

Comhairle Chontae Luimnigh

Limerick County Council

Tier 1 - Landfill Risk Assessment

For

Churchtown, Co. Limerick County Council

EPA Ref: S22-02465

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Tier 1 - Landfill Risk Assessment

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Churchtown, Co. Limerick County Council

EPA Ref: S22-02465

Report Status Draft

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EXECUTIVE SUMMARY

Churchtown historic landfill site is located on the western perimeter of Newcastle West, Co. Limerick. The site was used by Limerick County Council for the disposal of commercial and domestic waste from 1935 until the closure of the site in 1986.

The *Waste Management (Certification of Historic Unlicensed Waste Disposals and Recovery Activity) Regulations* require Local Authorities to carry out an environment risk assessment on landfill sites which operated from 1977 to 1997. The investigations are carried out in a three tiered approach in accordance with the EPA publication, **Code of Practice: Environment Risk Assessment for Unregulated Waste Disposal Sites**. This report contains the findings of the Tier 1 Risk Assessment for Churchtown landfill site. The report incorporates sections of a previous Risk Assessment Report produced by *Tobin Consulting Engineers* in September 2007.

The main conclusions of the Tier 1 Assessment Report are:

Churchtown landfill site is classified as a **High Risk** Site as defined by the Code of Practice. The High Risk Status is associated with four Source-Pathway-Receptor linkages. These are:

- Leachate migrating to private wells.
- Leachate migration to the underlying aquifer.
- Landfill gas migrating laterally to surrounding houses.
- Landfill gas migrating vertically to surrounding houses.

The main recommendations of this Report are:

1. Carry out a Tier 2 Preliminary and Tier 2 Main Investigation for the site in accordance with the Code of Practice. The Tier 2 Investigation Report will incorporate the findings of the 2007 site investigation supervised by Tobins and the following additional information:

- The nature and extent of the waste
- Groundwater quality and flow regime
- Additional gas and leachate monitoring.

2. Following completion of the Tier 2 onsite investigations and monitoring programme, Limerick County Council intends to apply for a Certificate of Authorisation for this site.

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1. INTRODUCTION

1.1 Background

In 2008, the *Waste Management (Certification of Historic Unlicensed Waste Disposals and Recovery Activity) Regulations* were enacted. These regulations require Local Authorities to identify and register municipal landfill sites which operated from 1977 to 1996. The Regulations require that Local Authorities obtain a Certificate of Authorisation for each site by completing an environmental risk assessment in accordance with the **Code of Practice: Environment Risk Assessment for Unregulated Waste Disposal Sites**.

In accordance with the Regulations, Limerick County Council identified and registered 22 Historic Landfill sites, of which two were identified as being of HIGH risk status, namely Churchtown and Rathbane. The Department of the Environment is anxious that that all HIGH risk sites are prioritised in obtaining Certificates of Authorisation. In September 2011, Limerick County Council applied to the Department of the Environment for funding for this site. In December 2011, the Department granted funding to allow this site to proceed towards obtaining a Certificate of Authorisation.

A considerable amount of onsite investigations and monitoring has already been carried out at this site. In 2007, Tobin Consulting Engineers were commissioned to produce an Aftercare and Closure Plan for the site. Tobins supervised an extensive site investigation and monitoring programme in accordance with the EPA document, **Code of Practice: Environment Risk Assessment for Unregulated Waste Disposal Sites**. Tobins subsequently produced a Risk Assessment Report dated September 2007 which contained a Tier 1 and Tier 2 Assessment for the site. – See Appendix 1. Tobins considered that further site investigations were required in order to produce a Tier 3 Risk Assessment.

In March 2010, the Department issued detailed guidance on the extent of site investigations and monitoring required in carrying out environmental risk assessments in accordance with the Code of Practice. The guidance indicates that further testing and

monitoring are required at Churchtown landfill site in order to achieve a Certification of Authorisation.

1.2 Limitations of Report

This report contains information required for a Tier 1 assessment in accordance with the **Code of Practice: *Environment Risk Assessment for Unregulated Waste Disposal Sites***. Following completion of the further site investigations and monitoring, separate reports will be produced for:

- Tier 2 Preliminary Investigation
- Tier 2 Main Investigation
- Tier 3 Risk Assessment

1.3 Information sources used

The main sources of information used for this report are;

- ***Newcastle Risk Assessment for Churchtown Landfill Site*** , September 2007 by Tobin Consulting Engineers
- EPA Code of Practice: *Environment Risk Assessment for Unregulated Waste Disposal Sites*
- Walk Over Survey in November 2011 by B. Murphy, Limerick County Council
- GSI maps
- Limerick County Council archived files
- O/S 6” and 25” Historic Maps
- Current and Former members of Limerick County Council
- GSI Geology of the Shannon Estuary

2. SITE LOCATION AND DESCRIPTION

2.1 Site location

Churchtown landfill site is located on the north western perimeter of Newcastle West, Co. Limerick. The site is accessed from the Old Mill Road, approximately 150 metres west of its junction with the R521.



Figure 1: Location of Churchtown Landfill (Co-ordinates 127459, 134603)

2.2 Site description

The site was acquired by Limerick County Council at some time towards the end of the 1940's or early 1950's although there is no record of the formal acquisition. The total area of the site is approximately 1.7 hectares. In 2005, Limerick County Council sold a narrow strip of land along the eastern perimeter of the site to eight householders whose property backed onto the landfill site.

The site has not been used for agricultural or recreation purposes since the site was closed in 1986. The site is very overgrown and the western section is largely inaccessible due to briars – see Appendix 2 for photographs. The eastern section of the site is less overgrown and contains areas of unmaintained grass. There has been some unauthorised grazing of

horse in recent years. The entrance to the site is now blocked with a clay bund in order to prevent further unauthorised grazing.

The lands to the north and the west of the site are used for grazing cattle. The eastern and part of the southern perimeter back directly onto private and commercial properties. There are approximately 15 houses within 50 metres of the waste body and a further 30 within 250 metres of the site.

The site slopes gradually from the north-east towards the south-west. A detailed topographical survey of the site was taken in September 2006 by Townland Surveys – See Appendix 1. The survey shows the boundary of the landfill site, the existing contours and the infrastructure on the site and surrounding areas. The survey shows the site varies in height from 105.25 m O.D. in the north-west down to 96.25 m O.D. at the south-west corner.

There were no visual signs of contamination during a walkover survey carried out by Barry Murphy, Executive Engineer on the 16th November 2007 – See Appendix 3 for details. There were no detectable odours or signs of die back in the vegetation. There are no environmental complaints regarding this site on the Limerick County Council complaints data base.

3. SITE GEOLOGY, HYDROGEOLOGY AND

3.1 Geology

The Geological Survey of Ireland indicates that the underlying bedrock is composed of Waulsortian Limestone. This rock unit may be up to 1000m thick and is the thickest known Waulsortian succession anywhere in the world. A borehole drilled near the site has penetrated over 500 metres of Waulsortian limestone

The limestone is formed from massive, unbedded lime-mudstone.

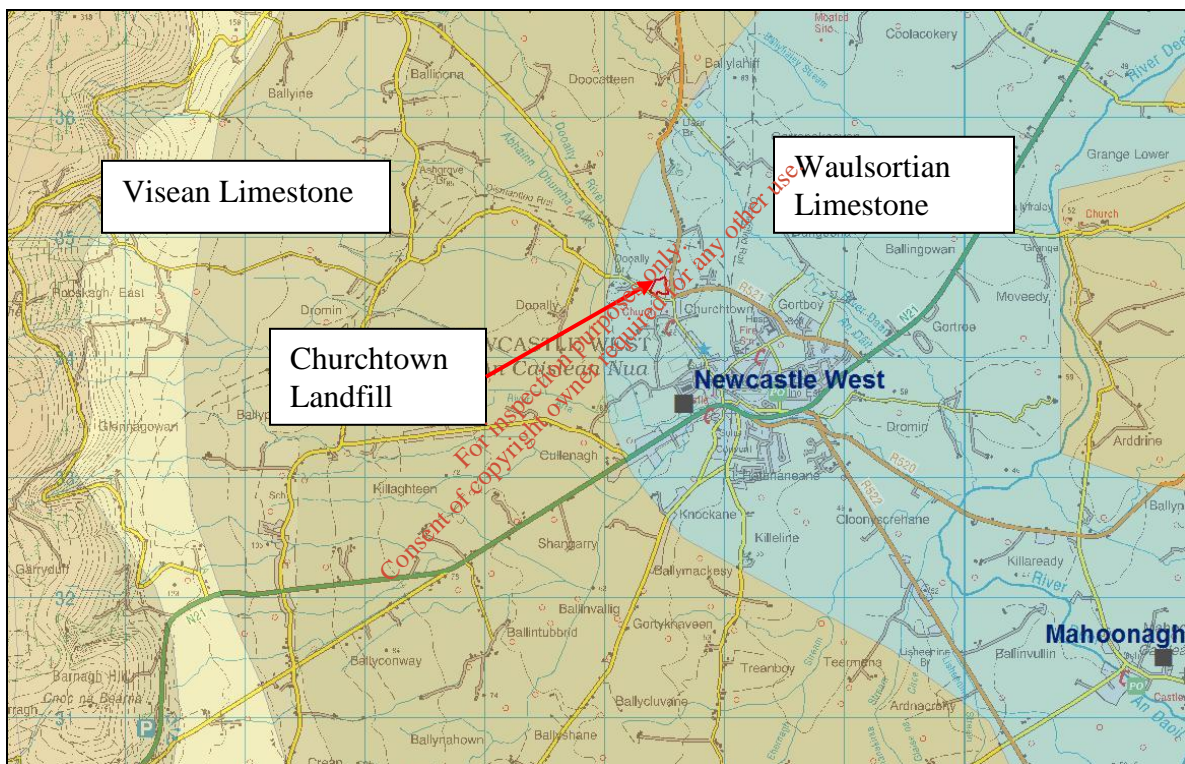


Figure 2: Bedrock Map for Churchtown Landfill Site

In 2007, Tobin Consulting Engineers supervised the drilling of 8 boreholes on the site, 3 leachate monitoring boreholes were drilled into the waste body and five monitoring wells were drilled outside the landfill site. The borehole locations are shown on Tobin Drawing 2928-1004-A. Full borehole logs are included in the Site Investigation Report contained in Appendix 1.

3.2 Hydrogeology

The site overlies a regionally important karstified aquifer. The *GSI Groundwater Protection Scheme* considers that the groundwater in the vicinity of the site is highly vulnerable to contamination. The groundwater vulnerability rating within the site is increase to extreme as the bedrock is exposed due to quarrying operations.

The direction of groundwater flow has not been established but is likely to flow from north-east to south-west. Boreholes taken in 2007 indicate that the water table ranges from 71.18mAD at the north-east of the site to 66.14mAD at the south-west corner of the site.

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4. SITE HISTORY

4.1 History

Quarry 1840 to 1913

The landfill site is located at the site of a former limestone quarry. The O/S historic maps for the area show that the quarry operated in the period 1840 to 1913. The 6" historic maps produced from 1837 to 1842 does not show a quarry at this location. The 25" historic maps produced in the period 1888 to 1913 shows that the site contains a large disused quarry.

Dump 1935 to 1986

The site was used locally as a dump since 1935. Sometime towards the end of the 1940's or early 1950's, Limerick County Council acquired the site for use as a landfill site. The site was used for relatively small scale disposal of municipal and commercial waste from 1940 until the early 1970's. Limerick County Council commenced the collection of domestic and commercial waste in 1973. The Churchtown site was the main disposal site for Newcastle West and surrounding areas.

During the 1970 and 1980s, the site had two permanent employees, one gateman and a dozer driver. A letter dated 6th December 1973 from the County Secretary to the Department of Local Government says that refuse was routinely covered with clay, and vermin and fly control was in place for the summer months.

During the working life of the quarry, there were numerous complaints from local residents regarding odours and vermin nuisance. The Limerick County Council archives show very large volumes of clay were used to cover waste on a daily basis in order to reduce odour problems. It seems that equal volumes of clay and waste were used to backfill the quarry.

Decommissioning Phase 1986 to 1990

During the lifetime of the landfill site, there were numerous campaigns by local residents to have the site closed down due to odour and vermin problems. However, in the absence of any other suitable landfill site, the site continued to operate until the former quarry site reached maximum capacity. The site was eventually closed in November 1986 when the site reached maximum capacity.

In 1987, a small pumping station was installed at the south-west corner of the site to pump surface water from the site to the nearby public foul main.

There are no records of any major capping contracts being carried out at the site. It seems likely that the waste was capped off with imported material as filling proceeded.

No gas, leachate collection or monitoring systems were installed when the site closed.

Post Closure 1990 to 2011

The site was closed in 1986 and has not been used since then. Towards the end of the 1980's, the site may have contributed flooding to the neighbouring site at the south-west corner of the site. The NCW area set up a small pumping station to pump surface water from the site into the nearby foul sewer. There are very few details of the operation and maintenance of this system.

4.2 Information from Statutory Authorities

In December 1986, An Foras Forbartha published a document called 'National Database on Waste'. This provided a national inventory on landfill sites operating at that time. The publication indicates that Churchtown landfill had closed by December 1986. The annual capacity was given as 10,000 tonnes and that there was a leachate containment system at this site. The site was fully manned and no hazardous waste was accepted.

5 CONCEPTUAL SITE MODEL

5.1 Introduction

A conceptual model is a means of understanding the manner in which a system used for a waste related activity is likely to behave. A picture is built up progressively, on the basis of systematic investigations, through the application of a conceptual model of the relationship between the existence of a potential hazard and the linkage to the likely receptors. The programme of investigations is designed to establish the actual situation.

A well-defined conceptual site model (CSM) should be used as basis for all the subsequent risk assessments. It should be used to identify all possible sources (S), pathways (P) and receptors (R) as well as the processes that are likely to occur along each of the source-pathway-receptor (S-P-R) linkages and uncertainties.

5.2 Source

In order for a risk to exist there must be a source or hazard. The principal hazards associated with the waste body at Churchtown are the generation of leachate and landfill gas. The waste at Churchtown is now 25 to 70 years old but still has the potential to generate leachate and landfill gas.

5.2.1 Composition and Extent of Waste

The composition and volume of leachate and landfill gas now being produced is dependent on many factors including the composition, extent of the waste, and the age of the waste.

Churchtown landfill site was used for the disposal of domestic and commercial waste from the late 1940's until the closure of the site in 1986. The volume of waste deposited from the 1940's to 1970 was likely to have been very small. In 1973, Limerick County Council commenced a commercial waste collection service using a number of landfill sites throughout the county. An Foras Forbartha Report dated 1988 indicates that the site accepted 10,000 tonnes per annum. Assuming this collection rate for 25 years, the volume of waste deposited at this site is in the order of 250,000 tonnes.

In 2007, Tobin Consultants identified the extent of the waste using a series of 87 cobra probes and a geophysical survey. The plan extent of the waste is shown on Tobin Drg: 2928-1003-A. The volume of the waste body is approximately 85,000 -cubic metres. The waste at the site is now 25 to 70 years old.

From probe results taken in 2007, the waste type includes glass, plastic, rubble, concrete, fibre glass, rotten vegetable matter, dark grey clay, rotten wood, rotten fabric etc.

The landfill site was permanently manned during the 1970-80's which should have prevented hazardous wastes from being disposed at the site.

5.2.2 Leachate

Leachate is produced when water percolates through a waste body. Leachate can create serious environmental harm when it enters into surface and groundwater. The strength and chemical composition of leachate varies widely from each landfill site. The concentration of leachate contamination declines with time. The rate of decline is dependent of several factors which include:

- Waste type and organic content
- Age of waste
- Infiltration of surface water
- Moisture Content of waste body.
- Depth to water table

The amount of leachate produced is dependant on the volume of surface infiltration. High volumes of surface infiltration produce large volumes of leachate. Conversely, high volumes of infiltration increase the rate at which contaminants are flushed out from the waste body into the surrounding environment and consequently reduce the concentration of the leachate.

The landfill cap at Churchtown is of poor quality and allows high levels of surface infiltration into the waste body. Consequently, any leachate now produced by the waste body is likely to have low levels of contamination. Dynamic probes taken in 2007 showed that the cap ranged in depth from 0 to 2 metres with an average depth of 0.5

metres. The capping layer is composed mainly of gravel, silt or clay. The capping layer was absent at 28 out of 83 probing locations.

5.2.3 Landfill Gas

The decomposition of waste produces large volumes of landfill gas, notably methane. The majority of gas is produced within 15 years of waste placement but residual amounts of gas can be produced for upwards of 50 years.

The volumes of landfill gas now being produced at Churchtown is likely to be very small. No landfill gas was detected in adjoining properties during a survey carried out by Limerick Co Council in 2007.

5.3 Pathway

A pathway is a mechanism or route, by which a contaminant comes into contact with, or otherwise, affects a receptor. A pathway must exist if a hazard is to pose a risk to a receptor.

5.3.1 Pathway for Leachate Migration

The groundwater flow direction is not known but is likely to be from the north-east towards the south-west.

The site overlies a regionally important karstified aquifer. The *GSI Groundwater Protection Scheme* considers that the groundwater in the vicinity of the site is highly vulnerable to contamination. The groundwater vulnerability rating within the site is increased to extreme as the bedrock is exposed due to quarrying operations.

There are no surface water drains within or along the perimeter of the site. In the early 1990's, Limerick County Council installed a small pumping station at the south-west corner of the site. Water was pumped up to the public sewer. Further investigation is required to determine if the pumps are still working.

5.3.2 Pathway Landfill gas migration

The existing landfill cap is of poor quality and is likely it have allowed landfill gas to vent freely to the atmosphere. The landfill was capped off in the early 1990's using

subsoil of variable quality and composition. Dynamic probes taken in 2007 showed that the cap ranged in depth from 0 to 2 metres with an average depth of 0.5 metres. The capping layer is composed mainly of gravel, silt or clay. The capping layer was absent at 28 out of 83 probing locations.

The underlying bedrock type consists of massive unbedded Waulsortian limestone. The subsoils consist of glacial tills.

There are a number of dwellings adjacent to the landfill which have service connections and water mains and sewers in the public road. However, there are no service ducts connecting onto the site.

5.4 Receptors

A receptor is a person, living organism (e.g. livestock, crops, pets or wildlife), ecological system, controlled waters, atmosphere, structures and utilities that could be adversely affected by the source.

5.4.1 Receptors at Risk from Leachate

The following receptors are at risk from leachate:

- The underlying regionally important karstified (diffuse) aquifer
- Private wells within 250 metres of the site.

Surface water is not considered to be a risk. The nearest surface water body is the Dooally River which is located 400 metres to the west of the site. There are no direct connections from the site to the river.

The landfill site is not within a protected area.

5.4.1 Receptors at Risk from Landfill Gas

There are approximately 50 houses within 250 metres of the site which may be at risk from the lateral migration of landfill gas. The houses along the western perimeter are within 50 metres of the waste body. The extent of the waste body is not known with certainty and these houses could be at risk from the vertical migration of landfill gas.

5.5 Conceptual Site Model for Churchtown Landfill Site

The conceptual site model (CSM) for Churchtown landfill site is shown below:

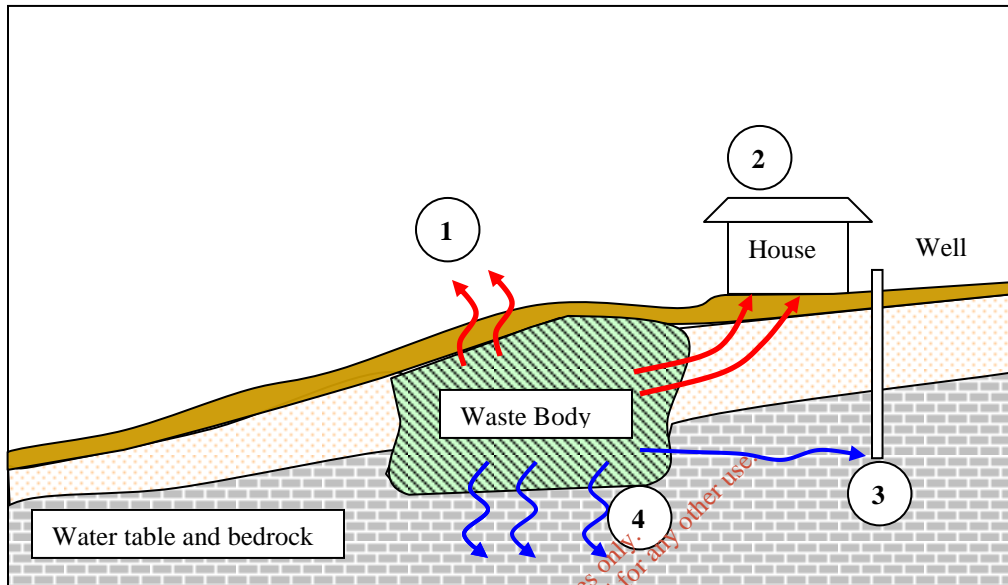


Figure 3: Conceptual Site Model for Churchtown Landfill Site

The Source-Pathway- Receptors linkages for Churchtown are:

1. Vertical migration of landfill gas to nearby houses
2. Lateral migration of landfill gas to nearby houses.
3. Migration of leachate to private wells
4. Migration of leachate to the underlying aquifer

The location of properties within 250 m and 500 m of the site is shown below:

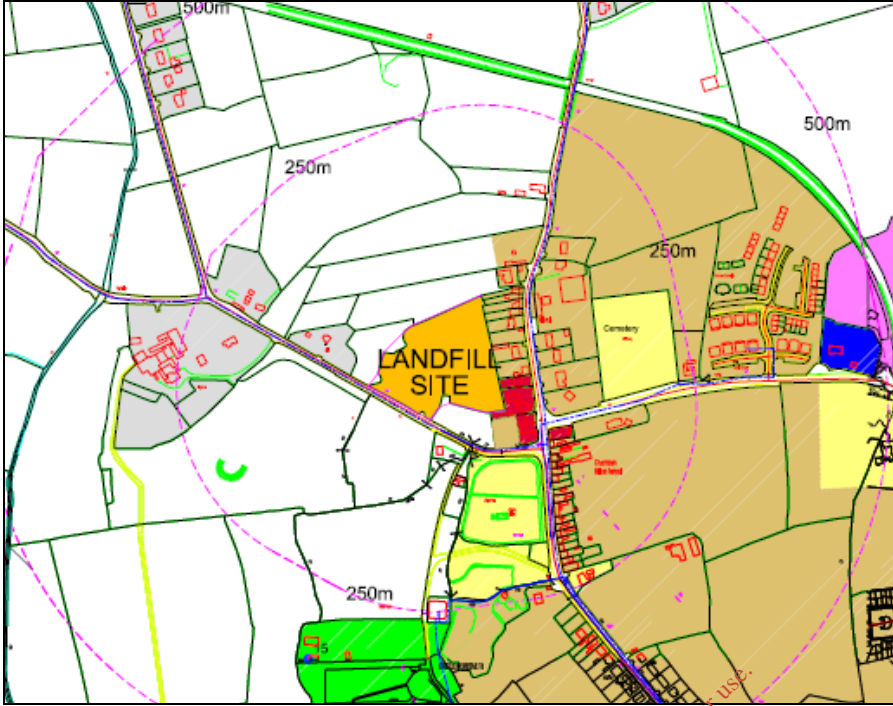


Figure 4 : Site Plan showing houses within 250 metres of Landfill

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6. RISK SCREENING AND PRIORITISATION

6.1 Introduction

Risk screening represents an assessment of the source-pathway-receptor (S-P-R) linkages in the conceptual model. The risk prioritisation process assigns a score to each linkage and, the overall site score is the maximum of the individual linkages for the site in question. This allows the potentially high-risk sites and associated significant linkages to be identified. It is likely that some S-P-R linkages will be more important than others thereby identifying the most sensitive receptors at each time.

The scoring system allocates higher numbers for the higher risk elements and thus it allows a meaningful comparison to be made between different sites and between different linkages. Each of the S-P-R linkages will have a score, which can be assessed to identify the receptor most at risk. The higher the score a site/ linkage receives the higher the risk. Where there is a high degree of uncertainty (or where information is not known) for a particular element of risk, the highest score is assumed.

6.2 Churchtown Risk Assessment.

The scoring system used for Risk Assessments is contained in the EPA document **Code of Practice: *Environment Risk Assessment for Unregulated Waste Disposal Sites***. The risk assessment scoring indicates that four linkages have a HIGH risk score for this site:

- Leachate migrating to private wells.
- Leachate migration to the underlying aquifer.
- Landfill gas migrating laterally to surrounding houses.
- Landfill gas migrating vertically to surrounding houses.

The scores for the SPR Linkages for Churchtown are shown in Figure 5 with a more detailed analysis and rationale contained in **Appendix 4**

SPR Linkage	Source	Pathway	Receptor	Linkage Score	Norm Score	Classification
SPR1	Leachate	Vertical and Horizontal Groundwater to Surface water	Surface water	56	19	Low
SPR2	Leachate	Vertical and Horizontal Groundwater to Surface water	Surface water protected area (SWDTE)	0.	0	Low
SPR3	Leachate	Vertical and Horizontal Groundwater Migration	Human presence (wells)	169	70	HIGH
SPR4	Leachate	Vertical and Horizontal Groundwater Migration	Groundwater protection area (GWDTE)	0	0	Low
SPR5	Leachate	Vertical and Horizontal Groundwater Migration	Aquifer	280	70	HIGH
SPR6	Leachate	Vertical and Horizontal Groundwater Migration	Public water supplies	168	30	Moderate
SPR7	Leachate	Vertical and Horizontal Groundwater Migration	Surface water body	56	23	Moderate
SPR8	Leachate	Surface water Drainage / runoff	Surface water body	0	0	Low
SPR9	Leachate	Surface water Drainage / runoff	Surface water protected area (SWDTE)	0	0	Low
SPR10	Landfill gas	Lateral migration (subsoil)	Human Presence	105	70	HIGH
SPR11	Landfill gas	Vertical migration (subsoil)	Human Presence	175	70	HIGH

Figure 5: S-P-R Linkage Scores

The Risk Classification for this site is Class A: Highest Risk

7. PROPOSED TIER 2 INVESTIGATION

7.1 Introduction

The CSM and Risk Assessment Prioritisation developed in this report form the basis of the proposed Tier 2 Investigations. The proposed investigation takes into account the previous site investigation carried out by Tobin Consulting Engineers in 2007. It is intended to combine the proposed site investigation results with the Tobin site investigation to produce a revised and expanded Tier 2 Investigation Report.

7.2 Proposed Investigation

The proposed Tier 2 Investigations will include:

1. Installation of 2 monitoring boreholes
2. Pumping Test
3. Additional 12 Trial holes and trenching
4. Groundwater sampling – Taken from Boreholes
5. Soil Sampling – Existing Cap and subsoils
6. Leachate Sampling - Taken from Trail Holes
7. Waste Sampling – Taken from Trail Holes
8. Gas Monitoring
9. Geophysical Survey
10. Topographical Survey

The estimated cost for the site investigation is €49,150 ex VAT, see Appendix 5 for a detailed explanation and estimate of the costs.

Appendix 1

: Newcastle Landfill Risk Assessment Report

September 2007

Tobin Consulting Engineers

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Appendix 2:

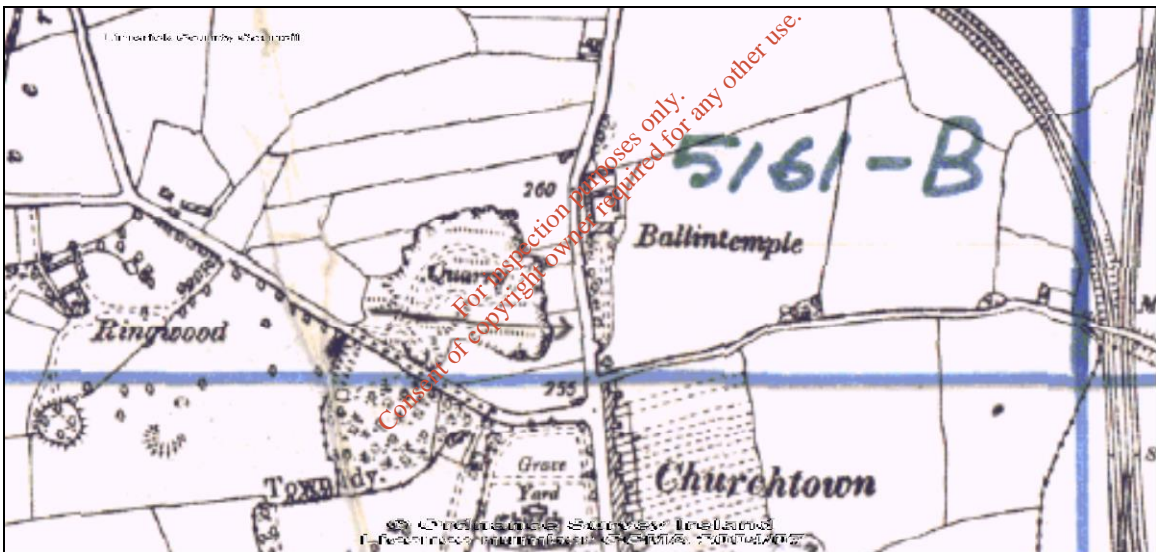
Historic Maps

Site Photographs

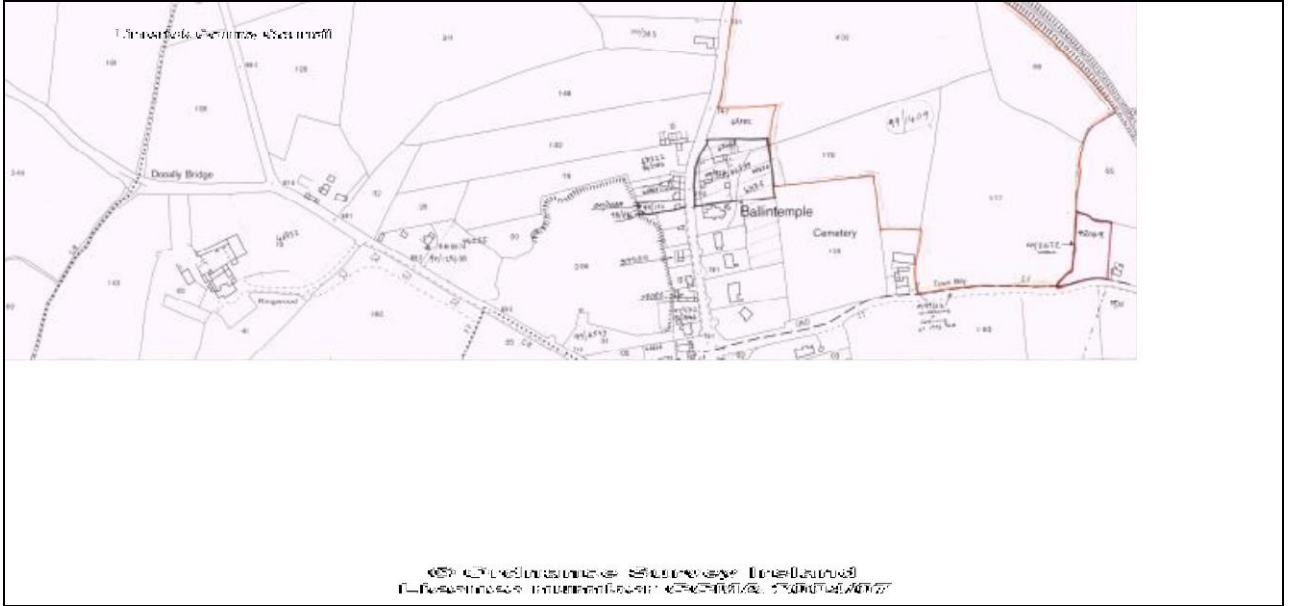
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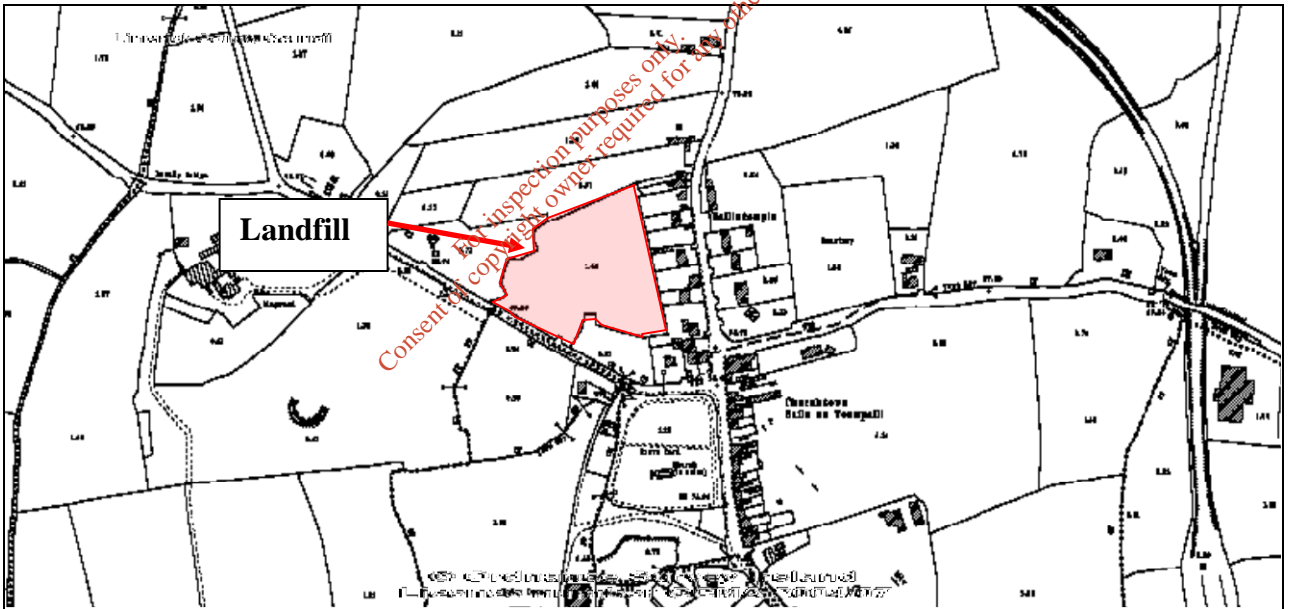
Map 1: c 1840 - No Quarry at Churchtown



Map 2 : c 1910 – Quarry still in use



Map 3: c 1980 Old Quarry mainly backfilled



Map 4: Present Day

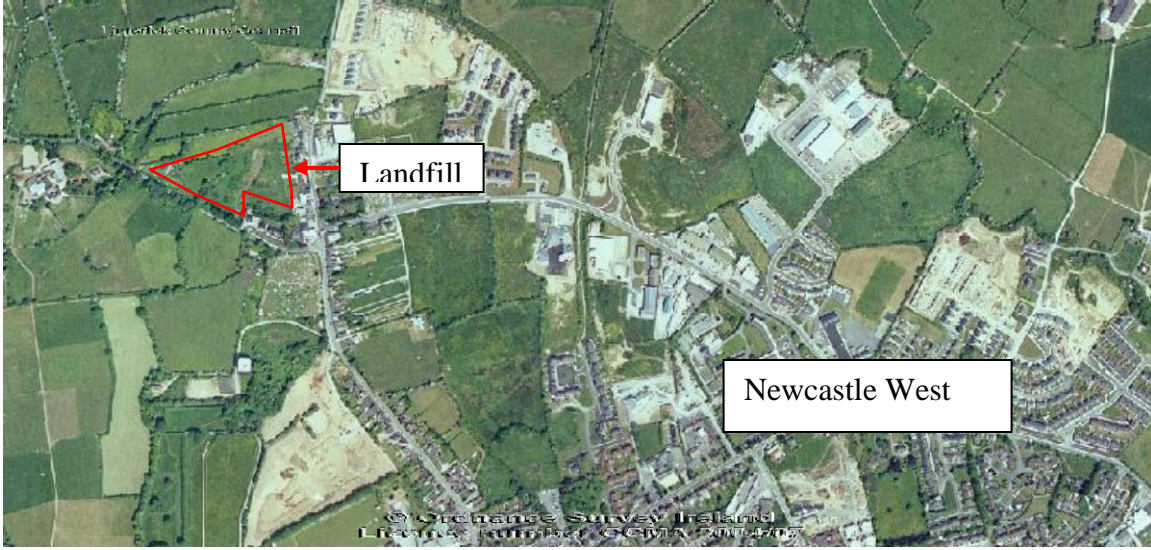


Photo 1: Aerial View 2006

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Appendix 3:

Site Walk Over Churchtown Landfill Site 16 November 2011

**B Murphy
Executive Engineer
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Limerick Co. Council**

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Walkover Survey Checklist
B. Murphy E.E
Environment Section
16th November 2011

Information	Checked	Comment
1. What is the current land use	BM	The site is not in use and is very overgrown with large sections inaccessible.
2. What are the neighbouring land uses?	BM	The lands to the north and west are used for agricultural purposes. The lands to the east and south-east are built up and form part of the town of Newcastle West.
3. What is the size of the site?	BM	The site is approximately 1.7 hectares.
4. What is the topography?	BM	The land slopes gently from the north-east to the south-west.
5. Are there potential receptors?		
Houses	BM	The site is located along the north-western perimeter of Newcastle West. There are approximately 50 houses within 250 metres of the site.
Surface Water Features	BM	The nearest surface water feature is the Dooaaly River which flows from north to south at 400 metres to the west of the site. There are no connecting drains to the river.
Wetland / Protected Area	BM	There are no protected areas within 1 km of the site.
Public Water Supplies	BM	There are no public water supplies within 1 km of the site.
Private Wells	BM	There are a number of public wells approximately 400 metres to the south of the site, there may be other wells in properties to the south-west of the site.
Services	BM	There is a small pumping chamber in the south-west corner of the site which is connected to the public main.
Other Buildings	BM	None

6. Are there any sources of contamination		The site has been used for the disposal of domestic and commercial waste from 1935 to 1986.
Surface waste	BM	No.
Surface ponding of leachate	BM	None visible.
Leachate seepage	BM	None evident.
Landfill gas odours	BM	None detected.
7. Are there any outfalls to surface water?	BM	There are no natural drainage channels in or around the site. In 1987, a small pumping station with an associated rising main was installed at the south-west corner of the site.
8. Are there any signs of impact on the environment?		There are no signs of environmental impacts.
Vegetation	BM	There are no signs of die back or bare ground. The site is covered with dense growth of bushes and trees.
Leachate seepages	BM	There was no evidence of leachate seepages.
Odours	BM	There were no odours detected.
Litter	BM	The site was free from litter.
Gas bubbling through water	BM	None.
Signs of settlement, subsidence, water logged area.	BM	There were no signs of settlement, subsidence or water logging.
Drainage or hydraulic issues	BM	The small pumping station was difficult to access due to vegetation and does not look to have been regularly maintained.
Downstream water quality appears poorer than upstream water	BM	Not applicable, there is no surface discharge form the site.

quality?		
9. Are there any indications of remedial measures?		
Capping	BM	There is a poor quality cap in place.
Landfill gas collection	BM	There is no gas collection system in place.
Leachate collection system	BM	There is no leachate collection system.
10. Describe fences and security features.	BM	The access gate along the southern perimeter has been blocked off with a clay berm. The northern perimeter is fence off with a 4-strand barded wire which is good condition. The eastern perimeter backs onto a number of residential properties. The boundary consists mainly of a variety of hedges and fences. The southern boundary consists of timber fencing and a stone wall. The western boundary is formed from an established ditch.
Any other relevant information?		<p>A section of land along the eastern perimeter was sold to the adjoining landowners in early 2000's. In not clear if the waste body extended into these lands.</p> <p>There are 8 monitoring boreholes in place since 2007 but these have not been sampled since 2007 and require some remedial works.</p>

Appendix 4

Risk Assessment for Churchtown Landfill Site

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Appendix 4: Risk Assessment for Churchtown Landfill Site

Table	Description	Max Points Available	Points Assigned	Rationale
1a	Leachate source	10	7	The site measures 1.7 hectares. Historic knowledge supported by trial holes taken in 2007 show that the waste body consists of municipal waste.
1b	Landfill gas source	10	7	The site measures 1.7 hectares. Historic knowledge supported by trial holes taken in 2007 show that the waste body consists of municipal waste
2a	Leachate migration-groundwater vertical pathway	3	3.	The GSI Groundwater Protection Scheme considers that the site is extremely vulnerable to contamination. A significant proportion of the waste was placed in a disused quarry. Consequently, some of the waste body is in direct contact with the underlying bedrock.
2b	Leachate migration – groundwater horizontal pathway	5	5	The site overlies a regionally important karsified aquifer.
2c	Leachate migration – surface water drainage	2	0	There is no direct connection between the drainage ditches associated with the waste body and adjacent surface water body. A walk over service carried out by B. Murphy, Limerick Co. Council on the 16 November 2011 shows that there are no surface water drains around the perimeter of the site. There is no obvious surface water drains discharging from the site.

Table	Description	Max Points Available	Points Assigned	Rationale
				During the early 1990's a small pumping station was installed at the south-west corner of the site to remove ponding water from the site. The water was pumped to the Newcastle West foul sewer. The pumping station is difficult to access due to briars. Further investigation is required to see if the pumps are still working.
2d	Landfill gas pathway by lateral migration	3	3	Tobin Drg 2928-1002 Rev A indicates that there are approximately 50 dwellings within 250 metres of the waste body. The landfill was capped off in the early 1990's using subsoil. Dynamic probes taken in 2007 showed that the cap ranged in depth from 0 to 2 metres with an average depth of 0.5 metres. The capping layer is composed mainly of either gravel, silt or clay. The capping layer was absent at 28 out of 83 probing locations. The lack of a proper engineering cap has allowed landfill gas to migrate freely in a vertical direction, thereby reducing the degree of lateral migration of landfill gas. In 2007, no landfill gas was detected during a survey of properties adjacent to the landfill site.
2e	Landfill gas pathway by vertical migration.	5	5	Tobin Drg 2928-1003 Rev B shows the extent of the waste body. There is a degree of uncertainty as to the exact boundary. The houses along the eastern boundary are within 50 metres of the waste body and taking a precautionary approach should be considered for the purposes of the Tier 1 assessment to locate on top of the waste body.
3a	Leachate receptor presence of house with	3	3	There are approximately 20 dwellings within 50 metres of the waste body. These houses are supplied from the public water supply scheme

Table	Description	Max Points Available	Points Assigned	Rationale
	potential for private well.			and are unlikely to have any private wells. However, this needs to be confirmed .
3b	Leachate receptor – special protected area	3	0	There are no Water Framework Direction protected areas within 1 km of the site.
3c	Leachate migration receptor - aquifer	5	5	The site overlies a regionally important karst aquifer.
3d	Leachate migration receptor - Public Water Supplies	3	3	There are a number of wells located 800 to 1,000 metres to the south of the site used by Ballygowan Water.
3e	Leachate migration receptor – surface water	3	1	The Dooaaly River flows 350 metres to the west of the site.
3f	Landfill gas receptor – human presence	5	5	There are a number of houses within 50 metres of the site.

Appendix 5

Cost Estimate for Tier 2 Site Investigations

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Appendix 5 Tier 2 Investigation

Item	QTY	Unit	Rate	Amount	Comment
1. Installation of 2 monitoring boreholes Assume that the boreholes will involve boring through 10 metres of soil and rotary coring through 30 metres bedrock. Rate to include mobilisation, insurances and report on findings. Allowance of €500 at each borehole for owner permission to install monitoring points and allow future access.	2	No	7250	14500	Rates based on previous quotation from Glover, €150/metre through rock and €70 through soils.
2. Pumping Test Carry out under hydrogeologist supervision including interpretive report.	1	No	7000	7000	Estimate based on €4000 for hydrogeologist scoping, supervision and report and €3000 for pumping contractor onsite attendance.
3. Additional 12 Trial holes and trenching 30T tracked excavator for 5 days. Machine delivery costs Supervision by engineer, including taking photographs, logging of waste in accordance with BS5960 and report. Rate includes travel and meal allowances Allowance for 7 days with 5 days on site.	50 2 7	Hrs Item Days	65 150 450	3250 300 3150 6700	Rates based on LA quotes
4. Groundwater sampling – Taken from Boreholes Groundwater sampling from 4 existing and 2 proposed boreholes. One full suite of parameters to be assessed are List 1 and 2 and Table C.2 of EPA design manual.	6	No	750	4500	Rates based on BHP estimate

Item	QTY	Unit	Rate	Amount	Comment
2 rounds of samples from 6 boreholes at six monthly intervals for indicator parameters.	12	No	250	3000	
5. Soil Sampling – Existing Cap and subsoils Soil description, particle distribution test, permeability test on existing cap and subsoils.	4	No.	475	1900	Rates based on recent works at Gortadroma landfill site.
6. Leachate Sampling - Taken from Trail Holes Leachate sampling as per Table c.2 of the EPA Landfill design Manual	2	No	750	1500	Rates based on Adare investigation
7. Waste Sampling – Taken from Trail Holes 10 soil samples taken and analysed in accordance with Waste Acceptance Criteria	6	No	450	2700	Rates based on Adare landfill site landfill site
8. Gas Monitoring A. Gas monitoring using groundwater monitoring boreholes. Quarterly testing required in 2012 to coincide with groundwater monitoring.	4	No	250	1000	Based on Adare landfill rates.
B. survey of existing properties along eastern and southern boundary	1	No	450	450	Estimate of 1 day for executive engineer.
C. Gas monitoring with handheld monitor and sampling tubes.	1	No	900	900	Estimate of 2 days for executive engineer
9. Geophysical Survey Carry out geophysical survey including ground conductivity,	1	No	4000	4000	Based on 2 days work

Item	QTY	Unit	Rate	Amount	Comment
resistivity and seismic profiling.					
10. Topographical Survey Carry out a topographical survey in digital format.	1	Item	1000	1000	

Item	QTY	Unit	Rate	Amount	Comment
1. Installation of 2 monitoring boreholes Assume that the boreholes will involve boring through 10 metres of soil and rotary coring through 30 metres bedrock. Rate to include mobilisation, insurances and report on findings. Allowance of €500 at each borehole for owner permission to install monitoring points and allow future access.	2	No	7250	14500	Rates based on previous quotation from Glover, €150/metre through rock and €70 through soils.
2. Pumping Test Carry out under hydrogeologist supervision including interpretive report.	1	No	7000	7000	Estimate based on €4000 for hydrogeologist scoping, supervision and report and €3000 for pumping contractor onsite attendance.
3. Additional 12 Trial holes and trenching 30T tracked excavator for 5 days. Machine delivery costs Supervision by engineer, including taking photographs, logging of waste in accordance with BS5960 and report. Rate includes travel and meal allowances	50 2 7	Hrs Item Days	65 150 450	3250 300 3150 6700	Rates based on LA quotes

Item	QTY	Unit	Rate	Amount	Comment
Allowance for 7 days with 5 days on site.					
4. Groundwater sampling – Taken from Boreholes Groundwater sampling from 4 existing and 2 proposed boreholes. One full suite of parameters to be assessed are List 1 and 2 and Table C.2 of EPA design manual.	6	No	750	4500	Rates based on BHP estimate
2 rounds of samples from 6 boreholes at six monthly intervals for indicator parameters.	12	No	250	3000	
5. Soil Sampling – Existing Cap and subsoils Soil description, particle distribution test, permeability test on existing cap and subsoils.	4	No.	475	1900	Rates based on recent works at Gortadroma landfill site.
6. Leachate Sampling - Taken from Trail Holes Leachate sampling as per Table c.2 of the EPA Landfill design Manual	2	No	750	1500	Rates based on Adare investigation
7. Waste Sampling – Taken from Trail Holes 10 soil samples taken and analysed in accordance with Waste Acceptance Criteria	6	No	450	2700	Rates based on Adare landfill site landfill site
8. Gas Monitoring A. Gas monitoring using groundwater monitoring boreholes. Quarterly testing required in 2012 to coincide with groundwater monitoring.	4	No	250	1000	Based on Adare landfill rates.
B. survey of existing properties along eastern and southern boundary	1	No	450	450	Estimate of 1 day for executive engineer.

Item	QTY	Unit	Rate	Amount	Comment
C. Gas monitoring with handheld monitor and sampling tubes.	1	No	900	900	Estimate of 2 days for executive engineer
9. Geophysical Survey Carry out geophysical survey including ground conductivity, resistivity and seismic profiling.	1	No	4000	4000	Based on 2 days work
10. Topographical Survey Carry out a topographical survey in digital format.	1	Item	1000	1000	

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