^3. In considering this option further in Section 4 the restoration levels have been increased. A vertical lining system could be installed in this cell, however, similar to issues raised in Section 3.2 the increase in voidspace (approx. 24,000m^3) would not warrant the increased cost which would be in excess of €300,000. In addition to this access into the landfill would be difficult since the haul road would be removed as part of the excavation to produce the sub-vertical face against which the lining system would be installed.

Whilst no hazardous waste has been disposed of to date within this landfill, it may still be considered to have a strategic value in the future, given the cost of treating and disposing of such waste outside of Malta and therefore WasteServ may want to retain the void for the disposal of hazardous waste.

3.5 Improved Compaction Techniques

Improving the compaction of waste will increase the total tonnage of waste which the landfill is able to accommodate. Achieving the maximum density for waste placed within the landfill is not only influenced by size of the compaction plant but also by the method of placement.

The working face is defined as the active portion of the landfill where wastes are deposited and where they are spread and compacted with landfill equipment. To allow efficient compaction of waste, the working face should generally be constructed on a 1V in 4H to 1V in 3H slope. Each load of waste should be compacted with at least three passes by the tracked landfill plant, taking care to compact the whole surface (see Figure 7 below). The slope should not be steeper than 1V in 3H.

The following compaction methodology is considered good practice:

- Cover soil should be stripped from the area designated for the day's waste placement each morning;
- Waste shall be spread in thin lifts not to exceed 0.6 metres in thickness and at the end of a push the machine should roll beyond the deposited refuse;
- Waste shall not be placed on top of a previous 0.6 metre lift until the previous lift has been compacted by a minimum of three (3) equipment passes. Compact the refuse until the equipment “walks out” of the refuse (does not sink into the waste but stays on top);
- 3 - 5 passes are considered necessary to achieve required compaction; and
- After the waste has been compacted, the operator shall regrade, filling areas that have settled and trimming any high spots so that the finished cell has a smoothly graded surface;
- At the end of each day daily cover should be placed over the trimmed waste; and
- The surface of the waste should be monitored on a regular basis to ensure that a consistently high waste density.

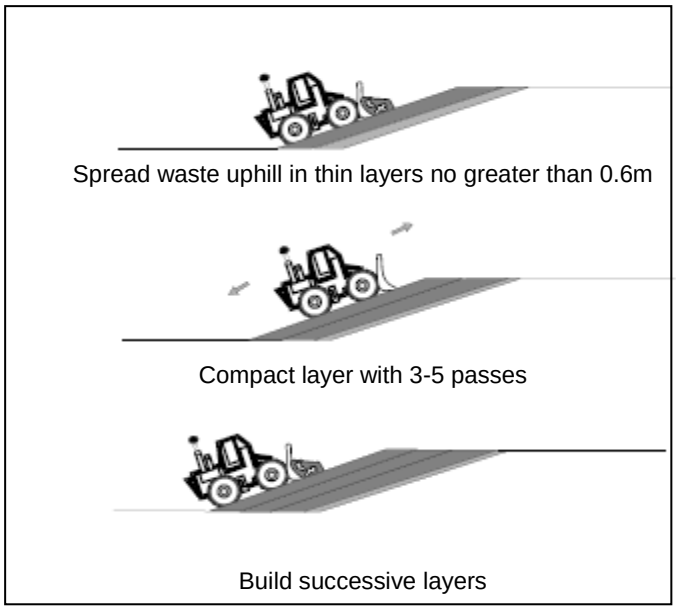

Figure 7
Compaction Guidance

The above principles should be adopted in any scenario considered for increasing the voidspace at Ghallis Landfill. We can confirm that based on numerous site to the landfill site over many years, it is SLR opinion the current site practices adopted by WasteServ to place and compact the waste are in line with practices adopted throughout the European Union.

4.0 PRELIMINARY VOID CALCULATIONS

To demonstrate the likely increase in waste void space four options have been modelled based upon the options discussed in Section 3, as described below and summarised in Table 1. For Options 1, 2 and 3 the volumes are reported as the increase in waste void above the voidspace calculated in September 2015 of 1,350,000m^3. The volume reported for Option 4 is reported as the increase in void above 155,700m^3, the value quoted on survey provided by WasteServ (Drawing No. 165HZ01, produced by Alan Micallef Surveying Services).

4.1 Option 1 Increase Restoration Levels

The existing waste slopes are steep and increasing the gradient of the slopes is considered to be both difficult to construct and not economically viable. However, the maximum elevation of the landfill could be increased by raising the elevation at which the gradient of the landform slackens to form the upper plateau. Drawing No. 2 presents a conceptual design developed on this basis.

The conceptual design extends the steeper outside slopes of the landfill at a gradient of 1V in 4V, from 60maOD up to 65maOD. Above the steeper slope section, the gradient then flattens off to 1V in 10H extending to a maximum elevation of 72maOD. This conceptual landform increases the volume of the landfill by approximately 150,000m^3 more than the current design.

4.2 Option 2 Perimeter Bund

Option 2 considers a bund constructed around the southern and western perimeters of Ghallis Landfill, as shown on Drawing No. 3. The bund varies in height along its length from 2m high on the southern boundary to a maximum of 6m on the western boundary. In order to construct the bund the access road to the recycling facility would have to be moved as can be seen on Drawing No. 3.

The conceptual design assumes an initial gradient of 1V in 3V up to 70maOD and then flattens off between 70maOD and 75maOD to 1V in 6H. Above 75maOD the gradient flattens off to 1V in 8H extending to a maximum elevation of 80maOD. This design increases the volume of the landfill by approximately 835,000m^3 more than the current design.

4.3 Option 3 Perimeter Bund and Overtipping Maghtab

Option 3 combines two of the construction of the perimeter bund with overtipping of Maghtab up to the first bench, i.e. approximately 55maOD, as shown on Drawing No. 4.

The conceptual design assumes the same outside slopes to the landfill as in Option 2; however, the upper plateau elongates allowing the maximum height of the landfill to rise to 82maOD. This conceptual landform increases the volume of the landfill by approximately 270,000m^3 more than Option 2 and 1,105,000m^3 than the current design.

4.4 Option 4 Utilise Hazardous Waste Landfill

The final option considers the use of the hazardous waste landfill for the disposal of non-hazardous waste. The conceptual design extends the waste slopes of the landfill at a gradient of 1V in 3V, from the perimeter of the landfill up to 60maOD. Above the steeper slope section, the gradient then flattens off to 1V in 6H extending to a maximum elevation of 65maOD. This conceptual landform provides a waste void of approximately 250,000m^3, which is 94,300m^3 more than the current restoration model.

Table 1: Summary of Preliminary Calculations for the Increased Waste Void

Option	Concept	Voidspace (m^3)	Increase in Void (m^3)	Engineering Issues	Approval Issues
1	Increased restoration levels over existing footprint of landfill (Drawing No. 2)	1,500,000	150,000	• Stability of restored profile will need to be checked. • Possible issue with protection to geomembrane liner, due to increased restoration levels.	• Increased restoration levels will require planning permission (potential assessment of visual impact).
2	Extend footprint of landfill by constructing bund around perimeter of site (Drawing No. 3)	2,200,000	835,000	• Stability of restored profile will need to be checked. • Possible issue with protection to geomembrane liner, due to increased restoration levels. • Road to MBT plant will need to be moved. • Services around the perimeter of the landfill will need to be moved.	• Increased landfill footprint and restoration levels will require planning permission (potential of reassessment of 2005 EIA studies).
3	Extend footprint of landfill by constructing bund around perimeter of site and overtipping Maghtab (Drawing No. 4)	2,455,000	1,105,000	• Stability of restored profile will need to be checked. • Possible issue with protection to geomembrane liner, due to increased restoration levels. • Geotechnical issues of “piggy back” lining system. • Road to MBT plant will need to be moved. • Services around the perimeter of the landfill will need to be moved.	• Increased landfill footprint and restoration levels will require planning permission (potential of reassessment of 2005 EIA studies). • Contravenes previous commitment to keep sites separate.
4	Utilise hazardous waste landfill	270,000	94,300	• Stability of restored profile will need to be checked. • Possible issue with protection to geomembrane liner, due to increased restoration levels.	• Chnages to restoration levels will require planning permission (potential assessment of visual impact). • Change of use will require re-permitting

5.0 CLOSURE

This report has been prepared by SLR Consulting Limited with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of WasteServ; no warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the client and others in respect of any matters outside the agreed scope of the work.

N

Xaghra tal-Bahar

Ta' Zannar

Il-Merhla

Ta'Hammud

Is-Swieqi

Il-Ghallis ta'Barra

L-Ghallis

Ħabel Żmejra

SITE ENTRANCE

0 50 100 150 200m 300 400 500

Metres 1:5000

NOTES

1. SURVEY OBTAINED FROM WASTESERV MALTA LIMITED REF: BLOCK PLAN.DWG.

LEGEND

- LEACHATE TANK
- GHALLIS LANDFILL
- MAGHTAB LANDFILL
- MECHANICAL WASTE TREATMENT PLANT
- HAZARDOUS WASTE CELL
- BIOLOGICAL TREATMENT PLANT
- ZWEJRA LANDFILL
- GAS MANAGEMENT PLANT

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GHALLIS LANDFILL SITE

LANDFILL PHASING & CONSTRUCTION

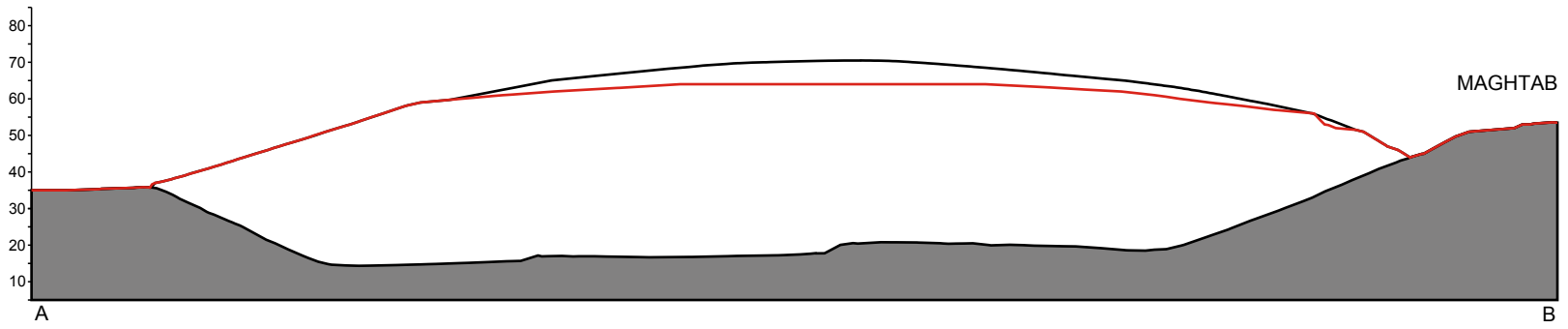
GENERAL SITE LAYOUT

001

Scale 1:5,000 @ A3

Date APRIL 2016

403.00585.00026.11.001.0 General Site Layout.dwg



KEY

- PROPOSED INCREASE IN RESTORATION LEVELS
- RESTORATION LEVELS FROM APPROVED SCHEME
- EXISTING SITUATION

NOTE:
1. Restoration levels from existing scheme taken from "Ghallis Non Hazardous Landfill, Landfill Phasing and Construction Programming September 2015". Maximum elevation 65mAOD.

N

NOTE:
1. Maximum elevation increased to 72mAOD.

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GHALLIS LANDFILL SITE

LANDFILL PHASING & CONSTRUCTION

OPTION 1 INCREASE RESTORATION LEVELS

002

Scale	Date
1:2,000 @ A3	APRIL 2016

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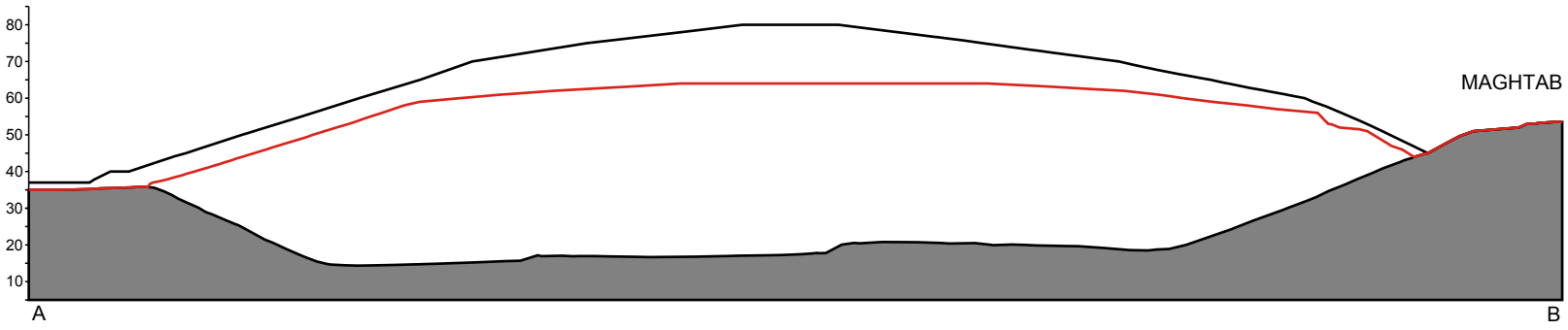


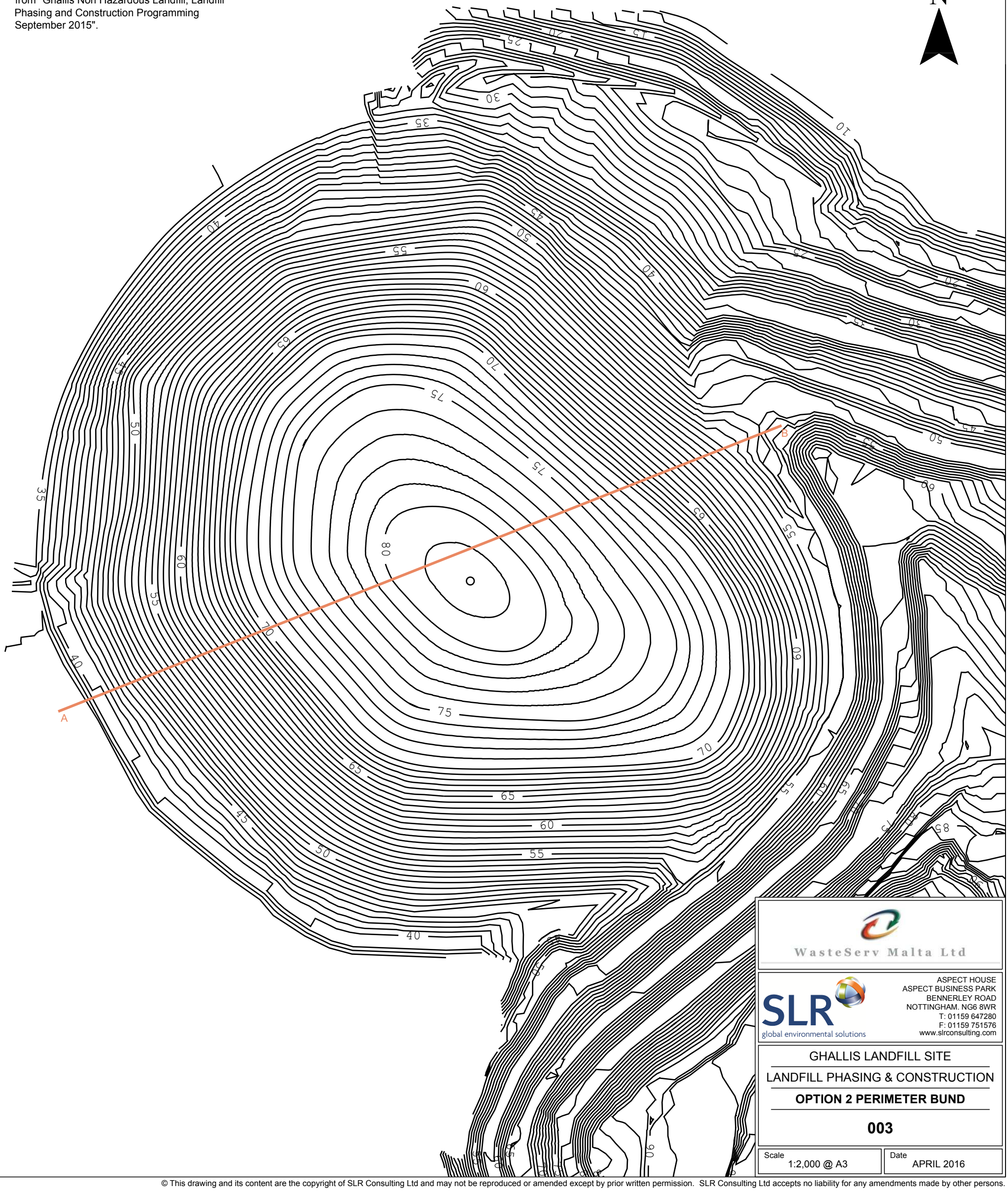
KEY

- PROPOSED INCREASE IN RESTORATION LEVELS
- RESTORATION LEVELS FROM PREVIOUS SCHEME
- EXISTING SITUATION

NOTE:

1. Restoration levels from existing scheme taken from "Ghallis Non Hazardous Landfill, Landfill Phasing and Construction Programming September 2015".

N



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GHALLIS LANDFILL SITE

LANDFILL PHASING & CONSTRUCTION

OPTION 2 PERIMETER BUND

003

Scale	Date
1:2,000 @ A3	APRIL 2016

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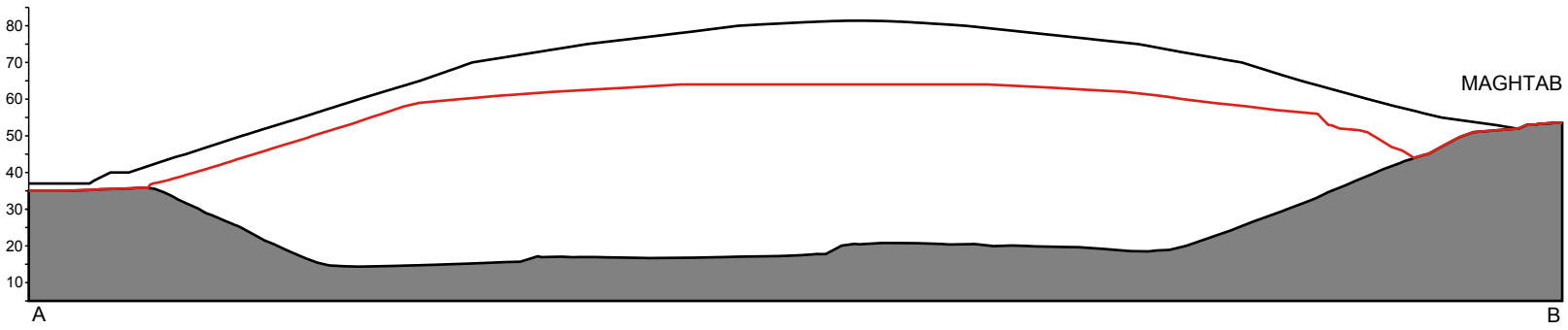

KEY

- PROPOSED INCREASE IN RESTORATION LEVELS
- RESTORATION LEVELS FROM PREVIOUS SCHEME
- EXISTING SITUATION

NOTE:

1. Restoration levels from existing scheme taken from "Ghallis Non Hazardous Landfill, Landfill Phasing and Construction Programming September 2015".

N

A

B

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GHALLIS LANDFILL SITE

LANDFILL PHASING & CONSTRUCTION

OPTION 3 PERIMETER BUND AND OVERTIPPING MAGHTAB

004

Scale	Date
1:2,000 @ A3	APRIL 2016

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N

LEGEND

50 PROPOSED CONTOURS

RESTORATION LEVELS FROM APPROVED SCHEME

EXISTING SITUATION

A

B

60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0

A

B

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GHALLIS LANDFILL SITE

LANDFILL PHASING & CONSTRUCTION

OPTION 4

005

Scale 1:1,000 @ A3

Date JUNE 2016

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