Appendix I

Tier 1 Study

Ballymulvey Landfill

Datagap Analysis & Tier 1 Assessment

Longford County Council

Project number: 60549441

27 September 2017

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Quality Information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position
01	11/09/2017	Issue 1 Draft	Y	Clare Glanville	Project Director
02	27/09/2017	Issue 2 Final	Y	Clare Glanville	Project Director

Distribution List

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0	1	Longford County Council

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1. Introduction

1.1 General Introduction

AECOM Ireland Limited (AECOM) is pleased to present this report to Longford County Council (LCC) detailing a datagap analysis and Tier 1 risk assessment of an unregulated former waste disposal site in Ballymahon, Co. Longford. This report has been prepared in accordance with AECOM proposal reference OPP-644585, dated 09 May 2017; and authorised by Mr Bernard Shea, Senior Executive Engineer, Environment Section, LCC, under purchase order number 400144546.

1.2 Background

LCC identified a former unregulated waste disposal area to the northeast of Ballymahon, Co. Longford, known as Ballymulvey Landfill, see Appendix A Figure 1. Under waste management regulations[1], LCC is required to complete a risk assessment of unregulated waste disposal sites.

The Environmental Protection Agency (EPA) prepared a code of practice[2] to assist local authorities in meeting the requirements of waste management regulations with regard to unregulated landfill sites. The code of practice outlines a staged process with three tiers of assessment. Once the risk assessment and, if necessary, remediation have been completed to the satisfaction of the EPA an application can be made for the granting of a *Certification of Authorisation* to demonstrate compliance with the regulations.

The first stage, a Tier 1 Assessment, comprises the following:

- Development of a conceptual site model (CSM);
- Identification of contaminant sources, pathways of contaminant migration and potential receptors which may be vulnerable if exposed to those contaminants; i.e. the identification of Source-Pathway-Receptor (SPR) linkages; and
- The prioritisation of sites and SPR linkages based on their perceived risk.

It is understood that Ballymulvey Landfill is registered as an unregulated landfill with the EPA (Section 22 register) and that a Tier 1 risk rating was supplied by LCC. However, there does not appear to be a record of a Tier 1 risk assessment report on file with the Local Authority. The Section 22 registered risk category was classified as low, C[3]. Based on this classification, subsequent tiers of assessment have not been completed and no application for a Certificate of Authorisation has been submitted to the EPA.

1.3 Objective

The objective of this project was to complete a gap anaylsis of existing LCC data, complete a Tier 1 risk assessment and to assess whether additional tiers of assessment are required in order to submit an application to the EPA for a Certificate of Authorisation for the Ballymulvey Landfill.

1.4 Scope of Works

The scope of works completed was developed with reference to the EPA code of practice (COP) for the assessment of unregulated waste disposal sites. It comprised three main tasks:

- Task 1 – Desk Study and Document Review;
- Task 2 – Site Walkover; and
- Task 3 – Datagap Identification and Tier 1 Reporting.

[1] Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations 2008, S.I. No. 524 of 2008
[2] Environmental Protection Agency, Code of Practice Environmental for Unregulated Waste Disposal Sites, 2007,
[3] Eastern-Midlands Regional Waste Management Plan, Appendix F, http://emwr.ie/download-the-eastern-midlands-regional-waste-management-plan

1.4.1 Task 1 – Desk Study and Document Review

AECOM received an archive of available information relating to the Ballymulvey Landfill from LCC. However, given the age of the site (it is understood to have begun accepting waste in the 1960s and to have ceased in the 1990s), there was no documentary evidence available with regard to the composition and volumes of waste accepted by the site. In addition, no former employees who may have worked at the landfill were available for consultation.

A database of monitoring data, in the form of Excel™ workbooks, was provided by LCC with data for landfill gas, surface water, leachate and groundwater collated between 1992 and 2014. In addition, some monitoring reports for that period were provided in electronic format.

Public sources of information were also consulted, including:

- Ordnance Survey of Ireland (OSI), www.osi.ie
- Geological Survey of Ireland (GSI), www.gsi.ie
- EPA, http://gis.epa.ie/Envision
- Office of Public Works (OPW), http://www.opw.ie/hydro/index.asp?mpg=main.asp
- Water Maps, http://watermaps.wfdireland.ie/
- EPA Hydrometric Data System, http://193.1.208.39/HydroTool/Default.aspx
- National Parks and Wildlife Services, http://webgis.npws.ie/npwsviewer/

1.4.2 Task 2 – Site Walkover

A site walkover was conducted on 20 July 2017 by an AECOM Principal Consultant in the presence of LCC personnel. During the walkover, the following tasks were undertaken:

- Visually inspect the site setting and adjacent land-use;
- Photograph relevant site features;
- Inspect accessible groundwater/leachate/gas monitoring points;
- Inspect surrounding drains/streams for evidence of environmental stress resulting from leachate discharge from the landfill; and
- Examine waste exposures if present to assess the types of waste buried at the site.

Observations were also made regarding access constraints in case of a requirement for a Tier 2 intrusive site investigation.

1.4.3 Task 3 – Datagap Identification and Tier 1 Reporting

On completion of Tasks 1 and 2, AECOM has prepared this Tier 1 report outlining the findings of the document review and site walkover including any identified datagaps. Based on these findings a CSM has been completed in line with the EPA's COP developed under the following headings:

- Contaminant sources;
- Groundwater vulnerability, flow regime and aquifer category;
- Potential leachate and landfill gas migration pathways; and
- Receptors (human and environmental).

On completion of the CSM, risk screening and site prioritisation has been carried out using the scoring system outlined in Chapter 4 of the EPA COP and the site has been categorised according to the following risk classes:

- Highest Risk (Class A);
- Moderate Risk (Class B); and
- Lowest Risk (Class C).

This report also identifies whether the previous assessment of viable SPR linkages remains valid and if the low 'C' classification assigned continues to be appropriate for the identified risks.

The report also recommends whether a Tier 2 Assessment, incorporating site investigation and testing, is required in order for LCC to be in a position to submit an application to the EPA for a Certificate of Authorisation.

2. Desk Study and Document Review

2.1 Site Setting

Location The site is located in Ballymulvey, approximately 1.5 km north-east of Ballymahon, Co. Longford, see Appendix A Figure 1. The site is situated on the south-western side of the L1121 roadway, with access to the site through a locked gateway 250 m from its junction with the N55 road to the north-west, Toome Cross Roads.

Surrounding Landuse The area immediately surrounding the site is predominantly agricultural with some low density residential housing (one-off housing developments). The closest house to the site is a bungalow 150 m to the north-west, on the opposite side of the L1121. The next closest dwelling is a farm house, 200 m south-east of the site, also on the opposite side of the L1121. The Antley Industrial Estate is located approximately 400 m west of the site on either side of the N55. Development consists of low density commercial warehousing, retailers and hauliers.

Land immediately south of the site is undeveloped bog and woodland with agricultural land further south between the site and the River Inny. Cloonkeen Woods are located 500 m south-east of the site, on the north-eastern side of L1121. The south-eastern boundary of Cloonkeen Woods is formed by the River Inny with Newcastle Woods further south-east of the river.

Surface Water The River Inny flows from north-east to south-west along the south-eastern boundary of Cloonkeen Woods. Approximately 1.5 km south-east of the site the flow direction of the River Inny changes course to a more westerly direction, and the river passes through Ballymahon 1.6 km south-west of the site. Approximately 350 m north-west of the site is the Royal Canal, Toome Bridge.

The EPA has classified the River Inny as being of Good Status (Q4) at the following monitoring locations:

- Newcastle Bridge, RS2610112000 1.5 km south-east of the site, based on data from 2004 to 2016
- Ballymahon Bridge, RS26101300 1.6 km south-west of the site, based on date prior to 2004
- Shrule Bridge, RS261011350 4 km south-west of the site, based on data from 2004 to 2016

The River Inny is not used for public water supply purposes down-gradient of the site.

An unnamed tributary of the River Inny, flowing from north to south, is mapped along the N55 approximately 700 m west of the site. Several land drains are also mapped between the site and this tributary which appear to feed into it.

There is no record of a flood event within 1.5 km of the site. However, stretches of the River Inny to the south-west of Ballymahon have been known to flood. In 2009 Longford, including areas around Ballymahon, suffered a one in 50 year flood which caused considerable damage to residential and commercial properties but this did not affect the site.

Topography Outside of the site, the area is generally quite flat, undulating between 50 m and 60 m above Ordnance Datum (OD). There is a gentle topographic gradient from north/north-east to south/south-west, generally towards the River Inny to the south of the site.

Geology Bedrock beneath the site is Waulsortian Limestone – massive, unbedded, pale grey limestone and mudstone of the Carboniferous era. The closest outcrop of bedrock to the site is 1 km to the west at Ballybranigan. A well record for the townland of Ballymulvey indicates that the depth to bedrock at that location was 0.6 m.

Overlying limestone beneath the site and land to the south-east, on the south-western side of the L1121, is cut-away raised bog; with limestone gravel to the north of the L1121 and in zones to the south of the site. To the west, overburden is comprised of glacial till with sandstone gravel.

Hydrogeology Bedrock is classified as a locally important aquifer which is moderately productive in local zones. Vulnerability of groundwater to contamination is also classified as moderate. The single well record in the vicinity of the site indicates that the well dates from the nineteenth century and was drilled to a depth of 19.2 m below ground level. The abstraction rate is not noted and, given its age and its location between 150 m and 1.15 km south of the site, it is considered likely that it was for domestic/agricultural use. Whether the well remains in use or not is not recorded. There are no zones of contribution for a groundwater sourced public or group water scheme within a 10 km radius of the site.

Based on the topography and surface water features in the area, the direction of groundwater flow is considered to be to the south/south-west, towards the River Inny.

Groundwater beneath the site and in the general area is classified as a being of good status and a protected area for drinking water supply.

SAC/SPA There are no Special Areas of Conservation or Special Protection Areas within a 5 km radius of the site.

Licensed Sites There are no EPA licensed facilities within a 5 km radius of the site.

2.2 Historical Development

Prior to the site's use as a landfill it appears to have been undeveloped or used for agricultural purposes. The 6" historical map (1837 – 1842) indicates that the site was undeveloped at that time. A thick hedgerow is mapped along the north-east border of the site with the L1121 road, and the Royal Canal is present to the north-west, beyond Toome Cross Roads.

The later (1888-1913) 25'' historical map indicates that the site is boggy and several land drains appear to have been installed, particularly across bogland to the east/south-east of the site. A gravel pit is evident approximately 150 m north-east of the site. The thick hedgerow was still present along the roadside boundary. A spring is mapped to the north-west of Toome Cross Roads, approximately 400 m north west of the site.

It is understood that the site began operation as a landfill sometime in the mid-1960s and ceased sometime in the mid-1990s, following a High Court Order. Despite the lack of written records, it is understood that the site accepted municipal waste/domestic refuse, but no chemical/hazardous waste; although, asbestos containing material (ACM) was accepted and deposited in a discrete area of the landfill (see Appendix A Figure 2, and Appendix B site plans F061-01 A and F061-02 B).

From the limited records that are available, it appears that the ACM waste originated from Lanesborough Power Station, located 20 km north-west of the site. The ACM waste was accepted on site between 22 and 27 July 1987 and was brought to site double-bagged and marked as *Danger Asbestos* and *Do not Inhale*.

A discrete hole was excavated a distance of 75 m in from the roadside boundary and 10 m in from the north-western boundary fence. The excavation was 19 m in length (parallel to the L1121) and 4 m in width (parallel to the boundary fence). Records indicate that 6' (~1.8 m) of double-bagged ACM waste was buried beneath 2' to 3' (~0.6 to 1 m) of sand, with an additional 3' to 4' (~1.2 m) layer of refuse above this. When initially deposited on site the total cover was ~1.8 m at the end of the day, with the final cover between 3 m to 3.7 m in thickness.

From available maps it is estimated that the site as a whole is approximately 4.3 ha in area, with 50% of the site occupied by the waste body.

In the 1995 aerial photograph the site appears to be active with a small access road from the L1121 visible. Most activity appears to be in the eastern quadrant of the site. There does not appear to be any structure or building present.

Two site maps dating from May 1997 are included in Appendix B. The first, F061-01 A, illustrates that existing site layout at that time, while the second illustrates how it was proposed to completed the landfill following closure and capping.

The site plan for its existing condition in 1997 indicates that waste was deposited into three separate cells:

- Cell 1 in the eastern quadrant
- Cell 2 to the south-west of Cell 1
- Cell 3 running from north-east to south-west inside the north-western site boundary, it was in this cell that the ACM waste was disposed

The map indicates that there were several sheds/huts close to the access gate but that they had been demolished. No gas, leachate or surface water monitoring points are indicated, but several borehole markers are noted which could indicate the presence of groundwater monitoring wells. A lagoon is present in the southern portion of the site.

The second map, F061-02 B, illustrates how the waste body was to be capped and the top profiled to form two separate mounds, one either side of the entrance gate running north-east to south-west. The eastern mound (Bund 1 on the map, encompassing Cells 1 and 2) was to have a domed profile with a crest height of 62 m above OD, while the western mound (Bund 2, encompassing Cell 3 in which the ACM waste was deposited) was to have a crest height of 60 m above OD. The sides of the mounds were designed with sloped sides with gradients of between 1:4 and 1:3; elevations of natural ground outside of the waste body are mapped as being between 53 m and 55 m above OD.

According to drawing F061-05 in Appendix B, it was proposed that the cap consist of 0.7 m of impermeable material, overlain by 0.6 m of subsoil and topped with 0.15 m of top soil, to be seeded.

Within each mound a series of gas trenches and vents were to be installed. In addition, the map indicates a series of land drains draining to the toe-drain around the perimeter of the waste body. In the southern part of the site is a lagoon and around the perimeter of the site as a whole is a cut-off drain. Along the north-eastern site boundary with the L1121 roadway it is indicated that the cut-off drain was to be filled with stone while on the other three sides it appears that the cut-off drain was to remain open.

The aerial photograph from 2000 indicates that the site is in the process of being capped and profiled, the small access road from the L1121 is no longer visible.

A third site plan included in Appendix B, BLS-01, dates from 2001 and illustrates the as built condition of the site following reinstatement. It is broadly consistent with the proposed drawing from 1997 with some differences. The crest heights are slightly higher than those proposed; Bund 1 is completed at 61 m above OD while Bund 2 is 63 m above OD. A network of stone filled gas trenches are illustrated with six passive vents (1 to 6) and four gas monitoring points (G4 to G7). However, no stone filled leachate drains or toe-drain are illustrated. Two leachate monitoring points within the waste body are present, BH5 and BH6.

The 2005 aerial photograph shows the profiled cap to be covered in vegetation. In the aerial photographs no open water is visible in the lagoon area, it appears to be vegetated. In none of the aerial photographs are structures or buildings apparent.

2.3 Monitoring Results

From the database of monitoring data provided the site monitored landfill gas, leachate, surface water and groundwater. A summary of results is provided in Appendix C with known locations illustrated in Appendix A Figures 2 and 3.

2.3.1 Landfill Gas Monitoring

Monitoring appears to have been conducted annually in 2002 and 2003 with two rounds of monitoring conducted in 2004 and one round in 2005 (see Appendix C Table 1). Limited gas monitoring was

completed in 2005 as only four monitoring points could be located. It is noted in the monitoring report that other monitoring locations had been overgrown with grass and could not be located.

From the data it appears that there were seven landfill gas monitoring points installed, G1 to G7. Of these, G4, G5, G6 and G7 were installed within the waste body and G3 was installed to the south of the lagoon (Appendix B drawing BLS-01); however, the locations of G1, G2 and G4 are not clear. Gas monitoring also appears to have been conducted from BH1, BH2, BH3, BH5 and BH6, which are groundwater or leachate monitoring wells.

Generally methane was below detection limits or detected at 0.1%. It is only in landfill gas from G7 and BH5 that higher concentrations of methane were detected. The methane concentrations decreased over time.

Table 1. Summary of Methane Detections

Monitoring Point	Sep-2002	Oct-2003	May-2004	Nov-2004	2005
G7	1.9%	1.1%	0.1%	0.1%	0.1%
BH5	22.5%	10.9%	0.1%	0.1%	0.1%

The presence of methane indicates that putrescible material within the waste was decomposing but, within a relatively short period of time following capping, methane concentrations had declined to 0.1% or less.

2.3.2 Leachate Monitoring

There are two leachate monitoring wells within the waste body, BH5 and BH6. Monitoring data are available from 2002 through to 2014. The frequency of monitoring varied from year to year; in some years, such as 2003, one monitoring event was conducted; while in other years, such as 2005, four monitoring rounds were conducted. Available results are presented in Appendix C Table 2.

The monitoring suite varied over time but generally included: chemical and biological oxygen demand (COD and BOD), ammonia, total organic carbon, chloride, potassium, sodium and selected metals.

Results for selected parameters have been graphed in Appendix C to highlight changes in leachate chemistry over time. There is a consistent pattern to be seen in the parameters. Generally, higher and more variable results are seen up to 2008/2010, with results after 2010 generally lower and more consistent.

2.3.3 Groundwater Monitoring

Groundwater monitoring was conducted from a network of three monitoring wells: BH1, BH2 and BH3; between 2002 and 2014. Similarly to leachate monitoring, the frequency of sampling in any given year varied. The analytical suite was similar to that for leachate but did not include COD or BOD. Results are tabulated in Appendix C Table 3, with trends for selected parameters graphed.

Unlike leachate results, there is not such a clear distinction between elevated and variable results pre-2008/2010 and lower more consistent data post-2010. There is, however, one exception to this, total organic carbon (TOC). Early TOC results for all three wells were generally above 20 mg/L (and up to 87 mg/L), while later results were less than 20 mg/L.

However, for many parameters which are indicators of landfill sourced contamination, concentrations in groundwater are generally an order of magnitude lower than in leachate.

Table 2. Groundwater and Leachate Comparison

	Conductivity, µS/cm	Ammonia as N, mg/L	Total Organic Carbon, mg/L	Chloride, mg/L	Potassium, mg/L	Sodium, mg/L
Groundwater						
BH1 Average	1535	33	23	34	20	24
BH2 Average	1007	12	17	26	10	18
BH3 Average	1137	15	21	95	30	72
Leachate						
BH5 Average	11590	373	55	716	159	510
BH6 Average	8536	1022	411	5408	734	3929

2.3.4 Surface Water Monitoring – On-Site

Results for surface water monitoring conducted between 2002 and 2014 for five on-site monitoring points (SS1 to SS5) are presented in Appendix C Table 4. The frequency of monitoring was variable but this was due to some monitoring locations being periodically dry. The analytical suite was similar to that for groundwater and leachate samples, including COD and BOD, but also included suspended solids and orthophosphate.

Trends for selected parameters are graphed in Appendix C. Unlike for leachate results, there are no clear trends apparent, results for many parameters are quite variable. For any given parameter the highest results tend to be detected in SS3 from the lagoon.

2.3.5 Surface Water Monitoring – Off-Site

There is an extensive network of off-site surface water monitoring points (A to P), results for which are tabulated in Appendix C Table 5. Initial monitoring was intermittent between 1992 and 2002 with the monitoring frequency increasing after 2002 but dependent on whether locations were dry.

Trends for selected parameters are graphed and indicate that results were generally higher in the early/mid-1990s when the landfill would have been operational than following closure and capping.

Sampling locations A, B, C, M and L were on drains in close vicinity of the site, see Appendix A Figure 3; locations A and L were not sampled after 2002. Sample location K was on a drain/stream to the south-east of the site, and was sampled up to 2014. Sample locations D, E, F, and G were on drains/stream to the west of the site that feed into the River Inny and were sampled up to 2014. Sample locations H and J are on the River Inny to the south-west of the site, up-stream and down-stream of its confluence with the tributary, they were sampled up to 2014. It is not known where monitoring points N, O and P were in relation to the site.

Changes in surface water quality are evident when results are considered in relation to their distance from the site. There is a general trend for concentrations of the following to decrease with distance from the site: COD, BOD, suspended solids, chloride and ortho-phosphate; electrical conductivity also decreases with distance from the site. A further indication that surface water quality improves with distance from the site is that dissolved oxygen concentrations increase. However, it should be borne in mind that the surface water bodies close to the site are little more than land drains with limited flow and poor/variable water quality would not be unexpected.

Table 3. Average Surface water Monitoring Results, 1992 - 2014

	Conductivity, µS/cm	Dissolved Oxygen, mg/L	Chemical Oxygen Demand, mg/L	Biological Oxygen Demand, mg/L	Suspended Solids, mg/L	Ammonia (N), mg/L	Nitrate (NO_3), mg/L	Chloride, mg/L	Ortho-phosphate, mg/L
On Site Monitoring Points									
SS1	2055	3.8	76	9	14	24	7.9	172	0.17
SS2	682	4.7	96	4	6	0	1.3	28	0.03
SS3	12890	4.2	275	15	70	315	4.4	1059	1.21
SS4	718	4.1	118	15	86	31	1.7	79	0.04
SS5	1208	4.1	78	6	11	1	2.7	192	0.09
Off-Site Monitoring Points, Close to Site									
M	499	4.6	163	12	11	2.5	3.6	32	0.12
B	616	3.7	729	17	128	12	2.8	66	0.79
C	1201	3.9	143	16	84	18	5.3	152	1.2
D	815	5.8	57	4	11	2.1	1.7	37	0.09
E	1067	6.8	163	9	80	8.0	3.0	128	0.49
Off-Site Monitoring Points, Far from Site									
F	1015	6.5	41	2	33	0.20	1.9	91	0.064
G	676	11	19	1	6	0.14	2.6	25	0.037
K	635	6.4	33	3	50	0.15	1.3	8	0.10
Off-Site Monitoring Points, Farthest from Site									
H	566	10.1	20	1	5	0.067	1.8	16	0.044
J	475	10.1	21	1	7	0.054	1.5	13	0.048

3. Site Walkover

A photographic log from the site walkover is included in Appendix D.

The site is currently unused with access is through a locked gate from the L1121 roadway. There are no buildings on the site and there appear to be no services to the site in the form of electricity, sanitation or water.

The appearance of the site is consistent with that indicated in the as built layout map from 2001:

- There are two mounds to either side of the entrance gate which are grass covered (photographs 1 and 11);
- There is a slight valley between the mounds through the centre of the site and slopes are evenly graded on all sides (photographs 2 and 3); and
- The southern portion of the site is very overgrown with small trees and scrub, the lagoon is present with abundant reed growth (photographs 4 and 9), hence the vegetated appearance in aerial photographs.

Several open standpipes are present across the waste mound. Some locations appear to be coincident with landfill or leachate monitoring points illustrated on the 2001 site plan, see Appendix A Figure 2 and Appendix B drawing BLS-01; it is understood that gas monitoring points consist of large diameter metal standpipes while leachate monitoring points consist of plastic (black HDPE) standpipe (photographs 5, 6 ,7, 10 and 12).

There is a small concrete structure between Bund 1 and the lagoon. It is not known what this structure was used for but there is no evidence of staining which could indicate the burning of waste or storage of chemicals (photograph 8).

The walkover survey checklist is summarised below.

Table 4. Site Walkover Checklist

Information	Checked	Comment
What is the current landuse?	Yes	The site is unused, no evidence of any activity on site; mounds over the waste body are covered in grass and evidence that deer access the site was observed, they possibly use it for grazing. The lagoon, in the southern portion of the site, is overgrown with reeds.
What are the neighbouring landuses?	Yes	Predominantly low intensity agriculture, with some one-off housing within 300 m of the site, across-gradient to the north-west and south-east. Land to the south of the site is boggy woodland with bog also present to the east/south-east.
What is the size of the site?	Yes	4.3 ha, ~180 m x ~240 m, waste body occupies approximately 50% of the site.
What is the topography?	Yes	Undulating, general topographic gradient of the area as a whole is from north/north-east to south/south-west, the overall gradient is gentle. Within the site, the waste body is divided into two mounds with maximum heights between 61 m and 63 m above OD. Ground elevation outside of the waste body is between 53 m and 56 m above OD.
Are there potential receptors?	Yes	
Houses		Residence 150 m north-west, across-gradient Residence 180 m north, up-gradient Farmhouse 200 m south-east, across-gradient Residence 400 m west, across-gradient Farmhouses (3) 550 m south, down-gradient

Information	Checked	Comment
Surface water features		Lagoon in the southern portion of the site; abundant reed growth within the lagoon. Cut-off drain around the perimeter of the site. South-westerly flow was observed in the cut-off drain along the north-western site boundary. There was very little/no flow in the cut-off drain along the south-western and south-eastern site boundaries; there could be overflow/seepage from the lagoon southwards to the cut-off drain. Seepage from the perimeter cut-off drain south/south-westwards across boggy woodland was observed. Further south, maps indicate that there are land-drains across agricultural land/bog to the north-west and south-east. It appears that these land-drains feed into a tributary of the River Inny, 700 m west of the site. Land-drains are mapped east and west of the site, no open land-drains were observed at these locations during the site walkover. Land to the east was waterlogged bog.
Wetland or protected areas		Land to the south of the site is boggy woodland, with bog also present to the east. The bog is described on some maps as cut-away, however no cutting faces were observed, the bog was covered in heather, it is not a designated protected area. There is no NHA/SPA/SAC within a 5 km radius of the site.
Public water supplies		None.
Private water supplies		Potentially; well records indicate a well from the nineteenth century located between 150 m and 1.15 km south of the site, not known if it is still in use.
Services		None, overhead electricity/telecom cables along the roadway.
Other buildings		None; small structure on site between Bund 1 and the lagoon, not clear what function this structure served.
Any potential sources of contamination?	Yes	
Surface waste		None observed.
Surface ponding of leachate		None observed.
Leachate seepage		None observed.
Landfill gas odours		None observed.
Any outfalls to the surface water?	Yes	Standing water level in the perimeter cut-off drain and lagoon was observed to be very high (at ground level); potential for overflow/seepage from lagoon to cut-off drain. Seepage southwards/south-westwards from cut-off drain to boggy woodland south of the site was observed.
Are there any signs of impact on the environment?	Yes	
Vegetation die off, bare ground		No sign of vegetative stress across the site, outside the perimeter cut-off drain or around the lagoon.
Leachate seepages		None observed.
Odours		None observed.
Litter		None observed.
Gas bubbling through water		None observed.

Information	Checked	Comment
Signs of settlement, subsidence, water logged areas		No signs of settlement or subsidence. No waterlogged areas across the waste mounds. Waterlogged areas around the lagoon, boggy woodland and bog, this is consistent with land surrounding the site being mapped as bog/cut-away bog and marsh on maps dating back to 1888-1913.
Drainage or hydraulic issues		Standing water level in the perimeter cut-off drain and lagoon was observed to be very high (at ground level); potential for overflow/seepage from lagoon to cut-off drain. Seepage southwards/south-westwards from cut-off drain to boggy woodland south of the site was observed.
Downstream water quality appears poorer than upstream water quality		Monitoring results up to 2014 indicate that surface water quality improves with distance from the site. Water quality in the River Inny from upstream and downstream of the site is classified as good (Q4).
Are there any indications of remedial measures?	Yes	
Capping		The waste mounds have been capped with a soil cap, the thickness of which is reported as: 150 mm of top soil seeded with grass 600 mm of subsoil 700 mm of impermeable material
Landfill gas collection		The 2001 post-capping site layout indicates the presence of a network of gas trenches in both waste mounds. Gas vents are also mapped at the top of the waste mounds. The gas vents (numbered 1 to 4 and 6 on the 2001 drawing, Appendix B) are separate to the gas monitoring points (numbered G3 to G7, Appendix B Figure BLS-01). Several gas monitoring points were observed during the site walkover, no vents were observed. Any vents which were installed were passive rather than actively flared vents. The last round of gas monitoring was conducted in 2005 and little to no methane was detected.
Leachate collection		A series of gravel filled land-drains within the waste mounds draining to a toe-drain around the perimeter of the landfill. Not clear to where leachate in the toe-drain discharges.
Describe fences and security features?	Yes	Along the site boundary with the L1121 roadway is a 2 m chain link fence with concrete posts, a laurel hedge grows along the length of the roadside boundary. Access is through double gates onto the L1121 which are padlocked. Around the other three sides of the site, the boundary is a 1.2 m chain link fence with concrete posts. There is access via a stile across the fence between the site and the field in the west. The open cut-off drain runs inside the perimeter fence.

4. Preliminary Conceptual Site Model

A preliminary conceptual site model (CSM) identifies the possible sources (S), pathways (P) and receptors (R). Based on the available information, the following preliminary conceptual site model has been derived from information obtained during the desk study, site walkover and information provided by Longford County Council.

The possible SPR combinations have been assigned numbers, SPR1 to SPR11, as outlined in the COP and these SPR numbers are highlighted in the preliminary CSM summary table below. A schematic diagram of the CSM is presented in Appendix A Figure 4.

Table 5. Preliminary Conceptual Site Model

Sources	Pathways	Receptors
Leachate	Migration vertically downwards through subsoil into the aquifer, then migration horizontally (flow regime / direction) and discharges to the local drainage system.	**Surface Water Body SPR1** Drains around the site which feed into an unnamed tributary of the River Inny. *Protected Area (Surface Water Dependent Terrestrial Ecosystem SWDTE) SPR2* N/A Lagoon immediately south and cutaway bog to the south and south-east of the landfill, but neither is a designated NHA, SPA, or SAC. No designated area within a 1 km radius of the site.
	Migration vertically downwards and horizontally through bedrock.	**Human Presence (Private Well) SPR3** There are houses within 200 m up-gradient of the landfill and >500 m downgradient. *Protected Area (Groundwater Dependent Terrestrial Ecosystem GWDTE) SPR4* N/A No GWDTE with a 1 km radius of the site. **Aquifer Category SPR5** Bedrock Aquifer is classified as a locally important aquifer which is moderately productive in local zones and moderately vulnerable to contamination. *Public Supply (Well) SPR6* N/A No public supply well within a 1 km radius of the site. **Surface Water Body SPR7** Drains around the site which feed into an unnamed tributary of the River Inny. At its closest point the River Inny is 900 m south of the site. Lagoon immediately south of the waste mounds which may overflow into the cut-off drain to the south.
	Direct runoff to surface water drainage	**Surface Water Body SPR8** Drains around the site which feed into an unnamed tributary of the River Inny. *Protected Area (SWDTE) SPR9* N/A No SWDTE with a 1 km radius of the site.
Landfill Gas	Lateral migration via subsoil, bedrock, underground services or infrastructure	**Human Presence SPR10** There are houses between 150 m and 250 m from the site.
	Vertical migration via subsoil, bedrock, underground services or infrastructure	*Human Presence SPR11* N/A No building built above the waste body.

5. Risk Assessment

5.1 Risk Screening and Prioritisation

Based on the risk assessment methodology outlined in the COP, AECOM has developed a scoring matrix to classify the site according to low, medium and high risk. This will determine what, if any, further steps are required to manage potential environmental impacts at the site.

The potential risk of leachate and gas migration is assessed in the screening process which considers: waste type and quantity; 5 key potential pathways; and 6 key potential receptors. Individual scores are assigned for each and used in appropriate equations to determine a total score for each SPR linkage, see Table 19. The overall site score is the maximum of the individual normalised SPR scores, and this can be used to place the facility into an appropriate Risk Category as follows:

- High Risk Score ≥70%
- Medium Risk Score = 40% to 70%

- Low Risk Score ≤40%

Once this has been completed, the site can then proceed through the relevant steps of the COP that are considered appropriate for that Risk Category.

5.2 Source Risk Screening

The composition, size and age of the waste body are taken into account in assessing its significance as a source of leachate and landfill gas. As a worst case scenario, the highest score is taken into account.

Table 6. Leachate Source/Hazard Scoring Matrix – 1a

Waste Type	Waste Footprint			Comments
	≤1 ha	>1 ha to ≤5 ha	>5 ha	
Construction and demolition (C&D)	0.5	**1**	1.5	The waste body occupies ~50% of the 4.3 ha site. Predominantly municipal waste accepted but also some ACM containing C&D waste. Waste was accepted between 1960s and early/mid-1990s.
Municipal	5	**7**	10	
Industrial	5	7	10	
Pre-1977	1	2	3	
			1a Score	**7**

Table 7. Landfill Gas Source/Hazard Scoring Matrix – 1b

Waste Type	Waste Footprint			Comments
	≤1 ha	>1 ha to ≤5 ha	>5 ha	
Construction and demolition (C&D)	0.5	**0.75**	1	The waste body occupies ~50% of the 4.3 ha site. Predominantly municipal waste accepted but also some ACM containing C&D waste. Waste was accepted between 1960s and early/mid-1990s.
Municipal	5	**7**	10	
Industrial	3	5	7	
Pre-1977	0.5	0.75	1	
			1b Score	**7**

5.3 Pathway Risk Screening

Five migration pathways are considered:

- Two related to the migration of leachate to groundwater, horizontal and vertical pathways
- One related to the migration of leachate to surface water
- Two related to landfill gas migration, horizontal and vertical

Table 8. Leachate Migration Pathways – 2a

Groundwater Vulnerability (vertical)	Points	Comments
Vulnerability rating - extreme	3	Vulnerability of groundwater to contamination is classified as moderate
Vulnerability rating - high	2	
Vulnerability rating - moderate	**1**	
Vulnerability rating - low	0.5	
High to low vulnerability	2	
	2a Score	**1**

Table 9. Leachate Migration Pathways – 2b

Groundwater Flow Regime (horizontal)	Points	Comments
Karstified groundwater body (Rk)	5	Bedrock beneath the site is classified as a locally important aquifer which is moderately productive only in local zones (Ll).
Productive fissured groundwater body (Rf and Lm)	3	
Gravel groundwater body (Rg and Lg)	2	
Poorly productive bedrock groundwater Body (Ll, Pl and Pu)	**1**	
	2b Score	**1**

Table 10. Leachate Migration Pathways – 2c

Surface Water Drainage	Points	Comments
Direct connection between drainage ditches associated with the waste body and adjacent surface water body	**2**	The cut-off drain around the perimeter of the site links into land drains to the south, east and west that in turn feed into a tributary of the River Inny. The lagoon immediately south of the waste mounds can potentially overflow into the cut-off drain to the south.
No direct connection	0	
	2c Score	**2**

Table 11. Landfill Gas Migration Pathways – 2d

Landfill Gas Lateral Migration	Points	Comments
Sand and gravel; made ground; urban; karst	3	Soil in the area is a combination of cut-away bog (peat) and till.
Bedrock	2	
All other tills (limestone, sandstone etc. – moderate permeability)	**1.5**	
All Namurian or Irish Sea tills (low permeability)	1	
Clay, alluvium, peat	**1**	
	2d Score	**1.5**

Table 12. Landfill Gas Migration Pathways – 2e

Landfill Gas Vertical (Upwards) Migration	Points	Comments
Sand and gravel; made ground; urban; karst	5	There is no building or enclosed structure above the waste.
Bedrock	3	
All other tills (limestone, sandstone etc. – moderate permeability)	2	
All Namurian or Irish Sea tills (low permeability)	1	
Clay, alluvium, peat	1	
	2e Score	**0**

5.4 Receptor Risk Screening

Five receptors are considered in relation to leachate migration and one in relation to landfill gas migration.

Table 13. Leachate Migration Receptors – 3a

Human Presence	Points	Comments
On, or within 50 m of the waste body	3	Nearest dwelling is 150 m from the site, and several residences are present within 1 km of the site.
Greater than 50 m but less than 250 m	**2**	
Greater than 250 m but less than 1 km	**1**	
Greater than 1 km from the waste body	0	
	3a Score	**2**

Table 14. Leachate Migration Receptors – 3b

Protected Areas	Points	Comments
Within 50 m of the waste body	3	There is no designated area within a 1 km radius of the site.
Greater than 50 m but less than 250 m	2	
Greater than 250 m but less than 1 km	1	The lagoon immediately south of the waste body and boggy woodland further south, have abundant vegetation and are likely home to a variety of fauna; evidence of deer was noted during the site walkover across the waste body.
Greater than 1 km from the waste body	0	
Undesignated site within 50 m from waste body	**1**	
Undesignated site greater than 50 m but less than 250 m	0.5	
Undesignated site greater than 250 m from waste body	0	
	3b Score	**1**

Table 15. Leachate Migration Receptors – 3c

Aquifer Category	Points	Comments
Regionally important aquifer (Rk, Rf and Rg)	5	Bedrock beneath the site is classified as a locally important aquifer which is moderately productive only in local zones (Ll).
Locally important aquifer (Ll, Lm and Lg)	**3**	
Poor aquifers (Pl and Pu)	1	
	3c Score	**3**

Table 16. Leachate Migration Receptors – 3d

Public Water Supplies (other than private wells)	Points	Comments
Within 100 m of site boundary	7	There are no groundwater sourced public water supplies within a 10 km radius of the site.
Greater than 100 m but less than 300 m, or within an inner source protection area for a groundwater supply	5	
Greater than 300 m but less than 1 km, or within an outer source protection area for a groundwater supply	3	The bedrock aquifer is not karstified.
Greater than 1 km (karst aquifer)	3	
Greater than 1 km (no karst aquifer)	**0**	
	3d Score	**0**

Table 17. Leachate Migration Receptors – 3e

Surface Water Category	Points	Comments
Within 50 m of site boundary	**3**	The cut-off drain around the perimeter of the site discharges to land drains which in turn discharge to an unnamed tributary of the River Inny.
Greater than 50 m but less than 250 m	2	
Greater than 250 m but less than 1 km	1	
Greater than 1 km	0	
	3e Score	**3**

Table 18. Landfill Gas Migration Receptors – 3f

Human Presence	Points	Comments
On site or within 50 m of site boundary	5	Nearest dwelling is 150 m from the site.
Greater than 50 m or less than 150 m	3	
Greater than 150 m but less than 250 m	**1**	
Greater than 250 m	0.5	
	3f Score	**1**

5.5 SPR Risk Scores

Each individual SPR Score is derived by applying appropriate equations as outlined in Table 19 below. The individual SPR scores are normalised by dividing the individual SPR score by the maximum possible score for that SPR linkage and multiplying by 100. The overall site score is considered to be the maximum of the individual normalised SPR linkage scores.

Note: The table below represents the Tier 1 risk rating for viable SPR linkages identified in the preliminary CSM outlined in Table 5 for this site. SPR1 to SPR9 represent the leachate risk scores. SPR10 and SPR11 represent Landfill Gas risks. The migration pathways are colour coded as follows:

Leachate: Groundwater and Surface Water	**Leachate:** Groundwater Only	**Leachate:** Surface Water Only	**Landfill Gas:** Lateral and Vertical Migration

Table 19. SPR Risk Scores

SPR	SPR Equation and Linkages	Score	Max Score	% Max SPR
SPR1	1a x (2a + 2b + 2c) x 3e Leachate → Groundwater and Surface Water → Surface Water Body	84	300	28%
SPR3	1a x (2a + 2b) x 3a Leachate → Groundwater → Human Presence	28	240	12%
SPR5	1a x (2a + 2b) x 3c Leachate → Groundwater → Aquifer	42	400	11%
SPR7	1a x (2a + 2b) x 3e Leachate → Groundwater → Surface Water Body	42	240	18%
SPR8	1a x 2c x 3e Leachate → Surface Water → Surface Water Body	42	60	70%
SPR10	1b x 2d x 3f Gas → Lateral Migration → Human Presence	10.5	150	7%
		Overall Risk Score		**70%**

5.6 Risk Classification

The overall risk score outlined in Section 5.5 can be used to place the site into an appropriate Risk Classification as outlined in Table 20.

Table 20. Risk Classification

Risk Classification	Overall Risk Score	Action Required
High Risk – Class A	≥70%	Commence site investigations as soon as possible. Apply for a waste regularisation permit/licence.
Moderate Risk – Class B	40% to 70%	Complete site investigations to verify risk. Apply for a waste regularisation permit/licence.
Low Risk – Class C	≤40%	No action necessary unless there is a change in land use. In this circumstance a reappraisal of risk, based on detailed site investigations is required.

6. Discussion and Datagaps

The classification on record with the EPA for the Ballymulvey landfill is Class C – Low Risk. From the above assessment the majority of SPR linkages are low risk; however, the proximity of surface water bodies to the site is considered to raise the ranking to high risk. Results for surface water monitoring carried out up to 2014 indicate that the quality of surface water improves with distance from the site, and many of the surface water monitoring points located close to the site are on small land-drains/streams, in which water quality would be expected to be poor/variable.

An inventory of currently accessible surface water monitoring points and completion of a round of sampling could assist in revising the risk classification. It may also be beneficial to include monitoring of accessible groundwater and leachate monitoring points at the same time, with a topographic survey to assist in determining directions of flow and hydraulic gradients. Permeability tests would also assist in assessing the flux of mass loadings from the landfill to adjacent surface water.

While the EPA's matrix for the completion of Tier 2 assessments includes for the excavation of trial pits/trenches and determination of waste type as mandatory, given the low risk classification for all other SPR linkages in the case of Ballymulvey, it is not considered that this type of investigation is necessary.

Asbestos containing material (ACM) was accepted and deposited in a discrete area of the landfill (see Appendix A Figure 2, and Appendix B site plans F061-01 A and F061-02 B). The ACM waste was accepted on site between 22 and 27 July 1987 and was brought to site double-bagged and marked as *Danger Asbestos* and *Do not Inhale*. Records indicate that 6' (~1.8 m) of double-bagged ACM waste was buried beneath 2' to 3' (~0.6 to 1 m) of sand, with an additional 3' to 4' (~1.2 m) layer of refuse above this in an excavation 19 m in length and 4 m in width.

7. Recommendations

Given that the above assessment indicates that the majority of SPR linkages are low risk, and given the existing historical surface water monitoring data reviewed which indicates that the quality of surface water improves with distance from the site AECOM recommends:

1. that an inventory of currently accessible surface and groundwater monitoring points be completed;
2. that one round of surface and ground water monitoring be undertaken for these monitoring points; and
3. the completion of a topographic survey of the drainage inside and outside the site.

Based on the available data reviewed to date, AECOM consider that this would be sufficient to complete a Tier 3 and to move forward to further remediation works if required and an application for a *Certification of Authorisation* (COA) to demonstrate compliance with the regulations.

Records indicate that ACM was deposited in a designated area, double bagged and capped with sand and further waste. On this basis, and assuming the landfill is to remain as it is under its current use it is recommended that the ACM material remains in-situ and undisturbed. If redevelopment of the area is to take place in the future it should be re-assessed and appropriate managment and mitigation measures put in place to address potential risks at that stage.

Appendix A - Figures

CLIENT

LONGFORD COUNTY COUNCIL

PROJECT

BALLYMULVEY LANDFILL
BALLYMAHON, CO. LONGFORD

DRAWING TITLE

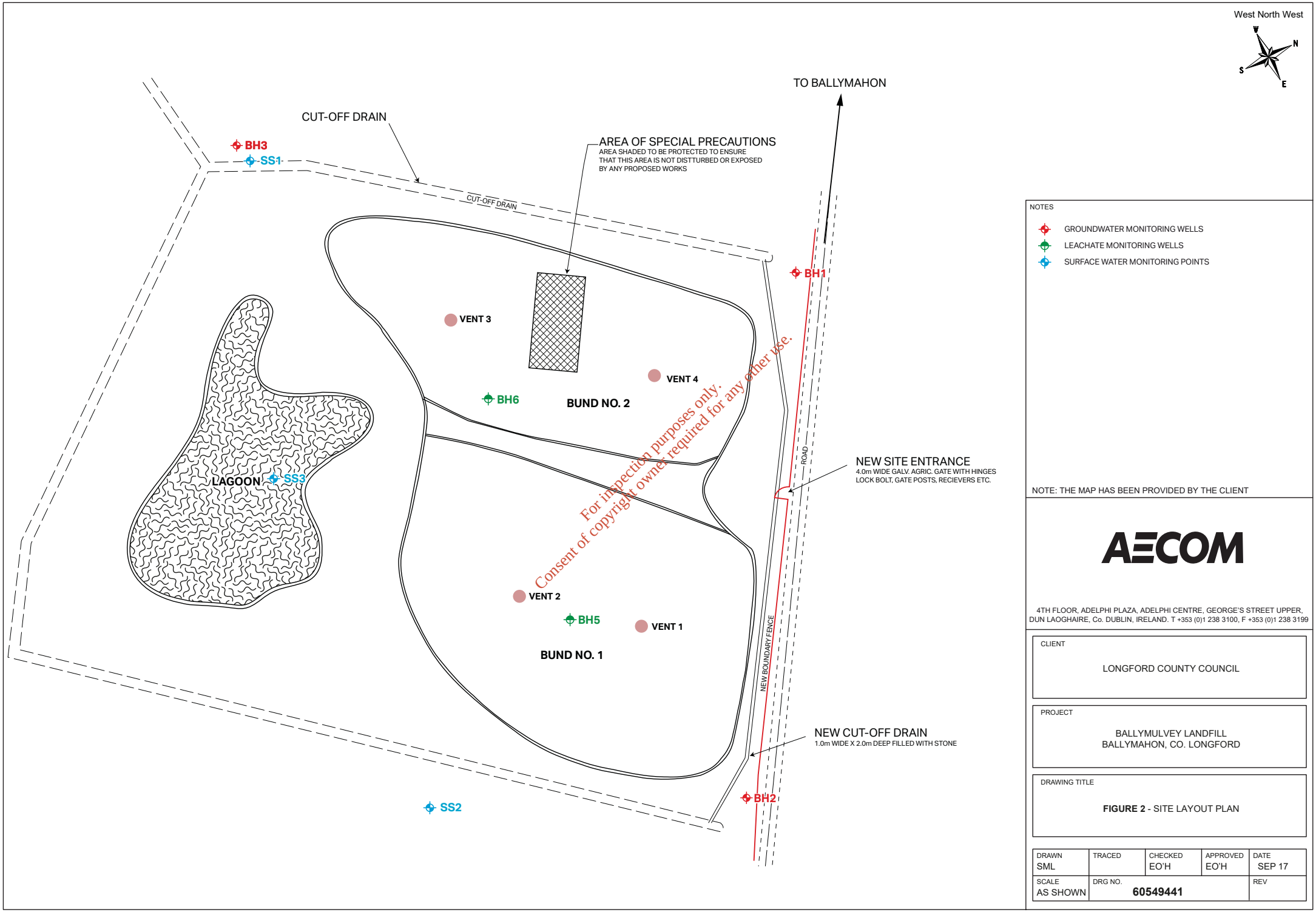
FIGURE 1 - SITE LOCATION PLAN

AECOM

4th Floor, Adelphi Plaza, Adelphi Centre, George's Street Upper, Dun Laoghaire, Co. Dublin, Ireland
T +353 (0)1 238 3100 F +353 (0)1 238 3199 www.aecom.com

DRAWN	ILLUSTRATED	CHECKED	APPROVED	DATE
SML		EO'H	EO'H	AUG 2017

SCALE	Job No.	REV.
N.T.S	60549441	1



NOTES

- GROUNDWATER MONITORING WELLS
- LEACHATE MONITORING WELLS
- SURFACE WATER MONITORING POINTS

NOTE: THE MAP HAS BEEN PROVIDED BY THE CLIENT

AECOM

4TH FLOOR, ADELPHI PLAZA, ADELPHI CENTRE, GEORGE'S STREET UPPER, DUN LAOGHAIRE, Co. DUBLIN, IRELAND. T +353 (0)1 238 3100, F +353 (0)1 238 3199

CLIENT
LONGFORD COUNTY COUNCIL

PROJECT
BALLYMULVEY LANDFILL
BALLYMAHON, CO. LONGFORD

DRAWING TITLE
FIGURE 2 - SITE LAYOUT PLAN

DRAWN	TRACED	CHECKED	APPROVED	DATE
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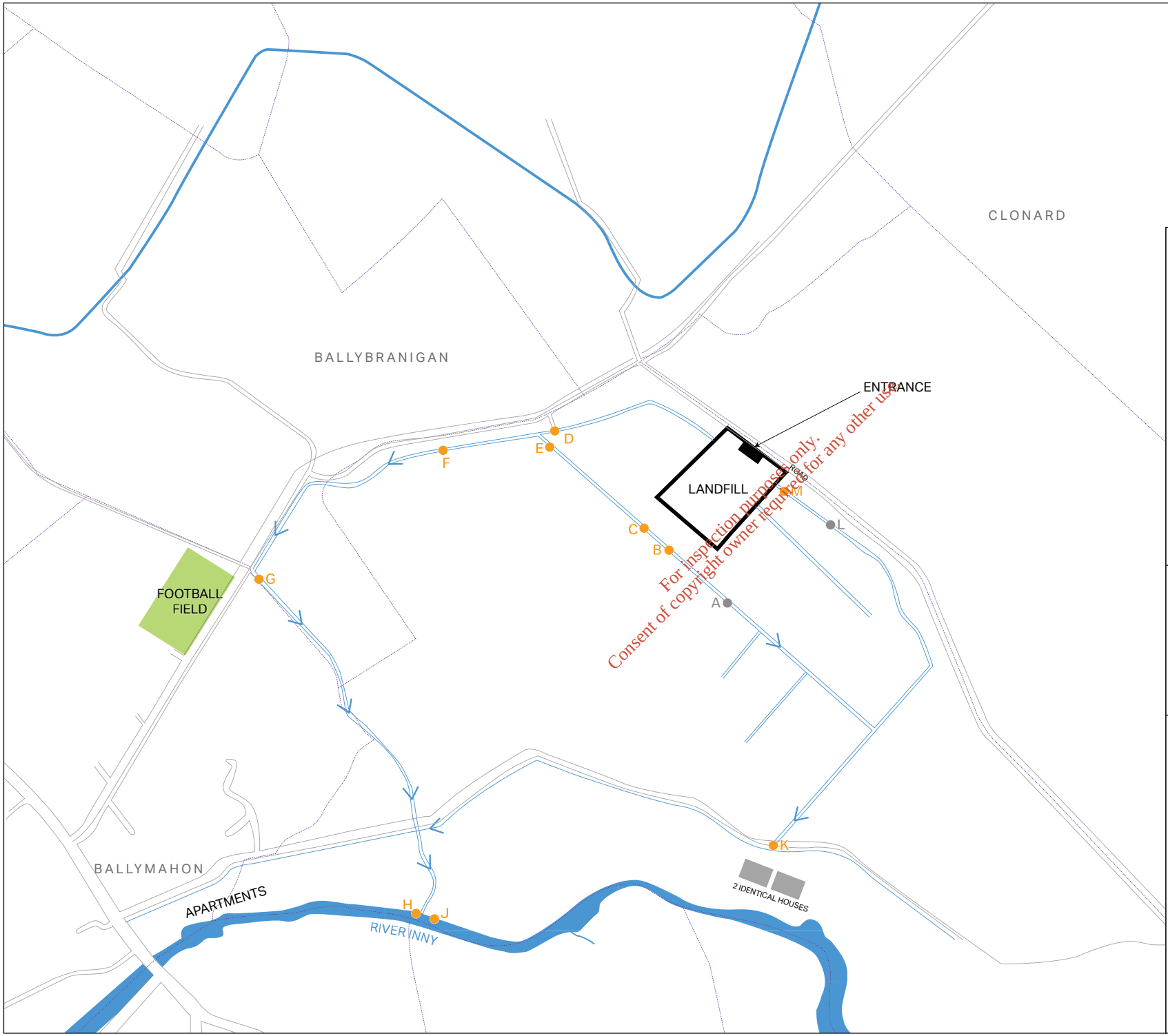
SCALE	DRG NO.			REV
AS SHOWN	**60549441**			



NOTES

- SURFACE WATER MONITORING POINTS
- SURFACE WATER MONITORING POINTS FREQUENTLY DRY AND NOT SAMPLED

AECOM

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CLIENT

LONGFORD COUNTY COUNCIL

PROJECT

BALLYMULVEY LANDFILL
BALLYMAHON, CO. LONGFORD

DRAWING TITLE

FIGURE 3 - SURFACE WATER MONITORING POINTS

DRAWN	TRACED	CHECKED	APPROVED	DATE
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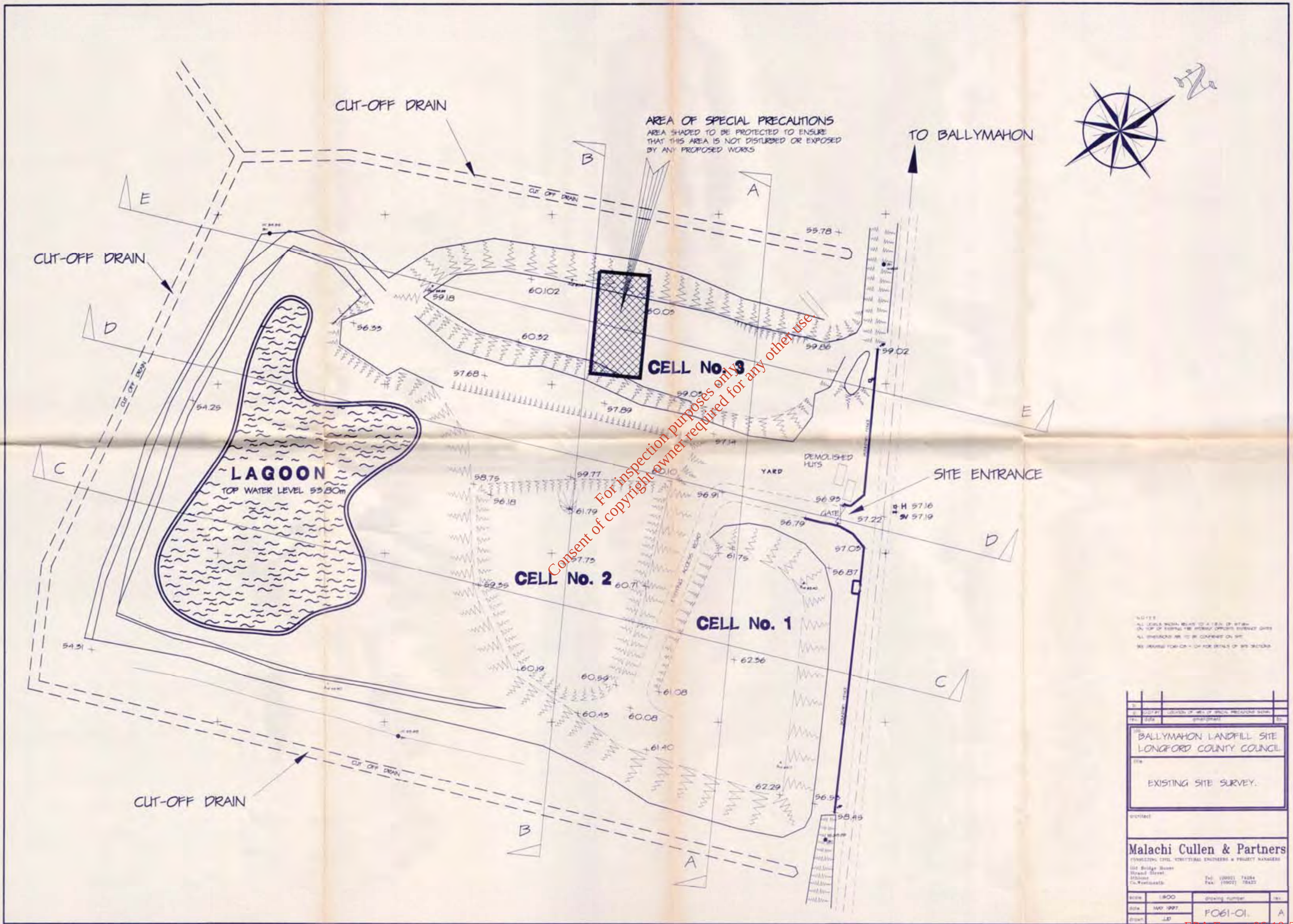
SCALE	DRG NO.			REV
AS SHOWN	**60549441**			

Appendix B - Site Drawings and Plans


CUT-OFF DRAIN
AREA OF SPECIAL PRECAUTIONS
AREA SHADED TO BE PROTECTED TO ENSURE THAT THIS AREA IS NOT DISTURBED OR EXPOSED BY ANY PROPOSED WORKS
TO BALLYMAHON
CUT-OFF DRAIN
CELL No. 3
LAGOON
TOP WATER LEVEL 55.80m
CELL No. 2
CELL No. 1
SITE ENTRANCE
DEMOLISHED HUTS
YARD
GATE
CUT-OFF DRAIN
A
B
C
D
E
55.78
59.18
60.102
60.05
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60.32
59.86
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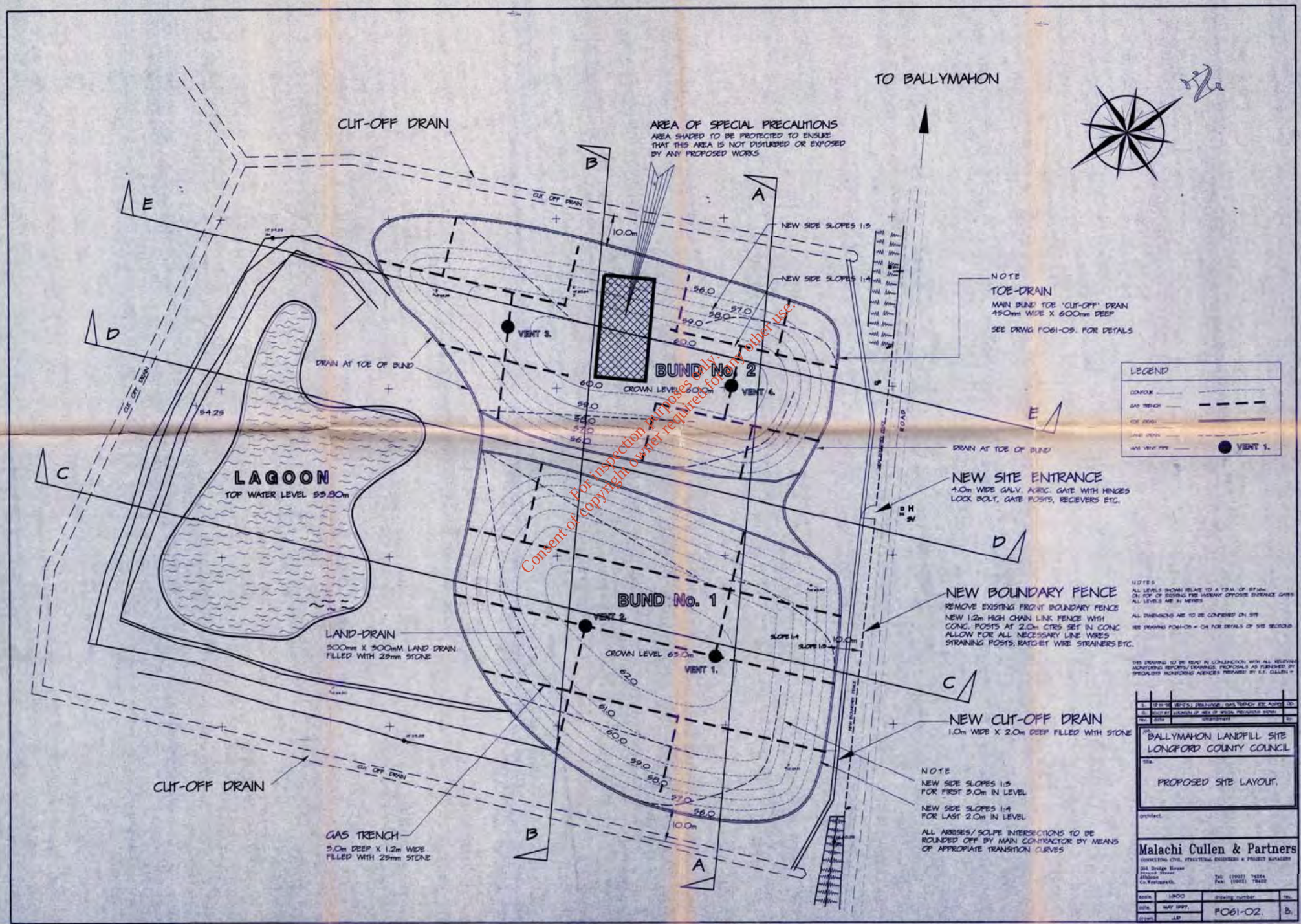
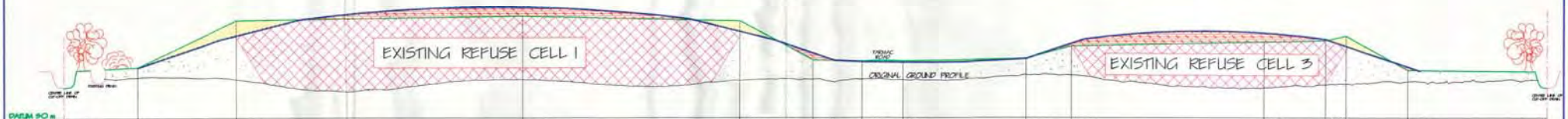
58.49
BALLYMAHON LANDFILL SITE
LONGFORD COUNTY COUNCIL
EXISTING SITE SURVEY.
Malachi Cullen & Partners
scale 1:800
date MAY 1997
drawing number F061-01.
rev. A



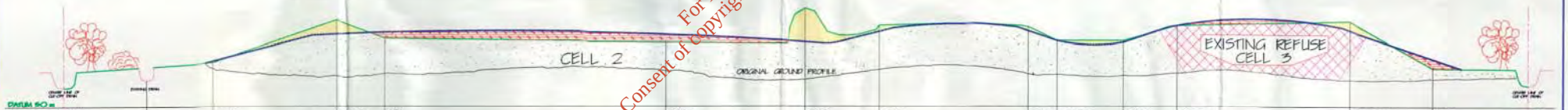
PROPOSED BUND No. 1

PROPOSED BUND No. 2



DATUM 90 m														
EXIST GR LEVEL	0.00 m	96.2	61.849	62.56	61.79	96.99	96.89	96.89	97.19	98.68	99.17	99.39	99.9	99.79	99.69
PROP LEVEL															
CHAINAGE	0.00 m	9.0 m	21 m	56 m	82.5 m	91.9 m	97.9 m	102.9 m	117.9 m	125 m	146.9 m	154 m	156.9 m	164 m	181 m

CROSS SECTION A - A



DATUM 90 m														
EXIST GR LEVEL	54.2		59.52	60.510	58.1	97.75	61.79	59.77	59.7	57.85	57.89	59.679	60.290	54.6	54.5
PROP LEVEL															
CHAINAGE	0.00 m	10 m	18 m	34 m	59 m	75 m	90 m	99 m	117 m	120.9 m	128.5 m	155 m	196 m	166 m	177.9 m

CROSS SECTION B - B

DENOTES PROPOSED FILL

DENOTES PROPOSED CUT

DENOTES REFUSE FILL

EXISTING GROUND LEVEL

PROPOSED GROUND LEVEL

rev.	date	amendment	by

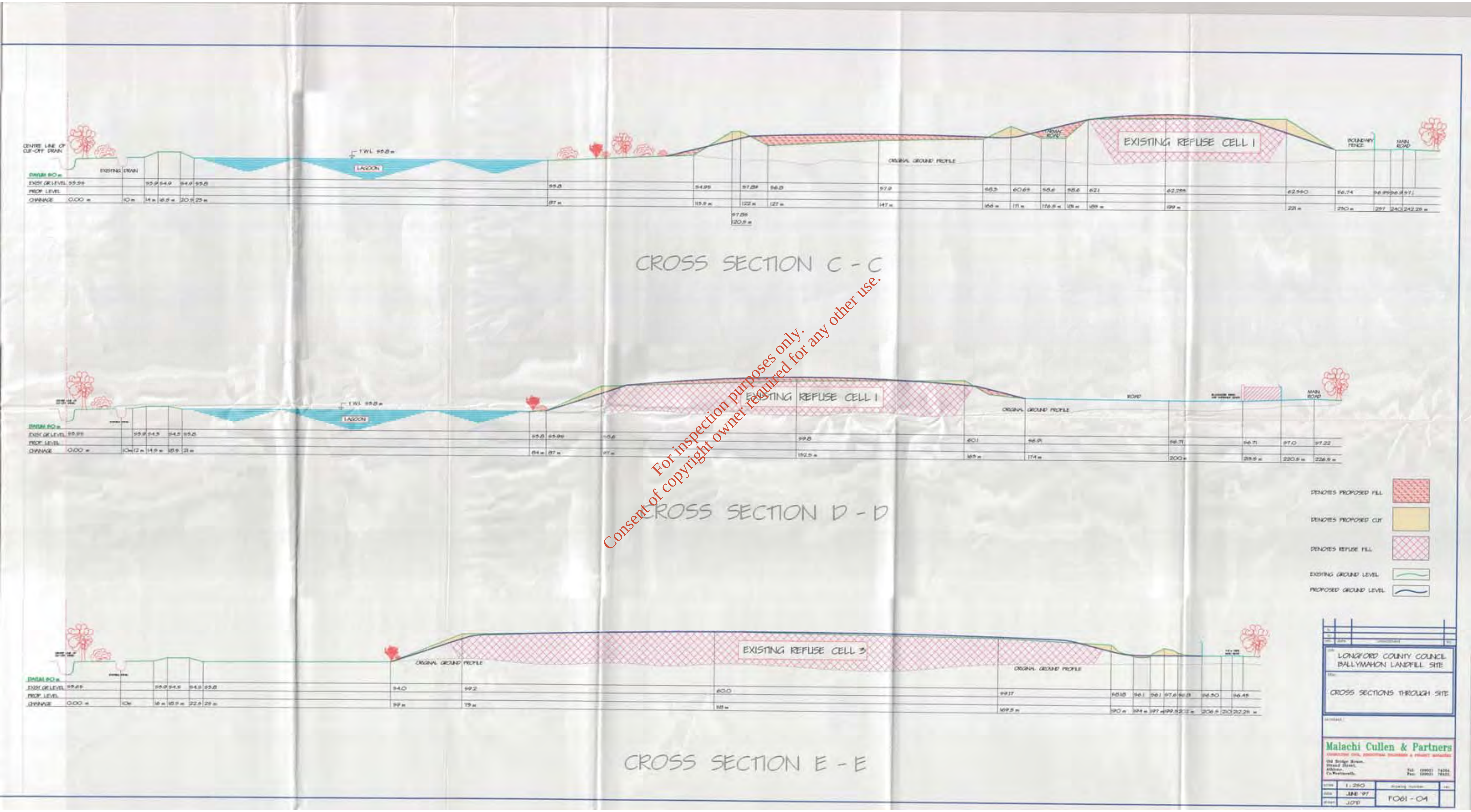
job: LONGFORD COUNTY COUNCIL
BALLYMAHON LANDFILL SITE

title: CROSS SECTIONS THROUGH SITE

architect:

Malachi Cullen & Partners
CONSULTING CIVIL, STRUCTURAL ENGINEERS & PROJECT MANAGERS
Old Bridge House,
Strand Street,
Athlone,
Co.Westmeath.
Tel: (0902) 74084.
Fax: (0902) 78422.

scale:	1 : 250	drawing number:	rev:
date:	JUNE '97	F061 - 05	
drawn:	JOYD		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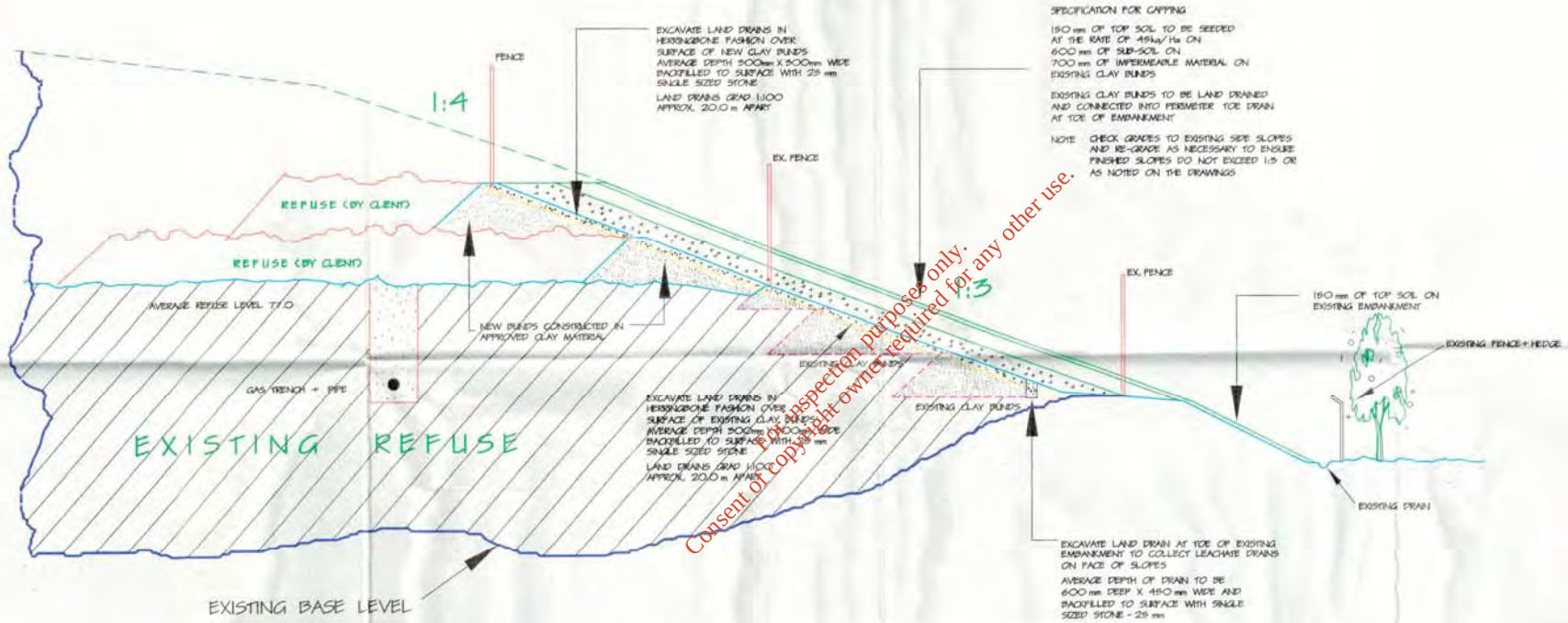
LAGOON
ORIGINAL GROUND PROFILE
CROSS SECTION C - C
EXISTING REFUSE CELL I
CROSS SECTION D - D
EXISTING REFUSE CELL 3
CROSS SECTION E - E
DENOTES PROPOSED FILL
DENOTES PROPOSED CUT
DENOTES REFUSE FILL
EXISTING GROUND LEVEL
PROPOSED GROUND LEVEL
LONGFORD COUNTY COUNCIL
BALLYMAHON LANDFILL SITE
CROSS SECTIONS THROUGH SITE
Malachi Cullen & Partners
1:250
JUNE '97
JOD
F061 - 04



FINAL CAPPING DETAILS OF SIDE EMBANKMENT - 1:100 H+V

rev.	date	amendment	by
b.			
a.			

job. LONGFORD COUNTY COUNCIL BALLYMAHON LANDFILL SITE

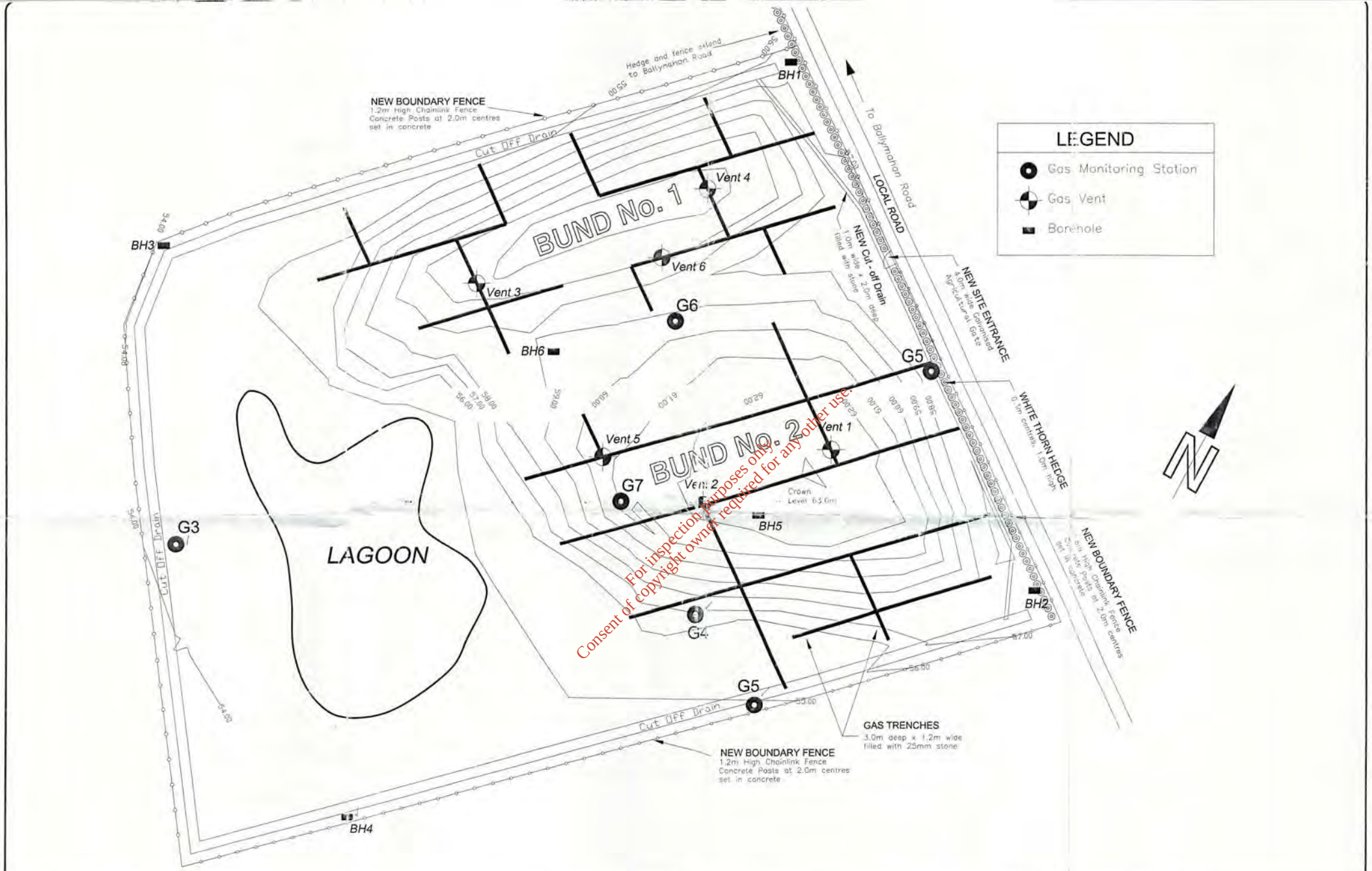
title. DETAILS OF COVER MATERIAL

architect.

Malachi Cullen & Partners
CONSULTING CIVIL, STRUCTURAL ENGINEERS & PROJECT MANAGERS
Old Bridge House, Strand Street, Athlone, Co. Westmeath.
Tel: [0902] 74884, Fax: [0902] 75422

scale.	1:100	drawing number.	rev.
date.	JUNE 1997.	F061-05.	
drawn.	JJP		

CAD File Ref. No. C61_05



Wills Bros. Ltd.
Civil Engineering Contractors
Ballylahan Bridge,
Foxford,
Co. Mayo.
Telephone: 094 - 56221
Facsimile: 094 - 56221

Rev	By	Date	Description

Project:	*Ballymahon Landfill Site*
Component:	Reinstatement
Title:	As-built details
Designed:	
Drawn:	
Checked:	
File Name:	
Scale:	1:500
Date:	26th February 2001
Drawing No.	BLS-01

Appendix C - Monitoring Results

Appendix C Table 1 - Landfill Gas Monitoring Data
Ballymulvey Landfill, Longford County Council

Station Name	Sample Date	Atmospheric Pressure	Carbon Dioxide (free)	Methane CH_4	Oxygen
		hPa	%	%	%
BH1	11-Sep-2002	993	0.4	0.0	20.9
BH1	30-Oct-2003	998	0.0	0.0	20.4
BH1	26-May-2004	1016	0.0	0.1	20.5
BH1	02-Nov-2004	1006	0.0	0.0	20.6
BH2	11-Sep-2002	993	0.8	0.0	20.1
BH2	26-May-2004	1016	0.0	0.1	20.8
BH2	02-Nov-2004	1006	0.0	0.0	20.8
BH3	11-Sep-2002	993	0.0	0.0	20.8
BH3	30-Oct-2003	998	0.1	0.0	20.3
BH3	26-May-2004	1017	20.2	0.1	20.2
BH3	02-Nov-2004	1007	0.1	0.1	20.4
BH3	2005	-	-	0.1	-
BH5	11-Sep-2002	994	9.5	22.5	17.5
BH5	30-Oct-2003	998	7.1	10.9	18.9
BH5	26-May-2004	1014	0.0	0.1	20.6
BH5	02-Nov-2004	1006	0.0	0.1	20.6
BH5	2005	-	-	0.1	-
BH6	11-Sep-2002	994	0.1	0.0	20.8
BH6	30-Oct-2003	998	0.6	0.3	19.6
BH6	26-May-2004	1015	0.0	0.0	20.8
BH6	02-Nov-2004	1006	0.0	0.0	20.7
G1	11-Sep-2002	993	0.0	0.0	20.6
G1	30-Oct-2003	997	0.2	0.0	20.3
G1	26-May-2004	1015	0.0	0.0	20.2
G1	02-Nov-2004	1007	0.0	0.0	20.5
G2	11-Sep-2002	993	0.1	0.0	20.7
G2	30-Oct-2003	997	0.0	0.0	20.6
G2	26-May-2004	1016	0.0	0.1	20.2
G2	02-Nov-2004	1007	0.0	0.0	20.4
G3	11-Sep-2002	AR	AR	AR	AR
G4	11-Sep-2002	993	0.2	0.0	20.8
G5	11-Sep-2002	992	0.0	0.0	20.9
G5	30-Oct-2003	998	0.0	0.0	20.7
G5	26-May-2004	1016	0.1	0.2	20.5
G5	02-Nov-2004	1008	0.0	0.1	20.6
G5	2005	-	-	0.1	-
G6	11-Sep-2002	991	0.1	0.0	20.7
G6	30-Oct-2003	997	0.1	0.0	20.5
G7	11-Sep-2002	992	3.6	1.9	18.5
G7	30-Oct-2003	998	0.6	1.1	17.6
G7	26-May-2004	1015	0.0	0.1	20.4
G7	02-Nov-2004	1008	0.0	0.1	20.3
G7	2005	-	-	0.1	-
Gx	11-Sep-2002	993	0.1	0.0	20.6

Assumed units

Appendix C Table 2 - Leachate Monitoring Data
Ballymulvey Landfill, Longford County Council

Data from *ballymahon landfill.xls*

All other data from Ballymulvey monitoring data.xlsx

Data don't tally with those in *ballymahon landfill.xls*

Assumed units

Blank cell indicates no data

Station Name	Sample Date	Depth	pH	Conductivity	Temperature	Chemical Oxygen Demand	Biological Oxygen Demand	Ammonium	Nitrate (NO_3)	Total Organic Carbon	Alkalinity	Calcium	Chloride	Cyanide
		m		µS/cm @ 20°C	°C	mg/L	mg/L	NH_4 as N mg/L	mg/L	mg/L	$CaCO_3$ mg/L	mg/L	mg/L	mg/L
BH5 Average		6.35	7.1	11590	12.4	212	25	373	1.7	55		277	716	
BH5 Standard Deviation		0.31	0.09	13973	0.71	167	35	305	3.3	41		66	565	
BH5 Maximum		7.00	7.3	57300	14.6	621	186	1509	13	151		419	2158	
BH5 Minimum		5.50	7.0	459	11.1	23	1	57	0.05	4		142	250	
BH5	29-May-2002		7.0	10810		570	22	610		119	3240	242	1747	
BH5	11-Sep-2002	NT	7.0	20500		521	49	665		151	3660	203	2158	
BH5	16-Oct-2003	7.0	7.1	913	12.8	621	36	1509	10	137	NT	255	1663	
BH5	25-Feb-2004	6.1	7.0	9370	11.6	61	14	182		24		358	315	
BH5	19-May-2004	5.5	7.1	6520	12.9	268	12	336		48		258	747	
BH5	12-Aug-2004	6.7	7.1	9130	14.6	423	30	472	1.1	70		256	1180	
BH5	27-Oct-2004	6.6	7.2	9140	11.9	348	20	325	<1	85		244	1000	
BH5	16-Feb-2005	6.3	7.3	5380	12.1	126	17	230	0.39	91		419	600	
BH5	20-Apr-2005	6.6	7.1	6440	12.3	170	15	380	0.61	44		301	440	
BH5	06-Jul-2005	6.3	7.2	6820	11.1	206	17	800	0.70	54		142	400	
BH5	02-Nov-2005	6.7	7.1	8830	13.0	323	23	545	1.1	107		246	1520	
BH5	07-Mar-2006	6.3	7.0	6350	12.3	113	33	340	13	44		334	250	
BH5	09-May-2006	6.5	7.2	6240	12.6	151	13	330	2.2	37		308	860	
BH5	09-Aug-2006	6.5	7.1	6310	12.6	174	14	590	0.05	46		309	320	
BH5	17-Oct-2007	6.6	7.0	57300	12.4	140	1	245	0.20	35			360	
BH5	16-Apr-2009	6.4	7.0	5320	12.5	141	20	236	1.9	33			280	<0.05
BH5	20-Oct-2009	6.0	7.1	5350	12.6	186	186	186	0.39	25			401	<0.01
BH5	14-Apr-2010	6.2	7.3	44300	11.2	159	11	168	0.25	82			296	0.004
BH5	29-Sep-2010	6.3	7.1	37300	12.2	118	10	149	0.25	57			358	<5
BH5	06-Apr-2011	6.3	7.1	4610	12.5	55	6	135	0.19	4			260	<10
BH5	29-Mar-2012	6.2	7.1	459	12.2	73	14	152	0.22	12			295	<10
BH5	06-Nov-2012	6.4	7.0	4970	11.5	69	14	160	0.51	4			294	<0.009
BH5	10-Jul-2013	6.1	7.1	4260	12.9	43	6	140	0.23	10				<0.009
BH5	19-Nov-2014	6.0	7.1	1546	12.0	23	7	57	0.25	10				<0.009

Appendix C Table 2 - Leachate Monitoring Data
Ballymulvey Landfill, Longford County Council

Data from *ballymahon landfill.xls*

All other data from Ballymulvey monitoring data.xlsx

Data don't tally with those in *ballymahon landfill.xls*

Assumed units

Blank cell indicates no data

Station Name	Sample Date	Depth	pH	Conductivity	Temperature	Chemical Oxygen Demand	Biological Oxygen Demand	Ammonium	Nitrate (NO_3)	Total Organic Carbon	Alkalinity	Calcium	Chloride	Cyanide
		m		µS/cm @ 20°C	°C	mg/L	mg/L	NH_4 as N mg/L	mg/L	mg/L	$CaCO_3$ mg/L	mg/L	mg/L	mg/L
BH6 Average		5.47	7.3	8536	12.8	1274	73	1022	5.9	411		71	5408	
BH6 Standard Deviation		0.42	0.36	17885	0.60	1353	61	986	7.2	491		25	5441	
BH6 Maximum		7.00	8.0	84900	14.0	3900	174	3500	33	2186		116	13800	
BH6 Minimum		5.00	6.8	1275	11.5	20	1	11	0.12	2		9	12	
BH6	29-May-2002		7.0	1765		82	1	10.6		10	300	9	88	
BH6	11-Sep-2002	NT	7.5	12600		845	28	1055		300	5490	66	7398	
BH6	16-Oct-2003	5.8	8.0	2249	13.3	3500	147	1632	6.6	488	NT	48	1350	
BH6	25-Feb-2004	5.5	7.8	4830	12.2	189	79	879		482		52	11279	
BH6	19-May-2004	5.5	7.6	3600	13.3	3295	85	1370		469		58	NT	
BH6	12-Aug-2004	5.7	7.6	4300	13.6	2740	133	650	7.0	456		50	5000	
BH6	27-Oct-2004	7.0	7.6	3950	12.3	2325	80	1590	7.9	623		82	12500	
BH6	16-Feb-2005	5.4	7.6	3770	12.8	2070	114	1300	8.6	947		79	27	
BH6	20-Apr-2005	5.7	7.5	4120	12.9	170	100	2540	9.8	622		95	12200	
BH6	06-Jul-2005	5.5	7.5	4450	11.5	2484	162	3500	10	2186		116	13800	
BH6	02-Nov-2005	5.5	7.5	4340	13.6	2656	160	1650	9.2	781		93	13400	
BH6	07-Mar-2006	5.2	7.5	42600	12.8	3900	150	1705	33	675		88	12000	
BH6	09-May-2006	5.4	7.6	3910	12.9	2255	148	1510	8.1	601		78	6100	
BH6	09-Aug-2006	5.5	7.5	3710	13.0	2818	174	1550	7.4	975		76	12600	
BH6	17-Oct-2007	5.4	7.4	84900	13.1	354	42	310	1.0	106			1400	
BH6	16-Apr-2009	5.0	6.9	6740	13.0	430	51	2859	6.4	49			3100	<0.05
BH6	20-Oct-2009	5.1	6.9	2023	14.0	118	24	83	0.42	25			390	<0.01
BH6	14-Apr-2010	5.0	7.0	1368	11.6	84	4	53	0.52	11			260	0.0015
BH6	29-Sep-2010	5.0	6.9	1730	13.0	86	10	47	0.35	9			482	<5
BH6	06-Apr-2011	5.2	7.0	1693	12.6	62	13	39	0.12	9			86	<10
BH6	29-Mar-2012	5.1	6.8	1552	12.6	34	11	38	0.13	7			87	<10
BH6	06-Nov-2012	5.5	6.8	1275	12.2	29	8	36	0.28	2			12	<0.009
BH6	10-Jul-2013	5.5	6.8	1657	12.9	20	4	43	0.26	9				<0.009
BH6	19-Nov-2014	5.9	6.9	1728	12.4	38	18	69	0.23	11				<0.009

Appendix C Table 2 - Leachate Monitoring Data
Ballymulvey Landfill, Longford County Council

Data from *ballymahon landfill.xls*

All other data from Ballymulvey monitoring data.xlsx

Data don't tally with those in *ballymahon landfill.xls*

Assumed units

Blank cell indicates no data

Station Name	Sample Date	Magnesium	Potassium	Sodium	Sulphate	Boron	Cadmium	Copper	Chromium	Iron	Lead	Manganese	Mercury	Nickel	Zinc
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
BH5 Average		234	159	510		1.479			0.0331	0.41		0.60		0.009	0.022
BH5 Standard Deviation		52	95	352		0.32			0.0413	0.69		0.18		0.011	0.020
BH5 Maximum		317	480	1350		2.150			0.1410	2.8		1.1		0.050	0.078
BH5 Minimum		60	9	21		0.878			0.0020	0.017		0.34		0.002	0.005
BH5	29-May-2002	219	192	1350	76		0.001	0.005	0.0080	0.36	<0.005	0.505	<0.005	0.018	0.016
BH5	11-Sep-2002	194	340	1025	<3		<0.0004	<0.005		0.56	<0.005	0.344	0.00156	0.014	0.02
BH5	16-Oct-2003	257	276	1040	NT	1.400	<0.4			0.23	<5	0.614	<0.05	<10	0.006
BH5	25-Feb-2004	271	148	450		1.310	<0.4	<5	<1	0.076	<5	0.564	<0.05	<10	<5
BH5	19-May-2004	210	176	660		1.330	<0.4	<5	<1	0.081	<5	0.472	<0.05	<10	<5
BH5	12-Aug-2004	216	480	1130		1.360	0.0008	<5	0.0040	0.054	<5	0.488	<0.05	<10	<5
BH5	27-Oct-2004	244	200	860		1.420	<0.4	<5	0.0090	0.34	<5	0.64	<0.05	0.010	<5
BH5	16-Feb-2005	302	104	485		1.460	<0.4	<5	<1	0.12	0.005	0.69	0.0001	<10	<5
BH5	20-Apr-2005	197	144	400		1.688	<0.4	<1	0.0900	0.23	<1	0.70	<0.05	<1	<3
BH5	06-Jul-2005	60	178	570		1.300	<0.4	<1	0.0160	<5	0.06	1.1	<0.05	0.003	0.078
BH5	02-Nov-2005	267	200	860		1.647	<1	<1	0.0840	0.77	<1	0.71	<0.05	0.011	0.026
BH5	07-Mar-2006	317	180	515		1.923	<1	<1	0.0760	0.017	0.003	0.79	<0.05	0.007	0.016
BH5	09-May-2006	286	116	395		2.150	<1	<1	0.1410	0.19	<1	0.71	<0.05	0.010	0.013
BH5	09-Aug-2006	286	170	505		1.318	<1	<1	0.0590	0.12	<1	0.74	<0.05	0.005	0.008
BH5	17-Oct-2007	262	140	360		1.900	<0.4	<1	0.0830	0.14	0.006	0.62	<0.05	0.006	0.005
BH5	16-Apr-2009	257	99	264		1.460	<0.00022	0.00348	0.0394	0.34	0.000433	0.54	<0.00001	0.007	0.0518
BH5	20-Oct-2009	245	107	269		2.090	<0.0005	<0.001	0.0040	2.3	0.021	0.91	<0.00005	0.005	0.032
BH5	14-Apr-2010	223	90	207		0.878	<0.0005	<0.001	0.0020	0.13	<0.0005	0.48	<0.00005	0.002	<0.005
BH5	29-Sep-2010	<21	9	21		<10	<0.5	<1	0.0020	0.14	<0.5	0.67	<0.05	0.002	0.006
BH5	06-Apr-2011	181	100	165		1.095	<0.5	<1	0.0020	0.12	<0.5	0.44	<0.05	0.002	<5
BH5	29-Mar-2012	209	85	198		1.340	<0.5	<1	0.0020	2.8	<0.5	0.49	<0.05	0.008	0.012
BH5	06-Nov-2012	209	80	209		1.491	<0.5	<1	0.0030	0.16	<0.5	0.36	<0.05	0.002	<5
BH5	10-Jul-2013	265	89	194		1.500	<0.5	<1	0.0030	0.055	<0.5	0.41	<0.05	0.050	<5
BH5	19-Nov-2014	201	115	114		1.045	<0.5	<1	0.0020	0.095	0.003	0.50	<0.05	0.007	<5

Appendix C Table 2 - Leachate Monitoring Data
Ballymulvey Landfill, Longford County Council

Data from *ballymahon landfill.xls*

All other data from Ballymulvey monitoring data.xlsx

Data don't tally with those in *ballymahon landfill.xls*

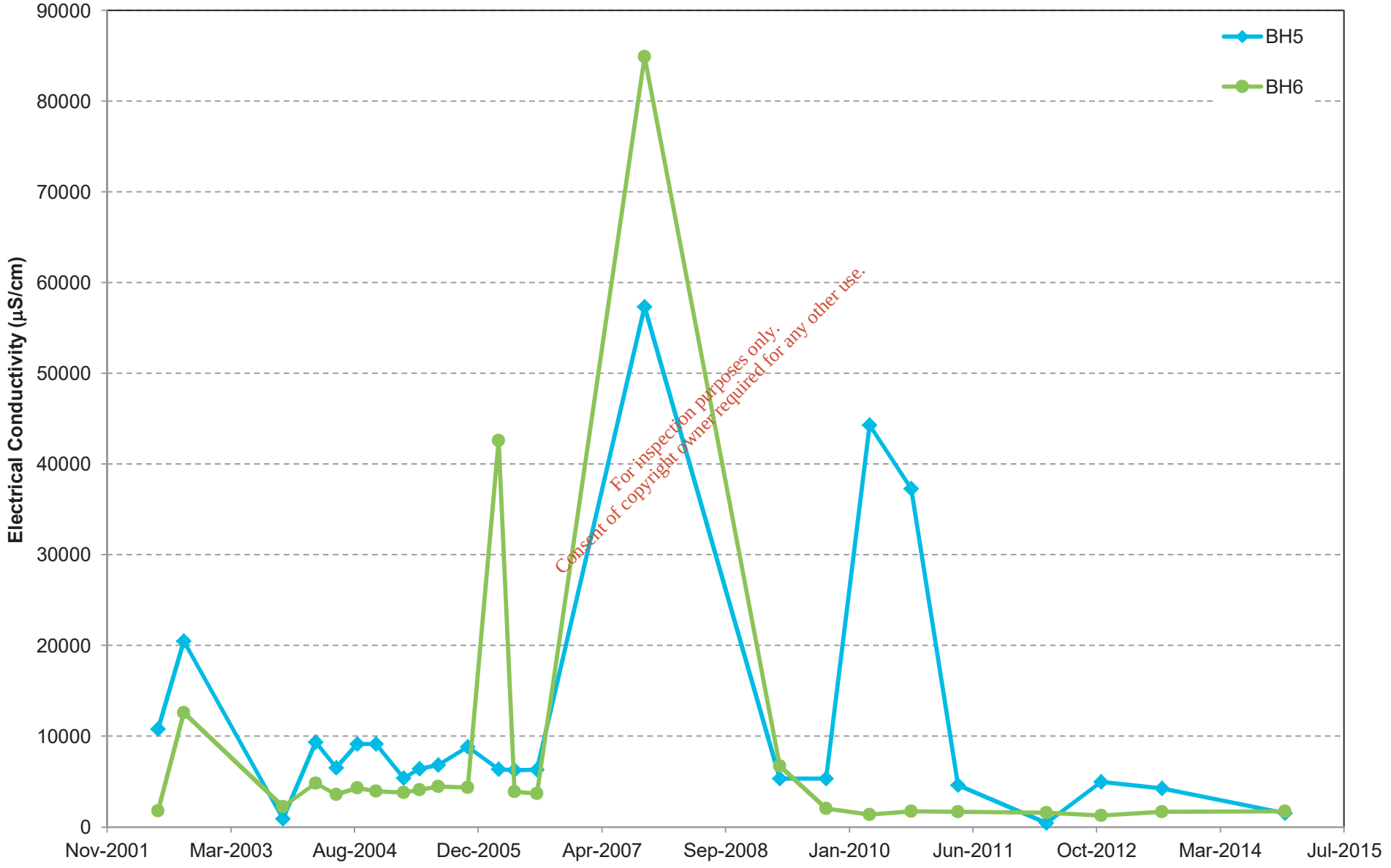
Assumed units

Blank cell indicates no data

Station Name	Sample Date	Magnesium	Potassium	Sodium	Sulphate	Boron	Cadmium	Copper	Chromium	Iron	Lead	Manganese	Mercury	Nickel	Zinc
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
BH6 Average		53	734	3929		0.948			0.0905	2.22		0.18		0.035	0.028
BH6 Standard Deviation		31	1402	3811		0.70			0.1214	2.67		0.14		0.038	0.023
BH6 Maximum		92	7200	10000		2.450			0.3880	8.3		0.5		0.109	0.084
BH6 Minimum		3	3	13		0.060			0.0008	0.022		0.01		0.001	0.006
BH6	29-May-2002	3	192	230	424		<0.004	<0.005	<0.001	0.075	<0.005	0.006	<0.00005	<0.01	0.007
BH6	11-Sep-2002	89	740	3950	75		<0.0004	0.008		0.90	<0.005	0.15	0.00006	0.038	0.025
BH6	16-Oct-2003	86	820	6800	NT		<0.4	<5		0.10	<5	0.029	<0.05	0.040	0.013
BH6	25-Feb-2004	72	360	4750		0.910	<0.4	0.005	0.0410	0.85	<5	0.051	<0.05	0.032	0.014
BH6	19-May-2004	73	670	7600		1.200	<0.4	<5	0.0440	1.3	<5	0.046	0.00006	0.040	0.023
BH6	12-Aug-2004	71	7200	6900		1.170	<0.4	<5	0.0400	1.2	<5	0.050	<0.05	0.035	0.015
BH6	27-Oct-2004	88	860	8600		1.540	<0.4	<5	0.0140	0.20	<5	0.16	<0.05	<10	0.007
BH6	16-Feb-2005	67	980	7400		1.270	0.0006	<5	0.0700	3.4	0.045	0.14	0.00017	0.065	0.061
BH6	20-Apr-2005	92	660	8900		1.77	<0.4	0.003	0.2880	6.4	0.004	0.15	<0.05	0.105	0.044
BH6	06-Jul-2005	58	920	9800		1.400	<0.4	<1	0.0130	<5	0.003	0.44	<0.05	0.002	0.011
BH6	02-Nov-2005	90	1020	8500		1.938	<1	0.005	0.2900	7.7	0.003	0.18	<0.05	0.012	0.057
BH6	07-Mar-2006	80	990	1050		1.760	<1	0.003	0.2480	6.7	0.005	0.16	<0.05	0.102	0.084
BH6	09-May-2006	73	720	7000		2.450	<1	<1	0.3880	8.3	<1	0.16	<0.05	0.109	0.052
BH6	09-Aug-2006	72	940	10000		1.196	<1	<1	0.2070	5.9	0.002	0.15	<0.05	0.109	0.055
BH6	17-Oct-2007	15	200	1600		0.328	<0.4	0.001	0.0540	1.3	0.007	0.16	<0.05	0.020	0.014
BH6	16-Apr-2009	7	69	470		0.094	<0.00022	0.00383	0.0149	1.9	0.000818	0.16	1.67E-05	0.008	0.010
BH6	20-Oct-2009	10	38	199		0.130	<0.0005	0.008	0.0030	2.2	0.004	0.15	<0.00005	0.006	0.031
BH6	14-Apr-2010	11	38	194		0.060	<0.0005	<0.001	0.0020	0.28	<0.0005	0.12	<0.00005	0.004	<0.004
BH6	29-Sep-2010	<0.8	3	13		<10	<0.5	<1	0.0010	0.57	<0.5	0.11	<0.05	0.005	0.006
BH6	06-Apr-2011	34	38	65		0.266	<0.5	<1	<0.5	1.1	<0.5	0.42	<0.05	0.001	<5
BH6	29-Mar-2012	33	38	57		0.250	<0.5	<1	0.0008	0.31	0.0006	0.43	<0.05	0.003	0.008
BH6	06-Nov-2012	27	31	60		0.264	<0.5	<1	0.0008	0.27	<0.5	0.008	<0.05	<0.5	<5
BH6	10-Jul-2013	51	55	74		0.386	<0.5	<1	<0.5	0.022	<0.5	0.52	<0.05	0.002	<5
BH6	19-Nov-2014	18	38	82		0.629	<0.5	<1	0.0008	0.044	0.017	0.36	<0.05	0.003	<5

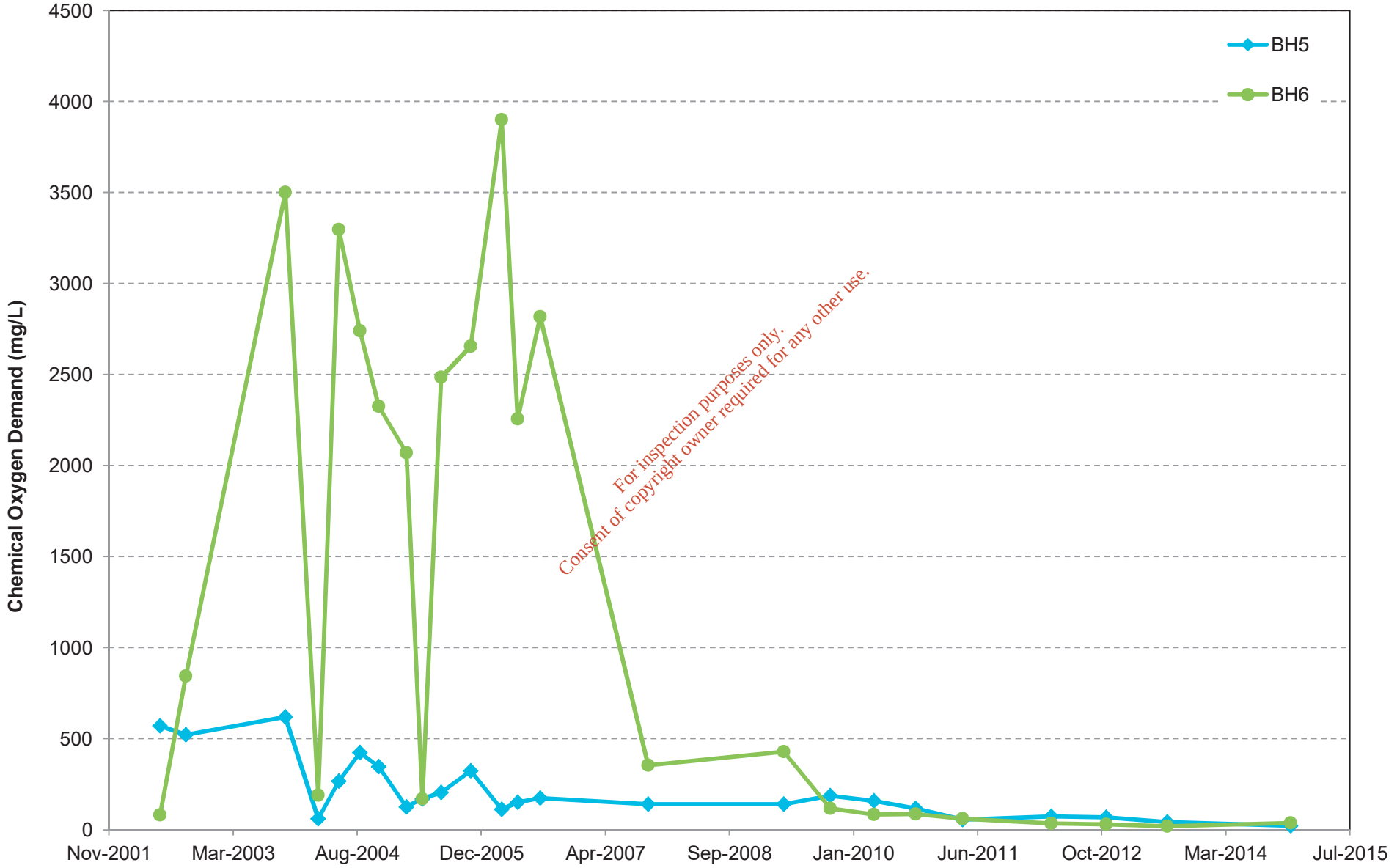
Appendix C - Ballymulvey Landfill Monitoring Data

Electrical Conductivity Trends in Leachate



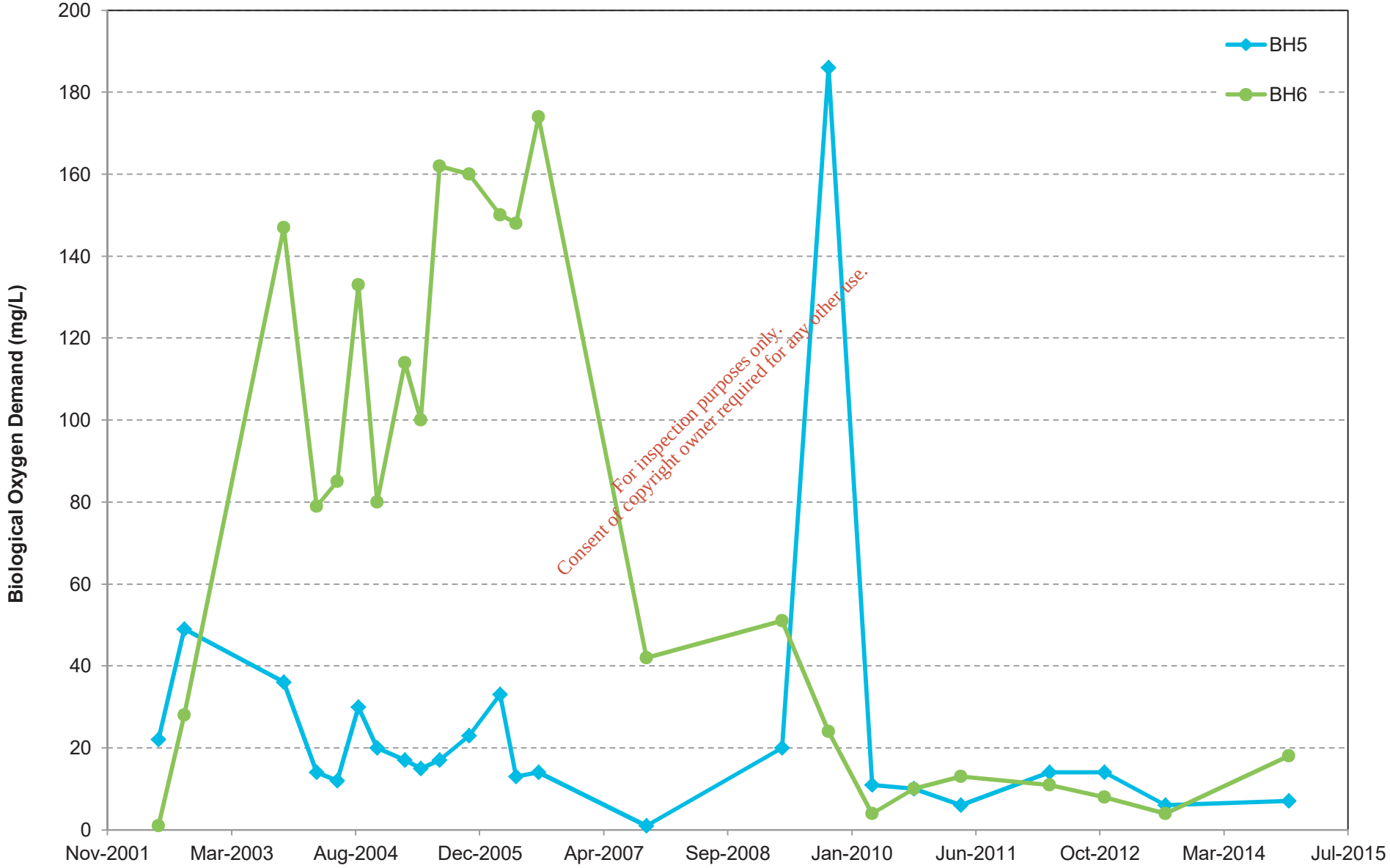
Appendix C - Ballymulvey Landfill Monitoring Data

Chemical Oxygen Demand Trends in Leachate



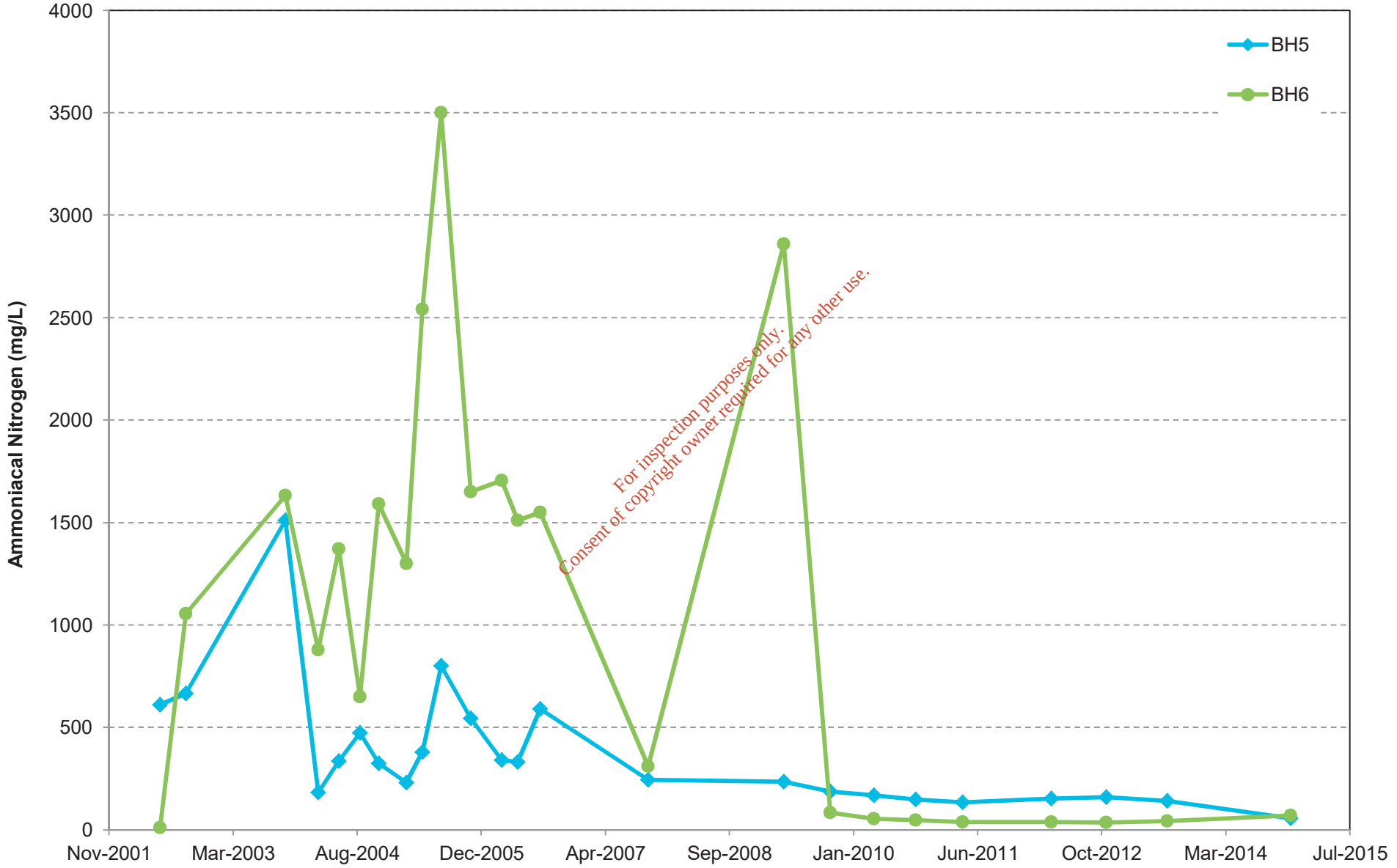
Appendix C - Ballymulvey Landfill Monitoring Data

Biological Oxygen Demand Trends in Leachate



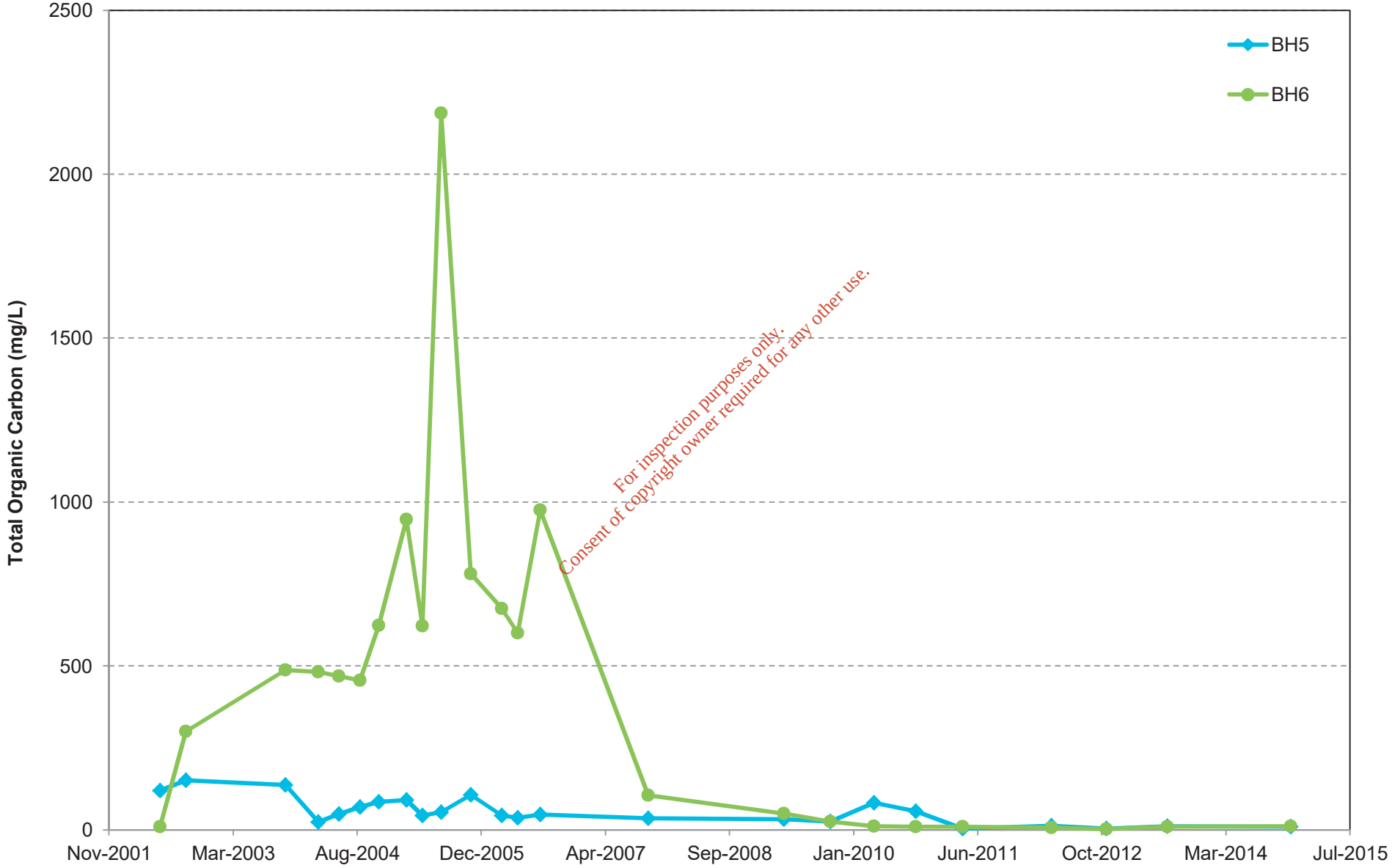
Appendix C - Ballymulvey Landfill Monitoring Data

Ammoniacal Nitrogen Trends in Leachate



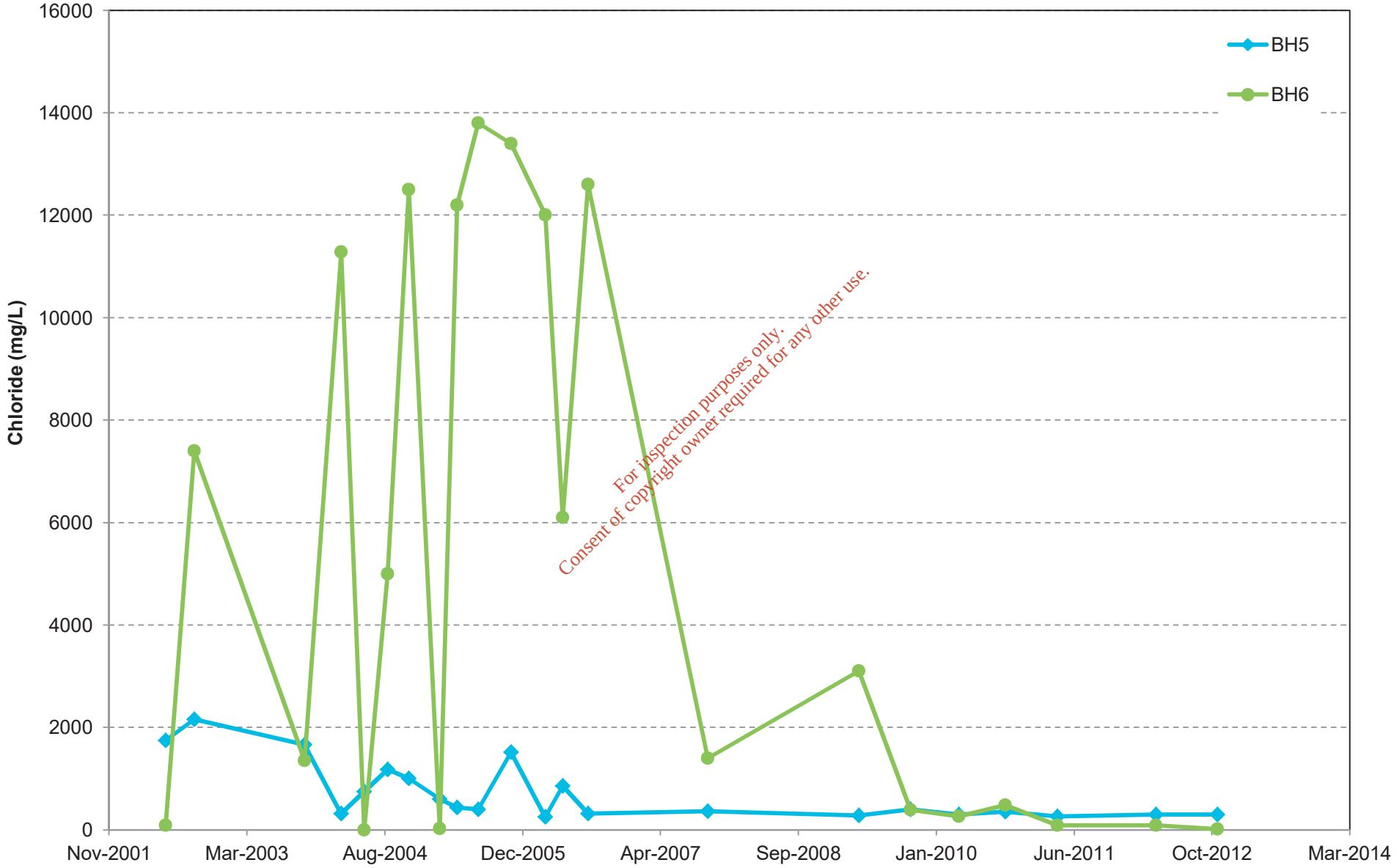
Appendix C - Ballymulvey Landfill Monitoring Data

Total Organic Carbon Trends in Leachate



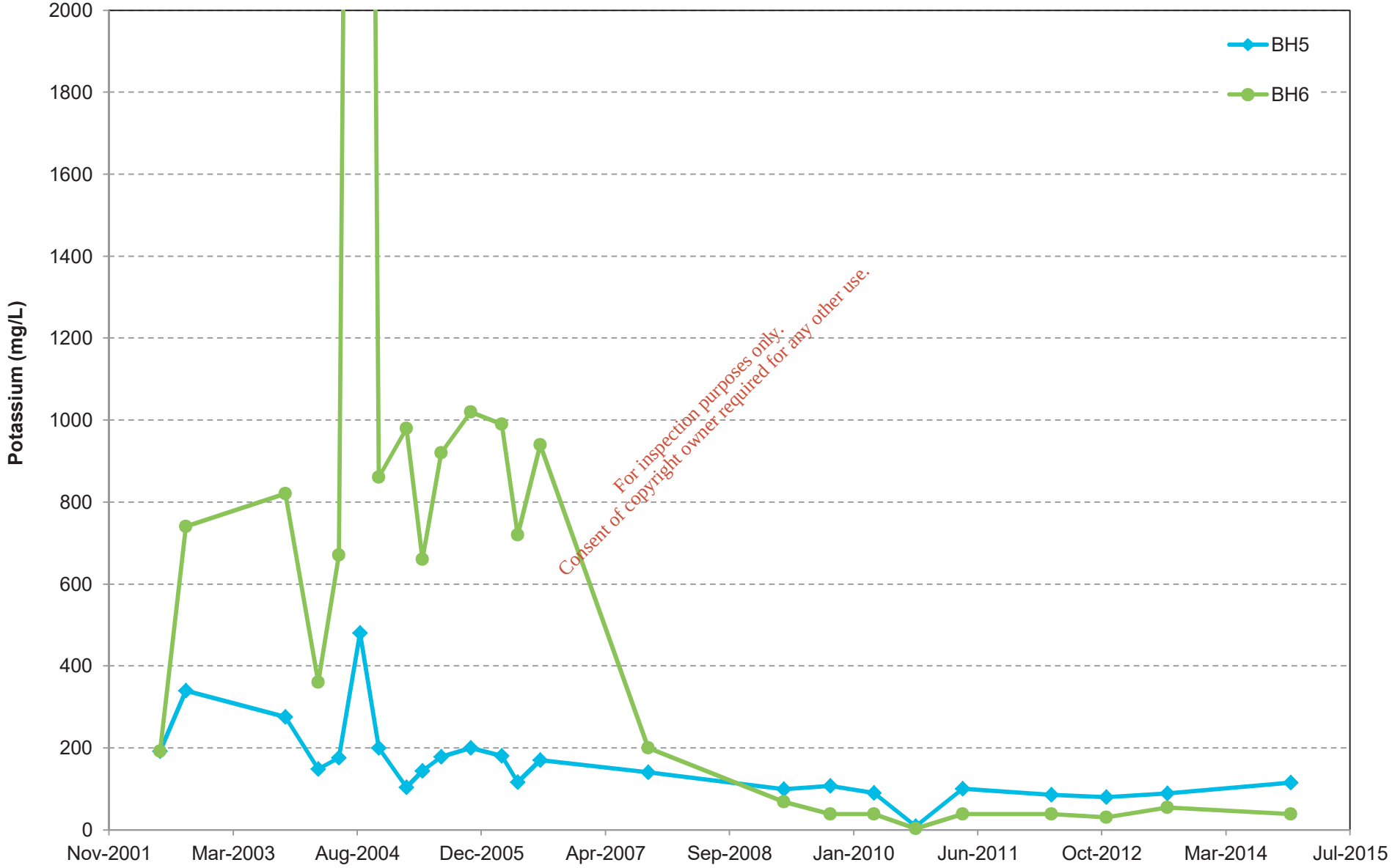
Appendix C - Ballymulvey Landfill Monitoring Data

Chloride Trends in Leachate



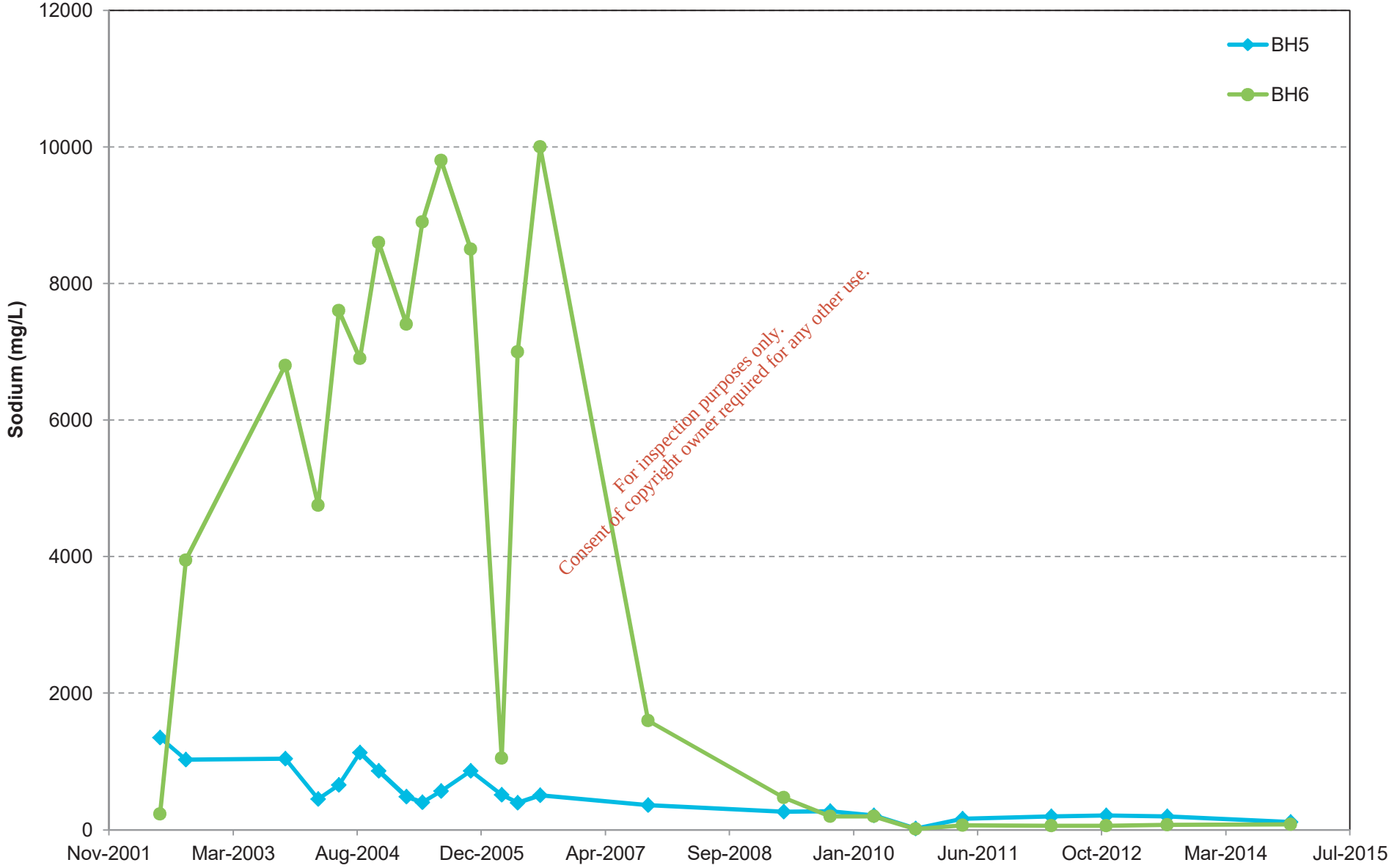
Appendix C - Ballymulvey Landfill Monitoring Data

Potassium Trends in Leachate



Appendix C - Ballymulvey Landfill Monitoring Data

Sodium Trends in Leachate



Data from ballymahon landfill.xls

All other data from *Ballymulvey monitoring data.xlsx*

Assumed units

Blank cell indicates no data

Station Name	Sample Date	Depth	pH	Conductivity	Conductivity	Dissolved Oxygen	Dissolved Oxygen	Temperature	Ammonia	Nitrate	Total Oxidised Nitrogen	Total Organic Carbon	Total Alkalinity
		m		µS/cm @ 20°C	µS/cm @ 25°C	mg/L	% Saturation	°C	NH_4 as N mg/L	NO_3 mg/L	mg/L	mg/L	$CaCO_3$ mg/L
Groundwater Threshold Value, SI 366 2016				800 - 1875					0.065 - 0.175	37.5			
Interim Guideline value, EPA 2003			6.5 - 9.5							25			
BH1 Average		1.39	7.1	1535		2.0		10.9	33	1.7		23	
BH1 Standard Deviation		0.21	0.4	1203		2.0		1.9	42	3.4		16	
BH1 Maximum		1.80	8.7	6520		7.4		14.4	168	15		80	
BH1 Minimum		1.00	6.8	287		0.2		7.6	0.27	0.25		3	
BH1	29-May-2002		7.0	1285		7.4			15		<0.3	3	508
BH1	11-Sep-2002		6.9	1369		5.1			14		<0.3	19	1696
BH1	06-Nov-2003	AR	6.9	986		1.4		9.2	8.7	2.3	NT	18	1400
BH1	25-Feb-2004	1.20	8.7	3320		3.1		7.9	111		NT	45	
BH1	19-May-2004	1.60	7.1	6520		0.6		10.5	48		NT	32	
BH1	12-Aug-2004	1.80	6.9	1781		0.3		14.4	75	<1	NT	43	
BH1	27-Oct-2004	1.30	7.1	1618		1.3		12.3	27	<1	NT	19	
BH1	16-Feb-2005	1.30	7.0	1569		2.3		9.1	22	0.94	NT	39	
BH1	20-Apr-2005	1.00	7.1	1969		1.5		9.3	30	0.93	NT	18	
BH1	06-Jul-2005	1.80	7.2	1461		0.8		11.9	110	0.81	NT	33	
BH1	02-Nov-2005	1.30	7.0	1264		1.8		13.0	30	0.75	NT	19	
BH1	07-Mar-2006	1.40	7.1	1163		6.5		8.6	7.9	1.8	NT	18	
BH1	09-May-2006	1.30	7.1	942		1.6		9.5	7.9	1.9	NT	21	
BH1	09-Aug-2006	1.65	7.0	1851		0.2		13.2	61	0.50	NT	80	
BH1	17-Oct-2007	1.60	7.0	1102		0.3		12.7	26	1.0	NT	24	
BH1	16-Apr-2009	1.60	6.9	693			1.5	9.4	4.3	15		18	
BH1	20-Oct-2009	1.40	7.0	1079		0.8		12.4	12	0.41	NT	20	
BH1	14-Apr-2010	1.20	7.2	579			5.2	7.6	1.2	0.55		5	
BH1	29-Sep-2010	1.30	7.1	1068		1.0		13.5	0.27	0.52	NT	20	
BH1	06-Apr-2011	1.10	7.1	623		4.5		8.9	2.0	0.73	NT	12	
BH1	29-Mar-2012	1.40	7.0	1134		0.9		11.6	13	0.32	NT	12	
BH1	06-Nov-2012	1.20	7.4	287		0.9		11.1	1.6	0.50	NT	4	
BH1	10-Jul-2013	1.50	6.8	2130		0.2		12.1	168	0.65	NT	19	
BH1	19-Nov-2014	1.20	7.3	1044		1.7		11.5	4.2	0.25	NT	6	

Data from ballymahon landfill.xls

All other data from *Ballymulvey monitoring data.xlsx*

Assumed units

Blank cell indicates no data

Station Name	Sample Date	Depth	pH	Conductivity	Conductivity	Dissolved Oxygen	Dissolved Oxygen	Temperature	Ammonia	Nitrate	Total Oxidised Nitrogen	Total Organic Carbon	Total Alkalinity
		m		µS/cm @ 20°C	µS/cm @ 25°C	mg/L	% Saturation	°C	NH_4 as N mg/L	NO_3 mg/L	mg/L	mg/L	$CaCO_3$ mg/L
Groundwater Threshold Value, SI 366 2016				800 - 1875					0.065 - 0.175	37.5			
Interim Guideline value, EPA 2003			6.5 - 9.5							25			
BH2 Average		1.66	6.9	1007		1.8		10.6	12	1.2		17	
BH2 Standard Deviation		0.47	0.1	252		1.4		2.0	9	1.9		13	
BH2 Maximum		2.20	7.2	1381		5.1		13.5	39	8		64	
BH2 Minimum		0.45	6.6	360		0.4		6.8	0.61	0.23		3	
BH2	29-May-2002		7.0	697		5.1			5.4		<0.3	4	380
BH2	11-Sep-2002		6.8	1135		1.6			8.7		<0.3	20	1076
BH2	25-Feb-2004	1.80	6.9	1284		5.1		7.8	5.3		NT	10	
BH2	19-May-2004	1.90	6.7	1011		0.6		10.6	12		NT	13	
BH2	12-Aug-2004	0.45	6.6	1304		1.7		13.5	18	0.80	NT	64	
BH2	27-Oct-2004	2.00	7.0	1315		0.5		12.2	24	<1	NT	23	
BH2	16-Feb-2005	1.50	6.8	888		2.1		6.8	10	2.1	NT	22	
BH2	20-Apr-2005	1.80	6.7	866		3.2		9.9	7.0	1.4	NT	14	
BH2	06-Jul-2005	2.20	7.0	1152		1.3		12.8	9.0	0.57	NT	21	
BH2	07-Mar-2006	1.70	6.8	1095		2.1		8.7	11	0.60	NT	17	
BH2	09-May-2006	1.80	6.8	924		1.3		9.5	8.8	1.0	NT	16	
BH2	09-Aug-2006	2.20	6.9	1284		0.6		12.7	31	0.54	NT	37	
BH2	17-Oct-2007	2.20	6.9	1381		1.1		12.2	39	0.60	NT	33	
BH2	16-Apr-2009	2.00	6.7		1133		1.7	9.7	8.8	8.2		6	
BH2	20-Oct-2009	1.90	6.9		1151		0.4	11.9	17	0.46		15	
BH2	14-Apr-2010	1.40	7.2	360	NT		2.0	7.0	0.61	<0.297		9	
BH2	29-Sep-2010	1.80	6.9	760		1.6		12.5	2.4	0.23	NT	9	
BH2	06-Apr-2011	1.60	6.8	861		2.8		8.9	2.1	0.31	NT	7	
BH2	29-Mar-2012	1.70	6.7	962		0.8		9.9	7.6	0.31	NT	7	
BH2	06-Nov-2012	0.60	6.7	801		0.6		11.0	4.1	0.45	NT	3	
BH2	10-Jul-2013	1.00	6.8	1055		0.4		13.0	12	0.43	NT	13	
BH2	19-Nov-2014	1.60	7.2		375	0.9	NT	11.8	12	0.41		6	

Data from ballymahon landfill.xls

All other data from *Ballymulvey monitoring data.xlsx*

Assumed units

Blank cell indicates no data

Station Name	Sample Date	Depth	pH	Conductivity	Conductivity	Dissolved Oxygen	Dissolved Oxygen	Temperature	Ammonia	Nitrate	Total Oxidised Nitrogen	Total Organic Carbon	Total Alkalinity
		m		µS/cm @ 20°C	µS/cm @ 25°C	mg/L	% Saturation	°C	NH_4 as N mg/L	NO_3 mg/L	mg/L	mg/L	$CaCO_3$ mg/L
Groundwater Threshold Value, SI 366 2016				800 - 1875					0.065 - 0.175	37.5			
Interim Guideline value, EPA 2003			6.5 - 9.5							25			
BH3 Average		0.49	7.1	1137		2.1		10.5	15	1.1		21	
BH3 Standard Deviation		0.47	0.2	322		1.5		2.4	16	1.2		21	
BH3 Maximum		2.35	7.4	2030		7.5		14.9	60	5		87	
BH3 Minimum		0.20	6.7	749		0.2		6.5	0.38	0.18		2	
BH3	29-May-2002		7.1	1107		7.5			4.3		<0.3	3	400
BH3	11-Sep-2002		6.8	1513		2.9			8.8		<0.3	25	872
BH3	16-Oct-2003	0.90	6.7	1023		1.3		12.3	38	5.0	NT	87	
BH3	25-Feb-2004	0.30	6.8	2030		4.4		7.3	3.5		NT	21	
BH3	19-May-2004	0.60	6.7	977		0.9		10.0	3.0		NT	21	
BH3	12-Aug-2004	2.35	6.8	1515		0.2		14.9	52	<1	NT	78	
BH3	27-Oct-2004	0.40	7.0	968		2.1		11.0	6.5	<1	NT	20	
BH3	16-Feb-2005	0.30	7.2	1167		1.6		7.8	11	<1	NT	22	
BH3	20-Apr-2005	0.30	7.0	1150		2.4		8.9	11	0.18	NT	15	
BH3	06-Jul-2005	0.50	7.1	1182		2.6		12.9	60	0.37	NT	20	
BH3	02-Nov-2005	0.30	7.0	1098		2.0		12.2	8.5	1.5	NT	21	
BH3	07-Mar-2006	0.20	6.9	1394		2.7		6.5	4.0	0.20	NT	16	
BH3	09-May-2006	0.30	7.3	788		1.8		9.4	0.38	0.59	NT	13	
BH3	09-Aug-2006	0.40	7.2	775		1.3		14.4	2.5	1.5	NT	28	
BH3	16-Apr-2009	0.30	7.0		1550		1.5	8.8	7.1	1.5		15	
BH3	20-Oct-2009	0.20	7.2	850		1.4		11.8	10	0.18	NT	8	
BH3	14-Apr-2010	0.30	7.2	1502	NT		6.6	7.0	12	0.23		4	
BH3	29-Sep-2010	0.30	7.1	824		1.8		13.0	13	1.2	NT	10	
BH3	06-Apr-2011	0.30	7.0	1451		2.0		8.6	7.7	0.20	NT	11	
BH3	06-Nov-2012	0.20	7.4	770		1.5		9.7	26	2.5	NT	2	
BH3	10-Jul-2013	0.40	7.2	1038		1.1		13.1	36	0.68	NT	15	
BH3	19-Nov-2014	1.00	7.3	749		1.5		10.9	2.0	0.41	NT	8	

Data from ballymahon landfill.xls

All other data from *Ballymulvey monitoring data.xlsx*

Assumed units

Blank cell indicates no data

Station Name	Sample Date	Calcium	Chloride	Cyanide	Magnesium	Potassium	Sodium	Sulphate	Boron	Cadmium	Copper	Chromium	Iron	Lead	Manganese	Mercury	Nickel	Zinc
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Groundwater Threshold Value, SI 366 2016			24 - 187.5									0.0075		0.0075		0.00075		0.075
Interim Guideline value, EPA 2003		200	30	0.01	50	5	150	200	1	0.005	0.030	0.030	0.20	0.010	0.05	0.001	0.02	0.10
BH1 Average		251	34		25	20	24		0.21			0.089	9.1		1.6		0.68	0.14
BH1 Standard Deviation		59	27		11	14	12		0.27			0.263	36		1.0		2.5	0.27
BH1 Maximum		383	148		61	59	42		1.20			1	177		4.6		10	0.96
BH1 Minimum		163	8		4	1	1		0.04			0.001	0.02		0.25		0.001	0.004
BH1	29-May-2002	250	40	<0.05	19	9	36	114		<0.0004	0.005		0.18	<0.0005	2.1	<0.05	<0.01	0.005
BH1	11-Sep-2002	245	41	<0.05	20	13	24	23		<0.0004	0.008		0.98	<0.0005	1.3	<0.05	<0.01	0.007
BH1	06-Nov-2003	NT	30	<0.05	NT	10	20	NT		<0.4	<5		0.83	<0.005	0.62	<0.05	<0.001	0.007
BH1	25-Feb-2004	257	42	<0.05	26	29	37		<0.05	<0.4	<5	1	0.021	<5	1.3	<0.05	<10	<5
BH1	19-May-2004	232	40	<0.05	22	23	35		<0.05	<0.4	<5	<1	0.17	<5	1.7	<0.05	10	<5
BH1	12-Aug-2004	247	47	<0.05	23	58	26		<0.05	<0.4	<5	<1	0.24	0.008	1.4	<0.05	<10	0.60
BH1	27-Oct-2004	334	23	<0.05	28	18	38		0.07	<0.4	<5	<1	0.039	<5	2.9	<0.05	<10	<5
BH1	16-Feb-2005	383	27	<0.05	30	19	41		0.09	<0.4	<5	<1	0.076	<5	2.7	0.00006	<10	<5
BH1	20-Apr-2005	291	21	<0.05	29	17	36		0.10	<0.4	<1	0.021	0.17	<1	2.8	<0.05	<1	<3
BH1	06-Jul-2005	163	40	<0.05	61	19	38		1.20	<0.4	<1	0.016	<5	<1	1.2	<0.05	0.004	0.21
BH1	02-Nov-2005	228	17	<0.05	24	16	23		0.16	<1	<1	0.014	2.1	<1	2.0	<0.05	0.030	0.015
BH1	07-Mar-2006	188	37	<0.05	22	33	17		0.09	<1	<1	0.007	0.64	0.001	1.2	<0.05	0.005	0.016
BH1	09-May-2006	170	20	<0.05	20	13	15		0.21	<1	<1	0.021	0.18	<1	1.6	<0.05	0.007	0.015
BH1	09-Aug-2006	269	40	<0.05	28	23	25		0.12	<1	<1	0.017	12	<1	3.1	<0.05	0.003	0.011
BH1	17-Oct-2007		27	<0.05	20	19	14		0.13	<0.4	<1	0.017	0.26	0.006	1.5	<0.05	0.005	0.004
BH1	16-Apr-2009		148	<0.05	23	9	13		0.08	<0.00022	0.006	0.009	0.15	0.001	0.85	<0.00001	0.004	0.012
BH1	20-Oct-2009		18	<0.01	38	17	27		0.44	0.01	0.005	0.031	177	0.079	4.6	<0.00005	0.181	0.96
BH1	14-Apr-2010		8	<0.0007	22	6	5		0.06	<0.0005	0.009	0.001	9.5	0.005	0.55	<0.00005	0.004	0.028
BH1	29-Sep-2010		19	<5	4	1	1		<10	<0.5	<1	<0.5	0.41	<0.5	0.85	<0.05	0.001	<5
BH1	06-Apr-2011		15	<10	24	59	42		0.12	<0.5	<1	<0.5	0.66	<0.5	0.79	<0.05	0.001	<5
BH1	29-Mar-2012		28	<10	27	8	16		0.09	0.00	<1	0.003	0.91	<0.5	1.3	<0.05	0.014	0.14
BH1	06-Nov-2012		11	<0.009	8	12	3		0.04	<0.5	<1	<0.5	1.6	<0.5	0.28	<0.05	<0.5	<5
BH1	10-Jul-2013		NT	<0.009	36	23	21		0.16	<0.5	<1	0.001	0.29	<0.5	0.63	<0.05	0.002	<5
BH1	19-Nov-2014		NT	<0.009	20	15	18		0.40	<0.5	<1	<0.5	0.10	0.004	0.25	<0.05	0.004	NT

Data from ballymahon landfill.xls

All other data from *Ballymulvey monitoring data.xlsx*

Assumed units

Blank cell indicates no data

Station Name	Sample Date	Calcium	Chloride	Cyanide	Magnesium	Potassium	Sodium	Sulphate	Boron	Cadmium	Copper	Chromium	Iron	Lead	Manganese	Mercury	Nickel	Zinc
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Groundwater Threshold Value, SI 366 2016			24 - 187.5									0.0075		0.0075		0.00075		0.075
Interim Guideline value, EPA 2003		200	30	0.01	50	5	150	200	1	0.005	0.030	0.030	0.20	0.010	0.05	0.001	0.02	0.10
BH2 Average		203	26		16	10	18		0.15			0.012	13.2	0.013	1.7	0.04	0.014	0.17
BH2 Standard Deviation		51	35		12	9	16		0.30			0.009	34	0.023	0.7	0.03	0.029	0.30
BH2 Maximum		297	139		60	39	82		1.20			0.028	157	0.073	2.9	0.07	0.115	1.1
BH2 Minimum		120	3		1	3	2		0.03			0.001	0.01	0.001	0.26	0.00	0.002	0.003
BH2	29-May-2002	120	17	<0.05	8	4	32	15		<0.0004	0.007		0.052	<0.005	1.2	<0.05	<0.01	0.21
BH2	11-Sep-2002	202	18	<0.05	12	6	19	<3		<0.0004	<0.005		11	<0.0005	2.0	0.07	<0.01	0.006
BH2	25-Feb-2004	143	7	<0.05	9	5	14		<0.05	<0.4	<5	<1	0.008	<5	0.85	<0.05	<10	<5
BH2	19-May-2004	190	9	<0.05	14	8	25		<0.05	0.40	<5	<1	<1	<5	1.8	<0.05	<10	<5
BH2	12-Aug-2004	297	139	<0.05	16	32	12		<0.05	<0.4	<5	<1	1.9	<5	2.6	<0.05	<10	<5
BH2	27-Oct-2004	259	9	<0.05	14	12	26		0.06	<0.4	<5	<1	0.082	<5	2.9	<0.05	<10	<5
BH2	16-Feb-2005	185	19	0.08	10	5	13		<0.05	<0.4	<5	<1	0.038	0.006	1.6	0.00	<10	<5
BH2	20-Apr-2005	182	53	<0.05	13	5	20		0.03	<0.4	<1	0.016	0.32	<1	1.8	<0.05	<1	0.003
BH2	06-Jul-2005	160	12	<0.05	60	9	21		1.20	<0.4	<1	0.017	<5	<1	1.2	<0.05	0.003	0.21
BH2	07-Mar-2006	241	3	<0.05	18	7	23		0.05	<1	<1	0.021	0.10	0.002	2.0	<0.05	0.005	0.022
BH2	09-May-2006	187	15	<0.05	13	5	11		0.15	<1	<1	0.028	0.084	<1	1.7	<0.05	0.006	0.018
BH2	09-Aug-2006	271	16	<0.05	18	9	12		0.06	<1	<1	0.013	0.26	<1	2.5	<0.05	0.004	0.010
BH2	17-Oct-2007		12	<0.05	16	9	11		0.05	<0.4	<1	0.025	2.6	0.006	2.7	<0.05	0.005	0.004
BH2	16-Apr-2009		114	<0.05	11	4	7		0.04	<0.00022	0.007	0.011	5.8	0.001	2.0	<0.00001	0.003	0.007
BH2	20-Oct-2009		16	<0.01	26	11	18		0.16	0.01	0.004	0.014	157	0.073	2.9	<0.00005	0.115	1.1
BH2	14-Apr-2010		6	0.00	41	39	82		<0.01	<0.0005	0.007	<0.0005	0.24	0.007	0.88	<0.00005	0.005	<0.005
BH2	29-Sep-2010		11	0.01	1	<0.5	<1		<10	<0.5	<1	0.001	16	<0.5	1.4	<0.05	0.002	<5
BH2	06-Apr-2011		10	<10	7	3	2		0.03	<0.5	<1	<0.5	0.91	<0.5	0.79	<0.05	0.002	<5
BH2	29-Mar-2012		17	<10	8	14	6		0.03	0.00	<1	0.002	33	<0.5	1.2	<0.05	0.018	<5
BH2	06-Nov-2012		8	<0.009	9	6	5		0.04	0.01	0.097	0.003	34	0.011	1.2	<0.05	0.017	0.31
BH2	10-Jul-2013		NT	<0.009	12	7	7		0.04	<0.5	<1	0.001	1.4	<0.5	0.95	<0.05	0.002	<5
BH2	19-Nov-2014			<0.009	14	9	15		0.23	<0.5	<1	0.001	0.62	0.002	0.26		0.003	<5

Appendix C Table 3 - Groundwater Monitoring Data
Ballymulvey Landfill, Longford County Council

Data from ballymahon landfill.xls

All other data from *Ballymulvey monitoring data.xlsx*

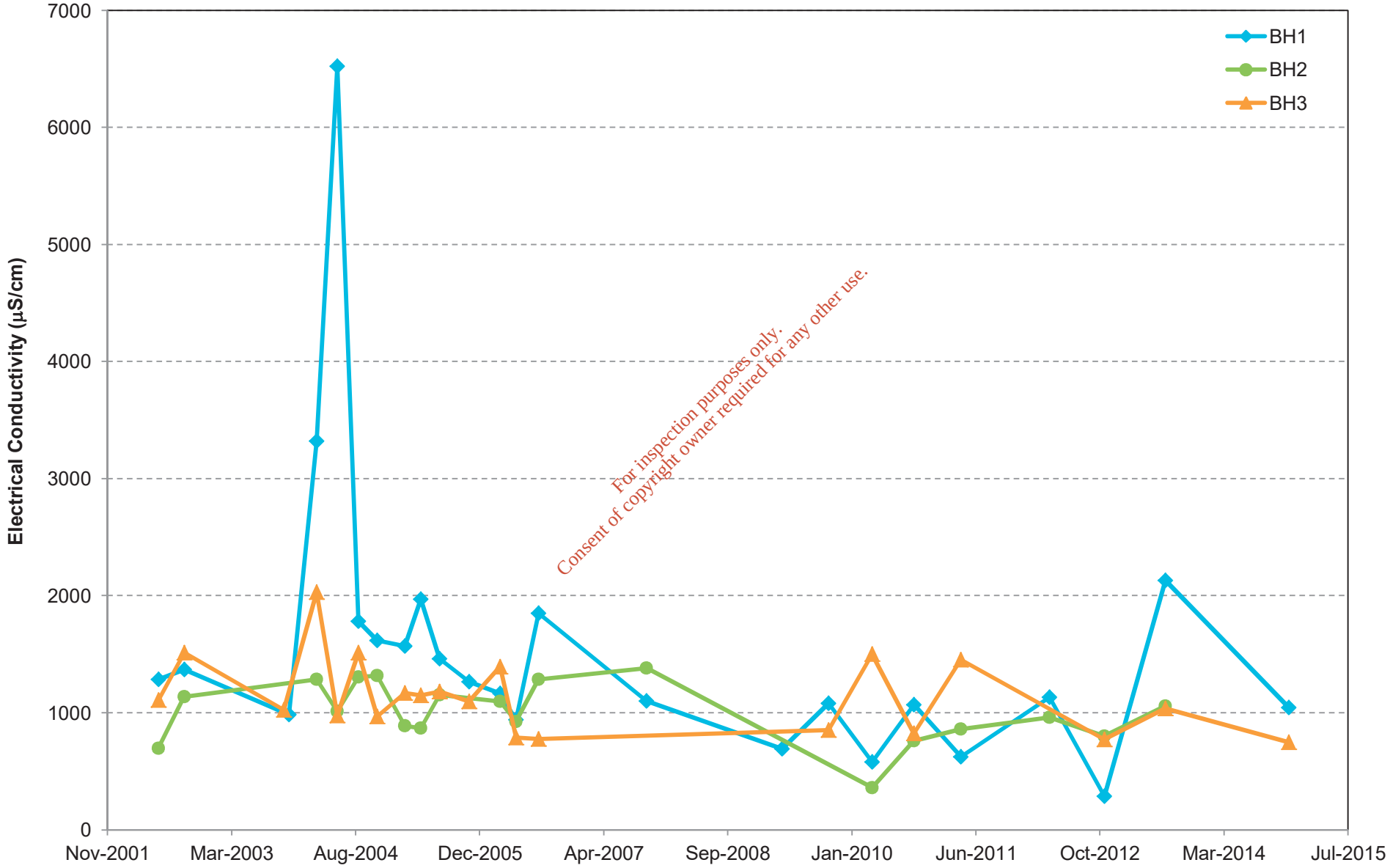
Assumed units

Blank cell indicates no data

Station Name	Sample Date	Calcium	Chloride	Cyanide	Magnesium	Potassium	Sodium	Sulphate	Boron	Cadmium	Copper	Chromium	Iron	Lead	Manganese	Mercury	Nickel	Zinc
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Groundwater Threshold Value, SI 366 2016			24 - 187.5									0.0075		0.0075		0.00075		0.075
Interim Guideline value, EPA 2003		200	30	0.01	50	5	150	200	1	0.005	0.030	0.030	0.20	0.010	0.05	0.001	0.02	0.10
BH3 Average		129	95	0.01	32	30	72		0.20			0.010	1.7		0.6		0.003	0.47
BH3 Standard Deviation		25	53		38	17	38		0.27			0.006	5	0.005	0.4	0.00	0.002	1.43
BH3 Maximum		174	208	0.01	184	78	145		1.20			0.018	25		1.5		0.011	5.0
BH3 Minimum		87	6	0.01	2	2	3		0.04			0.001	0.03		0.09		0.001	0.006
BH3	29-May-2002	140	<0.001	<0.05	13	15	41	9		<0.004	0.005		0.033	<0.005	1.4	<0.05	<0.01	0.011
BH3	11-Sep-2002	162	208	<0.05	17	29	92	<3		<0.0004	<0.005		2.0	0.005	1.5	<0.05	0.011	0.017
BH3	16-Oct-2003	NT	25	<0.05	NT	72	87	NT		<0.4	<5		1.6	<5	0.72	<0.05	<10	0.006
BH3	25-Feb-2004	144	145	<0.05	22	32	120		<0.05	<0.4	<5		0.59	<5	0.70	<0.05	<10	<5
BH3	19-May-2004	113	108	<0.05	<16.67	31	85		0.05	<0.4	<5	<1	0.29	<5	0.61	<0.05	<10	<5
BH3	12-Aug-2004	115	18	<0.05	19	78	96		<0.05	<0.4	<5	<1	0.35	<5	0.74	<0.05	<10	5.0
BH3	27-Oct-2004	87	133	<0.05	13	33	125		0.07	<0.4	<5	<1	1.6	<5	0.63	<0.05	<10	<5
BH3	16-Feb-2005	150	52	<0.05	25	24	88		0.07	<0.4	<5	<1	0.35	0.006	0.96	0.00	<10	<5
BH3	20-Apr-2005	141	120	<0.05	27	32	95		0.30	<0.4	<1	0.018	0.68	<1	1.0	<0.05	<1	<3
BH3	06-Jul-2005	136	125	<0.05	59	34	110		1.20	<0.4	<1	0.015	<5	<1	0.98	<0.05	0.003	0.013
BH3	02-Nov-2005	108	159	<0.05	184	33	102		0.13	<1	<1	0.008	0.34	<1	0.15	<0.05	0.003	0.016
BH3	07-Mar-2006	174	131	<0.05	35	45	145		0.10	<1	<1	0.010	0.062	0.002	0.61	<0.05	0.004	0.019
BH3	09-May-2006	100	33	<0.05	18	22	43		0.15	<1	<1	0.014	0.12	<1	0.10	<0.05	0.004	0.021
BH3	09-Aug-2006	101	57	<0.05	17	29	51		0.10	1.00	<1	0.003	0.17	<1	0.19	<0.05	0.004	0.015
BH3	16-Apr-2009		139	<0.05	39	33	83		0.13	<0.00022	0.003	0.010	0.083	0.000	0.44	<0.00001	0.005	0.007
BH3	20-Oct-2009		51	<0.01	19	30	56		0.17	<0.0005	0.002	<0.0005	1.3	0.016	0.47	<0.00005	0.003	0.032
BH3	14-Apr-2010		106	<0.0007	4	3	3		0.04	<0.0005	0.002	<0.0005	25	<0.0005	0.40	<0.00005	0.001	<0.005
BH3	29-Sep-2010		93	<5	2	2	4		<10	<0.5	<1	<0.5	0.064	<0.5	0.33	<0.05	0.001	<5
BH3	06-Apr-2011		89	<10	51	32	60		0.18	<0.5	<1	<0.5	0.11	<0.5	0.56	<0.05	0.002	<5
BH3	06-Nov-2012		6	<0.009	14	19	27		0.11	<0.5	<1	<0.5	0.040	<0.5	0.09	<0.05	<0.5	<5
BH3	10-Jul-2013		NT	<0.009	25	22	33		0.13	<0.5	<1	0.001	0.057	<0.5	0.74	<0.05	0.002	<5
BH3	19-Nov-2014		NT	0.01	41	12	35		0.21	<0.5	<1	<0.5	0.072	0.004	0.42	<0.05	0.002	<5

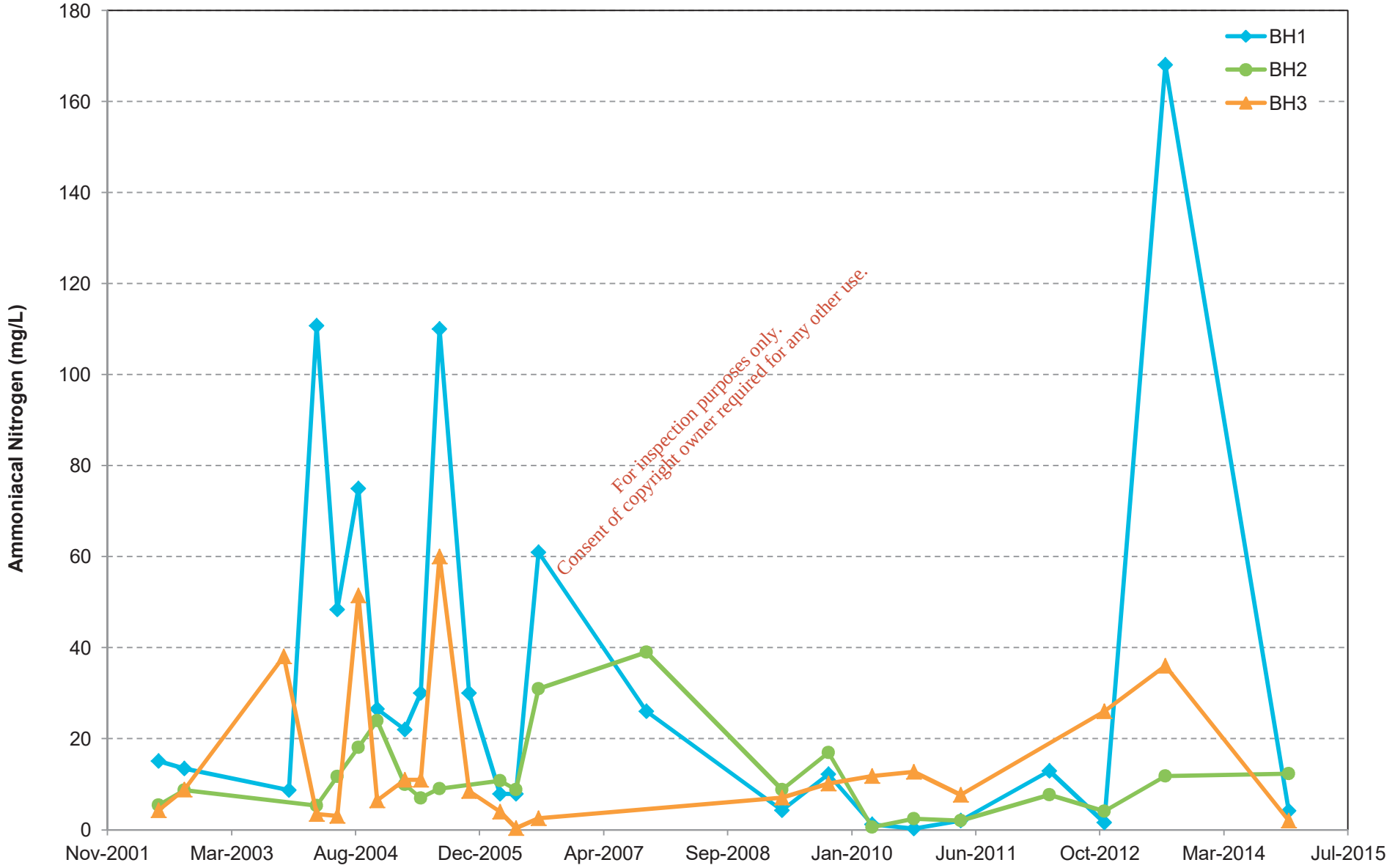
Appendix C - Ballymulvey Landfill Monitoring Data

Electrical Conductivity Trends in Groundwater



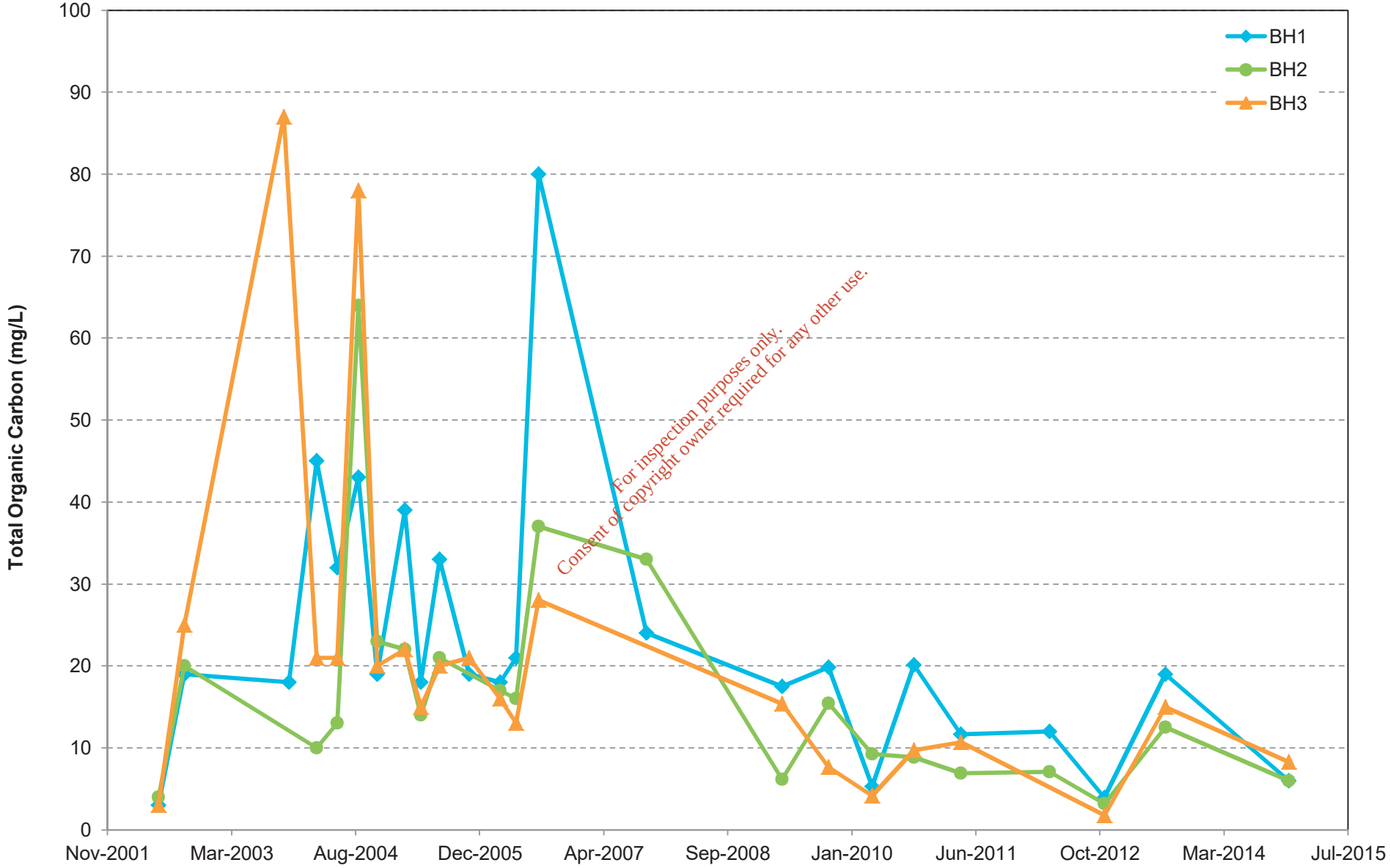
Appendix C - Ballymulvey Landfill Monitoring Data

Ammoniacal Nitrogen Trends in Groundwater



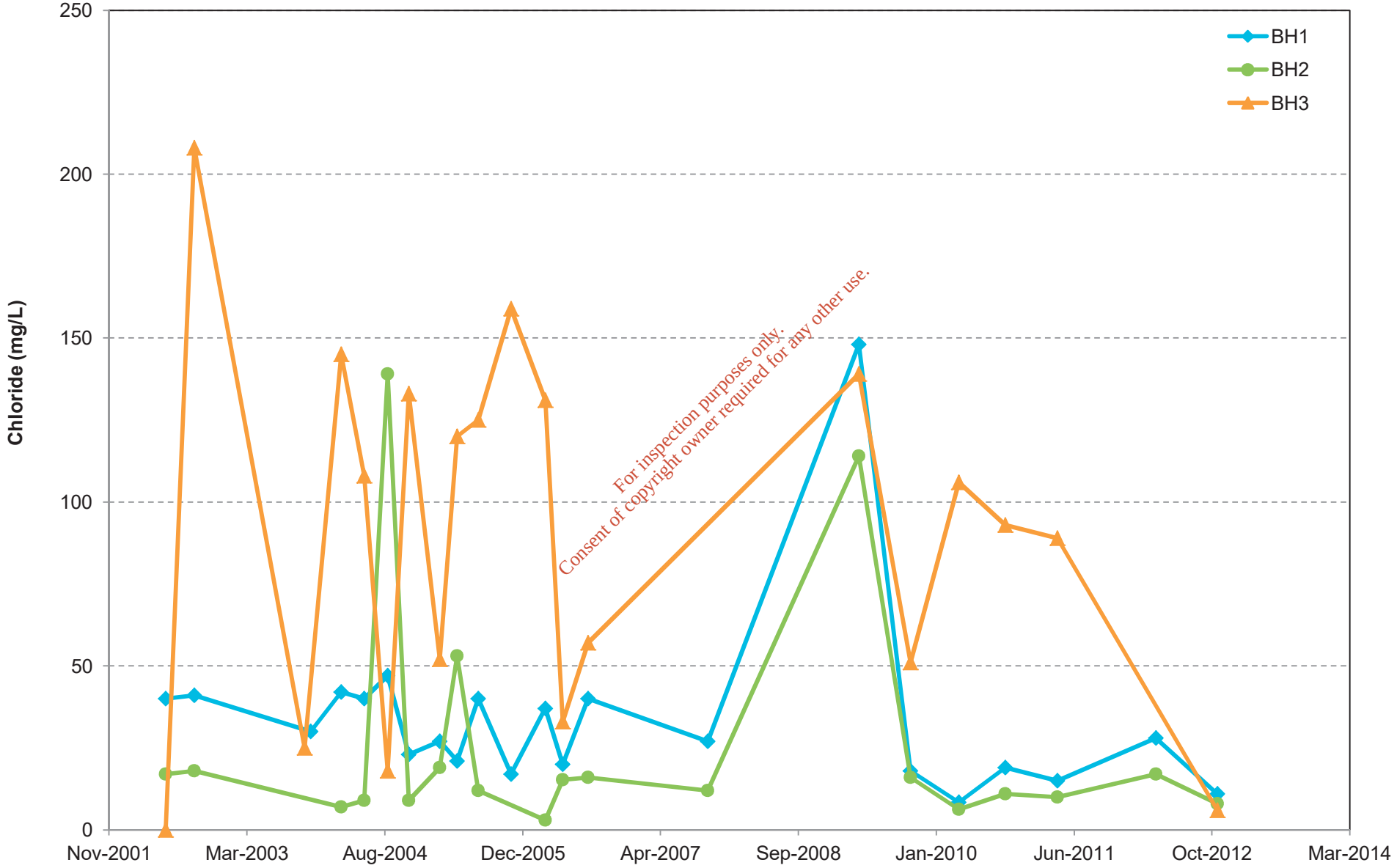
Appendix C - Ballymulvey Landfill Monitoring Data

Total Organic Carbon Trends in Groundwater



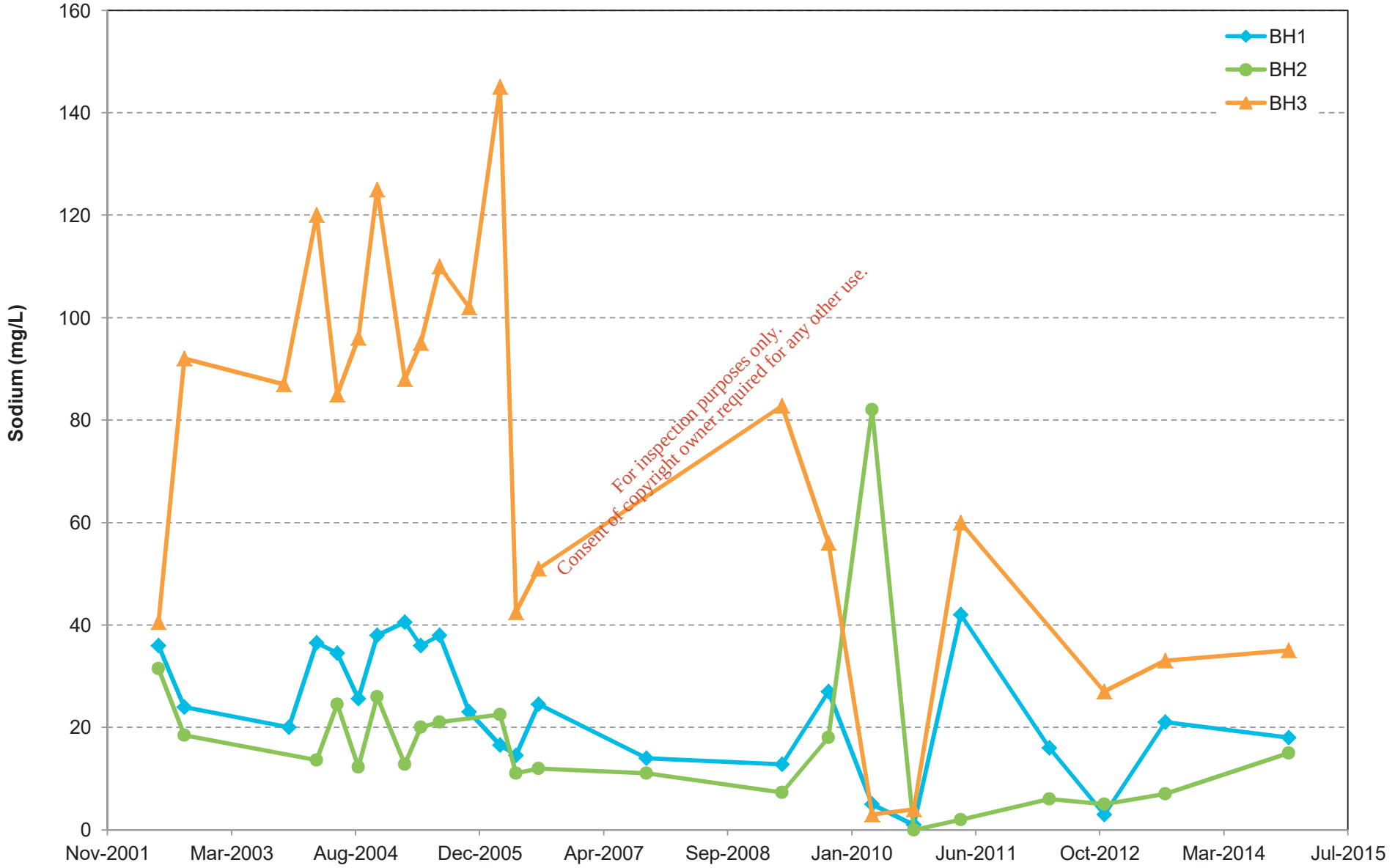
Appendix C - Ballymulvey Landfill Monitoring Data

Chloride Trends in Groundwater



Appendix C - Ballymulvey Landfill Monitoring Data

Sodium Trends in Groundwater



Data from *ballymahon landfill.xls*
All other data from
Ballymulvey monitoring data.xlsx
Assumed units
Blank cell indicates no data

Station Name	Sample Date	pH	Conductivity	Dissolved Oxygen	Temperature	Chemical Oxygen Demand	Biological Oxygen Demand	Suspended Solids	Ammonia	Nitrate (NO_3)	Chloride	Ortho-phosphate	Total Phosphorus	Cadmium	Chromium	Copper	Zinc
			µS/cm @ 20°C	mg/L	°C	mg/L	mg/L	mg/L	NH_4 as N mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Inland Surface Water EQS, AA, High Status, SI 272 2009				>80%			<1.3		<0.04			<0.025			0.0034	0.005	0.008
Inland Surface Water EQS, AA, High Status, SI 386 2015														0.00008			
SS1 Average		7.5	2055	3.8	10.6	76	9	14	24	7.9	172	0.17			0.56		0.356
SS1 Standard Deviation		0.22	1584	1.8	4.0	123	11	26	78	11	125	0.34			1.8		1.2
SS1 Maximum		7.9	8130	9.3	19.0	646	55	130	384	43	486	1.4			7.0		5
SS1 Minimum		7.1	225	1.5	3.5	9	1	1	0.73	1.1	30	0.016			0.001		0.006
SS1	29-May-2002	7.1	1162	7.2	14.8	47	5		1.5		99						
SS1	11-Sep-2002	7.8	2010	4.9	19.0	116	21		18		486						
SS1	16-Oct-2003	7.7	1824	3.0	11.3	92	4	2	6.9	2.0	374			<0.4	7	<5	<5
SS1	25-Feb-2004	7.3	1857	2.7	4.2	9	4	8	55		138			0.0026	<1	<5	0.035
SS1	19-May-2004	7.5	8130	4.4	13.9	646	55	130	384	3.0	154	1.38		<0.4	<1	<5	5
SS1	12-Aug-2004	7.7	1865	3.5	15.9	97	6	13	3.3	3.3	370	0.19		0.4	<1	<5	<5
SS1	27-Oct-2004	7.2	1334	2.5	8.1	24	1	7	0.90	1.8	71	<0.01		0.0099	0.012	0.01	0.078
SS1	16-Feb-2005	7.5	1604	1.5	3.5	27	4	2	<0.05	8.4	250	<0.01		<0.4	<1	<5	0.028
SS1	20-Apr-2005	7.3	1258	4.9	7.4	27	4	4	1.67	4.7	77	<0.01		<0.4	0.019	0.002	0.014
SS1	06-Jul-2005	7.9	1752	5.2	14.8	79	6	2	0.73	1.8	180	0.068		<0.4	0.259	<1	NT
SS1	02-Nov-2005	7.2	1319	3.9	10.0	29	2	1	0.85	2.1	30	0.019		<1	0.008	<1	0.019
SS1	07-Mar-2006	7.1	803	9.3	4.1	58	4	10	2.2	3.0	32	0.028		<1	0.008	<1	0.024
SS1	09-May-2006	7.6	1392	5.0	10.8	32	3	4	1.9	6.4	98	0.069		<1	0.024	<1	0.028
SS1	09-Aug-2006	7.8	1661	3.5	14.4	110	10	25	1.0	1.1	230	0.11		<1	0.005	<1	0.006
SS1	17-Oct-2007	7.8	2180	3.3	8.7	72	5	9	5.8	2.3	190	0.16		<0.4	0.018	<1	<1
SS1	16-Apr-2009	7.3	1970	3.1	9.9	41	3	6	4.8	42	154		<0.2	<0.00022	0.0111	0.00407	0.0112
SS1	20-Oct-2009	7.3	1931	1.6	10.0	46	7	6	8.8	3.5	138	<0.2	NT	<0.0005	<0.0005	0.002	0.012
SS1	14-Apr-2010	7.4	1559	3.9	6.5	26	3	7	8.0	7.2	64	<0.02	NT	<0.0005	<0.0005	0.002	0.027
SS1	29-Sep-2010	7.4	1250	2.2	10.8	26	7	16	3.1	4.4	57	0.023	NT	<0.5	<0.5	0.002	0.011
SS1	06-Apr-2011	7.3	3930	4.6	14.7	72	4	8	64	43	371	0.026	NT	<0.5	0.003	0.002	<5
SS1	29-Mar-2012	7.5	225	4.4	7.7	35	7	7	18	10	174	0.021	NT	<0.5	<0.5	<1	<0.013
SS1	06-Nov-2012	7.2	5120	2.5	7.3	26	8	9	5.5	6.2	42	0.016	NT	<0.5	0.001	0.001	0.022
SS1	10-Jul-2013	7.6	2150	2.5	15.6	84	26	22	1.4	1.9		0.14	NT	<0.5	0.009	0.001	0.03
SS1	19-Nov-2014	7.5	1044	1.6	9.8	15	8	8	3.9	8.3		0.16	NT	<0.5	0.5	0.002	<0.005

Data from *ballymahon landfill.xls*
All other data from
Ballymulvey monitoring data.xlsx
Assumed units
Blank cell indicates no data

Station Name	Sample Date	pH	Conductivity	Dissolved Oxygen	Temperature	Chemical Oxygen Demand	Biological Oxygen Demand	Suspended Solids	Ammonia	Nitrate (NO_3)	Chloride	Ortho-phosphate	Total Phosphorus	Cadmium	Chromium	Copper	Zinc
			µS/cm @ 20°C	mg/L	°C	mg/L	mg/L	mg/L	NH_4 as N mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
SS2 Average		7.0	682	4.7	11.0	96	4	6	0	1.3	28	0.03			0.13		1.263
SS2 Standard Deviation		0.31	979	2.4	4.2	25	4	3	0	0	9	0.02			0.3		2.2
SS2 Maximum		7.7	4820	11.5	17.3	161	15	14	2	3	53	0.1			1.0		5
SS2 Minimum		6.4	296	1.5	3.7	49	1	1	0.00	0.8	17	0.002			0.002		0.006
SS2	29-May-2002	7.2	468	8.4	17.1	161	2		0.40		29						
SS2	11-Sep-2002	6.4	500	2.3	17.3	109	5		0.40		53						
SS2	16-Oct-2003	7.0	301	4.8	10.6	120	12	5	1.7	1.2	23			<0.4	<1	<5	<5
SS2	25-Feb-2004	6.9	518	5.2	4.0	64	1	4	0.60		34			0.0058	<1	<5	<5
SS2	19-May-2004	6.8	432	5.1	14.5	76	2	9	<0.01	1.3	24	0.015		<0.4	<1	<5	<5
SS2	12-Aug-2004	6.9	347	4.7	16.5	104	6	14	1.3	<1	25	0.094		<0.4	<1	<5	5
SS2	27-Oct-2004	6.9	389	5.3	8.7	118	2	5	0.090	1.9	30	0.023		<0.4	<1	<5	<5
SS2	16-Feb-2005	6.9	546	1.6	5.2	76	1	1	0.35	2.6	25	0.003		<0.4	1	<5	5
SS2	20-Apr-2005	7.0	490	4.2	7.6	83	2	4	0.036	1.4	18	0.002		<0.4	0.013	<1	<3
SS2	06-Jul-2005	7.2	4820	4.5	15.5	101	7	8	0.005	1.1	20	0.030		<0.4	0.244	0.001	NT
SS2	02-Nov-2005	6.5	429	2.6	11.3	103	1	3	0.31	1.1	31	0.018		<1	0.002	<1	0.018
SS2	01-Mar-2006	7.3	513	7.3	3.7	49	1	4	0.24	0.83	43	0.003		<1	0.006	<1	<1
SS2	03-May-2006	7.3	485	4.4	8.7	92	6		0.002	0.91	23	<0.01		<1	0.009	<1	0.014
SS2	02-Aug-2006	6.7	296	3.2	15.0	94	5	3	<0.01	1.6	17	0.061		<1	0.003	<1	0.022
SS2	14-Apr-2010	7.4	361	11.5	7.4	117	15		0.076	1.3	23	<0.02	NT	0.0005	0.005	0.001	0.006
SS2	29-Sep-2010	6.8	352	1.5	12.3	117	2	13	0.15	1.4	28	0.015	NT	<0.5	0.002	0.002	0.033
SS2	06-Apr-2011	7.1	608	5.0	13.6	78	1	6	0.21	0.83	26	0.022	NT	<0.5	<0.5	<1	<5
SS2	29-Mar-2012	7.3	591	6.1	8.9	76	1	4	0.061	0.79	33	0.033	NT	<0.5	<0.5	<1	<5
SS2	07-May-2014	7.7	507	2.4	10.7	78	2	9	0.053	1.1		0.025	NT	<0.03	0.00208	<0.85	0.00877

Data from *ballymahon landfill.xls*
All other data from
Ballymulvey monitoring data.xlsx
Assumed units
Blank cell indicates no data

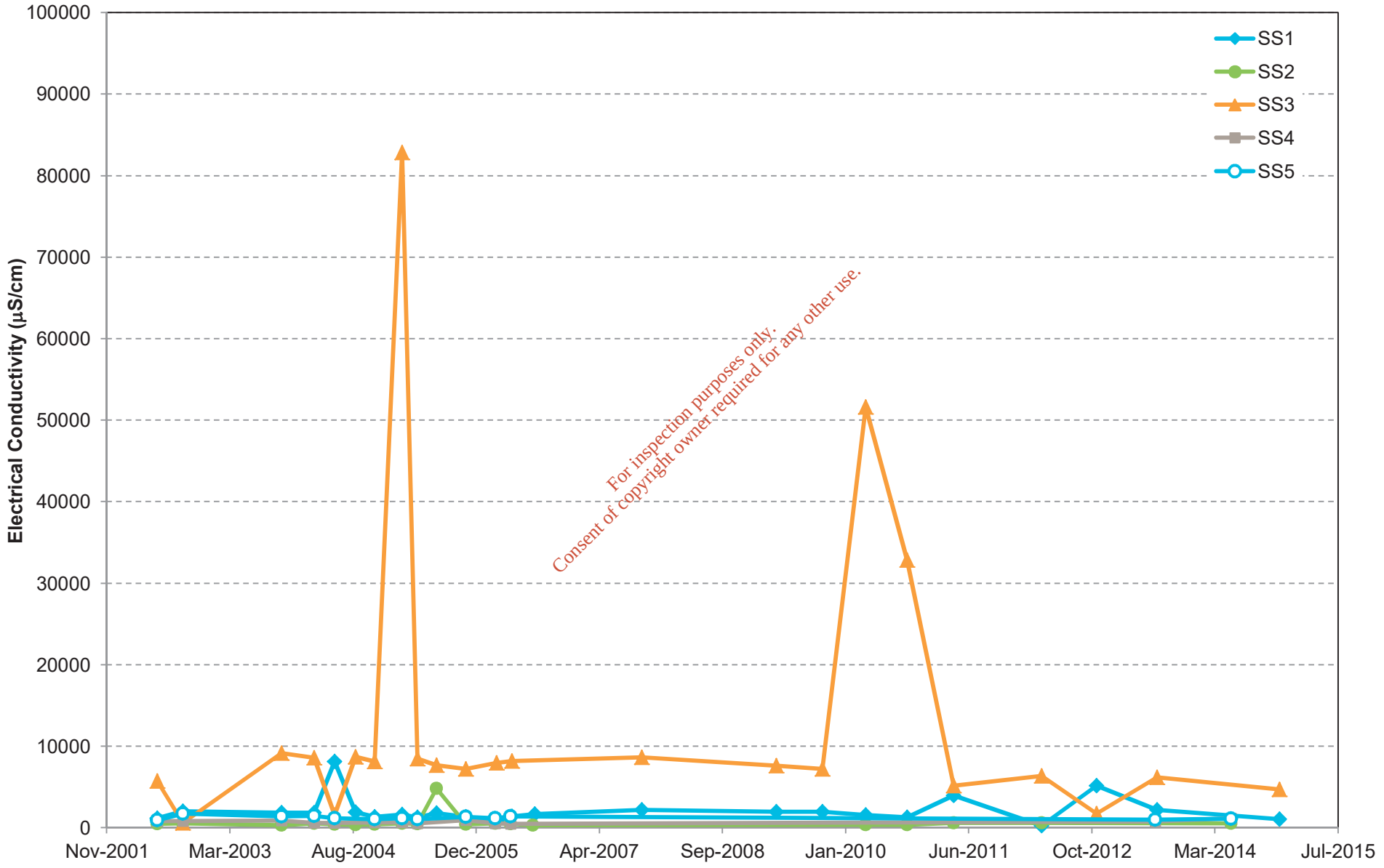
Station Name	Sample Date	pH	Conductivity	Dissolved Oxygen	Temperature	Chemical Oxygen Demand	Biological Oxygen Demand	Suspended Solids	Ammonia	Nitrate (NO_3)	Chloride	Ortho-phosphate	Total Phosphorus	Cadmium	Chromium	Copper	Zinc
			µS/cm @ 20°C	mg/L	°C	mg/L	mg/L	mg/L	NH_4 as N mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
SS3 Average		7.5	12890	4.2	12.9	275	15	70	315	4.4	1059	1.21			0.63		0.015
SS3 Standard Deviation		0.26	18335	3.2	3.7	160	16	47	407	4	548	0.75			2.3		0.012
SS3 Maximum		8.0	82800	15.0	21.6	745	80	187	1961	16	1839	3.1			10.0		0.052
SS3 Minimum		6.8	570	0.8	6.5	25	2	7	0.10	0.8	83	0.203			0.001		0.001
SS3	29-May-2002	7.0	5740	2.1	15.0	325	2		195		1181						
SS3	11-Sep-2002	6.8	570	4.4	17.4	222	5		53.6		990						
SS3	16-Oct-2003	8.0	9130	3.6	10.9	745	30	22	1961	6.0	1839			<0.4	10	<5	0.005
SS3	25-Feb-2004	7.4	8550	5.4	6.5	405	8	47	366		1764			0.0004	0.005	<5	0.012
SS3	19-May-2004	7.6	1524	15.0	15.3	25	2	7	5.0	4.1	129	<0.01		<0.4	<1	0.005	0.006
SS3	12-Aug-2004	7.9	8710	2.5	16.6	382	9	28	378	2.9	1780	1.5		0.001	0.005	<5	<5
SS3	27-Oct-2004	7.6	8130	4.2	10.2	313	8	32	0.10	4.7	1610	0.71		<0.4	0.007	<5	0.012
SS3	16-Feb-2005	7.5	82800	1.2	8.5	318	10	56	<0.01	4.0	1250	1.4		<0.4	<1	<5	0.007
SS3	20-Apr-2005	7.5	8460	3.5	11.0	326	12	54	<0.01	1.8	245	1.2		<0.4	0.09	<1	<3
SS3	06-Jul-2005	8.0	7640	3.9	15.1	302	14	41	700	1.7	1400	2.1		<0.4	0.24	0.001	NT
SS3	02-Nov-2005	7.5	7210	6.5	13.0	156	11	45	258	16	1455	0.63		<1	0.051	<1	0.022
SS3	07-Mar-2006	7.6	7940	6.6	8.5	297	20	116	400	4.4	1825	1.2		<1	0.063	<1	0.024
SS3	09-May-2006	7.6	8150	4.4	13.3	463	13	66	360	3.8	875	1.6		<1	0.131	<1	0.026
SS3	17-Oct-2007	7.6	8630	1.9	8.5	331	15	130	393	1.4	1410	3.1		<0.4	0.083	<1	0.006
SS3	16-Apr-2009	7.4	7620	2.1	11.9	470	41	187	404	9.2	83		3.3	<0.00022	0.0466	0.00579	0.0125
SS3	20-Oct-2009	7.5	7180	1.3	11.5	308	13	59	213	1.1	1040	2.0	NT	<0.0005	0.007	0.002	0.012
SS3	14-Apr-2010	7.5	51600	10.9	10.3	289	80	120	216	1.1	548	0.74	NT	<0.0005	<0.0005	<0.001	0.011
SS3	29-Sep-2010	7.3	32800	2.9	13.0	108	6	38	10	7.7	693	0.33	NT	<0.5	<0.5	<1	0.007
SS3	06-Apr-2011	7.3	5160	6.1	13.3	105	6	59	89	8.7	687	0.84	NT	<0.5	0.004	<1	<5
SS3	29-Mar-2012	7.5	6350	4.5	13.2	130	14	163	268	0.79	869	2.0	NT	<0.5	0.007	0.001	0.011
SS3	06-Nov-2012	7.4	1709	1.9	10.5	91	6	59	18	1.4	560	0.78	NT	<0.5	0.001	0.002	0.024
SS3	10-Jul-2013	7.4	6170	0.8	21.6	142	10	80	250	0.97		0.34	NT	<0.5	0.003	0.006	0.052
SS3	19-Nov-2014	7.3	4700	1.2	21.0	75	20		82	6.9		0.20	AR	<0.5	0.003	0.005	0.0011

Data from *ballymahon landfill.xls*
All other data from
Ballymulvey monitoring data.xlsx
Assumed units
Blank cell indicates no data

Station Name	Sample Date	pH	Conductivity	Dissolved Oxygen	Temperature	Chemical Oxygen Demand	Biological Oxygen Demand	Suspended Solids	Ammonia	Nitrate (NO_3)	Chloride	Ortho-phosphate	Total Phosphorus	Cadmium	Chromium	Copper	Zinc
			µS/cm @ 20°C	mg/L	°C	mg/L	mg/L	mg/L	NH_4 as N mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
SS4 Average		6.9	718	4.1	10.5	118	15	86	31	1.7	79	0.04			0.29		0.014
SS4 Standard Deviation		0.21	185	2.1	3.4	137	39	209	104	1	55	0.03			0.4		0.006
SS4 Maximum		7.4	1124	7.8	16.7	583	149	742	390	4	202	0.1			1.0		0.021
SS4 Minimum		6.6	464	0.8	4.8	32	1	3	0.05	0.1	23	0.012			0.002		0.007
SS4	29-May-2002	7.1	826	2.7	12.9	115	9		390		202						
SS4	11-Sep-2002	6.8	822	1.8	16.7	108	13		5.2		148						
SS4	16-Oct-2003	7.4	881	0.8	12.4	583	149	742	2.3	2.0	96			<0.4	<1	<5	<5
SS4	25-Feb-2004	6.8	574	3.1	5.7	77	7	10	1.9		33			<0.4	<1	<5	<5
SS4	19-May-2004	7.1	589	6.0	14.5	55	6	22	0.14	1.8	27	0.026		<0.4	1	<5	<5
SS4	27-Oct-2004	6.8	662	4.1	10.1	89	1	5	0.050	1.2	49	0.033		<0.4	<1	<5	<5
SS4	16-Feb-2005	7.1	653	5.0	6.3	84	4	65	0.28	4.3	44	0.090		<0.4	1	<5	<5
SS4	20-Apr-2005	6.9	502	7.8	8.9	69	2	11	0.047	1.4	23	<0.01		<0.4	0.017	<1	<3
SS4	02-Nov-2005	6.6	923	4.3	12.9	82	1	3	0.094	3.2	140	0.063		<1	0.003	<1	0.021
SS4	01-Mar-2006	6.9	545	7.6	4.8	32	2	10	0.089	0.060	90	0.012		<1	0.004	<1	<1
SS4	03-May-2006	7.0	464	3.7	8.8	132	1	5	0.056	1.7	37	0.015		<1	0.006	<1	0.018
SS4	03-Jul-2013	7.2	766	1.9	12.8	58	1	7	0.18	0.54	56	0.074	NT	<0.5	<0.5	<1	0.009
SS4	07-May-2014	6.7	1124	4.5	10.0	45	4	68	0.22	0.94		0.030	AR	0.00005	0.00242	0.00137	0.00736
SS5 Average		7.0	1208	4.1	9.8	78	6	11	1	2.7	192	0.09			0.01		1.010
SS5 Standard Deviation		0.50	207	2.2	3.6	41	7	12	1	2	101	0.11			0.0		1.995
SS5 Maximum		7.4	1698	10.2	16.0	175	30	46	3	7	424	0.3			0.0		5.000
SS5 Minimum		5.3	920	2.0	3.4	14	1	3	0.07	0.6	18	0.007			0.001		0.005
SS5	29-May-2002	7.1	920	2.1	13.6	175	4		2.7		237						
SS5	11-Sep-2002	5.3	1698		16.0	123	30		3.0		424						
SS5	16-Oct-2003	7.3	1363	2.0	12.0	124	10	46	1.4	1.0	295			<0.4	0.001	<5	<5
SS5	25-Feb-2004	7.1	1415	2.4	4.3	61	6	3	2.9		201			0.0011	<1	<5	0.005
SS5	19-May-2004	7.1	1133	2.8	12.1	38	3	10	0.070	2.8	185	0.27		<0.4	<1	<5	NT
SS5	27-Oct-2004	7.0	1046	4.3	9.5	82	1	4	0.24	1.6	186	0.30		<0.4	<1	<5	5
SS5	16-Feb-2005	7.1	1162	2.5	5.5	55	7	14	2.1	6.7	78	0.023		<0.4	<1	<5	<5
SS5	20-Apr-2005	7.1	1021	6.5	7.9	64	4	3	1.3	3.5	152	0.007		<0.4	0.021	<1	<3
SS5	02-Nov-2005	6.9	1343	5.0	11.9	77	1	6	0.076	4.6	234	0.026		<1	0.005	1	0.021
SS5	01-Mar-2006	7.0	1154	10.2	3.4	14	1	3	0.17	2.3	198	0.028		<1	0.008	0.001	<1
SS5	03-May-2006	7.2	1353	3.8	9.0	98	1	5	0.35	2.4	18	0.025		<1	0.012	<1	0.013
SS5	03-Jul-2013	7.4	992	3.4	12.7	58	8	12	0.17	0.64	98	0.089	NT	AR	AR	AR	AR
SS5	07-May-2014	7.0	1102	4.4	10.1	45	2	14	0.19	1.1		0.020	AR	0.000057	0.00251	0.00145	0.013

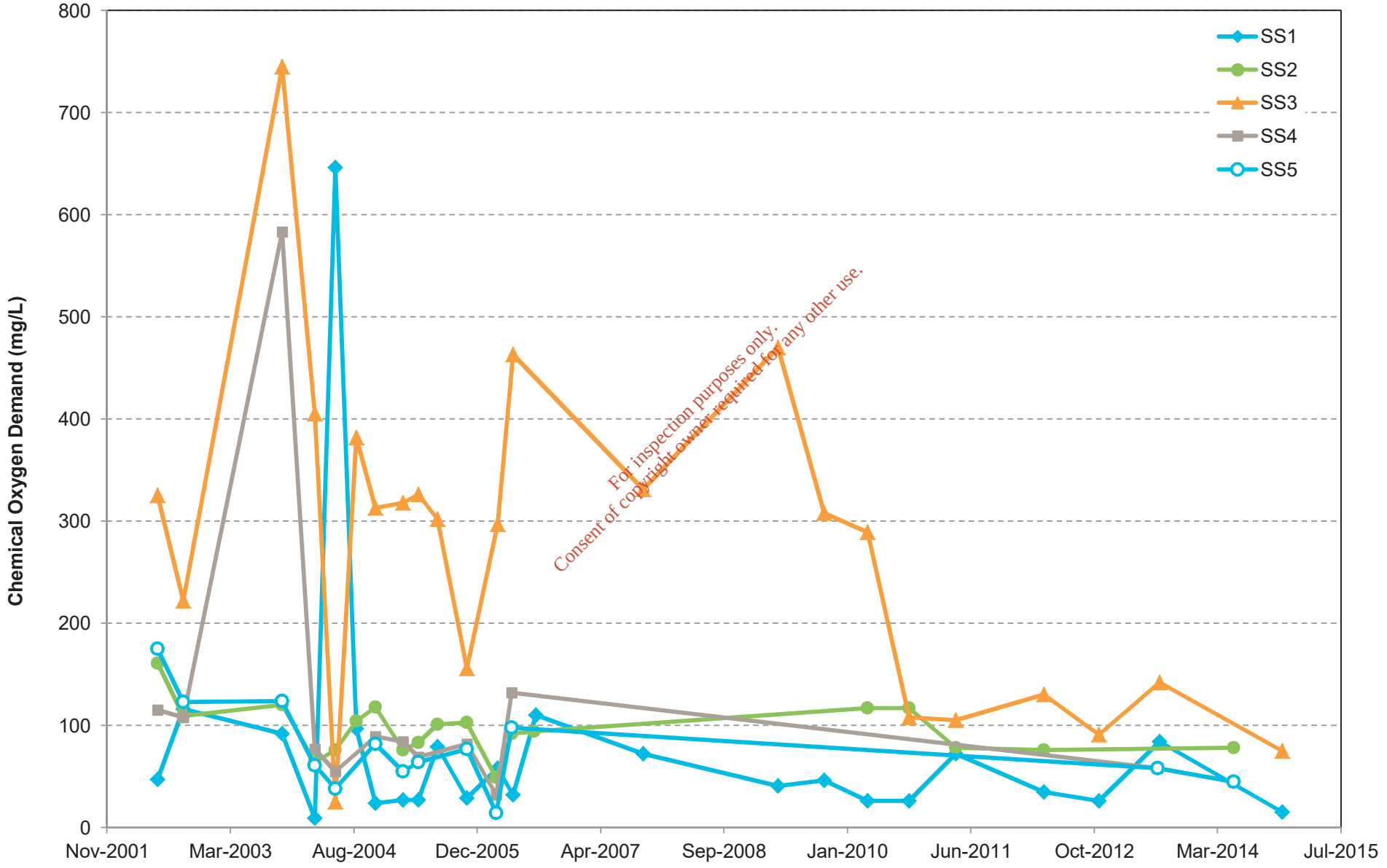
Appendix C - Ballymulvey Landfill Monitoring Data

Electrical Conductivity Trends in On-Site Surface Water



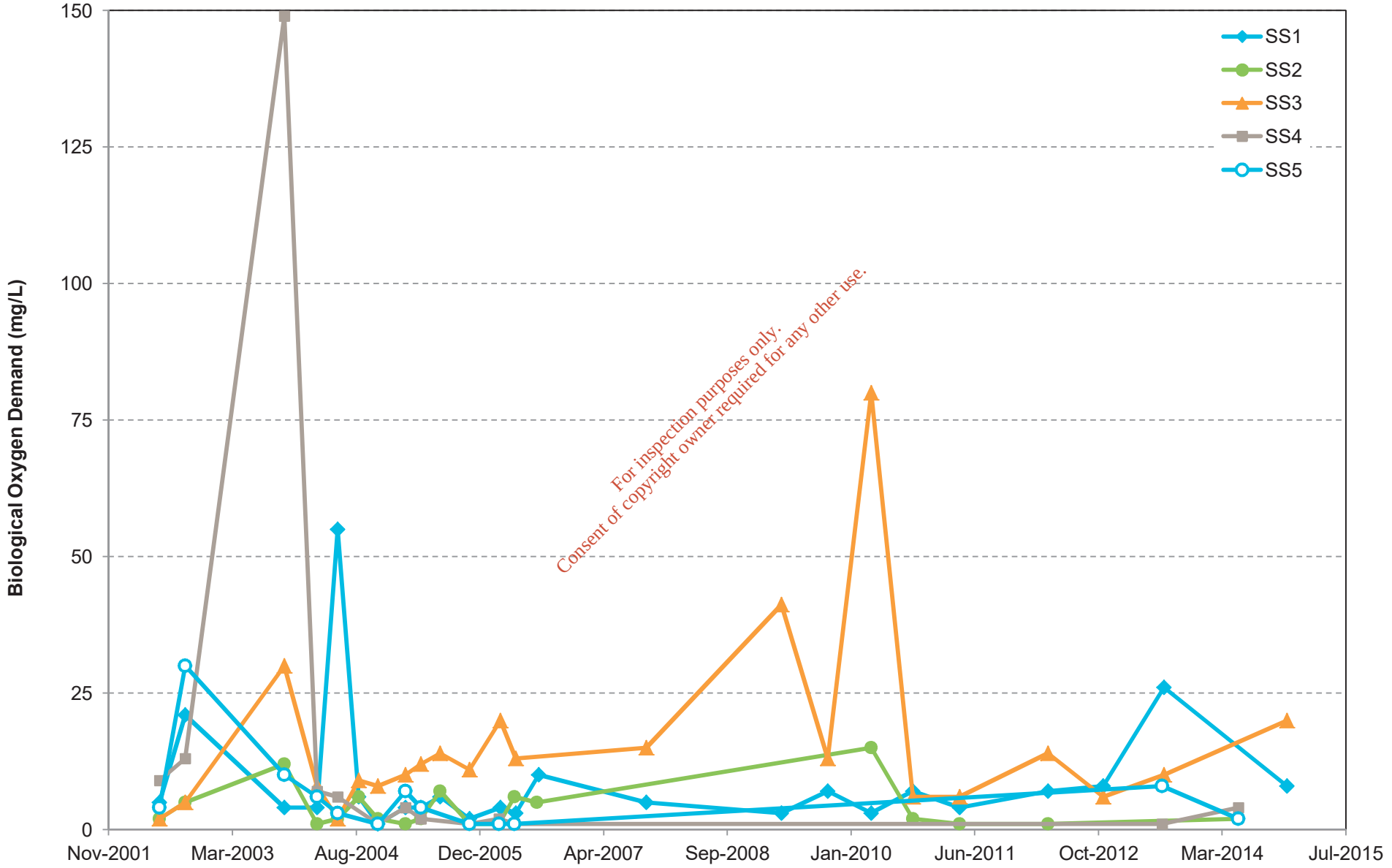
Appendix C - Ballymulvey Landfill Monitoring Data

Chemical Oxygen Demand Trends in On-Site Surface Water



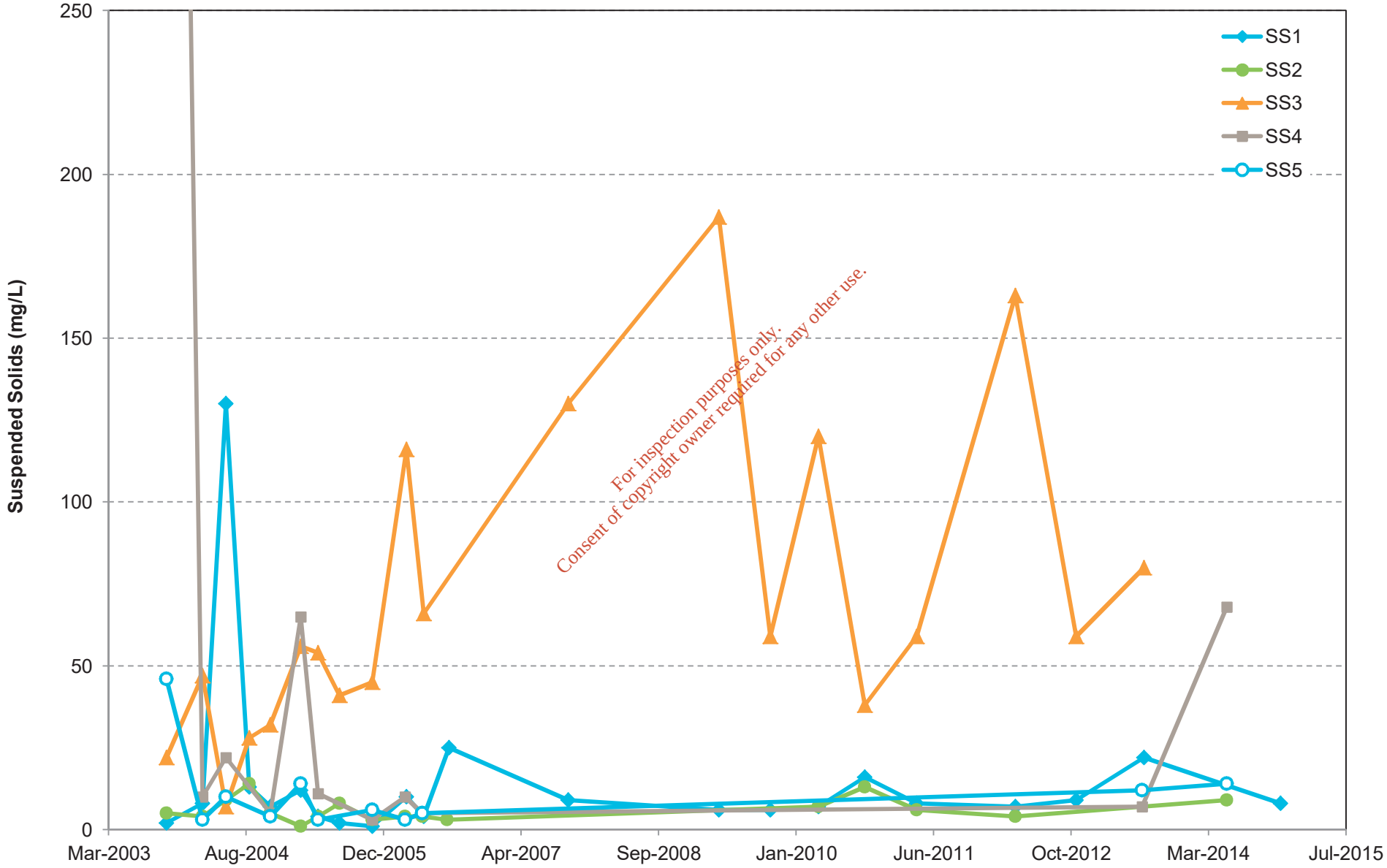
Appendix C - Ballymulvey Landfill Monitoring Data

Biological Oxygen Demand Trends in On-Site Surface Water



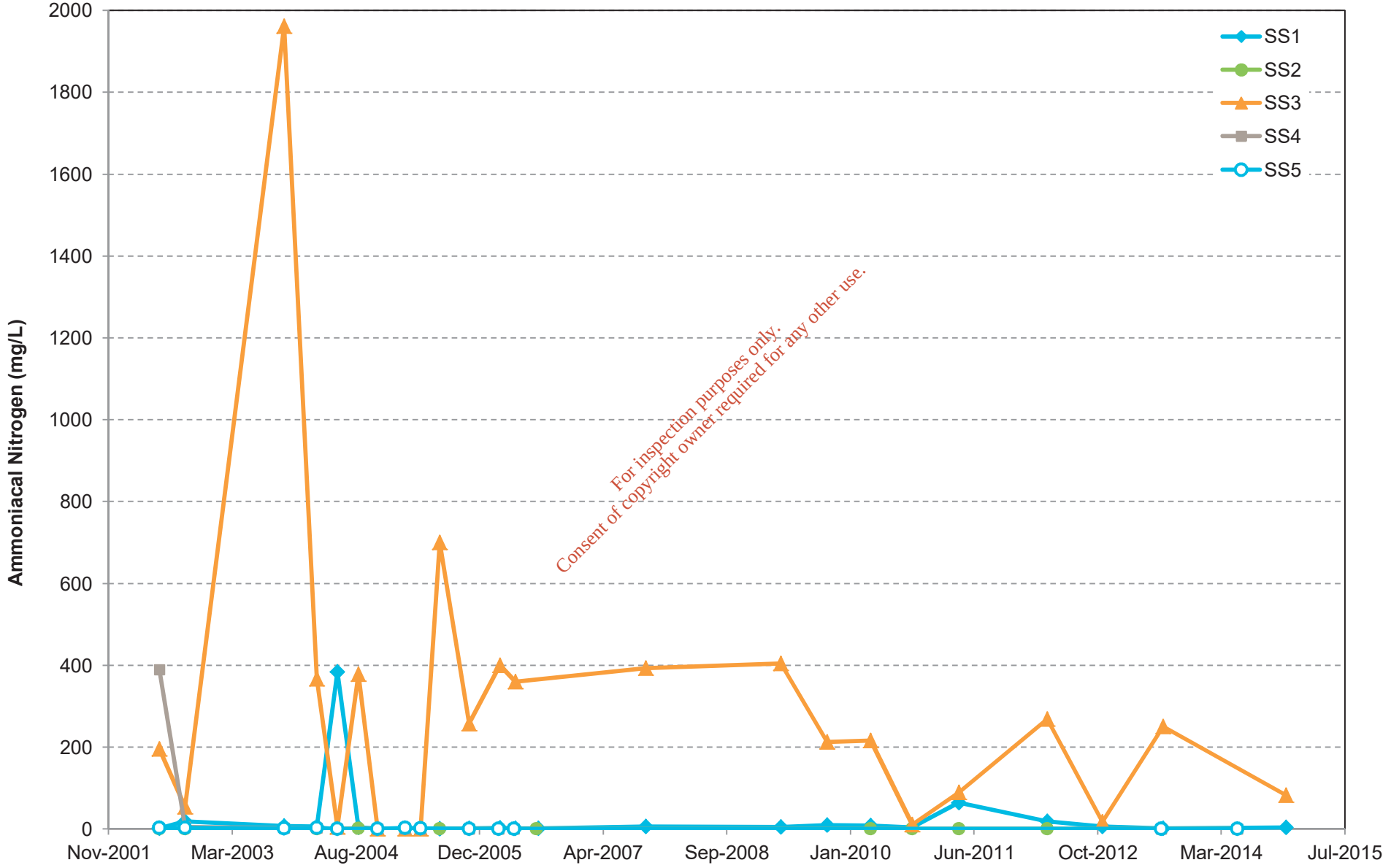
Appendix C - Ballymulvey Landfill Monitoring Data

Supended Solids Trends in On-Site Surface Water



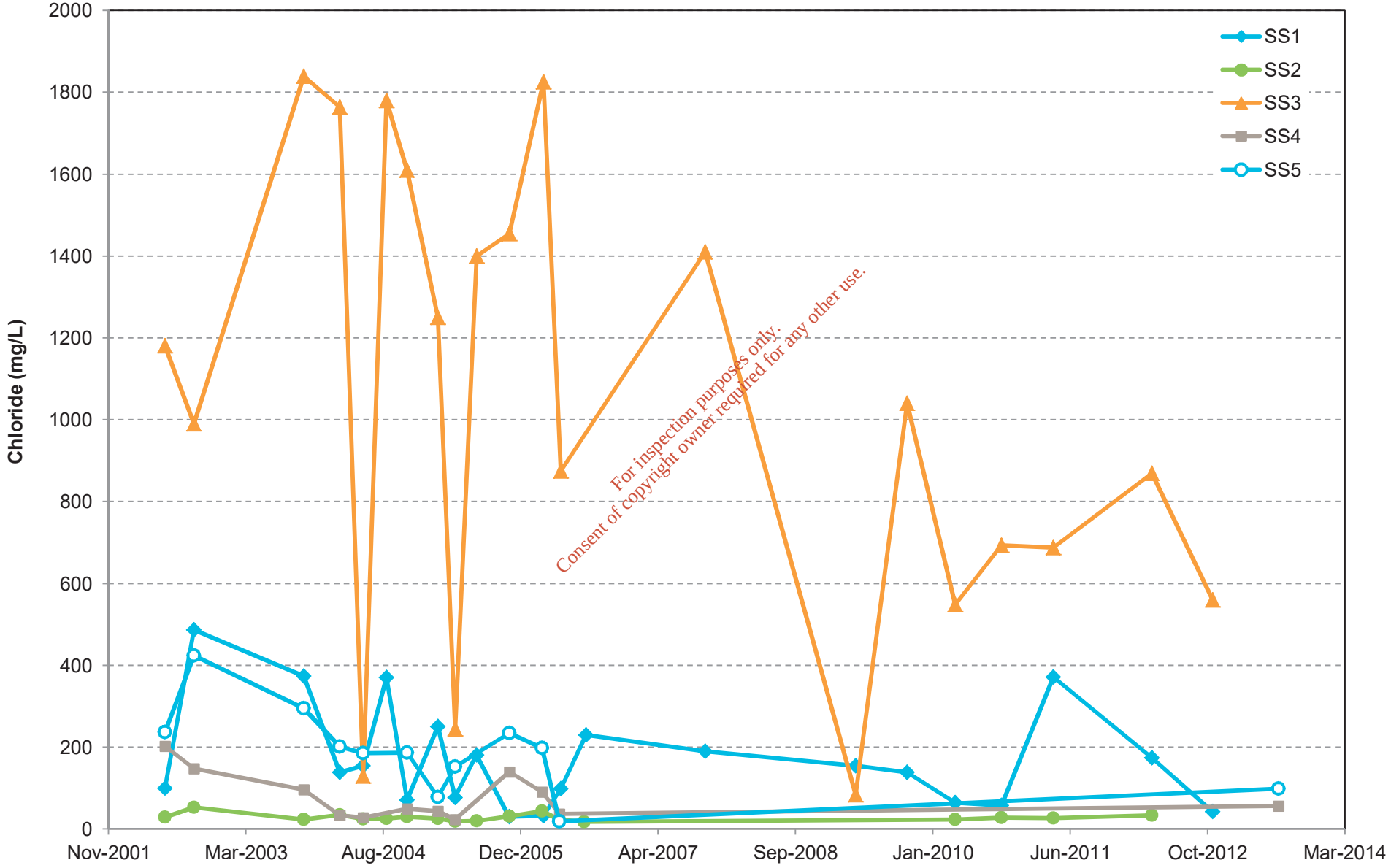
Appendix C - Ballymulvey Landfill Monitoring Data

Ammoniacal Nitrogen Trends in On-Site Surface Water

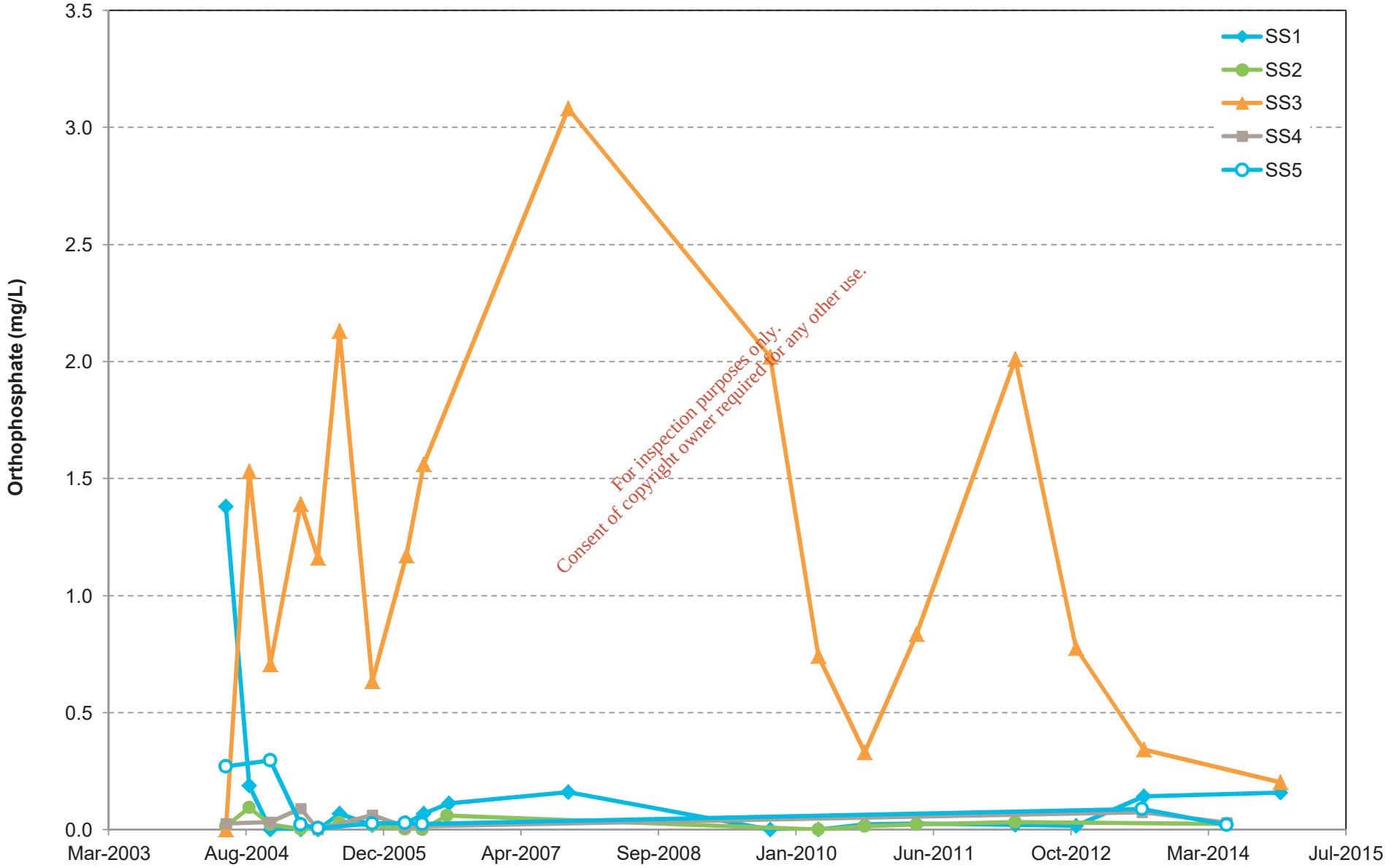


Appendix C - Ballymulvey Landfill Monitoring Data

Chloride Trends in On-Site Surface Water



Orthophosphate Trends in On-Site Surface Water



Appendix C Table 5 - Off-Site Surface Water Monitoring Data
Ballymulvey Landfill, Longford County Council

Data from *ballymahon landfill.xls*
All other data from Ballymulvey monitoring data.xlsx
Data don't tally with those in *ballymahon landfill.xls*
Result given as N converted to NO_3
Assumed units
Result given as NH_4 converted to N
Blank cell indicates no data

Station Name	Sample Date	pH	Conductivity	Dissolved Oxygen	Temperature	Chemical Oxygen Demand	Biological Oxygen Demand	Suspended Solids	Ammonia (N)	Ammonium (NH_4)	Nitrate (NO_3)	Chloride	Ortho-phosphate	Total Phosphorus	Cadmium	Chromium	Copper	Zinc
			µS/cm @ 20°C	mg/L	°C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Inland Surface Water EQS, AA, High Status, SI 272 2009				>80%			<1.3		<0.04				<0.026			0.0034	0.005	0.008
Inland Surface Water EQS, AA, High Status, SI 386 2015															0.00008			
A Average		7.1		5.4		123	9		1.9		3.3		0.90					
A Standard Deviation		0.3		1.8		66	7		3.1		3.0		1.4					
A Maximum		7.6		7.2		219	19		8.6		9.1		3.7					
A Minimum		6.8		3.2		47	2		0.070		0.60		0.028					
A	04-Jun-1992	6.8		4.2		196	2		0.13		2.3		0.028					
A	03-Feb-1993	7.1				47	6		0.29		5.0		0.090					
A	22-Mar-1993	7.6		7.1		137	15		8.6		9.1		0.43					
A	24-Aug-1994	6.8				73	3		0.070		0.6		3.70					
A	29-May-2002	7.1		7.2		219	19	82	0.30		1.4		<0.03					
A	11-Sep-2002	7.2		3.2		66	<2	82	1.9		1.2		0.23					
B Average		7.1	616	3.7	10.3	729	17	128	12	0.21	2.8	66	0.79					
B Standard Deviation		0.4	160	2.3	1.5	2457	23	352	20	0.10	1.9	35	1.3					
B Maximum		7.7	1011	9.2	12.6	11400	90	1392	68	0.34	6.9	142	5.1					
B Minimum		6.5	416	0.8	7.1	40	1	4	0.017	0.022	0.55	37	0.017					
B	04-Jun-1992	7.7		3.7		228	27		61		2.8		2.09					
B	15-Jul-1992	7.5		0.8		11400	90		30		2.0		2.40					
B	12-Aug-1992	7.4		4.4		145	42		21		3.8		5.10					
B	08-Sep-1992	7.3		6.9		1060	71		26		6.9		0.40					
B	03-Feb-1993	7.7				241	10		68		5.3		1.40					
B	22-Mar-1993	7.6		7.3		100	9		31		3.9		0.31					
B	24-Aug-1994	6.8				112	3	23	2.0		5.9		0.10					
B	29-May-2002	7.1		9.2		122	3	18	3.9		4.6		<0.03					
B	11-Sep-2002	6.9		2.3		72	5	1392	3.4		0.9		0.10					
B	06-Nov-2003	7.2	721	2.9	9.4	65	8	4	0.68		2.6		0.030		<0.4	<1	<5	5
B	03-Mar-2004	6.9	639	4.1	7.1	40	6	114	0.40			45			<0.4	<1	<5	<5
B	02-Jun-2004	7.3	660	1.2	12.0	62	16	95	0.033		0.55	37	0.21		<0.4	<1	<5	<5
B	10-Oct-2007	6.8	1011	1.6	10.4	109	7	7	0.37		1.3	124	0.15		<0.4	0.009	<1	<1
B	22-Apr-2009	6.9	694	4.9	10.6	139	4	33	0.17	0.221	4.8	142	NT	0.406	<0.00022	0.00251	0.00374	0.0186
B	28-Oct-2009	6.5	592	1.1	12.6	151	14	46	0.14	0.177	1.4	68	<0.05	NT	<0.0005	<0.0005	0.003	0.024
B	21-Apr-2010	6.8	497	3.3	9.0	121	5	8	0.12	0.149	1.1	51	0.15	NT	<0.0005	<0.0005	<0.001	0.009
B	06-Oct-2010	6.8	416	4.1	12.2	114	1	6	0.017	0.022	1.0	49	0.017	NT	<0.5	<0.5	<1	0.013
B	12-Feb-2011	6.5	503	3.2	10.0	102	1	10	0.22	0.279	1.1	55	0.036	NT	<0.5	<0.5	0.002	0.009
B	02-May-2012	7.1	418	4.2	9.8	89	5	8	0.22	0.283	1.0	40	0.021	NT	<0.5	<0.5	<1	<5
B	25-Oct-2012	6.7	627	1.1	10.1	102	5	34	0.26	0.337	1.3	44	0.085	NT	<0.5	0.0007	<1	0.009

Data from *ballymahon landfill.xls*
All other data from Ballymulvey monitoring data.xlsx
Data don't tally with those in *ballymahon landfill.xls*
Result given as N converted to NO_3
Assumed units
Result given as NH_4 converted to N
Blank cell indicates no data

Station Name	Sample Date	pH	Conductivity	Dissolved Oxygen	Temperature	Chemical Oxygen Demand	Biological Oxygen Demand	Suspended Solids	Ammonia (N)	Ammonium (NH_4)	Nitrate (NO_3)	Chloride	Ortho-phosphate	Total Phosphorus	Cadmium	Chromium	Copper	Zinc
			µS/cm @ 20°C	mg/L	°C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
C Average		7.2	1201	3.9	10.3	143	16	84	18	1.4	5.3	152	1.2					
C Standard Deviation		0.3	265	2.3	1.7	104	19	198	26	1.1	5.3	47	2.0					
C Maximum		7.7	1591	9.8	12.4	424	80	776	82	3.8	18	260	7.5					
C Minimum		6.7	626	1.0	6.2	39	1	5	0.28	0.35	0.85	102	0.030					
C	04-Jun-1992	7.7		2.9		150	18		67		7.9		2.3					
C	15-Jul-1992	7.4		4.0		424	80		26		2.2		7.5					
C	12-Aug-1992	7.5		5.4		320	51		31		18		4.8					
C	08-Sep-1992	7.5		8.1		185	21		51		13		1.6					
C	03-Feb-1993	7.5				275	12		67		6.4		1.4					
C	22-Mar-1993	7.7		9.8		316	28		82		12		0.59					
C	24-Aug-1994	6.7				137	8	22	9.2		14		0.400					
C	29-May-2002	7.1		4.3		129	30	194	2.4		9.9		<0.03					
C	11-Sep-2002	7.1		3.4		68	<2	776	4.3		0.90		<0.08					
C	06-Nov-2003	7.3	1506	5.2	8.6	60	3	5	0.66		2.2		0.030		<0.4	<1	<5	<5
C	03-Mar-2004	7.0	1436	1.5	6.2	39	4	9	1.6			178			<0.4	<1	<5	<5
C	02-Jun-2004	7.0	1113	1.0	11.8	114	17	26	3.7		1.0	162	0.31		<0.4	<1	<5	<5
C	10-Oct-2007	7.2	1591	2.1	10.7	88	6	15	0.85		3.1	200	0.24		<0.4	0.017	<1	<1
C	22-Apr-2009	7.0	1429	2.2	10.0	76	3	6	2.9	3.760	3.4	260	NT	0.141	<0.00022	0.00276	0.00212	0.00533
C	28-Oct-2009	7.0	1257	1.0	12.4	92	5	40	1.2	1.480	0.85	140	0.18	NT	0.0005	<0.0005	0.003	0.022
C	21-Apr-2010	7.2	1028	4.0	11.6	63	5	5	1.3	1.640	0.99	142	0.062	NT	<0.0005	0.001	<0.001	0.006
C	06-Oct-2010	6.8	626	2.3	11.7	100	1	14	0.39	0.495	1.1	105	0.063	NT	<0.5	<0.5	<1	<5
C	12-Feb-2011	6.9	1064	5.2	10.2	73	2	7	0.28	0.354	1.3	118	0.045	NT	<0.5	<0.5	<1	<5
C	02-May-2012	6.9	1096	4.9	10.1	78	4	14	0.28	0.362	1.5	112	0.048	NT	<0.5	<0.5	<1	<5
C	25-Oct-2012	7.1	1063	3.5	10.1	71	9	43	1.1	1.470	1.1	102	0.095	NT	<0.5	0.0008	0.002	0.007

Data from *ballymahon landfill.xls*
All other data from Ballymulvey monitoring data.xlsx
Data don't tally with those in *ballymahon landfill.xls*
Result given as N converted to NO_3
Assumed units
Result given as NH_4 converted to N
Blank cell indicates no data

Station Name	Sample Date	pH	Conductivity	Dissolved Oxygen	Temperature	Chemical Oxygen Demand	Biological Oxygen Demand	Suspended Solids	Ammonia (N)	Ammonium (NH_4)	Nitrate (NO_3)	Chloride	Ortho-phosphate	Total Phosphorus	Cadmium	Chromium	Copper	Zinc
			µS/cm @ 20°C	mg/L	°C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
D Average		7.4	815	5.8	9.9	57	4	11	2.1	0.10	1.7	37	0.09					
D Standard Deviation		0.2	140	2.7	2.7	34	4	10	7.9	0.10	2.2	37	0.15					
D Maximum		8.0	1288	12.5	15.2	195	22	40	39.9	0.33	9.4	175	0.70					
D Minimum		6.8	619	1.8	3.9	2	1	1	0.006	0.021	0.20	14	0.010					
D	04-Jun-1992	7.6		7.2		55	1		0.080		1.9		0.096					
D	12-Aug-1992	8.0		6.4		195	>16		8.5		7.6		0.70					
D	08-Sep-1992	7.6		8.4		58	1		0.20		1.9		0.020					
D	03-Feb-1993	7.6				117	22		40		5.5		0.070					
D	22-Mar-1993	7.6		9.3		78	11		0.35		9.4		0.090					
D	24-Aug-1994	6.8				36	1	5	0.11		0.20		<0.05					
D	29-May-2002	7.1		7.2		66	2	12	0.20		2.1		0.030					
D	11-Sep-2002	7.5		7.7		48	<2	40	0.20		0.60		<0.08					
D	06-Nov-2003	7.5	841	3.1	9.4	48	2	3	0.59		0.44		0.010		<0.4	<1	<5	0.006
D	03-Mar-2004	7.3	1288	8.3	6.5	40	1	7	<0.2			175			<0.4	<1	<5	<5
D	02-Jun-2004	7.4	656	3.1	12.8	46	2	11	0.019		0.78	16	0.064		<0.4	<1	0.006	<5
D	02-Nov-2004	7.4	780	5.1	9.4	50	4	4	0.16		0.90	19	<0.01		<0.4	<1	0.009	<5
D	23-Feb-2005	7.6	796	8.1	4.1	34	1	7	0.055		0.94	26	<0.01		<0.4	<1	<5	0.028
D	27-Apr-2005	7.6	754	8.1	10.0	39	3	3	0.011		1.4	21	<0.01		<0.4	0.009	<1	0.003
D	13-Jul-2005	7.5	647	3.3	15.2	52	4	3	0.093		0.78	38	0.026		<0.4	0.007	0.003	<3
D	02-Nov-2005	7.4	756	7.7	8.3	54	3	9	0.045		1.5	21	0.048		<1	0.007	<1	0.012
D	01-Mar-2006	7.3	823	12.5	3.9	2	1	9	0.92		2.2	55	<0.01		<1	0.008	0.002	<1
D	03-May-2006	7.3	793	7.2	8.6	107	1	3	0.078		1.0	21	0.012		<1	0.017	<1	0.017
D	10-Oct-2007	7.4	886	1.9	10.4	71	8	4	0.006		0.80	19	0.15		<0.4	0.014	<1	<1
D	22-Apr-2009	7.5	917	5.8	11.2	48	2	7	<0.015	<0.019	1.4	77		0.058	<0.00022	0.00332	0.004	0.0184
D	28-Oct-2009	6.8	820	3.3	12.5	47	1	22	<0.012	<0.015	0.38	24	<0.05	NT	<0.0005	<0.0005	0.003	0.007
D	21-Apr-2010	7.4	619	6.2	12.7	17	2	1	0.016	0.021	0.55	23	0.030	NT	<0.0005	0.001	<0.001	0.007
D	06-Oct-2010	7.3	626	2.0	11.2	56	1	19	0.037	0.047	0.43	30	0.033	NT	<0.5	<0.5	0.001	0.005
D	12-Feb-2011	7.3	872	4.0	9.4	52	3	34	0.11	0.136	0.38	40	0.066	NT	<0.5	<0.5	<1	<5
D	02-May-2012	7.4	881	5.2	10.0	45	2	10	0.058	0.074	0.34	38	0.030	NT	<0.5	<0.5	<1	<5
D	25-Oct-2012	7.2	877	2.6	10.2	51	4	17	0.022	0.028	0.51	17	0.038	NT	<0.5	0.0007	<1	<5
D	03-Jul-2013	7.4	802	1.8	12.8	61	5	8	0.26	0.329	0.46	14	0.12	NT	<0.5	<0.5	<1	0.006
D	07-May-2014	7.0	868	4.8	9.9	36	9	10	0.051	0.065	0.63		0.019	AR	<0.03	0.003	0.0018	0.004

Data from *ballymahon landfill.xls*
All other data from Ballymulvey monitoring data.xlsx
Data don't tally with those in *ballymahon landfill.xls*
Result given as N converted to NO_3
Assumed units
Result given as NH_4 converted to N
Blank cell indicates no data

Station Name	Sample Date	pH	Conductivity	Dissolved Oxygen	Temperature	Chemical Oxygen Demand	Biological Oxygen Demand	Suspended Solids	Ammonia (N)	Ammonium (NH_4)	Nitrate (NO_3)	Chloride	Ortho-phosphate	Total Phosphorus	Cadmium	Chromium	Copper	Zinc
			µS/cm @ 20°C	mg/L	°C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
E Average		7.4	1067	6.8	9.1	163	9	80	8.0	0.13	3.0	128	0.49					
E Standard Deviation		0.2	127	2.5	3.2	407	15	225	16	0.10	3.0	50	0.90					
E Maximum		7.8	1382	15.1	15.5	2145	65	994	50	0.32	10.5	249	2.8					
E Minimum		6.8	777	2.9	2.0	30	1	2	0.008	0.031	0.000	45	0.010					
E	04-Jun-1992	7.4		2.9		155	>82		36		5.2		2.8					
E	12-Aug-1992	7.8		5.8		2145	65		17		6.1		2.7					
E	08-Sep-1992	7.6		8.0		171	23		37		7.8		0.40					
E	03-Feb-1993	7.5				127	27		50		6.2		0.78					
E	22-Mar-1993	7.5		7.3		196	33		48		11		0.37					
E	24-Aug-1994	6.8				49	2	8	0.22		0.80		<0.05					
E	29-May-2002	7.1		5.6		93	2	98	0.80		4.9		<0.03					
E	11-Sep-2002	7.3		3.1		76	3	994	1.0		0.60		<0.08					
E	06-Nov-2003	7.6	1382	5.3	9.3	60	3	2	0.56		0.00		0.010		<0.4	<1	<5	0.007
E	03-Mar-2004	7.5	963	9.1	6.5	30	1	4	<0.1			45	0.010		<0.4	<1	<5	5
E	02-Nov-2004	7.0	940	6.3	9.0	71	2	8	0.008		1.4	143	<0.01		<0.4	<1	0.006	<5
E	23-Feb-2005	7.4	1114	8.3	3.0	33	1	2	0.019		3.3	150	<0.01		<0.4	<1	<5	<5
E	27-Apr-2005	7.4	1043	7.4	8.7	60	1	2	0.029		0.84	149	<0.01		<0.4	0.008	<1	3
E	02-Nov-2005	7.2	1131	8.5	7.1	65	1	9	0.024		1.9	181	0.018		<1	0.005	<1	0.012
E	01-Mar-2006	7.3	1098	15.1	2.0	51	1	9	0.020		2.0	180	<0.01		<1	0.008	0.001	<1
E	03-May-2006	7.7	1094	7.5	9.0	87	1	9	0.033		1.2	69	<0.01		<1	0.011	<1	0.014
E	22-Apr-2009	7.5	1229	6.4	9.9	76	2	13	0.057	0.073	3.3	249		0.133	<0.00022	0.00347	0.00237	0.0091
E	28-Oct-2009	7.3	1166	4.8	12.4	78	2	7	0.22	0.289	1.0	106	<0.05	NT	<0.0005	<0.0005	0.002	0.005
E	21-Apr-2010	7.6	994	9.1	15.5	52	4	5	0.25	0.315	1.4	123	0.055	NT	<0.0005	0.001	<0.001	0.005
E	06-Oct-2010	7.4	777	5.5	10.8	67	1	7	0.024	0.031	0.78	142	0.022	NT	<0.5	<0.5	0.001	0.008
E	12-Feb-2011	7.3	1085	6.3	8.5	63	1	12	0.050	0.064	1.0	109	0.030	NT	<0.5	<0.5	<1	<5
E	02-May-2012	7.8	1120	7.5	10.1	99	16	377	0.044	0.057	9.7	110	0.11	NT	<0.5	0.0009	<1	<5
E	25-Oct-2012	7.2	1012	3.8	10.2	62	4	20	0.088	0.113	1.5	84	0.051	NT	<0.5	0.0007	<1	<5
E	03-Jul-2013	7.6	980	4.5	13.0	66	3	8	0.12	0.151	0.65	76	0.085	NT	<0.5	<0.5	<1	0.008
E	07-May-2014	7.5	1018	7.6	10.2	42	2	10	0.044	0.057	0.87		0.023	NT	<0.03	0.0026	0.0015	0.012

Data from *ballymahon landfill.xls*
All other data from Ballymulvey monitoring data.xlsx
Data don't tally with those in *ballymahon landfill.xls*
Result given as N converted to NO_3
Assumed units
Result given as NH_4 converted to N
Blank cell indicates no data

Station Name	Sample Date	pH	Conductivity	Dissolved Oxygen	Temperature	Chemical Oxygen Demand	Biological Oxygen Demand	Suspended Solids	Ammonia (N)	Ammonium (NH_4)	Nitrate (NO_3)	Chloride	Ortho-phosphate	Total Phosphorus	Cadmium	Chromium	Copper	Zinc
			µS/cm @ 20°C	mg/L	°C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
F Average		7.4	1015	6.5	10.1	41	2	33	0.20	0.083	1.9	91	0.064					
F Standard Deviation		0.3	313	2.7	2.9	19	1	122	0.23	0.054	1.4	40	0.10					
F Maximum		8.1	2320	15.2	14.4	79	5	632	0.80	0.19	7.1	186	0.47					
F Minimum		6.8	731	2.1	2.5	6	1	2	0.004	0.034	0.57	15	0.004					
F	04-Jun-1992	8.0		9.7		22	2		0.72		3.9		0.035					
F	15-Jul-1992	7.9		7.2		24	1		0.080		2.0		0.030					
F	12-Aug-1992	7.8		5.8		21	1		0.050		2.2		0.040					
F	08-Sep-1992	7.8		9.3		40	1		0.80		2.0		0.020					
F	03-Feb-1993	8.0				6	1		0.52		7.1		<0.05					
F	22-Mar-1993	8.1		9.3		13	1		0.53		2.8		<0.05					
F	24-Aug-1994	6.8				25	1	6	0.12		0.70		<0.05					
F	29-May-2002	7.1		8.2		79	2	10	0.70		4.2		<0.03					
F	11-Sep-2002	7.9		5.1		34	<2	632	0.30		4.0		<0.08					
F	06-Nov-2003	7.3	1055	2.9	10.1	42	2	2	0.50		2.2		0.020		<0.4	<1	<5	<5
F	03-Mar-2004	7.4	1068	8.7	6.9	32	1	2	0.2			130			<0.4	<1	<5	<5
F	02-Jun-2004	7.1	744	2.1	10.5	22	1	4	0.074		0.93	30	0.13		<0.4	<1	<5	<5
F	18-Aug-2004	7.1	811	7.6	14.4	16	3	18	0.28		<1	60	0.030		<0.4	0.002	<5	0.012
F	02-Nov-2004	7.3	908	5.7	9.4	58	1	4	0.013		1.3	108	<0.01		<0.4	<1	0.007	<5
F	23-Feb-2005	7.4	992	8.2	3.8	43	1	2	0.023		3.1	110	<0.01		<0.4	<1	<5	<5
F	27-Apr-2005	7.5	964	8.4	10.5	52	1	2	0.004		0.88	115	<0.01		<0.4	0.009	0.002	0.009
F	13-Jul-2005	7.2	819	5.5	13.5	21	2	2	0.20		1.1	15	<0.01		<0.4	0.006	0.004	0.003
F	02-Nov-2005	7.3	2320	7.5	7.6	64	1	8	0.058		1.7	129	0.47		<1	0.006	<1	0.011
F	01-Mar-2006	7.4	921	15.2	2.5	43	1	4	0.058		2.2	115	0.004		<1	0.009	0.002	0.004
F	03-May-2006	7.3	973	7.8	8.7	76	1	12	0.056		1.8	55	0.005		<1	0.014	<1	0.089
F	02-Aug-2006	7.1	739	2.2	13.5	21	2	4	0.25		1.2	50	0.072		<1	0.007	<1	0.024
F	10-Oct-2007	7.5	1257	4.3	10.9	62	2	7	0.080		0.95	145	0.047		<0.4	0.014	0.003	<1
F	22-Apr-2009	7.2	1107	5.8	9.6	54	2	6	<0.015	<0.019	2.3	186		0.067	<0.00022	0.00372	0.00212	<0.005
F	28-Oct-2009	7.3	1048	3.5	12.4	64	2	5	0.081	0.104	0.75	76	<0.05	NT	<0.0005	<0.0005	0.002	<0.005
F	21-Apr-2010	7.4	812	7.6	13.7	32	3	14	0.15	0.187	1.0	73	0.042	NT	<0.0005	0.002	<0.001	<0.005
F	06-Oct-2010	7.4	731	4.0	11.0	57	1	17	0.026	0.034	0.65	110	0.027	NT	<0.5	<0.5	0.001	0.005
F	12-Feb-2011	7.3	1018	6.4	10.3	56	1	7	0.030	0.038	0.88	89	0.032	NT	<0.5	<0.5	0.002	<5
F	02-May-2012	7.7	1028	6.9	9.8	46	4	17	0.038	0.049	0.90	88	0.051	NT	<0.5	<0.5	0.002	0.005
F	25-Oct-2012	7.4	976	4.6	10.1	54	5	10	0.047	0.061	1.1	69	0.041	NT	<0.5	0.0008	<1	<5
F	03-Jul-2013	7.1	976	3.1	12.9	40	2	6	0.12	0.150	0.57	62	0.12	NT	<0.5	<0.5	0.002	0.007
F	07-May-2014	7.4	1054	7.0	10.2	44	1	9	0.031	0.040	0.88		0.012	AR	<0.03	0.003	0.0015	0.007

Data from *ballymahon landfill.xls*
All other data from Ballymulvey monitoring data.xlsx
Data don't tally with those in *ballymahon landfill.xls*
Result given as N converted to NO_3
Assumed units
Result given as NH_4 converted to N
Blank cell indicates no data

Station Name	Sample Date	pH	Conductivity	Dissolved Oxygen	Temperature	Chemical Oxygen Demand	Biological Oxygen Demand	Suspended Solids	Ammonia (N)	Ammonium (NH_4)	Nitrate (NO_3)	Chloride	Ortho-phosphate	Total Phosphorus	Cadmium	Chromium	Copper	Zinc
			µS/cm @ 20°C	mg/L	°C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
G Average		7.9	676	11	10.5	19	1	6	0.14	0.17	2.6	25	0.037					
G Standard Deviation		0.3	96	7	3.3	18	1	7	0.22	0.40	1.9	14	0.046					
G Maximum		8.8	1047	47	17.2	98	4	36	0.96	1.2	7.8	74	0.24					
G Minimum		7.0	486	7	3.6	0	1	1	0.002	0.008	0.65	9	0.001					
G	04-Jun-1992	8.0		10.0		23	3		0.50		3.3		0.028					
G	15-Jul-1992	7.9		47.0		0	1		0.070		1.9		0.030					
G	12-Aug-1992	7.7		8.0		0	1		0.050		2.2		0.050					
G	08-Sep-1992	7.8		9.1		32	1		0.50		1.9		0.020					
G	03-Feb-1993	8.1				11	1		0.40		6.3		<0.05					
G	22-Mar-1993	8.0		8.2		21	2		0.20		2.4		<0.05					
G	24-Aug-1994	7.0				25	1	7	<0.05		0.70		<0.02					
G	29-May-2002	7.1		8.5		40	2	<10	0.30		7.6		0.030					
G	11-Sep-2002	7.9		6.7		<15	<2	36	0.20		7.8		<0.08					
G	06-Nov-2003	8.1	697	9.7	9.3	30	1	5	0.16		3.5		0.010		<0.4	1	<5	<5
G	03-Mar-2004	8.0	684	11.4	7.2	5	1	4	0.2			28			<0.4	<0.1	<5	0.008
G	02-Jun-2004	7.8	619	8.1	11.9	10	1	4	0.010		2.4	22	0.236		<0.4	<1	<5	<5
G	18-Aug-2004	8.1	636	7.7	14.8	17	1	1	0.040		1.0	31	0.001		<0.4	0.002	<5	<5
G	02-Nov-2004	7.9	638	10.0	9.9	19	1	6	0.092		2.5	<10	0.012		<0.4	0.003	<5	<5
G	23-Feb-2005	8.1	658	12.2	4.1	11	1	3	0.021		3.6	15	0.022		<0.4	<1	<5	<5
G	27-Apr-2005	8.1	643	20.6	8.9	9	1	3	0.003		2.7	15	<0.01		<0.4	0.01	<1	0.003
G	13-Jul-2005	8.0	634	12.0	16.3	21	4	7	0.10		2.4	74	0.063		<0.4	0.002	<1	0.006
G	02-Nov-2005	7.8	645	11.3	8.1	27	1	5	0.022		3.0	15	0.050		<1	0.006	<1	0.012
G	01-Mar-2006	8.0	656	15.6	3.6	20	1	1	0.076		3.7	24	<0.01		<1	0.009	<1	<1
G	03-May-2006	7.9	605	10.8	9.0	98	1	6	0.030		2.3	20	0.006		<1	0.012	<1	0.075
G	02-Aug-2006	7.7	636	7.5	14.5	3	1	7	0.002		1.9	34	0.020		<1	0.006	<1	0.022
G	10-Oct-2007	8.0	746	9.7	10.9	15	1	5	<0.05		1.6	28	0.017		<0.4	0.01	<1	<1
G	22-Apr-2009	8.0	713	9.3	10.4	16	1	4	<0.015	<0.019	5.3	36		0.064	<0.00022	0.00225	0.00186	0.00595
G	28-Oct-2009	7.3	1047	9.4	12.6	29	2	4	0.015	0.019	1.0	23	<0.05	NT	<0.0005	<0.0005	0.002	<0.005
G	21-Apr-2010	8.1	648	8.9	10.3	2	2	6	0.023	0.029	1.7	20	0.040	NT	<0.0005	0.001	<0.001	0.006
G	06-Oct-2010	8.0	486	8.1	10.8	16	1	9	0.006	0.008	1.2	20	0.022	NT	<0.5	<0.5	<1	<5
G	12-Feb-2011	7.9	695	10.5	8.5	20	1	6	0.015	0.019	1.5	20	0.031	NT	<0.5	<0.5	<1	<5
G	02-May-2012	8.8	677	9.3	12.1	6	1	6	0.96	1.240	0.65	22	0.022	NT	<0.5	<0.5	<1	<5
G	25-Oct-2012	7.5	743	7.7	10.8	14	2	2	0.021	0.027	0.89	9	0.025	NT	<0.5	<0.5	<1	<5
G	03-Jul-2013	8.0	676	8.5	17.2	6	1	3	0.027	0.035	1.0	10	0.062	NT	<0.5	<0.5	0.003	<5
G	07-May-2014	7.5	680	10.3	10.4	12	1	5	0.011	0.014	1.4		0.024	AR	<0.03	0.0023	0.00154	0.007

Appendix C Table 5 - Off-Site Surface Water Monitoring Data
Ballymulvey Landfill, Longford County Council

Data from *ballymahon landfill.xls*
All other data from Ballymulvey monitoring data.xlsx
Data don't tally with those in *ballymahon landfill.xls*
Result given as N converted to NO_3
Assumed units
Result given as NH_4 converted to N
Blank cell indicates no data

Station Name	Sample Date	pH	Conductivity	Dissolved Oxygen	Temperature	Chemical Oxygen Demand	Biological Oxygen Demand	Suspended Solids	Ammonia (N)	Ammonium (NH_4)	Nitrate (NO_3)	Chloride	Ortho-phosphate	Total Phosphorus	Cadmium	Chromium	Copper	Zinc
			µS/cm @ 20°C	mg/L	°C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
H Average		7.9	566	10.1	11.4	20	1	5	0.067	0.042	1.8	16	0.044					
H Standard Deviation		0.3	91	2.4	3.8	13	0	4	0.065	0.054	1.2	5	0.059					
H Maximum		8.4	760	20.3	19.6	62	2	18	0.20	0.19	5.9	29	0.27					
H Minimum		6.8	366	6.4	3.6	0	1	1	0.004	0.012	0.23	7	0.001					
H	15-Jul-1992	8.4		9.2		0	1		0.080		1.9		0.020					
H	12-Aug-1992	8.4		8.5		12	1		0.050		2.2		0.020					
H	08-Sep-1992	7.9		9.7		62	1		0.20		1.6		0.020					
H	03-Feb-1993	7.9				15	1		0.18		5.9		<0.05					
H	22-Mar-1993	7.8		10.0		15	1		0.12		2.1		<0.05					
H	24-Aug-1994	6.8				29	1	2	0.080		0.40		0.050					
H	11-Sep-2002	8.3		6.4		19	<2	<10	0.20		2.0		<0.08					
H	06-Nov-2003	8.0	645	9.4	9.5	36	1	2	0.16		3.1		0.010		<0.4	1	<5	<5
H	03-Mar-2004	8.0	662	11.9	5.9	4	1	7	<0.2			20			0.4	<1	<5	<5
H	02-Jun-2004	8.0	533	8.3	14.0	10	1	1	<0.04		1.7	17	0.27		<0.4	<1	<5	<5
H	18-Aug-2004	8.0	539	8.3	15.5	17	1	1	0.070		<1	18	0.004		<0.4	0.002	<5	0.006
H	02-Nov-2004	7.7	524	9.7	9.6	25	1	6	0.16		2.0	<10	0.015		<0.4	1	0.008	<5
H	23-Feb-2005	8.1	552	12.3	4.0	13	1	7	0.026		2.8	11	0.010		<0.4	<1	<5	<5
H	27-Apr-2005	8.1	531	11.0	10.6	19	1	5	0.004		1.9	7	<0.01		NT	<5	<20	<2
H	13-Jul-2005	8.1	484	11.5	19.6	20	1	5	0.016		1.2	22	<0.01		NT	<5	<20	<20
H	02-Nov-2005	7.0	594	12.3	11.6	27	1	9	0.037		0.23	12	0.049		<1	0.004	<1	0.021
H	01-Mar-2006	8.1	527	20.3	3.6	8	1	9	0.015		2.5	10	<0.01		<1	<5	<20	<20
H	03-May-2006	7.9	528	10.7	9.2	51	1	4	0.030		2.4	18	0.001		<1	0.01	<1	0.033
H	02-Aug-2006	8.1	460	7.9	16.7	4	1	10	0.039		0.73	14	0.12		<1	0.005	<1	0.022
H	10-Oct-2007	8.1	539	9.3	13.1	18	1	5	0.020		1.2	11	<0.01		<0.4	0.007	<1	<1
H	22-Apr-2009	8.1	608	9.6	12.3	21	2	6	<0.015	<0.019	4.7	29		0.112	<0.00022	0.00194	0.0018	0.00731
H	28-Oct-2009	8.0	746	9.1	12.3	28	1	3	0.018	0.023	0.96	21	<0.05	NT	<0.0005	<0.0005	0.003	0.005
H	21-Apr-2010	8.1	545	9.4	11.3	11	2	1	0.024	0.031	1.3	16	0.036	NT	<0.0005	0.001	<0.001	0.003
H	06-Oct-2010	8.1	366	7.9	13.3	26	1	3	0.015	0.019	0.81	17	0.039	NT	<0.5	<0.5	<1	<5
H	12-Feb-2011	7.9	678	11.6	9.0	20	1	4	0.016	0.020	1.5	20	0.031	NT	<0.5	<0.5	<1	0.006
H	02-May-2012	7.8	612	9.8	10.3	18	1	2	0.022	0.028	1.3	21	0.028	NT	<0.5	<0.5	<1	<5
H	25-Oct-2012	7.7	760	8.7	10.7	10	2	8	0.14	0.185	1.1	9	0.061	NT	<0.5	<0.5	<1	<5
H	03-Jul-2013	8.1	465	10.9	15.7	13	1	3	0.014	0.018	0.49	11	0.036	NT	<0.5	<0.5	0.001	0.019
H	07-May-2014	7.7	545	9.5	12.0	15	<1	18	0.009	0.012	1.3		0.020	AR	0.00003	0.0024	0.00188	0.0126

Data from *ballymahon landfill.xls*
All other data from Ballymulvey monitoring data.xlsx
Data don't tally with those in *ballymahon landfill.xls*
Result given as N converted to NO_3
Assumed units
Result given as NH_4 converted to N
Blank cell indicates no data

Station Name	Sample Date	pH	Conductivity	Dissolved Oxygen	Temperature	Chemical Oxygen Demand	Biological Oxygen Demand	Suspended Solids	Ammonia (N)	Ammonium (NH_4)	Nitrate (NO_3)	Chloride	Ortho-phosphate	Total Phosphorus	Cadmium	Chromium	Copper	Zinc
			µS/cm @ 20°C	mg/L	°C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
J Average		8.0	475	10.1	11.8	21	1	7	0.054	0.018	1.5	13	0.048					
J Standard Deviation		0.3	74	2.3	4.3	15	1	11	0.067	0.005	1.2	6	0.076					
J Maximum		8.4	687	19.3	21.8	76	8	57	0.23	0.028	6.2	29	0.36					
J Minimum		7.0	321	6.1	2.8	0	1	1	0.001	0.010	0.05	6	0.003					
J	15-Jul-1992	8.2		9.0		0	2		0.12		1.9		0.020					
J	12-Aug-1992	8.3		8.6		0	1		0.05		2.0		0.030					
J	08-Sep-1992			9.5		47	8		0.2		1.7		0.020					
J	03-Feb-1993	8.0				18	1		0.06		6.2		<0.05					
J	22-Mar-1993	8.3		9.5		19	1		0.14		1.9		0.050					
J	24-Aug-1994	7.0				27	<1	4	<0.05		0.20		<0.05					
J	11-Sep-2002	8.4		6.1		18	<2	14	0.2		2.0		<0.08					
J	06-Nov-2003	8.1	463	9.9	9.9	43	2	2	0.28		1.8		0.030		<0.4	<1	<5	<5
J	03-Mar-2004	8.1	545	12.1	4.8	10	1	7	<0.2			14			<0.4	<1	<5	<5
J	02-Jun-2004	8.2	435	8.3	16.5	15	1	4	<0.04		0.86	12	0.36		<0.4	<1	<5	<5
J	18-Aug-2004	8.2	390	8.8	15.5	21	1	1	0.030		<1	<10	0.010		<0.4	0.001	<5	<5
J	02-Nov-2004	7.8	465	9.5	9.7	28	1	57	0.035		1.5	<10	0.080		<0.4	0.006	<5	<5
J	23-Feb-2005	8.1	476	12.3	3.8	11	1	3	0.027		2.2	6	0.025		<0.4	<1	5	5
J	27-Apr-2005	8.2	463	10.9	11.8	18	1	5	0.001		1.5	7	0.014		<0.4	0.01	<1	<3
J	13-Jul-2005	8.2	410	11.2	21.8	20	1	1	0.010		0.66	21	<0.01		<0.4	0.011	<1	0.004
J	02-Nov-2005	7.8	464	13.1	10.6	27	1	6	0.055		0.05	6	0.045		<1	<5	<1	<20
J	01-Mar-2006	8.1	483	19.3	2.8	11	1	9	0.030		1.8	6	<0.01		<1	0.007	<1	<1
J	03-May-2006	7.8	460	10.5	10.0	76	1	4	0.015		1.6	17	0.014		<1	0.007	<1	0.04
J	02-Aug-2006	7.8	380	8.0	18.0	6	1	7	0.010		0.38	7	0.003		<1	0.005	<1	0.029
J	10-Oct-2007	8.1	474	9.7	13.0	15	1	5	0.020		1.0	7	<0.01		<0.4	0.006	<1	<1
J	22-Apr-2009	8.2	521	9.1	13.1	24	2	10	<0.015	<0.019	4.2	29		0.071	0.000287	0.00175	0.00294	0.0201
J	28-Oct-2009	8.1	442	9.9	12.4	31	1	3	0.016	0.021	0.71	15	<0.05	NT	<0.0005	<0.0005	0.003	<0.005
J	21-Apr-2010	8.2	461	9.3	11.5	15	2	2	0.008	0.010	1.0	13	0.030	NT	<0.0005	0.0009	<0.001	0.006
J	06-Oct-2010	8.0	321	7.5	13.3	29	1	6	0.009	0.011	0.65	17	0.012	NT	<0.5	<0.5	1	<5
J	12-Feb-2011	8.1	503	10.6	11.8	28	1	2	0.015	0.019	1.1	15	0.031	NT	<0.5	<0.5	0.001	<5
J	02-May-2012	7.8	603	9.9	10.3	20	1	4	0.016	0.021	1.3	18	0.026	NT	<0.5	<0.5	<1	<5
J	25-Oct-2012	7.8	531	10.0	11.1	25	1	3	0.022	0.028	0.86	9	0.036	NT	<0.5	<0.5	<1	<5
J	03-Jul-2013	8.1	464	10.9	15.8	5	1	2	0.012	0.015	0.45	10	0.095	NT	<0.5	<0.5	0.001	0.006
J	07-May-2014	7.7	687	9.6	11.9	12	<1	6	0.014	0.018	1.5		0.019	AR	<0.03	0.00236	0.00111	0.009

Appendix C Table 5 - Off-Site Surface Water Monitoring Data
Ballymulvey Landfill, Longford County Council

Data from *ballymahon landfill.xls*
All other data from Ballymulvey monitoring data.xlsx
Data don't tally with those in *ballymahon landfill.xls*
Result given as N converted to NO_3
Assumed units
Result given as NH_4 converted to N
Blank cell indicates no data

Station Name	Sample Date	pH	Conductivity	Dissolved Oxygen	Temperature	Chemical Oxygen Demand	Biological Oxygen Demand	Suspended Solids	Ammonia (N)	Ammonium (NH_4)	Nitrate (NO_3)	Chloride	Ortho-phosphate	Total Phosphorus	Cadmium	Chromium	Copper	Zinc
			µS/cm @ 20°C	mg/L	°C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
K Average		7.4	635	6.4	9.1	33	3	50	0.15	0.28	1.3	8.4	0.10					
K Standard Deviation		0.2	65	2.6	3.4	30	2	165	0.30	0.59	1.2	4.9	0.12					
K Maximum		7.9	761	12.0	14.2	99	9	710	1.3	1.7	5.3	17	0.52					
K Minimum		7.1	547	0.9	2.4	2	1	2	0.013	0.020	0.022	2.0	0.0					
K	04-Jun-1992	7.2		8.6		78	7		0.15		2.2		0.033					
K	12-Aug-1992	7.9		6.8		80	5		0.35		2.0		0.20					
K	08-Sep-1992	7.5		9.1		99	8		0.20		1.6		0.030					
K	29-May-2002	7.1		9.2		93	<1	<10	0.30		1.7		<0.03					
K	11-Sep-2002	7.5		5.6		26	<2	710	0.20		5.3		0.090					
K	03-Mar-2004	7.4	690	8.0	5.8	2	1	2	<0.2			11			0.001	<1	<5	0.007
K	02-Jun-2004	7.2	548	2.8	12.1	25	6	5	0.021		0.90	5	0.22		<0.4	<1	<5	0.006
K	02-Nov-2004	7.5	654	6.8	9.0	17	2	6	0.016		0.40	<10	0.070		<0.4	0.009	<5	<5
K	23-Feb-2005	7.7	592	0.9	2.5	2	2	2	0.023		1.8	4	0.011		<0.4	<0.4	<5	<5
K	27-Apr-2005	7.6	596	9.2	10.4	11	1	7	0.013		<0.1	<10	0.007		<0.4	0.01	<1	<3
K	02-Nov-2005	7.3	665	5.6	7.0	24	1	19	0.058		0.95	14	0.19		<1	0.006	<1	0.014
K	01-Mar-2006	7.4	590	12.0	2.4	4	1	2	0.049		1.8	3	<0.01		<1	0.008	<1	<1
K	03-May-2006	7.2	553	6.0	6.0	54	2	6	0.037		1.7	17	0.002		<1	0.013	<1	0.009
K	22-Apr-2009	7.1	726	5.5	10.1	27	2	5	0.051	0.065	2.3	6		0.111	<0.00022	0.00285	0.00396	0.0158
K	28-Oct-2009	7.4	761	2.2	13.3	59	9	32	<0.012	<0.015	0.18	16	0.11	NT	<0.0005	<0.0005	0.004	0.011
K	21-Apr-2010	7.6	638	8.2	9.9	3	2	3	0.024	0.031	<0.2	6	0.048	NT	<0.0005	0.002	<0.001	<0.005
K	06-Oct-2010	7.7	547	4.3	12.7	22	1	8	0.016	0.020	0.19	13	0.52	NT	<0.5	<0.5	<1	<5
K	12-Feb-2011	7.5	615	8.1	9.0	23	3	6	0.058	0.074	0.02	6	0.048	NT	<0.5	<0.5	<1	<5
K	25-Oct-2012	7.3	738	5.3	10.3	8	2	13	0.016	0.020	0.16	2	0.041	NT	<0.5	<0.5	<1	<5
K	03-Jul-2013	7.5	638	3.3	14.2	16	1	30	1.3	1.720	0.25	6	0.10	NT	AR	AR	AR	AR
K	07-May-2014	7.8	611	7.0	10.6	12	2	4	0.017	0.022	0.23		0.030	AR	<0.03	0.00203	<0.85	0.00756
L Average		6.9		6.8		117	5		0.74		2.5		0.59					
L Standard Deviation		0.3		1.3		70	5		0.90		1.64		0.88					
L Maximum		7.3		8.9		266	15		2.7		5.7		2.1					
L Minimum		6.6		5.3		61	2		0.090		0.70		0.028					
L	04-Jun-1992	7.2		7.3		98	15		0.090		2.4		0.028					
L	08-Sep-1992	6.6		5.4		266	4		0.30		1.6		0.14					
L	03-Feb-1993	6.7				84	2		0.41		5.7		<0.05					
L	22-Mar-1993	7.3		7.2		65	2		0.23		1.3		0.090					
L	29-May-2002	7.1		8.9		126	3	16	0.70		3.1		<0.03					
L	11-Sep-2002	6.6		5.3		61	3	280	2.7		0.70		2.1					

Data from *ballymahon landfill.xls*
All other data from Ballymulvey monitoring data.xlsx
Data don't tally with those in *ballymahon landfill.xls*
Result given as N converted to NO_3
Assumed units
Result given as NH_4 converted to N
Blank cell indicates no data

Station Name	Sample Date	pH	Conductivity	Dissolved Oxygen	Temperature	Chemical Oxygen Demand	Biological Oxygen Demand	Suspended Solids	Ammonia (N)	Ammonium (NH_4)	Nitrate (NO_3)	Chloride	Ortho-phosphate	Total Phosphorus	Cadmium	Chromium	Copper	Zinc
			µS/cm @ 20°C	mg/L	°C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
M Average		7.0	499	4.6	10.4	163	12	11	2.5	0.2	3.6	32	0.1					
M Standard Deviation		0.5	113	4.0	2.7	177	30	22	7.9	0.04	6.6	15	0.20					
M Maximum		8.6	689	17.2	15.1	765	116	76	31	0.2	26	69	0.7					
M Minimum		6.5	313	1.4	5.0	56	1	1	0.020	0.1	0.3	20	0.007					
M	04-Jun-1992	6.8		3.2		146	3		0.12		1.8		0.071					
M	08-Sep-1992	8.6		17.2		765	116		31		26		0.20					
M	22-Mar-1993	6.7		6.4		314	8		0.85		1.3		0.70					
M	29-May-2002	7.1		6.0		121	3	<10	0.40		2.3		<0.03					
M	11-Sep-2002	6.5		6.1		108	<2	76	0.40		0.30		<0.08					
M	06-Nov-2003	6.7	396	3.1	8.9	98	4	2	1.5		3.5		0.040		<0.4	<1	<5	<5
M	03-Mar-2004	6.8	509	2.3	5.0	56	1	6	0.30			32			<0.4	<1	<5	<5
M	02-Jun-2004	7.0	492	1.7	12.2	85	7	1	0.13		1.5	29	0.10		<0.4	<1	<5	<5
M	18-Aug-2004	6.9	313	7.5	15.1	101	5	5	0.060		1.3	20	0.008		<0.4	0.001	<5	0.02
M	02-Nov-2004	6.7	408	3.6	9.0	112	2	3	0.099		1.9	34	0.020		<0.4	<1	<5	<5
M	10-Oct-2007	7.0	480	1.6	10.1	95	2	6	0.020		1.0	24	0.007		<0.4	0.006	<1	<1
M	22-Apr-2009	7.1	689	2.4	10.0	68	3	3	0.17	0.221	3.2	69		0.124	0.00022	0.00421	0.00182	0.0097
M	28-Oct-2009	7.3	638	1.4	13.2	107	2	2	0.15	0.199	1.2	27	0.055		<0.0005	<0.0005	0.002	0.005
M	25-Oct-2012	7.0	570	2.1	10.4	106	4	6	0.097	0.125	1.4	20	0.042	NT	<0.5	<0.5	<1	<5
N Average		8.0		8.0		1268	74		74		26		2.7					
N Standard Deviation		0.3		2.1		1032	58		38		20		1.8					
N Maximum		8.4		11.2		3540	200		120		57		6.0					
N Minimum		7.2		5.5		213	20		8		2.6		0.3					
N	04-Jun-1992	8.3		9.8		1865	200		81		56		1.6					
N	15-Jul-1992	8.4		5.5		1860	90		79		27		2.9					
N	12-Aug-1992	8.1		8.3		490	24		58		11		4.5					
N	08-Sep-1992	7.9		5.8		3540	93		120		57		6.0					
N	03-Feb-1993	8.0				564	20		114		12		2.5					
N	22-Mar-1993	8.1		11.2		851	32		105		36		0.34					
N	24-Aug-1994	8.2				760	105	416	8		2.6		1.3					
N	29-May-2002	7.2		7.2		213	25	94	28		4.4		<0.03					

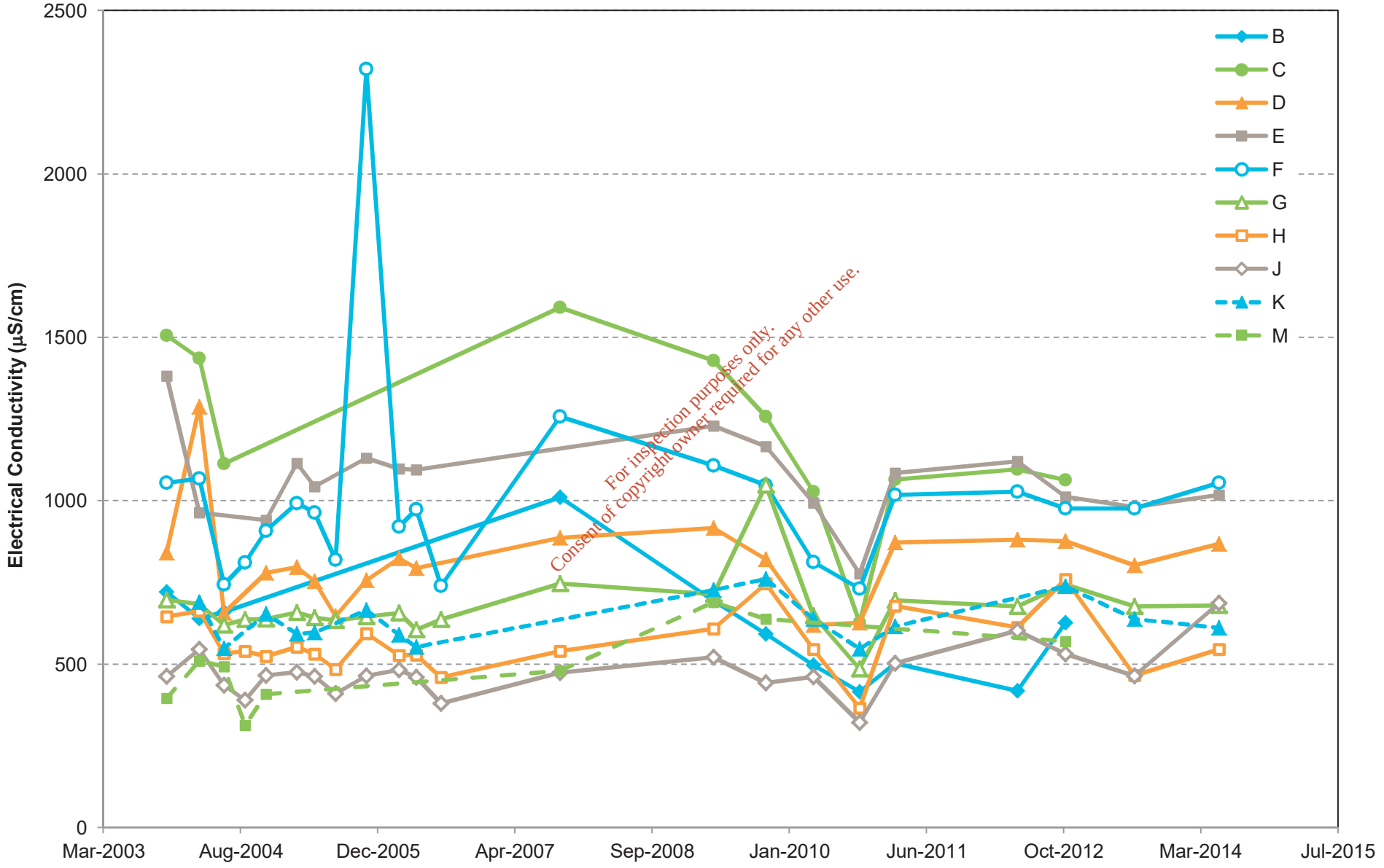
Appendix C Table 5 - Off-Site Surface Water Monitoring Data
Ballymulvey Landfill, Longford County Council

Data from *ballymahon landfill.xls*
All other data from Ballymulvey monitoring data.xlsx
Data don't tally with those in *ballymahon landfill.xls*
Result given as N converted to NO_3
Assumed units
Result given as NH_4 converted to N
Blank cell indicates no data

Station Name	Sample Date	pH	Conductivity	Dissolved Oxygen	Temperature	Chemical Oxygen Demand	Biological Oxygen Demand	Suspended Solids	Ammonia (N)	Ammonium (NH_4)	Nitrate (NO_3)	Chloride	Ortho-phosphate	Total Phosphorus	Cadmium	Chromium	Copper	Zinc
			µS/cm @ 20°C	mg/L	°C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
O Average		7.7		3.9		2758	167		80		35		4.1					
O Standard Deviation		0.4		2.4		3002	165		18		28		3.0					
O Maximum		8.5		7.6		10160	500		110		100		8.3					
O Minimum		7.2		0.8		493	22		59		12		0.1					
O	04-Jun-1992	7.9		0.8		10160	500		75		100		8.3					
O	15-Jul-1992	7.9		1.3		4130	140		99		25		7.5					
O	12-Aug-1992	7.8		3.0		1870	150		62		50		5.2					
O	08-Sep-1992	7.5		5.4		505	24		97		12		3.2					
O	03-Feb-1993	7.3				2260	370		59		41		6.0					
O	22-Mar-1993	8.5		5.4		1501	110		110		17		1.7					
O	24-Aug-1994	7.5				493	22	73	65		15		0.40					
O	29-May-2002	7.2		7.6		1145	23	986	78		16		0.10					
P Average		7.4		4.9		1197	102		66		17		1.7					
P Standard Deviation		0.3		3.4		1577	161		22		24		1.3					
P Maximum		7.9		9.2		5040	460		104		76		3.9					
P Minimum		7.1		0.5		335	20		30		1.4		0.0					
P	04-Jun-1992	7.2		2.5		335	>82		63		1.4		1.1					
P	15-Jul-1992	7.5		0.5		5040	460		52		76		3.9					
P	12-Aug-1992	7.9		4.0		425	34		63		7.6		2.8					
P	03-Feb-1993	7.4				489	22		84		6.8		2.0					
P	22-Mar-1993	7.7		9.2		651	20		104		8.3		1.9					
P	24-Aug-1994	7.1				557	55	154	64		13		0.20					
P	29-May-2002	7.1		8.4		880	21	776	30		5.1		0.040					

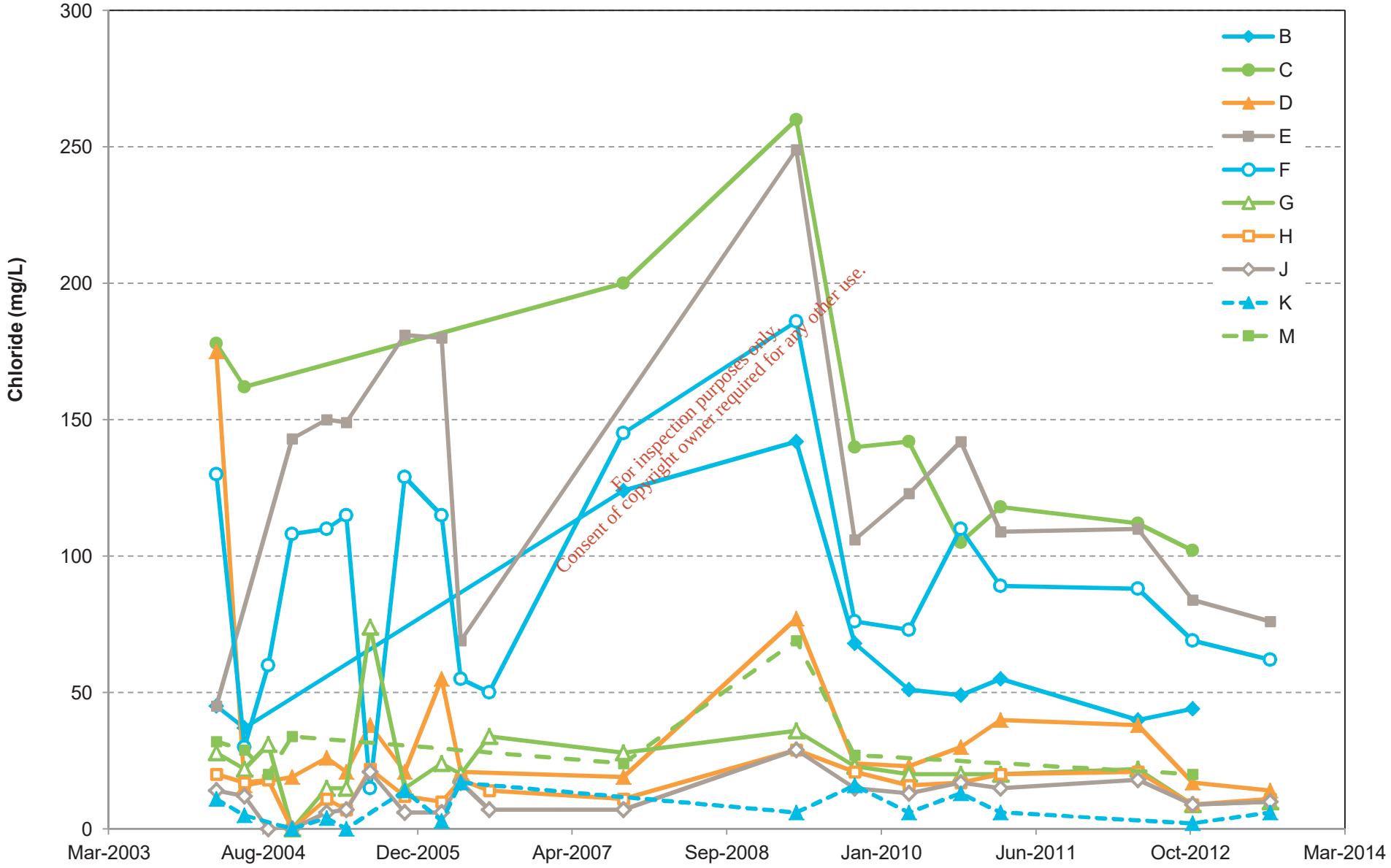
Appendix C - Ballymulvey Landfill Monitoring Data

Electrical Conductivity Trends in Off-Site Surface Water



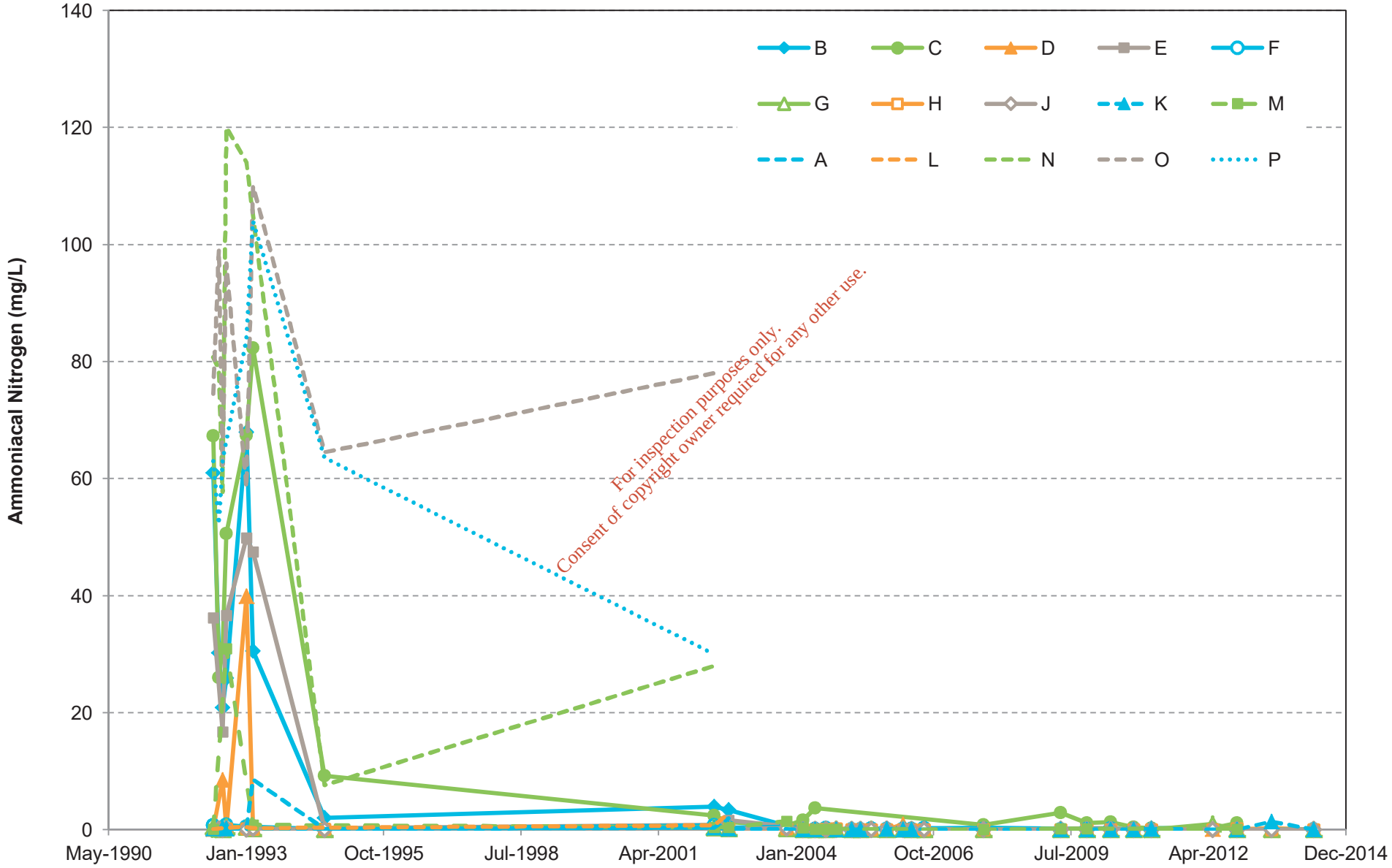
Appendix C - Ballymulvey Landfill Monitoring Data

Chloride Trends in Off-Site Surface Water

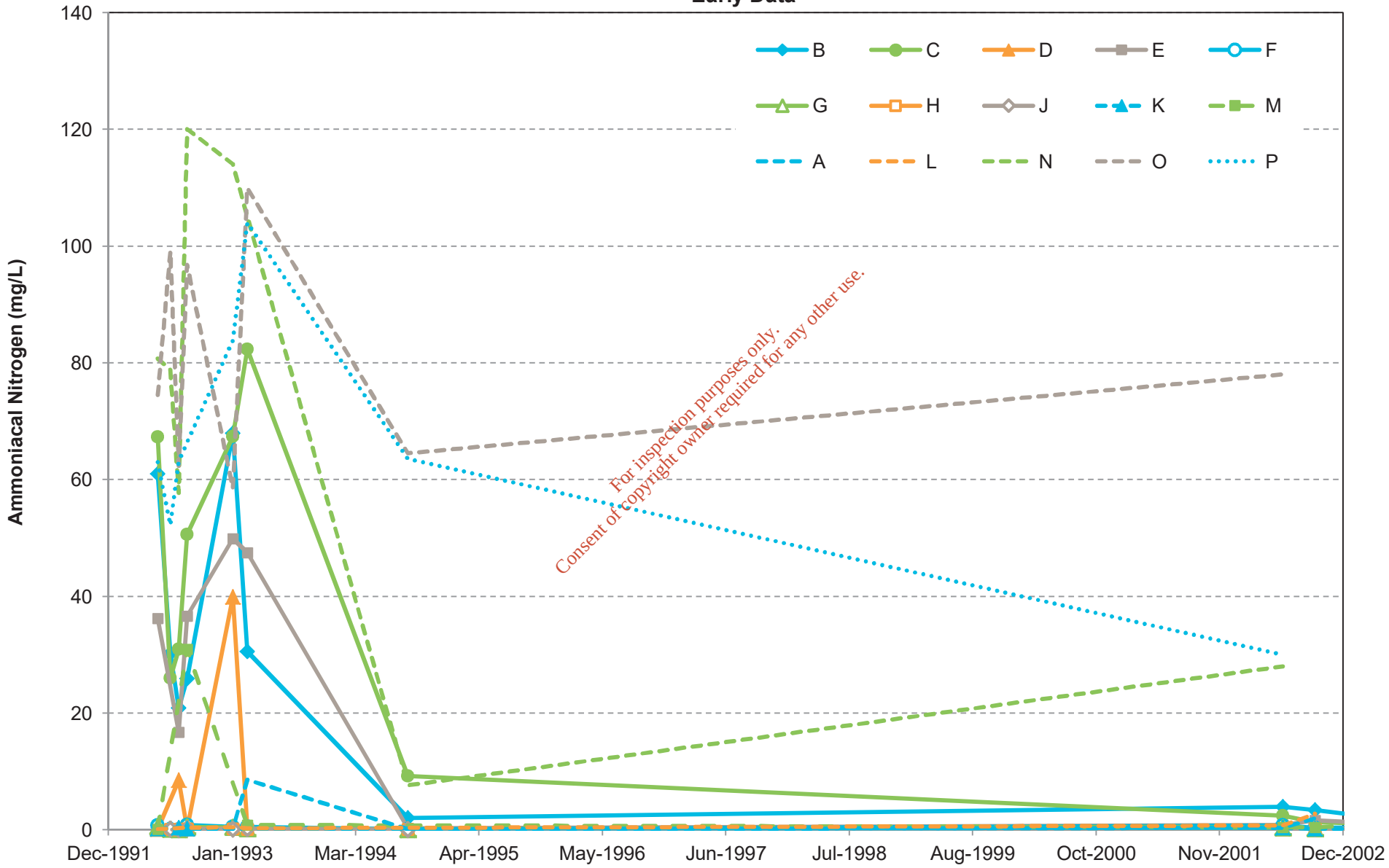


Appendix C - Ballymulvey Landfill Monitoring Data

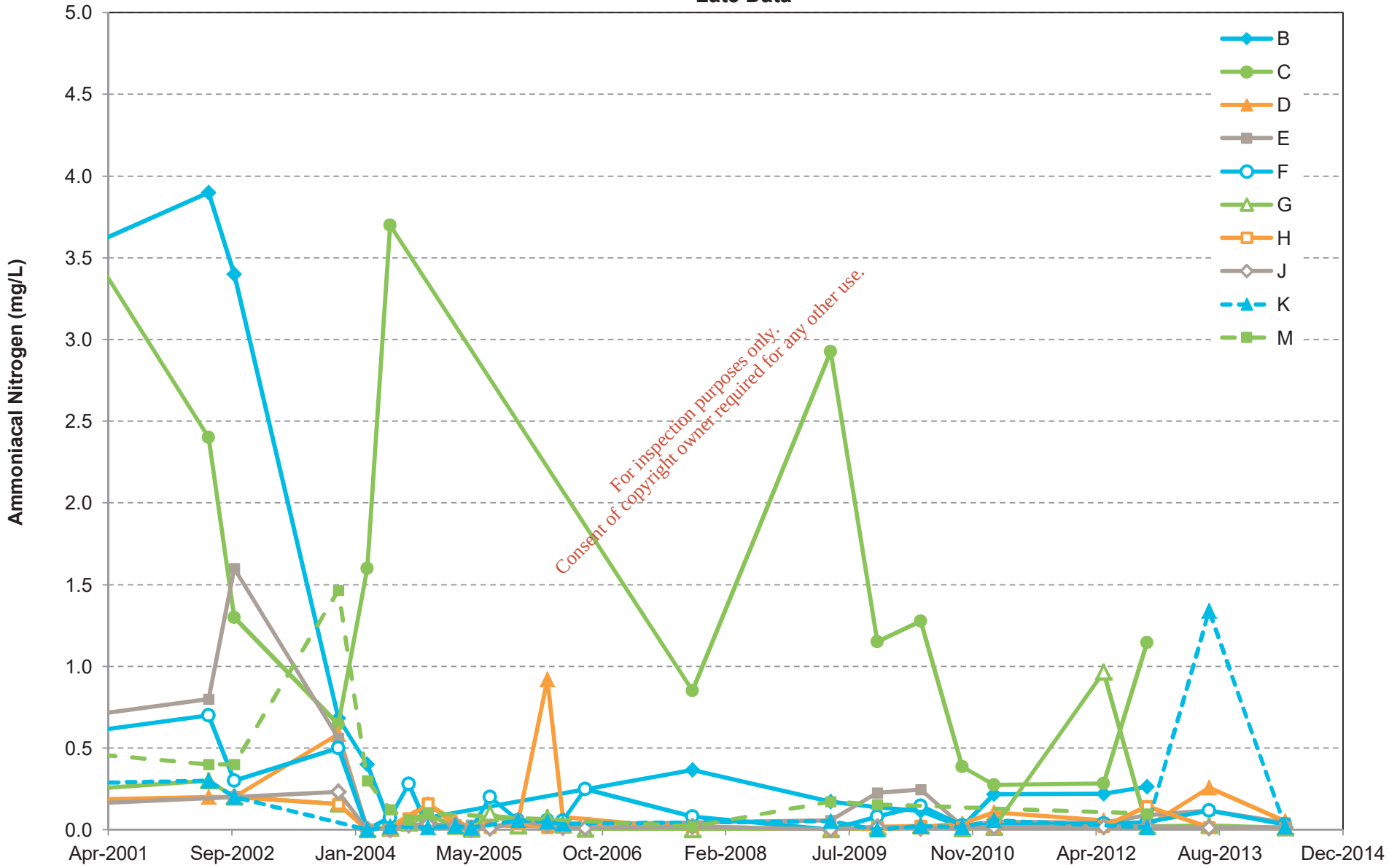
Ammoniacal Nitrogen Trends in Off-Site Surface Water



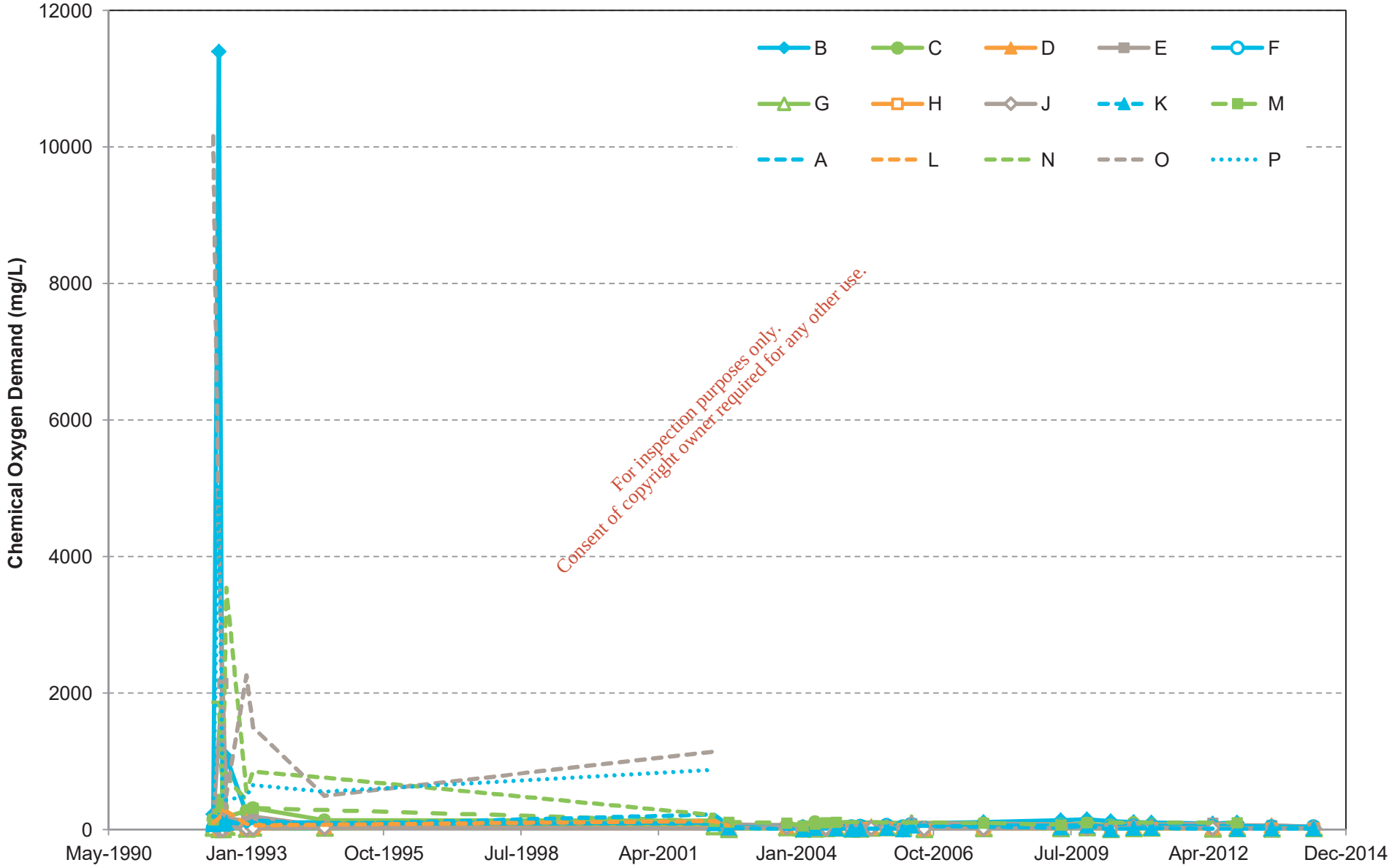
Ammoniacal Nitrogen Trends in Off-Site Surface Water
Early Data



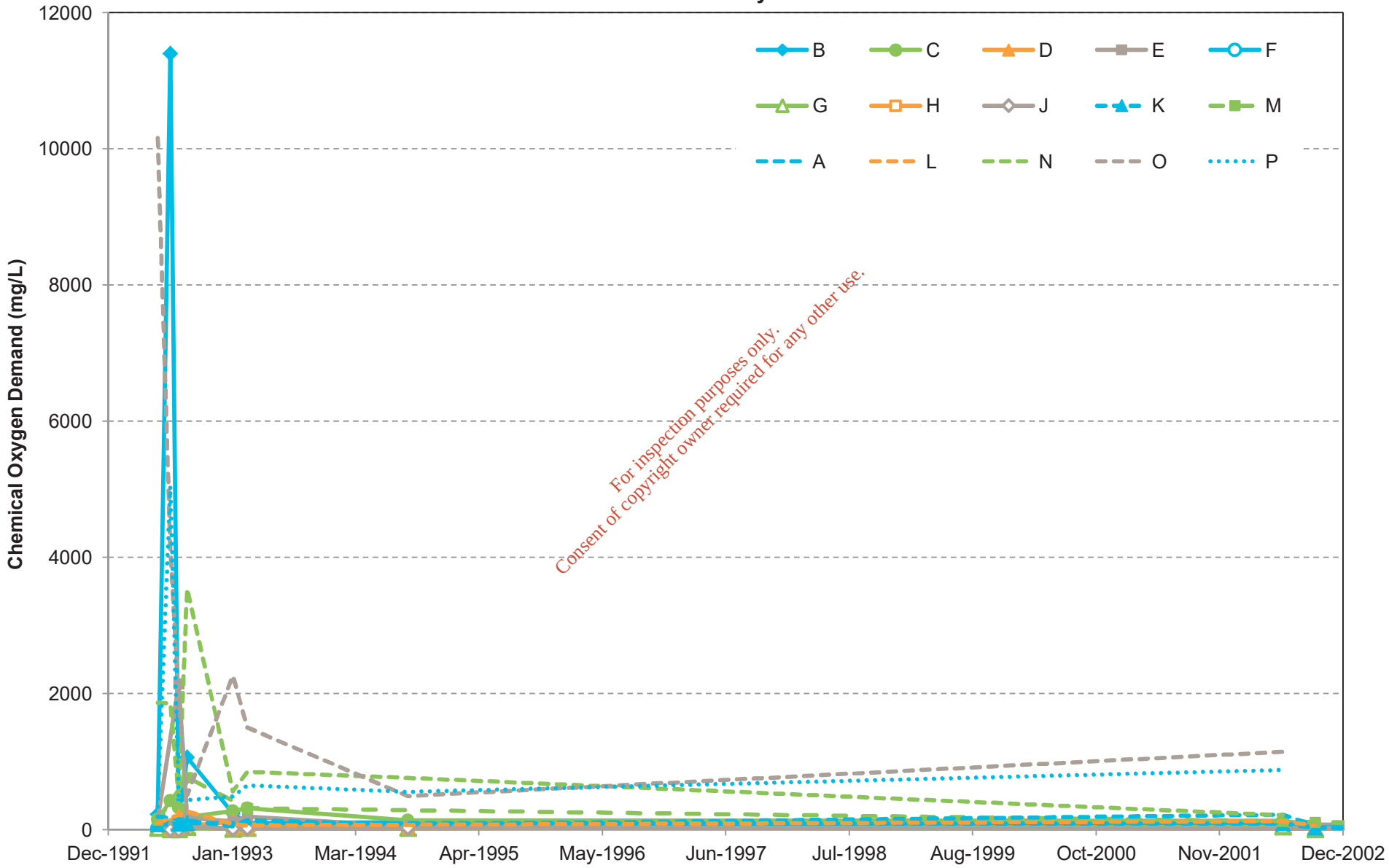
Ammoniacal Nitrogen Trends in Off-Site Surface Water
Late Data



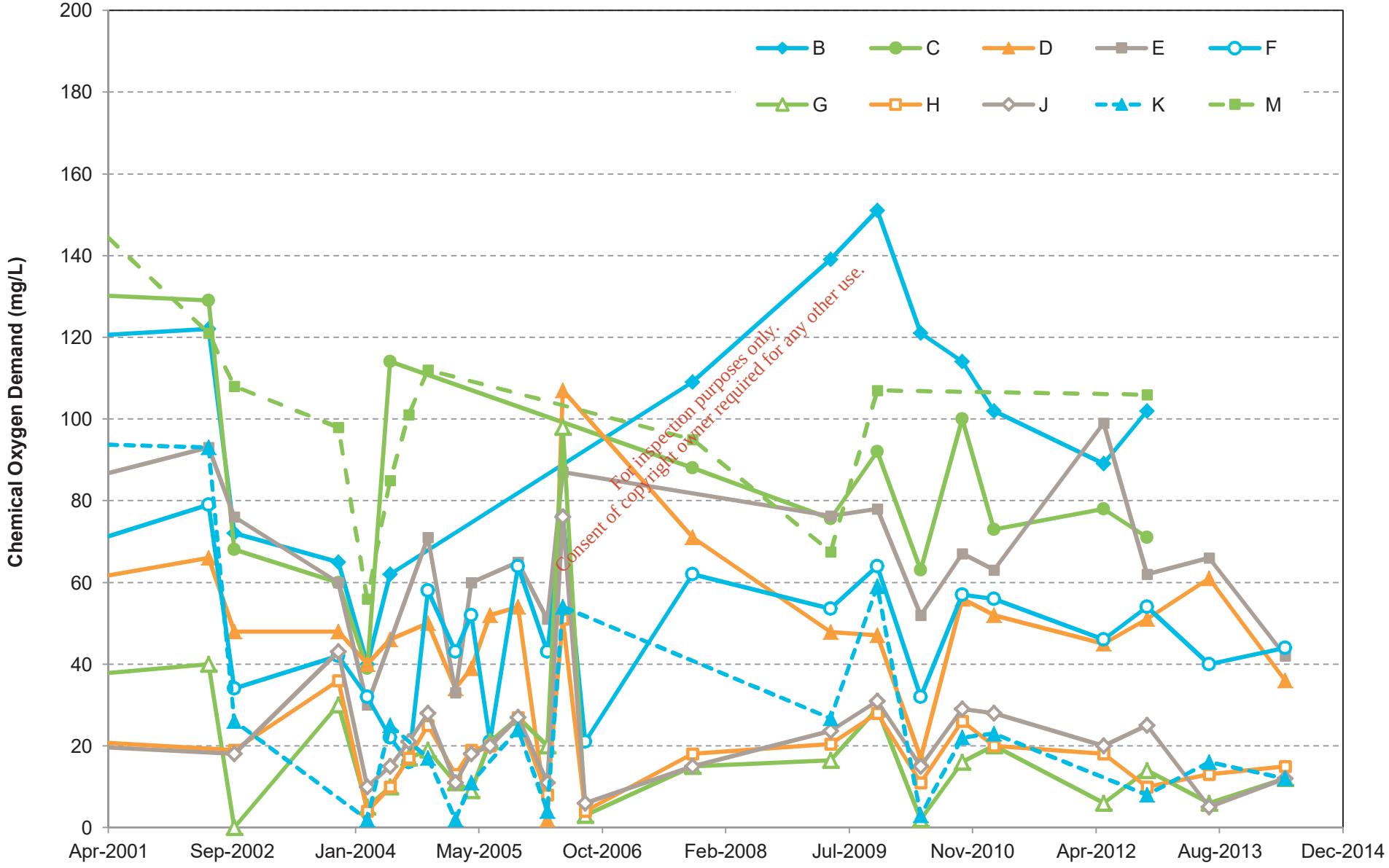
Chemical Oxygen Demand Trends in Off-Site Surface Water



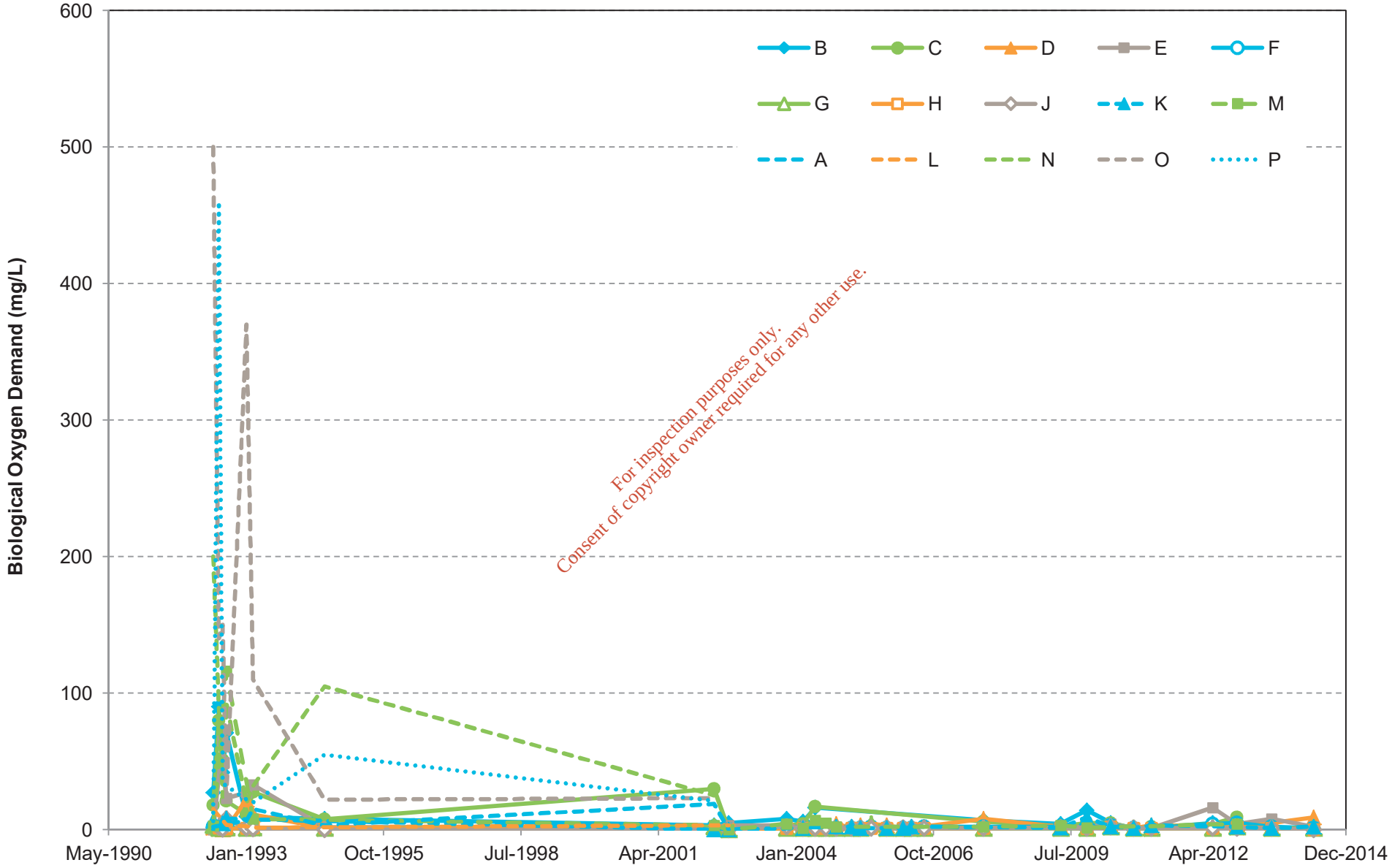
Chemical Oxygen Demand Trends in Off-Site Surface Water
Early Data



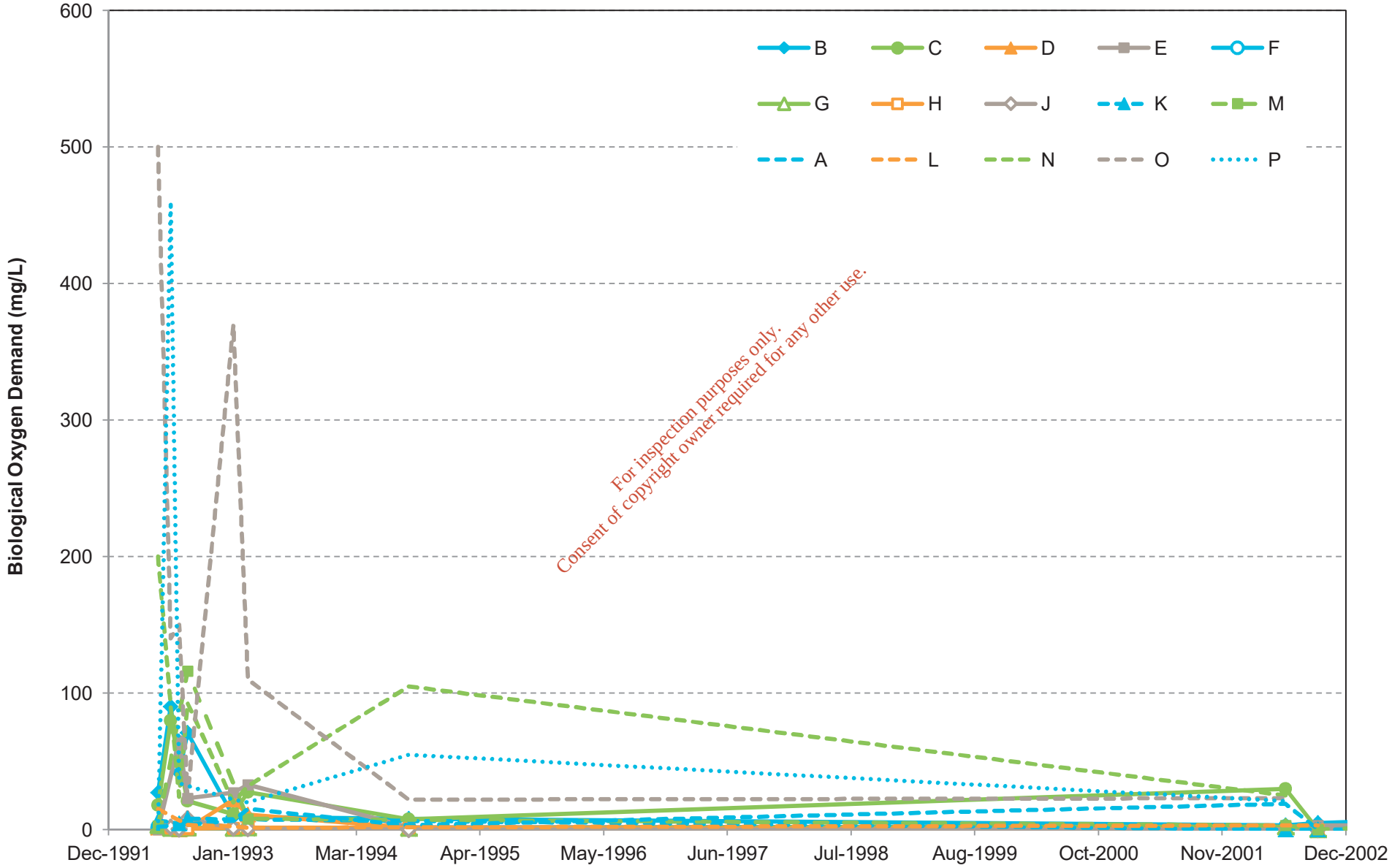
Chemical Oxygen Demand Trends in Off-Site Surface Water
Late Data



Biological Oxygen Demand Trends in Off-Site Surface Water

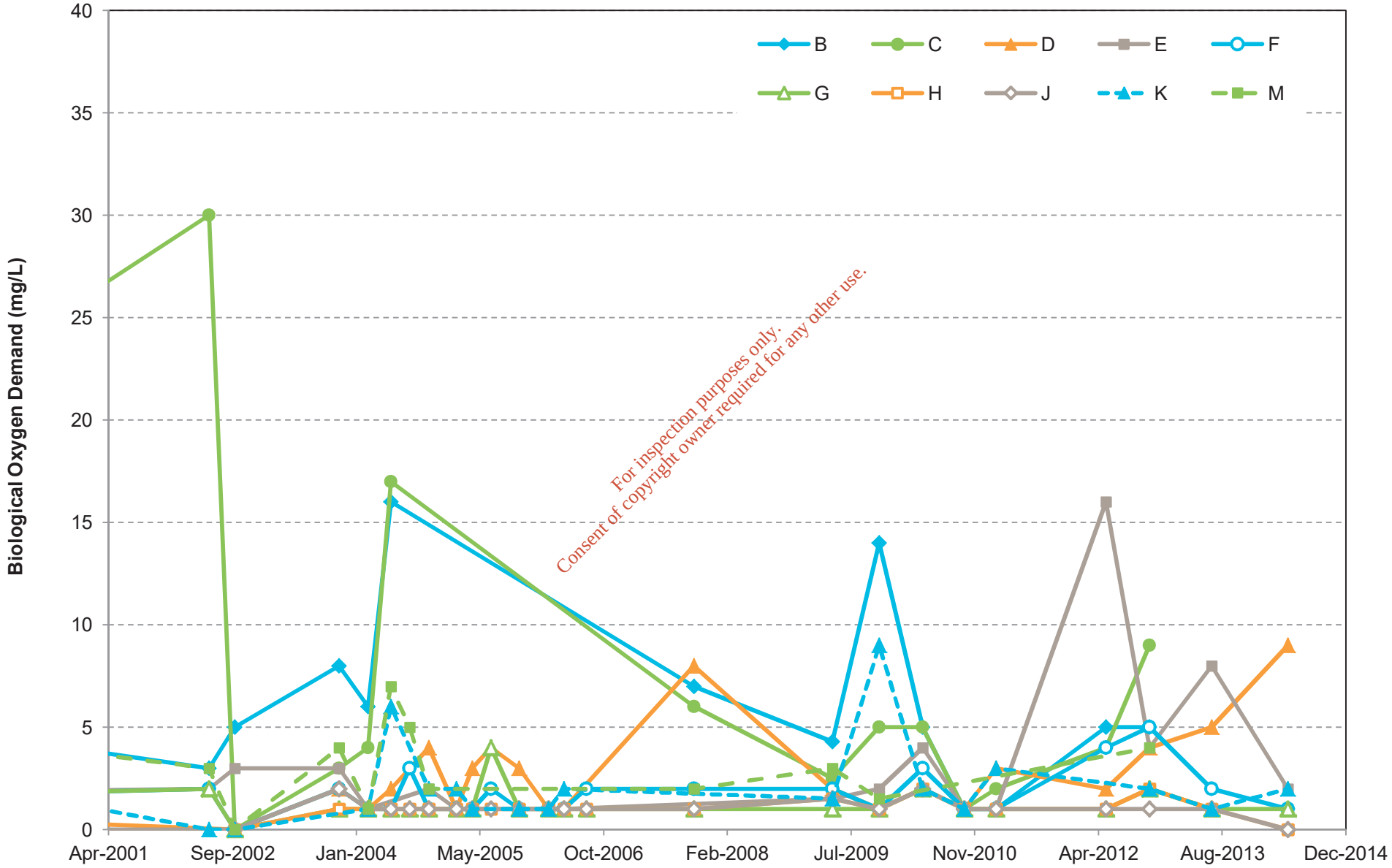


Biological Oxygen Demand Trends in Off-Site Surface Water
Early Data



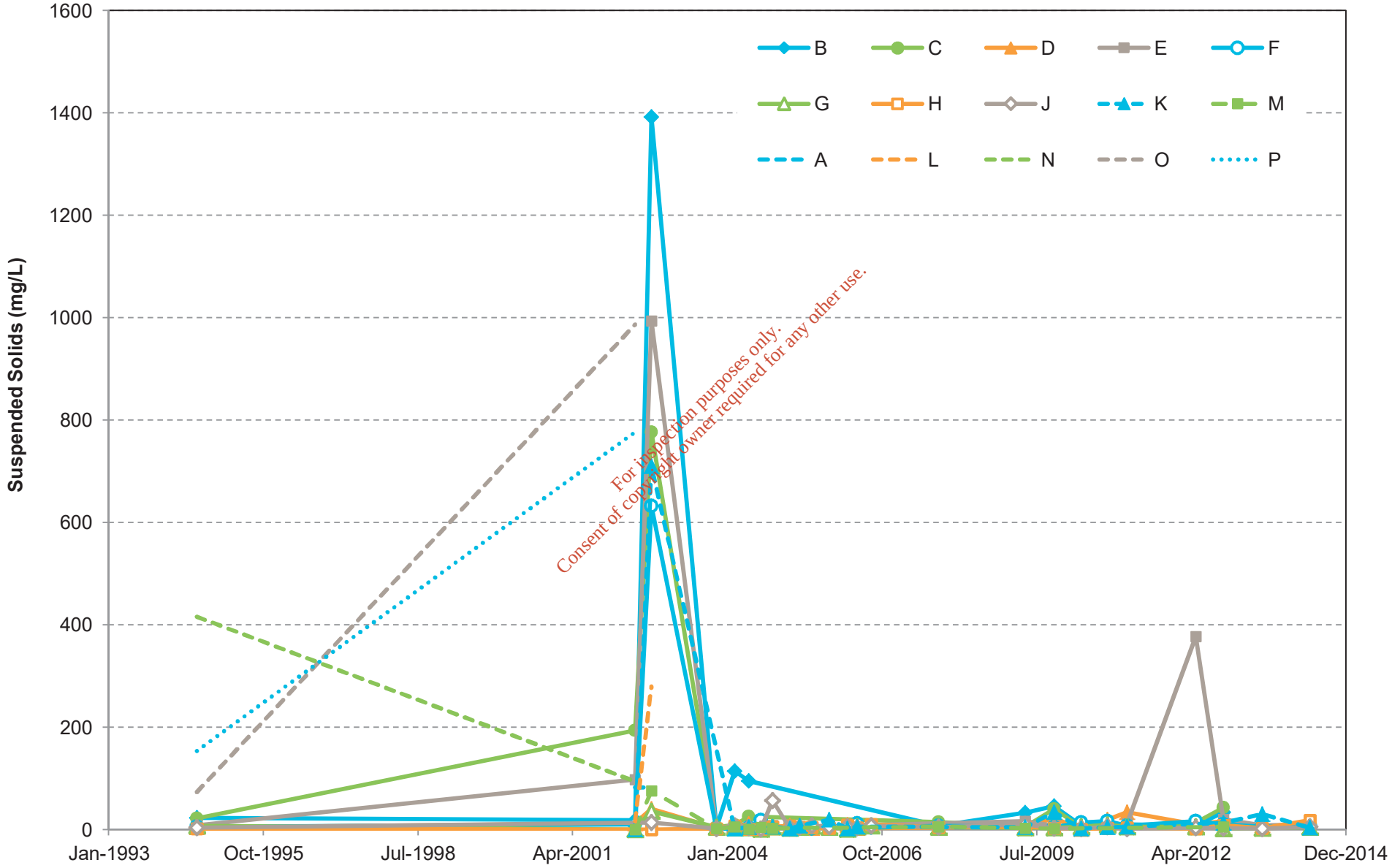
Appendix C - Ballymulvey Landfill Monitoring Data

Biological Oxygen Demand Trends in Off-Site Surface Water
Late Data



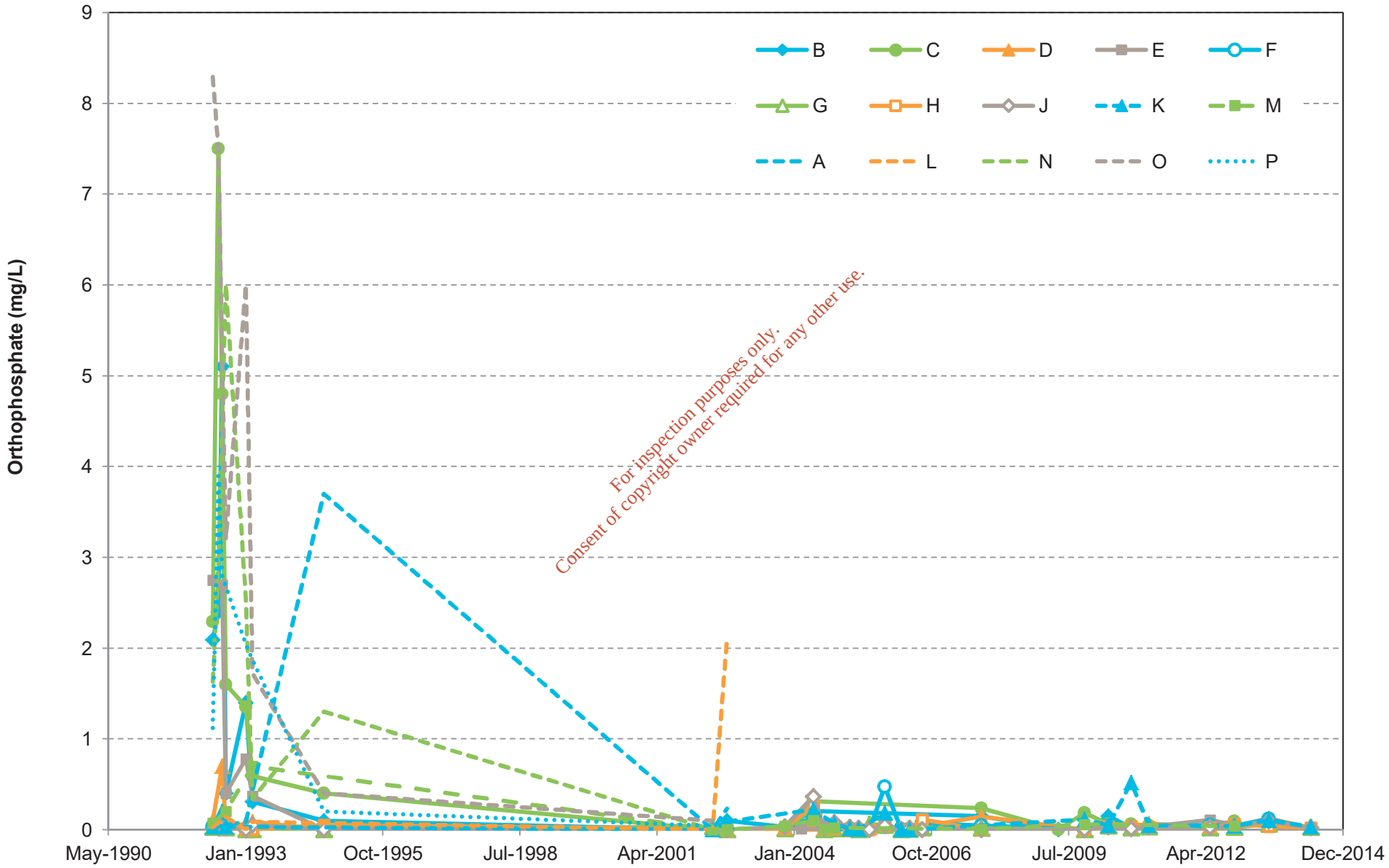
Appendix C - Ballymulvey Landfill Monitoring Data

Suspended Solids Trends in Off-Site Surface Water

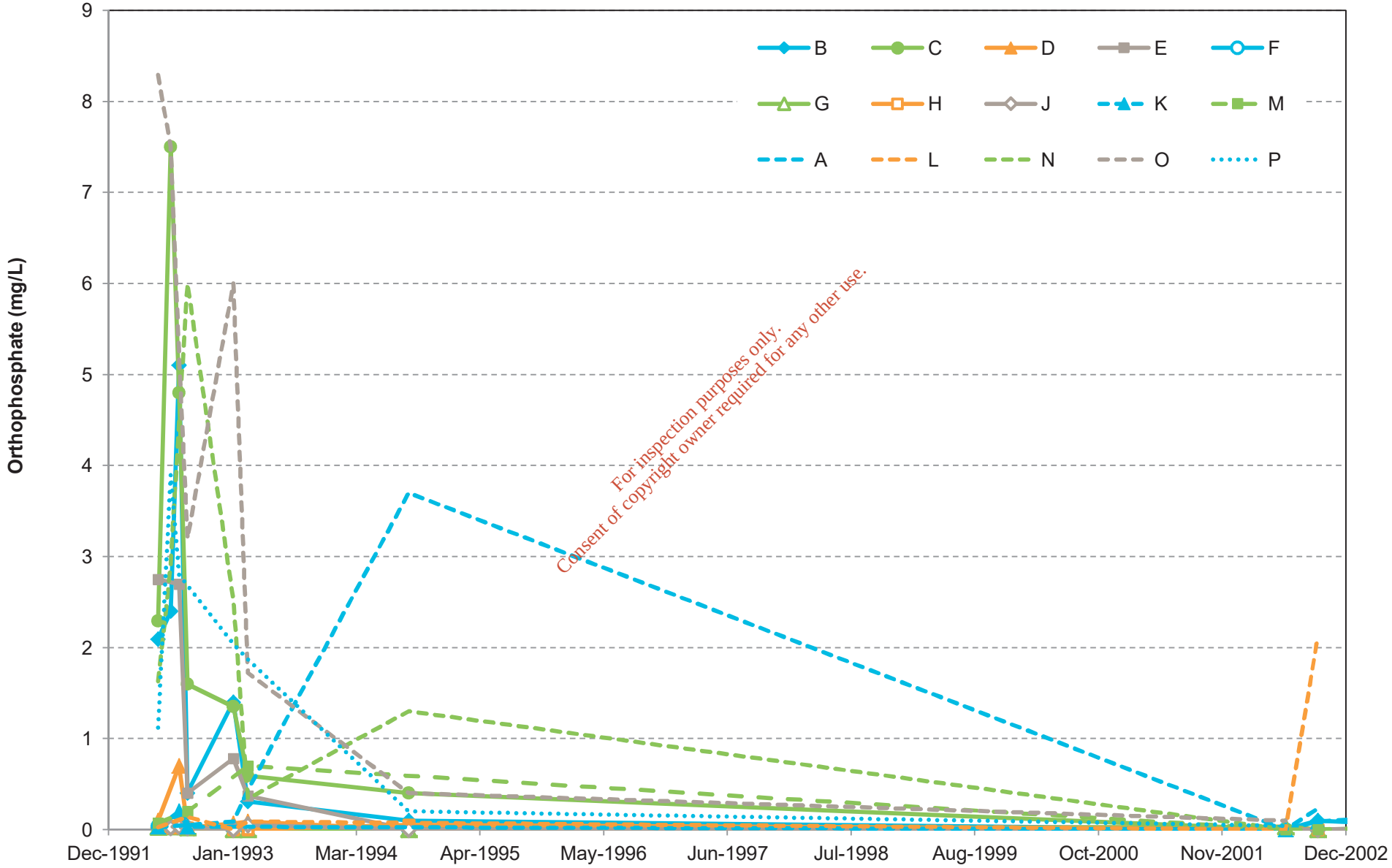


Appendix C - Ballymulvey Landfill Monitoring Data

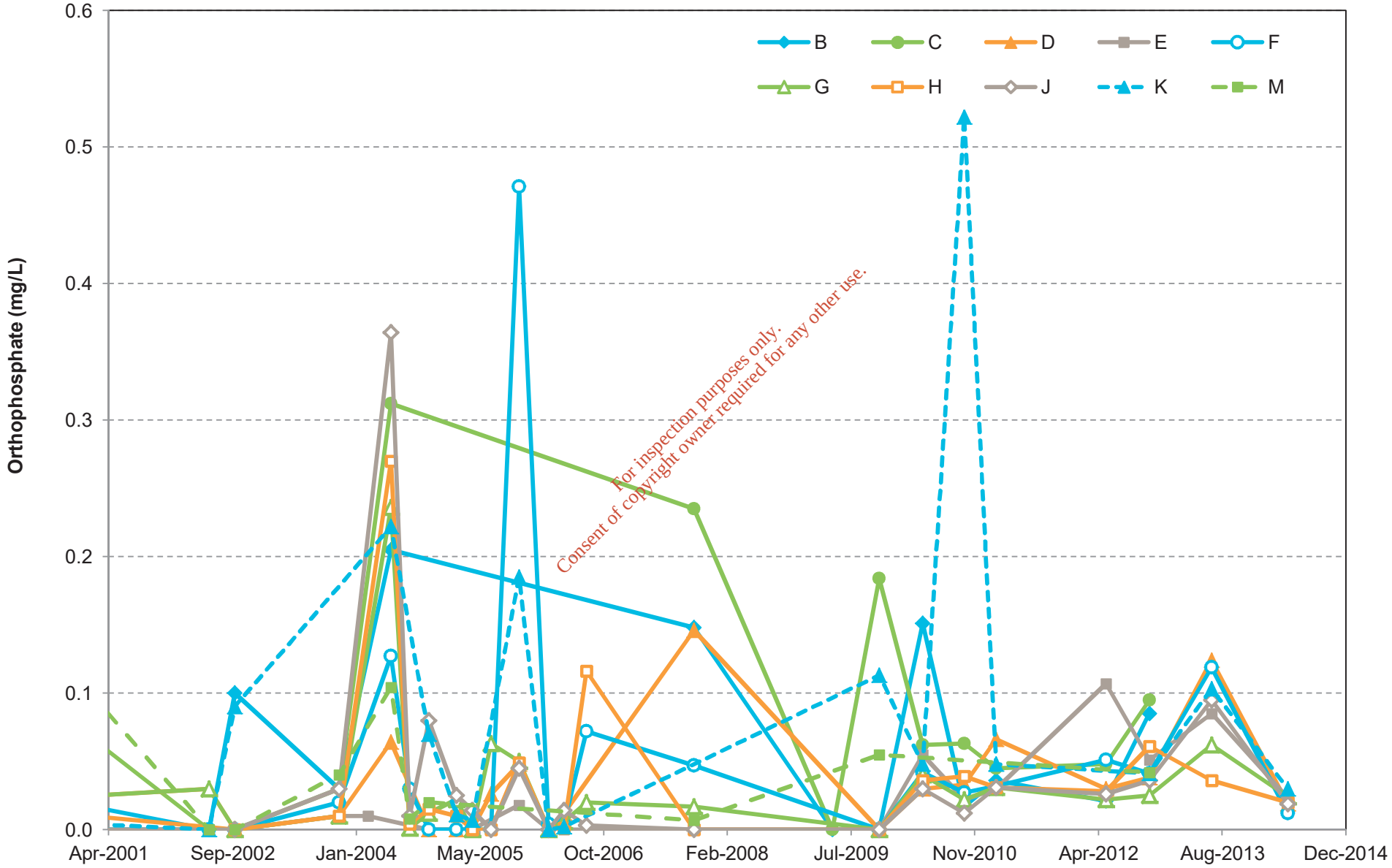
Orthophosphate Trends in Off-Site Surface Water



Orthophosphate Trends in Off-Site Surface Water
Early Data



Orthophosphate Trends in Off-Site Surface Water
Late Data



Appendix D - Photographic Log

AECOM

PHOTOGRAPHIC LOG

Client Name: Longford County Council

Site Location: Ballymulvey Landfill, Ballymahon, Longford

Project Number: 60549441

Photo No.	**Date:**
1	20/07/2017

Description:

Looking south-westwards across site from entrance gate on L1121.

Photo No.	**Date:**
2	20/07/2017

Description:

View north-eastwards into north-eastern corner of site.

AECOM

PHOTOGRAPHIC LOG

Client Name: Longford County Council

Site Location: Ballymulvey Landfill, Ballymahon, Longford

Project Number: 60549441

Photo No. 3

Date: 20/07/2017

Description:

View south-westwards along -easteastern perimeter.

Photo No. 4

Date: 20/07/2017

Description:

View southwards into south-eastern corner of site.

AECOM

PHOTOGRAPHIC LOG

Client Name: Longford County Council

Site Location: Ballymulvey Landfill, Ballymahon, Longford

Project Number: 60549441

Photo No.	Date:
5	20/07/2017

Description:

Leachate monitoring point, possibly BH5.

Photo No.	Date:
6	20/07/2017

Description:

Gas monitoring point, possibly G4, and view north from top of landfill.

AECOM

PHOTOGRAPHIC LOG

Client Name: Longford County Council

Site Location: Ballymulvey Landfill, Ballymahon, Longford

Project Number: 60549441

Photo No. 7

Date: 20/07/2017

Description:

Leachate monitoring point, and view north-westwards along south-western perimeter of landfill.

Photo No. 8

Date: 20/07/2017

Description:

Unidentified structure between south-western perimeter of landfill and lagoon; no staining or evidence of burning.

AECOM

PHOTOGRAPHIC LOG

Client Name: Longford County Council

Site Location: Ballymulvey Landfill, Ballymahon, Longford

Project Number: 60549441

Photo No.	Date:
9	20/07/2017

Description:

View southwards across lagoon, abundant reeds.

Photo No.	Date:
10	20/07/2017

Description:

Gas monitoring point close to south-western perimeter of landfill, possibly G7 or vent 3.

AECOM

PHOTOGRAPHIC LOG

Client Name: Longford County Council

Site Location: Ballymulvey Landfill, Ballymahon, Longford

Project Number: 60549441

Photo No. 11

Date: 20/07/2017

Description:

View north-eastwards across western dome toward site entrance.

Photo No. 12

Date: 20/07/2017

Description:

Gas monitoring point in western dome, possibly G6.

AECOM

PHOTOGRAPHIC LOG

Client Name: Longford County Council

Site Location: Ballymulvey Landfill, Ballymahon, Longford

Project Number: 60549441

Photo No.	**Date:**
13	20/07/2017

Description:

Northern corner of site and access to adjacent field.

Photo No.	**Date:**
14	20/07/2017

Description:

Groundwater monitoring well BH1, adjacent to stile in northern corner; well covered with boulder/slab for protection, could not be lifted.

AECOM

PHOTOGRAPHIC LOG

Client Name: Longford County Council

Site Location: Ballymulvey Landfill, Ballymahon, Longford

Project Number: 60549441

Photo No.	Date:
15	20/07/2017

Description:

View north-westwards, across field to west of site. Telegraph poles are along the L1121 road.

Photo No.	Date:
16	20/07/2017

Description:

North-western fenceline and perimeter cut-off drain.

AECOM

PHOTOGRAPHIC LOG

Client Name: Longford County Council

Site Location: Ballymulvey Landfill, Ballymahon, Longford

Project Number: 60549441

Photo No. 17

Date: 20/07/2017

Description:

View north-westwards across field to west of site, photo taken further south than Photo No. 15.

Photo No. 18

Date: 20/07/2017

Description:

Walking south-westwards outside north-western perimeter of site.

AECOM

PHOTOGRAPHIC LOG

Client Name: Longford County Council

Site Location: Ballymulvey Landfill, Ballymahon, Longford

Project Number: 60549441

Photo No. 19

Date: 20/07/2017

Description:

Perimeter cut-off drain inside north-western boundary fence; flow is south-westwards.

Photo No. 20

Date: 20/07/2017

Description:

Boundary fence in western corner.

AECOM

PHOTOGRAPHIC LOG

Client Name: Longford County Council

Site Location: Ballymulvey Landfill, Ballymahon, Longford

Project Number: 60549441

Photo No.	**Date:**
21	20/07/2017

Description:

View north-eastwards across south-western boundary fence and perimeter cut-off drain; little flow at this point.

Photo No.	**Date:**
22	20/07/2017

Description:

View south-eastwards across seepage from south-western perimeter cut-off drain into boggy woodland to south of site.

AECOM

PHOTOGRAPHIC LOG

Client Name: Longford County Council

Site Location: Ballymulvey Landfill, Ballymahon, Longford

Project Number: 60549441

Photo No.	**Date:**
23	20/07/2017

Description:

Boggy woodland to south of site.

Photo No.	**Date:**
24	20/07/2017

Description:

View north-eastwards across south-western boundary fence and perimeter cut-off drain with reed-filled lagoon further north.

AECOM

PHOTOGRAPHIC LOG

Client Name: Longford County Council

Site Location: Ballymulvey Landfill, Ballymahon, Longford

Project Number: 60549441

Photo No.	Date:
25	20/07/2017

Description:

View north-eastwards from outside south-eastern perimeter fence.

Photo No.	Date:
26	20/07/2017

Description:

Bogland to east of site.

AECOM

PHOTOGRAPHIC LOG

Client Name: Longford County Council

Site Location: Ballymulvey Landfill, Ballymahon, Longford

Project Number: 60549441

Photo No.	Date:
27	20/07/2017

Description:

South-west flowing stream on south-eastern side of N55, across from GAA pitch; up-stream of surface water monitoring point G.

Photo No.	Date:
28	20/07/2017

Description:

View westwards along westerly flowing River Inny, at riverside park in Ballymahon town.

AECOM

PHOTOGRAPHIC LOG

Client Name: Longford County Council

Site Location: Ballymulvey Landfill, Ballymahon, Longford

Project Number: 60549441

Photo No.	Date:
29	20/07/2017

Description:

River Inny, Ballymahon.

Photo No.	Date:
30	20/07/2017

Description:

Riverwalk eastwards along River Inny, access to surface water monitoring points H and J from riverside park.

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