



**Geophysical Geotechnical Environmental**

---

# Report

Geological and Hydrogeological Study of the Corranure Landfill,  
County Cavan

for

M. C. O'Sullivan & Co. Ltd.

***BMA GeoServices Ltd.***

**Ground Engineering Consultants**  
*Comhairleoirí Cré-Innealtóireachta*

BMA GeoServices Ltd.  
8 Strawhall Business Park  
Athy Road, Carlow  
Co. Carlow  
Reg. No. 335742  
VAT. No. 6355742G

For inspection purposes only.  
Consent of copyright owner required for any other use.

For inspection purposes only.  
Consent of copyright owner required for any other use.

# **BMA GeoServices Ltd.**

<b>AUTHOR</b>	<b>CHECKED</b>	<b>JOB No.</b>	<b>DATE</b>
Dr. Davide Gallazzi PGeo	EuroGeol B.J.Murphy M.Sc. DIC MIEI	1229	25 <sup>th</sup> August 2003

## **FOREWORD**

This report has been prepared by BMA GeoServices Ltd. in line with best current practice and with all reasonable skill, care and diligence within the limitations imposed by the survey techniques applied and the resources devoted to it by agreement with the client. The client should take the interpretative basis for any conclusions or opinions contained therein into account in any future use of this report.

## **CONFIDENTIAL REPORT**

Not to be issued or copied without the consent of M.C. O'Sullivan & Co. Ltd.

*For inspection purposes only.  
Consent of copyright owner required for any other use.*

## **TABLE OF CONTENTS**

<b>SUMMARY</b> .....	<b>5</b>
<b>1. INTRODUCTION</b> .....	<b>6</b>
1.1 OBJECTIVES .....	6
1.2 SCOPE OF WORK .....	6
1.3 SITE LOCATION AND DESCRIPTION .....	7
<b>2. GEOLOGY</b> .....	<b>8</b>
2.1.1 REGIONAL GEOLOGY .....	8
2.2 LOCAL GEOLOGY.....	9
2.2.1 Boulder Clay .....	9
2.2.2 Waste.....	9
2.2.3 Bedrock.....	10
<b>3. HYDROLOGY</b> .....	<b>11</b>
3.1 DRAINAGE .....	11
3.2 SURFACE WATER.....	11
3.2.1 Annalee River.....	11
3.2.2 Cavan River .....	11
<b>4. HYDROGEOLOGY</b> .....	<b>12</b>
4.1 REGIONAL HYDROGEOLOGY.....	12
4.2 LOCAL HYDROGEOLOGY .....	12
4.2.1 Overburden.....	12
4.2.2 Bedrock.....	13
4.2.3 Vulnerability .....	14
4.3 GROUNDWATER LEVELS.....	14
<b>5. HYDROCHEMISTRY</b> .....	<b>16</b>
5.1 SURFACE WATER.....	16
5.2 GROUNDWATER.....	16
<b>6. CONCLUSIONS</b> .....	<b>17</b>
<b>9. REFERENCES</b> .....	<b>18</b>

For inspection purposes only.  
Consent of copyright owner required for any other use.



# **BMA GeoServices Ltd.**

---

## **Maps**

- Map 1                      Site Location and Regional Geology
- Map 2                      Locations of Boreholes and Trial Pits
- Map 3                      Reconstruction of Piezometric Surface in Bedrock

## **Appendices**

- Appendix A                Borehole and Trial Pits Logs
- Appendix B                Permeability Tests Data
- Appendix C                Chemical Analyses Reports: Surface Water and Groundwater

*For inspection purposes only.  
Consent of copyright owner required for any other use.*

# **BMA GeoServices Ltd.**

## **SUMMARY**

As part of an Environmental Impact Statement to be submitted to the Environmental Protection Agency for a Revised Waste Licence Application for Corranure Landfill, Cavan, County Cavan, BMA GeoServices Ltd. undertook a Geological and Hydrogeological Study of the area.

A desk study was carried out on the existing information regarding the geology, hydrology, and hydrogeology of the site. The available information was integrated with data gained from a recent programme of drilling a total of 6 no. boreholes and the excavation of a total of 9 no. trial pits.

The site lies on an overburden cover made of impermeable Boulder Clay with a thickness generally over 10 m, with a restricted area around R04 where bedrock is at 8 m below ground level. Bedrock is made of greywackes, shales and spilitic lavas.

Groundwater in the overburden is not classified as an aquifer and is unlikely to have any significant resource potential, while the bedrock aquifer has been provisionally classified as Poor (P1). Groundwater vulnerability varies from moderate to low. This gives to the site a rating of R2<sup>1</sup>, which could improve to R1 if the area around R04 is excluded from the proposed landfill extension. A schematic reconstruction of the piezometric surface in bedrock indicates that groundwater flows toward north-northeast.

An examination of the results of chemical analyses conducted on surface water and groundwater samples, made available by Cavan County Council indicates the presence of surface water and groundwater pollution. However, the source of the pollution has not been determined, and the possibility of a source other than the waste body can not be excluded.

# **BMA GeoServices Ltd.**

## **1.3 Site Location and Description**

The site is located ca. 2 km to the north-east of Cavan Town, on the north side of the R188 to Cootehill, on the western side of a gently sloping hill (see Map 1). The area of the present landfill has a maximum elevation of ca. 118 m OD. The area of the proposed extension lies to the north and north-west of the present landfill, with elevation between 101 mOD and 116 mOD.

For inspection purposes only.  
Consent of copyright owner required for any other use.



## **2. GEOLOGY**

### **2.1.1 Regional Geology**

The 1:100,000 map of the bedrock geology for the area (Map 1) and the accompanying booklet, published by the Geological Survey of Ireland (GSI) in 1997 indicate that the site is underlain by lithotypes belonging to the Longford – Down Inlier. This is made of a belt of rocks which extends from the coast of County Down to County Longford. Moreover the Longford – Down Inlier is part of greater belt-like structure, which extends into Scotland and into north-eastern America. All of these rocks were deposited on the submarine margin of the paleo-continent Laurentia, which laid on the north-western margin of the paleo-ocean Iapetus. This paleo-ocean disappeared as a consequence of continental drift around the end of the Silurian (ca. 410 Ma), with connected oceanic plate subduction, volcanic activity, continental collision and formation of mountains (Caledonian Orogeny). The zone of this collision is believed to extend, in Ireland, from County Louth to the Shannon Estuary.

The Longford – Down Inlier can be divided into two distinct zones, a Northern and a Central-Southern Belt, which in turn can be subdivided into several tectono-stratigraphical fault-bounded Tracts.

The GSI map shows that the site is crossed with a NE-SW trend by a section of the Caticketeane Fault, which separates Tract 2 (on the western side) from Tract 3 (on the eastern side). Tract 2 is represented by the green greywackes, red shales and minor spilitic lavas of the Coronea Formation. Shales and argillites are particularly abundant in the lower part of the Formation, where they can reach a thickness of 30 m with a lateral continuity of several hundred metres. Features found in the lava indicate that the same has been erupted underwater at depths greater than 4,000 m. This geological formation has an estimated thickness between 1,600 m and 2,300 m.

Tract 3 is represented by the Red Island Formation. This formation consists of green to greenish-grey medium or coarse-grained, locally conglomeratic, volcanoclastic greywacke with subordinate grey to greyish black shales.

Both the Coronea Formation and the Red Island Formation are believed to be of Middle Ordovician Age (468-458 Ma).

The NE-SW trend of faulting is predominant in the area. Another set of faults, with a NW-SE trend is also present, with clear indication of having developed at a later stage. One of these faults is located ca. 2 km north-east of the site.

No evidence of mining activity is reported in the immediate vicinity of the site. The GSI geological map reports a disused mine for Iron ca. 8 km to the NNE. Two quarries for extraction of greywackes are also reported ca. 2 km to the East and 6 km to the north-east.

## **2.2 Local Geology**

A total of 9 no. trial pits (see Map 4 for boreholes and trial pits location) were excavated in the proposed extension area with a tracked excavator EX200 during the 2003 study. The depth of excavation varies between 3.90 m and 6.70 m bgl.

A total of 6 no. boreholes were drilled on site with a shell and auger and with a coring rig during the activities undertaken in 1998 in relation to the application for the current Waste Licence.

A further 6 no. boreholes (GW1-3, R01, R02 and R04), each of 150 mm in diameter, were drilled in the proposed extension area in the period 12-27 June 2003 with an air rotary rig (see Map 4 for location). An ODEX technique was used for drilling through the overburden, while rock coring was used in bedrock. The depth of the boreholes varies between 9 m (R04) and 21.50 m (GW3).

### *2.2.1 Boulder Clay*

The trial pit and borehole logs reveal the presence of a firm to stiff brown sandy, gravelly clay with boulders and cobbles (Boulder Clay). Occasionally the Boulder Clay presents intermittent and thin layers more rich in sand or in gravel. The thickness of the Boulder Clay varies between 8 m (R04) and 18 m (GW3). However, a thickness of 25 m is reported in a borehole (RC5) drilled during the previous phase of field activity (1998). The results of the geophysical surveys carried out in 1998 and in 2003 and the borehole logs indicate that the thickness of the boulder clay is increasing toward the west.

### *2.2.2 Waste*

A total of 4 no. boreholes (L 1-4), each of 200 mm in diameter, were drilled in the waste body with a shell and auger rig in the period 12-19 June 2003. Another borehole (SA6) was drilled during the previous field activities.

The boreholes drilled during this phase of field activity intersected a maximum of 20.40 m of waste, while a total of 26.70 m of waste was encountered by SA6 in 1998. In both cases it is evident that the bottom of the waste body is at least 5 m below the elevation of the surrounding ground level. This indicates that the waste was originally dumped in the Lismagraty Lough.



## 2.2.3 *Bedrock*

No bedrock outcrops are recorded on the 6" GSI field datasheets within the site.

Six boreholes (GW1-3, R01, R02 and R04), each of 150 mm in diameter, were drilled in the proposed extension area in the period 12-27 June 2003 with an air rotary rig to depths between 9 and 21.5 m bgl. Greater depths (to a maximum of 29.60 m) were reached during the borehole drilling undertaken in 1998.

An examination of the borehole logs (see Appendix A) and of the geophysical data shows that depth to bedrock is generally of ca. 20 m throughout the site. However, the geophysical survey and the borehole logs indicate the presence of a bedrock high in the around R02 and R04.

The borehole logs indicate that the bedrock is represented by brown highly weathered shale or by grey fractured greywacke. These lithologies are consistent with both the Coronea and the Red Island Formation, which are reported to be underlying the site.

For inspection purposes only.  
Consent of copyright owner required for any other use.

## **3. HYDROLOGY**

### **3.1 Drainage**

The drainage on the higher portion of the area under investigation appears to be quite good, probably as a consequence of fast run-off due to the presence of relatively steep slopes. The presence of boggy grounds in the lower part of the site is evidence of a poorer underlying drainage.

### **3.2 Surface Water**

The area under investigation falls within the catchment area of the Annalee to the north and the Cavan River to the south-west.

#### **3.2.1 *Annalee River***

Two small streams are present in the boggy area to the north-west and the east of the existing landfill site. Both these streams flow towards the north-west and eventually become tributary of the Annalee River. According to data published by the EPA in 1997 the estimated dry weather flow rate in the Annalee River is  $0.02 \text{ m}^3/\text{s}$ , based on data from a gauging station at Lisdarn.

A biological assessment of the Annalee River, based on samples collected at a station located at the Ballinaise Bridge ca. 2.5 km to the north, indicates that the Annalee River is classified as "Class 4 Unpolluted" (Mac Garrigle et others, 2000).

#### **3.2.2 *Cavan River***

The southern half of the site, including the existing landfill, is drained by the Kinneypottle River, which originates in the high grounds to the north of the site. This stream flows south-west towards Cavan Town and eventually becomes a tributary of the Cavan River. According to data published by the EPA in 1997, the estimated dry weather flow in the Cavan River, based on data from a gauging station at Lisdarn, is between  $0.01$  and  $0.02 \text{ m}^3/\text{s}$ .

A biological assessment of the Cavan River carried out by the EPA (Mac Garrigle et others, 2000), based on samples collected at a bridge near Brefni Park, ca. 4.5 Km to the south-west, awards to the river a rating of "Class 4 Unpolluted" (Mac Garrigle et others, 2000).



## **4 HYDROGEOLOGY**

### **4.1 Regional Hydrogeology**

The bedrock underlying the site is made of argillites, greywackes and spilitic lavas. In these lithologies groundwater flow is generally structurally controlled (fissure flow permeability), hence well yields could be extremely variable.

At the time of this report compilation the GSI has not yet published a Groundwater Protection Scheme for County Cavan, and therefore a definitive classification of the importance of the aquifers present in the bedrock is not available as yet. However, the GSI has provided a provisional classification of the two bedrock formations underlying the area under investigation. This classification is based on the current understanding of the hydrogeology of the area and on available hydrogeological data. The above-mentioned provisional classification for both the Coronea and the Red Island Formation is "Poor Aquifer, Generally Unproductive except for Local Zones (Pl)".

### **4.2 Local Hydrogeology**

Each of the six boreholes, with the exception of R04, was drilled to bedrock and completed as groundwater monitoring well with the installation of 50 mm HDPE standpipes (see Appendix A for borehole logs and monitoring wells completion details).

#### **4.2.1 Overburden**

The overburden on site is not classified as an aquifer by the GSI, nor it is expected to be carrying significant amounts of water, due to its geological characteristics. Boulder Clay is made mainly of stiff impermeable clay, which does not favour circulation of water. Groundwater could therefore be encountered during drilling operations, but it usually constitutes more a restricted perched almost stagnant water table, without lateral extension and linked to the presence of more sandy lenses rather than a proper aquifer. Limited circulation of groundwater would be confined to more sandy or gravelly lenses.

During drilling operations groundwater was encountered only in R01, at a depth of 7 m bgl in a more sandy horizon of the boulder clay. It was however decided to install a 19 mm in diameter standpipe in the overburden in four of the boreholes (R01, R02, GW1 and GW2) to monitor the possible presence of groundwater.

Groundwater flow in the overburden is intergranular (primary permeability).

# **BMA GeoServices Ltd.**

During field activities undertaken in June 2003 variable head permeability tests were carried out at different depth to measure the permeability of the overburden. These results are summarised in Table 4.2.1§1, and included in Appendix B.

**Table 4.2.1§1: Variable Head Permeability Tests**

<b>Borehole No.</b>	<b>Depth of Test (mbgl)</b>	<b>Overburden Material</b>	<b>Permeability (m/s)</b>
<b>GW 2</b>	2.50	Stiff gravelly sandy clay	$5.0 \times 10^{-09}$
<b>GW 2</b>	5.00	Stiff gravelly sandy clay	$1.9 \times 10^{-08}$
<b>GW 2</b>	10.10	Stiff gravelly very sandy clay	$2.8 \times 10^{-06}$
<b>GW 3</b>	2.50	Stiff gravelly sandy clay	$7.5 \times 10^{-09}$
<b>GW 3</b>	4.90	Stiff gravelly sandy clay	$3.0 \times 10^{-09}$
<b>GW 3</b>	10.00	Stiff gravelly sandy clay	$4.5 \times 10^{-09}$
<b>R0 1</b>	2.30	Stiff gravelly sandy clay	$1.5 \times 10^{-09}$
<b>R0 1</b>	5.00	Stiff gravelly sandy clay	$1.3 \times 10^{-08}$
<b>R0 1</b>	10.00	Stiff gravelly sandy clay	$6.0 \times 10^{-09}$
<b>R0 2</b>	3.00	Stiff gravelly sandy clay	$1.9 \times 10^{-07}$

The results of permeability testing indicate very low permeability values ( $2.8 \times 10^{-06}$  to  $1.5 \times 10^{-09}$  m/s). The relatively more elevated value from GW 2 at a depth of 10.10 m bgl could be due to the presence of slightly more sand and/or gravel in the soil horizon. These results are consistent with the nature of the overburden and with the results of similar tests undertaken in 1998, which show a permeability of the overburden between  $1.89 \times 10^{-06}$  m/s and  $7.01 \times 10^{-08}$  m/s. It should be noted that these tests generally reflect horizontal rather than vertical permeability, which could be up to an order of magnitude lower.

## **4.2.2 Bedrock**

Due to the lithology of the bedrock fissure flow is the dominant type of groundwater flow.

Four packer tests were performed in bedrock during drilling operations in 1998. The highest permeability value was of  $7.8 \times 10^{-06}$  m/s, indicating a low to moderate permeability.

No further permeability tests were undertaken during drilling in June 2003.

# Table 1. Summary of Data

Table 1. Summary of Data

Year	Category	Value	Unit
2000	Category 1	100	kg
2001	Category 1	100	kg
2002	Category 1	100	kg
2003	Category 1	100	kg
2004	Category 1	100	kg
2005	Category 1	100	kg
2006	Category 1	100	kg
2007	Category 1	100	kg
2008	Category 1	100	kg
2009	Category 1	100	kg
2010	Category 1	100	kg
2011	Category 1	100	kg
2012	Category 1	100	kg
2013	Category 1	100	kg
2014	Category 1	100	kg
2015	Category 1	100	kg
2016	Category 1	100	kg
2017	Category 1	100	kg
2018	Category 1	100	kg
2019	Category 1	100	kg
2020	Category 1	100	kg

For inspection purposes only.  
Consent of copyright owner required for any other use.



For inspection purposes only.  
Consent of copyright owner required for any other use.

For inspection purposes only.  
Consent of copyright owner required for any other use.

## 4.2.3 Vulnerability

The area under investigation is covered by boulder clay with a thickness generally in excess of 10 m, apart from the area near R04, where the boulder clay has a thickness of 8 m. This implies a general vulnerability rating of low, which would become moderate in the area near R04.

The application of the Response Matrix for Landfills from Groundwater Protection Schemes would give to the area under investigation a rating of R2<sup>1</sup>, which could improve to R1 if the area around R04 is excluded from the proposed landfill extension.

## 4.3 Groundwater Levels

Groundwater levels were measured in the new and in the pre-existing monitoring wells on 25<sup>th</sup> July 2003, and are reported in Table 4.2.3§1 and Table 4.2.3§2.

**Table 4.2.3§1 – Overburden Groundwater Levels**

Monitoring Well No.	Depth to Water m b.g.l.	Water Level mOD
GW 1	1.81	110.13
GW 2	4.38	109.44
R0 1	7.41	102.55
R0 2	2.22	100.82

The water levels measured in the standpipes installed in the overburden suggest that a limited amount of groundwater is present in the Boulder Clay. However, it is our opinion that this does not represent a groundwater table extended over the whole area of interest, but is more likely to be the expression of localised almost stagnant perched groundwater table without lateral extension. A reconstruction of the groundwater direction flow was therefore not considered appropriate.

# **BMA GeoServices Ltd.**

**Table 4.2.3§1 – Bedrock Groundwater Levels**

<b>Monitoring Well No.</b>	<b>Depth to Water m b.g.l.</b>	<b>Water Level mOD</b>
GW 1	2.04	109.09
GW 2	3.34	110.48
GW 3	1.91	105.08
R0 1	7.73	102.23
R0 2	1.99	101.05

The elevation of depth to water measured on the field the 25<sup>th</sup> July 2003 show that the water level in all the monitoring wells has risen significantly above the bedrock elevation, so suggesting a semi-artesian nature of the bedrock aquifer.

Groundwater level in the bedrock varies between 101.05 mOD and 110.48 mOD. The direction of groundwater flow appears to be toward north with a gradient of 0.06 (Map 3).

*For inspection purposes only.  
Consent of copyright owner required for any other use.*



## **5 HYDROCHEMISTRY**

### **5.1 Surface Water**

A total of five surface water sampling locations were selected by the E.P.A. in Table E.4.1 of the Waste Licence No. 77-1 issued to Cavan County Council. Sampling is carried out on a regular basis by Cavan County Council personnel, in accordance with the requirements of the above-mentioned Waste Licence.

Reports compiled by personnel of Cavan County Council involved in the landfill monitoring, relating to the quarterly sampling of surface water from January 2002 to March 2003 are included in Appendix C. An examination of these Reports indicates that the quality of surface water deteriorates between K1 (which is located upstream) and K2 (just downstream from the waste body), and improves in K3 (further downstream), probably due to dilution. The potentially detrimental influence of the landfill on the quality of the surface water can not be excluded. However, it is reported that the fields adjacent to sampling location K2 are used for grazing cattle, which may be the source of the pollution of the stream.

### **5.2 Groundwater**

A total of five groundwater sampling locations were selected by the E.P.A. in Table E.4.2 of the Waste Licence No. 77-1 issued to Cavan County Council, in addition to all the private wells within 500 m of the landfill boundary. At present groundwater sampling is carried out on a regular basis by Cavan County Council personnel, in accordance with the requirements of the above-mentioned Waste Licence at the only groundwater monitoring point available (SA1). The boreholes drilled during this phase of site investigation were completed as monitoring wells in order to fulfil the waste Licence requirements.

Reports compiled by personnel of Cavan County Council involved in the landfill monitoring, relating to the quarterly sampling of surface water from January 2002 to March 2003 are included in Appendix C. An examination of these Reports indicates the presence of groundwater pollution from Phenols, Total and Faecal Coliforms, metals. However, the possibility of a source of pollution other than the waste body can not be excluded at this stage.



## **6. CONCLUSIONS**

The area under investigation is underlain by the argillites, greywackes and spilitic lavas of the Red Island and the Coronea formations, both of lower Palaeozoic age.

The area under investigation falls within the catchment area of the Cavan River and of the Annalee River. Both these rivers are classified as "Unpolluted (Class 4)" by the EPA on the survey on water quality in Ireland 1998-2000.

The overburden consists of low permeability stiff brown sandy, gravelly clay (Boulder Clay). The thickness of the overburden, as revealed by direct site investigation undertaken in June 2003 varies between 8 m and 18 m. However, the geophysical surveys and previous site investigation indicate that the thickness could be greater in some locations.

Variable Head Permeability Tests undertaken in June 2003 on the new monitoring wells indicates very low permeability values (between  $2.8 \times 10^{-6}$  to  $1.5 \times 10^{-9}$  m/s) for the overburden. These results are consistent with the results of similar tests undertaken in 1998, which show a permeability of the overburden between  $1.89 \times 10^{-6}$  m/s and  $7.01 \times 10^{-8}$  m/s. It should be noted that these tests generally reflect horizontal rather than vertical permeability, which could be up to an order of magnitude lower.

The overburden is not classified as an aquifer by the GSI.

No permeability tests were carried out in the bedrock during the current investigation. The results from tests performed in 1998 indicate a low to moderate permeability (maximum value  $7.8 \times 10^{-6}$  m/s).

Both the Red Island and the Coronea Formation are provisionally classified as "Poor Aquifer, Generally Unproductive except for Local Zones (PI)".

The reconstruction of the piezometric surface for groundwater in bedrock indicates a flow northward, with a gradient of 0.06.

The vulnerability rating of the bedrock is generally low, with an area of moderate vulnerability around R04.

The application of the Response Matrix for Landfills from Groundwater Protection Schemes would give to the area under investigation a rating of R2<sup>1</sup>, which could improve to R1 if the area around R04 is excluded from the proposed landfill extension.

Results of chemical analyses on water samples indicate the presence of pollution of the groundwater and of surface water in the stream flowing into the Cavan River. However, at this stage the possibility that groundwater pollution could originate from a source other than the waste body can not be excluded.

## **9. REFERENCES**

Department of the Environment and Local Government, Environmental Protection Agency and Geological Survey of Ireland, Groundwater Protection Schemes, 1999.

Environmental Protection Agency, Parameters of water Quality –Interpretation and Standards, 2001.

Geological Survey of Ireland, Bedrock Geology 1:100,000 Scale Map Series, Sheet 8/9, Monaghan - Carlingford, 1997.

Geological Survey of Ireland, Geology of Monaghan - Carlingford, A Geological Description to Accompany the Bedrock Geology 1:100,000 Scale Map Series, Sheet 8/9, Monaghan – Carlingford, 1997.

Mac Cártaigh M., Hydrological data, Environmental Protection Agency, 1997.

Mac Garrigle M. L., Bowman J. J., Clabby K. J., Lucey J., Cunningham P., Mac Cártaigh M., Keegan M., Cantrell B., Lehane M., Clenaghan C., Toner P. F., Water Quality in Ireland 1998-2000, Environmental Protection Agency, 2000.

For inspection purposes only.  
Consent of copyright owner required for any other use.

# Final Report

Page 1 of 1

The following information was obtained from the records of the Department of the Interior, Bureau of Land Management, regarding the proposed project.

The project is located on the eastern side of the state, within the boundaries of the National Forest System.

The project area is approximately 100 acres in size and is situated in a rural area with some agricultural land nearby.

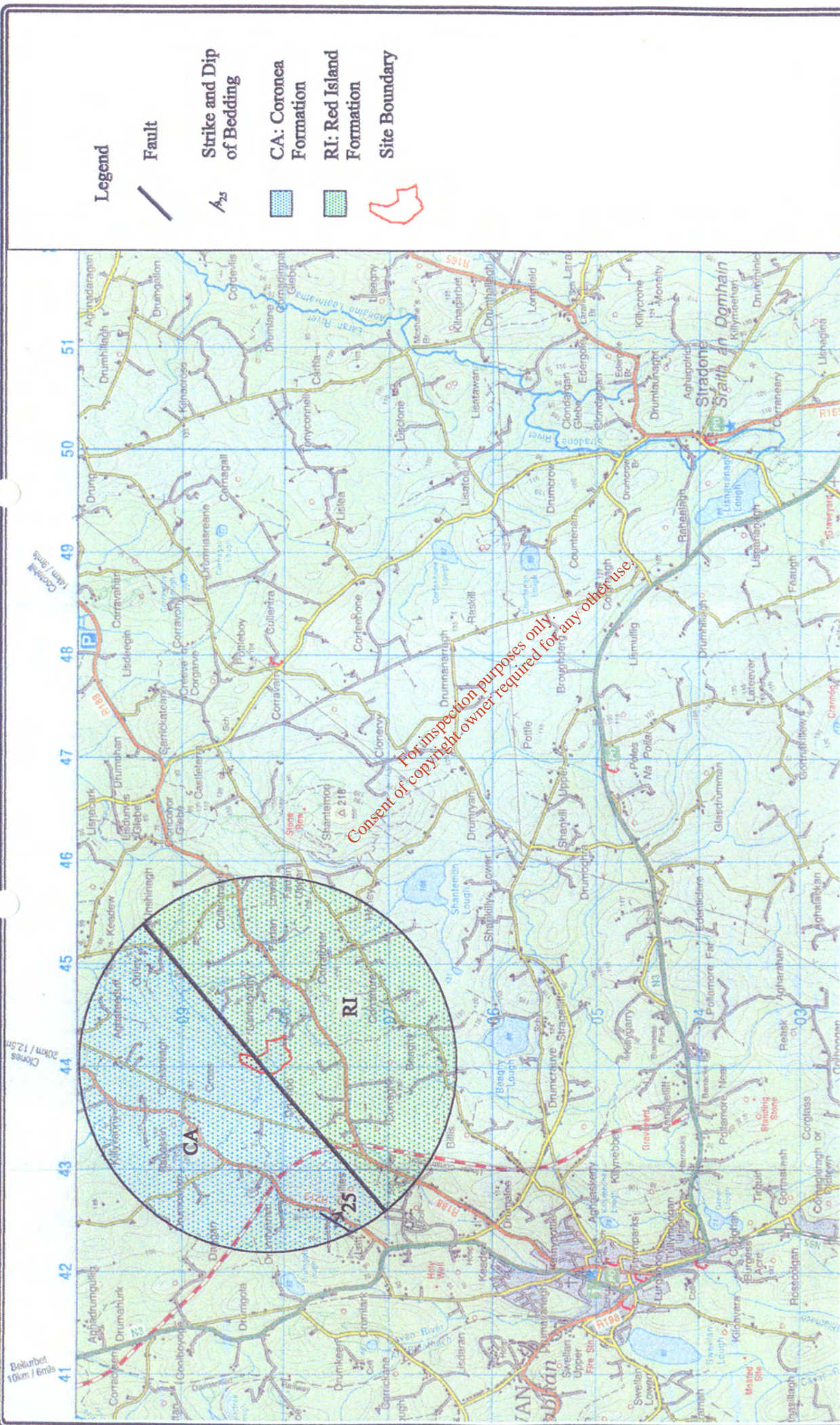
The project is proposed to be used for recreational purposes, including hiking, horseback riding, and hunting.

The project is located on the eastern side of the state, within the boundaries of the National Forest System.

The project area is approximately 100 acres in size and is situated in a rural area with some agricultural land nearby.

For inspection purposes only.  
Consent of copyright owner required for any other use.





**BMA Geoservices**  
Ground Engineering Consultants  
Cobhaisíocht Ceilínneach

BMA,  
Strawhall Business Park,  
Athy Road,  
Carrow,  
Ireland.

Phone: 353-503-34488  
Mobile: 087-8165910  
Fax: 353-503-34480  
E-mail: kgalvin@bma.ie

**M. C. O'Sullivan & Co. Ltd.**

**Corranure Landfill - Geological and Hydrogeological Study**

**Map 1 Site Location and Regional Geology**

**Client:** M. C. O'Sullivan & Co. Ltd.

**Job:** Corranure Landfill - Geological and Hydrogeological Study

**Draw No:** 1229/Map 1

**Scale:** 1:500

**Date:** Aug 2003

**Drawn by:** Kevin Galvin

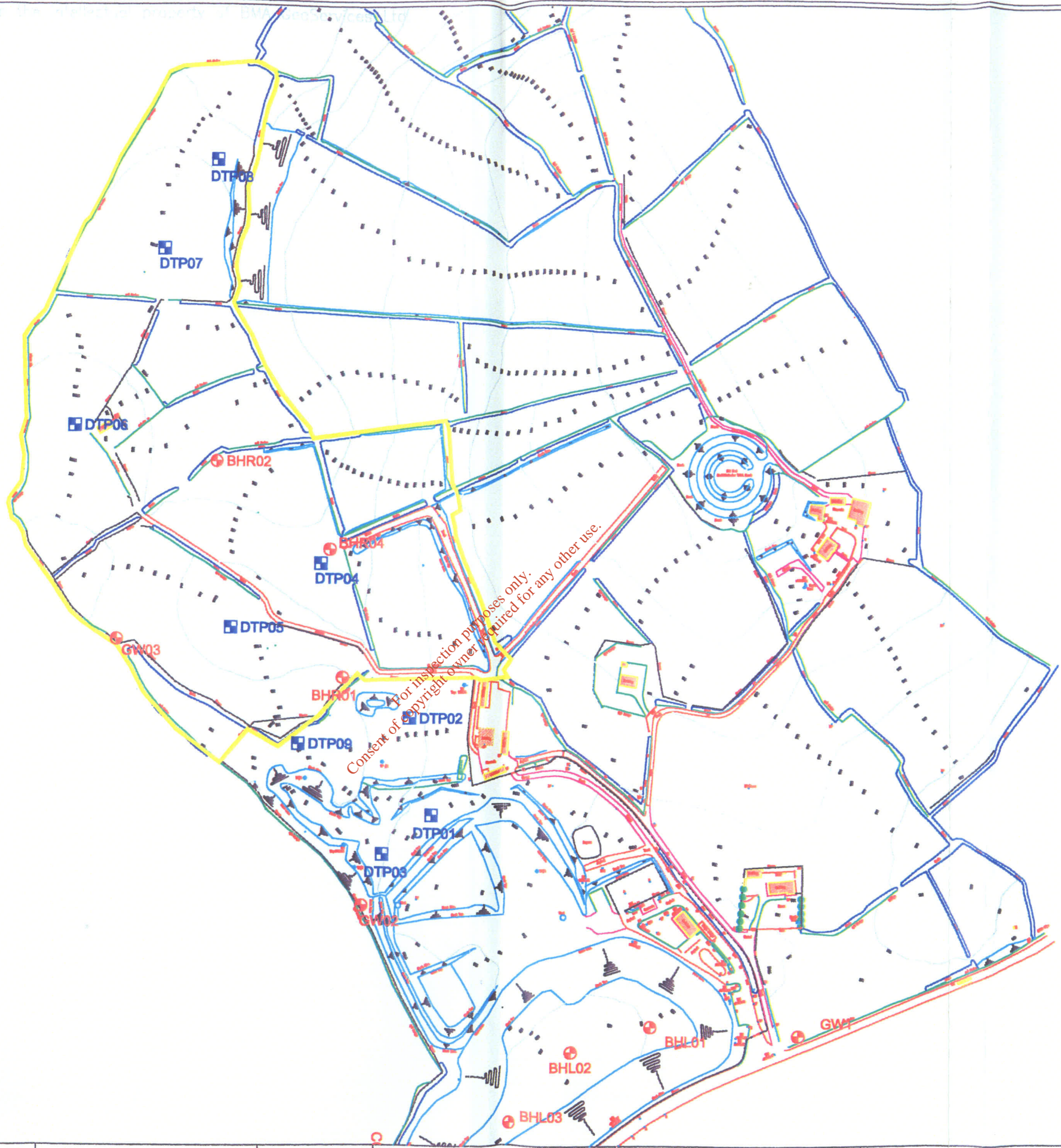
**Checked by:** Davida Gallazzi

**Drawn by:** David O'R



For inspection purposes only.  
Consent of copyright owner required for any other use.





- Legend**
- DTP07 Trial Pit
  - GW03 Borehole

**BMA GeoServices**  
 Ground Engineering Consultants  
 Comhairleoirí Crí-Innealtóireachta

BMA,  
 Strawhall Business Park,  
 Athy Road,  
 Carlow,  
 Ireland.

Phone: 353-503-34488  
 Mobile: 087-2477823  
 Fax: 353-503-34480  
 E-mail: bmacarlow@bma.ie

Notes:

Revision Details	Issue	By	Date	Rev

Drawn: Kevin Galvin	Title: MAP 2 BOREHOLES AND TRIAL PITS LOCATIONS
Scale: not to scale	Job: CORRANURE LANDFILL-GEOLOGICAL AND HYDROGEOLOGICAL STUDY
Date: Aug 2003	Client: M.C. O'SULLIVAN & CO. LTD.
Checked: Davide Galazzi	
Issued On:	



**BMA GeoServices**  
 Ground Engineering Consultants  
 Comhairleoirí Crí-Innealtóireachta

BMA,  
 Strawhall Business Park,  
 Athy Road,  
 Carlow,  
 Ireland.

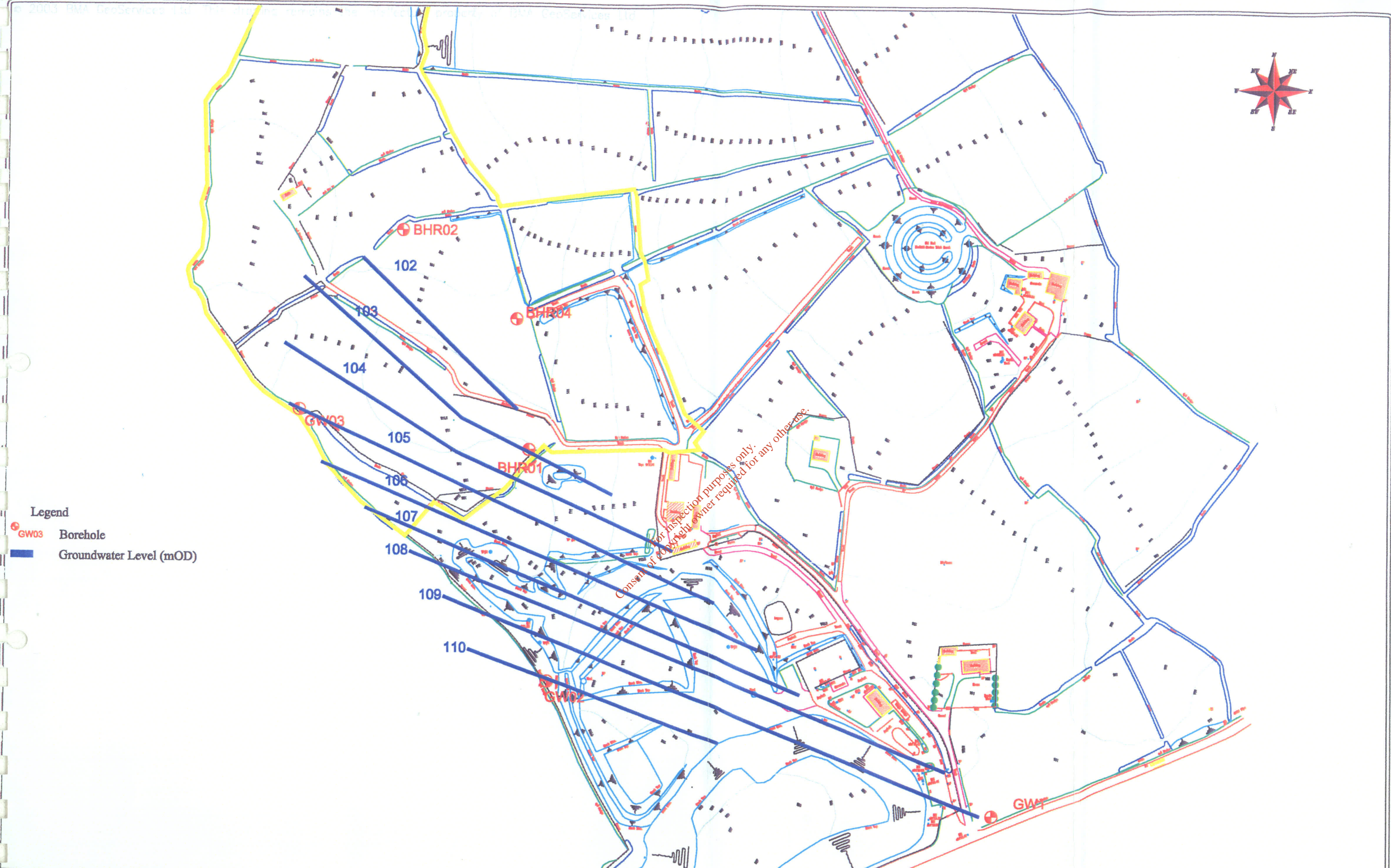
Phone: 353-503-34488  
 Mobile: 087-8165610  
 Fax: 353-503-34480  
 E-mail: bmacarlow@bma.ie

**BMA GeoServices**  
 Ground Engineering Consultants  
 Comhairleoirí Crí-Innealtóireachta

BMA,  
 Strawhall Business Park,  
 Athy Road,  
 Carlow,  
 Ireland.

Phone: 353-503-34488  
 Mobile: 087-8165610  
 Fax: 353-503-34480  
 E-mail: bmacarlow@bma.ie





**BMA GeoServices**  
**Ground Engineering Consultants**  
 Comhairleoir Cré-Innealtóireachta

BMA,  
 Strawhall Business Park,  
 Athy Road,  
 Carlow,  
 Ireland.

Phone: 353-503-34488  
 Mobile: 087-2477823  
 Fax: 353-503-34490  
 E-mail: bmacarlow@bma.ie

Notes:

Revision Details	Issue	By	Date	Rev

Drawn: Davide Galluzzi  
 Scale: 1/2500  
 Date: Aug 2003  
 Checked: Davide Galluzzi  
 Issued On:

**MAP 3**  
**Piezometric Surface in Bedrock**

**JOB:**  
**CORRANURE**  
**LANDFILL-GEOLOGICAL**  
**AND HYDROGEOLOGICAL**  
**STUDY**

**Client:**  
**M.C. O'SULLIVAN & CO.**  
**LTD.**

**BMA GeoServices**  
**Ground Engineering Consultants**  
 Comhairleoir Cré-Innealtóireachta

BMA,  
 Strawhall Business Park,  
 Athy Road,  
 Carlow,  
 Ireland.

Phone: 353-503-34488  
 Mobile: 087-8165810  
 Fax: 353-503-34490  
 E-mail: bmacarlow@bma.ie

**A  
P  
P  
E  
N  
D  
I  
X  
  
A**

*For inspection purposes only.  
Consent of copyright owner required for any other use.*