

**ATTACHMENT A.1.**

**NON – TECHNICAL SUMMARY**

**APPLICATION TO THE EPA FOR A CERTIFICATE OF AUTHORISATION**

**FORMER MUNICIPAL HISTORIC LANDFILL**

**DUNAREE**

**KINGSCOURT**

**CO. CAVAN**

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**JUNE 2014**

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## 1.0 INTRODUCTION

Cavan County Council has completed a Tier 1 risk assessment for the closed former historic landfill located at Dunaree, Kingscourt. Co Cavan in accordance with the Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations 2008 (S.I. No. 524 of 2008). Further to this, Traynor Environmental Ltd in conjunction with the Waste Management Section of Cavan County Council has prepared a Tier 2 and Tier 3 risk assessment for the site. Cavan County Council must apply to the Environmental Protection Agency (EPA) for a certificate of authorisation in respect of this risk assessment.

Traynor Environmental Ltd was appointed by Cavan County Council to prepare the documentation for the application.

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## 2.0 SITE DESCRIPTION

### 2.1. LOCATION AND BRIEF DESCRIPTION

Kingscourt Historic landfill is located approximately 0.6 km from Kingscourt town, in the townland of Dunaree on local roadway (L-3536-0). The site encompasses an area of approximately 1.2 hectares. The land surrounding the site slopes moderately in a north easterly direction towards the town of Kingscourt. It is bounded on three sides by urban dwellings and buildings. An undeveloped construction site also adjoins the site along the south eastern boundary. The site is secure and delineated by palisade fencing along this boundaries Boundary.

The main receptors are the residential dwellings located along the north eastern and south western aspect of the site boundary. There were no watercourses encountered on the site. The housing estates are served by Kingscourt Public water supply. The boundaries are marked by local road L-3536-0 to the northwest. The area to the east is delineated by palisade fence. To the west of the site is a boundary wall adjoining the rear gardens of the An Tor Aonarach housing estate. The site is currently used as a storage yard by Cavan County Council. The surrounding land use is predominantly residential and industrial.

### 2.2. SITE HISTORY

It is understood that waste disposal began at the site in January 1970 (approximate date). A variety of wastes may have been deposited, including Municipal Solid Waste (MSW) and Construction and Demolition (C&D) wastes. The landfill mainly accepted municipal waste from the surrounding area. The landfill was finally closed on the 28<sup>th</sup> March 1991.

It is understood that the site was formerly a quarry. Historical evidence demonstrates that there was a quarry at the site as far back as 1837 and possibly longer. Tipping on the site had ceased by 1991. The outline of the landfill and its waste material can be observed on aerial photography 1995 (Drawing No. 13.120.104 Appendix F of the Tier 2 Risk Assessment) .The site appears to have been a local and largely informal tip rather than a large organised dump. An Aerial photograph from 2000 (Drawing No. 13.120.103 - Appendix F of the Tier 2 Risk Assessment)), shows the site to contain large amounts of overgrown vegetation and outcropping rock. There is no evidence of tipping.

The lateral extent of the waste covers an area of approximately 2300 m<sup>2</sup>. It is estimated, that approximately 6000 tonnes of waste is deposited at the site. Following site investigations it was discovered that the waste encountered comprises of a large variety of wastes including plastics, paper, glass, metal and textiles all of which were supported by a stony clay matrix. The nature of waste is typical of municipal waste that has been buried for over 20 years which has undergone considerable biodegradation.

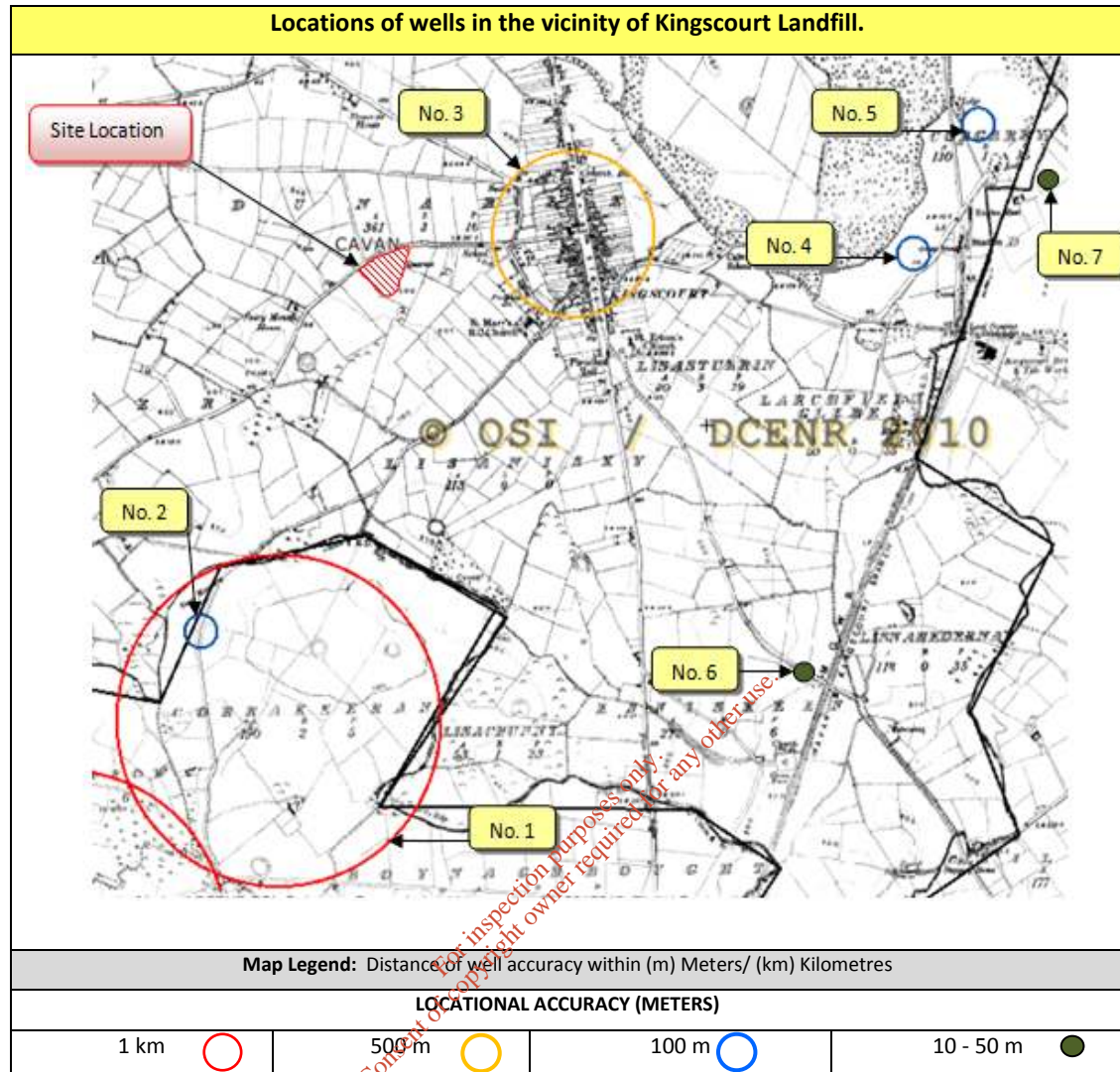
**3.0 HYDROLOGY AND HYDROGEOLOGY OF THE SITE****3.1. HYDROGEOLOGY**

The GSI, EPA and the Department of the Environment, Community and Local Government (DOECLG) have developed a programme of Groundwater Protection Schemes (GPWS) with the aim of maintaining the quality and quantity of groundwater in Ireland, and in some cases improving the groundwater quality, by applying a risk assessment approach to groundwater protection and sustainable development. From the GPWS for the area it is evident that the bedrock aquifer underlying the site has a classification of “Poor Aquifer” – Bedrock which is generally unproductive except for local zones (Drawing No. 13.120.106 - Appendix F of the Tier 2 Risk Assessment). The Geological Survey of Ireland has classified the vulnerability of the aquifers within the region as Extreme (Rock at/near surface or Karst) and Extreme to the northwest of the site. According to the GSI Well Database, there are seven wells within 2.0 km of the site. Refer to Table 1, Well data and location in the vicinity of Kingscourt.

Locations of wells in the vicinity of Kingscourt Historic Landfill.

**Table 1: Well data and location in the vicinity of Kingscourt**

Groundwater Well Data								
Well Ref. No.	Approx Distance From Site (Km)	Direction away from site	Use	Yield Class	Yield m <sup>3</sup> /day	Depth (metres)	Depth to Rock (metres)	Grid Ref.
No. 1	1.4 km	South West	Domestic use only	Poor	38.2	16.2	4.6	277862 294842
No. 2	1.2 km	South West	Public Supply (Co. Co)	-	-	12.8	-	277400 294670
No. 3	0.8 km	East	AGRI and Domestic	Good	-	12.2	7.9	278297 295865
No. 4	1.65 km	East	Public Supply (Co. Co)	Failure	10	99	2	279556 295839
No. 5	1.9 km	North East	Agri and Domestic	-	-	2.6	-	279796 296149
No. 6	1.8 km	South East	Public Supply (Co. Co)	Poor	10	91.4	7.5	279253 294536
No. 7	2.0 km	North East	Industrial	Excellent	7200	40	18.3	280010 296016



Source of Map: Geological Survey of Ireland-Online Mapping - Groundwater Public Viewer

**Groundwater Vulnerability**

The GSI vulnerability map ([www.gsi.ie](http://www.gsi.ie)) indicates that the vulnerability rating within the site is Extreme (Rock at/near surface or Karst) (Drawing No 13.120.107 - Appendix F of the Tier 2 or Tier 3 Risk Assessment). The vulnerability mapping is based on the response matrix for landfills (as summarised in Table 2 below), which assigns a vulnerability rating depending on the characteristics of the overburden deposits, the thickness of the strata and in the case of drift aquifers, depth of the unsaturated zone. Taking account of the fact that the aquifer is a poor aquifer coupled with the vulnerability level an R2<sup>2</sup> response is recommended. The level of response depends on the different elements of risk; the vulnerability, the value of the groundwater and the contaminant loading. A response level of R2<sup>2</sup> is acceptable in principle depending on the zone and activity. All the above facts would minimise the impact on groundwater resources.

**Table 2: Response Matrix for Landfills**

VULNERABILITY RATING	SOURCE PROTECTION AREA		RESOURCE PROTECTION					
			Aquifer Category					
	Inner (SI)	Outer (SO)	Regionally Important (R)		Locally Important (L)		Poor Aquifer (P)	
Rk			Rf/Rg	Lm/Lg	L1	PI	Pu	
Extreme (E)	R4	R4	R4	R4	R3 <sup>2</sup>	R2 <sup>2</sup>	R2 <sup>2</sup>	R2 <sup>1</sup>
High (H)	R4	R4	R4	R4	R3 <sup>1</sup>	R2 <sup>1</sup>	R2 <sup>1</sup>	R1
Moderate (M)	R4	R4	R4	R3 <sup>1</sup>	R2 <sup>2</sup>	R2 <sup>1</sup>	R2 <sup>1</sup>	R1
Low (L)	R4	R3 <sup>1</sup>	R3 <sup>1</sup>	R3 <sup>1</sup>	R1	R1	R1	R1

**Source of Map:** [www.gsi.ie](http://www.gsi.ie) - Responses Matrices for Groundwater Protection Schemes

R2<sup>2</sup> Acceptable subject to guidance in the EPA Landfill Design Manual or conditions of a waste licence.

- Special attention should be given to checking for the presence of high permeability zones. If such zones are present then the landfill should only be allowed if it can be proven that the risk of leachate movement to these zones is insignificant. Special attention must be given to existing wells down gradient of the site and to the projected future development of the aquifer.

- Groundwater control measures such as cut-off walls or interceptor drains may be necessary to control high water table or the head of leachate may be required to be maintained at a level lower than the water table depending on site conditions.



### 3.2. HYDROLOGY

Historic maps from the Department of Communications, Energy and Natural Resources and the Geological Survey of Ireland were examined for hydrological information relating to the site. A site walk over was also conducted as part of the Tier 1 Risk Assessment. From this combined research it has been ascertained that there are no open drains or watercourses located on the site or its boundaries. For this reason it was not possible to carry out Q value ratings which are used for the assessment of the water quality up and down stream of the landfill site. No water table was encountered on the site.

### 4.0 ECOLOGY OF SITE AND SURROUNDING AREA

The Ecological Report carried out by Noreen McLoughlin MSc MIEEM. is included in Appendix B of the Tier 2 Assessment. The ecological assessment of the landfill site at Dunaree was carried out using aerial photographs, ground photographs and historical maps in conjunction with a site walkover. After consultation with National Parks and Wildlife Service website it was ascertained that there are no designated sites adjacent to or close to the site of the old landfill. The main habitats identified on the site are hedgerows, tree lines, scrub and overgrown vegetation. These are predominantly located on the lower area of the site towards the northern boundary and also along the boundary of the site.

### 5.0 POTENTIAL RISKS

#### 5.1. RISK CATEGORY

The site was classified as Class A - High Risk, after the Tier 1 risk assessment. After the Tier 2 risk assessment the classification was revised downwards to Class B - Moderate Risk in accordance with the Code of Practice Environmental Risk Assessment for Unregulated Waste Disposal Sites (EPA 2007).

#### 5.2. ACTUAL AND POTENTIAL ENVIRONMENTAL IMPACTS

The following environmental impacts were considered when undertaking the site risk assessment:

##### 5.2.1 *Surface Water Contamination –Actual Environmental Impacts*

There was no surface water encountered in the vicinity of Kingscourt historic landfill therefore the landfill is not having an impact on any surface water quality.

##### 5.2.2 *Surface Water Contamination –Potential Environmental Impacts*

Road drainage culverts outside the footprint of the landfill could potentially be at risk from works and potential run-off. The removal of waste could mobilize polluting compounds which are currently bound within the waste/clay matrix of the landfill. No surface water bodies were identified in the vicinity of the site.

**5.2.3 Groundwater Contamination – Actual Environmental Impacts**

There was no groundwater encountered during the risk assessment investigations of Kingscourt historic landfill. The waste is not saturated and no water/groundwater and/or leachate were encountered in any of the trial holes. The majority of the waste is underpinned by the bedrock which would potentially allow the downward movement of any leachate resulting in preferential flow to groundwater. Leachate would have discharged from the waste body over time.

**5.2.4 Groundwater Contamination – Potential Environmental Impacts**

The movement of the waste by an excavator during remediation works could potentially lead to the vertical movement of contaminants to groundwater.

**5.2.5 Landfill Gas Migration - Actual Environmental Impacts**

A comprehensive regime of landfill gas monitoring was completed on site. Landfill gas was monitored on 14 No. occasions between 11<sup>th</sup> July 2013 and the 26<sup>th</sup> August 2013. Readings were collected using a GA 2000 landfill gas analyser. From analysis of the gas monitoring results Gas Well No. 2 (GW2) showed the highest levels for both methane and carbon dioxide. Negligible amounts of methane concentrations were evident in all of the other gas well monitoring locations. This indicates that the gas being generated from the biodegradation of the waste is not laterally migrating away from the main body of waste. Therefore the current environmental impact of landfill gas migration is negligible. Extended Gas monitoring was also carried out as part of the Tier 2 Risk Assessment

**5.2.6 Landfill Gas Migration - Potential Environmental Impacts**

Landfill gas monitoring was also carried out during the Tier 3 Risk Assessment. The main objective of this monitoring was to reaffirm the findings of the Tier 2 assessment; that there is no immediate or long term risk of landfill gas migration to offsite receptors from Kingscourt historic landfill. The risk posed by landfill gas to off-site receptors is considered to be negligible.

**5.2.7 Human Beings - Actual Environmental Impacts**

Currently the waste material is bound within the landfill and covered with a thin cap layer. The material appears stable, immobile and situated on bedrock. Human presence is considered to be the principal sensitive receptor with respect of landfill gas migration. This is due to the potential for the accumulation of higher than normal levels of gas; however the risk posed by landfill gas to off-site receptors is considered to be negligible. No evidence of land fill gas migration was found during the Tier 2 investigations.

**5.2.8 Human Beings - Potential Environmental Impacts**

According to the GSI Well Database, there are seven wells within 2.0 km of the site. However due to no evidence of leachate present at the site, the potential risk to these wells is negligible. The housing estates are served by Kingscourt Public water supply.

## 6.0 PROPOSED REMEDIATION WORKS

### 6.1 GENERAL

The Tier 2 Risk Assessment and trial hole investigations confirmed that landfill material consisted mainly of household waste. The waste material unearthed, comprised mainly of plastics, paper, glass, metal and textiles. There was no evidence of any potentially hazardous waste on site. The key objective of remediation, being cognisant of time, and health and safety constraints is to prevent the lateral migration of landfill gas to offsite receptors and minimise the impact on the environment.

The proposed measures considered for the historic landfill are as follows:

- Removal of Waste Material;
- Passive Venting Wells;
- Vent Trenches;
- Virtual Curtain System;
- Landfill Gas Monitoring;
- Capping of Kingscourt Landfill;
- Surface water Control and Management.

### 6.2 SUMMARY OF MEASURES

#### 6.2.1 Removal of Hazardous Wastes

The removal of all waste material from the historic landfill would ultimately remove the source of contamination from the site and the environment as a whole. However the potential removal of the waste material from the site poses a number of potential risks. The physical act of removing the waste could potentially mobilise contaminants which are dormant within the site and aid their migration. The removal of the waste could create airborne particulates in the vicinity of the work area. Workers immediate to the work area and residents downwind of the site could be negatively impacted by the dig-out and removal of the waste material. The cost for the removal of the waste would be considerable as the waste would have to be removed and transported to a licensed facility. The estimated tonnage for dig-out and removal is 6000 Tonnes.

#### Alternative Considered

Leaving the waste in-situ and monitoring the levels of Landfill Gas was also considered a feasible option given the nature of the site and fill material encountered. Gas venting systems such as passive venting wells, vent trench and virtual curtain were also considered as an alternative to removal of waste material. Capping of the landfill will also form part of the remediation works

**Recommended Remediation Measure**

Following consideration of the positive and negative effects from the complete removal of all waste material, the Waste Management Section of Cavan County Council in conjunction with Traynor Environmental Ltd would not recommend the complete dig-out and removal of waste from the landfill. As outlined under section 3.2.1.1 of the Tier 3 Risk Assessment **Impact of the Remediation Measures**, the cost involved and the possible risk / proximity to offsite receptors would not justify the complete removal of the waste material from the site.

**Timescale for Completion of Works**

The Waste Management Section of Cavan County Council in conjunction with Traynor Environmental Ltd would estimate a timeframe of 5 - 6 months for the dig-out and removal of waste material from the site. The said timescale for the removal of the waste is dependent on resources available, weather conditions and no unforeseen problems during the excavation works e.g. encountering quantities of hazardous waste that were not unearthed during the trial hole excavation.

**6.2.2 Passive Venting Wells**

Landfill gas can be controlled by installing a passive venting system. A basic system may consist of simple venting trenches that release landfill gas into the atmosphere. A more sophisticated passive venting system may consist of a horizontal network of slotted HDPE pipes connected together and fed to vertical venting columns. Columns may be fitted with rotating aspiromatic cowl to provide a small vacuum and increase the efficiency of the extraction. A proposed passive venting well system would consist of installation of 300 mm boreholes at 1 m centres to the base of the fill material and constructed with 160 mm diameter perforated vertical pipe with filter sock. All vertical pipes would be connected to a horizontal, 160mm diameter perforated pipe with filter sock located within a gravel-filled trench located in the top 1.0 meters below ground level (mbgl). Vent stack manifolds and vertical risers located at 10m centres along the horizontal gas collection duct would vent the landfill gases to the atmosphere. The efficiency of a passive collection system depends on how well the gas is contained within the landfill.

**Alternative Considered**

The exact nature of the infrastructure used to control landfill gas is site specific. The over-riding objective is to prevent landfill gas passing beyond the perimeter of the site, while protecting off site receptors and those using the lower part of the site (Cavan County Council). There are numerous gas control systems and the alternatives considered for use at the Kingscourt historic landfill are outlined in section 3.2.3 Vent Trenches and 3.2.4 Virtual Curtain System of the Tier 3 risk assessment.

**Recommended Remediation Measure**

In order to maximise the efficiency of the venting system, the preferred approach would be to install the venting measures in the area of the site where the main body of waste has been identified. The area of waste on site stretches from the eastern boundary of the site, which is bordered at this point by an undeveloped construction site. Venting Wells would be installed to the base of the fill material which from previous trial holes excavation is underlined by a layer of bedrock. The excavation of a vent trench to the base of the fill would entail the removal

of large volumes of waste materials which would require costly on-site or offsite disposal. With this proposed option there are also increased health and safety risks associated with working around deep excavations.

### **Timescale for Completion of Works**

The Waste Management Section of Cavan County Council in conjunction with Traynor Environmental Ltd estimates a timeframe of 1 - 2 months for the installation of the chosen passive venting system. The said timescale for the installation of the system is dependent on resources available, weather conditions and no unforeseen problems during the excavation and installation works.

### **6.2.3 Vent Trenches**

A proposed vent trench system would consist of the excavation of a minimum 1.2m wide trench to the base of the fill material, i.e. 5 - 6 meters below ground level (mbgl). This trench would then be lined with a geotextile and backfilled with graded aggregate around 160 mm perforated, vertical pipes with filter sock installed at 1m centres. These pipes would be connected to a horizontal gas collection duct with vent stack manifolds and vertical risers as per the venting system. The vertical vent pipes should be proud of the capping material and should not be slotted at the point where they pass through the capping material.

### **Alternative Considered**

Often combinations of both passive and active gas venting systems are used. However due to the low levels of landfill gas detected during the Tier 2 Risk Assessment, a combination of venting measure was not considered as an alternative. There are numerous gas control systems and the alternatives considered for use at the Kingscourt historic landfill are outlined in section 3.2.2 Passive Venting Wells and 3.2.4 Virtual Curtain System, refer to the Tier 3 risk assessment.

### **Recommended Remediation Measure**

A number of different gas venting systems have been considered as part of remediation options propose for the site. From investigation carried out during the Tier 2 Risk Assessment, Kingscourt landfill has shown to be in phase VII of the evolution of gas production over the lifetime of a landfill. This classification is due to the low volumes of methane and carbon dioxide within the landfill gas detected. The installation of vent trenches is not considered necessary or viable remediation option. The constraints of the site such as bedrock would also affect the installation and effectiveness of the vent trenches.

### **Timescale for Completion of Works**

The Waste Management Section of Cavan County Council in conjunction with Traynor Environmental Ltd would estimate a timeframe of 1 - 2 months for the installation of the appropriate number of vent trenches on the site. The said timescale for the installation of the system is dependent on a number of conditions such as no unforeseen problems during the excavation and installation works, available resources, appropriate weather conditions to carry out trench works.

#### 6.2.4 Virtual Curtain System

This unique method utilises a series of individual vertically driven, highly voided geosynthetic vents that are positioned at calculated centres to create a linear, in-ground "Venting Curtain" gas barrier. The zone of influence and consequent designed spacing of each vent node is dependent on site specific ground conditions. Virtual Curtain, a proprietary remediation system used widely in the UK, was also considered for installation. This system consists of vent nodes constructed of a gas-permeable geocomposite material installed to the base of the fill material at 1m centres. A horizontal gas collection duct located within a shallow, gravel-filled trench connects the nodes. A prefabricated vent bollard, which vents the diluted landfill gases to the atmosphere, is installed every 10m along the horizontal gas collection duct. Diagram of a representative vent trench construction are shown in figure no. 5 of the Tier 3 risk assessment. Landfill gas monitoring would take place on both sides of the virtual curtain in order to show whether gas is reaching the barrier and also to test the effectiveness of the barrier.

#### Alternative Considered

There are numerous gas control systems and the alternatives considered for use at the Kingscourt historic landfill are outlined in section 3.2.2 Passive Venting Wells and 3.2.3 Vent Trenches of the Tier 3 risk assessment. Complete removal of all waste material from the site has also been considered. A programme of landfill gas monitoring will form part of the remediation measure for the site.

#### Recommended Remediation Measure

Following consideration of the positive and negative effects associated with the installation of a virtual curtain and the site constraints it was not considered a suitable remediation measure for the Kingscourt site. From extensive gas monitoring carried out during the Tier 2 and Tier 3 Risk Assessment it has been shown that no landfill gas was detected at the gas well No. 6 (GW 6) which is located beside the boundary at the closest housing estate. If waste material was present in this area or landfill gas detected it would be an ideal location for a virtual curtain system. Where low levels of landfill gas were detected the site is adjoined by an undeveloped construction site. However the site boundary in closest proximity to the waste material, where low levels of landfill gas were detected (GW 2), does not pose a risk to offsite receptors. A virtual curtain was not considered a suitable remediation for the site.

#### Timescale for Completion of Works

The Waste Management Section of Cavan County Council in conjunction with Traynor Environmental Ltd estimate a timeframe of 1 - 2 month for the installation of the Virtual Curtain system on the site. The said timescale for the installation of the system is dependent on a number of parameters such as site constraints (bedrock), proximity to offsite receptors, weather and no unforeseen problems during the excavation.

#### 6.2.5 Landfill Gas Monitoring

There is currently No. 6 Gas monitoring wells installed at the site. As part of a continued programme of monitoring it is proposed to install three additional gas monitoring wells at the site. These additional monitoring locations will be positioned according to the EPA Landfill Manuals - Landfill Operation Practices. In combination

with the existing six gas monitoring location the new gas monitoring locations will be positioned on both sides of the passive gas venting system in order to show:

- a) whether gas is breaching the gas venting barrier
- b) to test the effectiveness(or otherwise) of the gas venting system

#### **6.2.6 Capping of Kingscourt Landfill**

##### **Re- Grading of Landform**

The re-grading of the landform is vital to the overall remediation of the site and will break the infiltration of rainfall into the waste body. This re-grading will take place with whatever combination of remediation options are carried out.

##### **Capping**

Capping of the landfill with a suitable capping layer will minimise the infiltration of precipitation into the waste body whilst allowing sufficient moisture to penetrate in order to maintain the decomposition process.

##### **Low Permeability layer**

The main function of this layer is the control of leachate generation by minimising the infiltration of water into the underlying waste. This layer should consist of a material which can be compacted to a suitably low hydraulic conductivity which prevents most, but not all, of the moisture infiltrating into the waste.

##### **Subsoil**

In addition to the low permeability layer a 400mm subsoil layer would be required across the capping layer in order to protect the low permeability layer and to help support vegetation. A loamy and relatively stone-free soil could be used for this layer.

##### **Topsoil or Similar Layer**

This layer is necessary to provide a foundation into which grass and any other vegetation might be planted. The topsoil or similar product should be uniform and have a minimum slope of 1 to 30 prevent surface water ponding.

##### **Tree Planting and Final Landscaping**

The landfill at Kingscourt could be planted with a suitable mix of trees to ensure the establishment of a good sustained vegetative cover and aid the integration of the landfill into the landscape.

#### **6.2.7 Surface water Control and Management**

The capping and regarding of the landfill will reduce the infiltration of precipitation into the waste body. This will prevent the interaction of clean precipitation with the waste body.

## 7.0 SUMMARY OF ALL REMEDIATION MEASURES

The Tier 2 Risk Assessment process resulted in the risk rating for the historic landfill being reduced from **High Risk** down to **Moderate Risk**. The risk rating was initially high due to the estimated area of the site containing waste and the possible levels of landfill gas present. The area of the site containing waste material has been shown to be less than initial estimates and landfill gas levels recorded are of very low levels with no evidence of lateral migration. The SPR Linkage number 10 has therefore been shown to be less of a risk after the Tier 1 & Tier 2 risk assessment, therefore the risk rating assigned accordingly as **Moderate**.

Seven key remediation options have been proposed, in relation to the historic landfill at Kingscourt. The specific circumstance of the site will require a combination of these proposed measures. The Waste Management Section of Cavan County Council in conjunction with Traynor Environmental Ltd recommends a combining four of the measures which have been proposed for the remediation of Kingscourt Historic Landfill.

A combination of the following measures is proposed;

- 3.2.2 - Passive Gas Venting System
- 3.2.5 - Landfill Gas Monitoring
- 3.2.6 - Capping of Kingscourt Landfill
- 3.2.7 - Surface water Control and Management

## 8.0 CONCLUSION AND RECOMMENDATIONS

### 8.1 CONCLUSION

The Tier 2 Exploratory and intrusive investigations identified that there was waste encountered in trial holes TH1, TH4, TH5 TH6, TH7, TH10, TH12, TH14, TH15, and TH24 at the historic landfill located at Dunaree, Kingscourt Co. Cavan.

No watercourses or drains were encountered on, or in the vicinity of the site. For this reason it was not possible to carry out Q value ratings which are used for the assessing of the water quality up and down stream of the landfill site. No water table was encountered on the site.

The bedrock aquifer underlying the site has a classification of "Poor Aquifer" – Bedrock which is generally unproductive except for local zones. The Geological Survey of Ireland has classified the vulnerability of the aquifers within the region as extreme (Rock at/near surface or Karst). Taking account of the fact that the aquifer is a poor aquifer coupled with the vulnerability level an R2<sup>2</sup> response is recommended.



There was no surface water encountered at the site therefore no surface water sampling took place. There was no groundwater encountered during trial hole excavations therefore no groundwater sampling took place.

Six Gas Wells were strategically located around the site. Gas Wells (GW) 1 – 3 were placed within the main waste body located to the southeast of the site. GW4 was located on the western boundary of the site adjacent to a residential housing estate where a small amount of waste was encountered. GW5 and GW6 were located in the lower yard area to the North of the site which is currently used as a storage area by Cavan County Council; no waste was encountered in GW5 and GW6. GW4, GW5 and GW6 was used to assess whether there was any lateral mitigation of gas away from the main waste body located to the southeast of the site.

Extended gas monitoring was completed at all No. 6 gas monitoring wells (refer to table for results and graphs in appendix E of the Tier 2 Risk Assessment). The main objective of the extended gas monitoring was to reaffirm the findings of the Tier 2 assessment; that there is no immediate or long term risk of landfill gas migration to offsite receptors from Kingscourt historic landfill.

The Tier 2 Risk Assessment process has resulted in the risk rating for the historic landfill being reduced from a High Risk Site (Class A) to a Moderate Risk (Class B). SPR Linkage number 20 has been proven and thus risk rating assigned accordingly as **Moderate**. As part of the Tier 2 risk assessment the intrusive site investigation works have confirmed the area where the waste was deposited was lesser than previously expected, accounting for approximately 2300m<sup>2</sup> (0.23 Ha). This has changed a number of SPR linkages, namely:

- SPR1 has changed from a linkage score of 9.33 to 0.00;
- SPR3 has changed from a linkage score of 35.00 to 25.00;
- SPR 5 has changed from a linkage score of 7.00 to 5.00;
- SPR 7 has changed from a linkage score of 11.67 to 0.00 ;
- SPR 10 has changed from a linkage score of 70.0 to 50.0.
- SPR 11 has changed from a linkage score of 42.0 to 0.00

## 8.2 RECOMMENDATIONS

Based on the low volumes of landfill gas being generated at the site, it is not considered that an active landfill gas system is required. Following analysis of a number of venting systems (passive and active), a passive venting system was considered to be the most appropriate remediation technique for the site. This type of system presents the most viable remedial option for the site based on logistical programme and cost considerations. In conjunction with the system three additional gas monitoring wells will be installed at the site. A programme of monitoring will be undertaken to insure the venting system is functioning as intended and the lateral migration of landfill gas is not occurring. Monitoring will take place at the existing No.6 monitoring wells and at the newly installed GW 7, GW 8 and GW 9.

The re-grading of the landfill is vital to the overall remediation of the site and will break the infiltration of rainfall into the waste body. This re-grading will take place in conjunction with remediation options 3.2.2 Passive Gas Venting System and 3.2.5. Landfill Gas Monitoring, refer to the Tier 3 Risk Assessment. The main aspect of the re-grading is to pull back the side slopes of the landfill to a slope not greater than 1 (v):2.5(h). Re-grading is also considered necessary in terms of the stability of the side slopes. These watersheds should contain silt traps and removable dams to stop water leaving the site in an emergency situation. The final contour plan for the waste, prior to capping will be agreed with the Environmental Protection Agency (EPA)/Local Authority.

Subject to remediation measures being carried out, the risk rating for Kingscourt historic landfill would be reduced from a Moderate Risk to a Low Risk site as a number of SPR linkages would have been broken. The SPR Linkage diagrams for each option have been detailed under each section.

- Passive Gas Venting System;
- Capping of the landfill which reduces and /or eliminates infiltration of rainwater and the mobilisation of residual contaminants (if any);
- Additional Landfill Gas monitoring;
- Tree plantation and landscaping of the site to minimise reduce rainfall infiltration and leachate generation.

The effectiveness of works carried out will be closely recorded in the time frame after completion of remediation and removal works. This will be achieved through a comprehensive schedule of monitoring. Results will be documented and comparisons drawn from prior sampling at the site to evaluate effectiveness of remediation measures.

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**8.3 SPR LINKAGES AFTER REMEDIATION WORKS CARRIED OUT****Table 3: SPR Linkages If Remediation Works Carried Out On Site As detailed In Option A Tier 3 Environmental Risk Assessment Report**

Risk Equation	SPR Values	Max Score	Linkages	Normalised Scores (%)
SPR 1 = $1a \times (2a + 2b + 2c) \times 3e$	0	300	Leachate → Surface Water	0.00
SPR 2 = $1a \times (2a + 2b + 2c) \times 3b$	0	300	Leachate → SWDTE	0.00
SPR 3 = $1a \times (2a + 2b) \times 3a$	0	240	Leachate → human Presence	0.00
SPR 4 = $1a \times (2a + 2b) \times 3b$	0	240	Leachate → GWDTE	0.00
SPR 5 = $1a \times (2a + 2b) \times 3c$	0	400	Leachate → Aquifer	0.00
SPR 6 = $1a \times (2a + 2b) \times 3d$	0	560	Leachate → Surface Water	0.00
SPR 7 = $1a \times (2a + 2b) \times 3e$	0	240	Leachate → SWDTE	0.00
SPR 8 = $1a \times 2c \times 3e$	0	60	Leachate → Surface Water	0.00
SPR 9 = $1a \times 2c \times 3b$	0	60	Leachate → SWDTE	0.00
SPR 10 = $1b \times 2d \times 3f$	0	150	Landfill Gas → Human Presence	0.00
SPR 11 = $1b \times 2e \times 3f$	0	250	Landfill Gas → Human Presence	0.00

Risk Classification	Score Range
High Risk (Class A)	Greater than or equal to 70% for any individual SPR linkage
Moderate Risk (Class B)	Between 40% and 70% for any individual SPR linkage
Low Risk (Class C)	Less than or equal to 40% for any individual SPR linkage

Overall Risk after Completed Remediation Works	Low Risk (Class C)
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