

ANNUAL ENVIRONMENTAL REPORT 2015

For Kilbarry Landfill and Civic Amenity Site

**Compiled by : Facility Manager, John McKeown.
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Kilbarry Landfill Site

Annual Environmental Report

1.0 Introduction

Kilbarry Landfill site is located (National Grid Reference 2598E 1103N) on the outskirts of Waterford City on the Dunhill Road, approximately 300m of the N25.

The site occupies an area of 20.1 hectares. Land use in the vicinity of the site is a mixture of open flat farmland with wetland to the south-east. The area to the north and west of the site is a mixture of residential and commercial properties.

The landfilling of waste at the site has resulted in the formation of a mound of waste above ground level. The waste body has a maximum height of 20mOD in the centre of the site. The remainder of the site has a maximum height of 17.5mOD on top of the waste body and a base level of 2m to 3mOD on the edge of the site.

The site was in operation for approximately 40 years. The landfilling of waste has occurred on a former area of wetland known as Kilbarry Bog. A series of drains or channels are found on the entire western, southern and eastern perimeter of the landfill.

The waste license for the site was issued on the 19th of October 2001. Condition 2.4 of the Waste License (18-1) requires the preparation of an Annual Environmental Report within thirteen months from the date of grant of the license, and within one month of the end of each year thereafter.

This report has been prepared in accordance with Schedule C of Waste License 18-1 and the EPA "Draft Guidance on Environmental Management Systems and reporting to the Agency". This report covers the reporting period 1st January 2015 to 31st December 2015.

1.1 Management and Staffing Structure of the Facility

The site is operated by Waterford City and County Council (Environmental Services, Waterford City and County Council, Menapia Building, The Mall, Waterford).

The site is under the overall control of Mr. Fergus Galvin, Director of Services, Environmental Services and Water. John Nolan, Senior Executive Engineer, is responsible for the overall operation of the site. Mr. John McKeown, Executive Engineer, is responsible for reporting to the E.P.A. and compliancy with the licence. And he is responsible for the day to day supervision and management of the Civic Amenity

Site and is assisted by the Facility Supervisor, Mr. James Flavin. Details of the additional site staff are provided in Table 1.

Table 1: Operational Staff (Currently on Site)

Employee	Duties and Responsibilities
Mr. James Flavin	Collection of charges. Maintenance of onsite records. Implementation of waste acceptance procedures. Site inspections. Monthly monitoring of gas boreholes. Any other duties as required by site manager
Mr. Ferdy Ozturk	Daily litter patrols. Maintenance of metals recovery compound. Any other duties as required by the site manager/supervisor.

A staff member Patrick Fitzgerald has been assigned since Autumn 2014 to carry out maintenance duties to Kilbarry Landfill and to the Civic Amenity Centre. His duties include grass cutting, litter picking, anti-dog fouling measures.

The Facility Supervisor maintains regular contact with the Executive Engineer. Table 2 shows the current management structure of Kilbarry Landfill.

Table 2: Management Structure for Kilbarry Landfill

Position	Employee Contact Details
Director of Services Mr. Fergus Galvin	Waterford City Council, Environmental Services and Water Menapia Building, The Mall, Waterford. Tel: 051 309900 Fax: 051 849763
Senior Executive Engineer Mr. John Nolan	Waterford City Council, Environmental Services, Menapia Building, The Mall, Waterford. Tel: 051 309900 Fax: 051 849763
Executive Engineer (Landfill/EPA/CAS) Mr. John McKeown	Waterford City Council, Environmental Services, Menapia Building, The Mall, Waterford. Tel: 051 309900 Fax: 051 849763

Any changes to this structure will be submitted to the EPA by the Executive Engineer. It shall be the responsibility of the Civic Amenity Site Manager to organise staff in the absence of the named persons from the facility.

2.0 SITE DESCRIPTION

2.1 Waste Management Activities at the Facility

The waste categories and quantities that may be accepted for disposal and recovery, as outlined in Table A.1 of the Waste License, are shown below in Table 3.

Table 3: Waste Categories & Quantities for Disposal and Recovery

Waste Type	Maximum Tonnes Per Annum
Household	17,000
Commercial	12,500
Industrial Non Hazardous	28,500
Treated Sewage Sludges	2,500
Treated Industrial Non Hazardous Sludges	7,500
Construction & Demolition Waste	2,000
Wastes for Recycling & Recovery at the Civic Waste Facility	3,000
Waste for Recycling & Recovery at the Metal Recovery Area	2,000
Total	75,000

As of the 19th January 2003 commercial waste hauliers were stopped from disposing of waste at Kilbarry Landfill. As of 26th August 2005 Kilbarry Landfill ceased accepting domestic waste for landfill disposal and all landfilling activities ceased. From August 2005 to July 2009 all domestic waste collected by Waterford City Council was being deposited at Veolia's waste facility in Six Cross Roads Business Park before being brought to Powerstown Landfill in Carlow. Since July 2009 all domestic waste collected by Waterford City Council is deposited at Veolia's waste facility in Six Cross Roads Business Park before being hauled to Homestown Landfill in Wexford.

The landfill is closed to the public and remediation has taken place between 2005 and 2009 which included the installation of the final cap over the area of the waste body and installation of a gas abstraction system consisting of 82no. wells and a 500m³ permanent, enclosed gas flarestack. A surface water management system was installed in 2010. It was proposed that the site become a public amenity in the form of a park and an entrance and carpark were constructed in the North East area of the site during 2010. Landscaping for the park began in 2011 and completed in May 2012. The Kilbarry Nature Park opened to the public in June 2012 and its opening was officiated by Ireland's President Michael D. Higgins.

A Civic Amenity Site (C.A.S) is located adjacent to the old landfill entrance. The following range of goods are accepted for recycling or disposal:

- W.E.E.E.
- Scrap Metal
- Timber
- Metals
- Cardboard
- Car and Household Batteries
- Engine Oil, Gear and Lubricating Oils
- Oil Filters
- Cooking Oil
- Glass Bottles
- Aluminium Cans
- Recycling Paper
- Clothes and Textiles
- Fluorescent Tubes
- Energy Saving Light Bulbs
- Aerosols
- Paint Tins
- Biodegradable Waste

Mixed Municipal Waste

The opening hours at the C.A.S. are 11am to 4pm Monday to Friday.

2.2 Waste Quantities and Composition

The categories and quantities for the C.A.S. in 2015 are presented in Table 4 below:

Table 4: Breakdown of Waste Categories & Quantities for Civic Amenity Site

EWC Code	Description	Total Quantity 1/1/15 to 31/12/15 (tonnes)
13 02 --	Waste Engine, Gear & Lubricating Oils	4.5
15 02 02	Oil Filters	0.26
14 06 --	Aerosols	0
16 06 01	Lead Batteries	0.32
16 06 04	Alkaline Batteries	0.487
20 01 01	Cardboard	22.32
20 01 01	Recycling Paper	2.42
15 01 07	Glass	10.91
15 01 04	Aluminium Cans	0.3
20 01 11	Textiles	2.06
20 01 21	Fluorescent Tubes	0.242
20 01 25	Edible Oil & Fat	0.0
20 01 27	Paint Tins	2.19
20 01 36	W.E.E.E.	163.465
20 01 38	Wood	2.0 (estimated)
20 01 40	Metals	5.68
20 02 01	Biodegradable Waste	712.32
20 03 01	Mixed Municipal Waste	303.82

The specific categories of W.E.E.E. materials collected at the Civic Amenity Site are now reported by WEEE Ireland and ERP.

2.3 Methods of Waste Deposition

The following are locations to which waste from Kilbarry is transported.

Waste Engine, Gear and Lubricating oils, Oil Filters, Paint tins – Enva, Portlaoise, Co Loais.
Lead Batteries, WEEE , Fluorescent Tubes– KMK, Tullamore, Co Offaly. Cardboard, Mixed Municipal Waste – Greenstar, 6 Cross Roads, Waterford. Glass, Aluminium Cans – RehabGlassco, Naas, Co Kildare. Metals – Luke Mulrooney, Tramore Road, Waterford. Biodegradable Waste – AES, Bord na Mona, Newbridge, Co Kildare. Recycling Paper – Recycle2000, Wexford

2.4 Site Capacity

The site was in operation in the region of 40 years. The total volume of waste deposited to date is estimated to be 1,094,513m³.

The last area of landfilling was located in a lined cell constructed in 2002/2003 located at the northern end of the landfill. The site closed on 26th August 2005.

3.0 SITE DEVELOPMENT WORKS

3.1 Development Schedule

The following section describes works undertaken during 2012. A description of the existing situation for each component is provided below together with the details of the proposed works and a timescale for completion of the future work.

3.2 Report on Development Works Undertaken During Year 2012

The following works have been completed at Kilbarry Landfill during the period January 2012 to December 2012:

3.2.1 Landscaping

A landscape architect, Mitchell and Associates, was awarded the design contract in early 2010 and the design and contract documents were drawn up and agreed with WCC. The design of the landscaping at Kilbarry incorporates signage, information boards and pathways as well as specification of planting etc. The tendering process began in September 2010 with a prequalification stage. In November 2010 a letter of intent to award the contract to Grangemore Landscapes was sent out and this contract was signed in early 2011 and works began in March 2011. The schedule of works throughout 2012:

January 2012

- Landscaping of grass verges around newly laid tar paths
- Planting of tree areas in the north of park.

February 2012

- Works at entrance to park and car park. Landscaping, planting, gabions, planting of slopes either side of concrete path to plateau.

March 2012

- Erection of park signage
- Construction of park seating and marker posts
- Construction stepped access in north and south of park
- Construction of viewing areas

April 2012

- Finished off peripheral planting
- Finished off drainage in various locations
- Landscaping around arrivals plaza

May 2012

- Installation of fitness stations
- Finishing of landscaping to Plateau
- Erection of fencing to car park
- Completion of snag list

Drawing 4 shows a plan of the landscaped park at Kilbarry

3.3 Restoration & Aftercare Schedule

The following is the phasing of the remediation works to date:

Table 5: Phasing of the remediation works

Component	Commencement	Completion
Completion of liner and final capping	October 2005	June 2008
Completion of gas abstraction system	November 2006	April 2008
Installation 3 new leachate wells	January 2008	April 2008
Installation of Permanent Flare	October 2009	October 2009
Entrance,carpark and bridge Works	June 2010	November 2010
Surface Water Management	September 2010	January 2011
Landscaping	March 2011	May 2012

3.4 Environmental Liability and Risk Assessment

An Environmental Liability Risk Assessment (ELRA) was performed by Golders Associates early in 2009 on behalf of Waterford City Council for the Kilbarry site. This is included in the Appendix III.

4.0 EMISSIONS

4.1 Management of Emissions

Waterford City Council is committed to ensuring that any emissions at Kilbarry Landfill will not result in the contravention of any relevant standard, including any standard for an environmental medium or any relevant emission limit value, prescribed under any other enactment.

The council is committed that activities at Kilbarry Landfill and C.A.S. are carried on in accordance with such conditions as may be attached to the license and will not cause environmental pollution.

The council will also use the best available technology not entailing excessive costs to prevent or eliminate or, where that is not practicable, to limit, abate or reduce an emission from the activity concerned.

The potential emissions from the site include leachate, groundwater, surface water, air and noise.

Drawing 5 shows the positions of all monitoring points at the facility.

4.2 Leachate

A total of six boreholes were originally installed at the landfill, LM1 – LM6. However over time landfilling operations damaged a number of the boreholes. The damaged boreholes were replaced and an extra two were also installed. However a further two, LM2 and LM3 were damaged at some point prior to the commencement of final capping. During the capping works LM7 and LM8 were buried due to their low levels. For all of the year there was only one operational leachate monitoring borehole, LM1. LM4, LM5 and LM6 are now accessible again by jeep but remain under the final capping ground level, surrounded by manhole rings for protection. LM5 and LM6's manhole rings are full of water. A proposal is to be submitted to the EPA to abandon monitoring from these points as they are located in areas that will be wildflower meadows when the park is constructed. Future leachate monitoring will be proposed to be directly from the leachate storage lagoon in the form of grab samples.

Monitoring of the composition of leachate is undertaken on a quarterly basis, with analysis of a wider range of parameters on an annual basis. In addition leachate levels are also taken on a weekly basis. Leachate monitoring is carried out by the EPA, Kilkenny.

4.2.1 Interpretation of Results

Monitoring point LM1 is located on the north-western edge of the landfill. The results indicate that the composition of leachate at LM1 is of a low strength. Conductivity levels in 2015 range from 435 to 455. This is much similar to 2014. Ammonia levels in 2015 range from <0.02 to 0.11. This is a slight improvement on 2014. Chloride levels in 2015 range from 25 to 26. This is a very slight improvement on 2014. BOD ranges in 2015 from <1.0 to <6. This is a definite improvement on 2014.

4.3 Groundwater

There are currently seven boreholes operational around the perimeter of the site, GW2, GW4, GW5, GW6, GW15, GW16 and GW17. There were a further two boreholes, GW1 and GW18 located off-site. These boreholes are now gone due to works in the areas. GW7 and GW9 are currently inaccessible for groundwater sampling due to final capping levels but are situated inside the waste body and would yield leachate samples rather than true groundwater. GW5 and GW17 are also situated within the waste body. GW3, GW10, GW11, GW12, GW14 and GW15 were irreparably damaged or lost during remediation. A set of new boreholes, GW22 to GW29 were installed for gas migration monitoring along the Western perimeter between the landfill and the nearest residential properties. Two of these boreholes, GW25 and GW29 were used from the second quarter of 2012 to provide monitoring coverage on the western side as replacements for GW14 and GW15. Monitoring occurs on a quarterly basis. For 2015 GW2, GW4, GW5, GW6, GW16, GW25, GW29 were monitored by EPA, Kilkenny.

Monitoring location GW2 is located on the north of the landfill site. Results show that the borehole is not polluted. In 2014 ammonia ranged from <0.02mg/l N to 0.046mg/l N. Chloride was from 30mg/l Cl to 31mg/l Cl. Conductivity ranged from 668uS/cm to 673uS/cm. In 2015 Ammonia ranged from 0.044mg/l N to 0.3mg/l N. Chloride ranged from 30mg/l Cl to 32mg/l Cl. Conductivity ranged from 636uS/cm to 661uS/cm. This borehole is not polluted.

GW4 is located on the eastern boundary along the Tramore Road. Historically results have shown gross pollution with ammonia levels reaching a high of 61mg/l N in 2011. In 2014 Ammonia ranged from 13mg/l N to 59mg/l N. Chloride ranged from 31mg/l Cl to 59mg/l Cl. Conductivity ranged from 1033uS/cm to 1259uS/cm. In 2015 Ammonia ranged from 4.6mg/l N to 20mg/l N. Chloride ranged from 24mg/l Cl to 135mg/l Cl. Conductivity ranged from 970uS/cm to 1506uS/cm. This borehole is polluted.

Monitoring point GW5 is located towards the south-eastern corner of the site and is within the boundary of the waste body. In 2013 results show a grossly polluted borehole with Ammonia levels ranged from 130mg/l N to 570mg/l N. It would be better considered as leachate given the position of the borehole. The maximum chloride was 960mg/l and the maximum conductivity was 9440uS/cm. In 2014 ammonia ranged from 130mg/l N to 570mg/l N. Chloride ranged from 489mg/l N to 921uS/cm. Conductivity ranged from 5750uS/cm to 9340uS/cm. In 2015 ammonia ranged from 340mg/l N to 610mg/l N. Chloride ranged from 564mg/l N to 991uS/cm. Conductivity ranged from 7040uS/cm to 9450uS/cm. This borehole is grossly polluted.

Monitoring point GW6 is located on the southern tip of the landfill and is upgradient of the landfill. Ammonia levels reached a level of 22mg/l N in 2012. In 2014 ammonia ranged from 0.062mg/l N to 1.7mg/l N. Chloride ranged from 24mg/l to 29mg/l. Conductivity ranged from 427uS/cm to 521uS/cm.

In 2015 ammonia ranged from 0.032mg/l N to 3.2mg/l N. Chloride ranged from 26mg/l to 31mg/l. Conductivity ranged from 494uS/cm to 560uS/cm. This borehole is very slightly polluted.

Monitoring station GW16 is located along the eastern boundary of the site. Ammonia levels stabilised at this point in 2012 with a maximum level of 26mg/l N.

In 2014 ammonia ranged from 13mg/l N to 20mg/l N. Chloride ranged from 1160mg/l Cl to 1200mg/l Cl. Conductivity ranged from 5000uS/cm to 5070uS/cm

In 2015 ammonia ranged from 20mg/l N to 27mg/l N. Chloride ranged from 1160mg/l Cl to 1210mg/l Cl. Conductivity ranged from 5020uS/cm to 5060uS/cm. This borehole is polluted.

Monitoring point GW25 was sampled from quarter 2 in 2012, is located on the western perimeter and showed results of gross contamination with Ammonia levels as high as 210mg/l N.

In 2014 ammonia ranged from 120 mg/l N to 160mg/lN. Chloride ranged from 177mg/l Cl to 220mg/l Cl. Conductivity ranged from 3020uS/cm to 3880uS/cm.

In 2015 ammonia ranged from 140 mg/l N to 160mg/lN. Chloride ranged from 179mg/l Cl to 202mg/l Cl. Conductivity ranged from 3260uS/cm to 3550uS/cm. This borehole is very polluted.

Monitoring Point GW29 was also introduced to the groundwater sampling schedule from quarter 2 of 2012 and also showed poor quality with maximum Ammonia levels at 77 mg/l N.

In 2014 ammonia ranged from 13 mg/l N to 230mg/l N. Chloride ranged from 41mg/l Cl to 389mg/l Cl. Conductivity ranged from 948uS/cm to 4930uS/cm.

In 2015 ammonia ranged from 74 mg/l N to 250mg/l N. Chloride ranged from 133mg/l Cl to 387mg/l Cl. Conductivity ranged from 2110uS/cm to 4870uS/cm. This borehole is very polluted.

4.3.1 Interpretation of Results

Results show that GW2 remains unpolluted.

GW4 is polluted but has shown an improvement from 2014 to 2015.

GW5 is grossly polluted and has shown a marked dis-improvement from 2014 to 2015.

GW6 remains very slightly polluted.

GW16 is polluted and has shown a dis-improvement from 2014 to 2015.

GW25 is very polluted but has shown no improvement from 2014 to 2015.

GW29 is very polluted and has shown a dis-improvement from 2014 to 2015.

Where necessary, in September 2014, new paths were laid to allow better access to the sampling points.

4.4 Surface Water

The landfill is surrounded on its western, southern and eastern sides by a perimeter drain, which receives several flows from the west and south as well as water from the landfill itself. This drain flows from the western side of the landfill around its southern end before flowing northward along the eastern side of the landfill and entering the Lisduggan Stream. The Lisduggan stream flows along the northern edges of the site before exiting along the eastern perimeter and joining up with St. Johns River. The waste license requires the monitoring of surface water quality at nine locations around the landfill, S1-S9. Surface water monitoring is carried out by EPA Kilkenny.

There is also a tidal influence at the site, which results in water flowing from the Lisduggan stream into the perimeter drain.

For 2015 the maximum recorded levels for ammonia, chloride, conductivity BOD are as follows.

At S1 ammonia was 6.2mg/l N, chloride was 55mg/l Cl and conductivity was 538uS/cm, BOD was 8.3mg/l O₂.

This shows a dis-improvement from 2014 to 2015.

Monitoring point S2 is located on the western boundary of the site. This sampling station is no longer available as the boundary drain has been diverted through a conduit pipe.

At S3 the maximum recorded levels were, ammonia was 0.92mg/l N, chloride was 33mg/l Cl, conductivity was 525uS/cm, BOD was 3.3mg/l O₂. This shows a slight improvement from 2014 to 2015.

At S4 the maximum recorded levels were, ammonia was 1.7mg/l N, chloride was 36 mg/l Cl, conductivity was 572, BOD was 5.0 mg/l O₂. This shows a slight dis-improvement from 2014 to 2015.

S5 is located along the south-eastern boundary of the landfill. This was inaccessible for many years due to overgrowth in the pNHA bog which surrounds that edge of the landfill. A path was made in September 2014 to allow access to S5.

At S5 the maximum recorded levels were, ammonia 2.1mg/l N, chloride was 42mg/l Cl, conductivity was 582uS/cm, BOD was 5.9 mg/l O₂. In 2014 there was only one sample taken after the new path was made. In 2015 samples were taken in Q1 and Q2 only as the surface water levels were too low in Q3 and Q4. Based on the low number of samples available the results show a dis-improvement from 2014 to 2015.

At S6 the maximum recorded levels were, ammonia was 1.9mg/l N, chloride was 38mg/l Cl, conductivity was 581uS/cm, and BOD was 4.7mg/l O₂. This shows a dis-improvement from 2014 to 2015.

At S7 the maximum recorded levels were, ammonia was 2.3mg/l N, chloride was 92mg/l Cl, conductivity was 607uS/cm and BOD was 5.7mg/l O₂. This shows an improvement from 2014 to 2015.

At S8 the maximum recorded levels were, ammonia was 2.2mg/l N, chloride was 57mg/l Cl, conductivity was 488uS/cm and BOD was 3.7mg/l O₂. This shows a dis-improvement from 2014 to 2015.

At S9 the maximum recorded levels were, ammonia was 2.7mg/l N, chloride was 84mg/l Cl, conductivity was 555uS/cm and BOD was 3.7mg/l O₂. This shows a dis-improvement from 2014 to 2015.

B.O.D. levels range from <1.0mg/l O₂ at S1 in Q2 and S3 in Q4 to the maximums as outlined above from 3.3 mg/l O₂ to 8.3mg/l O₂. These readings indicate quality between pristine and polluted.

4.4.1 Interpretation of Results

Most of the sampling points have shown dis-improvements. Depending on the quarterly sampling the surface water would be considered at times to be pristine but mostly polluted.

4.5 Air Emissions

These include the following:

- Dust
- Odours
- Aerosols and airborne particulates (PM10)
- Landfill Gas

4.5.1 Dust Emissions

The main sources of dust on the landfill site are due to vehicle movement and control is effected by a mobile sprayer. Dust monitoring is required at seven locations in the vicinity of the site (D1, D2, B1, B2, S2, B6, and GW5). Dust monitoring is required three times per annum.

There were no dust limit breaches in 2015. Monitoring was carried out at the seven locations from 8th June 2015 to 10th July 2015, from 29th July 2015 to 28th August 2015, and from 10th October 2015 to 6th November 2015. The results ranged from 49mg/m²/day at station B2 to 297mg/m²/day at station B6. Levels did not exceed the 350 mg/m²/day limit specified in the waste licence W0018-01. All monitoring was carried out by Dixon.Brosnan.

4.5.1.1 Interpretation of Results

All results were well below the 350mg/m²/day limit for dust deposition.

4.5.2 Odours

Odour monitoring is required at a total of seven locations around the outskirts of the facility. Odour Ireland carried out all odour monitoring.

According to schedule F.3 of the waste licence, Waterford City Council is required to monitor odour emissions from seven monitoring locations. Four of the locations are stipulated in the licence as NSL2 to NSL5. The other three locations are NSL6, NSL7 and NSL8.

Odour monitoring was carried out on 27th April 2015 and 11th January 2016 (for 2015).

4.5.2.1 Interpretation of Results

For 27th April odour monitoring carried out at Kilbarry show results with a maximum value of 62 ou/m³ (odour units per cubic metre) at NSL2. There was no distinct odour from any of the samples. For 11th January 2016 (for 2015) odour monitoring at Kilbarry show results with a maximum value of 57 ou/m³ at NSL2. There was no distinct odour from any of the samples.

For 27th April and for 11th January 2016 the chemical analysis shows that the Hydrogen Sulphide samples give results of 3ppb at all locations. For 27th April and 11th January 2016 the Total Volatile Organic Compounds (TVOC) show results of 5ppb at all locations.

The Hydrogen Sulphide and TVOC recorded levels were indicative of ambient background.

Hydrogen sulphide concentrations are all below limits that would be needed to cause a nuisance. The organic acids were also only present in low concentrations. Levels are indicative of traffic based emissions.

As can be seen from these results odour is not a major problem at the site and this would be attributed to the fact that the site is closed and no longer operational. The closed landfill is a nature park and if odours were an issue the people who enjoy the amenity would bring it to the attention of the Council.

4.5.3 Aerosols

Aerosols are defined as fine particulate material water droplets and microbial emissions from activities carried out at the landfill. On site sources include re-suspension of fine material by wheel action of vehicles and fugitive emissions from tipping and distribution of waste. Since

the closure of the site aerosols are no longer an issue.

4.6 Landfill Gas

It is estimated that 1,094,513m³ tonnes of waste has been landfilled over the lifetime of the site. Assuming that each tonne of waste will have a typical yield of 200m³ of gas, it is estimated that the facility will produce in the order of 220Mm³ of gas in its lifetime. In October 2009 a 500m³ permanent, enclosed flarestack was connected to the completed gas abstraction system and ignited. The flare is connected to 82no. gas wells bored into the main waste body controlled by 5 manifolds housing valves for the separate pipe branches to the wells. There are 20 wells at the southern tip of the site all connected to Manifold 1, which are controlled at that manifold rather than individually due to low levels of methane. The manifold valve connected to the main header pipe is closed down 95% or more to allow what little gas building up in these southern wells to be drawn off without too much oxygen getting in also.

The waste license requires the monitoring of the composition of the gas within the landfill site. However with the gas abstraction system now fully operational this monitoring is redundant and flare monitoring or field balancing data can be used instead.

Perimeter gas monitoring locations include LM1, GW2, GW4, GW5, GW6, GW16, GW22, GW23, GW24, GW26, GW27, GW28, GW29 and GW30.

Boreholes GW22 to GW28 were installed to provide extra monitoring of any possible migratory gas between the landfill and the nearest residential houses in Lacken Wood Estate and are outside the main waste body as are LM1, GW2, GW6, GW12, GW15 and GW19. Boreholes GW12 and GW15 are obsolete. Boreholes GW, GW5, GW7, GW9 and GW17 are all within the waste body.

GW4 is within the waste body and showed a CH₄ reading of 4.9% on 30th April 2015 at 08.52hours, on 29th May 2015 at 9.09 hours it showed a reading of 1.2%, on 30th June 2015 at 9.49 hours it showed a reading of 10.4% and a CO₂ reading of 3.6%, on 30th September 2015 it showed a reading of 5.2%. and a CO₂ reading of 1.9%

Works adjacent to the landfill on a new industrial site made temporary monitoring points GW19, GW20 and GW21 obsolete. These points had been located outside the landfill boundary but the installation of GW22 – GW28 replaced them. Some boreholes have been lost due to landscaping and so it was decided to utilise GW16.

4.6.1 Interpretation of Results

The results from the field balancing indicate that there is limited production occurring in the southern part of the site. The different ages of the waste at the site means that there is likely to be some variability in the production of landfill gas in different parts of the site.

Results from the monitoring at perimeter boreholes, included in Appendix 1, show that there is no gas migration and the continued operation of the gas abstraction system should maintain this.

However, on 30th April at 8.52 hours, on 29th May at 9.09, on 30th June at 8.52, on 30th September at 8.44 hours at Borehole GW4 the CH₄ levels recorded indicate a breach of licence emission limits Schedule G, section G.2. On 30th June at 8.52 the CO₂ level was 3.6%, on 30th September at 8.44 the CO₂ level was 1.9%.

On 30th October at 10.25 hours at GW23 the CO₂ level was 1.9%. On 30th November at 10.13 hours the CO₂ level was 2.7%. On 31st December at 10.22hours the CO₂ level was 1.8%.

The licence CH₄ emission limit is 1% v/v and the licence CO₂ emission limit is 1.5% v/v. GW4 is outside the perimeter of the cap on the eastern side. It is known to be down into existing waste, so

there is no gas migration at this location. Comparing the 2015 CH₄ readings at GW4 to those of 2014 there is an increase in CH₄ at this borehole.

4.6.2 Landfill Gas Flare Monitoring

As per Table F.2.2 of Schedule F of waste licence 18-1 landfill gas flare monitoring is required on an annual basis for particulates, organics, hydrogen chloride and hydrogen fluoride and every six months for volumetric flow, SO₂ and NO_x. Results from both these monitoring events show emission values for all parameters to be within the limits prescribed by the licence.

In the PRTR returns sheet in Appendix IV the total volume of gas generated for 2013 is estimated from a gas generation curve produced by AFS during the gas flow trials when commissioning the enclosed gas flarestack. The volume was estimated at 585,381.74m³ for 2013. Using the Landfill Gas Survey template from the EPA the Total Methane Flared is calculated at 271,261.0m³ which gives a Net Methane Emission for 2013 of 314,120.74m³. This is logged as an estimate in the PRTR worksheet due to the total volume of gas being estimated from the gas curve in the first instance.

4.7 Noise

Noise monitoring is required on an annual basis. There are 14 noise monitoring locations in the vicinity of the site. B1, B2, B3, B4, B5, B6, B7 are the onsite locations. NSL2, NSL3, NSL4, NSL5, NSL6, NSL7 and NSL8 are the offsite locations. Dixon Brosnan performed the annual noise monitoring survey for the site on 1st September 2015 and 2nd September 2015.

4.7.1 Interpretation of Results

Schedule G.1 of the site waste license specifies that daytime noise levels should not exceed 55 dB at any of the monitoring stations as a result of site activities. Six of the seven onsite stations (B2-B7) are located at some distance from the civic amenity facility near the site entrance, and consequently no site emissions were audible at these stations other than pedestrian voices on the park walkway. LAeq 30 min levels at these stations measured 47-56 dB, arising chiefly from road traffic noise outside the site boundaries. At the seventh onsite station (B1), waste disposal activities and waste management operations at the civic amenity area were audible, resulting in an LAeq 30 min level of 52 dB. This station is not a noise sensitive location.

Stations NSL4 and NSL5 constitute the only offsite stations within earshot of the civic amenity facility. Road traffic noise was dominant at these stations, resulting in elevated LAeq 30 min levels of 62 dB and 59 dB respectively. Sporadic vehicle movements through the facility entrance, were audible at both stations. Contributions arising from these were estimated at less than 55 dB at both stations, and thus lower than the 55 dB daytime limit specified in waste licence W0018-01. Facility emissions were inaudible at the remaining offsite stations (NSL2-NSL3 and NSL6-NSL8). LAeq 30 min levels measured at these stations were 46-69 dB, with local noise environments affected chiefly by road traffic.

Noise levels measured at all onsite and offsite monitoring stations were satisfactory. In particular, site contributions at the only noise sensitive locations in proximity to the civic amenity facility (NSL4 and NSL5) were lower than the 55 dB daytime limit specified in the site licence.

Noise levels on the site are not considered to represent a nuisance to nearby residents. The

operating hours of the Civic Amenity Site are strictly adhered to and no operations take place outside these hours. In the event of complaints about noise levels, noise impact statements will be made to investigate further techniques for keeping noise levels to a minimum.

4.8 Ecology Survey

According to condition 9.20 of the waste license an annual ecological survey must be undertaken at Kilbarry Bog. David Horgan, Environmental Scientist, URS Ireland Ltd., Cork carried out the survey in 2015. During 2015, URS changed their company name to AECOM. The report is included in Appendix II.

4.9 Leachate Volumes

The leachate management system at the site is composed of 13 no. leachate abstraction boreholes, a perimeter leachate collection trench 1.2m depth and 1m wide and 5 no. leachate collection sumps. These boreholes and sumps pump to the leachate lagoon at the north of the site.

The leachate lagoon has a capacity of 3,670m³ (2,670m³ with a freeboard of 0.5m). The leachate is discharged to the sewer by gravity feed and a valve allows a percentage of outflow into the sump. A monitoring system has been installed on the outfall of the leachate lagoon in accordance with the waste licence. The system monitors flow, pH and dissolved methane concentration. Approximately 700m³ of leachate was discharged to the sewer for treatment at the Belview Wastewater Treatment Plant in 2015.

4.10 Emissions to Groundwater

The bedrock beneath the landfill site is situated in the Campile Formation. These rocks are considered to generally form Regionally Important Aquifers with fissure flow (Rf).

To the north and north west of the site the bedrock is predominantly mudstone and shale. To the south and east the rocks are of a predominately acid volcanic unit. In addition a dolerite body has been mapped separating these units and lying immediately south and south east of the landfill site.

Depth to bedrock to the north and east of the site is between 12-14m. To the south and west the general indications are of shallow rock with one anomalous data point indicated 15m depth to bedrock. An outcrop is observed to the southern end of the site, which comprises of grey/green felsite. An outcrop to the north west of the site is described as clayey shaly ash or tuff.

Due to the nature of the bedrock fissure flow will be the dominant type of groundwater flow. The groundwater levels in the area are generally close to the surface. Groundwater flow directions are from the ground to the south and east toward the stream to the west.

The results of in-situ permeability testing carried out in 1998 indicate generally low permeabilities in the bedrock with values between 10 e-6 and 10 e-8.

Due to the low permeability of the bedrock beneath the landfill site it is considered that the preferential migration of leachate from the landfill site is likely to be occurring along the southern and western sides where depth to bedrock is shallower.

The results of groundwater monitoring to date indicate a degree of contamination due to landfill activities. Monitoring of the groundwater surrounding the site showed elevated levels of ammonia and electrical conductivity indicating that leachate is entering the groundwater

system. The volumes of leachate entering the groundwater system can be seen to be reduced given the effect of final capping on the leachate volume calculations. There should be little to no new leachate generation and the continued operation of the leachate extraction system from the perimeter and waste body should further minimise leachate contamination to groundwater.

Under Amendment B of Kilbarry EPA Licence W0018-01 Waterford City and Council is obliged to carry out a risk screening and where necessary a technical assessment in accordance with the *Guidance on the Authorisation of Discharges to Groundwater* published by EPA. In 2015 RPS were appointed consultants to carry out this study. The full RPS report was submitted to EDEN website in November 2015.

5.0 ENERGY CONSUMPTION/GENERATION

5.1 Resource and Energy Consumption Summary

Contractors are employed to supply and operate the site machinery, therefore there is no available information regarding the quantities of fuel on site at any given time. There is no fuel stored onsite.

There was approximately 5m³ of water used from the mains supply to the site throughout 2014.

In 2015 €16,513.34 was paid to utility Airtricity on electrical supply to the site.

6.0 ENVIRONMENTAL INCIDENTS AND COMPLAINTS

6.1 Non-Conformances/Incidents and Complaints

There were no incidents reported in 2015.

There were no complaints made in 2015.

6.2 Review of Nuisance Controls

It is the responsibility of the facility manager to ensure that the control measures are implemented to prevent the spread of litter. Since the closure of the landfill a number of management practices implemented on site in order to control the spread of litter have become redundant. These include litter fencing, the application of daily cover and the spreading and compaction of waste in thin layers. Regular monitoring and site inspections are carried out to ensure site tidiness is maintained since the closure of the landfill.

The main area of concern in relation to litter at present is the Civic Amenity Site to the North of the landfill. Contractors transporting materials for recycling offsite shall be required to ensure that when transporting and discharging these loads that litter is kept to an absolute minimum. All vehicles are required to be totally sealed or covered with a net or tarpaulin to ensure that materials are not blown from the vehicles.

Routine litter patrols are carried out on a daily basis to ensure that any loose litter is collected, this shall include the area surrounding the landfill, all fences and the approach road to the site. The effectiveness of the litter control techniques are monitored on a weekly basis.

6.2.1 Birds

Since the closure of the landfill birds are no longer a nuisance on the site

6.2.2 Vermin

A contract is in place with Rentokil Ireland. A programme of baiting can be employed as required to control rat infestations with preventative baiting at regular intervals to ensure that large populations do not become established. Since closure of the landfill vermin has not been a significant issue on site

6.2.3 Flying Insects

The facility manager monitors the situation. Since closure of the landfill however there has been no issue and the materials collected at the Civic Amenity Site do not pose an issue.

6.2.4 Fires

The burning of waste or other material is not permitted at the facility. Hot or burning loads of waste arriving at the facility are rejected. In the event that a fire breaks out on the site it is treated as an emergency and dealt with immediately. The Emergency Response Procedures, containing steps for dealing with fires, is included in the appendices. No fire was reported in 2015.

6.2.5 Odour Control

Odour problems were kept to a minimum by implementing adequate compaction, speedy disposal and burial of malodorous wastes, effective and frequent use of cover material. These provisions are no longer needed due to closure of the landfill. A gas abstraction system began flaring in January 2008. A leachate management system is installed and had 3 additional wells installed in April 2008. Odour monitoring is carried out at bi-quarterly intervals. There were no odour complaints in 2015 and based on the monitoring results odour presents no significant issue at the site.

6.2.6 Dust Control

Dust control measures, in the form of a mobile water sprayer, are not deemed necessary along the roads network of the park since the opening of the park itself.

At the Civic Amenity Site a street sweeper unit is employed every 10 days or so to do an overall sweep of the CAS. This is on a regular basis especially with loading off site of WEEE.

6.3 Programme for Public Information

Communications Programme

The purpose of the Communications Programme is to ensure that members of the public can obtain information concerning the environmental performance of the facility at all reasonable times.

Council Directive 90/313/EEC on the Freedom of Access to Information on the Environment recognises the significance of the public's access to information relating to the environment. To ensure that members of the public can obtain information concerning the environmental performance of Kilbarry Landfill the communications programme described below shall be implemented at the facility.

The purpose of this programme is to allow any local community groups, key interest groups, local residents and members of the local community access to information on matters relating to the environmental performance of Kilbarry Landfill. This in turn will address any local community concerns and allow the public the opportunity to provide feedback on the facility.

The Facility Manager will be responsible for the implementation of this programme, which shall form a normal part of the routine operation and management of the facility.

Programme:

1. All requests concerning the environmental performance of the facility should be made in writing to:

Mr. John McKeown,
Facility Manager,
Environmental Services,
Floor 4 Menapia Building,
The Mall,
Waterford City.

2. The Facility Manager shall copy all requests to:

Mr. Fergus Galvin,
Director of Services,
Environmental Services,
Menapia Building,
The Mall,
Waterford.

3. Each request should indicate the name, address and contact telephone number of the concerned party, an outline of the information required and the manner in which they require the information i.e. copy of record, computed disk, etc.

4. If requested, a suitable member of staff will provide a clear, unbiased explanation of the information provided.

5. The Director of Services or other authorised, nominated representative in Waterford City and County Council or any other nominated person will deal with replies to requests made by the media for information relating to the environmental performance of the landfill.

Record keeping

All records of requests for information regarding the environmental performance of the landfill and all minutes of meetings with concerned parties and details of site visits/ open-days shall be maintained and kept secure from loss, damage or deterioration. All of the aforementioned files shall be stored at the site office at Kilbarry Landfill and the Offices of Waterford City and County Council, Environment Department, Menapia Building, The Mall, Waterford.

The Facility Manager shall keep a register of all requests for information from the public on site.

7.0 OBJECTIVES AND TARGETS

7.1 Schedule of Environmental Objectives and Targets for the Forthcoming Year

The objectives and targets have been based on the conditions set by Waste License 18-1. The purpose of this section is to establish a summary of objectives and targets for the prevention of pollution and for the continual improvement of the site.

2016 Schedule of Objectives and Targets

Prepared by: John McKeown, Facility Manager

Date : May 2016

Approved by : Mr Fergus Galvin, Director of Services, Waterford County Council

Objective 1 To	Target	Plan	Responsible Party	Timescale (for completion)
establish site	Repair all defects in the existing site gates and fences	Regular inspections are carried out of gates and fencing	Facility Manager	Within three working days of defect
infrastructure as required by Licence	Install active collection and flaring system for landfill gas	Active gas collection system and permanent flare installed	Facility Manager/ Consultant Contractor	Completed
Conditions	Investigate utilisation of landfill gas	Utilisation not feasible	Facility Manager/ Consultant	Completed
	Surface Water Management	Install system as proposed	Facility Manager Consultant, Contractor	Completed
	Landscaping	Suitable tree and shrub planting required on the perimeter of the facility and for final capping/restoration.	Horticulturist	Completed
	Permanent Enclosed Flarestack	Install flare and connect to gas abstraction system	Facility Manager, Contractor	Completed

2016 Schedule of Objectives and Targets

Prepared by: John McKeown, Facility Manager

Date : May 2016

Approved by : Mr Fergus Galvin, Director of Services, Waterford County Council

	Target	Plan	Responsible Party	Timescale (for completion)
Objective 2 Management & Operation of the Facility Objective 3 To Prevent Environmental Nuisance & Emissions	Develop written waste acceptance procedures and ensure all staff are familiar with same	To minimise nuisance and ensure only permitted material accepted for recycling	Facility Manager & Compactor Operator	Reviewed annually
	Implement Litter Control Measures	To maintain litter control measures	Facility Manager Site Staff	Ongoing
	Dust Control	To maintain dust control measures	Facility Manager Site Staff	Ongoing
	Vermin Control	Contract with Rentokil Ireland	Facility Manager	In Place
	Continue existing gas monitoring programme	Continue with existing monitoring programme	Facility Manager	On Going
	Continue existing leachate monitoring programme	Monitor changes in the composition of the leachate with time	Facility Manager	On Going

	Monitor dust control measures during construction works at the facility	Dust control measures to be implemented on site during all construction works at the facility	Facility Manager	On Going
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2016 Schedule of Objectives and Targets

Prepared by: John McKeown, Facility Manager

Date: May 2016

Approved by: Mr. Fergus Galvin, Director of Services, Waterford County Council

	Target	Plan	Responsible Party	Timescale (for completion)
Objective 4 Promotion of Waste Recycling	Make public aware of recycling initiatives, techniques and current methods as well as materials accepted at Kilbarry	Promotion through local newspapers, radio, school talks and information leaflets	Environmental Officer Facility Manager	Ongoing

2016 Schedule of Objectives and Targets

Prepared by : John McKeown, Facility Manager

Date : May 2016

Approved by : Mr Fergus Galvin, Director of Services, Waterford County Council

	Target	Plan	Responsible Party	Timescale (for completion)
Objective 5 To improve the Environmental Performance	Establish an Environmental Management System	To monitor the facility's environmental performance	Facility Manager	Reviewed Annually
	Prepare the Annual Environmental Report	Summarise the results of environmental monitoring programme and assess facility's progress towards achieving its objectives and targets	Facility Manager Consultant	March 2016
	Reduce non-compliance	Carry out site inspections	Facility Manager Site Supervisor	Ongoing
	Improve Environmental Monitoring Programme	Continue and expand groundwater, surface-water, leachate and landfill gas monitoring to ensure complete compliance with licence.	Facility Supervisor Facility Manager	Ongoing
	Reduce risk of gas migration	Install active gas abstraction system and flare. Also, gas utilisation system, to be assessed.	Facility Manager Consultant Contractor	Gas abstraction system completed. Utilisation unfeasible.

2016 Schedule of Objectives and Targets

Prepared by : John McKeown, Facility Manager

Date : **May 2016**

Approved by : Mr Fergus Galvin, Director of Services, Waterford County Council

Objective 5 To improve the Environmental Performance (Continued)	Target	Plan	Responsible Party	Timescale (for completion)
	Reduce visual impact	Landscaping of site into a public amenity park	Horticulturist	Completed
	Control dust emissions	Monitoring	Contractor	Quarterly
		Spray roads during dry weather	Facility Manager	Ongoing
		Operate and maintain wheel wash	Facility Manager	Ongoing
		Enforce speed limits	Facility Manager	Ongoing
	Litter control	Daily Litter inspections	Facility Supervisor	Ongoing
	Reduce emissions to surface water	Install management system	Facility Manager	Ongoing
	Reduce emissions of leachate from unlined waste body	Maintain leachate collection system	Facility Manager, Contractor	Ongoing

Objective 5 (continued)	Target	Plan	Responsible Party	Timescale (for completion)
	Reduce long-term impact	Restoration and Aftercare Plan	Senior Engineer	After landscaping

2016 Schedule of Objectives and Targets

Prepared by : John McKeown, Facility Manager

Date : March 2016

Approved by : Mr Fergus Galvin, Director of Services, Waterford County Council

	Target	Plan	Responsible Party	Timescale (for completion)
Objective 6 To Monitor Management of Facility	Environmental Management System	Environmental Management System developed and included in this submission	Facility Manager	Reviewed annually
	Environmental Management Programme	Environmental Management Plan established and included in this submission	Facility Manager	Reviewed annually
	Establish and maintain Corrective Action Procedures	Procedures have been developed and are included in this submission	Facility Manager	Reviewed annually
	Establish Awareness and Training Procedures to identify training needs	Procedures have been developed by Waterford City Council	Facility Manager	Reviewed annually
	Establish Communications Programme to ensure public access to information	Details included in this submission	Facility Manager	Reviewed annually
	Record keeping to ensure proper site management	Written records to be kept	Facility Manager	Reviewed annually

OBJECTIVE 1 – ESTABLISH INFRASTRUCTURE AT THE FACILITY IN ACCORDANCE WITH THE REQUIREMENTS OF WASTE LICENSE 18-1.

All remediation works were finished out in 2012 and the new Kilbarry Nature Park was opened in June 2012 by the president Mr. Michael D. Higgins. Infrastructure for control of leachate, landfill gas and surface water had already been installed. Monitoring and maintenance of the infrastructures for any upgrades or repair will be ongoing.

OBJECTIVE 2 – OPERATION & MANAGEMENT OF THE FACILITY IN ACCORDANCE WITH THE CONDITIONS OF THE WASTE LICENSE 18-1.

It is the objective of Waterford City Council to comply with the conditions of the Waste License (18-1) for Kilbarry Landfill Site.

As required by the waste license conditions, written waste acceptance procedures have been developed and ongoing training is being provided for all staff to ensure that they are familiar with them. Regular meetings are undertaken to review the performance of the facility. The meetings are attended by senior management staff and external consultants. The frequency of the meetings is reviewed as necessary. Procedures have been developed for the following:

- Waste acceptance procedures
- Emergency response procedures
- Corrective action procedure
- Communications programme
- Awareness and training

It is proposed that regular site meetings be undertaken to assess the performance of the facility and bring any potential problems to the attention of the Agency and Waterford City Council senior management staff.

OBJECTIVE 3 – TO PREVENT ENVIRONMENTAL NUISANCE & EMISSIONS.

In line with the objective of Waterford City Council to minimise environmental nuisance caused by the operation of the landfill at Kilbarry, actions have been implemented for the following:

- Litter control measures
- Dust control
- Vermin control
- Gas monitoring
- Leachate monitoring
- Groundwater monitoring
- Surface water monitoring

Litter control measures are in place as per condition 6.4 of the waste license.

The dust control measures employed have been outlined in section 6.2.5. The facility manager is responsible for the implementation of the dust control measures.

As part of the ongoing environmental monitoring at the facility the composition of surface water, groundwater and leachate is reported on a quarterly basis, with the analysis of a wider range of parameters on an annual basis. Monitoring of landfill gas is undertaken on a monthly basis with a continual monitoring system installed in the site office and weighbridge office.

In order to prevent landfill gas emissions to the environment the installation of an active gas abstraction system with permanent enclosed flare was begun in 2006 and completed in 2009. It can generally be seen from the monthly monitoring data that there are no migratory gas emissions occurring at the site.

As part of an overall surface water management system 3 existing retention ponds have been redeveloped and expanded in the form of constructed wetlands along with a fourth to be constructed at the southern end of the landfill. A collection drain for surface waters was installed at the top of the perimeter slopes also.

13 leachate abstraction boreholes are in place in the main waste body and a further 5 sumps collect leachate from the slotted pipe which surrounds the waste body at the bottom of the slopes. These all pump leachate to the lagoon at the north of the site.

OBJECTIVE 4 – PROMOTION OF WASTE RECYCLING AT SOURCE AND MINIMISE RELIANCE ON LANDFILL

It is the objective of Waterford City Council to promote recycling and thereby reduce the reliance on landfill for both commercial, household and construction and demolition waste. A three-bin collection system for household waste is operated in the city. This consists of a green bin for dry recyclables, a brown bin for organic waste and a black bin for residual waste.

In addition to this three-bin system the range of goods accepted for recycling at Kilbarry Civic Amenity site are:

- Timber
- Cardboard
- Batteries
- Engine oil
- Cooking oil
- Textiles
- Aluminium cans
- Glass bottles
- Fluorescent tubes
- Energy saving lightbulbs
- Metal
- W.E.E.E.
- Aerosols
- Paint tins
- Biodegradable waste
- Mixed Municipal Waste

The services at the civic amenity site are regularly promoted in local newspapers and Waterford City Councils Environmental Officer, Ella Ryan, frequently discusses the benefits and recycling and developments within the area in a column in the local papers also.

OBJECTIVE 5 – TO DEVELOP AND IMPLEMENT PROCEDURES TO MONITOR THE MANAGEMENT OF THE FACILITY

In order to monitor the management of the facility the following procedures have been developed:

- Schedule of Environmental Objectives and Targets
- Environmental Management Programme
- Corrective Action Procedures
- Awareness and Training Procedures
- Communications Programme
- Environmental Management System

It is the objective of Waterford City Council to improve the environmental performance of the site. In order to achieve this the implementation of the following is proposed:

- Prepare an Annual Environmental Report
- Improve record keeping
- Prevent non-compliance
- Continue and improve the environmental monitoring programme
- Reduce general nuisances
- Reduce risk of gas migration through the installation of a gas abstraction system

7.2 Financial Provisions

Waterford City Council have the ability to meet any financial commitments or liabilities incurred by the carrying out of the disposal activities relating to Kilbarry Landfill. These commitments include compliance with the waste management license and restoration and aftercare of the site as specified in Condition 8 of the license.

Under section 38 of the Waste Management Act, 1996, Waterford City Council “shall provide and operate, or arrange of, such facilities as may be necessary for the recovery and disposal of household waste arising within the functional area”. Compliance with section 38 and all other relevant sections of the waste management act, 1996 is a statutory obligation of Waterford City Council. Waterford City Council annually in the preparation of the “Book of Estimates” and the passing of these estimates shall make provision for any capital works and maintenance works required to fulfil conditions of the waste license for the Kilbarry Landfill.

Appendix I

Landfill Gas Perimeter Borehole Data and Landfill Gas Survey 2014

Appendix 1

Landfill Gas Perimeter Data and Landfill Gas Survey 2015

A survey of landfill sites to determine the quantity of methane flared and or recovered in utilisation plants for 2015

Please choose from the drop down menu the license number for your site	<input type="text" value="W0018"/>
Please choose from the drop down menu the name of the landfill site	<input type="text"/>
Please enter the number of flares operational at your site in 2015	<input type="text"/>
Please enter the number of engines operational at your site in 2015	<input type="text"/>
Total methane flared	<input type="text" value="129,304"/> kg/year
Total methane utilised in engines	<input type="text" value="0"/> kg/year

Please note that the closing date for receipt of completed surveys is 31/03/2016

Introduction

The Office of Environmental Sustainability (OES) of the Environmental Protection Agency acts as the inventory agency in Ireland with responsibility for compiling and reporting national greenhouse gas inventories to the European Commission and the United Nations Framework Convention on Climate Change. In addition to meeting international commitments Ireland's national greenhouse gas inventory informs national agencies and Government departments as they face the challenge to curb emissions and meet Ireland's emission reduction targets under the Effort Sharing Decision (No. 406/2009/EC). The national inventory also informs data suppliers, making them aware of the importance of their contributions to the inventory process and a means of identifying areas where input data may be improved.

It is on this basis that the Environmental Protection Agency is asking landfill operators to partake in this survey so that the most up to date information on methane flaring and recovery in utilisation plants at landfill sites is used in calculating the contribution of the landfill sector to national greenhouse gas emissions

The Environmental Protection Agency wishes to thank you for partaking in this survey. If you have any questions about the survey and how to complete it please view the "Help sheet" worksheet. If however, your query is not answered by viewing the "Help sheet" worksheet please contact:

LFGProject@epa.ie

Once completed please send the completed file as an attachment clearly stating the name and or license number of the landfill site (e.g. W000 Xanadu landfill_2015) to:

LFGProject@epa.ie



A survey of landfill sites to determine the quantity of methane flared and or recovered in utilisation plants for 2015

How to use the survey?

- 1) Please enter your license details in the title sheet
- 2) Please enter the landfill name in the title sheet
- 3) Please enter the number of flares present and in use at your site in 2015 in the title sheet
- 4) Please enter the number of engines present and in use at your site in 2015 in the title sheet
- 5) The survey consists of 10 worksheets for flares. Only complete the number of worksheets for the number of flares present and in use in 2015 at your site
- 6) The survey consists of 10 worksheets for utilisation engines. Only complete the number of worksheets for the number of engines present and in use in 2015 at your site
- 7) Data can either be directly entered in each cell of the tables or chosen from the drop down menus. Where data is outside of the range of values presented in the drop down menus an error message will appear. Please check the value and try again. Where data or description is not provided in the drop down menus please type the answer in the box provided
- 8) Please view a copy of the worksheet for flare No. 1 below and click on the cells under each of the headings to help you fill out the survey questionnaire.
- 9) Please note under the method heading
 M = Measured e.g. direct from scada
 C = Calculated e.g. from weekly/fortnightly/monthly checks/monitoring
 E = Estimated e.g. based on operational design of flare/engine
- 10) Please note that data is only to be entered in either the monthly or the yearly tables but not both

		to be filled in by licensee											
		calculated by spreadsheet											
Flare No. 1													
Flare type ?		If "other" enter flare description here											
Is the flare an open or enclosed flare ?		Rated flare capacity ? m3/hr											
Month /year commissioned ?													
Month decommissioned if decommissioned in 2015 ?													
What is the function of the flare ?		If "other" enter flare function here											
Monthly	Method	Runtime	Runtime	Downtime	Total runtime	Average Inlet	Average Flow	Average CH ₄	Average CO ₂	Average O ₂	Combustion	Total CH ₄	Total CH ₄
	M/C/E	days/month	hrs/day	hrs	hrs/month	Pressure (mbg)	Rate (m ³ /hr)	%v/v	%v/v	%v/v	efficiency (%)	m ³	kgs
January	C	29	21	10	599	-21	700	32	44	4	98	131,492	88,907

to be filled in by licensee	calculated by spreadsheet
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Flare No. 1

Flare type ? If "other" enter flare description here

Is the flare an open or enclosed flare ? Rated flare capacity ? m3/hr

Month /year comissioned ?

Month decomissioned if decomissioned in 2015 ?

What is the function of the flare ? If "other" enter flare function here

Monthly	Method M/C/E	Runtime days/month	Runtime hrs/day	Downtime hrs	Total runtime hrs/month	Average Inlet Pressure (mbg)	Average Flow Rate (m ³ /hr)	Average CH ₄ %v/v	Average CO ₂ %v/v	Average O ₂ %v/v	Combustion efficiency (%)	Total CH ₄ m ³	Total CH ₄ kgs
January	C	31	24.0	142.5	602	-18	41	32.80	18.30	1.90	98.0	7,927	5,376
February	C	28	24.0	235.0	437	-20	40	27.30	18.40	4.30	98.0	4,653	3,149
March	C	31	24.0	480.6	263	-19	39	27.10	22.70	1.60	98.0	2,707	1,834
April	C	30	24.0	83.5	637	-19	132	25.20	20.60	3.30	98.0	20,686	14,015
May	C	31	24.0	0.0	744	-18	121	26.60	23.30	1.60	98.0	23,506	15,942
June	C	30	24.0	20.3	700	-18	119	25.20	22.50	2.80	98.0	20,511	13,910
July	C	31	24.0	0.0	744	-17	109	26.40	23.20	2.50	98.0	21,058	14,296
August	C	31	24.0	12.0	732	-15	97	27.90	24.90	2.70	98.0	19,444	13,226
September	C	30	24.0	81.5	639	-15	97	31.50	21.30	3.10	98.0	19,198	13,059
October	C	31	24.0	58.0	686	-16	96	29.10	18.60	4.10	98.0	18,810	12,783
November	C	30	24.0	119.2	601	-12	72	36.40	21.40	1.20	98.0	15,424	10,524
December	C	31	24.0	36.3	708	-11	67	35.50	19.80	1.00	98.0	16,385	11,190
Total					7,491							190,311	129,304

Please note: Only fill the "Yearly" table if data is not available or cannot be calculated nor estimated on a monthly basis

Yearly	Method M/C/E	Runtime days/year	Runtime hrs/day	Downtime hrs	Total runtime hrs/year	Average Inlet Pressure (mbg)	Average Flow Rate m ³ /hr	Average CH ₄ %v/v	Average CO ₂ %v/v	Average O ₂ %v/v	Combustion efficiency (%)	Total CH ₄ m ³	Total CH ₄ kgs
2015					0						98.0	0	0

ID	DATE	O2 %	CO2 %	CH4 %	BALANCE %
...L.M.1	30/01/2015 09:55	20.9	0	0	79.1
...G.W.2	30/01/2015 09:59	21.1	0.1	0	78.8
...G.W.4	30/01/2015 10:07	21.5	0.1	0	78.4
..G.W.16	30/01/2015 10:14	21.7	0.1	0	78.2
...G.W.5	30/01/2015 10:17	21.7	0.1	0	78.2
..G.W.30	30/01/2015 10:22	21.7	0.1	0	78.2
...G.W.6	30/01/2015 10:25	21.7	0.1	0	78.2
..G.W.29	30/01/2015 10:29	21.6	0.1	0	78.3
..G.W.22	30/01/2015 10:32	21.6	0.1	0	78.3
..G.W.23	30/01/2015 10:34	21.5	0.1	0	78.4
..G.W.24	30/01/2015 10:37	21.5	0.1	0	78.4
..G.W.25	30/01/2015 10:40	21.5	0.1	0	78.4
..G.W.26	30/01/2015 10:43	21	1.2	0	77.8
..G.W.26	30/01/2015 10:43	20.9	0.8	0	78.3
..G.W.27	30/01/2015 10:46	21.3	0.5	0	78.2
..G.W.28	30/01/2015 10:50	21.5	0.1	0	78.4

ID	DATE	O2 %	CO2 %	CH4 %	BALANCE %
...L.M.1	27/02/2015 09:47	21.3	0	0	78.7
...G.W.2	27/02/2015 09:52	21.4	0.1	0	78.5
...G.W.4	27/02/2015 10:03	21.8	0.1	0	78.1
..G.W.16	27/02/2015 10:07	21.8	0	0	78.2
...G.W.5	27/02/2015 10:10	21.7	0	0	78.3
..G.W.30	27/02/2015 10:17	21.6	0.1	0	78.3
...G.W.6	27/02/2015 10:20	21.5	0	0	78.5
..G.W.29	27/02/2015 10:24	21.4	0.1	0	78.5
..G.W.22	27/02/2015 10:32	21.2	0.1	0	78.7
..G.W.23	27/02/2015 10:36	21.1	0.1	0	78.8
..G.W.24	27/02/2015 10:40	21.1	0	0	78.9
..G.W.25	27/02/2015 10:44	21.1	0	0	78.9
..G.W.26	27/02/2015 10:48	20.9	0.4	0	78.7
..G.W.27	27/02/2015 10:53	21.2	0.1	0	78.7
..G.W.28	27/02/2015 11:01	21.2	0.2	0	78.6

ID	DATE	O2 %	CO2 %	CH4 %	BALANCE %
...L.M.1	31/03/2015 08:50	20.8	0	0	79.2
...G.W.2	31/03/2015 08:55	21.1	0	0	78.9
...G.W.4	31/03/2015 09:04	21.5	0	0	78.5
..G.W.16	31/03/2015 09:07	21.6	0.1	0	78.3
...G.W.5	31/03/2015 09:10	21.6	0	0	78.4
..G.W.30	31/03/2015 09:17	21.5	0	0	78.5
...G.W.6	31/03/2015 09:21	21.4	0.1	0	78.5
..G.W.29	31/03/2015 09:26	21.4	0	0	78.6
..G.W.22	31/03/2015 09:29	21.3	0	0	78.7
..G.W.23	31/03/2015 09:32	21.3	0	0	78.7
..G.W.24	31/03/2015 09:36	21.3	0	0	78.7

..G.W.25	31/03/2015 09:38	21.2	0	0	78.8
..G.W.26	31/03/2015 09:43	21.1	0	0	78.9
..G.W.27	31/03/2015 09:46	21	0.1	0	78.9
..G.W.28	31/03/2015 09:49	21.1	0	0	78.9
OFFICE.1	31/03/2015 10:10	20.9	0.1	0	79
OFFICE.2	31/03/2015 10:12	20.7	0.1	0	79.2
OFFICE.3	31/03/2015 10:14	20.7	0.1	0	79.2

ID	DATE	O2 %	CO2 %	CH4 %	BALANCE %
...L.M.1	30/04/2015 08:34	20.2	0.1	0	79.7
...G.W.2	30/04/2015 08:41	20.2	0.1	0	79.7
...G.W.4	30/04/2015 08:52	19	1.4	4.9	74.7
..G.W.16	30/04/2015 08:55	20.3	0.2	0	79.5
...G.W.5	30/04/2015 08:58	20.5	0.1	0	79.4
..G.W.30	30/04/2015 09:05	20.4	0.1	0	79.5
...G.W.6	30/04/2015 09:07	20.4	0	0	79.6
..G.W.29	30/04/2015 09:13	18.4	1.4	0	80.2
..G.W.22	30/04/2015 09:16	20.6	0	0	79.4
..G.W.23	30/04/2015 09:18	20.6	0	0	79.4
..G.W.24	30/04/2015 09:21	20.6	0	0	79.4
..G.W.25	30/04/2015 09:24	20.6	0	0	79.4
..G.W.26	30/04/2015 09:28	20.5	0.1	0	79.4
..G.W.27	30/04/2015 09:31	20.5	0.1	0	79.4
..G.W.28	30/04/2015 09:34	20.6	0	0	79.4
OFFICE.1	30/04/2015 09:46	20.7	0	0	79.3
OFFICE.2	30/04/2015 09:50	20.7	0.1	0	79.2
...L.M.1	29/05/2015 08:54	20.7	0	0	79.3
...G.W.2	29/05/2015 08:59	20.7	0	0	79.3
...G.W.4	29/05/2015 09:09	20.1	0.6	1.2	78.1
..G.W.16	29/05/2015 09:12	20.4	0.3	0	79.3
...G.W.5	29/05/2015 09:15	20.8	0	0	79.2
..G.W.30	29/05/2015 09:22	21.1	0	0	78.9
...G.W.6	29/05/2015 09:24	21.1	0	0	78.9
..G.W.29	29/05/2015 09:28	20.6	0.3	0	79.1
..G.W.22	29/05/2015 09:31	21.2	0	0	78.8
..G.W.23	29/05/2015 09:34	20.8	0.4	0.1	78.7
..G.W.24	29/05/2015 09:36	21	0	0	79
..G.W.25	29/05/2015 09:39	21	0	0	79
..G.W.26	29/05/2015 09:42	20.9	0	0	79.1
..G.W.27	29/05/2015 09:45	20.9	0	0	79.1
..G.W.28	29/05/2015 09:49	21	0	0	79
...G.W.2	30/06/2015 08:40	20.3	0	0	79.7
...G.W.4	30/06/2015 08:52	16.6	3.6	10.4	69.4
..G.W.16	30/06/2015 08:56	19.7	0.8	0	79.5
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..G.W.30	30/06/2015 09:05	20.6	0	0	79.4

...G.W.6	30/06/2015 09:07	20.6	0	0	79.4
..G.W.29	30/06/2015 09:13	20	0.4	0	79.6
..G.W.22	30/06/2015 09:17	20.6	0	0	79.4
..G.W.23	30/06/2015 09:19	20.5	0.1	0	79.4
..G.W.24	30/06/2015 09:22	20.6	0	0	79.4
..G.W.25	30/06/2015 09:24	20.5	0	0	79.5
..G.W.26	30/06/2015 09:28	20.5	0	0	79.5
..G.W.28	30/06/2015 09:34	20.5	0	0	79.5

...L.M.1	31/07/2015 08:17	20.2	0	0	79.8
...G.W.2	31/07/2015 08:22	20.1	0.1	0	79.8
...G.W.4	31/07/2015 08:31	20.1	0.1	0	79.8
..G.W.16	31/07/2015 08:34	19.8	0.5	0	79.7
...G.W.5	31/07/2015 08:38	20.1	0	0	79.9
..G.W.30	31/07/2015 08:42	20	0.1	0	79.9
...G.W.6	31/07/2015 08:44	20	0	0	80
..G.W.29	31/07/2015 08:48	9	9	0	82
..G.W.22	31/07/2015 08:50	19.8	0.1	0	80.1
..G.W.23	31/07/2015 08:52	19.3	0.5	0.1	80.1
..G.W.24	31/07/2015 08:54	19.7	0	0	80.3
..G.W.25	31/07/2015 08:56	19.6	0	0	80.4
..G.W.26	31/07/2015 08:58	19.6	0	0	80.4
..G.W.27	31/07/2015 09:01	19.5	0.2	0	80.3
..G.W.28	31/07/2015 09:02	19.6	0	0	80.4

...L.M.1	31/08/2015 08:29	20.2	0	0	79.8
...G.W.2	31/08/2015 08:35	20.3	0	0	79.7
...G.W.4	31/08/2015 08:46	20.4	0.1	0	79.5
..G.W.16	31/08/2015 08:49	20.4	0	0	79.6
...G.W.5	31/08/2015 08:57	20.4	0	0	79.6
..G.W.30	31/08/2015 09:02	20.4	0.1	0	79.5
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..G.W.29	31/08/2015 09:10	7.7	9.7	0.2	82.4
..G.W.22	31/08/2015 09:12	20.3	0.1	0	79.6
..G.W.23	31/08/2015 09:14	19.8	0.6	0	79.6
..G.W.24	31/08/2015 09:16	20.4	0	0	79.6
..G.W.25	31/08/2015 09:18	20.4	0.1	0	79.5
..G.W.26	31/08/2015 09:20	20.4	0	0	79.6
..G.W.27	31/08/2015 09:22	20.3	0.2	0	79.5

...L.M.1	30/09/2015 08:31	20.2	0	0	79.8
...G.W.2	30/09/2015 08:35	20.3	0	0	79.7
...G.W.4	30/09/2015 08:44	18.9	1.9	5.2	74
..G.W.16	30/09/2015 08:47	20.5	0	0	79.5
...G.W.5	30/09/2015 08:51	20.5	0	0	79.5
..G.W.30	30/09/2015 08:56	20.4	0.1	0	79.5
...G.W.6	30/09/2015 08:57	20.5	0	0	79.5

..G.W.29	30/09/2015 09:01	19.4	1.4	0	79.2
..G.W.22	30/09/2015 09:03	20.3	0.2	0	79.5
..G.W.23	30/09/2015 09:05	20	0.6	0.1	79.3
..G.W.24	30/09/2015 09:07	20.4	0	0	79.6
..G.W.25	30/09/2015 09:09	20.4	0	0	79.6
..G.W.26	30/09/2015 09:12	20.4	0.1	0	79.5
..G.W.27	30/09/2015 09:14	20.3	0.3	0	79.4
..G.W.28	30/09/2015 09:16	20.5	0.1	0	79.4

...L.M.1	30/10/2015 09:50	20	0	0	80
...G.W.2	30/10/2015 09:55	20.2	0	0	79.8
...G.W.4	30/10/2015 10:04	20.3	0	0	79.7
..G.W.16	30/10/2015 10:06	20.4	0	0	79.6
...G.W.5	30/10/2015 10:10	20.4	0	0	79.6
..G.W.30	30/10/2015 10:14	20.4	0.1	0	79.5
...G.W.6	30/10/2015 10:16	20.4	0	0	79.6
..G.W.29	30/10/2015 10:20	20.1	0.3	0	79.6
..G.W.22	30/10/2015 10:23	20.4	0	0	79.6
..G.W.23	30/10/2015 10:25	18	1.9	0.2	79.9
..G.W.24	30/10/2015 10:26	20.5	0	0	79.5
..G.W.25	30/10/2015 10:28	20.5	0	0	79.5
..G.W.26	30/10/2015 10:31	20.4	0.1	0	79.5
..G.W.27	30/10/2015 10:33	20.2	0.5	0	79.3
..G.W.28	30/10/2015 10:35	20.4	0.1	0	79.5

...L.M.1	30/11/2015 09:39	20	0	0	80
...G.W.2	30/11/2015 09:43	20	0.1	0	79.9
...G.W.4	30/11/2015 09:52	20.2	0	0	79.8
..G.W.16	30/11/2015 09:55	20.3	0	0	79.7
...G.W.5	30/11/2015 09:58	20.3	0	0	79.7
..G.W.30	30/11/2015 10:03	20.4	0.1	0	79.5
...G.W.6	30/11/2015 10:05	20.4	0.1	0	79.5
..G.W.29	30/11/2015 10:09	20.3	0.2	0	79.5
..G.W.22	30/11/2015 10:11	20.4	0.1	0	79.5
..G.W.23	30/11/2015 10:13	17.1	2.7	0.6	79.6
..G.W.24	30/11/2015 10:14	20.5	0.1	0	79.4
..G.W.25	30/11/2015 10:16	20.5	0	0	79.5
..G.W.26	30/11/2015 10:19	20.4	0.3	0	79.3
..G.W.27	30/11/2015 10:21	20	1.1	0	78.9
..G.W.28	30/11/2015 10:23	20.5	0.1	0	79.4

...L.M.1	31/12/2015 09:34	20.1	0.1	0	79.8
...G.W.2	31/12/2015 09:39	20.3	0.1	0	79.6
...G.W.4	31/12/2015 09:50	20.5	0.1	0	79.4
..G.W.16	31/12/2015 09:54	20.5	0.1	0	79.4
...G.W.5	31/12/2015 09:58	20.6	0.1	0	79.3
..G.W.30	31/12/2015 10:01	20.4	0.4	0	79.2

...G.W.6	31/12/2015 10:03	20.6	0.1	0	79.3
..G.W.29	31/12/2015 10:07	20.7	0.1	0	79.2
..G.W.22	31/12/2015 10:10	20.5	0.4	0.3	78.8
..G.W.23	31/12/2015 10:12	18.8	0.8	0.6	79.8
..G.W.24	31/12/2015 10:15	20.7	0.1	0	79.2
..G.W.25	31/12/2015 10:16	20.7	0.1	0	79.2
..G.W.26	31/12/2015 10:20	20.5	0.5	0	79
..G.W.27	31/12/2015 10:22	19.6	1.8	0	78.6
..G.W.28	31/12/2015 10:24	20.6	0.3	0	79.1

Appendix II

Ecological Assessment 2015

***Kilbarry Bog
Ecological
Monitoring 2015***

14 March 2016

***47093008 / CKRP0001 Issue 2
Final***

***Prepared for: Waterford City &
County Council***

***Prepared by: AECOM
Infrastructure & Environment
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¹ On 16 March 2015 the name of URS Ireland Limited changed to AECOM Infrastructure & Environment Ireland Limited to reflect the company's status as a wholly owned subsidiary through which AECOM operates in Ireland.

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EASTERN AND WESTERN REEDBEDS**

APPENDIX D – WATER QUALITY TREND GRAPHS

APPENDIX E – PHOTOLOG

1. INTRODUCTION

1.1 Project Contractual Basis and Personnel

AECOM Infrastructure & Environment Ireland Limited (AECOM) was requested by Waterford City & County Council (WCCC) to carry out an ecological assessment of the Kilbarry Bog proposed Natural Heritage Area (pNHA) and associated watercourses in 2015. This work was undertaken in accordance with AECOM Proposal 3152400, dated 24 April 2015 and authorised by Mr. John McKeown of Waterford City & County Council on 26 May 2015.

The project has been managed from AECOM's Cork office, with:

- Project Director: Kevin Forde, Technical Hydrogeologist
- Project Manager: Paul Lynas, Ecologist
- Field Scientist: David Horgan & Fergus O'Regan, Environmental Scientists

1.2 Project Background

Monitoring at Kilbarry Bog is a requirement of Kilbarry Landfill's Waste Licence (W0018-01) issued by the Environmental Protection Agency (EPA) in 2001. Condition 9.20.1 of the licence, titled 'Ecological Monitoring' states that:

An ecological assessment of the habitats and associated plant and animal communities within and immediately adjoining (i) the Kilbarry Bog proposed Natural Heritage Area and (ii) the associated watercourses, shall be undertaken annually and shall be submitted to the Agency. This assessment shall include a description of remedial measures to be introduced to control discharges of leachate and contaminated water from the landfill into surface and groundwater regime within Kilbarry Bog. The assessment shall establish the status of salmonid species, kingfisher and otter in the watercourses and adjoining habitats within Kilbarry Bog and in the Johns River and its tributaries in the immediate vicinity of, upstream and downstream of the landfill.

Results from monitoring are used to produce an informed assessment of the potential impacts on the ecology of Kilbarry Bog from activities at the former Kilbarry Landfill (now known as the Kilbarry Park). Findings of the ecological monitoring are presented below along with a discussion and recommendations.

1.3 Site History

Kilbarry Bog was originally designated as Kilbarry Bog Area of Scientific Interest (ASI) by An Foras Forbartha. At the time of ASI designation the bog was described as "an area of fen, swamp and open water"² A large part of the bog was destroyed by the development of Kilbarry Landfill during the 1970s. As a result of significant loss of wetland habitat, an adjacent wetland called Ballynakill marsh, an area south of the landfill, was incorporated into the boundary of the Kilbarry Bog ASI. This area is now known as Kilbarry Bog pNHA. A site location map detailing the boundaries of the Kilbarry Landfill and the current Kilbarry Bog pNHA is presented in Figure 1, with historical boundaries of Kilbarry ASI presented in Figure 2.

In recent years the Waterford Outer Ring-road dual-carriageway has been constructed along the southern and south western edge of the pNHA. In 2010, road improvement works on the Tramore Road, which passes through the pNHA, were carried out by WCCC to prevent flooding of the road. Most of the works were kept to within the existing road.

Kilbarry Landfill was closed in August 2005 and now operates in a limited capacity to monitor leachate and control methane gas being generated by the waste. The landfill has undergone re-development since 2010 to make it into a public amenity park. It now includes several walkways, viewing points, seating/picnic areas, a car park and information boards around the former landfill site. The park's landscaping is now complete and is open to the public for recreational use.

² Young (1972), *Report on Areas of Scientific Interest in County Waterford*. An Foras Forbartha, Dublin.

In response to the European Court of Justice Case 494/01, WCCC procured approximately 3.6 hectares of land adjacent to Kilbarry Bog for the creation of a compensatory wetlands habitat. It is proposed to create habitats similar to those found at Kilbarry Bog. Works were due to commence in the summer of 2014, however, as a result of further consultation with the appropriate state bodies, WCCC have re-scheduled construction works to take place in early 2016.

1.4 Site Description and Setting

Kilbarry Bog is situated on the southern outskirts of Waterford City. The site is flat and irregular in shape, with the Tramore Road (R675) dividing the bog into two reedbeds. The majority of the 45 hectare site occupies an area to the east of the Tramore Road, with less than a quarter occupying the western reedbed adjacent to Kilbarry landfill. Although the site is called Kilbarry Bog it is not a bog but rather a swamp, consisting of common reed and large sedge species.

The site is drained by the St Johns and Couse River, which join within the bog and flow in a northerly direction, ultimately discharging to the Lower River Suir Estuary approximately 2 km away. The Lisduggan Stream flows along the northern boundary of the Kilbarry Landfill and joins the St Johns River approximately 300m north of the pNHA boundary. A drainage ditch surrounding the landfill runs along a section of the bog's north western boundary and discharges to the Lisduggan Stream.

An amenity walkway, extending the length of the bog, was constructed as part of the Waterford Nature Park Project in recent years. This walkway is located on the eastern side of the Tramore Road (R675) and continues along part of the dismantled old Southern Railway line between the roadway and St Johns River.

Land use in the vicinity of the site is a mix of agricultural and residential, as summarised below:

North – Kilbarry Landfill to the north east and residential and commercial properties to the north and north-east.

South – Waterford City Outer Ring Road, agricultural land and individual houses.

East – Predominately agricultural land both grazing and cereal crops.

West – Housing estates separated by agricultural fields from the boundary of the bog.

A site layout map is presented in Figure 1. A site synopsis sheet produced by the National Parks and Wildlife Service (NPWS) is presented in Appendix A.

1.5 Current and Previous Studies

As part of the landfill management and facility's waste license conditions, the site has been surveyed a number of times in recent years.

Third party survey reports:

- 2003 by Biosphere Environmental Services³
- 2004 by Limosa Environmental and Ecoserve⁴
- 2008 - 2012 by WYG Environmental and Planning Limited

Government organisations have also reported on the site:

- 1972 - A Report on Areas of Scientific Interest in County Waterford
- 2005 - NPWS Site Synopsis Sheet⁵

³ Biosphere Environmental Services (2003). *An Ecological Assessment of Killbarry Bog and associated watercourses*. Unpublished Report.

⁴ Limosa Environmental and Ecoserve (2004). *Ecological Assessment of Kilbarry Bog and Environs*. Unpublished Report.

In 2008 the draft Kilbarry Bog Management Plan was prepared by Atkins Consulting on behalf of WCCC. In 2012 Atkins Consulting revised and updated the objectives of the Habitat Management Plan and is now referred to as Waterford Nature Park Management Plan (including Kilbarry Bog pNHA). The Management Plan has set out several objectives with a considerable emphasis on the conservation of Kilbarry Bog pNHA. The plan has also put forward recommendations to designate Kilbarry Bog as a statutory Nature Reserve.

1.6 Landfill Leachate Management

WCCC operate a leachate management system on site at Kilbarry Landfill. The system is designed to control discharge of leachate and contaminated groundwater from the landfill into surface water and groundwater bodies to the surrounding environs.

A collection trench was installed in 2002/2003 around the perimeter of the site, which drains to five sumps before being pumped to a lagoon on the northern end of the landfill. The trench and sump collection system is designed to intercept leachate seeping from the side of the waste body. To address potential migration of groundwater contamination from beneath the landfill, 13 leachate abstraction boreholes have been installed into the waste body at various depths.

All leachate is allowed to settle and within the lagoon before being discharged to the local sewer main. All discharges are monitored in accordance to the site waste licence requirements and monitored for flow, pH and dissolved methane.

⁵ <http://www.npws.ie>

2. PROJECT OBJECTIVES AND SCOPE OF WORKS

2.1 Project Objectives

The objectives of the ecological monitoring in 2015 were to:

- Fulfil requirements of Kilbarry Landfill's Waste Licence as per condition 9.20.1
- Continue monitoring site-specific trends to better understand the ecology of Kilbarry Bog pNHA
- Assess temporal trend data against baseline monitoring objectives set in 2013

2.1.1 Baseline Monitoring Objectives for Vegetation

Vegetative monitoring at Kilbarry Bog pNHA has been completed in a consistent manner by semi-quantitative means, annually since 2009. For the purpose of monitoring vegetation at Kilbarry Bog, guidance has been taken from *Common Standards Monitoring Guidance for Lowland Wetland Habitats*⁶. This guidance document discusses the generic attributes to be chosen for monitoring lowland wetlands, how to define interest features and set conservational objective for a site.

In 2013, six monitoring objectives were defined by AECOM (then URS) for assessing changes in vegetation at Kilbarry Bog; site specific targets are as follows:

1. No reduction in the total extent/area of Kilbarry Bog in relation to designation boundary.
2. No negative change to the key habitat types as indicated in previous habitat mapping of the Kilbarry Bog environs. Assess management of the wetland to maintain favourable conservation status.
3. Maintain structural elements of the wetland i.e. hydrological function from streams/drainage ditches, hollows and pools.
4. The frequency of positive indicator species will confirm the presence of the target community through quadrat monitoring. Site specific positive indicators for Kilbarry Bog will be to maintain the overall average coverage of common reed *Phragmites australis* at >75% and associated species greater pond sedge *Carex riparia* at >10% (only where the species occurs) and a continuous presence of meadowsweet *Filipendula ulmaria*, reed canary-grass *Phalaris arundinacea* and water horsetail *Equisetum spp.*
5. Invasive non-native species such as Japanese knotweed *Fallopia japonica* and Himalayan balsam *Impatiens glandulifera* should be absent, or no more than <5% total vegetation coverage. Negative non-woody ruderal specie such as nettle *Urtica dioica* and bindweed *Convolvulus arvensis* will have an overall coverage <10%
6. Woody species such as willow *Salix spp.* should be scattered and comprise of <15% of the total large reed and sedge swamp vegetation coverage where established canopy exists.

It's important to note that all of the above targets have been proposed in light of baseline ecological data recorded in 2008.

2.2 Scope of Works

The scope of work conducted in 2015 to fulfil the above project objectives was completed by a number of field surveys, as follows:

- Assessment of the vegetative communities within Kilbarry Bog by a quantitative quadrat survey

⁶ JNCC (2004) Common Standards Monitoring Guidance for Lowland Wetland Habitats. Joint Nature Conservation Committee, Peterborough, UK

- Assessment of the Kilbarry Bog's associated water courses by means of macroinvertebrate sampling and general habitat assessment for water quality
- Assessment of otter *Lutra lutra* activity along Kilbarry Bog's associated water courses
- Reporting of avian faunal observed during the above surveys (with specific emphasis on kingfishers - *Alcedo atthis*)

3. METHODOLOGY

3.1 Assessment of Kilbarry Bog's Flora

Kilbarry bog was mapped for habitat types in 2004 and 2008. Since 2008, a system of semi-quantitative monitoring in the form of quadrat surveys has been conducted. Typical habitat monitoring does not provide adequate resolution for assessing vegetative changes that may be occurring at the bog. Furthermore, detecting changes in species numbers in plant communities is notoriously ambiguous. Quadrats enable a surveyor to delimit stands of vegetation that appear homogenous and give a better overall indication of a sites floristic composition.

3.1.1 Quadrat Location

Nine (Q1-Q9) semi-permanent quadrats (demarked with dried bamboo stakes) are located within the confines of the bog and are surveyed annually. Locations were chosen to be representative of the typical vegetation composition found in that particular area of the bog. Quadrats Q1-Q5 are located in the north west section of the bog adjacent to the landfill, with Q7 located in the north east adjacent to a housing estate and the remain three, Q6, Q8 and Q9 located in the south. For the purpose of assessing possible interactions between the landfill and bog, the quadrats have been grouped into quadrats that occupy the western reedbed (Q1-Q5) and eastern reedbed (Q6-9). Comparisons can therefore be made between vegetative changes occurring adjacent to the landfill and typical background changes. A quadrat location map is presented in Figure 4.

3.1.2 Survey Methodology

Quadrats are sized (4m x 4m) as per the recommendation presented in the *National Vegetation Classification: Users' handbook*⁷. Each bamboo stake denotes one of four compass directions (North, South, East and West) and is further marked with different coloured tape, allowing the surveyor to establish the orientation of the remaining stakes and quadrat area. The vast majority of stakes have been damaged over time, mainly due to wind and with some destroyed by fire. AECOM replaced all marker stakes in June 2015.

Details of each quadrat surveyed were recorded into vegetative monitoring recording cards and are presented in Appendix B.

Vascular plants were recorded following the botanical nomenclature of Stace (2010)⁸ and Rose (1989)⁹. A measure of species abundance was classified using the Domin scale as per *National Vegetation Classification: User' handbook*. The Domin scale is an ordinal scale that indicates change in relative abundance; values of the scale are non-linear. This scale is outlined below:

TABLE 1: DOMIN SCALE

Cover	Domin Value
91–100%	10
76–90%	9
51–75%	8
34–50%	7

⁷ JNCC (2006) National Vegetation Classification: Users' handbook. Joint Nature Conservation Committee, Peterborough, UK

⁸ Stace, C. A. (2010) New Flora of the British Isles 3rd Edition, Cambridge University Press, Cambridge

⁹ Rose, F. (1989) Colour Identification Guide to the Grasses, Sedges, Rushes and Ferns of the British Isles and Northwestern Europe. Penguin Books Ltd., London

11–25%	5
4–10%	4
<4% (many individuals)	3
<4% (several individuals)	2
<4% (few individuals)	1

3.2 Assessment of Water Quality

As part of Kilbarry Landfill’s Licence requirements, adjacent water courses are to be monitored for water quality annually by means of biological assessment. The macroinvertebrate communities living within the aquatic environment of the St Johns River, Lisduggan Stream and Kilbarry Landfill’s drainage ditch are sampled by a ‘kick sampling’ method. This kick sampling method follows that which has been developed by the EPA (McGarrigle et al., 2002¹⁰).

Sampling involves a ‘D’ shaped net (approximately 35 cm in diameter with a 0.5mm size net mesh) being placed downstream of the sampler, who is standing at a selected location within the river/stream. The sampler proceeds to agitate the substrate of the river/stream bed to dislodge aquatic insect which subsequently float downstream and become captured by the net. This is followed by washing the surface of large stones whilst over the mouth of the net to remove other insect not targeted by the kick sample. Where weed is present, the sample net is swept up along the other edges of the vegetation to capture any potential insect that characteristically cling to their fronds.

The sample mass is then decanted into a tray for processing. Large objects (sticks, leaves and large gravels) are washed and removed, notable specimens are placed into labelled vials while the main bulk sample is transferred to a storage container with preservative (70% methylated spirits). All samples are taken off-site for desktop identification. Specimens are identified to the lowest taxonomic level possible using standard reference keys.

3.2.1 Q-value Methodology

The EPA Q-value classification system is a form of biometric indices. Water quality within a river is assessed by examining the relative abundance of key groups of aquatic insect species called ‘macroinvertebrates’ which live predominantly on the bed of that river. The key groups have different sensitivities or tolerances to pollution and as a result by examining the groups present, a determination on the ecological health of the water course can be made. Other parameters are also taken into account when calculating a Q-value such as physico-chemical parameters (pH, temperature, electrical conductivity, and dissolved oxygen), the presence of macrophytes, filamentous algae and sewage fungus, channel substrate and water shading.

The key groups of pollution sensitivity are A (sensitive), B (less sensitive), C (tolerant), D (very tolerant) and E (most tolerant). Example taxa of each group are as follows:

- Sensitive – Stonefly and Mayfly
- Less sensitive – Cased caddis fly
- Tolerant – Beetle species
- Very tolerant – Snail species

¹⁰ McGarrigle, M.L., Bowman, J.J., Clabby, K.J., Lucey, J., Cunningham, P., MacCarthaigh, M., Keegan, M., Cantrell, B., Lehane, M., Clenaghan, C., Toner, P.F. (2002). *Water Quality in Ireland 1998-2000*, EPA Publications, Wexford.

- Most tolerant – Certain worms and fly species

Where an assessment of the samples relative abundances has been made in relation to the above groupings, together with other recorded data, a Q-value can be assigned. EPA Q-value categories are presenting in Table 2.

TABLE 2: EPA Q-VALUE CATEGORIES

Biotic Index	Quality Status	Quality Class
Q5, Q4-5, Q4	Unpolluted	Class A
Q3-4	Slightly polluted	Class B
Q3, Q2-3	Moderately polluted	Class C
Q2, Q1-2, Q1	Seriously polluted	Class D

An additional suffix of ‘0’ or ‘**’ can be assigned to the Q-value where contamination or excessive substrate siltation is present during sampling.

Six kick samples were taken in 2015 in order to determine Q-values for the water courses surrounding Kilbarry Bog and Landfill. Location specific monitoring details, field water quality measurements and Q-value ratings are presented in Tables 6, 7 and 8.

3.3 Otter Survey

The European Otter (*Lutra Lutra*) is protected by national legislation (Wildlife Act 1976 Amended 2000), European legislation (listed on Annex II and IV of Habitat Directive) and other international legislation (Convention on Internal Trade in Endangered Species and the Bern Convention). Otters occur on almost all rivers and streams in Ireland and utilise even small drains as corridors to foraging grounds. They have extensive ranges, with territory size varying from c. 3 km of river to as much as 30 km or more (mean of c. 15-20 km). They mark their territories with their droppings (known as spraints) and hence their presence is easily ascertained. They often leave their droppings in prominent sites (e.g. bridges, boulders) within their home range. The mammal’s presence can also be indicated by other signs, such as dwellings (holts), feeding signs, footprints or slides, though direct observations are occasionally made.

The ‘standard otter survey’ (Lenton et al. 1980)¹¹ method was used to assess the Kilbarry bog environs for the absence or presence of the mammal. The survey consisted of a search of bridges within the area at locations identified in Figure 6. Accessible banks of the water courses, approximately 200m upstream and downstream and on both banks within the study area, were also surveyed. The pathway along the St Johns River was walked and banks of the river searched for otter signs. The River Couse was walked from the Outer Ring Road to where it meets the St. Johns River. Accessible sections of the Lisduggan Stream were surveyed along the northern section of the landfill.

3.4 Bird Survey

As part of Kilbarry Landfill’s license requirements, an assessment of the kingfisher *Alcedo atthis* status at Kilbarry Bog is to be carried out. Due to an unfavourable population status in Europe, kingfishers have been afforded protection under the European Birds Directive (2009/147/EC). The

¹¹ Lenton, E.J., Chanin, P.R.F. and Jefferies, D.J. 1980. Otter Survey of England 1977-79. Nature Conservancy Council, London.

bird has also been listed on the 'Amber List' of Birds of Conservation Concern in Ireland (Colhoun et al. 2013)¹².

No systematic survey was carried out for the kingfisher in 2015, as in previous years. However, due to the number of surveys undertaken at the bog each year, 'roving' records of the bird are taken where observations are made. Mammal surveys along the banks of the Kilbarry Bog watercourses were used as opportunities to make observations of kingfisher activity, as well as during the water quality assessment survey and vegetation survey. The area between the Ballindud Bridge and Outer Ring Road along the St Johns River in particular, were walked as previous sightings have been made in this area. Accessible banks along the Lisduggan Stream and along the banks of the drainage ditch to the east of the landfill site were also walked.

In 2012, an additional survey for birds was undertaken at Kilbarry Bog. The survey had specific emphasis on assessing the population status of the reed warbler *Acrocephalus scirpaceus* at the bog. This bird is known to breed at the site and five pairs were recorded in 1999 (NPWS Site Synopsis Sheet). The Birds of Conservation Concern in Ireland has placed the reed warbler on its amber list (medium conservational concern) for its breeding rarity (with between 65 and 100 breeding pairs in Ireland). Kilbarry Bog is reportedly supports between 5% and 10% of the national breeding population. A checklist for all species encountered during the survey was kept and numbers were recorded for scarcer species.

3.5 Invasive Non-native Species Survey

Invasive species are considered to be virulent non-native plants or animals that are capable of causing negative impacts to native species, the natural environment, the economy or human health.

Currently, Irish legislation contained in European Communities (Birds and Natural Habitats) Regulations (S.I. 477 of 2011) prohibits the introduction, dispersal, establishment or spread of an animal or plant that are considered non-native and/or invasive in Ireland. These invasive non/native species are listed under the 3rd Schedule of the Regulations.

The main invasive species that currently threatens the integrity of pNHA is Japanese knotweed *Fallopia japonica*. Himalayan balsam *Impatiens glandulifera* can also be found on the northern boundary of the Kilbarry Landfill. Where these plants have become established, they can out-compete other native plants for resources and habitat space and potentially cause bank erosion where substantial hydraulic conditions exist.

During field work in 2015, AECOM recorded all locations of invasive species with GPS co-ordinates. Other threats, such as illegal dumping were also recorded in this way.

3.6 Seasonal Limitation and Exclusions

There are a number of constraints around the timing of ecological surveys conducted during the year. In all cases, and where applicable, survey times are kept consistent between survey years.

Vegetative monitoring in 2015 was conducted in July. This is considered to be within the optimal survey time period (July) and botanical growing season of April to September, with the timing of the survey consistent with previous years.

Freshwater biological monitoring was conducted in October 2015, considered within the optimal time period for such a survey of between June and October, when flows are likely to be low and temperatures highest. The EPA's biological quality rating index (Q-values) requires that samples be taken from riffle habits. Oxygenated water from these locations allow for sensitive species (needed for higher Q-values) to exist. Deeper, less turbulent stretches of water will have less dissolved oxygen available than riffles areas to support sensitive macroinvertebrate species, hence skewing results. Depositing and/or deep slow flowing stretches of water are therefore not considered suitable for applying the EPA's biological quality rating.

¹² Colhoun, K., and Cummins, S. (2013). Birds of Conservation Concern In Ireland 2014 – 2019. Irish Birds 9: 523-544 (2013).

Mammals are active at all times through-out the year, albeit less so during the winter months. There are no seasonal limitations to conducting surveys for otters; however the early months of the year (spring) are preferred when vegetation cover is low and mammal activity begins to increase. The otter survey was conducted in April 2015.

There are no seasonal constraints to surveying kingfishers in Ireland as they are resident birds. No species specific survey was conducted for the kingfisher; however roving results were recorded where observations were made during other surveys carried out in April, July and October 2015.

4. MONITORING RESULTS

4.1 Site Habitats

Kilbarry Bog was mapped for habitat in 2004 and 2008. Several habitat types have been identified within the boundaries of the pNHA, with habitat classification following Fossitt (2000)¹³.

The dominant habitat type at Kilbarry Bog is a reed and large sedge swamp (FS1). The dominant species found within this habitat is the common reed *Phragmites australis*. Reed growth forms dense mono-dominant stands across much of the bog with greater species diversity occurring when transitioning to drier ground conditions prevail (along transitional boundaries at edges of reedbed). The sub-community is mainly comprised of greater pond sedge *Carex riparia*, while an impoverished understory generally contribute to less 25% of the total vegetation within a stand. A list all recorded plant species identified within quadrats since 2009 is presented in Table 4.

Other habitats mapped in 2008 include wet-willow-alder-ash (WN6) woodland and scrub (WS1) toward the southern end of the bog, depositing lowland rivers (FW2) and drainage ditches (FW4) of the St Johns and Couse Rivers. A wet grassland (GW4) area along part of the bogs western boundary has also been identified. The 2008 habitat map is presented in Figure 3.

4.1.1 Fire Incident 2015

A fire destroyed approximately 16 hectares (~36%) of Kilbarry Bog's eastern reedbed in April 2015. The burnt area of bog was confined to the south. The local fire brigade was called to ensure the fire, contained to the reedbed, was stopped from spreading to nearby properties along the Tramore Road.

During the mammal survey conducted in April 2015, AECOM investigated the remains of the vegetation to ascertain the level of damage caused to the reedbed. From an initial cursory assessment, it appeared that the key habitat destroyed was FS1 (reed and sedge swamp), with bordering habitats (such as the wet-willow-alder-ash and woodland scrub) only scorched by the blaze. The surface fire also burnt the leading tips of renewed reed growth; however, fresh green leaves at the base of each stem suggested the rhizomes survived and that the fire didn't penetrate the subsurface to any great extent (see Appendix E - Photolog). According to WCCC, it is unknown how the fire started; however, exceptionally dry weather (see Table 3) preceding the event was identified as a contributory factor, with dried stems from growth the previous year providing the flammable material.

AECOM returned to site in June 2015 to re-assess the damaged and preformed a standing crop biomass survey of quadrats located in the eastern (test) and western (control) reedbeds. During this visit to site, quadrats that were destroyed by the fire were replaced and into the exact location as previously recorded by use of GPS.

Growth in the eastern reedbed following the fire and as assessed in June 2015 recovered substantially since early April 2015 (see Appendix E). Although the vegetation growth appeared luxuriant, the height of vegetation was stunted by the effects of the fire damage. An average standing crop biomass from three quadrats (Q6, Q8 and Q9) located within the burnt area of reedbed yield a figure of 2.3 kg/m². The average standing crop biomass from two quadrats (Q5 and Q1) located in the western reedbed (untouched by the fire) was 3.8 kg/m². This represents a relative percentage difference of 49% between the western reedbed and the burnt section of the eastern reedbed. Visual evidence from the vegetation survey conducted in July 2015, considered to be the peak month of the botanical growing season, would suggest that the difference at that point in time was considerably less (see Appendix E). Literature suggests that the effect of fire on common reed may benefit the overall abundance post burning. Therefore, the negative changes to the key habitat type FS1 identified in April 2015 will likely be ameliorated by growth and recovery during future growing seasons.

There has been no reduction in the extent of Kilbarry Bog in relation to its designated boundaries (as depicted in Figure 1) in 2015.

¹³ Fossitt, J., (2000). *A Guide to Habitats Classification in Ireland*, published by the Heritage Council

4.1.2 Notable Flora

The National Parks and Wildlife Service (NPWS) site synopsis sheet for Kilbarry Bog pNHA (Site Code 001700) states that a scarce national species called the summer snowflake *Leucojum aestivum* was first recorded there in 1990 and subsequently recorded again in 1979. There has been no record of the species occurring at the site since 1979 and a review of the National Biodiversity Data Centre (NBDC) on-line species records have concluded the same. It is likely that the summer snowflake may have been located on part of the bog on which Kilbarry Landfill was constructed.

Other notable species that are considered rare on a county scale recorded within Kilbarry Bog include mare's-tail *Hippuris vulgaris*, greater bladderwort *Utricularia vulgaris* and pink water speedwell *Veronica catenata*.

No notable flora were detected during surveys conducted in 2015.

4.2 Quadrat Survey Results

All nine quadrats were surveyed on 29 July 2015 and within the optimal survey time period (botanical growing season of April to September). The nine quadrats are spread within the dominant habitat type (reed and large sedge swamp). The other significant habitat type of wet-willow-alder-ash woodland was assessed through aerial photography. Quadrat locations are shown in Figure 4.

According to data obtained from the field survey in July 2015, the common reed remains the overall dominant species in the majority of quadrats, with the greater pond sedge dominant in only one quadrat (Q9). This is a change from previous results where the greater pond sedge was also dominant in Q6 (pre-2014). This has been due to an overall decline in the proportion of greater pond sedge species numbers in comparison to the common reed in the eastern reedbed. It's important to note that the common reed in cases where it's not the overall dominant species comprises up to half of the total vegetation contained within that particular quadrat.

The low species diversity, which has been increasing slightly in recent years, has decreased in 2015, with the average number of plants recorded per quadrat in 2014 of 6.4 decreasing in 2015 to 6.0. The overall number of species identified in the western reedbed in 2015 remained stable when compared to 2014 records, however, the overall number decreased in the eastern reedbed in 2015. This was largely due to low species numbers recorded in Q7, as opposed to Q6, Q8 and Q9 (quadrats that were burnt due to the fire in April 2015). A summary of the dominant plant species and numbers of species recorded in each quadrat is presented in Table 5.

There was no new species identified from within the confines of the nine quadrats surveyed in 2015. Large tracts of Kilbarry Bog's eastern reedbed were walked in early June during an additional survey post-fire event. There were no new plant species identified during this site visit.

A full list of plants identified during the annual vegetation survey in the form of recording cards is presented in Appendix B.

4.2.1 Changes in Reedbed Vegetation

For the purpose of detecting changes in vegetative composition within the bog, annual average Domin values for the entire reedbed (Q1-Q9), eastern reedbed (Q6-Q9) and western reedbed (Q1-Q5) have been graphed and are presented in Appendix C. The four species of interest that have been chosen to assess the favourable status of the vegetation at Kilbarry Bog and for which targets have been set are:

Positive indicators

- Common reed
- Greater pond sedge

Negative non-woody indicators

- Nettle
- Bindweed

Trends in common reed and greater pond sedge species data reflect changes occurring within the main bog flora.

In 2015, the common reed has remained the dominant plant species across the majority of quadrats surveyed. The greater pond sedge has remained the dominant species in Q9, although widespread throughout the bog. The annual average Domin value for the common reed has decreased slightly (8.2 to 8.0) across the entire monitoring network from 2014 to 2015, while the greater pond sedge has increase slightly (3.3 to 3.6) over the same period (see Appendix C1).

A similar pattern can be seen from the trends of common reed and greater pond sedge abundance in the western reedbed between 2014 and 2015 to that of the overall averages, however, annual average Domin values remained stable for the greater pond sedge (3.8) in the eastern reed. Trend data for the common reed and greater pond sedge species in the eastern and western reedbeds are illustrated in Appendix C2 and C3 respectively.

The abundance of bindweed remained unchanged between 2012 and 2015 across the bog. Overall, there was a slight decrease in nettle abundance, with annual average Domin values of 1.6 in 2014 decreasing to 1.4 in 2015.

The total number of species recorded in quadrat Q1 increased in 2015, with a decrease in four quadrats (Q2, Q5, Q7 and Q9). There was no change in the number of plant species in four quadrats (Q3, Q4, Q6 and Q8).

The overall average number of species per quadrat has increased from 3.9 in 2009 to 6.0 in 2015 (see Table 5). Species number have been increasing year on year since 2009, however, there has been a modest decrease in overall average species per quadrat in 2015 (6.4 in 2014 to 6.0 in 2015).

In general, the plant species that vary the most from year to year contribute a small overall coverage of total plant species (<5% per quadrat) and make up the minor broadleaved component of the bogs vegetation

4.2.2 Wet-willow-alder-ash Woodland Results

Scrub and trees within wetland areas are often considered indicators of drying out. Growth of these woody species can often impact vegetation structure via shading effects, while root formation can cause changes to localised drainage patterns.

The wet-willow-alder ash woodland located on the southern end of Kilbarry Bog consists of sparsely distributed willow *Salix spp.*, common hawthorn *Crataegus monogyna*, blackthorn *Prunus spinosa* and alder *Alnus spp.* and gorse *Ulex europaeus*, often forming a broken canopy (dominated by willow) of approximately 3m in height. The shading effects of willow have not impacted the composition or extent of the reedbed in surrounding areas.

Information on the area of the bog was obtained following a review of the Ordinance Survey Ireland (OSI)¹⁴ photographs taken in 1995, 2000 and 2005 and from an online AECOM ArcGIS viewer web (© OpenStreetMap contributors).

Since 1995, there has been no significant change to the extent of the wet-willow-alder-ash woodland at the southern end of Kilbarry Bog. No sapling growth was identified during the quadrat survey in this area in 2015. It's estimated that the woodland comprise approximately 6.7% of the total coverage of the bog at 0.03 km².

There is also an established area of sparsely distributed willow, alder, common hawthorn and poplar *Populus spp.* trees within the western reedbed of Kilbarry Bog. These trees surround an infilled area due north of Q5 (see Figure 4) which has been colonised by gorse and willow saplings. This area has not been taken into account for calculating the total coverage of negative woody species at the bog due to the lack of aggregated canopy formation. However, growth of young poplar trees south of quadrat Q5 may impact the vegetation of the western reedbed over time. This will be reassessed during future monitoring rounds.

¹⁴ www.osi.ie

4.2.3 Hydrological Function

Maintenance of a favourable (stable) hydrological function at Kilbarry Bog is critical to the ecology of the wetland. However, the hydrology of Kilbarry Bog has not been assessed or monitored as part of the ecological monitoring programme carried out thus far.

The unique characteristics of wetland types can often be defined in terms of its hydraulic inputs (groundwater, surface water or precipitation) whether predominately from one source or in combination. The hydrological function can be affected by the variations in the proportions of groundwater to surface water or rainwater contributing to the water table, which in turn changes water chemistry and degree of flow across the area.

A Site Conceptual Model (CSM) for Kilbarry Bog has been presented by RPS in a hydrology study¹⁵ completed in 2013, suggests that the main hydraulic inputs to the bog is from the St. Johns River and Couse River. Water level data has been recorded at two OPW gauging stations (No.:16115 at Sheep Bridge Weir and No.:16128 at Tramore Road Roundabout) to the north and south of the bog since 2001. However, as flow rating curves have not been developed for either station, no flow data is available. Therefore, given the lack of supporting information, an assessment of how much of a contributing factor either surface water has to play in maintaining the bogs hydrological function cannot be made.

During the hydrology study completed in 2013, seven springs were confirmed to be flowing in areas surrounding the bog. One spring on the edge of the eastern reedbed, adjacent to the Avoca housing estate, was built over, while another on the southern end of the bog has been affected by the construction of the Outer Ring Road. It's likely that such developments and others adjacent have affected the infiltration of rainwater contributing to these springs and thus affecting discharge quantities to the wetland.

The nearest Met Eireann rainfall measuring station to Kilbarry Bog is located approximately 1.1 km north of the site boundary (Waterford Tycor No.: 1812). Long-term average annual precipitation at the Tycor rainfall station recorded between 1961 and 1990 was 1,102 mm of rain per year, while long term annual averages recorded between 1981 and 2010 were slightly lower at 1,021 mm of rain per year. Evapotranspiration is not recorded at the Tycor weather station. A time-series graph of monthly rainfall totals (mm) since 2009 at Tycor is provided in Figure 8.

From the six monthly rolling average plotted in Figure 8, it can be inferred that the driest months of the year are generally June to September and the wettest months November to February. The short term linear average trend since 2009 suggests that rainfall amounts are decreasing slightly.

Available monthly rainfall data for the monitoring period was obtained from Met Eireann¹⁶ for the nearest rainfall gauging station to the site at Waterford Tycor. Rainfall levels at Waterford have varied considerably over the first six months of 2015 as shown in Table 3 below.

TABLE 3: TOTAL RAINFALL AMOUNTS AT WATERFORD (TYCOR) JANUARY TO SEPTEMBER 2015

2015	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
	Botanical Growing Season											
Monthly Rainfall (mm)	79	37	58	18	130	39	129	61	55	NA	NA	NA
Long Term Average Monthly Rainfall (mm)	108	73	78	72	70	74	67	76	83	116	103	100
2015 Rainfall as % of Long Term Average	73%	51%	72%	24%	187%	53%	192%	80%	66%	-	-	-

NA – Not available at time of request

¹⁵ Doyle, C., *Hydrology Study of Kilbarry Bog* (RPS, 2013). Source: Water City Council, an unpublished report.

¹⁶ www.met.ie accessed 22 January 2014

For the first three months of 2015, rainfall amounts, as measured at Waterford Tycor, were approximately 65% of the long-term average for this period (174 mm compared to an average of 261 mm). From March to June 2015, generally considered the driest months of the year (conditions prior to vegetation monitoring), rainfall amounts were close to the long-term average (206 mm compared to 221 mm).

Standing water level measurements taken at each quadrat location in 2015 were higher than in 2014 when rainfall amount for the month of July in 2015 were 192% higher than in July 2014 (67 mm compared to 129 mm)

With regard to the bog's hydrochemistry, field measurements were not taken during the quadrat survey in 2015 due to in-adequate amounts of standing water (where present) at monitoring locations.

4.3 Water Quality Assessment

4.3.1 Field Observations and Physiochemical Parameters

Freshwater monitoring locations have been kept consistent since 2009, with details presented in Table 7.

The St. Johns River is monitored at two locations; an upstream location at Sheep's Bridge (S1) toward the southern end of Kilbarry Bog and a location downstream of the pNHA at Tramore Road Roundabout Bridge (S3/4). Even though the stretch of water at S3/4 is considered depositing, a short riffle section immediately upstream of the bridge provides the only area of aeration within the river for several hundred meters. This is also the case at L2 on the Lisduggan Stream (adjacent to landfill on northern boundary), where a depositing stretch is followed by a short riffle section. At both monitoring locations S3/4 and L2, samples are taken from fast-flowing water. The remaining monitoring location L1 on the Lisduggan Stream, further upstream than L2, is considered to be eroding/riffle in nature.

The drainage ditch monitoring location D1 (landfill northern site boundary), is slow flowing and heavily silted. However, given that this is the case for the majority of its short course, a sample has been taken to gather comparable water quality information from this area.

In 2014, an additional kick sampling location on the Couse River (C1) was added to the monitoring schedule. The location is approximately 250m upstream of the bog in a south easterly direction and approximately 50m from the Waterford City Outer Ring Road in the same direction (see Figure 5). The stretch of water surveyed at C1 is considered to be eroding in nature and appropriate for taking a representative sample.

Details of additional qualifying criteria (i.e. presence/absence of macrophytes or algae growths) and other observations taken at monitoring locations are also contained in Table 6.

Field measurements of pH, EC, temperature, dissolved oxygen and redox potential (converted to Eh) taken in the field at each kick sampling location (see Figure 5 for details) are presented in Table 7.

The surface water pH's of the St Johns River were all below neutral in October 2015 and were lower with results of previous monitoring rounds. A pH value of 6.85 was recorded at S3/4 and a value of 6.73 recorded at S1. A similar pH value, 6.54, was recorded on the Couse River at location C1 (see Figure 5). The pH of the Lisduggan Stream remains stable between upstream location L1 (6.78) downstream locations L2 (6.91) and D1 (7.00) in October 2015.

Temperatures across all water courses monitored in October 2015 ranged from 8.0°C (S1) to 11.5°C (L1). Surface water temperatures in October 2015 monitoring were some of the lowest on record.

EC results from the St Johns River and Lisduggan Stream appear to increase when moving from upstream to downstream locations. Conductivity readings on the St Johns River were 411µS/cm at S1 and 521 µS/cm at S3/4 in October 2015. Surface water conductivity results from the Lisduggan Stream and drainage ditch were similar to results from the St Johns River in 2015, with measurements ranging from 429 µS/cm (L2) to 497 µS/cm (L1). The surface water conductivity recorded in October 2015 from the Couse River (C1) was 488 µS/cm.

Dissolved oxygen (DO) readings are generally higher at upstream locations along the water courses of Kilbarry. Upstream measurements on the St Johns River at S1 (90%) were higher than downstream measurements at S3/4 (66%). Similarly, upstream measurement at L1 (82%) was higher than downstream measurements at L2 (54%) and D1 (50%). The surface water location on the Couse River (C1) recorded the highest dissolved oxygen reading of 94% in October 2015.

All downstream dissolved oxygen results in 2015 (S3/4, L2 and D1), were below the lower dissolved oxygen threshold of 80%, as outlined in S.I. No. 272 of 2009. The dissolved oxygen limits for surface waters of >80% to <120% ensures favourable oxygen conditions for aquatic organisms (especially fish species) in a riverine environment. Temporal trends in dissolved oxygen of all water courses monitored at Kilbarry Bog from 2004 to date are presented in Appendix D1.

Field readings of ORP (relative to Ag/AgCl) were compensated as per the manufacturer's instructions giving adjusted Eh readings of 200 mV (D1) to 288 mV (C1). This indicates that surface waters of the St Johns River, Lisduggan Stream, Couse River and drainage ditch have a slightly reducing redox state.

Water in the St Johns River, Lisduggan Stream and Couse River appeared clear and colourless during quality monitoring in 2015. There was hydrocarbon sheen on the water's surface at D1 when mud at this location was disturbed (similar to previous years).

4.3.2 Biological Monitoring

The Q-value results for monitoring in 2015 and a detailed list of taxa noted in each sample along with EPA indicator grouping, BMWP (Biological Monitoring Working Party) scoring, ASPT¹⁷ (Average Score per Taxa) scoring and a diversity index is presented in Table 8. A temporal trend illustration of Q-values in all water courses monitored to date, with the exception of L6, is presented in Appendix D2.

Biological monitoring results for the St Johns River have remained unchanged in 2015 when compared to 2014, with a value of Q3. This indicates that the river is moderately polluted and falls into the EPA's Quality Class C. The upstream location at S1 has remained at a Q-value of Q3 since 2003, while the downstream location at S3/4 (downstream of Kilbarry Landfill) has improved slightly from Q2-3 in 2008 to Q3 in 2009. Water quality in the St Johns River has remained at Q3 for both monitoring location since 2009.

The BMWP and ASPT scoring vary from year to year; with the latter scoring system giving a value of 4.4 at S1 and 3.8 at S3/4 in 2015 (see Appendix D3). It's important to note that sea lettuce (*Enteromorpha* spp.) can be found growing at location S3/4, which would suggest a saline influence at this point on the St Johns River (due to its proximity to Waterford Bay). Saline conditions have detrimental effects on sensitive macroinvertebrate species, therefore influencing that type of taxa likely to be found. The Q-value at S3/4 is not likely to ever reach a value greater than Q4 in this situation.

The sample taken at C1 on the Couse River in October 2015 indicated similar water quality results to that of the St Johns River, with a Q-value of Q3 and a similar ASPT score of 4.0.

Water quality of the Lisduggan Stream seems to be recovering in 2015 from the historic impact of pollution, with Q-values at upstream (of landfill) location L1 and downstream locations L2 both improving by an half a Q-value. This marks a continuing increase in water quality results from the Lisduggan Stream since 2009.

The drainage ditch sampling point D1 located on the landfill's northwest boundary deteriorated in water quality from Q1-2 in 2011 to Q1 in 2012. There was a slight improvement in 2015 with values increasing from Q1 in 2014 to Q1-2. This marks the first increase in water quality at this location since 2012.

The ASPT scores trend at L1 (Appendix D3) and has been greater than ASPT scores trend at L2 since 2011, however in 2013, and following the contamination incident in April 2012, ASPT scores at L1 (1.8) deteriorated to below L2 (3.3) (L1 immediately downstream of spill). In 2014, the ASPT

¹⁷ Linear Scale of Water Quality with 0 indicating very poor status vs. 10 indicating pristine water quality

score for L1 (3.7) improved to greater than that of L2 (2.3), restoring the original temporal trend between these two locations. The ASPT scores at L1 (3.1) remains higher than L2 (2.6) in 2015 and indicates improved water quality upstream of the landfill since the contamination incident in 2012.

4.3.3 Fisheries Assessment

In 2004 and 2008 a fish stock assessment was undertaken on the St Johns River and Lisduggan Stream. The surveys were carried out by Ecofact by means of electro-fishing. The 2008 fish stock assessment report concluded that there was no value in repeating the assessment until such time as there is a significant improvement in water quality of these two water courses.

WCCC has supplied AECOM with information relating to a fisheries assessment carried out on the Lisduggan Stream and St Johns River in 2008. The reported concluded that the numbers of fish species detected upstream of Kilbarry Landfill appear to be greater in numbers when compared to fish numbers detected downstream of the landfill. The upstream location also had the highest numbers of brown trout *Salmo Trutta*, eel *Anguilla Anguilla* and brook lamprey *Lampetra planeri* recorded in all water courses examined. The Lisduggan Stream recorded only eel. There were no salmon *Salmo salar* detected in any samples taken in the 2008 fisheries assessment from the waters of the Lisduggan Stream or St Johns River.

There have been modest improvements in the water quality at sampling location S3/4 on the St Johns River and L2 on the Lisduggan Stream since 2008, however it's considered unlikely that there has been significant improvements in water quality and associated habitats of either water course to allow favourable increases in salmonid species populations.

4.4 Otter Assessment

A record of previous otter survey results, along with 2015 results are presented in Table 9. Bridge survey locations are presented in Figure 6.

The survey was completed on 24 April 2015. Otter spraints were observed (only otter evidence identified during surveys) along all water courses surveyed i.e. St. Johns River, Couse River and Lisduggan Stream.

Otter activity has remained consistent at Sheep's Bridge on the St Johns River since 2009. Evidence of otter activity was also identified at a bridge location off the Tramore Road, south of the Ballindud Roundabout in 2015. Otter spraint was last detected at this location in 2003.

There was evidence of otter activity noted on the Couse River, upstream of a culvert and south of the Waterford Outer Ring Road in 2015.

A sprainting site along the Couse River, upstream of the Waterford Outer Ring Road culvert offers adequate seclusion for resting otters. Spraints were recorded at a prominent rock or 'seat' upstream of the culvert in 2015, which remains consistent with records from 2011 - 2013. There was no evidence of otter activity at the Couse Bridge (downstream of the culvert) since 2004. It's important to note that a mammal pass has been constructed beneath the Waterford Ring Road to allow safe passage of mammals between areas of their habitat upstream and downstream of the roadway.

Otter activity has increased on the Lisduggan Stream in recent years. Spraints have been identified beneath a bridge which crosses the stream near the confluence with Kilbarry's north eastern drainage ditch. Evidence has been recorded consistently at this location since 2012.

There were no signs of mink evident during the mammal survey conducted in April 2015. No otter holts have been located within the survey area.

4.5 Bird Assessment

There were no sightings of kingfishers within the area of Kilbarry Bog in 2015. Water courses of the St Johns River, Lisduggan Stream and drainage ditch were walked in conjunction with other surveys carried out in April, June, July and October 2015. The last recorded sighting of a kingfisher was in 2003 at a location along the drainage ditch east of Kilbarry Landfill.

In 2012, a bird survey was conducted at Kilbarry Bog. The survey was designed to focus on assessing the population of the reed warbler along with other avian fauna at the site. The bird survey

was carried out in May and July 2012 and identified one reed warbler in the North West corner of the western reedbed on both occasions. This confirmed an earlier roving observation recorded in July 2011 at the same location (near Q3).

A total of 34 other bird species were also recorded at the bog in 2012. Of these species, 15 were identified to be breeding, with a further 10 considered likely to be breeding at the site. Of the 34 species identified in 2012, nine species (~26%) are listed on the 'Amber List' of Birds of Conservation Concern in Ireland; these are the swift *Apus apus*, barn swallow *Hirundo rustica*, spotted flycatcher *Muscicapa striata*, starling *Sturnus vulgaris*, house sparrow *Hirundo rustica*, greenfinch *Carduelis chloris*, sparrowhawk *Accipiter nisus*, robin *Erithacus rubecula* and goldcrest *Regulus regulus*.

Other than a reed warbler's call identified by AECOM while surveying Q3, there were no other birds of notable interest recorded during the 2015 surveys.

4.6 Other Flora and Fauna

As with each year of surveying, additional wildlife species are often identified in conjunction with site works. In 2015, several additional invertebrates were identified and include one species of damselfly (beautiful demoiselle *Calopteryx virgo*) and seven species of butterfly (Meadow brown *Maniola jurtina*, ringlet *Aphantopus hyperantus*, small tortoiseshell *Aglais urticae*, peacock *Aglais io* the orange tip *Anthocharis cardamines*, red admiral *Vanessa atalanta* and the common blue *Polyommatus icarus*) and one species of moth (the drinker *Euthrix potatoria*).

4.7 Invasive Species and Threats to the Conservation of Kilbarry Bog

There are two main invasive non-native species of flora that have been identified and recorded at Kilbarry Bog since 2009, Japanese knotweed *Fallopia japonica* and Himalayan balsam *Impatiens glandulifera*.

Japanese knotweed has been identified on the banks of the St Johns and several other 'clumped' locations along the St Johns River walkway. One knotweed stand was identified on the boundary of eastern reedbed and Avoca Drive housing estate in 2013, 2014 and 2015 (see Figure 7 for location details).

A large growth of Himalayan balsam has been recorded along the northern boundary of Kilbarry landfill on the banks of the drainage ditch during previous surveys.

A list of invasive species and threats to Kilbarry Bog with grid reference details are given in Table 10, with locations presented in Figure 7.

Illegal dumping has taken place within the boundary of the pNHA at two locations identified in 2013. An area of in-filling has occurred within the western reedbed adjacent to the R675 roadway. Aerial photographs from 1995 indicate that the area covered by this in-fill is c. 1 ha in size. This area has resulted in the direct loss of reedbed and allowed the establishment of woody species to proliferate. This in-filled area is gated and can be clearly observed while driving along the R675. At the area noted above on the boundary between the eastern reedbed and Avoca Drive housing, building waste material and grass/hedge cuttings have been dumped. A disused hide, made of scrap pieces of timber, was also identified within the western reedbed in 2013, adjacent to quadrat Q4, and remains in-situ in 2015.

Domestic refuse has been dumped in a field adjacent the Couse river on the south eastern side of Kilbarry Bog, although not within the pNHA boundary. Grid reference details are shown in Table 10.

5. DISCUSSION AND CONCLUSION

5.1 Habitats

Baseline monitoring objectives were introduced in 2013 for the main conservational interest feature at Kilbarry Bog (reed and large sedge swamp habitat) in order to assess annual data records against baseline ecological data gathered in 2008. Targets have been set for habitat extent, composition and structure, positive and negative vegetative indicators and the preservation of distinctive features.

Results from the semi-quantitative quadrat survey carried out in 2015 indicated no obvious changes to the bog's vegetation when compared to previous years monitoring. In general, the plant species that vary the most from year to year contribute a small overall coverage of total plant species (<5% per quadrat) and make up the minor broadleaved component of the bog's vegetation. However, there has been no significant change in the floristic composition of the bog's vegetation or structure between 2009 and 2015. Furthermore, there has been little or no change to the physical structural elements of the wetland in 2015.

A fire in April 2015 destroyed approximately 16 hectares of Kilbarry Bog's eastern reedbed. According to WCCC, it is unknown how the fire started; however, exceptionally dry weather preceding the event (refer to Table 3 in Section 4.2.3) was identified as a contributory factor along with dried/withered vegetation. In June 2015, AECOM performed a standing crop biomass survey to assess the lag in reed growth between the burnt area of bog and untouched reedbed in the west. Results indicated a difference of 65% between the growth of reedbed in the controlled area and the burnt area, approximately seven weeks post fire. During the vegetation survey in July 2015, visual evidence suggested that reed growth and abundance was almost on par with that of the untouched reedbeds, with the only noticeable difference being a reduced reed height. It is considered that any immediate negative effects from the fire destroying a large section of the eastern reedbed in April was ameliorated by the growth that took place in the summer of 2015 and will be further amended during future growing seasons.

There has been no reduction in the extent of Kilbarry Bog in relation to its designated boundaries (as depicted in Figure 1) in 2015.

The overall abundance of common reed and greater pond sedge has remained stable at Kilbarry Bog since 2011; with variation in abundance trends of both species differing between eastern and western reedbeds (see Appendices C2 and C3). The average abundance of the common reed has been maintained at its target level of >75% in 2015. The overall average abundance of the greater pond sedge, where it occurs, has also maintained its proposed conservational target of >10%. Minor broadleaved herbs, such as meadowsweet, reed canary-grass and water horsetail, continued to show a presence across one or more quadrat locations in 2015.

The target for negative non-woody species of <10% total vegetation coverage was achieved in 2015 with a total combined annual average Domin value of <4% (many individuals) recorded.

There was a slight decrease in nettle abundance in the eastern reedbed, while bindweed abundance remained stable across the bog. The average number of minor herbaceous species (generally <5%) being recorded across all quadrat locations in the bog is increasing. This would suggest that the vegetation at Kilbarry Bog is becoming more diverse and may indicate (in-directly) that the wetland is becoming drier.

The woody species that make up the wet-willow-alder ash woodland located on the southern end of the bog are sparsely distributed among the surround swamp vegetation and are estimated to cover approximately 7% of the total vegetation coverage of the 45 hectare pNHA. An area of trees (willow, alder, whitethorn and poplar) and scrub that surround the infilled area of the western reedbed has also been identified as having potential to be included in the overall woody species coverage total (target of <15%), however due to the lack of aggregated canopy coverage, this area has not been included in 2015.

There has been no reduction in the extent of Kilbarry Bog in relation to its designated boundaries (as depicted in Figure 1) in 2015. The site has been subject to a habitat management plan which commenced in 2008, with the most recent revision for the period 2012 – 2019, drafted in March 2012. The management plan for the bog has incorporated the area of the Kilbarry Landfill, with the combined areas referred to as the 'Waterford Nature Park'.

A hydrology assessment of Kilbarry Bog was conducted by RPS in 2013. The study put forward a CSM for the bog based on desk top information and some site specific data. In conclusion, the main hydraulic inputs to the wetland are believed to be from the St. Johns River and Couse River. However, there is a lack of supporting site specific information to confirm this. Several springs in area's surrounding the bog were identified during the hydrology assessment. The majority were found discharging to the western reedbed, while a spring identified to the east was either damaged or affected by housing and road development. In addition to the recommendation to install a groundwater monitoring networks in the pNHA, an assessment into the technical feasibility of measuring the total surface water flows along water courses prior to flowing through the study area and after should be made. This may involve the installation of a third monitoring point on the Couse River and the development of flow rating curves for all stations taking into account the possible accuracy issues presented by tidal influences in the rivers.

It's considered likely that the main water supply to the bog is from a combination of precipitation (normally the largest contributor in wetlands of this type) and groundwater springs. Historical rainfall data from a local weather station has indicated that there is an overall declining trend in precipitation amounts in the area, however, without specific evapotranspiration data, only a cursory assessment can be made. An unnamed stream to the south of the eastern reedbed is likely to contribute to the overall water input in this area of the bog, however across the majority of the bog, surface waters will affect hydraulic function rather than make up a substantial amount of the water input. The St Johns River floods on occasion and backs up regularly due to the effects of tide. As water backs up in the river, seepage from the bog is inhibited, allowing water levels in the wetland to remain relatively stable.

In light of a number of unknowns site specific characteristics regarding Kilbarry Bog's hydrological function, an assessment of such cannot be made. Maintenance of a stable water level is considered crucial to the ecology of the wetland. However, the monitoring of the bog's hydrology has remained outside the scope of the ecological monitoring to date. Instead, direct impacts that would result from changes in the hydrology are continually assessed through annual vegetation monitoring. To date, there has been no significant changes in the bog's vegetation, therefore it's considered unlikely that there has been any significant changes to the bog hydrological function.

5.2 Water Quality and Fisheries Assessment

Field measurements of EC remained within historical ranges for all water courses surveyed in 2015. However, the majority of surface water pH and temperature measurements recorded in 2015 were lower than results of previous monitoring rounds. Dissolved oxygen has remained relatively stable across all sampling location monitored in 2015, with three (S1, L1 and C1) of six within the DO thresholds outlined in Surface Water Regulations S.I. No. 272 of 2009.

Water quality in within the St Johns River both upstream and downstream of the landfill remains moderately polluted (EPA Q-value of Q3 since 2009). Upstream scores at S1 would suggest that pollution pressures within the river catchment are contributing to the poor status of the river. Likewise, upstream scores on the Couse River indicated similar water quality conditions with a Q-value of Q3. Land-use upstream of Kilbarry Bog and landfill is predominately agricultural; therefore farming activities may be having an impact on water quality. The highest ASPT score between the St Johns River and Couse River in 2015 was at S1 (upstream on St Johns River) with a value of 4.4. Dissolved oxygen levels on the St Johns River and Couse River generally average above 80%.

The Lisduggan Stream and drainage ditch remain seriously polluted in 2015, as in previous assessments. However, water quality of the Lisduggan Stream has improved slightly and increased by half of one Q-value across two sampling locations. Water quality of the drainage ditch has also made a modest improvement of half of one Q-value and marks to first increase in water quality since 2012.

The ASPT scoring at L1 has increased to above that of L2 in 2014, indicating that water quality improved at the upstream location (L1) following a noticeable decline, a possible results of a contamination incident several meters upstream, in temporal trend data. This ASPT score remains higher at L1 than at L2 in 2015.

The EPA has conducted water sampling on the Lisduggan Stream and associated drainage ditch adjacent to the landfill. Analytical results indicate that certain parametric values exceed the relevant legislative screening thresholds. This would suggest that groundwater from beneath the landfill may

contribute to the poor water quality of these streams directly adjacent to and downstream of the site boundary. However, seriously polluted water upstream of the landfill (L1) would suggest that the main source(s) originate upgradient of the site.

One of the overall objectives in of the EU Water Framework Directive (2000/60/EC) is to have all water bodies achieve a 'good' status by 2015. In 2010, the Suir Estuary Water Management Plan (WMP) classified the sub basin in which the Lisduggan Stream flows (Kilbarry, Tributary of Suir IE_SE_16_3817) as being of 'moderate' ecological status (based on reporting between 2007 and 2009). According to the EPA's¹⁸ online mapping tool (EPA Map Viewer) the Lisduggan Stream has deteriorated further between 2010 and 2012 to a 'bad' status. The Suir Estuary WMP's target for this sub basin is to achieve a 'good' ecological status by 2021. It is understood that remediation of the stream is now underway by WCCC and catchment pressures along the Lisduggan Stream have been identified.

According to the fisheries assessment in 2008, salmonid stocks in the St Johns River are considered of poor status. No salmon were identified within the study area, suggesting that the water quality of the river has possibly impacted the fish populations at Kilbarry. A review of the OSI historical 6" map from 1829-1841 and 25" map from 1897-1913 indicates that the St Johns River originally traversed the bog as a long straight section of water. The course of the river (toward the northern end of Kilbarry bog) was altered to facilitate the construction of the Waterford and Tramore Railway line (now dismantled). Such changes may have contributed the river becoming more channelized and thus affecting the natural habitat conducive to salmonid species. Heavy siltation of the river bed will also decrease the potential for nursery development along section of the river and available habitat for macroinvertebrates. Changes to the rivers morphology over time together with pollution affects from upstream are impacting the fishery stocks of the St Johns River within the pNHA boundary.

The Lisduggan Stream appears to be devoid of salmonid species (according to fisheries assessment in 2008). Pollution originating from source(s) upstream of the landfill are likely to be the main contributor of negatives impacts on fish stocks in these waters. As only minor improvements have taken place at monitoring location L2 and L6 in past years and more recently (2014), it's considered likely that pollution effects continue to occur in 2014. It's important to note that macroinvertebrate numbers at L6 (adjacent to AIB and IDA Business Park) have increased in 2014, suggesting that pollution originating upstream of this location may have stopped.

Where pollution from point or diffuse sources have been identified and addressed within the catchments of the St Johns River and Lisduggan Stream, additional improvements to address the quality of the physical habitat will need to be implemented to restore the overall quality these habitats as fisheries.

5.3 Otters

Otter activities have remained consistent along the St Johns River since monitoring began in 2003. Results from the otter survey in 2015 indicate that the mammal is returning to a location beneath Sheep's Bridge upstream of the landfill with consistent evidence being recorded each year since 2009. Similarly, a sprainting site identified on the Couse River upstream of the bog has shown intermittent use by the otter since 2011. As otters are can travel large distance within their home territories (up to 20 km) and evidence of the mammal along the St. Johns River and Couse River would suggest their presence on the entire length the water course.

Signs of otter activity continue to occur beneath the bridge upstream of water monitoring location L2 on the Lisduggan Stream in 2015. Signs in 2012 of activity at this location were the first to be discovered since spraint was found at the upstream Bleach Bridge location in 2003. These signs are positive indications that the habitat may have improving, however given the poor water quality of the Lisduggan Stream it's considered likely that the water course is used as a commuting route between foraging grounds

5.4 Bird Survey

There were no sightings of kingfishers within the area of Kilbarry Bog in 2015. Water courses of the St Johns River, Lisduggan Stream and drainage ditch were walked in conjunction with other surveys

¹⁸ www.epa.ie

carried out in April, June, July and October 2015. The last recorded sighting of a kingfisher was in 2003 at a location along the drainage ditch east of Kilbarry Landfill.

Sections of the St. Johns River and Couse River which flow through the pNHA are slow moving and lack the tall vertical banks consisting of soft sediment typically used by the kingfisher as a nesting site. Furthermore, poor water quality within these water courses is less likely to attract or support a resident bird population. As water quality and physical structures of the rivers that flow through the pNHA have not changed significantly since 2009, the site has not improved as potential habitat the kingfisher.

In 2012, a bird survey was completed to assess the current population status of the reed warbler at Kilbarry Bog. The bird breeds on the site during the summer months. The Birds of Conservation Concern in Ireland has placed the reed warbler on its amber list (medium conservational concern) indicating that the species is rare in Ireland with less than 100 breeding pairs. Five pairs were recorded in 1999 (NPWS Site Synopsis Sheet), with only one bird recorded in 2012. This bird was identified in the North West corner of the western reedbed, a similar location to an earlier observation made in 2011. The warblers call was noted during the vegetation survey at Q3 in July 2015. Populations that reside at Kilbarry Bog during the summer months may be influenced by others factors outside the pNHA (i.e. changes to African wintering grounds).

A total of 34 other bird species were also recorded at the bog in 2012. Of these species, 15 were identified to be breeding, with a further 10 considered likely to be breeding at the site. Of the 34 species identified in 2012, nine species (~26%) are listed on the 'Amber List' of Birds of Conservation Concern in Ireland; these are the swift *Apus apus*, barn swallow *Hirundo rustica*, spotted flycatcher *Muscicapa striata*, starling *Sturnus vulgaris*, house sparrow *Hirundo rustica*, greenfinch *Carduelis chloris*, sparrowhawk *Accipiter nisus*, robin *Erithacus rubecula* and Goldcrest *Regulus regulus*. In 1999, a bird survey¹⁹ at Kilbarry Bog recorded 48 different bird species. Of the 48 species, eight species recorded were on the 'Amber List', while two birds (lapwing *Vanellus vanellus* and twite *Carduelis flavirostris*) were 'Red List'. The kingfisher was not recorded during this survey; however the reed warbler was noted.

It's considered likely that an unknown number of birds were displaced by the fire in the eastern reedbed of Kilbarry Bog in April 2015. However, given that it occurred early in the breeding season and the fact that a large portion of the bog's reedbed remained untouched by the fire, the vast majority of these birds would have survived and likely bred successfully in other parts of the habitat in 2015.

5.5 Invasive Species and Threats

Japanese knotweed and Himalayan balsam are listed under Schedule 3, Part 1 - Plants of the EU Birds and Natural Habitats Regulation 2011 (S.I. 477 of 2011). The regulations state that plants listed in Part 1 of Schedule 3 are prohibited from introduction or dispersal within member states.

Japanese knotweed presents a threat to the integrity of the main conservational interest of Kilbarry Bog; its vegetation. The plant was recorded at a number of locations along the St Johns River Walkway and within the site boundary of the eastern reedbed. With respect to the latter recorded location, if left unchecked, the knotweed may encroach on the natural habitats in this area and displace them. Established growths of Japanese knotweed would also have negative impacts on the natural biodiversity at the bog.

Himalayan balsam was not noted within the pNHA boundary, but was identified along the Lisduggan Stream north of Kilbarry Landfill. The growths in this area have increased in extent since consistent monitoring began in 2009 and may possibly spread to other locations via transport along the water courses. However, the current location of the plants are unlikely to spread to the bog via water way, as the Lisduggan Stream joins the St Johns River downstream of the site.

Aerial photographs from 1995 indicate an area in the western reedbed was infilled with aggregate. This has resulted in the loss of approximately 1 ha of reedbed from the pNHA and allowed the establishment of negative woody species to grow in this area. The infilling may have also impacted on the hydrology of reedbed locally.

¹⁹ O'Meara, M. (1999a) *Report on Bird Ringing at the Kilbarry Bog, Waterford City 1999*. An unpublished Report.

At the boundary of the eastern reedbed and Avoca Drive housing estate, building waste material and grass/hedge cuttings have been dumped. If the boundary of the pNHA is not protected, illegal dumping will more than likely continue.

There were no faunal threats to Kilbarry Bog identified in 2015.

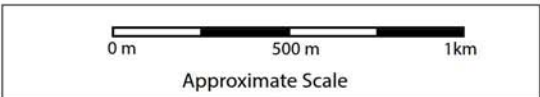
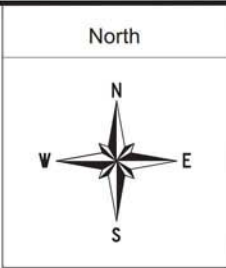
6. RECOMMENDATIONS

6.1 Recommended Way Forward

Based on the current status of the site and results obtained between 2009 and 2015, AECOM recommends the following:

- Continue habitat assessment in the form of quadrat survey in 2016, with a view to reducing the frequency of monitoring to biennially, provided there are no changes to vegetation composition. Monitoring of this kind will act as an indirect indicator of the bogs temporal hydrological function.
- Kick sampling on the Lisduggan Stream, St Johns River and drainage ditch should continue in 2016.
- An assessment of otters within the environs of the bog should continue in 2016.
- Dumping of domestic rubbish and hedge clippings in Avoca Drive Estate adjacent the eastern reedbed has continued as in previous years. Japanese knotweed at this location may have been spread through this type of activity. It is recommended that WCCC eradicate the Japanese knotweed at the boundary through spraying with herbicide and erect a fence to prevent further fly-tipping at this location.
- All invasive species identified within the boundary of the pNHA should be eradicated at the next available opportunity to prevent the continual spreading of these environmental pests and conserve the integrity of the bog's vegetation.
- Based on the most recent WFD reporting in 2012 (EPA website), the Lisduggan Stream has been classified as having 'bad' status. The stream forms part of the water body Kilbarry, Tributary of Suir (IE_SE_16_3817) which has been assigned as at risk '1A' of not meeting achieving 'good' status by 2015. The overall objective for the waterbody is to restore by 2021.
- The stream's ecology has improved slightly since 2014, however, its recommended that further measure are undertaken by WCCC in order to improve the streams status to 'good' by 2021 and meet the overall objectives of the WFD.

FIGURES



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 ECOLOGICAL MONITORING 2015**

PROJECT LOCATION
KILBARRICK BOG, CO. WATERFORD

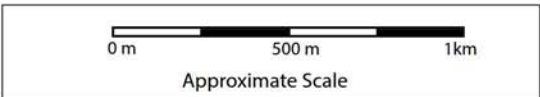
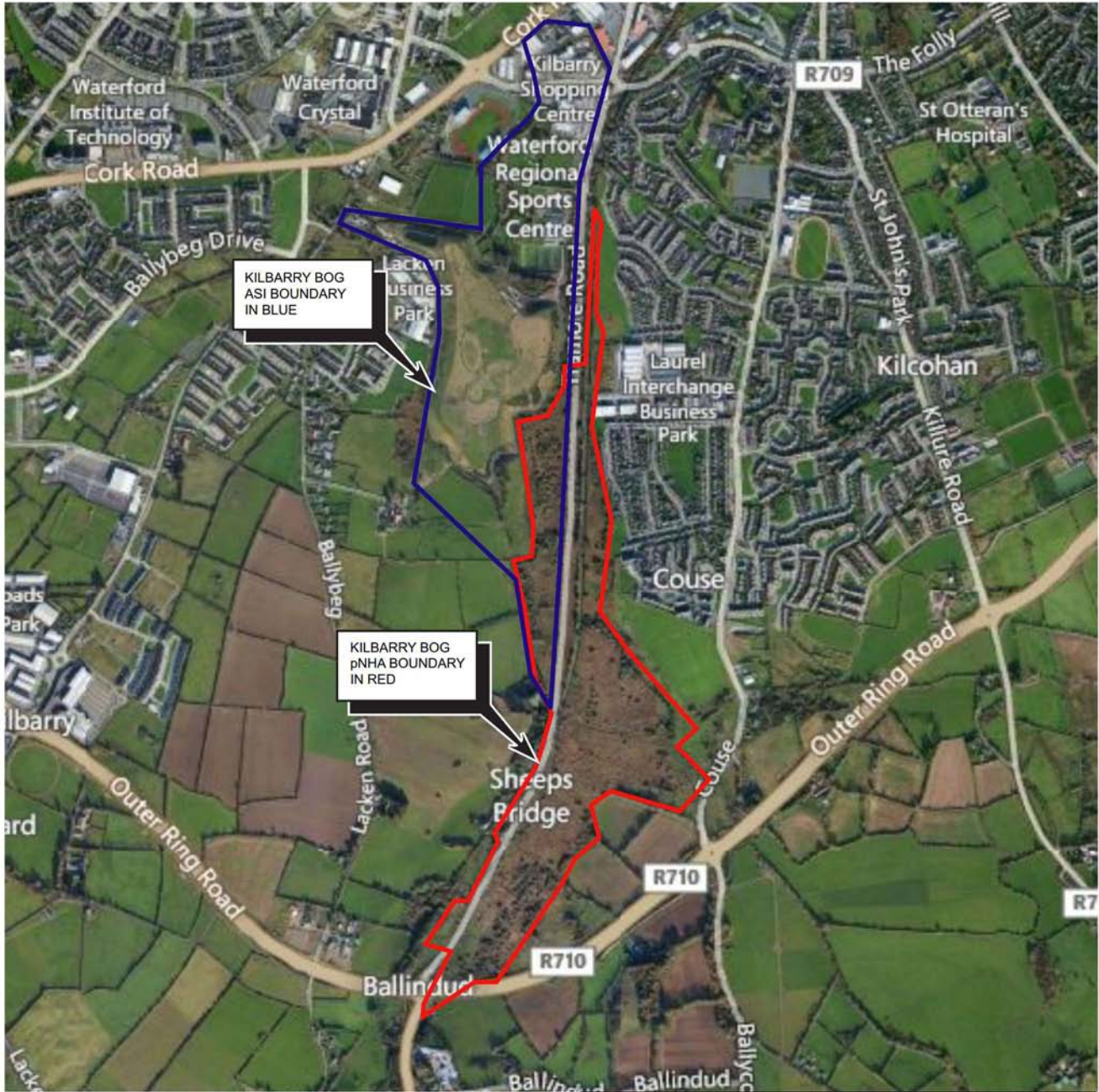
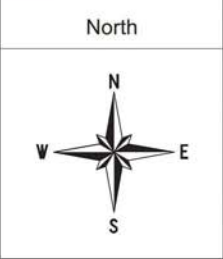
DRAWING TITLE
**FIGURE 1 - SITE LOCATION MAP
 AND BOUNDARY OUTLINE**


ENVIRONMENTAL CONSULTANTS



Douglas Business Campus, Carrigaline Road, Douglas, Cork
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DRAWN DH	TRACED	CHECKED PL	APPROVED PL/BEL	DATE JAN 2016
SCALE AS SHOWN	Job No. 47093008			A



 **esri** Ordnance Survey, Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors and the GIS User Community

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DRAWING TITLE
**FIGURE 2 - KILBARRICK BOG HISTORICAL ASI AND
CURRENT pNHA OUTLINE BOUNDARIES**

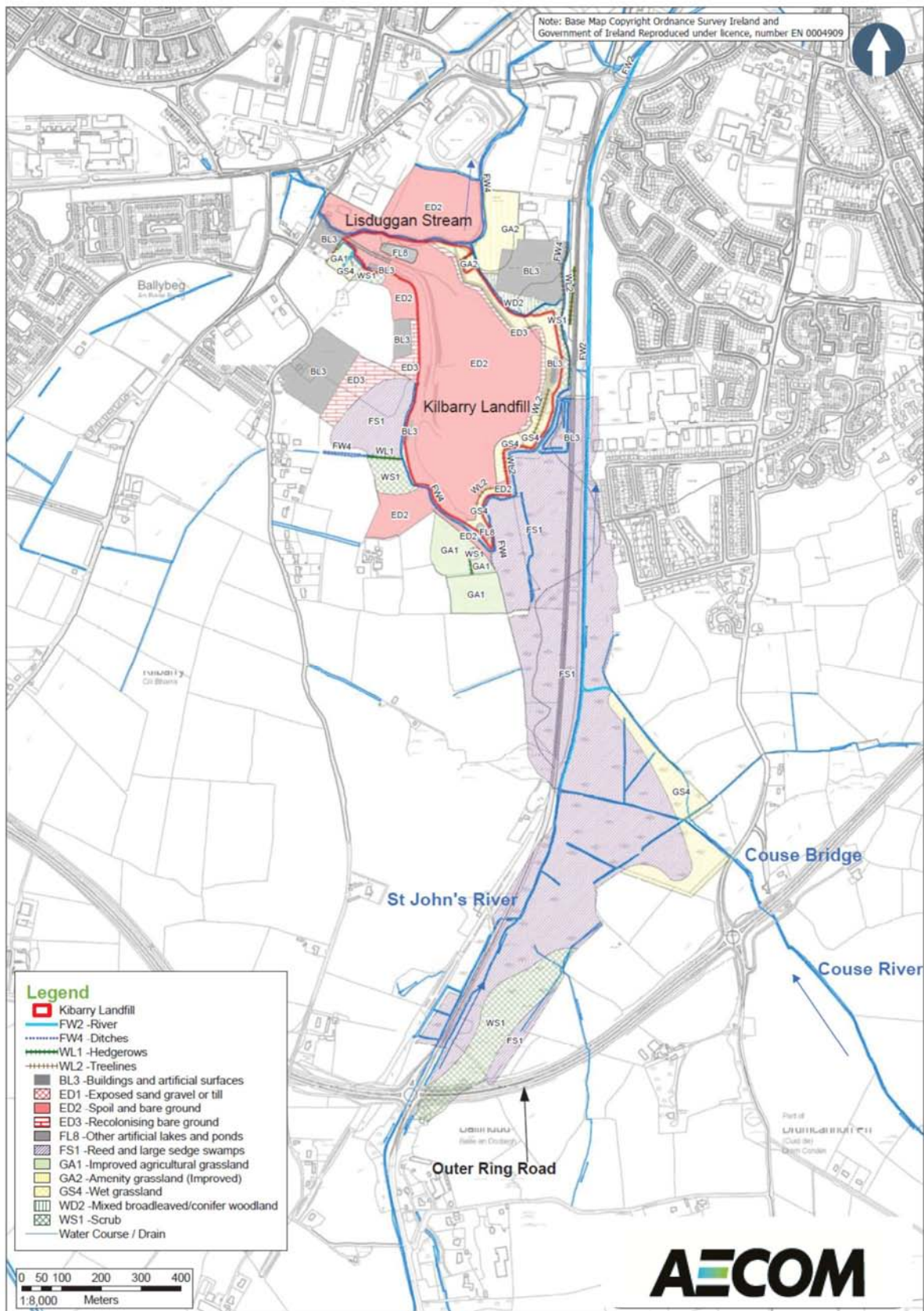
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DRAWN DH	TRACED	CHECKED PL	APPROVED PL/BEL	DATE JAN 2016
SCALE AS SHOWN	Job No. 47093008			A

Waterford City Council – Ecological Monitoring 2015
Figure 3: Habitat Map (WYG Environmental & Planning (Ireland) Ltd.)



Source: Waterford City Council. Annual Ecological Monitoring 2010 of Kilbarry Bog pNHA, Waterford. (WYG Environmental & Planning (Ireland) Limited)




 Ordnance Survey, Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors and the GIS User Community

CLIENT WATERFORD CITY & COUNTY COUNCIL ECOLOGICAL MONITORING 2015
PROJECT - LOCATION KILBARRICK BOG, CO. WATERFORD
DRAWING TITLE FIGURE 4 - QUADRAT LOCATION MAP

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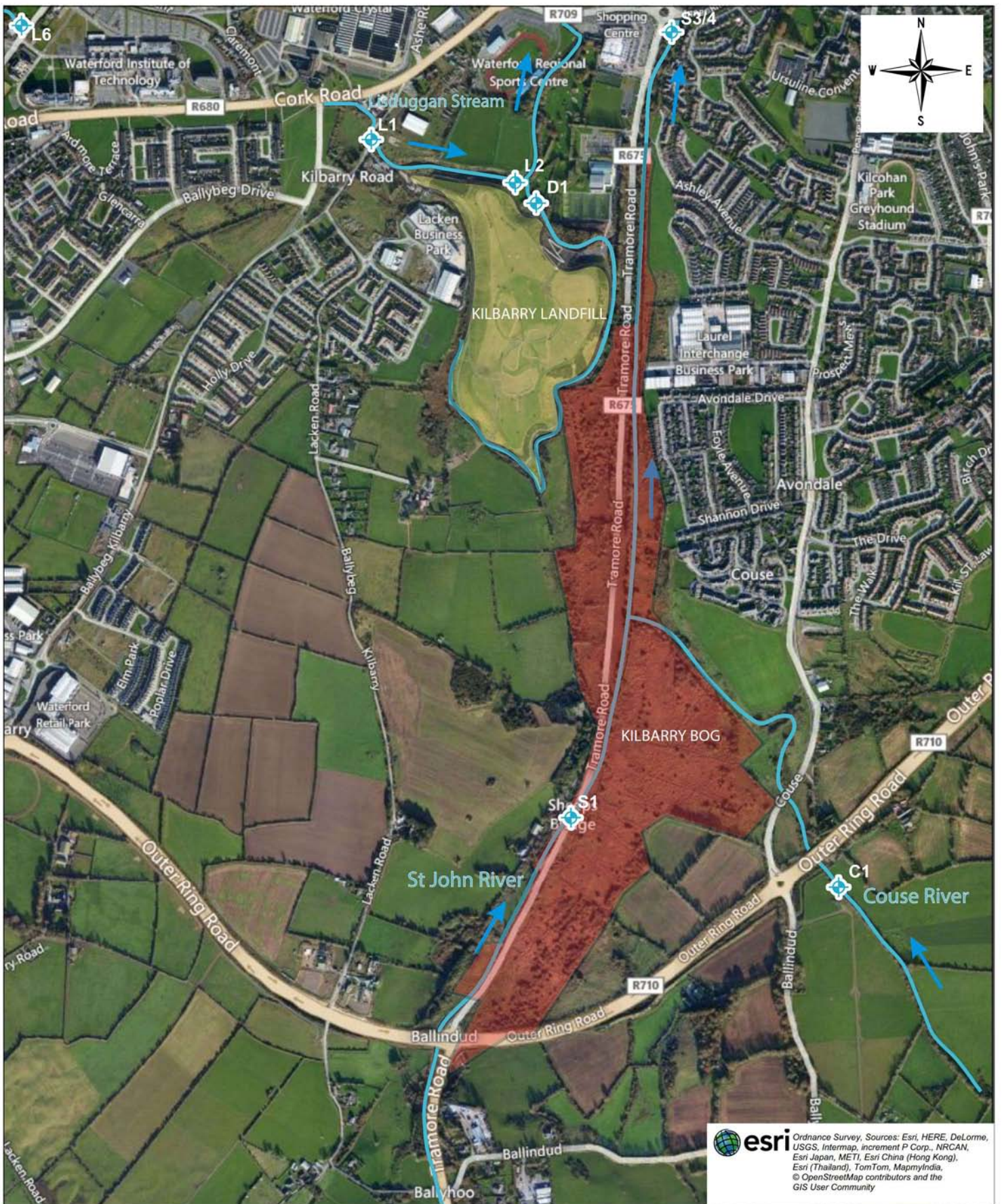
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DRAWN DH	TRACED	CHECKED PL	APPROVED PL/BEL	DATE JAN 2016
SCALE AS SHOWN	Job No.	47093008		REV A

NOTES

Key

-  QUADRAT LOCATION
-  EXTENT WESTERN REEDBED
-  EXTENT OF EASTERN REEDBED
-  EXTENT OF KILBARRICK LANDFILL




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 FIGURE 5 - KICK SAMPLING
 LOCATIONS MAP





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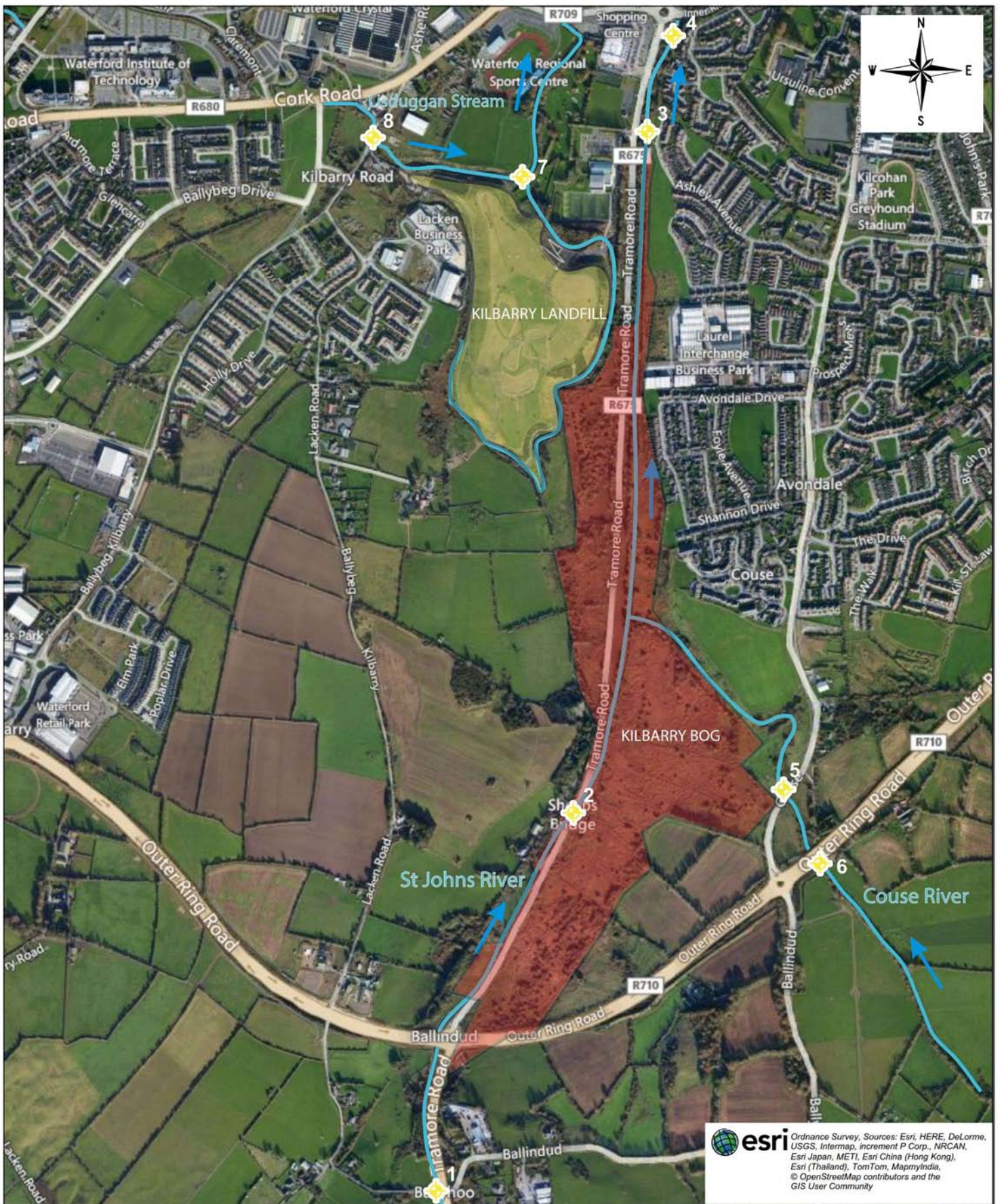



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DH		PL	PL/BEL	JAN 2016
SCALE AS SHOWN		Job No.	47093008	REV A

NOTES

- Key**
-  KICK SAMPLE LOCATION
 -  EXTENT OF KILBARRY BOG
 -  EXTENT OF KILBARRY LANDFILL
 -  DIRECTION OF WATER COURSE FLOW




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PROJECT - LOCATION KILBARRY BOG, CO. WATERFORD
DRAWING TITLE FIGURE 6 - BRIDGE SURVEY LOCATION MAP

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SCALE AS SHOWN	47093008		REV A	

NOTES	
Key 	BRIDGE SURVEY LOCATIONS
	EXTENT OF KILBARRY BOG
	EXTENT OF KILBARRY LANDFILL
	DIRECTION OF WATER COURSE FLOW




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PROJECT - LOCATION
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DRAWING TITLE
 FIGURE 7 - INVASIVE SPECIES
 AND THREATS MAP

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DH		PL	PL/BEL	JAN 2016
SCALE AS SHOWN	Job No.	47093008		REV A

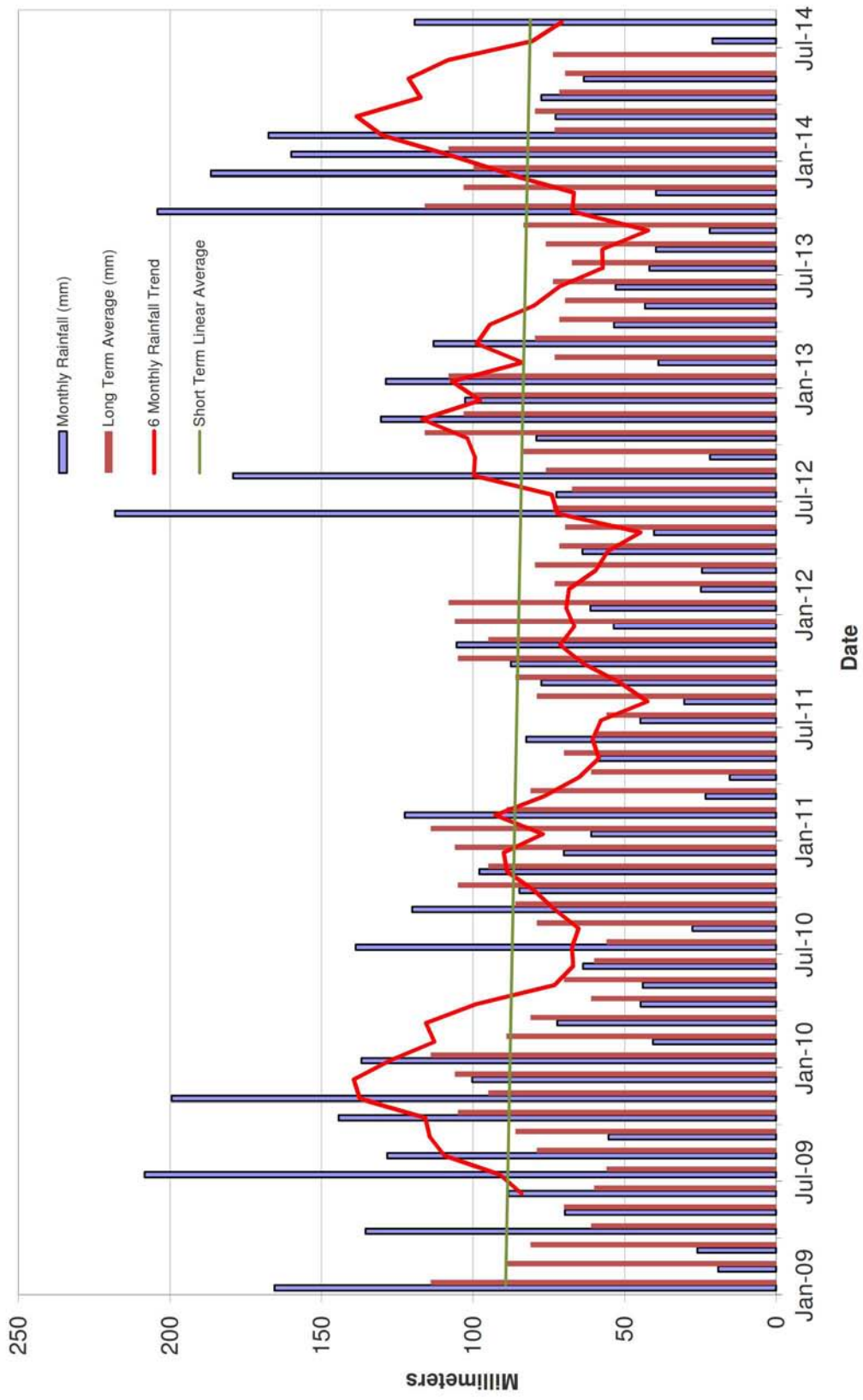
NOTES

Key

	FLORAL THREATS
	WASTE/DUMPING SITES
	EXTENT OF KILBARRY BOG
	EXTENT OF KILBARRY LANDFILL

FIGURE 8 - Historical Rainfall Data

Total Monthly Rainfall Recorded at Waterford (Tycor) vs. time



TABLES

Common Name	Scientific Name
Angelica	<i>Angelica sylvestris</i>
Bindweed	<i>Convolvulus arvensis</i>
Bittersweet	<i>Solanum dulcamara</i>
Common Bistort	<i>Persicaria bistorta</i>
Common Duckweed	<i>Lemna spp.</i>
Common Reed	<i>Phragmites australis</i>
Common Valerian	<i>Valeriana officinalis</i>
Creeping Bent	<i>Agrosits Stolonifera</i>
Erect Bur-reed	<i>Sparagnumium erectum</i>
Fool's-water-cress	<i>Apium nodiflorum</i>
Greater pond sedge	<i>Carex riparia</i>
Greater Tussock-sedge	<i>Carex paniculata</i>
Gypsywort	<i>Lycopus europaeus</i>
Marsh-bedstraw	<i>Galium palustre</i>
Meadowsweet	<i>Filipendula ulmaria</i>
Nettle	<i>Urtica dioica</i>
Purple-loosestrife	<i>Lythrum salicaria</i>
Red Fescue	<i>Festuca rubra</i>
Reed Canary-grass	<i>Phalaris arundinacea</i>
Water horsetail	<i>Equisetum fluviatile</i>
Water Mint	<i>Mentha aquatica</i>
Willowherb	<i>Epilobium sp.</i>
Rosebay Willowherb	<i>Chamerion angustifolium</i>
Yellow Iris	<i>Iris pseudoacorus</i>

Note: No new species identified in 2015

Quadrat Code		ING Easting	ING Northings	Dominant Species	DOMIN Value						Number of Plant Species in Quadrat							
		(m)	(m)	2014 - 2015	2009	2010	2011	2012	2013	2014	2015	2009	2010	2011	2012	2013	2014	2015
Q1	Kilbarry Bog's western reedbed	S 60053	09697	Common Reed	10	10	8	8	8	8	8	4	5	4	4	4	4	6
Q2		S 60028	09913	Common Reed	5	7	7	7	9	8	8	4	5	5	5	5	6	5
Q3		S 60061	09970	Common Reed	10	10	10	10	10	10	9	2	3	2	2	3	4	4
Q4		S 60067	09789	Common Reed	10	10	10	10	9	8	8	4	3	4	5	6	7	7
Q5		S 60046	09550	Common Reed	10	10	10	10	9	8	8	4	3	4	6	7	8	7
Q6	Kilbarry Bog's eastern reedbed	S 60113	08692	Common Reed	9	9	8	8	8	8	8	4	6	5	4	5	4	4*
Q7-A		S 60162	09667	Common Reed	n/a	9	9	9	9	8	8	nr	7	7	8	9	10	7
Q8		S 59896	08591	Common Reed	7	9	10	10	9	9	9	5	4	4	4	6	6	6*
Q9		S 59976	08740	Greater pond sedge	9	9	8	8	8	8	8	4	6	5	6	7	9	8*
Average Number of Plant Species Per Quadrat											3.9	4.7	4.4	4.9	5.8	6.4	6.0	

Note:

* - Approximately 16 hectares of Kilbarry Bog's eastern reedbed was destroyed by a fire in April 2015 - plant numbers likely to be lower than expected.

Location Reference		ING Easting	ING Northings	Habitat Type	Substrate composition	Filamentous Algae	Sewage Fungus	Submerged vegetation	Water shading	Water depth	Observations
		(m)	(m)					%	%	(cm)	
St. John's River	S1	S 59914	08800	Riffle	Gravel and cobbles	No	No	30	70 - 80	40 - 60	Clear and colourless water, no odour.
	S3/4	S 60225	10894	Depositing	Mud, gravelly, concrete blocks	Yes	No	20	40 - 50	70	Clear and colourless water, no odour.
Lisduggan Stream	L1	S 59455	10592	Riffle	Gravel, sand	Yes	No	5	50	1 - 10	Clear and colourless water, no odour.
	L2	S 59841	10502	Depositing	Gravel, mud	Yes	No	10	60 - 70	35 - 50	Clear and colourless water, no odour.
	L6	S 58611	10875	Eroding/Riffle	Gravel and cobbles	No	No	NR	NR	NR	NR
Drainage Ditch	D1	S 60047	10351	Depositing	Sandy/silty mud	Yes	No	20	70	50 - 60	Clear and colourless water, no odour. Hydrocarbon sheen generated after walking on sediment.
Couse River	C1	S 606334	08773	Eroding/Riffle	Gravel and cobbles	No	No	10	70 - 90	30 - 40	Clear and colourless water, no odour.

Note:

Freshwater monitoring completed: 15 October 2015

ING - Irish National Grid co-ordinate

- not surveyed

* Water height can be maintained artificially high with the influence of tide.

NR - Not recorded

Location Reference		Dissolved Oxygen		pH	EC	Temperature	Redox Potential	Observations
		%	mg/L		µS/cm @ 25 °C	°C	Eh (mV)	
St. John's River	S1	90	10.7	6.73	411	8.0	268	Clear and colourless water, no odour.
	S3/4	66	7.7	6.85	521	8.4	255	Clear and colourless water, no odour.
Lisduggan Stream	L1	82	8.9	6.78	497	11.5	226	Clear and colourless water, no odour.
	L2	54	6.2	6.91	429	9.7	229	Clear and colourless water, no odour.
	L6	nr	nr	nr	nr	nr	nr	nr
Drainage Ditch	D1	50	5.7	7	438	9.7	200	Clear and colourless water, no odour. Hydrocarbon sheen generated after walking on sediment.
Couse River	C1	94	11.2	6.54	488	8.1	288	Clear and colourless water, no odour.

Note:

Freshwater monitoring completed: 15 October 2015

ING - Irish National Grid co-ordinate

nr: not recorded

mg/L - Milligrams per litre

EC: Electrical Conductivity

µS/cm - Microsiemens per centimetre

°C - Degrees Celsius

mV - Millivolts

244

Location Reference	EPA Indicator Group	BMWP Score	St. John's River		Lisduggan Stream		Drainage Ditch	Couse River
			S1	S3/4	L1	L2	D1	C1
Sampling Date			15-Oct-15	15-Oct-15	15-Oct-15	15-Oct-15	15-Oct-15	15-Oct-15
Mayflies (Ephemeroptera)								
<i>Heptageniidae</i>	A	10	2					
<i>Ephemeridae</i>	A	10						
<i>Siphonuridae</i>	A	10						
<i>Leptophlebiidae</i>	B	10						
<i>Ephemerellidae</i>	C	10						
<i>Caenidae</i>	C	7						
<i>Baetidae</i>	B	4						27
<i>Baetis Rhodani</i> **	C	4			4			
Stoneflies (Plecoptera)								
<i>Perlidae</i>	A	10						
<i>Perlodidae</i>	A	10						
<i>Nemouridae</i>	A	7						
<i>Leuctridae</i>	B	10						
Caddis flies (Trichoptera)								
Cased								
<i>Sericostomatidae</i>	B	10	6					2
<i>Goeridae</i>	B	10						
<i>Limnephilidae</i>	B	7		1				
<i>Glossosomatidae</i>	B							
<i>Lepidostomatidae</i>	B	10						
Caseless								
<i>Hydropsychidae</i>	C	5						19
<i>Philopotamidae</i>	C							
<i>Polycentropodidae</i>	C	7						
<i>Rhyacophilidae</i>	C	7						2
Beetles (Coleoptera)								
<i>Elmidae</i>	C	5	40					12
<i>Dytiscidae</i>	C	5				2	2	
Flatworms (Platyhelminthes)								
<i>Planariidae</i>	C	5	1	15		2	3	17
<i>Crenobia alpina</i>	C	5						
<i>Dendrocoelidae</i>	C	5						
Crustaceans (Crustacea)								
<i>Gammaridae</i>	C	6	64	62	3			332
<i>Asellidae</i>	D	3	8	40	20	3	8	14
True flies (Diptera)								
<i>Simuliidae</i>	C	5			1	1		1
<i>Pediciidae</i>			1					1
<i>Tipulidae</i>	C	5			1			
<i>Chironomidae</i>	C	2			3	24		10
<i>Chironomus spp.</i> **	E	2		2	3	7	10	
<i>Syrphidae</i>	E							
Mites (Hydracarina)								
<i>Hydracarina</i>	C				3	1		
Snails & Limpets (Gastropoda)								
<i>Ancylidae</i>	C	6	4	6	10			
<i>Hydrobiidae</i>	C	3	28	240	15			
<i>Bithynia tentaculata</i>	C	3						
<i>Planorbidae</i>	C	3						
<i>Lymnaeidae</i>	C	3		8				1
<i>Lymnaea peregra</i> **	D	3				1		
<i>Physidae</i>	D	3						
Mussels (Bivalvia)								
<i>Sphaeriidae</i>	D	3						
Leeches (Hirudinae)								
<i>Piscicolidae</i>	C	4						
<i>Glossiphoniidae</i>	D	3	4	11	1	7	13	2
<i>Erpobdellidae</i>	D	3		2	9		3	
Worms (Oligochaeta)								
<i>Tubificidae</i>	E	1	9	3	8		10	4
<i>Lumbriculus</i>		1	1		1	1		5
Stickleback (Gasterosteidae)								
<i>Gasterosteus aculeatus</i>						7		
Number of individuals			168	390	82	56	49	449
Number of types of taxa			12	11	14	11	7	15
Q-value			Q3	Q3	Q2-3	Q2-3	Q1-2	Q3
BMWP			53	42	44	29	22	60
ASPT			4.42	3.82	3.14	2.64	3.14	4.00
Shannon Diversity Index			0.76	0.57	0.97	0.79	0.77	0.50

Note:

BMWP = Biological Monitoring Working Party Score

ASPT = Average Score Per Taxa

Q-value with suffix '0' indicates toxic effect from hydrocarbon contamination

* indicates evidence of contamination

**Species level of identification

Table 9: Kilbarry Bog Ecological Monitoring -
Otter Monitoring Results and Trends

Location Reference		ID*	ING Easting	ING Northings	Oct-2003	Sep-2004	Jul-2008	Sep-2009	Sep-2010	Apr-2011	Apr-2012	May-2013	May-2014	Apr-2015
			(m)	(m)										
St. John's River	Tramore Road	1	S 59669	07993	Otter spraint	-	-	-	-	-	-	-	-	Otter spraint
	Sheep's Bridge	2	S 59911	08786	Otter spraint & mink scats	Otter spraint	-	Otter spraint	Otter spraint	Otter spraint	Otter spraint	Otter spraint	Otter spraint	Otter spraint
	Foot Bridge at leisure Centre	3	S 60143	10614	nr	nr	-	Otter spraint	Otter spraint	-	-	-	-	-
	SuperValu Bridge (Tramore Road Roundabout)	4	S 60232	10902	nr	nr	nr	-	-	-	-	-	-	-
Couse River	Couse Bridge	5	S 60234	10902	Otter smear	Otter spraint	-	-	-	-	-	-	-	-
	Waterford Outer Ring Road culvert	6	S 60619	08795	nr	nr	nr	nr	nr	Otter spraint	Otter spraint	Otter spraint	-	Otter spraint
Lisduggan Stream	Drainage Ditch	7	S 59830	10505	nr	nr	nr	Mink scats	-	-	Otter spraint	Otter spraint	Otter spraint	Otter spraint
	Bleach Bridge	8	S 59458	10587	Otter spraint	-	-	-	-	Mink footprints	-	Mink footprints	-	-

Note:

ING: Irish National Grid co-ordinate
 -: No evidence of otter activity
 * - see Figure 6 for location
 nr: not recorded

Table 10: Kilbarry Bog Ecological Monitoring -
 Invasive Species and Threats to Kilbarry Bog

Location	ING Easting (m)	ING Northings (m)	Type	Threat Description
St John River river-walkway	S 60125	09722	Floral	Japanese knotweed
	S 60125	09832	Floral	Japanese knotweed
	S 60126	09867	Floral	Japanese knotweed
	S 60134	10087	Floral	Japanese knotweed
	S 60121	10217	Floral	Japanese knotweed
At boundary of eastern reedbed and Avoca Drive housing estate	S 60120	09682	Floral	Japanese knotweed
Confluence of Lisduggan Stream and Landfill drainage ditch	S 59782	10557	Floral	Himalayan Balsam
At boundary of eastern reedbed and Avoca Drive housing estate	S 60120	09682	Waste	Builders Waste Material
At bridge on small road joining R675 Tramore Road	S 59593	08041	Waste	Domestic refuse
In western reedbed adjacent to quadrat location Q4	S 60034	09775	Waste	Hunters hide (timber sheeting)
In western reedbed North of quadrat location Q5	S 59973	09682	Waste	In-filling (gravel hardcore)

APPENDIX A – KILBARRY BOG SITE SYNOPSIS SHEET (NPWS)

SITE SYNOPSIS

SITE NAME: KILBARRY BOG

SITE CODE: 001700

Kilbarry Bog is located on the southern outskirts of Waterford City; it lies on either side of the former Great Southern Railway Line parts of which today are used as a foot path and cycle way. The site is drained by the St John's River in the north, whilst there is a flow of water into the site from the hills to the south-east. This wetland is not, in fact, a bog in the true sense, but rather comprises an area of reed swamp, freshwater marsh, wet grassland and scrub. Parts of the site are known as Ballynakill Marsh.

Over the years the wetland has been reduced in extent by municipal rubbish dumping and subsequent reclamation to the north. The present site includes areas of reed swamp that are dominated by Common Reed (*Phragmites australis*) and with an abundance of Greater Pond-sedge (*Carex riparia*) and Lesser Pond-sedge (*C. acutiformis*). Bushes of Eared Willow (*Salix aurita*) and Rusty Willow (*Salix cinerea* subsp. *oleifolia*) are scattered about the site. Other plant species present include Meadowsweet (*Filipendula ulmaria*), Common Valerian (*Valeriana officinalis*) and Tufted Hair-grass (*Deschampsia cespitosa*).

Around the swamp margins the vegetation grades into marsh and then to wet grassland; here, such species as Bottle Sedge (*Carex rostrata*), Brown Sedge (*Carex disticha*), Creeping Bent (*Agrostis stolonifera*), Soft Rush (*Juncus effusus*), Yellow Iris (*Iris pseudacorus*), Tall Fescue (*Festuca arundinacea*) and Royal Fern (*Osmunda regalis*) are found.

Summer Snowflake (*Leucojum aestivum*), a scarce species in Ireland, was first recorded from the site in 1900, and was present here at least as recently as 1979.

The site is used by Otter, a protected species in Ireland and one that is listed on Annex II of the E.U. Habitats Directive.


The site supports a good diversity of bird species associated with swamp vegetation. Those found throughout the year include Mallard, Water Rail, Moorhen, Grey Heron, Snipe, Reed Bunting and Grey Wagtail. In summer the site also supports important populations of migrant species, including Sedge Warbler, Reed Warbler, Willow Warbler, Chiffchaff, Whitethroat and Blackcap. Most, if not all, of these species breed at the site; the breeding population of Reed Warbler is of particular significance. This species was proved to be breeding at the site in 1999 (five pairs), the first breeding record for Co. Waterford. This is a scarce species in Ireland and Kilbarry Bog supports between 5% and 10% of the national breeding population. Other species using the site in late summer/autumn include Swallow, House Martin, Swift, Sand Martin and Starling, while in winter the site is visited by Lapwing, Black-headed Gull, Jack Snipe, Pied Wagtail and additional numbers of Mallard.


Kingfisher, a species that is listed on Annex I of the E.U. Birds Directive, has also been recorded from the site.


A range of interesting and often scarce invertebrate species has been recorded from the site. These include dragonflies, butterflies, moths and spiders.


Kilbarry Bog is a site of conservation importance for a variety of reasons: it is the only remaining wetland of its type of significance in the vicinity of Waterford City, it supports a variety of wetland vegetation types and plant species, it is the site of records for the scarce Summer Snowflake, it supports a good diversity of birds, including an important breeding population of Reed Warbler and a range of scarce invertebrate species has been recorded from the site.


APPENDIX B – VEGETATION MONITORING RECORDING CARDS


General Information			
Site Name	Kilbarry Bog pNHA	Quadrat Code	Q1
Site Location	Waterford City	GPS Co-ordinates	S60053 09697
Surveyor(s)	David Horgan & Fergus O'Regan	Quadrat Size (m)	4 X 4
Survey Date	29 July 2015	Slope	Flat
Client	Waterford City Council	Aspect	N - S
Land management	None	Fossitt Habitat Code	FS1 - Reed and large sedge swamps
Adjacent Landuse	Road, agricultural, landfill	Standing water height (cm)	5
Substrate type	Organic	Stability	Firm
Altitude (m)	5	Geology	Alluvial deposits
Quadrat Vegetation Composition			
Species	Domin Value		
Common Reed (<i>Phragmites australis</i>)	8		
Greater pond sedge (<i>Carex riparia</i>)	6		
Water horsetail (<i>Equisetum fluviatile</i>)	3 (change from 2 in 2014)		
Meadowsweet (<i>Filipendula ulmaria</i>)	1		
Rosebay willowherb (<i>Chamerion angustifolium</i>)	1 (not recorded in 2014)		
Purple-loosestrife (<i>Lythrum salicaria</i>)	1 (not recorded in 2014)		
Total number of species recorded	6		
Quadrat Photograph			
			
Comments			
Quadrat ~20m NNW of Poplar tree Four marker stacks replaced in June 2015			


General Information			
Site Name	Kilbarry Bog pNHA	Quadrat Code	Q2
Site Location	Waterford City	GPS Co-ordinates	S60028 09913
Surveyor(s)	David Horgan & Fergus O'Regan	Quadrat Size (m)	4 X 4
Survey Date	29 July 2015	Slope	Flat
Client	Waterford City Council	Aspect	N - S
Land management	None	Fossitt Habitat Code	FS1 - Reed and large sedge swamps
Adjacent Landuse	Road, agricultural, landfill	Standing water height (cm)	0 (damp)
Substrate type	Organic	Stability	Firm
Altitude (m)	5	Geology	Alluvial deposits
Quadrat Vegetation Composition			
Species		Domin Value	
Common Reed (<i>Phragmites australis</i>)		8	
Greater pond sedge (<i>Carex riparia</i>)		6	
Bindweed (<i>Convolvulus arvensis</i>)		4	
Nettle (<i>Urtica dioica</i>)		3 (change from 2 in 2014)	
Bittersweet (<i>Solanum dulcamara</i>)		1	
Meadowsweet (<i>Filipendula ulmaria</i>)		0 (change from 1 in 2014)	
Total number of species recorded		5	
Quadrat Photograph			
			
Comments			
Four marker stacks replaced in June 2015			


General Information			
Site Name	Kilbarry Bog pNHA	Quadrat Code	Q3
Site Location	Waterford City	GPS Co-ordinates	S60061 09970
Surveyor(s)	David Horgan & Fergus O'Regan	Quadrat Size (m)	4 X 4
Survey Date	29 July 2015	Slope	Flat
Client	Waterford City Council	Aspect	N - S
Land management	None	Fossitt Habitat Code	FS1 - Reed and large sedge swamps
Adjacent Landuse	Road, agricultural, landfill	Standing water height (cm)	0 (damp)
Substrate type	Organic	Stability	Firm
Altitude (m)	5	Geology	Alluvial deposits
Quadrat Vegetation Composition			
Species		Domin Value	
Common Reed (<i>Phragmites australis</i>)		9	
Reed Canary-grass (<i>Phalaris arundinacea</i>)		4	
Greater pond sedge (<i>Carex riparia</i>)		2 (change from 1 in 2014)	
Bindweed (<i>Convolvulus arvensis</i>)		1	
Total number of species recorded		4	
Quadrat Photograph			
			
Comments			
Willow trees within 10m of quadrat Four marker stacks replaced in June 2015			


General Information			
Site Name	Kilbarry Bog pNHA	Quadrat Code	Q4
Site Location	Waterford City	GPS Co-ordinates	S60067 09789
Surveyor(s)	David Horgan & Fergus O'Regan	Quadrat Size (m)	4 X 4
Survey Date	29 July 2015	Slope	Flat
Client	Waterford City Council	Aspect	N - S
Land management	None	Fossitt Habitat Code	FS1 - Reed and large sedge swamps
Adjacent Landuse	Road, agricultural, landfill	Standing water height (cm)	3
Substrate type	Organic	Stability	Firm
Altitude (m)	5	Geology	Alluvial deposits
Quadrat Vegetation Composition			
Species	Domin Value		
Common Reed (<i>Phragmites australis</i>)	8		
Bindweed (<i>Convolvulus arvensis</i>)	5		
Meadowsweet (<i>Filipendula ulmaria</i>)	4		
Creeping Bent (<i>Agrostis Stolonifera</i>)	3		
Nettle (<i>Urtica dioica</i>)	2		
Marsh-bedstraw (<i>Galium palustre</i>)	1		
Common Bistort (<i>Persicaria bistorta</i>)	1		
Total number of species recorded	7		
Quadrat Photograph			
			
Comments			
Willow and poplar trees located within 5m of quadrat Four marker stacks replaced in June 2015			

General Information			
Site Name	Kilbarry Bog pNHA	Quadrat Code	Q5
Site Location	Waterford City	GPS Co-ordinates	S60045 09550
Surveyor(s)	David Horgan & Fergus O'Regan	Quadrat Size (m)	4 X 4
Survey Date	29 July 2015	Slope	Flat
Client	Waterford City Council	Aspect	N - S
Land management	None	Fossitt Habitat Code	FS1 - Reed and large sedge swamps
Adjacent Landuse	Road, agricultural, landfill	Standing water height (cm)	10
Substrate type	Organic	Stability	Firm
Altitude (m)	5	Geology	Alluvial deposits
Quadrat Vegetation Composition			
Species		Domin Value	
Common Reed (<i>Phragmites australis</i>)		8	
Water horsetail <i>Equisetum fluviatile</i>		5	
Greater pond sedge (<i>Carex riparia</i>)		3 (change from 2 in 2014)	
Yellow Iris (<i>Iris pseudoacorus</i>)		2 (change from 3 in 2014)	
Common Duckweed (<i>Lemna spp.</i>)		1 (change from 2 in 2014)	
Fool's-water-cress (<i>Apium nodiflorum</i>)		1	
Willowherb (<i>Epilobium spp.</i>)		1 (not recorded in 2014)	
Gypsywort (<i>Lycopus europaeus</i>)		0 (change from 1 in 2014)	
Nettle (<i>Urtica dioica</i>)		0 (change from 1 in 2014)	
Total number of species recorded		7	
Quadrat Photograph			
			
Comments			
Surface water pool located 5m east of quadrat Four marker stacks replaced in June 2015			

General Information			
Site Name	Kilbarry Bog pNHA	Quadrat Code	Q6
Site Location	Waterford City	GPS Co-ordinates	S60113 08692
Surveyor(s)	David Horgan & Fergus O'Regan	Quadrat Size (m)	4 X 4
Survey Date	29 July 2015	Slope	Flat
Client	Waterford City Council	Aspect	N - S
Land management	None	Fossitt Habitat Code	FS1 - Reed and large sedge swamps
Adjacent Landuse	Road, agricultural	Standing water height (cm)	3
Substrate type	Organic	Stability	Firm
Altitude (m)	5	Geology	Alluvial deposits
Quadrat Vegetation Composition			
Species		Domin Value	
Common Reed (<i>Phragmites australis</i>)		8	
Greater pond sedge (<i>Carex riparia</i>)		7	
Meadowsweet (<i>Filipendula ulmaria</i>)		2	
Reed Canary-grass (<i>Phalaris arundinacea</i>)		2	
Total number of species recorded		4	
Quadrat Photograph			
			
Comments			
<p>This quadrat was destroyed by a fire in April 2015 Four marker stacks replaced in June 2015</p>			

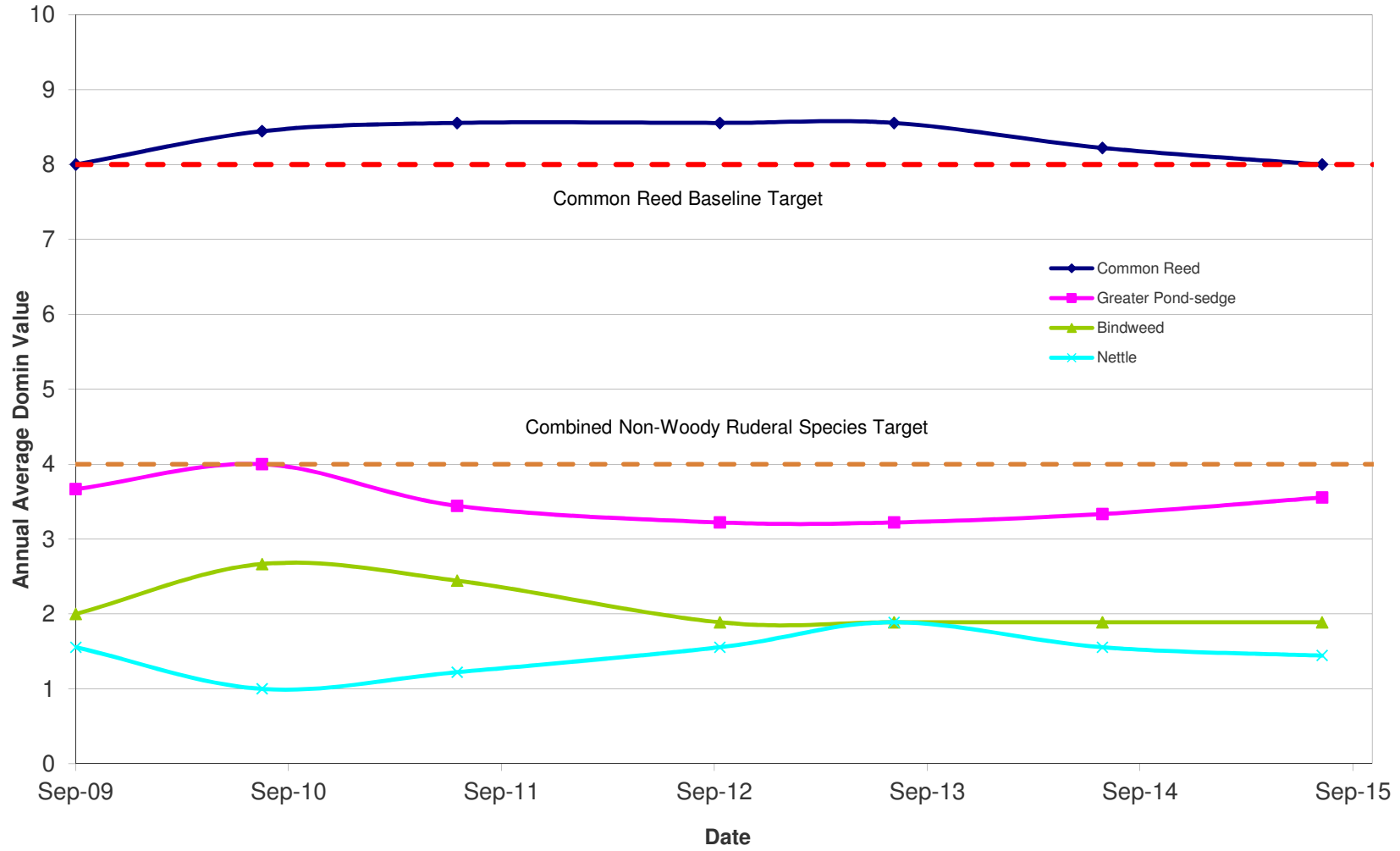
General Information			
Site Name	Kilbarry Bog pNHA	Quadrat Code	Q7
Site Location	Waterford City	GPS Co-ordinates	S60162 09667
Surveyor(s)	David Horgan & Fergus O'Regan	Quadrat Size (m)	4 X 4
Survey Date	29 July 2015	Slope	Flat
Client	Waterford City Council	Aspect	N - S
Land management	None	Fossitt Habitat Code	FS1 - Reed and large sedge swamps
Adjacent Landuse	Road, agricultural, residential	Standing water height (cm)	0 (damp)
Substrate type	Organic	Stability	Firm
Altitude (m)	5	Geology	Alluvial deposits
Quadrat Vegetation Composition			
Species	Domin Value		
Common Reed (<i>Phragmites australis</i>)	8		
Meadowsweet (<i>Filipendula ulmaria</i>)	4 (change from 5 in 2014)		
Willowherb (<i>Epilobium spp.</i>)	5		
Bindweed (<i>Convolvulus arvensis</i>)	4		
Common Valerian (<i>Valeriana officinalis</i>)	1 (change from 2 in 2014)		
Purple-loosestrife (<i>Lythrum salicaria</i>)	1		
Wild Angelica (<i>Angelica sylvestris</i>)	1 (not recorded in 2014)		
Reed Canary-grass (<i>Phalaris arundinacea</i>)	0 (change from 3 in 2014)		
Nettle (<i>Urtica dioica</i>)	0 (change from 1 in 2014)		
Water Mint (<i>Mentha aquatica</i>)	0 (change from 1 in 2014)		
Water horsetail (<i>Equisetum fluviatile</i>)	0 (change from 1 in 2014)		
Total number of species recorded	7		
Quadrat Photograph			
			
Comments			
Four marker stacks replaced in June 2015			

General Information			
Site Name	Kilbarry Bog pNHA	Quadrat Code	Q8
Site Location	Waterford City	GPS Co-ordinates	S59896 08591
Surveyor(s)	David Horgan & Fergus O'Regan	Quadrat Size (m)	4 X 4
Survey Date	29 July 2015	Slope	Flat
Client	Waterford City Council	Aspect	N - S
Land management	None	Fossitt Habitat Code	FS1 - Reed and large sedge swamps
Adjacent Landuse	Road, agricultural	Standing water height (cm)	0 (damp)
Substrate type	Organic	Stability	Firm
Altitude (m)	5	Geology	Alluvial deposits
Quadrat Vegetation Composition			
Species		Domin Value	
Common Reed (<i>Phragmites australis</i>)		9	
Reed Canary-grass (<i>Phalaris arundinacea</i>)		6	
Nettle (<i>Urtica dioica</i>)		3	
Meadowsweet (<i>Filipendula ulmaria</i>)		2	
Common Valerian (<i>Valeriana officinalis</i>)		2 (change from 1 in 2014)	
Willowherb (<i>Epilobium spp.</i>)		1	
Total number of species recorded		6	
Quadrat Photograph			
			
Comments			
This quadrat was destroyed by a fire in April 2015 Four marker stacks replaced in June 2015			

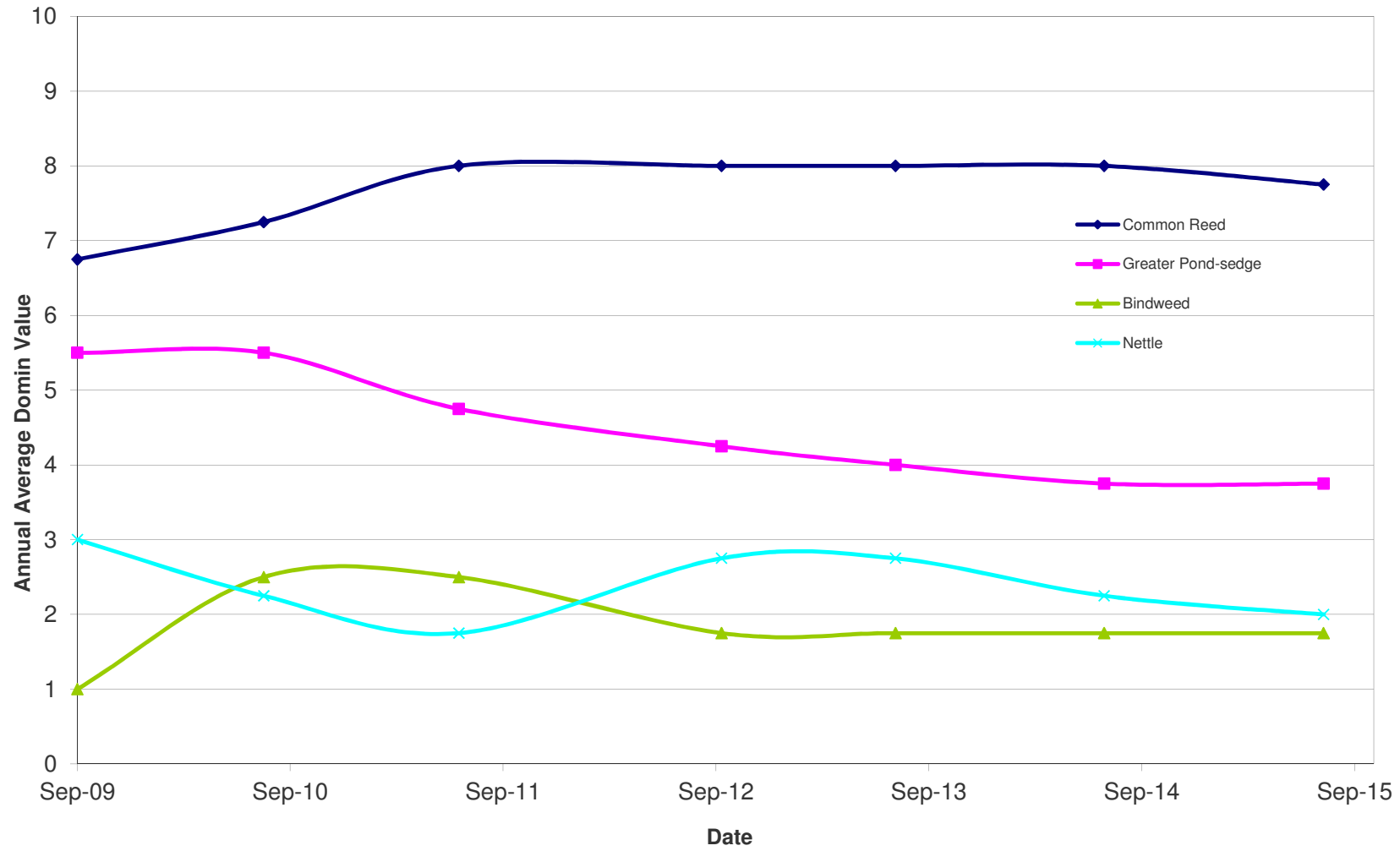
General Information			
Site Name	Kilbarry Bog pNHA	Quadrat Code	Q9
Site Location	Waterford City	GPS Co-ordinates	S59976 08740
Surveyor(s)	David Horgan & Fergus O'Regan	Quadrat Size (m)	4 X 4
Survey Date	29 July 2015	Slope	Flat
Client	Waterford City Council	Aspect	N - S
Land management	None	Fossitt Habitat Code	FS1 - Reed and large sedge swamps
Adjacent Landuse	Road, agricultural	Standing water height (cm)	5
Substrate type	Organic	Stability	Firm
Altitude (m)	5	Geology	Alluvial deposits
Quadrat Vegetation Composition			
Species	Domin Value		
Greater pond sedge (<i>Carex riparia</i>)	8		
Common Reed (<i>Phragmites australis</i>)	7		
Nettle (<i>Urtica dioica</i>)	5		
Bindweed (<i>Convolvulus arvensis</i>)	3		
Reed Canary-grass (<i>Phalaris arundinacea</i>)	2 (change from 4 in 2014)		
Meadowsweet (<i>Filipendula ulmaria</i>)	1		
Common Valerian (<i>Valeriana officinalis</i>)	1		
Gypsywort (<i>Lycopus europaeus</i>)	1		
Marsh-bedstraw (<i>Galium palustre</i>)	0 (change from 1 in 2014)		
Total number of species recorded	8		
Quadrat Photograph			
			
Comments			
This quadrat was destroyed by a fire in April 2015 Four marker stacks replaced in June 2015			

**APPENDIX C – VEGETATION TRENDS GRAPHS FOR ENTIRE BOG,
EASTERN AND WESTERN REEDBEDS**

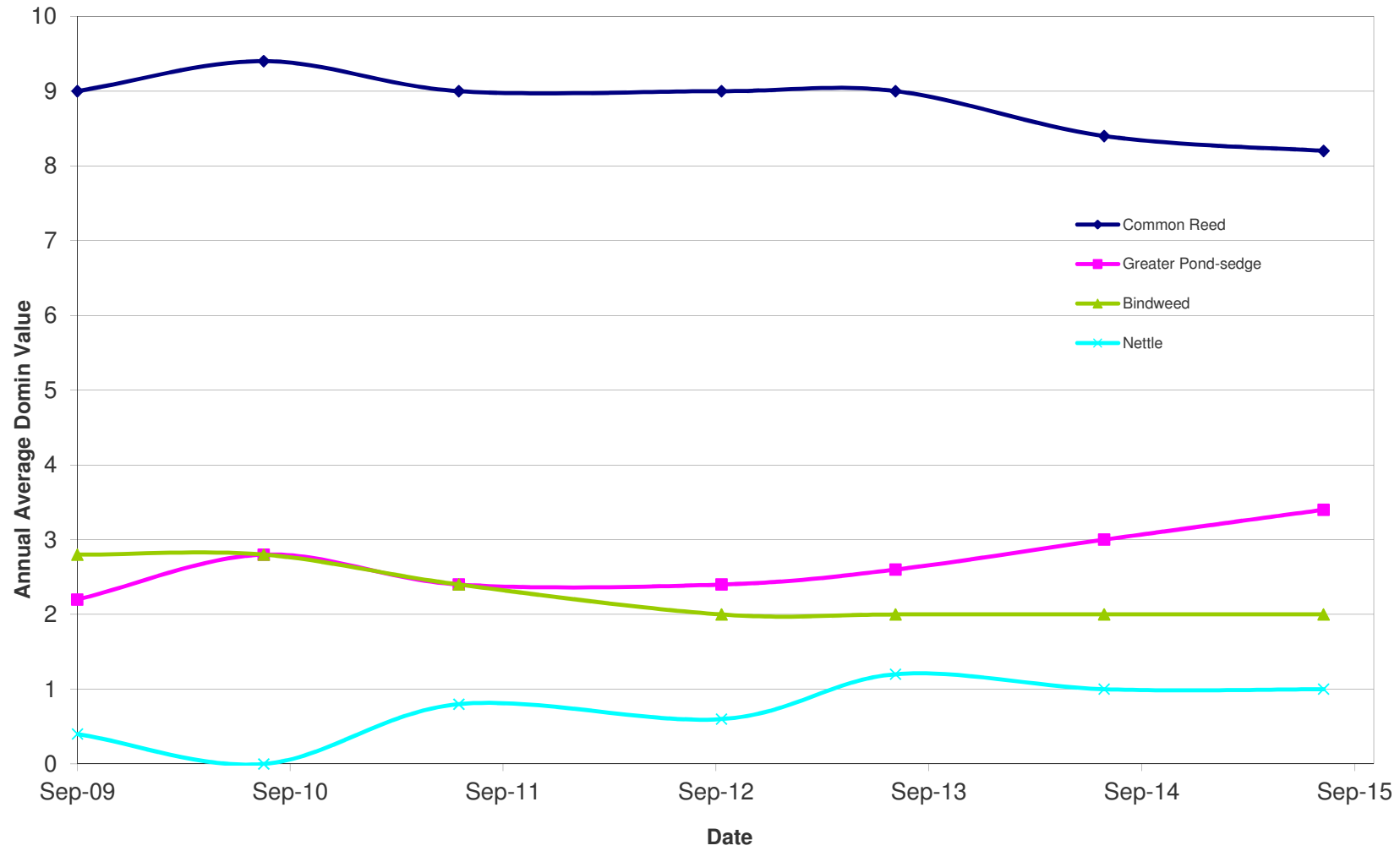
Appendix C1: Vegetative Changes at Kilbarry Bog vs. time



Appendix C2: Vegetative Changes in Eastern Reedbed vs. time

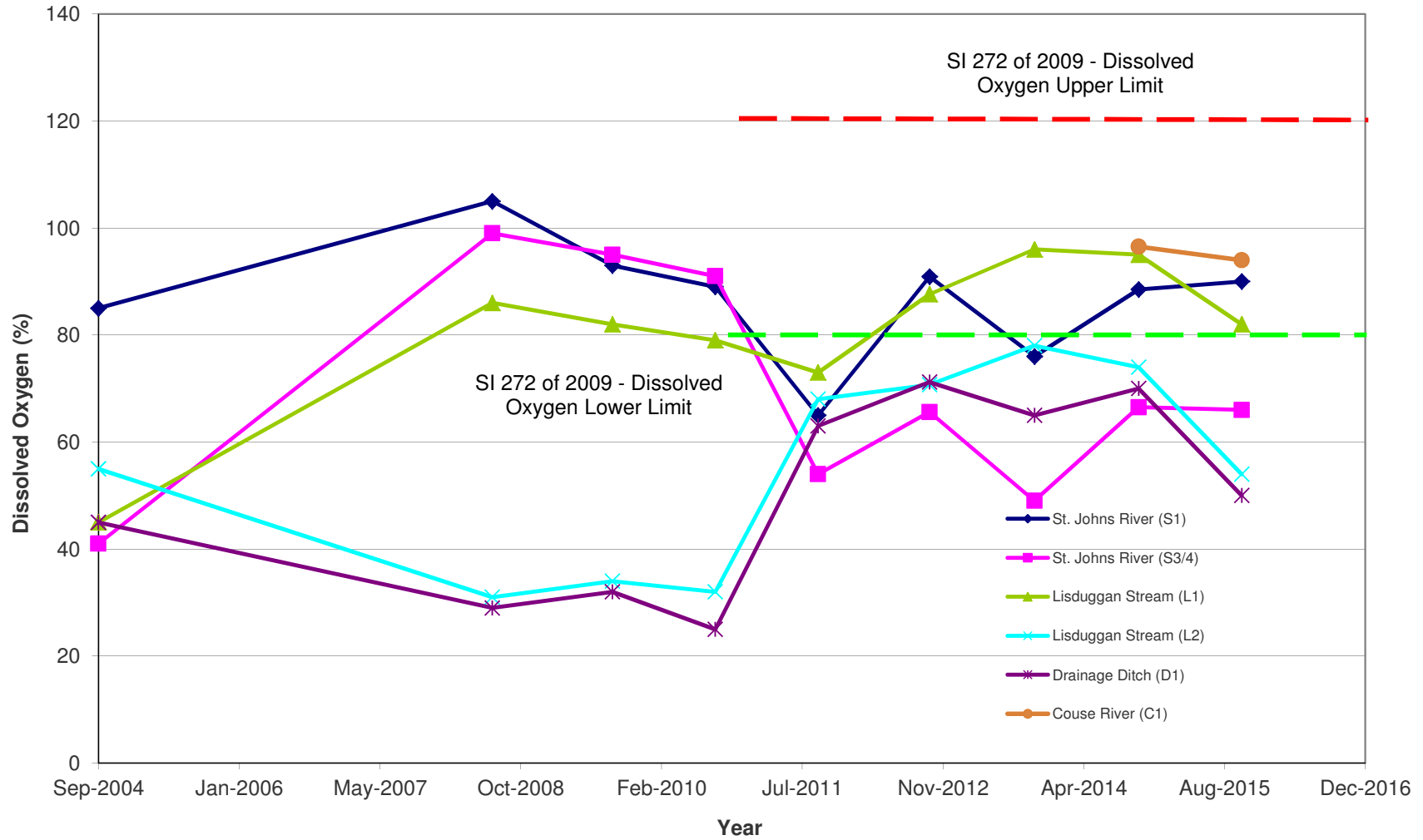


Appendix C3: Vegetative Changes in Western Reedbed vs. time

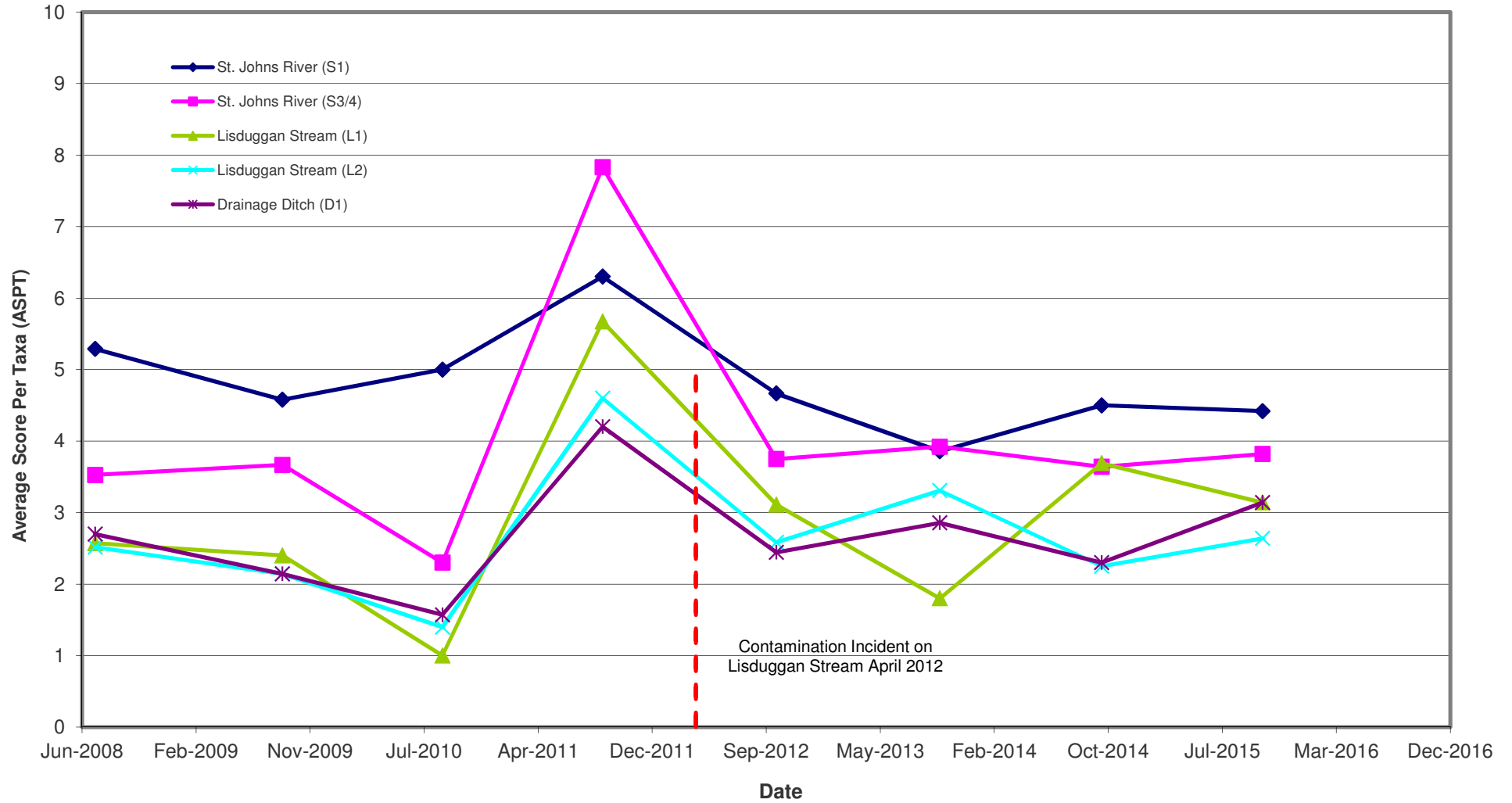


APPENDIX D- WATER QUALITY TREND GRAPHS

Appendix D1: Temporal trend graph of dissolved oxygen recorded since 2004 (L6 not included)



Appendix D3: Temporal trend graph of ASPT recorded since 2008 (L6 not included)



APPENDIX E- PHOTOLOG

Client Name: Waterford City & County Council

Site Location: Kilbarry Bog, Waterford City, Waterford

Photo No.
1

Date:
April 2015

Description: Adjacent to Sheeps Bridge looking North East



Photo No.
2

Date:
April 2015

Description: Adjacent to Sheeps Bridge looking South



Client Name: Waterford City & County Council

Site Location: Kilbarry Bog, Waterford City, Waterford

Photo No.
3

Date:
September
2015

Description: Adjacent to Sheeps Bridge looking East



Photo No.
4

Date:
September
2015

Description: : Close-up of burnt Tussock Sedge



Client Name: Waterford City & County Council

Site Location: Kilbarry Bog, Waterford City, Waterford

Photo No.
5

Date:
April 2015

Description: Renewed Common Reed growth. Note burnt tip of leading shoot.



Photo No.
6

Date:
April 2015

Description: Close-up of burnt reedbed condition



Client Name: Waterford City & County Council

Site Location: Kilbarry Bog, Waterford City, Waterford

Photo No.
7

Date:
April 2015

Description: Adjacent to Sheeps Bridge looking South East



Photo No.
8

Date:
April 2015

Description: Adjacent to Avoca Drive estate looking South. Note burnt reedbed in background and un-touch reedbed in foreground.



Client Name: Waterford City & County Council

Site Location: Kilbarry Bog, Waterford City, Waterford

Photo No.
9

Date:
June 2015

Description: Adjacent to Sheeps Bridge looking East



Photo No.
10

Date:
June 2015

Description: Adjacent to Sheeps Bridge looking South



Client Name: Waterford City & County Council

Site Location: Kilbarry Bog, Waterford City, Waterford

Photo No.
11

Date:
June 2015

Description: Adjacent to Sheeps Bridge looking East



Photo No.
12

Date:
June 2015

Description: Close-up of Tussock Sedge recovery



Client Name: Waterford City & County Council

Site Location: Kilbarry Bog, Waterford City, Waterford

Photo No.
13

Date:
June 2015

Description: Adjacent to Sheeps Bridge looking North East



Photo No.
14

Date:
July 2015

Description: Adjacent to Sheeps Bridge looking North East



Client Name: Waterford City & County Council

Site Location: Kilbarry Bog, Waterford City, Waterford

Photo No.
15

Date:
July 2015

Description: Adjacent to Sheeps Bridge looking South East



Photo No.
16

Date:
July 2015

Description : Adjacent to Sheeps Bridge looking South



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Appendix III

Environmental Management System and E.L.R.A.

May 2016

Environmental Management System

Version 10, April 2016

Table of Contents

1.0 Environmental Management Plan

2.0 Schedule of Environmental Objectives and Targets

3.0 Corrective Action Procedure

4.0 Awareness and Training Procedures

5.0 Communications Programme

6.0 Waste Acceptance Procedures

7.0 Emergency Response Procedures

Kilbarry Landfill Site

1.0 Environmental Management Plan

1.0 Introduction

Kilbarry Landfill site is located (National Grid Reference 2598E 1103N) on the outskirts of Waterford City on the link road from Cork Road to Kilbarry Road,, approximately 300m of the N25.

The site occupies an area of 20.1 hectares. Land use in the vicinity of the site is a mixture of open flat farmland with wetland to the southeast. The area to the north and west of the site is a mixture of residential and commercial properties.

The landfilling of waste at the site has resulted in the formation of a mound of waste above ground level. The waste body has a maximum height of 20mOD in the centre of the site. The remainder of the site has a maximum height of 17.5mOD on top of the waste body and a base level of 2m to 3mOD on the edge of the site.

The site has been in operation for approximately 40 years. The landfilling of waste has occurred on a former area of wetland known as Kilbarry Bog. A series of drains or channels are found on the entire western, southern and eastern perimeter of the landfill.

The waste license for the site was issued on the 19th of October 2001. The purpose of this Environmental Management Plan is to act as a site manual for Kilbarry Landfill and Civic Amenity Site. It outlines the requirements of the waste license (18-1) and sets out a programme for achieving the schedule of objectives and targets. A complete copy of the plan shall be kept at the site office and an additional copy at the offices of Waterford City Council.

1.1 Management and Staffing Structure of the Facility

The site is operated by Waterford City Council. The site is under the overall control of Fergus Galvin, Director of Services, Waterford City Council. Mr. John Nolan, Senior Executive Engineer, is responsible for the overall operation of the site. Mr John McKeown, Executive Engineer, is responsible for reporting to the E.P.A. and fulfilling responsibilities of the waste licence. Mr John McKeown, Executive Engineer, is responsible for the day to day supervision and management of the Civic Amenity Site and is assisted by the Facility Supervisor Mr. James Flavin. Details of the additional site staff are provided in Table 1.

Table 1: Operational Staff (Currently on Site)

Employee	Duties and responsibilities
Mr James Flavin	Collection of charges. Maintenance of on-site records. Implementation of waste acceptance procedures. Site inspections. Monitoring of gas boreholes. Any other duties as required by site manager.
Mr Ferdy Ozturk	Daily litter patrols. Maintenance of metals recovery compound. Any other duties as required by site manager

A staff member Patrick Fitzgerald has been assigned since Autumn 2014 to carry out maintenance duties to Kilbarry Landfill and to the Civic Amenity Centre. His duties include grass cutting, litter picking, anti-dog fouling measures.

The facility manager maintains regular contact with the Senior Executive Engineer. Table 2 shows the current management structure of Kilbarry Landfill.

Table 2: Management Structure for Kilbarry Landfill

Position	Employee Contact Details
Director of Services Fergus Galvin	Waterford City And County Council, Environmental Services, Menapia Building, The Mall, Waterford. Tel: 051 309900 Fax: 051 849701
Senior Executive Engineer John Nolan	Waterford City Council, Environmental Services, Menapia Building, The Mall, Waterford. Tel: 051 309900 Fax: 051 849701
Landfill Manager JohnMcKeown C.A.S. Manager John McKeown Facility Supervisor James Flavin	Waterford City and County Council, Environmental Services, Menapia Building, The Mall, Waterford Tel: 051 309900 Fax: 051 849701 Kilbarry Landfill Tel: 051 379615 Fax: 051 379615

Any changes to this structure will be submitted to the EPA by the Landfill Manager. It shall be the responsibility of the C.A.S. Manager to organise staff in the absence of the named persons from the facility.

1.2 SITE DESCRIPTION

1.2.1 Waste Management Activities at the Facility

The waste categories and quantities that may be accepted for disposal and recovery, as outlined in Table A.1 of the Waste License, are shown below in Table 3.

Table 3: Waste Categories & Quantities for Disposal and Recovery

Waste Type	Maximum Tonnes Per Annum
Household	17,000
Commercial	12,500
Industrial Non Hazardous	28,500
Treated Sewage Sludges	2,500
Treated Industrial Non Hazardous Sludges	7,500
Construction and Demolition Waste	2,000
Wastes for Recycling and Recovery at the Civic Waste Facility	3,000
Waste for Recycling & Recovery at the Metal Recovery Area	2,000
Total	75,000

As of the 19th January 2003 commercial waste hauliers were stopped from disposing of waste at Kilbarry Landfill. As of 26th August 2005 Kilbarry Landfill ceased accepting domestic waste for landfill disposal. The landfill is currently closed to the public and restoration including permanent capping, gas and leachate abstraction works has been completed. Surface water drainage and landscaping works are to be completed. Currently all domestic waste collected by Waterford City Council is deposited at Veolias waste facility in Six Cross Roads Business Park before being hauled to Homestown Landfill in Wexford.

All waste loads arriving at the site were dealt with as per the waste acceptance procedures.

A civic amenity centre is located adjacent to the site entrance. The following range of goods are accepted for recycling: W.E.E.E., scrap metal, timber, cardboard, batteries, engine oil, cooking oil, glass bottles, aluminium cans, clothes, fluorescent tubes, energy saving light bulbs, aerosols and paint tins, biodegradable garden waste.

1.2.2 Methods of Waste Deposition

Previously any vehicle entering the site was weighed and all relevant information recorded. The vehicle was directed to the tipping area where the driver discharged the waste. The machine operator compacted the waste and covered it with daily cover material at the end of the day. Inert waste (such as clay, stone and C&D materials) was used as cover.

Currently all waste for landfilling weighed at Kilbarry is sent to Greenstar for bailing and export.

1.2.3 Site Capacity

The site has been in operation in the region of 41 years. The total volume of waste deposited to date is estimated to be 1,094,513m³.

The last area of landfilling was located in the new cell constructed in 2002/2003 located at the northern end of the landfill.

1.3 Engineering Details

1.3.1 Site Description

Kilbarry landfill is located on the outskirts of Waterford City. The landfilling of waste has primarily taken place in unlined cells. Only one lined cell was constructed on site and landfilling has been ongoing in this cell since June 2003. Once this cell was full landfilling operations ceased at the site in August 2005. The landfilling has resulted in the creation of a waste mound up to 20m in height.

A description of the existing situation for each component of the specified engineering works is provided below with details of the proposed works and timescale for completion of the future work.

1.3.2 Fencing, Gates and Other Security

Fencing is installed around the full perimeter of the site. The fencing is a palisade fence, 2.4m high. With the closure of the site the fencing is no longer of intrinsic security value except while works are ongoing onsite for the final capping and gas abstraction systems. The future use of the site is envisaged to be a park landscaped with respect to the NHA bog to the south and the fencing may not be required due to its visual impact.

As per Condition 4.3.2 of the waste license, the facility manager will ensure that any temporary repairs to gates/fencing will be carried out where necessary, before the end of each working day and final repairs will be carried out within three working days. It is the responsibility of the facility manager (or other nominated person) to ensure that all gates shall be locked shut when the facility is unsupervised.

Site lighting is provided at the civic amenity area, which also lights the area around the weighbridge and the site office.

1.3.3 Leachate Management System

A leachate collection trench was installed around the perimeter of the site in 2002/2003. This trench was designed so as to prevent any leachate migrating off site and pump it to the leachate lagoon. The trench is a minimum of 1.2m in depth and 1m wide. The outer wall and floor of the trench are lined with 2mm thick HDPE liner. Perforated pipes run along the floor of the trench to carry any leachate which is collected and the trench is backfilled with a noncalcareous, granular, rounded stone, 16-32mm in size. The collection trench drains to five sumps located at various intervals around the perimeter of the site. The leachate is then pumped from these sumps to the leachate lagoon.

10 leachate abstraction boreholes were installed in the main body of the waste. Leachate is pumped from these boreholes to the leachate lagoon. A further three abstraction boreholes were installed in 2008.

A leachate lagoon was constructed north of the new cell. The lagoon has an overall capacity of 3,670 m³ and allowing for a freeboard of 0.5m a capacity of 2,670m³. The lagoon is pumped directly to the sewer.

A monitoring system was installed on the outfall of the leachate lagoon in accordance with the waste license in 2005. This system monitors for flow, pH and methane. It also provides for a composite sampler that can be event controlled.

1.3.4 Construction of Lined Cell

Work began on the construction of a fully engineered lined cell in September 2002 and was completed in March 2003. The location of the cell is to the north of the site. The cell is made up of a number of different elements to ensure its integrity.

A subcell drainage layer 300mm thick was laid on the floor. Pipes were then laid in this layer to collect and carry water that may arise. These pipes were then run underneath the western bank of the cell and into the adjoining stream. A 500mm layer of bentonite enhanced soil was then laid on the drainage layer and on the side slopes. The BES was batched on site and regularly tested in the site laboratory to ensure it could achieve the correct permeability. The BES was laid in two layers of 250mm each and compacted with a roller as it was laid. It was then tested using a nuclear densometer to ensure that it had achieved the correct moisture content and density.

A 2mm thick HDPE plastic liner and an 8mm thick geotextile were then laid over the bentonite layer. Over these a 500mm thick leachate collection blanket was laid. This consisted of a non-calcareous granular, rounded stone, 16-32mm grain size. A network of perforated pipes was placed through this collection blanket to collect and carry leachate arisings to the leachate sump. The leachate is then pumped from the sump to the leachate lagoon and on the sewer.

The cell was completed in March 2003 and waste was first placed in the cell on the 6th June. The cell was filled and the landfill closed in August 2005.

1.3.5 Surface Water Ponds

Three surface water ponds have been installed on the site. These ponds were operational while the site was. Since closure and the completion of final capping the surface water management system has become redundant and needs to be reinstated for the new levels onsite. A surface Water Management Plan was submitted to the Agency in April 2008. This was accepted by the Agency in a letter dated 26/11/08. Based on this contract documents were drafted in consultation with National Parks and Wildlife Services for the installation of a new surface water management system which compliments the use of the site as a public park. A further surface water pond was installed to the south of the landfill as part of this contract. These works were completed in early 2011.

1.3.6 Dry Wheel Shakeout Grid

The dry wheel shake out was located north of the metals recovery compound and was completed in late November 2002. All vehicles leaving the facility first passed over the grid.

The shakeout grid occupied an area of 10m by 4m. As a vehicle travels over the grid, dirt and grit were loosened from the wheels and fell into a chamber below. The spoil was later removed from the chamber below. A power wash could also be used in tandem with the shakeout grid in particularly bad weather. This shakeout grid has been filled in since completion of all restoration works on site as it is no longer necessary for the operation of the

CAS.

1.3.7 Groundwater Monitoring Boreholes

The following is the list of groundwater monitoring boreholes that are now in operation at the site: GW2, GW4, GW5, GW6, GW16 (artesian), GW25 and GW29.

Monitoring of groundwater levels is undertaken weekly and sampling occurs quarterly with a more comprehensive analysis on an annual basis. The quarterly and comprehensive annual sampling is carried out by the EPA Kilkenny.

1.3.8 Leachate

A total of six boreholes were originally installed at the landfill, LM1 – LM6. However over time landfilling operations damaged a number of the boreholes. The damaged boreholes were replaced and an extra two were also installed. However a further two, LM2 and LM3 were damaged at some point prior to the commencement of final capping. During the capping works LM7 and LM8 were buried due to their low levels. For all of the year there was only one operational leachate monitoring borehole, LM1, due to capping works preventing access to the others. There are now currently four operational boreholes on site, LM1, LM4, LM5 and LM6. But, LM4, LM5 and LM6 remain under the final capping ground level surrounded by manhole rings for protection.

Leachate levels are monitored on a weekly basis.

Analysis of the composition of the leachate is undertaken at quarterly intervals for a limited range of parameters with a more comprehensive analysis on an annual basis. The quarterly and comprehensive annual sampling is carried out by the EPA Kilkenny.

1.3.9 Gas Monitoring Boreholes

82 no. gas abstraction wells have been installed for the active extraction and flaring of gas from the site. These wells can also be used to monitor the gas production in the waste body during field balancing.

Perimeter monitoring: LM1, GW2, GW4, GW5, GW6, GW7, GW9, GW12, GW15, GW17. Three temporary monitoring points GW19, GW20 and GW21 are now inoperable due to works adjacent to the landfill site. 8 new monitoring points have been established on the western perimeter between the landfill and the closest residential houses in Lacken Wood estate. These number GW22 to GW29.

1.3.10 Surface Water

The waste license requires the monitoring of surface water quality at the following locations,

- At monitoring points S1, S3 to S9 inclusive. Sampling point S2 is no longer available as the boundary drain has been diverted through a conduit pipe. S5 was inaccessible due to dense undergrowth for years, but in September a new path was laid to allow full access.
- EPA monitoring locations 0300, 0330, 0350 and 0400.
- Water quality monitoring including biological monitoring of the John's River and the Lisduggan Stream and other unnamed watercourses and tributaries upstream and downstream of the facility.

The quarterly sampling is undertaken by the EPA Kilkenny.

1.3.11 Ecological Monitoring

Annual ecological monitoring is required to include an ecological survey of habitats and associated plant and animal communities within and adjoining Kilbarry Bog proposed NHA.

1.3.12 Noise

Noise monitoring is required at 14 locations in the vicinity of the landfill. B1, B2, B3, B4, B5, B6, B7 are the onsite locations. NSL2, NSL3, NSL4, NSL5, NSL6, NSL7 and NSL8 are the offsite locations.

1.3.13 Dust

Dust monitoring is required at seven locations around the perimeter of the site. It is required three times annually, twice between the months of May and September.

1.3.14 Odours

Odour monitoring is required on a quarterly basis at seven locations in the vicinity of the site. Odour Ireland carry out all odour monitoring required.

1.3.15 Final Capping

Final capping commenced in the October of 2005. There is currently 100% of the landfill area capped to its final levels..

The phasing of the restoration works carried out was as follows:

Table 6: Phasing of the restoration works

Component	Commencement	Completion
Completion of liner and final capping	October 2005	June 2008
Completion of gas abstraction system	November 2006	April 2008
Installation of Permanent Flare	October 2009	October 2009
Installation 3 new leachate wells	January 2008	April 2008
Surface Water Management	September 2010	January 2011
Landscaping	March 2011	April 2012

1.4 Site Operation

1.4.1 Description of the operations

The landfilling of waste has ceased at Kilbarry but a Civic Amenity Site operates at the old landfill entrance to the North of the overall site. Materials accepted here are :

- W.E.E.E.
- Scrap Metal
- Timber

- Cardboard
- Car and Household Batteries
- Engine Oil
- Cooking Oil
- Glass Bottles
- Aluminium Cans
- Clothes and Textiles
- Fluorescent Tubes
- Energy Saving Light Bulbs
- Aerosols
- Paint Tins
- Oil filters
- Recycling paper
- Biodegradable Waste (Garden)
- Mixed Municipal Waste

1.4.2 Site Opening and Operation Hours

The hours of operation of the Civic Amenity Site are between 11am and 4pm, Monday to Friday.

1.4.3 Access

All personnel and vehicles entering the site are required to stop at the weighbridge which is located adjacent to the site entrance gate and report the purpose of their visit to the weighbridge operator. The weighbridge operator then directs vehicles to the relevant area. Public access to the site is limited to the civic amenity area and the metals recovery compound only.

Only personnel who are involved in monitoring, or otherwise authorised by the facility manager shall be permitted access to the landfill area outside the civic amenity/metal compound areas. Access to the site outside of normal working hours is not permitted unless authorised by the facility manager.

1.4.4 Waste Acceptance

All waste entering the facility is subject to the acceptance procedures. All staff involved in waste acceptance at the site are trained in the waste acceptance procedures. Cars and trailers including light vans carrying materials for recycling or disposal are directed to the civic amenity area. The site caretaker shall be responsible for ensuring that the area is kept tidy and that the goods for recycling are placed in the correct collection area.

1.4.5 Control of Nuisances

1.4.5.1 Litter Abatement Measures

It is the responsibility of the facility manager to ensure the prevention of the spread of litter. Regular monitoring and site inspections are carried out to this end.

Contractors transporting materials for recycling offsite are required to ensure that when

transporting and discharging these loads that litter is kept to an absolute minimum. All vehicles are required to be totally sealed or covered with a net or tarpaulin to ensure that materials are not blown from the vehicles.

Routine litter patrols are carried out on a daily basis to ensure that any loose litter is collected, this includes the area surrounding the landfill, all fences and the approach road to the site.

1.4.5.2 Birds

Birds are no longer a nuisance at the site since the landfill closed.

1.4.5.3 Vermin

A contract is in place with Rentokil Ireland. A programme of baiting can be employed as required to control rat infestations with preventative baiting at regular intervals to ensure that large populations do not become established.

1.4.5.4 Flying Insects

This does not pose a nuisance since the closure of the landfill.

1.4.5.5 Fires

The burning of waste or other material is not permitted at the facility. Hot or burning loads of waste arriving at the facility are rejected. In the event that a fire breaks out on the site it is treated as an emergency and dealt with immediately. No fire was reported in 2014.

1.4.5.6 Odour Control

Odour monitoring is carried out at quarterly intervals and the results for 2015 are contained in Appendix V. There were no odour complaints in 2015 and to date there have been no complaints or results of significance from monitoring.

1.4.5.7 Dust Control

The main sources of dust on the landfill site and the Civic Amenity Site are due to vehicle movement and control is effected by a mobile sprayer. Speed restrictions also apply to vehicles within the landfill. Dust monitoring is required at seven locations in the vicinity of the site (D1, D2, B1, B2, S2, B6, and GW5). Dust monitoring is required three times per annum. There were no dust limit breaches in 2015.

1.4.6 Wheel – Cleaning Procedures

A dry wheel shake out unit has been installed to the north of the metals recovery compound. All vehicles shall be required to pass through the unit on the instruction of the site caretaker prior to exiting the site. The site caretaker shall make an assessment as to the need for the vehicle to pass through the unit based on the site conditions at the time.

1.4.7 Emergency Response Procedures

The emergency response procedures for the facility are contained in Appendix X as part of the overall Environmental Management System

1.4.8 Awareness and Training

An ongoing training programme has been set up to ensure that staff involved with the facility are sufficiently trained in achieving compliance with the conditions of the waste license. The programme is maintained and updated as required.

1.4.9 Communications Programme

A communications programme has been set up in order to allow any local community groups or local resident's access to information concerning the environmental performance of the facility at all reasonable times.

1.4.10 Environmental Monitoring & Maintenance Procedures

Monitoring shall be undertaken at such locations and parameters as outlined in Schedule F: Monitoring of the waste license and as specified in Condition 9. All monitoring is to be carried out in accordance with the EPA Manual on Landfill Monitoring.

The facility manager shall be responsible for implementing the following:

- The monitoring and recording of landfill gas using an infrared gas analyser at the gas monitoring locations specified in the waste license. All monitoring equipment shall be calibrated, maintained and operated in accordance with the manufacturers' instructions. Written records of the calibrations and maintenance shall be kept. All equipment used for monitoring landfill gas shall be certified as being intrinsically safe.
- If a gas concentration reading at the site office exceeds the emission limit specified in Schedule G, the Emergency Response Procedures will apply.
- The visual inspection on a weekly basis of surface water monitoring locations as outlined in Schedule F: Monitoring
- The monitoring and recording of leachate levels within the filled waste on a weekly basis.
- Recording of data from the agreed climatological station on a monthly basis.
- The provision of safe and permanent access to all on-site sampling and monitoring points and off-site points.
- The maintenance and clear labelling of all sampling points.
- The replacement of all monitoring infrastructure which proves to be unsuitable for its purpose.

Upon the written instruction of the Agency only the facility manager shall amend that frequency, locations, methods and scope of monitoring, sampling, analyses and investigations and shall provide information concerning such amendments as may be requested in writing by the Agency.

The facility manager shall be responsible for forwarding copies of all environmental monitoring data to the Agency at the frequencies set out in schedule D of the waste license. In accordance with Condition 9.18 monthly inspections of the landfill for evidence of slippage shall be undertaken.

1.4.10.1 Emission Limits

Any exceedance of the trigger levels for emission limits as listed in Schedule G of the waste license shall be deemed an incident and documented in accordance with Condition 3.2 and 10.7 (a to e) of the waste license and reported to the Agency (and the Southern Regional Fisheries Board if necessary) by the facility manager in accordance with condition 3.3.

1.4.10.2 Annual Environmental Report

The facility manager shall prepare and submit to the Agency for its agreement the annual environmental report. In accordance with Condition 2.4 the facility manager shall submit the annual environmental report within one month of the end of each calendar year.

The facility manager shall ensure that the annual environmental report is prepared in accordance with any relevant written guidance issued by the Agency and includes at a minimum the information specified in Schedule C: Content of Annual Environmental Report.

1.4.11 Operational & Safety Rules Including Safety Statement

The general safety statement of Waterford City Council applies to operation in the Kilbarry Landfill. Regarding work to be constructed by outside contractors each contractor shall provide a specific safety statement and be appointed Project Supervisor Health & Safety as required by the Health, Safety & Welfare at Work Regulations 1995.

1.5 Closure & Aftercare

1.5.1 Final End Use of Site

The site has been turned into a public park.

A layout of the park is contained in Drawing 4 in the Appendices.

1.5.2 Aftercare Monitoring

The EU Directive on the Landfill of Waste (1999/31/EC) and the guidance published in the Agency's Landfill manual "Landfill Restoration & Aftercare" requires that the operators of landfill site continue to monitor the groundwater, surface water, leachate and landfill gas after the closure of the site.

The site management shall ensure that the aftercare programme for Kilbarry Landfill will

include stability assessment of the side slopes including slope stabilisation measures if required, monitoring of groundwater quality, leachate composition, surface water quality and landfill gas composition. The monitoring is to be carried out in accordance with the requirements of the EPA Manual on Landfill Monitoring. The following programme is proposed for the initial monitoring subsequent to the closure of the site. The proposed monitoring frequencies are outlined in Table 8 (based on EPA Landfill Monitoring Manual recommendations). The programme shall be reviewed on an annual basis.

Medium	Parameter	Frequency
Surface Water	Composition	Six monthly
Groundwater Levels	Composition	Six monthly
Landfill Gas	Gas Emissions	Six monthly
Stability & Settlement		Annually
Leachate	Levels	Six monthly
	Composition	Six monthly

Sampling to be carried out at representative locations.

1.5.3 Maintenance Programme for Aftercare Phase

It is proposed that maintenance shall be carried out as required at the site. Maintenance of the following equipment is envisaged during the aftercare period.

- Leachate pumps in collection sumps and abstraction wells
- Gas flarestacks and abstraction system
- Fencing and gates

It is recommended that the above items are inspected on a regular basis (minimum six monthly) and that maintenance shall be carried out as required.

2016 Schedule of Objectives and Targets

Prepared by: John McKeown, Facility Manager

Date : March 2016

Approved by : Mr Fergus Galvin, Director of Services, Waterford County Council

Objective 1 To	Target	Plan	Responsible Party	Timescale (for completion)
establish site	Repair all defects in the existing site gates and fences	Regular inspections are carried out of gates and fencing	Facility Manager	Within three working days of defect
infrastructure as required by Licence	Install active collection and flaring system for landfill gas	Active gas collection system and permanent flare installed	Facility Manager/ Consultant Contractor	Completed
Conditions	Investigate utilisation of landfill gas	Utilisation not feasible	Facility Manager/ Consultant	Completed
	Surface Water Management	Install system as proposed	Facility Manager Consultant, Contractor	Completed
	Landscaping	Suitable tree and shrub planting required on the perimeter of the facility and for final capping/restoration.	Horticulturist	Completed
	Permanent Enclosed Flarestack	Install flare and connect to gas abstraction system	Facility Manager, Contractor	Completed

2016 Schedule of Objectives and Targets

Prepared by: John McKeown, Facility Manager

Date : March 2016

Approved by : Mr Fergus Galvin, Director of Services, Waterford County Council

	Target	Plan	Responsible Party	Timescale (for completion)
Objective 2 Management & Operation of the Facility Objective 3 To Prevent Environmental Nuisance & Emissions	Develop written waste acceptance procedures and ensure all staff are familiar with same	To minimise nuisance and ensure only permitted material accepted for recycling	Facility Manager & Compactor Operator	Reviewed annually
	Implement Litter Control Measures	To maintain litter control measures	Facility Manager Site Staff	Ongoing
	Dust Control	To maintain dust control measures	Facility Manager Site Staff	Ongoing
	Vermin Control	Contract with Rentokil Ireland	Facility Manager	In Place
	Continue existing gas monitoring programme	Continue with existing monitoring programme	Facility Manager	On Going
	Continue existing leachate monitoring programme	Monitor changes in the composition of the leachate with time	Facility Manager	On Going

	Monitor dust control measures during construction works at the facility	Dust control measures to be implemented on site during all construction works at the facility	Facility Manager	On Going
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2016 Schedule of Objectives and Targets

Prepared by: John McKeown, Facility Manager

Approved by: Mr. Fergus Galvin, Director of Services, Waterford County Council

Date: March 2016

	Target	Plan	Responsible Party	Timescale (for completion)
Objective 4 Promotion of Waste Recycling	Make public aware of recycling initiatives, techniques and current methods as well as materials accepted at Kilbarry	Promotion through local newspapers, radio, school talks and information leaflets	Environmental Officer Facility Manager	Ongoing

2016 Schedule of Objectives and Targets

Prepared by : John McKeown, Facility Manager

Date : March 2016

Approved by : Mr Fergus Galvin, Director of Services, Waterford County Council

	Target	Plan	Responsible Party	Timescale (for completion)
Objective 5 To improve the Environmental Performance	Establish an Environmental Management System	To monitor the facility's environmental performance	Facility Manager	Reviewed Annually
	Prepare the Annual Environmental Report	Summarise the results of environmental monitoring programme and assess facility's progress towards achieving its objectives and targets	Facility Manager Consultant	March 2014 (Due to City and County amalgamation the AER delayed)
	Reduce non-compliance	Carry out site inspections	Facility Manager Site Supervisor	Ongoing
	Improve Environmental Monitoring Programme	Continue and expand groundwater, surface-water, leachate and landfill gas monitoring to ensure complete compliance with licence.	Facility Supervisor Facility Manager	Ongoing
	Reduce risk of gas migration	Install active gas abstraction system and flare. Also, gas utilisation system, to be assessed.	Facility Manager Consultant Contractor	Gas abstraction system completed. Utilisation unfeasible.

2016 Schedule of Objectives and Targets

Prepared by : John McKeown, Facility Manager

Date : **March 2016**

Approved by : Mr Fergus Galvin, Director of Services, Waterford County Council

Objective 5 To improve the Environmental Performance (Continued)	Target	Plan	Responsible Party	Timescale (for completion)
	Reduce visual impact	Landscaping of site into a public amenity park	Horticulturist	Completed
	Control dust emissions	Monitoring	Contractor	Quarterly
		Spray roads during dry weather	Facility Manager	Ongoing
		Operate and maintain wheel wash	Facility Manager	Ongoing
		Enforce speed limits	Facility Manager	Ongoing
	Litter control	Daily Litter inspections	Facility Supervisor	Ongoing
	Reduce emissions to surface water	Install management system	Facility Manager	Ongoing
	Reduce emissions of leachate from unlined waste body	Maintain leachate collection system	Facility Manager, Contractor	Ongoing

Objective 5 (continued)	Target	Plan	Responsible Party	Timescale (for completion)
	Reduce long-term impact	Restoration and Aftercare Plan	Senior Engineer	After landscaping

2016 Schedule of Objectives and Targets

Prepared by : John McKeown, Facility Manager

Date : March 2016

Approved by : Mr Fergus Director of Services, Waterford Ccounty Council

	Target	Plan	Responsible Party	Timescale (for completion)
Objective 6 To Monitor Management of Facility	Environmental Management System	Environmental Management System developed and included in this submission	Facility Manager	Reviewed annually
	Environmental Management Programme	Environmental Management Plan established and included in this submission	Facility Manager	Reviewed annually
	Establish and maintain Corrective Action Procedures	Procedures have been developed and are included in this submission	Facility Manager	Reviewed annually
	Establish Awareness and Training Procedures to identify training needs	Procedures have been developed by Waterford City Council	Facility Manager	Reviewed annually
	Establish Communications Programme to ensure public access to information	Details included in this submission	Facility Manager	Reviewed annually
	Record keeping to ensure proper site management	Written records to be kept	Facility Manager	Reviewed annually

3.0 Corrective Action Procedures

Throughout the operation of the landfill facility, there will be a need to resolve any noncompliances of the waste license that may arise as a result of problems with operation, complaints from the local community, non-conforming subcontractors etc. This procedure defines the approach that will be taken in implementing and evaluating corrective action to prevent the recurrence of non-compliances. The purpose of this procedure is to ensure that all corrective actions are documented and that the EPA are notified of any incident.

Responsibilities

The facility manager will be responsible for co-ordinating the corrective action procedures for Kilbarry Landfill and is responsible for retaining the corrective action file and forms. The Senior Engineer will be responsible for the review of corrective action forms and ensuring that controls are applied to ensure that corrective actions are implemented and effective. The landfill operational staff shall be responsible for following the procedure.

Corrective action is required in the event of the following:

- Any emission which results in the contravention of any relevant standard, including any standard for an environmental medium, or any relevant emission limit value, prescribed under the relevant enactment.
- Any emission which does not comply with the requirement of the license.
- Any trigger level specified in the license or in the EMS which is exceeded.
- Any indication that environmental pollution has, or may have taken place.
- Any occurrence with the potential for environmental pollution.
- Any emergency.
- Any incident which requires preventative action.
- Any failure to comply with procedures or systems.

Procedures

In the event of a non-compliance or incident occurring, the facility manager shall:

1. Take necessary short-term action to prevent the immediate reoccurrence of the problem or minimise any further impact.
2. Conduct a thorough investigation of the root cause of the problem to identify the nature, source and cause of the incident and any emission.
3. The person reporting the incident will identify the date, time and place of the incident. In the event that any monitoring, sampling or observations indicating that an incident has, or may have occurred the facility manager will be immediately notified.
4. Document the results of the investigation and propose a long-term corrective action to prevent recurrence of the problem on the corrective action form.
5. Enter the corrective action into the corrective action register.
6. Submit the completed corrective action form to the Senior Executive Engineer who shall review the recommendation and accept or require additional investigation. If additional investigation is required the form and attachments will be returned to the facility manager, who will continue with the investigation as detailed by the Senior Executive Engineer. If the recommendation is acceptable the facility manager will implement the corrective action.
7. Monitor the success of the corrective action.
8. Document the evidence that was reviewed to determine the effectiveness of the corrective action on the corrective action form.
9. File the original corrective action and any accompanying paperwork in the corrective action form and copy the completed form to the Senior Executive Engineer.
10. Notify the EPA.
11. Implement changes in procedure resulting from the corrective action.
12. Arrange staff training if required.

Corrective Action form

Non-compliance

Briefly describe what the root cause of the problem was after your investigation

Name of investigator :

Signature:

Date :

Short-term Corrective Action :

Briefly describe the immediate action that was taken to prevent further impact

Action taken by :

Signature :

Date :

Long –term corrective action:

Briefly describe recommended action to prevent recurrence

Details of further investigation if necessary

Approved By :

Responsibility assigned to :

Date :

Review of Monitoring :*Briefly describe the evidence that was reviewed to determine the effectiveness of the corrective action*

Signature :

Date :

4.0 Awareness and Training Procedures

Purpose

The purpose of this procedure is to identify and provide appropriate training needs for all personnel whose work is related to the operation of Kilbarry Landfill. It shall ensure that personnel are aware of the potential hazards and environmental impacts associated with their work on the landfill.

The operation of a modern landfill requires staff to have the relevant knowledge, training and experience in order to minimise the potential impacts of the landfill on the surrounding environment and to meet the requirements of the waste license and all relevant legislation.

Responsibility

The facility manager will be responsible for the following:

1. To identify and assess the training needs of all staff involved in the operation of the landfill.
2. To ensure that each employee receives the necessary training relating to his or her work procedures.
3. To ensure that contractors have received the relevant training prior to work on the landfill.
4. To organise all training courses.
5. To increase employee awareness of potential hazards and necessary precautions.
6. To ensure that all staff are provided with the necessary instruction and training to carry out their work having due regard to their safety, the safety of others and the public at large and also to ensure that best practice is followed in every respect of the landfill operation.

Procedure

The facility manager shall:

1. Set up a register of all training programmes completed by personnel involved in the operation of Kilbarry landfill.
2. Identify the training needs of staff based on their work procedures.
3. Research suitable training programmes and forward details to Senior Engineer for approval.
4. Organise staff to attend training programmes.
5. Ensure additional training will be provided when new procedures are established, new equipment is obtained or at any time a change in the employees working environment may create a potential hazard.

Documentation

Completion of the training for each individual will be documented on a separate form and maintained by the facility manager to ensure that each member of staff is provided with the information they are required to have to perform their job safely.

5.0 Communications Programme

The communications programme shall ensure that members of the public can obtain information concerning the environmental performance of the facility at all reasonable times.

Introduction

Council Directive 90/313/EEC on the Freedom of Access to Information on the Environment recognised the significance of the public's access to information relating to the environment. To ensure that members of the public can obtain information concerning the environmental

performance of Kilbarry landfill the communications programme described below shall be implemented at the facility.

The purpose of this programme is to allow any local community groups, key interest groups, local residents and members of the local community access to information on matters relating to the environmental performance of Kilbarry Landfill. This in turn will address any local community concerns and allow the public the opportunity to provide feedback on the facility

Programme:

1. All requests concerning the environmental performance of the facility should be made in writing to:

John McKeown,
Facility Manager, Kilbarry Landfill,
Menapia Building,
The Mall,
Waterford City.

2. The facility manager shall copy all requests to:

Fergus Galvin, Director of Services,
Waterford County Council,
Environment Department,
Menapia Building,
The Mall,
Waterford.

3. Each request should indicate the name, address and contact telephone number of the concerned party, an outline of the information required and the manner in which they require the information.

4. If requested, a suitable member of staff will provide and clear, unbiased explanation of the information provided.

5. The Director of Services or other authorised, nominated representative in Waterford County Council or any other nominated person will deal with replies to requests made by the media for information relating to the environmental performance of the landfill.

Record Keeping

1. All records of request for information regarding the environmental performance of the landfill and all minutes of meetings with concerned parties and details of site visits/open days shall be maintained. All of the aforementioned files shall be stored at the site office at Kilbarry Landfill and at the offices of Waterford County Council, Environment Department.

6.0 Waste Acceptance Procedures

Kilbarry Landfill comprises of a closed landfill site and a civic amenity centre for recycling for a limited number of streams of waste.

The following procedures have been put in place for waste acceptance by Waterford County Council:

Household Waste:

Household waste brought by the public to the Civic Amenity Site at Kilbarry is transferred to Greenstar for baling and export. There is a crush loader bin lorry kept onsite for any such household waste that is brought direct to the civic amenity site by the public. When the waste arrives at the landfill the weighbridge operator instructs the member of the public that it must be bagged.

Following a cursory visual inspection the householder is to be directed to the refuse lorry located in the civic amenity centre where he/she can dispose of the waste. If the weighbridge operator suspects that the load may contain unacceptable material (e.g. recyclables) a more thorough examination is to be carried out. If recyclable material is found that can be disposed of in the C.A. site the householder is to be directed to the appropriate location. If material is found that can neither be disposed of or recycled on site the householder should be instructed to remove said material off-site.

Fridges:

Fridges are a hazardous waste. Fridges are only stored on site before being transported off-site by KMK Recycling for correct disposal. When a householder arrives on-site he/she should be instructed to leave the fridge in or next to one of the two containers for the fridges. Every evening any fridges that have been deposited that day are moved into the container if not already done. If the container is nearing full KMK are contacted and a collection organised.

Small W.E.E.E. :

Anyone bringing small electrical goods to Kilbarry are directed to the cages for same inside the container in the Civic Amenity Site. These cages are emptied roughly once a week by KMK.

Large W.E.E.E.:

Large white electrical goods are stored in the metals compound in a neat and tidy manner for collection. The compound should be checked every evening and morning for signs of vandalism or dumping. Regular collections by KMK are essential to maintaining the compound in a clean and tidy state.

Commercial Waste:

There is no commercial waste of any type accepted at Kilbarry Civic Amenity Site.

Cardboard:

Householders bringing cardboard to the Civic Amenity Site are directed to the compactor onsite and accompanied by a member of staff. The staff member inspects the cardboard for contamination and removes any waste not suitable for compaction. This can be bagged and charged as per normal domestic waste. The cardboard is placed into the compactor while it is not operating. Once the hopper is full the staff member closes the hopper and opens the control mechanism locked in the compartment on the wall beside the compactor. The staff member can only operate the compactor whilst keeping the emergency stop button control in his hand at all times. The control must be locked away again once the hopper is empty and ready for more cardboard. The control mechanism must never be left unlocked and accessible to the public.

Biodegradable Waste (Garden)

From January 2015 to June 2015 the biodegradable waste that the public deposited in Kilbarry was shredded on site and then transported to the old compost site at the 6 Cross Roads for long term

storage. From July to December AES, Kildare have taken the biodegradable waste to their compost facility in Kildare. This biodegradable waste is recycled into commercial compost.

Other Recyclables:

The following materials are accepted for disposal at the recycling centre:

Aluminium cans and Glass bottles

Untreated timber

Paint Tins

Batteries

Waste engine oil

Waste edible oil

Metals

Aerosols

Textiles

Fluorescent tubes

When a person comes in wishing to recycle they are directed to the appropriate location. If a person wishes to dispose of waste oil a City Council staff member disposes of it for them.

7.0 Emergency Response Procedures

Condition No: 10.1 Emergency Response Procedures

Condition: The licensee shall, within six months of the date of grant of this licence, submit an updated written Emergency Response Procedure (ERP) to the Agency for its agreement. The ERP shall address any emergency situation which may originate on the facility and shall include provision for minimising the effects of any emergency on the environment.

7.1 Scope / Objective

Condition 10.1 of Waste Licence No. 18-1 granted to Waterford City Council for Kilbarry Landfill site by the Environmental Protection Agency (EPA) requires the City Council to prepare an Emergency Response Procedure (ERP). The ERP will apply to Kilbarry Landfill Site and describes the actions to be taken in the event of a site emergency.

The purpose of this procedure is to propose appropriate actions to ensure health and safety risks to employees and visitors, and damage to property and the environment is minimised.

7.2 Responsibility

This document describes the ERP for the Kilbarry Landfill Site. The ERP will be maintained at the landfill site by the Landfill Engineering Manager. He will be

responsible for the implementation of this procedure.

The Landfill Deputy Managers, Weighbridge Clerk and all Waterford City Council employees at the site will be responsible for following this procedure. Changes to the ERP will not be made without written approval from the Agency.

In the event of an emergency the EPA must be notified. The contact details are shown below:

**Ms. Emer O'Reilly,
Environmental Protection Agency,
PO Box 3000,
Johnstown Castle Estate,
Co. Wexford.
Tel: 053 60600
Fax: 053 60699**

7.3 Definition

Emergency

An emergency is defined as an unforeseen or sudden occurrence demanding immediate action.

7.4 Circulation List

The ERP is distributed to those named below and is available for reference from the Landfill Engineering Manager whose copy will be maintained at the site office. In order to maintain control of the procedures within the revision process, the ERP should not be copied without permission from Mr Fergus Galvin, Director of Services. Persons using this document are responsible to ensure that they are using the most up to date version.

	Position
Fergus Galvin	Director of Services
John Nolan	Senior Executive Engineer
John McKeown	Landfill Manager

7.5 Procedures

7.5.1 Emergency Response Procedures

1. Emergencies can be:-
 - activation of site office fire or gas alarm
 - discovery of a fire within the site boundary
 - landfill gas detected exceeding safe operating levels within the site boundary or outside the site
 - explosions
 - flooding
 - uncontained spillage / leakage

- major injury or dangerous occurrence

2. In the event of an emergency all employees should react promptly and calmly, following the guidelines outlined in this document.

7.5.2 Activation of Office Fire or Gas Alarms

1. The site office is fitted with fire and gas detection systems. The landfill gas concentration limits are 1% v/v for methane and 1.5% v/v for carbon dioxide. The gas alarm will sound if gas is detected above these specified limits and the smoke alarm will sound if smoke is detected in the office.
2. On hearing an alarm all personnel must evacuate the offices, closing all windows and doors behind them, if practical.
3. All personnel should proceed to the assembly point outside the front gates where employees, site visitors and site contractors will be accounted for (the site visitors book and contractors sheets should be checked if accessible).
4. The emergency services should be notified immediately by dialling 999 if it is suspected a fire has broken out or if the fire alarm sounds. Personnel should only tackle a fire if safe to do so and if they have been trained in the use of a fire extinguisher.
5. If the alarm is legitimate, the Landfill Engineering Manager should be notified as soon as is practicable.
6. The EPA should be notified as per condition 3.3 of the waste license (contact details above) and the incident should be recorded in the site incident report form.

7.5.3 Procedure for Dealing with Hot or Burning Loads

1. If on inspection a load is found to be hot or burning it should be refused admission to the site.
2. Details of the load (name, registration number, type of load, site of origin) should be recorded in the appropriate register retained in the site office.
3. If the load has entered the site, prior to deposition, it should be directed to the Quarantine area, away from the Civic Amenity Site to a location where the material can be extinguished. These loads must never be located close to areas of the site which are lined in case of heat damage to the liner.
4. If the load has been deposited it should be spread in a controlled manner and covered with inert material. This should always be carried out by working from the edges of the load inwards toward the centre. Machines must never be driven through the burning material.
5. The EPA should be notified as per condition 3.3 of the waste license (contact details above) and the incident should be recorded in the site incident report form.
Refer to 7.5.4 for dealing with fires.

7.5.4 Procedure for Dealing with Fires and Explosions on Site

The EPA should be notified of all fires and explosions on site.

1. Procedure for Dealing with Fires

The Landfill Engineering Manager or deputy should be informed immediately. The previous procedure for fires assumed an operational landfill. Since the closure of the landfill and installation of the gas abstraction system the possibility of a fire in the waste is greatly reduced. The following is the procedure for any fires within the existing site.

a) All personnel must evacuate the offices. The emergency services should be notified immediately by dialling 999. Personnel should only tackle a fire if safe to do so and if they have been trained in the use of a fire extinguisher

b) All personnel should proceed to the assembly point outside the front gates where employees, site visitors and site contractors will be accounted for (the site visitors' book and contractors sheets should be checked if accessible).

c) The EPA should be informed as per Condition 3.3 of the Licence (contact details above) and the incident should be recorded in the Site Incident Report Form.

2. Procedure for Dealing with Explosions

a) Ensure all personnel and site visitors are accounted for.

b) Check site for signs of fires resulting from the explosion. If identified follow the procedure in Section 1 above.

c) If the explosion results in personal injury the emergency services should be called by the Landfill Engineering Manager or his appointed deputy in his absence. In the event of a fire refer to Section 1 above. In addition, the EPA should be notified as soon as is practicable.

d) Access to the immediate area should be restricted. Under no circumstances should further waste be deposited until authorised by the Landfill Engineering Manager.

e) Every effort should be made after (d) above to identify the cause and source of the explosion.

f) The EPA should be informed as per Condition 3.3 of the Licence (contact details above) and the incident should be recorded in the Site Incident Report Form

7.5.5 Procedure for Dealing with Uncontained Spillage/Leakage

1. Immediately report the occurrence to the Landfill Engineering Manager or in his absence, his appointed deputy.

2. The spill/leak should be contained using the spill kit and the material recovered (if possible) by the most appropriate means available (plant, inert material etc.).

3. Access to the immediate area should be restricted, if necessary.

4. The EPA should be notified as soon as is practicable (contact details in Section 2.0).
5. Having carried out all practicable actions the EPA should be consulted to agree any further action which may be required.
6. The incident will be reported to the Site's Incident Report Form.

7.5.6 Procedure for Dealing with a Serious Injury

1. Immediately report the incident to the Landfill Engineering Manager or in his absence, his appointed deputy. If required, the emergency services should also be notified as soon as is practicable.
2. The immediate area should be kept clear to provide access for the emergency services.
3. Record all injuries in the accident book and note as much information about the accident as possible.
4. Report the incident to the Health and Safety Manager as soon as is practicable. The Health & Safety Officer is Ms Amanda Bolger, telephone number 051 309900.
5. If practicable the area in which the incident took place should remain undisturbed until any investigations into the circumstances are complete.
6. The incident will be reported on the Site's Incident Report Form.

7.5.7 Procedure for Dealing with a Landfill Gas Emergency

The following plan has been drawn up in accordance with the guidelines outlined in WMP 27. Areas around Kilbarry Landfill which may be affected by migrating gas include the landfill site offices and surrounding houses.

1. The landfill site office is currently monitored for the presence of methane and carbon dioxide.
2. If concentrations of methane and carbon dioxide in the office exceed 2,500ppm (0.25% v/v) and 5,00ppm (0.5% v/v) respectively, the building shall be ventilated and monitored until it can be demonstrated that concentrations remain below these levels.
3. If concentrations of methane and carbon dioxide in the landfill office exceed 10,000ppm (1% v/v) and 15,000ppm (1.5% v/v) respectively, the alarm will sound and the building shall be ventilated and then evacuated immediately.
4. The alarm will deactivate when the gas levels fall below the above levels. The building should be left to ventilate for another 15-20 minutes and then re-entered wearing the appropriate Personal Protective Equipment (PPE) and monitored until it can be demonstrated that concentrations remain below 0.25% and 0.5% for methane and carbon dioxide respectively.

5. The residence at the front of the landfill should be contacted and gas samples taken from the house to ascertain gas levels. The contact for this residence is Ms. Ann Kennedy, Kilbarry, Tel: 087 6717516.

6. If the gas levels exceed those in Step 2 the building should be monitored until it can be demonstrated that concentrations remain below those levels.

7. If gas levels persist both the Gardai (Telephone no. 051 305300) and Bord Gais (Telephone no. 1850 205 050) should be contacted.

7.6 Unable to Accept Waste

The inability to accept waste may be caused by one of the following:-

- Mechanical failure;
- Power failure;
- Industrial disputes;
- Fire;

In the event of a mechanical breakdown of plant at the site the Landfill Engineering Manager will make arrangements for the prompt repair of the machine. If the repair work will be prolonged then the Manager will make arrangements for replacement equipment.

7.7 Review

The Landfill Engineering Manager will review the cause of the emergency and will put appropriate measures in place to prevent the reoccurrence of such an emergency.

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REPORT ON

**ENVIRONMENTAL LIABILITY RISK ASSESSMENT
AND FINANCIAL PROVISION FOR KILBARRY
LANDFILL SITE, DUNHILL ROAD, KILBARRY,
WATERFORD CITY, CO. WATERFORD**

Submitted to:

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1.0 INTRODUCTION

This document represents the methodology and findings of an Environmental Liability Risk Assessment (ELRA), undertaken for the Kilbarry Landfill, Dunhill Road, Kilbarry, Waterford City, Co. Waterford. The document has been prepared by Golder Associates Ireland Ltd (Golder) on behalf of Waterford City Council. The document has been produced in compliance with Condition 8 (Restoration and Aftercare) and condition 11 (Charges & Financial Provision) of Waste Licence Register No. W0018-01. It is noted that no mention to ELRA is made in the waste licence as it predates the concept. This ELRA has been produced in response to a letter sent by the Agency to all licensed sites on the 13th of August 2008 seeking to assess the take-up of the ELRA concept by EPA licensed sites.

In addition, the Environmental Liability Directive 2004/35/EC which seeks to provide for the prevention and remediation of environmental damage and gives form and substance to the polluter pays principle was consulted in the preparation of this ELRA. It seeks to promote good environmental practice by inducing those concerned to adopt measures and develop practices that minimise the risks of environmental damage and reduce their exposure to financial liabilities.

A Closure Restoration Aftercare Management Plan (CRAMP) was sent to the Agency in September 2003. According to correspondence (Ref: cb/ol/letters08) sent to the Department of Environment, Heritage and Local Government from Director of Services and Environmental Services at Waterford City Council, it is envisaged that restoration of Kilbarry Landfill will be completed by summer of 2009.

The methodology outlined in the EPA *Guidance on Environmental Liability Risk Assessments, Residual Management Plans and Financial Provision* as well as the EU draft regulations transposing the Environmental Liability Directive have been followed in the preparation of this document.

2.0 SCOPE OF ENVIRONMENTAL LIABILITY RISK ASSESSMENT

The scope of this has been developed using the EPA Guidance and includes the following:

- A review of the activities that were and are carried out at the site is presented in section 3.3;
- The initial screening approach is set out in section 4.1;
- An examination of the potential hazards, pathways and associated receptors is set out in section 4.3, 4.4 & 4.5;

- The Known and Unknown liabilities associated with the closure and capping of the landfill are presented in section 4.2 and 4.3 with detailed figures presented in Appendix 2;
- Examination and assessment of mitigation measures at the site are presented in section 4.6;
- Conclusions are set out in section 4.7;
- The financial provision element of the ELRA is dealt with in section 4.; and
- Figure 1 Rev A and associated site photographs are presented in appendix 5.

3.0 SITE DETAILS

Kilbarry landfill is located (National Grid Reference 2598E 1103N) on the outskirts of Waterford City on the Dunhill Road.

The entire site occupies an area of 20.1 hectares. Land use surrounding the site is a mixture of open flat farmland with wetland to the south-east. The area to the north and west of the site is a mixture of residential and commercial properties. The landfill was in operation for 40 years until its closure in 2005 and has since been capped and a gas management system has been installed. The landfill opened in the mid 1960's but didn't become very active until the 1970's. A mixture of commercial, domestic and mixed municipal waste was accepted at the site until 2003 under Waste Licence W0018-01 when commercial waste deposition ceased. Waste license W0018-01 for the site was issued on the 19th of October 2001.

The landfilling of waste at the site has resulted in the formation of a mound of waste above ground level. The waste body has a maximum height of 20mOD in the centre of the site. The remainder of the site has a maximum height of 17.5mOD and a base level of 2 m to 3 mOD on the edge of the site. The final stage of the landfill consisted of a fully engineered cell in the north of the site. This cell comprised a total void size of 35,000 m³ and was constructed between 2002 and 2004. According to figures supplied by Kilbarry Landfill management, the total estimated wastes deposited at closure amounted to 1,112,410 m³. A topographical survey drawing indicating the current (June 2008) conditions is presented in Appendix 5.

3.1 Geology

The geology of the City is vital to the natural environment of Waterford City as the geology shapes the landscape and determines the overlying soil types and vegetation, all of which is integral to supporting a diverse flora and fauna. The city of Waterford stands on a bedrock of

rhyolitic volcanic rock; slaty mudstone formed about 450 million years ago (mya), during the Ordovician period, and reddish sandstone and conglomerate from the Devonian “Old Red Sandstone”, (ORS), period about 350 million years ago.

The bedrock beneath the site is classified as a Regionally Important Aquifer using the classification system prepared by the Geological Survey of Ireland (GSI). The direction of groundwater flow is from the south to the north/north west. A well search identified that there are no beneficial users of groundwater within 500 m of the site and all of the residents within 1 km of the site are connected to the Public Kilbarry water supply.

3.2 Hydrogeology

The major local discharge zone for the recharge area is Kilbarry Bog in which the landfill sits. The remaining areas of the bog to the south and east are now form a National Heritage Area.

The primary receptors of the identified environmental hazards include groundwater, surface water and the atmosphere. The secondary receptors of the environmental hazards would include humans, flora, fauna and livestock.

3.3 Activities Undertaken at the Site

The following processes and activities have been undertaken at the site in accordance with Schedule A: Waste Acceptance of Waste Licence W0018-01.

- i. The disposal of non-hazardous household, commercial and industrial waste;
- ii. The disposal of de-watered non-hazardous industrial treated sewage sludge/filtercake;
- iii. The disposal of treated industrial non-hazardous sludges;
- iv. The disposal of construction and demolition waste;
- v. Waste for recycling and recovery at the Civic waste site; and
- vi. Waste for recycling and recovery at the metal recovery area.

Moreover, a civic amenity site is located within the main site entrance accepting the following range of wastes for recycling:

- Metal;
- Timber;
- Cardboard;
- Batteries;
- Engine oil;
- Glass bottles;
- Fluorescent tubes; and
- Energy saving light bulbs.

4.0 ENVIRONMENTAL LIABILITY RISK ASSESSMENT

In the following, an approach as described in the ‘*Guidance Environmental Liability Risk Assessment, Residuals Management Plans incorporating Financial Provision*’ (EPA, 2006) has been adopted to describe and assess the ELRA for the facility. The Guidance proposes a system whereby higher risk facilities can reduce their risk profile through risk management in order to reduce the costs of implementing financial provision.

A systematic step-wise approach is outlined in the Guidance and has been adopted into this document:

- *Step 1 – Initial Screening & Operational Risk Assessment*
- *Step 2 – Preparation of a Closure, Restoration and Aftercare Management Plan (CRAMP) for KNOWN liabilities*
- *Step 3 – Environmental Liability Risk Assessment (ELRA) for UNKNOWN liabilities*
- *Step 4 – Identification of Financial Provision (FP) and Instruments*

4.1 Step 1 - Initial Screening and Operational Risk Assessment

Environmental risk may be assessed by considering the probability of occurrence of a defined hazard and the magnitude of the consequences of that occurrence.

To characterise and assess the risks identified in step 1 the risk assessment model set out in the EPA’s Guidance Document has been employed.

The risk assessment scores presented in Table 2 are based on the risk assessment methodology contained in Appendix 3.

The rationale for the likelihood and severity weightings is presented in Appendix 1.

These assessments have been undertaken with consideration to the findings outlined in Step 1 of this report and are based on the residual risk posed by the landfill after assessment of the engineering and operational controls deployed at the site.

A register of the risks, which is based on the site specific characteristics and the Classification Tables for Occurrence and Severity included in the Agency’s guidance document is presented in Table 2 below. The risk score is calculated by multiplying the likelihood score by the severity score. The assignment of the severity rating scores is based on the site specific assessment described in section 4.

Using the risk categorisation calculation tables presented in the Guidance document, the site can be given an accurate score and hence a risk category. The procedure is arranged using a combination of complexity, environmental sensitivity and the site's compliance record.

Using the tables set out Appendix B (IPPC & Waste Activities Complexity look-up Tables) of the Guidance document, sites can be given a risk banding ranging from G1 – least complex to G5 – most complex.

Closed landfill facilities are set a complexity rating of G4. This complexity band equates to an automatic category **3** status according to the guidance.

Table 2: Environmental Risk Register for the Site

Risk ID	Description of Risk	Likelihood Score	Severity Score	Risk Score
R1	Discharge of landfill gas to sub-soils.	2	3	6
R2	Discharge of leachate to groundwater.	2	3	6
R3	Cracking of Landfill's capping system resulting in uncontrolled release of landfill gas to the atmosphere.	2	3	6
R4	Failure of the Landfill's gas management infrastructure, resulting in uncontrolled release of gas to the atmosphere.	2	3	6
R5	Failure of leachate pipe work or lagoon resulting in release of leachate to surface water.	2	2	4
R6	Operational accident resulting in release of oils/chemicals to the Landfill surface water.	1	2	2
R7	Uncontrolled landfill fire resulting in a release of noxious gas to the environment	1	4	4
R8	Uncontrolled landfill fire resulting in contamination of surface water from the water/foam and litter discharged during fire fighting.	1	4	4

4.2 Step 2 - Closure, Restoration, Aftercare Management Plan (CRAMP) – Known Liabilities

A Closure, Restoration Aftercare Management Plan (CRAMP) was submitted to the Agency in September 2003. Costs associated with the closure and restoration plan are presented in Appendix 2.

4.3 Step 3 - Environmental Liability Risk Assessment (ELRA) – Unknown Liabilities

The methodology used for the risk identification component of the ELRA is as follows;

1. Identification of possible **hazard sources**;
2. Identification of potential hazard **pathways**; and,
3. Identification and assessment of environmental **receptors** for those identified pathways.

The aim of the process is to provide an analysis of the environmental conditions at the landfill so to provide a baseline by which environmental liabilities may be established and assessed.

Identification of the environmental pathways and receptors has been undertaken with reference to Waste Licence W0018-01 of 2001, and in light of the environmental monitoring undertaken over the past seven years.

4.3.1 Identification of Environmental Hazards

The major environmental hazards associated with landfilling activities involve an emission of either hydrocarbons/chemical, leachate or landfill gas that has the potential to result in pollution of the receiving environment. In addition noise monitoring and dust deposition monitoring is carried out as per the licence. A total monitoring cost of €15,342.80 was spent in 2008.

4.3.2 Hydrocarbons/ Chemicals Stored on Site

The landfill has been closed since 2003 and capping will be completed in summer 2009. The civic amenity site is located at the main entrance to the site and no chemicals or hydrocarbons are used or stored on-site. Site vehicles are all fuelled off-site.

4.3.3 Leachate

A leachate collection drain, consisting of a 150mm slotted HDPE pipe around the perimeter of the waste body which directs leachate to 5 sumps at various points on the perimeter.

Leachate is pumped from the sumps via an 80mm rising main to a lined lagoon at the Northern tip of the landfill. In addition to this there are 13 additional pumped boreholes located throughout the waste body accessed by manholes on the upper level of the site. These boreholes provide coverage of the landfill area for leachate abstraction. The borehole pumps and perimeter sump pumps are controlled from panels located to the north and east of the site. It has been found that since the final capping little leachate has been pumped to lagoon. This would be assumed to be due to the inability of rain waters to permeate the waste body.

At the point of outlet from the lagoon to sewer there is a sump which contains monitoring equipment for the determination of pH, dissolved methane and flow. The leachate is released from the lagoon via a gravity feed and a valve allows a percentage of the outflow into the sump where readings can be taken for the prescribed parameters set out in table F.5.5 of Schedule F: Monitoring of the waste licence.

While leachate is being released, the quality is monitored daily. Any breach of limits requires the flow to be stopped and an alternative disposal method used, e.g. tanker and haul the liquid for disposal.

4.3.4 Landfill Gas

Commercial and industrial wastes have been deposited historically at Kilbarry Landfill. These wastes contain some biodegradable materials such as paper, wood, textiles etc. Gases have formed in the landfill due to the development of anaerobic conditions.

In total, 81 gas abstraction wellheads are currently installed at Kilbarry Landfill and are connected by a network of 110mm and 160mm pipes, which connect via 5 manifolds to a 225mm ring main. This terminates at a compound west of the leachate lagoon where the gas is flared. Currently 1 No.1000 m³/hr open flare is operational onsite with plans to install a 500 m³ enclosed flare. All collection pipes fall back towards the wellheads to allow condensate to exit the system.

A total of 5 no. condensate traps were placed onsite, four near the manifolds and one approximately 25m before the flare. The trap at the flare is not in the waste body and therefore the condensate is pumped to the adjacent leachate lagoon for disposal. In addition to the gas abstraction system there are a series of boreholes around the perimeter of the waste body for the monitoring of landfill gas to ensure migration is not occurring.

Most recently, residential dwellings were built within 250m of the site and 7 new boreholes were installed between the landfill and these houses specifically to ensure gas was not migrating in this direction. These boreholes are currently monitored daily but due to the active abstraction system in place and the lack of evidence of gas migration this monitoring is going to be scaled back to a weekly basis in agreement with the Agency.

4.3.5 Dust Deposition

Dust deposition surveys were undertaken at 7 no. locations three times per year in 2008 as specified in Tables F.3 and F.3.2 of the waste licence. Dust samples were set out at the landfill for a period of between 28 and 30 days. The samples were then sent to Bodycote Consultus Laboratories in Cork for gravimetric analysis in accordance with standard methodology. Over the course of the three dust monitoring surveys, elevated levels of dust were recorded at 2 locations in total over the year. This elevation was attributed to on-going rehabilitation works at the site.

4.3.6 Noise

Noise monitoring was undertaken at 7 no. on-site locations and 4 no. noise sensitive locations once during 2008 as specified in schedule F.4.2 of the waste licence. Although there were some elevations above the 55 dB(A) limit as specified in the licence, the sources of this noise were attributed to off-site activities.

4.4 Identification of Environmental Pathways

The primary pathways for hazards from the waste body to the environment is through the atmosphere (emissions to air), overland (emissions to surface water or land) or through the ground (emissions to the soil or groundwater).

4.4.1 Air

Metrological data is obtained from Waterford Regional Airport and indicates that the prevailing wind directions is to the south and west, while the average wind speed is 10.6 km/hr.

4.4.2 Groundwater

Groundwater quality is measured by samples taken by the Agency on a quarterly basis at the 7 no. active groundwater monitoring locations situated around the site. All parameters required under Table F.5.5 of Schedule F of Waste Licence Register Number W0018-01 are analysed for.

Currently, groundwater samples retrieved from the monitoring boreholes indicate that some pollution of the groundwater has taken place with several parameters being above guideline values. Currently, 7 no. groundwater monitoring boreholes are active at the site. These are labelled GW2, GW4, GW5, GW6, GW15, GW16, GW17.

4.4.3 Surface Water

The EPA carry out surface water monitoring at the site at designated monitoring locations on a frequency in line with the requirements of Waste Licence W0018-01. The analysis indicates that the surface water has been impacted upon by the presence of historic wastes that were deposited at the site in the past. It is noted that the site has been a landfill since the 1960's and at that time, the lining of landfills and protection of the environment was not enforced. However, a surface water management programme was recently submitted to the Agency and was approved. Funding has been made available which will enable the existing surface water ponds to be repaired and allow the construction of further collection ponds bringing the total on site to 4.

4.5 Identification of Environmental Receptors

4.5.1 Local Air Quality

Quarterly monitoring of ambient air is carried out by Odour Monitoring Ireland. The conclusions from the reports indicate that the air quality is good with hydrogen sulphide levels at levels below 3 ppm and general odour quality less than 45 odour units m³.

The results of the air quality assessment found that concentrations of VOC, mercaptans and sulphide compounds were below detection levels.

4.5.2 Flora and Fauna

Kilbarry landfill is located in Kilbarry bog. Kilbarry bog (Provisional National Heritage Area pNHA) comprises an area of reed swamp, freshwater marsh, wet grassland and scrub. It is a site of conservation importance for a variety of reasons:

- It is the only remaining wetland of its type of significance in the vicinity of Waterford City;
- It supports a variety of wetland vegetation types and plant species; it is the site of records for the scarce Summer Snowflake;

- It supports a good diversity of birds, including an important breeding population of Reed Warbler; and a range of scarce invertebrate species has been recorded from this site; and
- The site is also used by Otter, a protected species in Ireland and one that is listed on Annex II of the E.U. Habitats Directive. (NPWS, 2005).

Waterford City Development Plan 2007-2013 identifies Kilbarry Bog as being important for biodiversity. The bog is considered of national importance for Reed Warbler and of regional importance for aquatic biodiversity. In a recent report the National Parks & Wildlife Service (NPWS) recommended that consideration be given to designating the site as a Nature Reserve (Waterford City Council, 2008).

4.5.3 Local Population and Land Use

The surrounding area around the landfill is dominated by industrial, commercial and residential premises with Waterford Crystal located within 0.5 km of the site. Waterford Institute of Technology is located approximately 1 km from the site also. Kilbarry landfill is also situated close to the Six Cross Business Park. The land use is dominated by industrial premises. According to the 2006 census, the population of Waterford City grew to 45,800 over the course of that year.

4.6 Identification and Assessment of Mitigation Measures

4.6.1 Lining System

The site has been operational for over 40 years and is unlined.

4.6.2 Capping System

The capping system for the Landfill was developed considering the requirements of the EPA's Landfill Manuals – Site Design and the UK Environment Agency's Technical Guidance on Capping and Restoration of Landfills. The installation of the cap was supervised and project managed by MCOS RPS Plc. Consultant Engineers and a CQA program was completed for its construction.

The capping system comprises, starting at the waste surface and working upwards to the completed restored surface:

- 80mm layer of quarry fines with maximum aggregate size of 20mm free of sharp stones;
- Gas collection layer – Geosynthetic layer with Geotextile filter/separator on top and bottom and similar or equivalent to Finesse Pozidrain 6S240D/NW8;
- Barrier layer – Geotextile protection layer similar or equivalent to Bentomat Cap 75 geosynthetic clay liner, GCL, with a minimum hydraulic conductivity of 1×10^{-9} m/s;
- Surface water drainage layer – Geosynthetic layer with Geotextile filter/separator on top and bottom similar or equivalent to Pozidrain 6S240D/NW8;
- Subsoil – 850mm silty sandy gravel; and
- Topsoil – 150mm.

4.6.3 Landfill Gas Management System

The gas management system or components of it, will be employed and maintained as long it is required to ensure control and management of landfill gas in compliance with the waste licence.

4.6.4 Surface Water Management System

Three (3 no.) surface water monitoring ponds were provided in accordance with licence conditions 7.6, 9.3 and 9.6. Surface water was planned to be diverted to these ponds for monitoring and storage before being discharged into peripheral drains. This situation had to be re-evaluated following the completion of the final capping layer.

The landfill falls from a high central level outwards to the external edges of the cap. A continuous surface water drain and compacted clay bund have already been proposed as part of the final restoration. The surface water from this upper circumferential drain would then be collected at 4 points before being conveyed to the lower level area via heavy duty PVC pipes. The drain will be inclined to each collection point and each pond will serve an estimated 25% of the site area.

The following surface water management program proposal which was accepted by the Agency on the 26th of November 2008 (Ref: W0018-01/ap01cok.doc) is as follows:

All existing surface water ponds that have been idle since the closure of the landfill be reinstated and repaired.

1. A fourth surface water pond will be constructed in the south of the site. This will be lined with a HDPE layer and secured and ballasted to prevent flotation due to tidal conditions.
2. Discharge trigger levels for surface water will be proposed to the Agency within 8 weeks based on sampling results from surrounding water courses.
3. A schedule of grab sampling will be initiated rather than the continuous monitoring. The frequency will be altered to reflect a weekly monitoring program whereby the current required parameters of pH, Conductivity and Total Organic Carbon will be analysed for. Should the samples reveal that the collected waters are below trigger level values, they will be allowed to be discharged to the peripheral drains. However, if the samples exceed the trigger levels, the surface water will be collected in the ponds and tankered and discharged to the leachate lagoon for later disposal to the foul sewer.
4. The weekly grab sampling schedule will be maintained for a period of 6 months after which point if the analysed parameters prove to be consistently clean, the monitoring frequency period will be addressed once more.

Currently, grass growth on the east and south of the capped landfill is plentiful with further growth already visible on rest of the site. This will assist greatly in the capture and control of surface water on the landfill.

4.6.5 Identification and Assessment of Operational Control Measures

Environmental Management System

Kilbarry Landfill operates an Environmental Management System. The system ensures continual improvement through a process of internal audit, management review and the setting of target and objectives relating to environmental hazards.

Waste Acceptance Procedures

Waste acceptance at Kilbarry Landfill was carried out in compliance with the requirements of Council Decision 2003/33/EC on establishing criteria and procedures for the acceptance of waste at landfills, and pursuant to Article 16 and Annex II of Council Directive 1999/31/EC on landfill waste. Waste acceptance at the site comprised waste characterisation, compliance testing and on-site verification.

Emergency Response Procedures

Kilbarry Landfill has developed site specific emergency response procedures. These procedures outline the actions that are required to be undertaken in the event of an emergency and cover both general and specific emergency situations.

Emergency situations covered by these procedures include:

- Activation of alarm;
- Gas in building emergency;
- Accident;
- Fire;
- Overturned vehicle;
- Spillage; and
- Handling hazardous and chemical wastes.

4.7 Conclusion

Considering the hazard, pathway and receptor model for the site, and in light of an assessment of current mitigation measures employed at the Landfill, the following have been identified and outlined as environmental risks at the Site.

Table 1 is not meant to be a comprehensive list of all potential environmental liabilities associated with the Landfill. The table considers those environmental liabilities that have the potential to have significant financial implication on the Landfill, both in terms of the cost associated with the repair of infrastructure and the cost arising from the environmental remediation that may be required if the incident was to occur.

Table 1: Environmental Risks Identified at Kilbarry Landfill

Risk Register No.	Description of Risk
R1	Discharge of landfill gas to sub-soils.
R2	Discharge of leachate to groundwater.
R3	Cracking of Landfill's capping system resulting in uncontrolled release of landfill gas to the atmosphere.
R4	Failure of the Landfill's gas pipe work or flares resulting in uncontrolled release of gas to the atmosphere.
R5	Failure of leachate pipe work or sumps resulting in release of leachate to surface water.
R6	Operational accident resulting in release of oils/chemicals to the Landfill surface water management system
R7	Landfill fire resulting in a release of noxious gas to the environment
R8	Landfill fire resulting in contamination of surface water from the water/foam and litter discharged during fire fighting.

4.8 Step 4 - Financial Provision – Known and Unknown Liabilities

The financial provision requirements for the site have been assessed in relation to the known and unknown liabilities associated with the site. Details of the financial provision for these liabilities spent to date at the site and monies that are expected in 2009 are presented in Appendix 2.

4.9 Known Liabilities

A full break-down of costs associated with the KNOWN closure and remediation of the Kilbarry Landfill area from the Department of Environment, Heritage & Local Government (DEHLG) Landfill Remediation Grant Scheme is presented in Appendix 2. A full breakdown of associated closure costs from 2006 to present is also presented.

The table presented in Appendix 2 has been compiled by Waterford City Council and issued by the DEHLG and can be verified by contacting Waterford City Council directly.

4.10 Financial Provision for Unknown Environmental Liabilities

In terms of the UNKOWN environmental liabilities at the site, Waterford City Council as a public body is insured with the Irish Public Bodies Mutual Insurances Ltd. Public liability insurance of €12.7 million is already in place.

However, following detailed advice from the Agency, it is apparent that separate and specific environmental liability insurance cover be prepared in order to cover the costs associated with future unknown liabilities. This insurance procedure is currently on-going.

It has been made clear by the Agency that when the appropriate insurance is in place, provision must be made that allows the Agency access to the insurance funds in respect to the unknown liabilities at the site.

Details of the environmental liability cover at the site are presented in appendix 4.

5.0 REVIEW OF THE ELRA AND FINANCIAL PROVISION

The Restoration and Aftercare Plan will be reviewed as necessary to reflect any changes on site or at a minimum every three years following agreement with the Agency. Any Changes to the plan will be documented and submitted to the Agency for approval.

APPENDICES

APPENDIX 1

COMPLETED ENVIRONMENTAL LIABILITIES RISK ASSESSMENT TABLES

Table A1: Environmental Liabilities Risk Assessment Tables

Risk ID	Description of Risk	Environmental Effect	Likelihood Score ^{Note 1}	Basis of Likelihood	Severity Score ^{Note 2}	Basis Of Severity	Risk Score ^{Note 3}
R1	Discharge of landfill gas to sub-soils.	<p>Build up of gases in confined spaces resulting in the potential for asphyxiation.</p> <p>Release of greenhouse gases</p> <p>Risk of explosion</p>	2	<p>While it is considered that landfill liner will deteriorate over time, the amount of deterioration in the first 30 years of its operation is expected to be minimal and the risk that deterioration of liner with cause environmental harm is considered low.</p>	3	<p>If liner deterioration were to become acute, the cost of detection of the deterioration and repair of the lining system would be significant.</p> <p>The discharge of gas into sub soil surrounding the site would be significant over the short term, but would have a minor long term effect on the environment.</p>	6

Table A1: Environmental Liabilities Risk Assessment Tables, continued

Risk ID	Description of Risk	Environmental Effect	Likelihood Score ^{Note 1}	Basis of Likelihood	Severity Score ^{Note 2}	Basis Of Severity	Risk Score ^{Note 3}
R2	Discharge of leachate to groundwater.	Groundwater contamination	2	While it is considered that landfill liner will deteriorate over time, the amount of deterioration in the first 30 years of its operation is expected to be minimal and the risk that deterioration of liner will cause environmental harm is considered low .	3	<p>The cost of repair of the lining system as outlined above would, be significant.</p> <p>The discharge of leachate to groundwater has the potential to cause significant long term harm to the underlying aquifer. It should be noted however, that quality of the receiving groundwater has been previously affected by pollution from the existing unlined landfill that has been in place for several decades.</p>	6

Table A1: Environmental Liabilities Risk Assessment Tables, continued

Risk ID	Description of Risk	Environmental Effect	Likelihood Score ^{Note 1}	Basis of Likelihood	Severity Score ^{Note 2}	Basis Of Severity	Risk Score ^{Note 3}
R3	Cracking of Landfill's capping system resulting in uncontrolled release of landfill gas to the atmosphere.	Release of greenhouse gases Risk of explosion	2	The landfill cap was designed, constructed and installed in accordance with EPA Guidelines, therefore the risk of the cap cracking is considered low .	3	In the event of cracking of the Landfill cap the cost of locating and repairing the crack would be significant . The discharge of gas into atmosphere surrounding the site would be significant over the short term, but would have an insignificant long term effect on the environment.	6

Table A1: Environmental Liabilities Risk Assessment Tables, continued

Risk ID	Description of Risk	Environmental Effect	Likelihood Score ^{Note 1}	Basis of Likelihood	Severity Score ^{Note 2}	Basis Of Severity	Risk Score ^{Note 3}
R4	Failure of the Landfill’s gas management infrastructure, resulting in uncontrolled release of gas to the atmosphere.	Release of greenhouse gases Risk of explosion	2	Due to the advanced monitoring system, the preventative maintenance program in place the risk of failure of the infrastructure is considered to be low .	3	In the event failure of the gas management system the cost of repair is expected to be significant . Due to its short term nature, the excepted environmental impact is considered to be minor .	6

Table A1: Environmental Liabilities Risk Assessment Tables, continued

Risk ID	Description of Risk	Environmental Effect	Likelihood Score ^{Note 1}	Basis of Likelihood	Severity Score ^{Note 2}	Basis Of Severity	Risk Score ^{Note 3}
R5	Failure of leachate pipe work or lagoon resulting in release of leachate to surface water.	Contamination of soil, ground water and surface water.	2	Due to the advanced monitoring system, and preventative maintenance program, the risk of failure of the infrastructure is considered to be low .	2	In the event of failure of leachate management infrastructure the cost of repair to the system is considered to be minor . In the event that leachate contaminated soil or groundwater, the environmental impact would be considered minor due to the minimal volume of discharge expected.	4

Table A1: Environmental Liabilities Risk Assessment Tables, continued

Risk ID	Description of Risk	Environmental Effect	Likelihood Score <small>Note 1</small>	Basis of Likelihood	Severity Score <small>Note 2</small>	Basis Of Severity	Risk Score <small>Note 3</small>
R6	Operational accident resulting in release of oils/chemicals to the Landfill surface water.	Contamination of soil, ground water and surface water.	1	The risk of an operational accident resulting in the spillage of either hydrocarbons or chemicals is considered very low due to the fact that that there are no continuing landfilling operations on site and operations ceased in 2005.	2	In the event on a hydrocarbon or chemical spill contaminating soil or groundwater, the environmental impact would be considered minor due to the minimal volume of discharge possible.	2

Table A1: Environmental Liabilities Risk Assessment Tables, continued

Risk ID	Description of Risk	Environmental Effect	Likelihood Score <small>Note 1</small>	Basis of Likelihood	Severity Score <small>Note 2</small>	Basis Of Severity	Risk Score <small>Note 3</small>
R7	Uncontrolled landfill fire resulting in a release of noxious gas to the environment	Release of greenhouse gases. Potential harm to the local population.	1	Due to the emergency response procedures in place, the capping design and the operational practices which were used to deposit waste, the risk of a landfill fire is considered to be very low .	4	The cost associated with a release of noxious gas/ smoke that would arise from a landfill fire has the potential to result in severe impact on the local population.	4

Table A1: Environmental Liabilities Risk Assessment Tables, continued

Risk ID	Description of Risk	Environmental Effect	Likelihood Score <small>Note 1</small>	Basis of Likelihood	Severity Score <small>Note 2</small>	Basis Of Severity	Risk Score <small>Note 3</small>
R8	Uncontrolled landfill fire resulting in contamination of surface water from the water/foam and litter discharged during fire fighting.	Pollution of surface water from contaminated fire fighting water and litter.	1	Due to the emergency response procedures in place, the capping design and the operational practices which were used to deposit waste, the risk of a landfill fire is considered to be very low .	4	The cost of remediation of local water course from the contamination caused by a landfill has the potential to be severe .	4

Note 1 **Rating for likelihood score is based on Risk Assessment Table A3.1 in Appendix 3**

Note 2 **Rating for Severity is based on Risk Assessment Table A3.2 in Appendix 3**

Note 3 **Risk score is based on likelihood of the hazard occurring and the severity of that hazard. The relationship between likelihood, severity and overall risk is shown in Table A3.3 in Appendix 3**

APPENDIX 2
FINANCIAL COST MODEL

Table A2 Most Likely Cost Financial Model

Risk Register No.	Likelihood Score	Likelihood of Occurrence Range <small>Note 1</small>	Median Likelihood of Occurrence	Severity Score	Likely Cost Range <small>Note 2</small>	Median Likely Cost	Most Likely Cost Scenario <small>Note 3</small>
R1	2	5-10%	7.5%	3	€100,001- €200,000	€ 150,000	€ 11,250
R2	2	5-10%	7.5%	3	€100,001- €200,000	€ 150,000	€ 11,250
R3	2	5-10%	7.5%	3	€100,001- €200,000	€ 150,000	€ 11,250
R4	2	5-10%	7.5%	3	€100,001- €200,000	€ 150,000	€ 11,250
R5	2	5-10%	7.5%	2	€10,0001 - €100,000	€ 55,000	€ 4,125
R6	1	0-5%	2.5%	2	€10,0001 - €100,000	€ 55,000	€ 1,375
R7	1	0-5%	2.5%	4	€200,001 - €500,000	€ 350,000	€ 8,750
R8	1	0-5%	2.5%	4	€200,001 - €500,000	€ 350,000	€ 8,750
R9	1	0-5%	2.5%	4	€200,001 - €500,000	€ 350,000	€ 8,750
R10	1	0-5%	2.5%	2	€10,0001 - €100,000	€ 55,000	€ 1,375
R11	2	5-10%	7.5%	2	€10,0001 - €100,000	€ 55,000	€ 4,125
R12	2	5-10%	7.5%	2	€10,0001 - €100,000	€ 55,000	€ 4,125
Total							€ 86,375

Note 1 See Table A3.1 for likelihood of occurrence ranges.

Note 2 See Table A3.2 for cost ranges.

Note 3 The most likely cost scenario is based on the median likelihood of occurrence, multiplied by the median likely cost.

**Department of Environment, Heritage & Local Government
Landfill Remediation Grant Scheme**

Local Authority	Waterford City Council				
Landfill Site	Kilbarry	Claim No.	5		
Grant Ref No	LR/09/08	Period of Claim	08/07/2008 – 02/12/2008		
Summary of Expenditure Details					
Approved Category	Approved Expenditure	Expenditure previous claims	Expenditure this claim	Total Expenditure claimed to date	Approved Expenditure - to be claimed
Preparatory Works	€ 130,298.14	€120,298.14	Nil	€120,298.14	€10,000.00
Leachate Collection	€ 182,541.29	€80,496.79	€72,488.89	€152,985.68	€29,555.61
Gas Collection	€2,341,605.90	€1,706,387.70	€223,730.44	€1,930,118.14	€411,487.76
Capping	€2,682,126.18	€2,442,802.36	€226,028.04	€2,668,830.40	€13,295.78
Landscaping	€1,209,910.00	Nil	Nil	Nil	€1,209,910.00
Project Management	€ 122,713.69	€52,713.69	€45,517.98	€98,231.67	€24,482.02
Other (Surface Water Management)	€ 350,000.00	Nil	Nil	Nil	€350,000.00
Expenditure Total	€7,019,195	€4,402,698.68	€567,765.35	€4,970,464.03	€2,048,731.17

Summary of Grant Claim Details

	Total Grant Approved	Grant previous claims	Grant this claim (75% of expenditure this claim)	Total Grant claimed to date	Approved Grant – to be claimed
Grant Total	€5,264,396	€3,302,024.01	€425,824.01	€3,727,848.02	€1,536,547.98

Return Form to: Waste Infrastructure & Regulation Section, Department of Environment, Heritage & Local Government, Custom House, Dublin 1.

**Department of Environment, Heritage and Local Government Landfill Remediation
Grant Application/Renewal of Grant Scheme**

Local Authority	Waterford City Council
Name of Landfill	Kilbarry Landfill LRG/05/06
EPA Licence Reference No.	18-1
Confirm that Restoration & Aftercare Plan is agreed with the Agency	Yes
Estimated Net-Total Cost of Plan	€7,019,194 (Est. Cost in '06 €6,943,416
Indicate if grant assistance was approved in 2006 or 2007	'06 -

Categories	Total costs incurred to 31/12/06	Total costs incurred to 31/12/07	Total costs estimated for 2008	Total estimated costs from 2009 onwards
1. Preparatory works (incl. design & consultation fees.	€73,650.58	€120,298.14	€10,000.00	
2. Leahate Collection	€71,493.76	€80,496.79	€102,044.00	
3. Gas Collection	€186,719.45	€1,523,878.80	€596,460.00 €182,508.90 *	
4. Capping	€2,518,536.75	€2,320,394.80	€238,192.00 €123,539.38 *	
5. Landscaping			€500,000.00	€709,910.00
6. Project Management	€50,078.09	€52,713.69	€50,000.00	€20,000.00
7. Other (Specify) Surface water mgmt Extracts			€350,000.00 €38,758.89	
Total Costs	€2,900,478.63	€4,097,782.22	€2,191,503.17	€729,910.00

*Included in claim 4

Additional Comments:

All grant aid approved has been claimed. Approval for additional expenditure of €2,615,285.00 now sought. The current estimated cost of €7,019,195.00 is €75,779.00 above the '06 estimate.

Signed Director of Service	Colette Byrne
County/City Council	Waterford City Council
Date	28/07/08

APPENDIX 3

RISK ASSESSMENT TABLES

Table A3: 1 – Risk Assessment - Likelihood

Rating	Likelihood		
	Description	Likelihood of Occurrence (%)	Category
1	Less than 5% of hazard occurring in 30 year period	0-5	Very Low
2	Low chance (5-10%) of hazard occurring in 30 year period	5-10	Low
3	Medium chance (10-20%) of hazard occurring in 30 year period	10-20	Medium
4	High chance (20-50%) chance of hazard occurring in 30 year period	20-50	High
5	Greater than 50% chance of the hazard occurring in 30 year period	>51	Very High

Table A3: 2 – Risk Assessment - Severity

Rating	Severity		
	Description	Cost of Remediation (€)	Category
1	No damage or negligible change to the environment	0-10,000	Insignificant
2	Minor impact/localised nuisance	10,001-100,000	Minor
3	Moderate damage to environment	100,001- 200,000	Significant
4	Severe damage to the environment	200,001-500,000	Severe
5	Catastrophic damage to a large area, irreversible in medium term	>500,001	Catastrophic

Table A3.3 – Risk Assessment - Overall Risk

The following risk assessment matrix is based the methodology proposed in the EPA’s Guidance Documents and Assessment Tools on Environmental Liabilities Risk Assessment and Residual Management Plan incorporation Environmental Liabilities Risk Assessment.

The matrix is designed to represent risk in terms of likelihood multiplied by severity and should be read in conjunction with Risk Assessment Tables A3.1 and A3.2.

			Risk Identification Number				
LIKELIHOOD	Very High	5					
	High	4					
	Medium	3					
	Low	2					
	Very Low	1					
Very Low Risk 1-5			1	2	3	4	5
Low Risk 6- 10							
Medium Risk 11-15			Insignificant	Minor	Significant	Severe	Catastrophic
High Risks 16- 20			SEVERITY				
Very High Risks 21-25							

The above risk assessment matrix is based the methodology proposed in the EPA’s Guidance Documents and Assessment Tools on Environmental Liabilities Risk Assessment and Residual Management Plan incorporation Environmental Liabilities Risk Assessment.

APPENDIX 4

**COPY OF ENVIRONMENTAL LIABILITY INSURANCE POLICY AND PROPERTY
INSURANCE POLICY**

APPENDIX 5

FIGURES & SITE PHOTOGRAPHS

Appendix IV

PRTR 2015



| PRTR# : W0018 | Facility Name : Kilbarry Landfill Site | Filename : 11
W0018_2015_B.xls | Return Year : 2015 |

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[Guidance to completing the PRTR workbook](#)

PRTR Returns Workbook

Version 1.1.19

REFERENCE YEAR	2015
-----------------------	------

1. FACILITY IDENTIFICATION

Parent Company Name	Waterford City & County Council
Facility Name	Kilbarry Landfill Site
PRTR Identification Number	W0018
Licence Number	W0018-01

Classes of Activity

No.	class_name
-	Refer to PRTR class activities below

Address 1	Kilbarry
Address 2	Waterford City
Address 3	
Address 4	
Country	Waterford
Country	Ireland
Coordinates of Location	-7.12405 52.2422
River Basin District	IESE
NACE Code	3821
Main Economic Activity	Treatment and disposal of non-hazardous waste
AER Returns Contact Name	John McKeown
AER Returns Contact Email Address	jmckeown@waterfordcouncil.ie
AER Returns Contact Position	Waterf Council
AER Returns Contact Telephone Number	051849588
AER Returns Contact Mobile Phone Number	0872024635
AER Returns Contact Fax Number	
Production Volume	0.0
Production Volume Units	
Number of Installations	0
Number of Operating Hours in Year	0
Number of Employees	0
User Feedback/Comments	There is a difference in emissions from the flare stack since 2014. This is because the methane quantity decreased since 2014 from an average of 45% to an average of 29%.
Web Address	

2. PRTR CLASS ACTIVITIES

Activity Number	Activity Name
5(d)	Landfills
5(c)	Installations for the disposal of non-hazardous waste
5(d)	Landfills
50.1	General

3. SOLVENTS REGULATIONS (S.I. No. 543 of 2002)

Is it applicable?	
Have you been granted an exemption ?	
If applicable which activity class applies (as per Schedule 2 of the regulations) ?	
Is the reduction scheme compliance route being used ?	

4. WASTE IMPORTED/ACCEPTED ONTO SITE

[Guidance on waste imported/accepted onto site](#)

Do you import/accept waste onto your site for on-site treatment (either recovery or disposal activities) ?	
--	--

This question is only applicable if you are an IPPC or Quarry site

4.1 RELEASES TO AIR

[Link to previous years emissions data](#)

| PRTR# : W0018 | Facility Name : Kilbarry Landfill Site | Filename : 11 W0018_2015_B.xls | Return Year : 2015 |

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SECTION A : SECTOR SPECIFIC PRTR POLLUTANTS

POLLUTANT		METHOD			Please enter all quantities in this section in KGs			
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Flare 1 Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
02	Carbon monoxide (CO)	M	EN 15058:2004	NCIR by Horiba PG-250	2.4	2.4	0.0	0.0
08	Nitrogen oxides (NOx/NO2)	M	EN 14792:2005	Chemiluminescence	11.26	11.26	0.0	0.0
11	Sulphur oxides (SOx/SO2)	M	OTH	TGN 21 NDIR Absorption	36.32	36.32	0.0	0.0
01	Methane (CH4)	M	OTH	calculated as below	0.0	131834.0	0.0	131834.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

SECTION B : REMAINING PRTR POLLUTANTS

POLLUTANT		METHOD			Please enter all quantities in this section in KGs			
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Flare 1 Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
80	Chlorine and inorganic compounds (as HCl)	M	EN 1911-1 to 3:2003	Ion chromatography	0.64	0.64	0.0	0.0
84	Fluorine and inorganic compounds (as HF)	M	ISO/DIS 15713:2004	Ion chromatography	2.0	2.0	0.0	0.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

SECTION C : REMAINING POLLUTANT EMISSIONS (As required in your Licence)

POLLUTANT		METHOD			Please enter all quantities in this section in KGs			
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Flare 1 Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
230	TA Luft organic substances class 1	M	ALT	EN13649:2002 Paramagnetic	0.7	0.7	0.0	0.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

Additional Data Requested from Landfill operators

For the purposes of the National Inventory on Greenhouse Gases, landfill operators are requested to provide summary data on landfill gas (Methane) flared or utilised on their facilities to accompany the figures for total methane generated. Operators should only report their Net methane (CH4) emission to the environment under T(total) KG/yr for Section A: Sector specific PRTR pollutants above. Please complete the table below:

Landfill: Please enter summary data on the quantities of methane flared and / or utilised	Kilbarry Landfill Site				
	T (Total) kg/Year	M/C/E	Method Used		Facility Total Capacity m3 per hour
			Method Code	Designation or Description	
Total estimated methane generation (as per site model)	261138.0	E	OTH	Gassim 2.5	N/A
Methane flared	129304.0	M	OTH	landfill gas survey	0.0 (Total Flaring Capacity)
Methane utilised in engine/s	0.0				0.0 (Total Utilising Capacity)
Net methane emission (as reported in Section A above)	131834.0	C	OTH	difference between estimate	N/A

4.2 RELEASES TO WATERS

[Link to previous years emissions data](#)

| PRTR# : W0018 | Facility Name : Kilbarry Landfill Site | Filename : 11 W0018_2015_B.xls | Return Year : 2015 |

29/06/2016 10:24

SECTION A : SECTOR SPECIFIC PRTR POLLUTANTS

Data on ambient monitoring of storm/surface water or groundwater, conducted as part of your licence requirements, should NOT be submitted under AER / PRTR Reporting as th

RELEASES TO WATERS					Please enter all quantities in this section in KGs			
POLLUTANT		Method Used			QUANTITY			
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
					0.0	0.0	0.0	0.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

SECTION B : REMAINING PRTR POLLUTANTS

RELEASES TO WATERS					Please enter all quantities in this section in KGs			
POLLUTANT		Method Used			QUANTITY			
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
					0.0	0.0	0.0	0.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

SECTION C : REMAINING POLLUTANT EMISSIONS (as required in your Licence)

RELEASES TO WATERS					Please enter all quantities in this section in KGs			
POLLUTANT		Method Used			QUANTITY			
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
					0.0	0.0	0.0	0.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

4.3 RELEASES TO WASTEWATER OR SEWER

[Link to previous years emissions data](#)

| PRTR# : W0018 | Facility Name : Kilbarry Landfill Site | Filename : 11 W0018_2015_B.xls | Return

29/06/2016 10:18

SECTION A : PRTR POLLUTANTS

OFFSITE TRANSFER OF POLLUTANTS DESTINED FOR WASTE-WATER TREATMENT OR SEWER					Please enter all quantities in this section in KGs			
POLLUTANT		METHOD			QUANTITY			
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
					0.0	0.0	0.0	0.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

SECTION B : REMAINING POLLUTANT EMISSIONS (as required in your Licence)

OFFSITE TRANSFER OF POLLUTANTS DESTINED FOR WASTE-WATER TREATMENT OR SEWER					Please enter all quantities in this section in KGs			
POLLUTANT		METHOD			QUANTITY			
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
					0.0	0.0	0.0	0.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

4.4 RELEASES TO LAND

[Link to previous years emissions data](#)

| PRTR# : W0018 | Facility Name : Kilbarry Landfill Site | Filename : 11 W0018_2015_B.xls | Return Year : 2015 |

29/06/2016 10:25

SECTION A : PRTR POLLUTANTS

POLLUTANT		RELEASES TO LAND			Please enter all quantities in this section in KGs		
No. Annex II	Name	M/C/E	METHOD		QUANTITY		
			Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year
					0.0	0.0	0.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

SECTION B : REMAINING POLLUTANT EMISSIONS (as required in your Licence)

POLLUTANT		RELEASES TO LAND			Please enter all quantities in this section in KGs		
Pollutant No.	Name	M/C/E	METHOD		QUANTITY		
			Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year
					0.0	0.0	0.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

5. ONSITE TREATMENT & OFFSITE TRANSFERS OF WASTE

| PRTR#: W0018 | Facility Name: Kibarry Landfill Site | Filename: 11 W0018_2015_B.xls | Return Year: 2015 |

29/06/2016 10:18

Please enter all quantities on this sheet in Tonnes

3

Transfer Destination	European Waste Code	Hazardous	Quantity (Tonnes per Year)	Description of Waste	Waste Treatment Operation	Method Used		Location of Treatment	Haz Waste: Name and Licence/Permit No of Next Destination Facility	Non-Haz Waste: Name and Licence/Permit No of Recover/Disposer	Haz Waste: Address of Next Destination Facility	Non-Haz Waste: Address of Recover/Disposer	Name and License / Permit No. and Address of Final Recoverer / Disposer (HAZARDOUS WASTE ONLY)	Actual Address of Final Destination i.e. Final Recovery / Disposal Site (HAZARDOUS WASTE ONLY)
						M/C/E	Method Used							
Within the Country	16 06 01	Yes	0.81	lead batteries	R4	M	Weighed	Offsite in Ireland	KMK ,WCP-OY-08-0607-01		Cappincur Industrial Estate Daingean Road Tullamore Co. Offaly,Tullamore,Co Offaly,,Ireland		KMK,WCP-OY-08-0607-01,Cappincur Industrial Estate, Daingean Road,Tullamore,Co Offaly,Ireland	Cappincur Industrial Estate, Daingean Road,Tullamore,Co Offaly,Ireland
Within the Country	16 01 07	Yes	0.26	oil filters	R12	M	Weighed	Offsite in Ireland	Enva Ireland Ltd,W0184-01		Enva Ireland Ltd (Portlaoise), Clonminam Industrial Estate, Portlaoise,,Ireland		Enva Ireland Ltd,W0184-01	Enva Ireland Ltd (Portlaoise), Clonminam Industrial Estate, Portlaoise,,Ireland
Within the Country	15 01 04	No	0.3	metallic packaging	R4	M	Weighed	Offsite in Ireland	Rehab Glassco,NCWP-08-01150-02		Rehab Glassco,NCWP-08-01150-02		Rehab Glassco,NCWP-08-01150-02	Rehab Glassco,NCWP-08-01150-02
Within the Country	20 01 01	No	22.32	paper and cardboard	R3	M	Weighed	Offsite in Ireland	Starrus Eco Holdings Ltd ,W0177-03		Carrignard,Six Cross Roads Business Park,Waterford City,,Ireland		Carrignard,Six Cross Roads Business Park,Waterford City,,Ireland	Carrignard,Six Cross Roads Business Park,Waterford City,,Ireland
Within the Country	15 01 07	No	10.91	glass packaging	R5	M	Weighed	Offsite in Ireland	Rehab Glassco,NCWP-08-01150-02		Rehab Glassco,NCWP-08-01150-02		Rehab Glassco,NCWP-08-01150-02	Rehab Glassco,NCWP-08-01150-02
To Other Countries	20 01 11	No	2.06	textiles	R12	M	Weighed	Abroad	Cookstown Textile Recyclers,36 Magheralane Road		Cookstown,Cookstown,Cookstown ,Tyronne,United Kingdom		Cookstown,Cookstown,Cookstown ,Tyronne,United Kingdom	Cookstown,Cookstown,Cookstown ,Tyronne,United Kingdom
Within the Country	13 02 06	Yes	4.5	synthetic engine, gear and lubricating oils	R9	M	Weighed	Offsite in Ireland	Enva Ireland Ltd,W0184-01		Enva Ireland Ltd (Portlaoise), Clonminam Industrial Estate, Portlaoise,,Ireland		Enva Ireland Ltd,W0184-01	Enva Ireland Ltd (Portlaoise), Clonminam Industrial Estate, Portlaoise,,Ireland
Within the Country	20 01 27	Yes	2.19	paint, inks, adhesives and resins containing dangerous substances	R3	M	Weighed	Offsite in Ireland	Enva Ireland Ltd,W0184-01		Enva Ireland Ltd (Portlaoise), Clonminam Industrial Estate, Portlaoise,,Ireland		Enva Ireland Ltd,W0184-01	Enva Ireland Ltd (Portlaoise), Clonminam Industrial Estate, Portlaoise,,Ireland
Within the Country	20 01 36	No	163.71	discarded electrical and electronic equipment other than those mentioned in 20 01 21, 20 01 23 and 20 01 35	R4	M	Weighed	Offsite in Ireland	KMK ,WCP-OY-08-0607-01		Cappincur Industrial Estate Daingean Road Tullamore Co. Offaly,Tullamore,Co Offaly,,Ireland		KMK,WCP-OY-08-0607-01,Cappincur Industrial Estate, Daingean Road,Tullamore,Co Offaly,Ireland	Cappincur Industrial Estate, Daingean Road,Tullamore,Co Offaly,Ireland
Within the Country	20 01 01	No	2.42	paper and cardboard	R3	M	Weighed	Offsite in Ireland	Recycle 2000,NWCPO-14-11480-01		Rosslare Road,Unit 17A/17B Wexford Enterprise Centre,Stranfield Business Park Kerlogue Rosslare,Wexford,Ireland		Rosslare Road,Unit 17A/17B Wexford Enterprise Centre,Stranfield Business Park Kerlogue Rosslare,Wexford,Ireland	Rosslare,Wexford,Ireland
Within the Country	20 01 40	No	5.68	metals	R4	M	Weighed	Offsite in Ireland	Luke Mulrooney Scrap Metals,WPO5-04		Luke Mulrooney Scrap Metals,WPO5-04		Luke Mulrooney Scrap Metals,WPO5-04	Luke Mulrooney Scrap Metals,WPO5-04
Within the Country	20 02 01	No	712.38	biodegradable waste	R3	M	Weighed	Offsite in Ireland	AES Bord Na Mona,W0198-01		Newbridge,Newbridge,Newbridge,Kildare,Ireland		Newbridge,Newbridge,Newbridge,Kildare,Ireland	Newbridge,Newbridge,Newbridge,Kildare,Ireland
Within the Country	20 03 01	No	303.82	mixed municipal waste	R12	M	Weighed	Offsite in Ireland	Starrus Eco Holdings Ltd ,W0177-05		Carrignard,Six Cross Roads Business Park,Waterford City,,Ireland		Carrignard,Six Cross Roads Business Park,Waterford City,,Ireland	Carrignard,Six Cross Roads Business Park,Waterford City,,Ireland
Within the Country	15 01 03	No	2.0	wooden packaging	R12	M	Weighed	Offsite in Ireland	Public,Public		Public,Public,Public,Public,Ireland		Public,Public,Public,Public,Ireland	Public,Public,Public,Public,Ireland

* Select a row by double-clicking the Description of Waste then click the delete button

[Link to previous years waste data](#)

[Link to previous years waste summary data & percentage change](#)

[Link to Waste Guidance](#)

Appendix V

AER Templates 2015

Facility Information Summary

AER Reporting Year	2015
Licence Register Number	W0018-01
Name of site	Kilbarry Landfill
Site Location	Kilbarry Lane, Waterford City
NACE Code	3821
Class/Classes of Activity	Treatment and Disposal of Non Hazardous Waste
National Grid Reference (6E, 6 N)	2598E, 1103N

A description of the activities/processes at the site for the reporting year. This should include information such as production increases or decreases on site, any infrastructural changes, environmental performance which was measured during the reporting year **and an overview of compliance with your licence listing all exceedances of licence limits (where applicable) and what they relate to e.g. air, water, noise.**

ord Council Civic Amenity Site is located at the northern area of the landfill and accepts small amounts of municipa

Declaration:

All the data and information presented in this report has been checked and certified as being accurate. The quality of the information is assured to meet licence requirements.

Signature Group/Facility manager (or nominated, suitably qualified and experienced deputy)	Date

AIR-summary template

Lic No:

W0018-01

Year

2015

Answer all questions and complete all tables where relevant

- 1 Does your site have licensed air emissions? If yes please complete table A1 and A2 below for the current reporting year and answer further questions. If **you do not have** licenced emissions and **do not complete a solvent management plan** (table A4 and A5) you do not need to complete the tables

Additional information	
SELECT	

Periodic/Non-Continuous Monitoring

- 2 Are there any results in breach of licence requirements? If yes please provide brief details in the comment section of TableA1 below

SELECT	
SELECT	

- 3 Was all monitoring carried out in accordance with EPA guidance [Basic air monitoring checklist](#) note AG2 and using the basic air monitoring checklist?

AGN2

Table A1: Licensed Mass Emissions/Ambient data-periodic monitoring (non-continuous)

Emission reference no:	Parameter/ Substance	Frequency of Monitoring	ELV in licence or any revision thereof	Licence Compliance criteria	Measured value	Unit of measurement	Compliant with licence limit	Method of analysis	Annual mass load (kg)	Comments - reason for change in % mass load from previous year if applicable
	volumetric flow	Biannual	3000m3/hr	100 % of values < ELV	86.5	m3	yes	MAB	647971.5	
	volumetric flow	Biannual	3000m3/hr	100 % of values < ELV		m3	yes	MAB		
	Carbon monoxide (CO)	Biannual	50mg/Nm3	100 % of values < ELV	3.7	mg/Nm3	yes	MAB	2.8	
	Carbon monoxide (CO)	Biannual	50mg/Nm3	100 % of values < ELV	5.73	mg/Nm3	yes	MAB	3.8	
	Nitrogen oxides (NOx/NO2)	Biannual	150mg/Nm3	100 % of values < ELV	17.37	mg/Nm3	yes	MAB	13.16	
	Nitrogen oxides (NOx/NO2)	Biannual	150mg/Nm3	100 % of values < ELV	143.79	mg/Nm3	yes	MAB	95.29	

AIR-summary template				Lic No:	W0018-01	Year	2015
	Sulphur oxides (SOx/SO2)	Biannual	na		15.37		
	Sulphur oxides (SOx/SO2)	Biannual	na		64.05		
	Chlorine and inorganic compounds (as HCl)	Annual	<50mg/Nm3	100 % of values < ELV	0.98	yes	EN 1911-1 to 3:2003
	Fluorine and inorganic compounds (as HF)	Annual	<5mg/Nm3	100 % of values < ELV	2.97	yes	EN 1911-1 to 3:2003
	TA Luft organic substances class 1	Annual	20mg/m3	100 % of values < ELV	<1.08	yes	EN 13649:2001
7	Did your site experience any abatement system bypasses? If yes please detail them in table A3 below				SELECT		

Table A2: Summary of average emissions -continuous monitoring

Emission reference no:	Parameter/ Substance	ELV in licence or any revision thereof	Averaging Period	Compliance Criteria	Units of measurement	Annual Emission	Annual maximum	Monitoring Equipment downtime (hours)	Number of ELV exceedences in current reporting year	Comments
	volumetric flow	3000m3/hr		100 % of values < ELV	m3			1269		
	SELECT				SELECT					
	SELECT				SELECT					
	SELECT				SELECT					
	SELECT				SELECT					

note 1: Volumetric flow shall be included as a reportable parameter.

Table A3: Abatement system bypass reporting table

[Bypass protocol](#)

Date*	Duration** (hours)	Location	Reason for bypass	Impact magnitude	Corrective action

* this should include all dates that an abatement system bypass occurred

** an accurate record of time bypass beginning and end should be logged on site and maintained for future Agency inspections please refer to bypass protocol link

AIR-summary template		Lic No: W0018-01	Year: 2015	
Solvent use and management on site				
8 Do you have a total Emission Limit Value of direct and fugitive emissions on site? if yes please fill out tables A4 and A5			No	
Table A4: Solvent Management Plan Summary Total VOC Emission limit value		Solvent regulations Please refer to linked solvent regulations to complete table 5 and 6		
Reporting year	Total solvent input on site (kg)	Total VOC emissions to Air from entire site (direct and fugitive)	Total VOC emissions as %of solvent input	
			Total Emission Limit Value (ELV) in licence or any revision thereof	
			Compliance	
			SELECT	
			SELECT	
Table A5: Solvent Mass Balance summary				
	(I) Inputs (kg)	(O) Outputs (kg)		
Solvent	(I) Inputs (kg)	Organic solvent emission in waste	Solvents lost in water (kg)	Collected waste solvent (kg)
				Fugitive Organic Solvent (kg)
				Solvent released in other ways e.g.
				Solvents destroyed onsite through
				Total emission of Solvent to air (kg)
				Total

AER Monitoring returns summary template-WATER/WASTEWATER(SEWER) Lic No: W0018-01 Year 2015

1 Does your site have licensed emissions direct to surface water or direct to sewer? If yes please complete table W2 and W3 below for the current reporting year and answer further questions. **If you do not have** licensed emissions you only need to complete table W1 and or W2 for storm water analysis and visual inspections

2 Was it a requirement of your licence to carry out visual inspections on any surface water discharges or watercourses on or near your site? If yes please complete table W2 below summarising only any evidence of contamination noted during visual inspections

SELECT	Additional information
SELECT	

Table W1 Storm water monitoring

Location reference	Location relative to site activities	PRTR Parameter	Licensed Parameter	Monitoring date	ELV or trigger level in licence or any revision thereof*	Licence Compliance criteria	Measured value	Unit of measurement	Compliant with licence	Comments
	SELECT	SELECT	SELECT			SELECT		SELECT	SELECT	
	SELECT	SELECT	SELECT			SELECT		SELECT	SELECT	

*trigger values may be agreed by the Agency outside of licence conditions

Table W2 Visual inspections-Please only enter details where contamination was observed.

Location Reference	Date of inspection	Description of contamination	Source of contamination	Corrective action	Comments
			SELECT		
			SELECT		

Licensed Emissions to water and /or wastewater(sewer)-periodic monitoring (non-continuous)

3 Was there any result in breach of licence requirements? If yes please provide brief details in the comment section of Table W3 below

4 Was all monitoring carried out in accordance with EPA guidance and checklists for Quality of Aqueous Monitoring Data Reported to the EPA? If no please detail what areas require improvement in additional information box [External/Internal Lab Quality checklist](#) [Assessment of results checklist](#)

SELECT	Additional information
SELECT	

Table W3: Licensed Emissions to water and /or wastewater (sewer)-periodic monitoring (non-continuous)

Emission reference no:	Emission released to	Parameter/ Substance ^{Note 1}	Type of sample	Frequency of monitoring	Averaging period	ELV or trigger values in licence or any revision thereof ^{Note 2}	Licence Compliance criteria	Measured value	Unit of measurement	Compliant with licence	Method of analysis	Procedural reference source	Procedural reference standard number	Annual mass load (kg)	Comments
	SELECT	SELECT	SELECT		SELECT		SELECT		SELECT	SELECT	SELECT	SELECT			

Note 1: Volumetric flow shall be included as a reportable parameter

Note 2: Where Emission Limit Values (ELV) do not apply to your licence please compare results against EQS for Surface water or relevant receptor quality standards

Continuous monitoring
 5 Does your site carry out continuous emissions to water/sewer monitoring? Additional Information

If yes please summarise your continuous monitoring data below in Table W4 and compare it to its relevant Emission Limit Value (ELV)

6 Did continuous monitoring equipment experience downtime? If yes please record downtime in table W4 below

7 Do you have a proactive service contract for each piece of continuous monitoring equipment on site?

8 Did abatement system bypass occur during the reporting year? If yes please complete table W5 below

Table W4: Summary of average emissions -continuous monitoring

Emission reference no:	Emission released to	Parameter/ Substance	ELV or trigger values in licence or any revision thereof	Averaging Period	Compliance Criteria	Units of measurement	Annual Emission for current reporting year (kg)	% change +/- from previous reporting year	Monitoring Equipment downtime (hours)	Number of ELV exceedences in reporting year	Comments
	SELECT	SELECT		SELECT	SELECT	SELECT					
	SELECT	SELECT		SELECT	SELECT	SELECT					

note 1: Volumetric flow shall be included as a reportable parameter.

Table W5: Abatement system bypass reporting table

Date	Duration (hours)	Location	Resultant emissions	Reason for bypass	Corrective action*	Was a report submitted to the EPA?	When was this report submitted?
						SELECT	

*Measures taken or proposed to reduce or limit bypass frequency

Bund testing

dropdown menu click to see options

Additional information

Are you required by your licence to undertake integrity testing on bunds and containment structures ? if yes please fill out table B1 below listing all **new bunds and containment structures** on site, in addition to **all bunds which failed** the integrity test **all bunding structures which failed including mobile bunds must be listed in the table below, please include all bunds outside the licenced testing period** (mobile bunds and chemstore included)

- 1
- 2 Please provide integrity testing frequency period
- Does the site maintain a register of bunds, underground pipelines (including stormwater and foul), Tanks, sumps and containers? (containers refers to "Chemstore"
- 3 type units and mobile bunds)
- 4 How many bunds are on site?
- 5 How many of these bunds have been tested within the required test schedule?
- 6 How many mobile bunds are on site?
- 7 Are the mobile bunds included in the bund test schedule?
- 8 How many of these mobile bunds have been tested within the required test schedule?
- 9 How many sumps on site are included in the integrity test schedule?
- 10 How many of these sumps are integrity tested within the test schedule?

Yes	
3 years	
No	
	1
	1
	0
SELECT	
	0
	0
	0
Yes	
No	
N/A	

Please list any sump integrity failures in table B1

- 11 Do all sumps and chambers have high level liquid alarms?
- 12 If yes to Q11 are these failsafe systems included in a maintenance and testing programme?
- 13 Is the Fire Water Retention Pond included in your integrity test programme?

Table B1: Summary details of bund /containment structure integrity test

Bund/Containment structure ID	Type	Specify Other type	Product containment	Actual capacity	Capacity required*	Type of integrity test	Other test type	Test date	Integrity reports maintained on site?	Results of test	Integrity test failure explanation <50 words	Corrective action taken	Scheduled date for retest	Results of retest (if in current reporting year)
	other (please specify)	Double Skinned Tank	Waste engine oil	2500L	2500L	Structural assessment		23/06/2015	Yes	Pass		SELECT	2015	
	SELECT					SELECT			SELECT	SELECT		SELECT		

* Capacity required should comply with 25% or 110% containment rule as detailed in your licence

Has integrity testing been carried out in accordance with licence requirements and are all structures tested in

- 15 line with BS8007/EPA Guidance?

[bunding and storage guidelines](#)

No	Visual inspection
SELECT	
SELECT	

- 16 Are channels/transfer systems to remote containment systems tested?

- 17 Are channels/transfer systems compliant in both integrity and available volume?

Pipeline/underground structure testing

Are you required by your licence to undertake integrity testing* on underground structures e.g. pipelines or sumps etc ? if yes please fill out table 2 below listing all

- 1 underground structures and pipelines on site **which failed the integrity test and all which have not been tested within the integrity test period as specified**

- 2 Please provide integrity testing frequency period

*please note integrity testing means water tightness testing for process and foul pipelines (as required under your licence)

SELECT	
SELECT	

Table B2: Summary details of pipeline/underground structures integrity test

Structure ID	Type system	Material of construction:	Does this structure have Secondary containment?	Type of secondary containment	Type integrity testing	Integrity reports maintained on site?	Results of test	Integrity test failure explanation <50 words	Corrective action taken	Scheduled date for retest	Results of retest (if in current reporting year)
	SELECT	SELECT	SELECT	SELECT	SELECT	SELECT	SELECT				SELECT

Please use commentary for additional details not answered by tables/ questions above

Groundwater/Soil monitoring template	Lic No: W0018-01	Year 2015
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		Comments	
1	Are you required to carry out groundwater monitoring as part of your licence requirements?	yes	
2	Are you required to carry out soil monitoring as part of your licence requirements?	no	
3	Do you extract groundwater for use on site? If yes please specify use in comment section	no	
4	Do monitoring results show that groundwater generic assessment criteria such as GTVs or IGVs are exceeded or is there an upward trend in results for a substance? If yes, please complete the Groundwater Monitoring Guideline Template Groundwater monitoring template Report (link in cell G8) and submit separately through ALDER as a licensee return AND answer questions 5-12 below.	yes	
5	Is the contamination related to operations at the facility (either current and/or historic)	yes	
6	Have actions been taken to address contamination issues? If yes please summarise remediation strategies proposed/undertaken for the site	yes	Leachate Management System Installed
7	Please specify the proposed time frame for the remediation strategy	SELECT	Completed
8	Is there a licence condition to carry out/update ELRA for the site?	yes	
9	Has any type of risk assessment been carried out for the site?	yes	
10	Has a Conceptual Site Model been developed for the site?	no	
11	Have potential receptors been identified on and off site?	yes	
12	Is there evidence that contamination is migrating offsite?	SELECT	

Please provide an interpretation of groundwater monitoring data in the interpretation box below or if you require additional space please include a groundwater/contaminated land monitoring results interpretation as an additional section in this AER

Please enter interpretation of data here

Table 1: Upgradient Groundwater monitoring results

Date of sampling	Sample location reference	Parameter/Substance	Methodology	Monitoring frequency	Maximum Concentration++	Average Concentration+	unit	GTV's*	IGV	Upward trend in pollutant concentration over last 5 years of monitoring data
2015	GW6	Ammonia		Quarterly	3.2	1.358	mg/l	0.15		no
2015	GW6	Chloride		Quarterly	31	28.25	mg/l	30		yes
2015	GW6	Total Oxidised Nitrogen		Quarterly	5.5	5.3	mg/l			no
2015	GW6	Potassium		Quarterly	3.3	2.075	mg/l	5		no
2015	GW6	Sodium		Quarterly	18	17.25	mg/l	150		no
2015	GW6	Flouride		Annually	<0.2		mg/l	1		no
2015	GW6	Sulphate		Annually	17		mg/l	200		no
2015	GW6	Boron		Annually	140		ug/l	1000		yes
2015	GW6	Cadmium		Annually	0.03		ug/l	5		no
2015	GW6	Calcium		Annually	69		mg/l	200		no
2015	GW6	Chromium		Annually	1.1		ug/l	30		no
2015	GW6	Iron		Annually	14		ug/l	200		no
2015	GW6	Lead		Annually	<1.0		ug/l	10		no
2015	GW6	Magnesium		Annually	18		mg/l	50		no
2015	GW6	Manganese		Annually	<5.0		ug/l	50		no
2015	GW6	Mercury		Annually	<0.5		ug/l	1		no
2015	GW6	Zinc		Annually	22		ug/l	100		no

Groundwater/Soil monitoring template Lic No: W0018-01 Year 2015

							SELECT			SELECT
							SELECT			SELECT
							SELECT			SELECT

Table 2: Downgradient Groundwater monitoring results

Date of sampling	Sample location reference	Parameter/ Substance	Methodology	Monitoring frequency	Maximum Concentration	Average Concentration	unit	GTV's*	SELECT**	Upward trend in yearly average pollutant concentration over last 5 years of monitoring data
2015	GW2	Ammonia		Quarterly	0.3	0.13	mg/l	0.15		yes
2015	GW2	Chloride		Quarterly	32	30.75	mg/l	30		yes
2015	GW2	Total Oxidised Nitrogen		Quarterly	1.3	1.3	mg/l			yes
2015	GW2	Potassium		Quarterly	1.7	1.5	mg/l	5		no
2015	GW2	Sodium		Quarterly	25	22.75	mg/l	150		no
2015	GW2	Flouride		Annually	<0.2		mg/l	1		no
2015	GW2	Sulphate		Annually	42		mg/l	200		no
2015	GW2	Boron		Annually	61		ug/l	1000		yes
2015	GW2	Cadmium		Annually	0.04		ug/l	5		no
2015	GW2	Calcium		Annually	98		mg/l	200		no
2015	GW2	Chromium		Annually	2.1		ug/l	30		yes
2015	GW2	Iron		Annually	21		ug/l	200		no
2015	GW2	Lead		Annually	<1.0		ug/l	10		no
2015	GW2	Magnesium		Annually	17		mg/l	50		no
2015	GW2	Manganese		Annually	180		ug/l	50		no
2015	GW2	Mercury		Annually	<0.5		ug/l	1		no
2015	GW2	Zinc		Annually	28		ug/l	100		no
							SELECT			data not available

*please note exceedance of generic assessment criteria (GAC) such as a Groundwater Threshold Value (GTV) or an Interim Guideline Value (IGV) or an upward trend in results for a substance indicates that further interpretation of monitoring results is required. In addition to completing the above table, please complete the Groundwater Monitoring Guideline Template Report at the link provided and submit separately through ALDER as a licensee return or as otherwise instructed by the EPA. [Groundwater monitoring template](#)

More information on the use of soil and groundwater standards/ generic assessment criteria (GAC) and risk assessment tools is available in the EPA published guidance [Guidance on the Management of Contaminated Land and Groundwater at EPA Licensed Sites \(EPA 2013\)](#) (see the link in G31)

**Depending on location of the site and proximity to other sensitive receptors alternative Receptor based Water Quality standards should be used in addition to the GTV e.g. if the site is close to surface water compare to Surface Water Environmental Quality Standards (SWEQS), if the site is close to a drinking water supply compare results to the Drinking Water Standards (DWS) [Groundwater regulations](#) [Drinking water \(private supply\) standards](#) [Surface water EQS](#) [Drinking water \(public supply\) standards](#) [Interim Guideline Values \(IGV\)](#)

Table 3: Soil results

Date of sampling	Sample location reference	Parameter/ Substance	Methodology	Monitoring frequency	Maximum Concentration	Average Concentration	unit
							SELECT
							SELECT

Where additional detail is required please enter it here in 200 words or less

Environmental Liabilities template

Lic No:

W0018-01

Year

2015

[Click here to access EPA guidance on Environmental Liabilities and Financial provision](#)

		Commentary	
1	ELRA initial agreement status	Submitted and agreed by EPA	
2	ELRA review status	Review required and not completed;	
3	Amount of Financial Provision cover required as determined by the latest ELRA	€86,375	
4	Financial Provision for ELRA status	Submitted and not agreed by EPA;	
5	Financial Provision for ELRA - amount of cover	€86,375	
6	Financial Provision for ELRA - type	Insurance with Environmental Impairment Liability cover,	
7	Financial provision for ELRA expiry date	N/A	
8	Closure plan initial agreement status	Closure plan submitted and agreed by EPA	
9	Closure plan review status	Review required and completed	
10	Financial Provision for Closure status	Submitted and agreed by EPA	
11	Financial Provision for Closure - amount of cover	N/A	
12	Financial Provision for Closure - type	Site is closed since 2005	
13	Financial provision for Closure expiry date	Enter expiry date	

Environmental Management Programme/Continuous Improvement Programme template	Lic No:	W0018-01	Year	2015
---	---------	----------	------	------

	Highlighted cells contain dropdown menu click to view	Additional Information
1	Do you maintain an Environmental Mangement System (EMS) for the site. If yes, please detail in additional information	Yes
2	Does the EMS reference the most significant environmental aspects and associated impacts on-site	Yes
3	Does the EMS maintain an Environmental Management Programme (EMP) as required in accordance with the licence requirements	Yes
4	Do you maintain an environmental documentation/communication system to inform the public on environmental performance of the facility, as required by the licence	Yes

Environmental Management Programme (EMP) report

Objective Category	Target	Status (% completed)	How target was progressed	Responsibility	Intermediate outcomes
Reduction of emissions to Air	Install Gas Abstraction System	100%	Contract	Individual	Individual
Groundwater protection	Leachate Management	100%	Contract	Section Head	Reduced emissions
Reduction of emissions to Air	Dust Control	100%	Monitoring and operational pr	Individual	Increased compliance with licence conditions
Reduction of emissions to Water	Surface water management	100%	Contract	Individual	Individual

Noise monitoring summary report	Lic No: W0018-01	Year	2015
--	------------------	------	------

1 Was noise monitoring a licence requirement for the AER period?

If yes please fill in table N1 noise summary below

2 Was noise monitoring carried out using the EPA Guidance note, including completion of the "Checklist for noise measurement report" included in the guidance note as table 6?

[Noise Guidance note NG4](#)

3 Does your site have a noise reduction plan

4 When was the noise reduction plan last updated?

5 Have there been changes relevant to site noise emissions (e.g. plant or operational changes) since the last noise survey?

Table N1: Noise monitoring summary

Date of monitoring	Time period	Noise location (on site)	Noise sensitive location -NSL (if applicable)	LA _{eq}	LA ₉₀	LA ₁₀	LA _{max}	Tonal or Impulsive noise* (Y/N)	If tonal /impulsive noise was identified was 5dB penalty applied?	Comments (ex. main noise sources on site, & extraneous noise ex. road traffic)	Is site compliant with noise limits (day/evening/night)?
02.09.15	1246-1316	B1		52	45	56	N/A	No	No		Yes
01.09.15	1506-1536	B2		47	45	48	N/A	No	No		Yes
01.09.15	1433-1503	B3		50	43	54	N/A	No	No		Yes
01.09.15	1244-1314	B4		54	46	56	N/A	No	No		Yes
01.09.15	1318-1348	B5		47	43	50	N/A	No	No		Yes
01.09.15	1353-1423	B6		42	38	44	N/A	No	No		Yes
02.09.15	1206-1236	B7		46	43	47	N/A	No	No		Yes
02.09.15	0844-0914		NSL2	56	52	58	N/A	No	No	Road traffic	Yes
02.09.15	1126-1156		NSL3	46	42	49	N/A	No	No	Lawnmower. Road traffi	Yes
01.09.15	1544-1614		NSL4	62	50	66	N/A	No	No	Truck. Road traffic	Yes
02.09.15	1000-1030		NSL5	59	50	61	N/A	No	No	Truck. Road traffic	Yes
02.09.15	0924-0954		NSL6	57	50	56	N/A	No	No	Road traffic	Yes
02.09.15	1034-1104		NSL7	48	43	48	N/A	No	No	Road traffic	Yes
02.09.15	0800-0830		NSL8	69	55	73	N/A	No	No	Road traffic	Yes
											Yes

*Please ensure that a tonal analysis has been carried out as per guidance note NG4. These records must be maintained onsite for future inspection

If noise limits exceeded as a result of noise attributed to site activities, please choose the corrective action from the following options?

** please explain the reason for not taking action/resolution of noise issues?

Any additional comments? (less than 200 words)

		Additional information
1	When did the site carry out the most recent energy efficiency audit? Please list the recommendations in table 3 below	Enter date of audit
2	Is the site a member of any accredited programmes for reducing energy usage/water conservation such as the SEAI programme linked to the right? If yes please list them in additional information	No
3	Where Fuel Oil is used in boilers on site is the sulphur content compliant with licence conditions? Please state percentage in additional information	SELECT

Energy Use	Previous year	Current year	Production +/- % compared to previous reporting year**	Energy Consumption +/- % vs overall site production*
Total Energy Used (MWHrs)				
Total Energy Generated (MWHrs)				
Total Renewable Energy Generated (MWHrs)				
Electricity Consumption (MWHrs)				
Fossil Fuels Consumption:				
Heavy Fuel Oil (m3)				
Light Fuel Oil (m3)				
Natural gas (m3)				
Coal/Solid fuel (metric tonnes)				
Peat (metric tonnes)				
Renewable Biomass				
Renewable energy generated on site				

* where consumption of energy can be compared to overall site production please enter this information as percentage increase or decrease compared to the previous reporting year.
 ** where site production information is available please enter percentage increase or decrease compared to previous year

Water use	Water extracted Previous year m3/yr.	Water extracted Current year m3/yr.	Production +/- % compared to previous reporting year**	Energy Consumption +/- % vs overall site production*	Water Emissions	Water Consumption	Unaccounted for Water:
					Volume Discharged back to environment(m ³ /yr):	Volume used i.e not discharged to environment e.g. released as steam m3/yr	
Groundwater							
Surface water							
Public supply	5	5					
Recycled water							
Total	5	5					

* where consumption of water can be compared to overall site production please enter this information as percentage increase or decrease compared to the previous reporting year.
 ** where site production information is available please enter percentage increase or decrease compared to previous year

	Total	Landfill	Incineration	Recycled	Other
Hazardous (Tonnes)					
Non-Hazardous (Tonnes)					

Resource Usage/Energy efficiency summary Lic No: W0018-01 Year 2015

Table R4: Energy Audit finding recommendations

Date of audit	Recommendations	Description of Measures proposed	Origin of measures	Predicted energy savings %	Implementation date	Responsibility	Completion date	Status and comments
			SELECT					
			SELECT					
			SELECT					

Table R5: Power Generation: Where power is generated onsite (e.g. power generation facilities/food and drink industry)please complete the following information

	Unit ID	Unit ID	Unit ID	Unit ID	Station Total
Technology					
Primary Fuel					
Thermal Efficiency					
Unit Date of Commission					
Total Starts for year					
Total Running Time					
Total Electricity Generated (GWH)					
House Load (GWH)					
KWH per Litre of Process Water					
KWH per Litre of Total Water used on Site					

WASTE SUMMARY	Lic No: W0018-01	Year: 2015
SECTION A-PRTR ON SITE WASTE TREATMENT AND WASTE TRANSFERS TAB- TO BE COMPLETED BY ALL IPPC AND WASTE FACILITIES	PRTR facility logon	dropdown list click to see options

SECTION B- WASTE ACCEPTED ONTO SITE-TO BE COMPLETED BY ALL IPPC AND WASTE FACILITIES

Additional Information

Were any wastes accepted onto your site for recovery or disposal or treatment prior to recovery or disposal within the boundaries of your facility?; (waste generated within your boundaries is to be captured through PRTR reporting)

No	
----	--

If yes please enter details in table 1 below

2 Did your site have any rejected consignments of waste in the current reporting year? If yes please give a brief explanation in the additional information

No	
----	--

3 Was waste accepted onto your site that was generated outside the Republic of Ireland? If yes please state the quantity in tonnes in additional information

No	
----	--

Table 1 Details of waste accepted onto your site for recovery, disposal or treatment (do not include wastes generated at your site, as these will have been reported in your PRTR workbook)

Licensed annual tonnage limit for your site (total tonnes/annum)	EWC code European Waste Catalogue EWC codes	Source of waste accepted	Description of waste accepted Please enter an accurate and detailed description - which applies to relevant EWC code European Waste Catalogue EWC codes	Quantity of waste accepted in current reporting year (tonnes)	Quantity of waste accepted in previous reporting year (tonnes)	Reduction/ Increase over previous year +/- %	Reason for reduction/ increase from previous reporting year	Packaging Content (%) only applies if the waste has a packaging component	Disposal/Recovery or treatment operation carried out at your site and the description of this operation	Quantity of waste remaining on site at the end of reporting year (tonnes)	Comments -
75,000	13 02--	13- OIL WASTES AND WASTES OF LIQUID FUELS (except edible oils, and those in chapters 05, 12 and 19)	Waste Engine Oil	4.5	0						
75,000	14 06--	14- WASTE ORGANIC SOLVENTS, REFRIGERANTS AND PROPELLANTS (except 07 and 08)	Aerosols	0	0						
75,000	16 06 01	16- WASTES NOT OTHERWISE SPECIFIED IN THE LIST	Lead Batteries	0.32	0.25						
75,000	16 06 04	16- WASTES NOT OTHERWISE SPECIFIED IN THE LIST	Alkaline Batteries	0.487	1.11						
75,000	20 01 01	20- MUNICIPAL WASTES (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS	Cardboard	22.32	21.72						
75,000	20 01 02	20- MUNICIPAL WASTES (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS	Glass	10.91	11.38						
75,000	20 01 11	20- MUNICIPAL WASTES (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS	Textiles	2.06	0.78						
75,000	20 01 21	20- MUNICIPAL WASTES (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS	Flourescent Tubes	0.242	0.24						

WASTE SUMMARY			Lic No: W0018-01		Year: 2015	
75,000	20 01 25	20- MUNICIPAL WASTES (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS	Edible oil and fats	0	0	
75,000	20 01 27	20- MUNICIPAL WASTES (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS	Paint Tins	2.19	4.63	
75,000	20 01 36	20- MUNICIPAL WASTES (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS	W.E.E.E.	163.465	168	
75,000	20 01 38	20- MUNICIPAL WASTES (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS	Wood	2	2	
75,000	20 01 40	20- MUNICIPAL WASTES (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS	Metals	5.68	11.21	
75,000	20 02 01	20- MUNICIPAL WASTES (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS	Biodegradable Garden Waste	712.32	328.28	
75,000	20 03 01	20- MUNICIPAL WASTES (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS	Mixed Municipal waste	303.82	273.48	
75,000	15 02 02	20- MUNICIPAL WASTES (HOUSEHOLD WASTE AND	Oil Filters	0.26		

SECTION C-TO BE COMPLETED BY ALL WASTE FACILITIES (waste transfer stations, Composters, Material recovery facilities etc) EXCEPT LANDFILL SITES

4 Is all waste processing infrastructure as required by your licence and approved by the Agency in place? If no please list waste processing infrastructure required onsite

SELECT	

5 Is all waste storage infrastructure as required by your licence and approved by the Agency in place? If no please list waste storage infrastructure required on site

SELECT	

6 Does your facility have relevant nuisance controls in place?

SELECT	
--------	--

7 Do you have an odour management system in place for your facility? If no why?

SELECT	
--------	--

8 Do you maintain a sludge register on site?

SELECT	
--------	--

SECTION D-TO BE COMPLETED BY LANDFILL SITES ONLY

WASTE SUMMARY	Lic No:	W0018-01	Year	2015
----------------------	---------	----------	------	------

Table 4 Environmental monitoring-landfill only [Landfill Manual-Monitoring Standards](#)

Was meteorological monitoring in compliance with Landfill Directive (LD) standard in reporting year +	Was leachate monitored in compliance with LD standard in reporting year	Was Landfill Gas monitored in compliance with LD standard in reporting year	Was SW monitored in compliance with LD standard in reporting year	Have GW trigger levels been established	Were emission limit values agreed with the Agency (ELVs)	Was topography of the site surveyed in reporting year	Has the statement under S53(A)(5) of WMA been submitted in reporting year	Comments

+ please refer to Landfill Manual linked above for relevant Landfill Directive monitoring standards

Table 5 Capping-Landfill only

Area uncapped*	Area with temporary cap	Area with final cap to LD Standard m2 ha, a	Area capped other	Area with waste that should be permanently capped to date under licence	What materials are used in the cap	Comments
SELECT UNIT	SELECT UNIT					

*please note this includes daily cover area

Table 6 Leachate-Landfill only

9 Is leachate from your site treated in a Waste Water Treatment Plant?

10 Is leachate released to surface water? If yes please complete leachate mass load information below

Volume of leachate in reporting year(m3)	Leachate (BOD) mass load (kg/annum)	Leachate (COD) mass load (kg/annum)	Leachate (NH4) mass load (kg/annum)	Leachate (Chloride) mass load kg/annum	Leachate treatment on-site	Specify type of leachate treatment	Comments

Please ensure that all information reported in the landfill gas section is consistent with the Landfill Gas Survey submitted in conjunction with PRTR returns

Table 7 Landfill Gas-Landfill only

Gas Captured&Treated by LFG System m3	Power generated (MW / KWh)	Used on-site or to national grid	Was surface emissions monitoring performed during the reporting year?	Comments
			SELECT	

DRAWINGS


Drawing No. 1	Site Location Plan
Drawing No. 2	Gas Abstraction Network
Drawing No. 3	Surface Water Management
Drawing No. 4	Landscaping Concept Design
Drawing No. 5	Map of Monitoring Points
Drawing No. 6	Leachate Collection System



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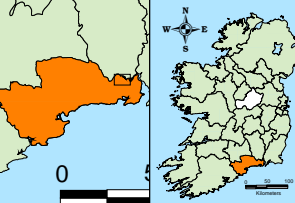
Client
Waterford City Council



Project
Kilbarry Landfill Permanent Gas Flare Contract

Title
1:50,000 Site Location Map

Figure DG0001



0

Issue Details

Drawn by: C. Doyle	Project No. MCW0568
Checked by: B. O'Leary	File Ref. MCW0568M0001B01
Approved by: K. O'Sullivan	
Scale: NTS	Drawing No. DG0001
Date: 03.02.09	Rev. B01

Notes

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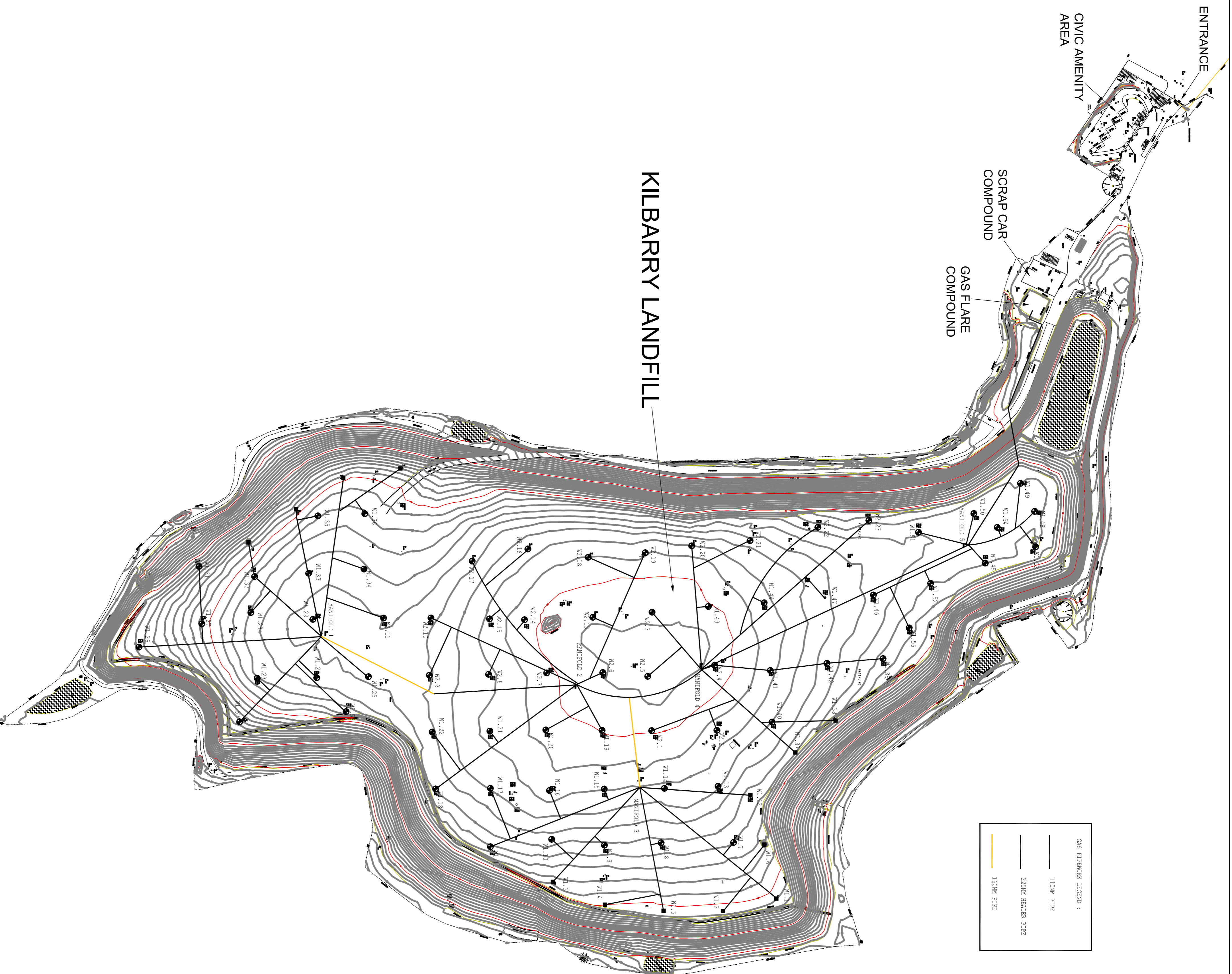
ENTRANCE

CIVIC AMENITY AREA

SCRAP CAR COMPOUND

GAS FLARE COMPOUND

KILBARRY LANDFILL



GAS PIPEWORK LEGEND :	
	1100M PIPE
	2250M HEADER PIPE
	1600M PIPE

NOTES

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No.	Date	Amendment / Issue	App
B01	Feb.09	ISSUE FOR TENDER	
A01	Nov.08	ISSUE FOR APPROVAL	

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Client
WATERFORD CITY COUNCIL

Project
**KILBARRY LANDFILL :
 PERMANENT GAS FLARE CONTRACT**

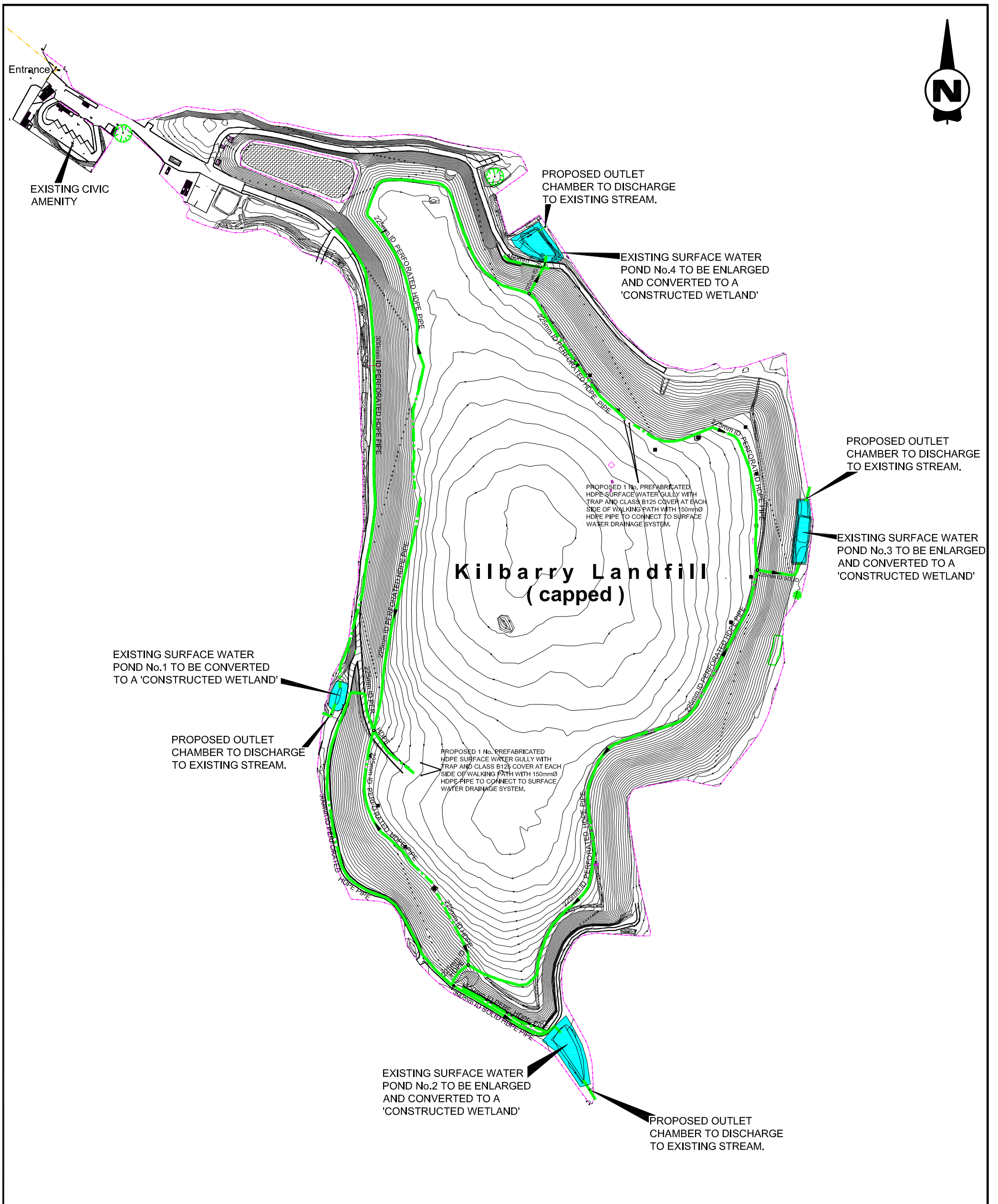
Title
**LAYOUT PLAN OF LANDFILL
 SHOWING GAS NETWORK**

Drawing Status	Sheet Size	Drawing Scale
For Tender	A1	1:1500


Drawn By	Checked By	Approved By	Date
JM	CD	KPOS	Nov.08

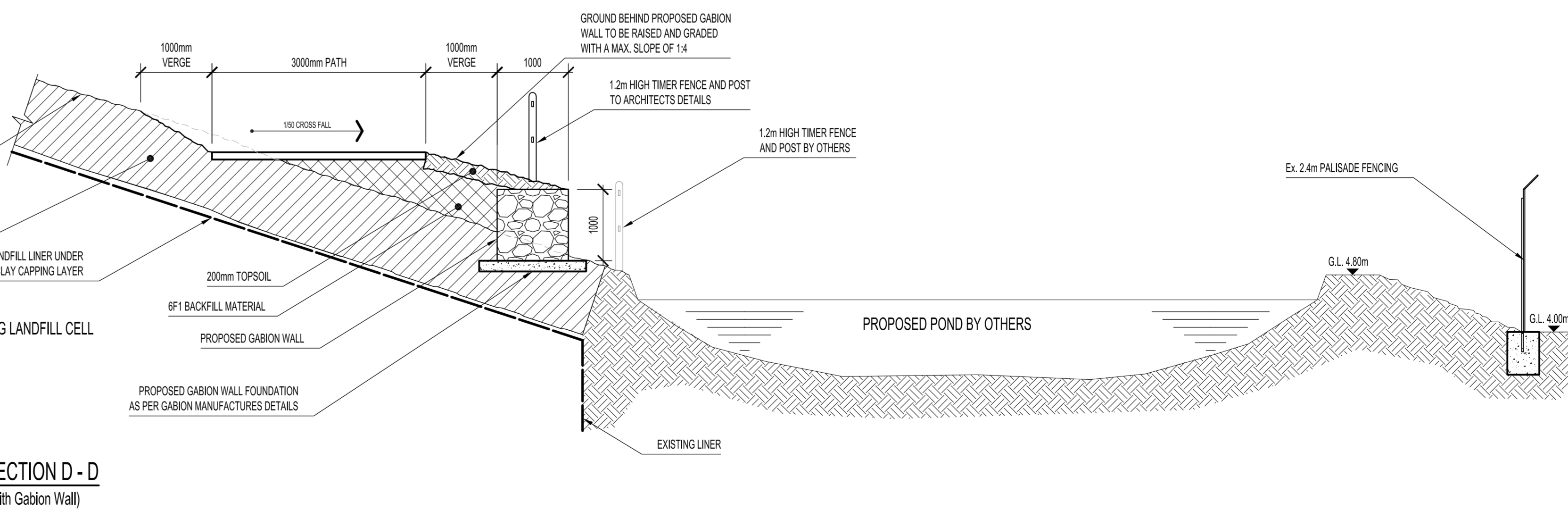
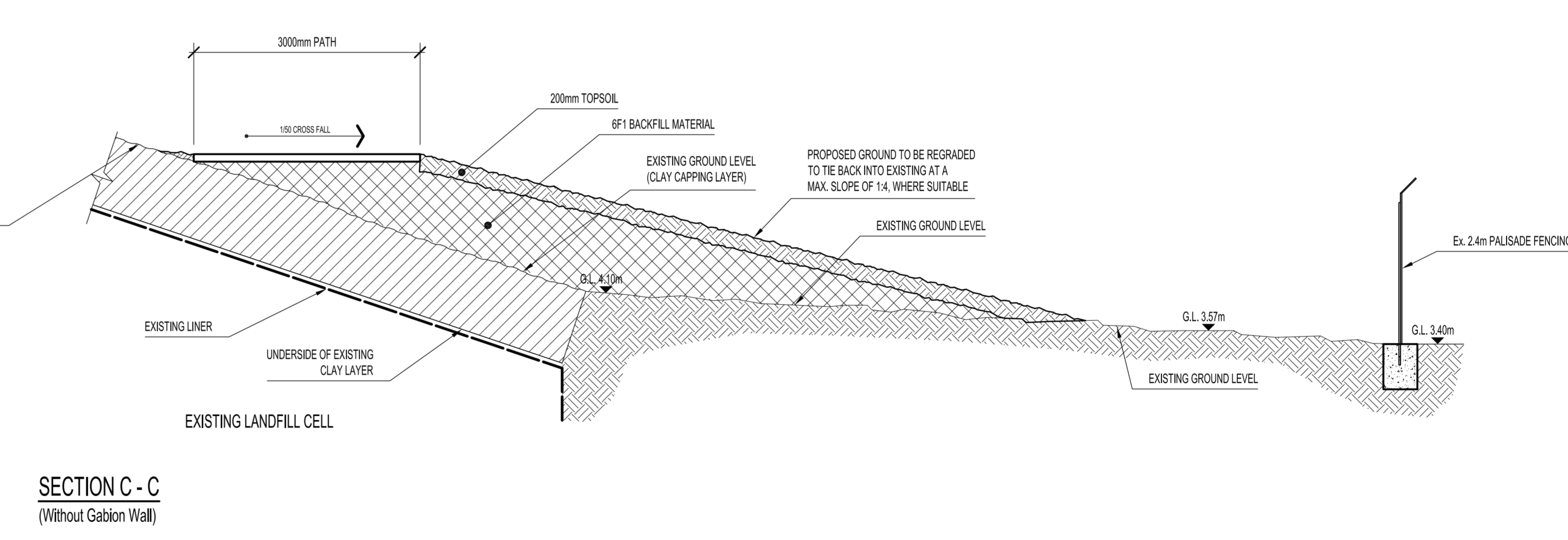
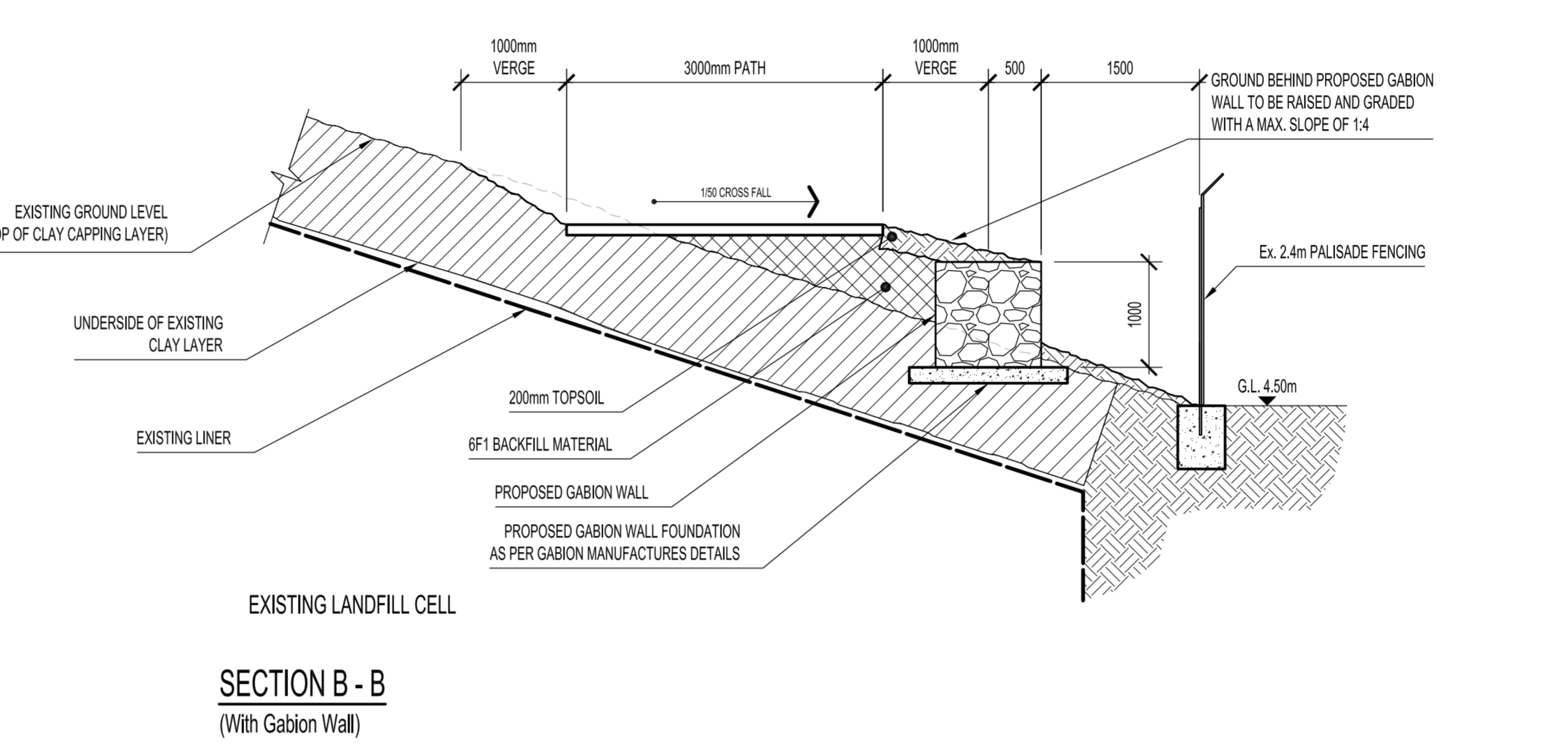
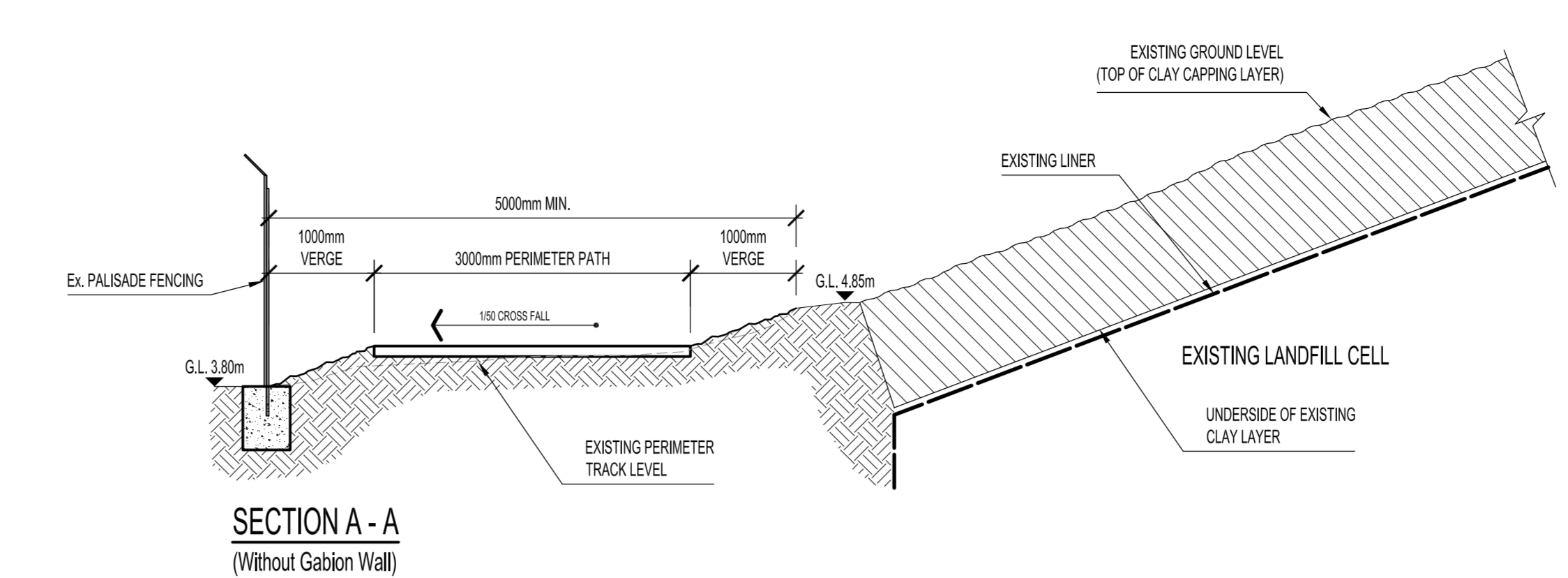
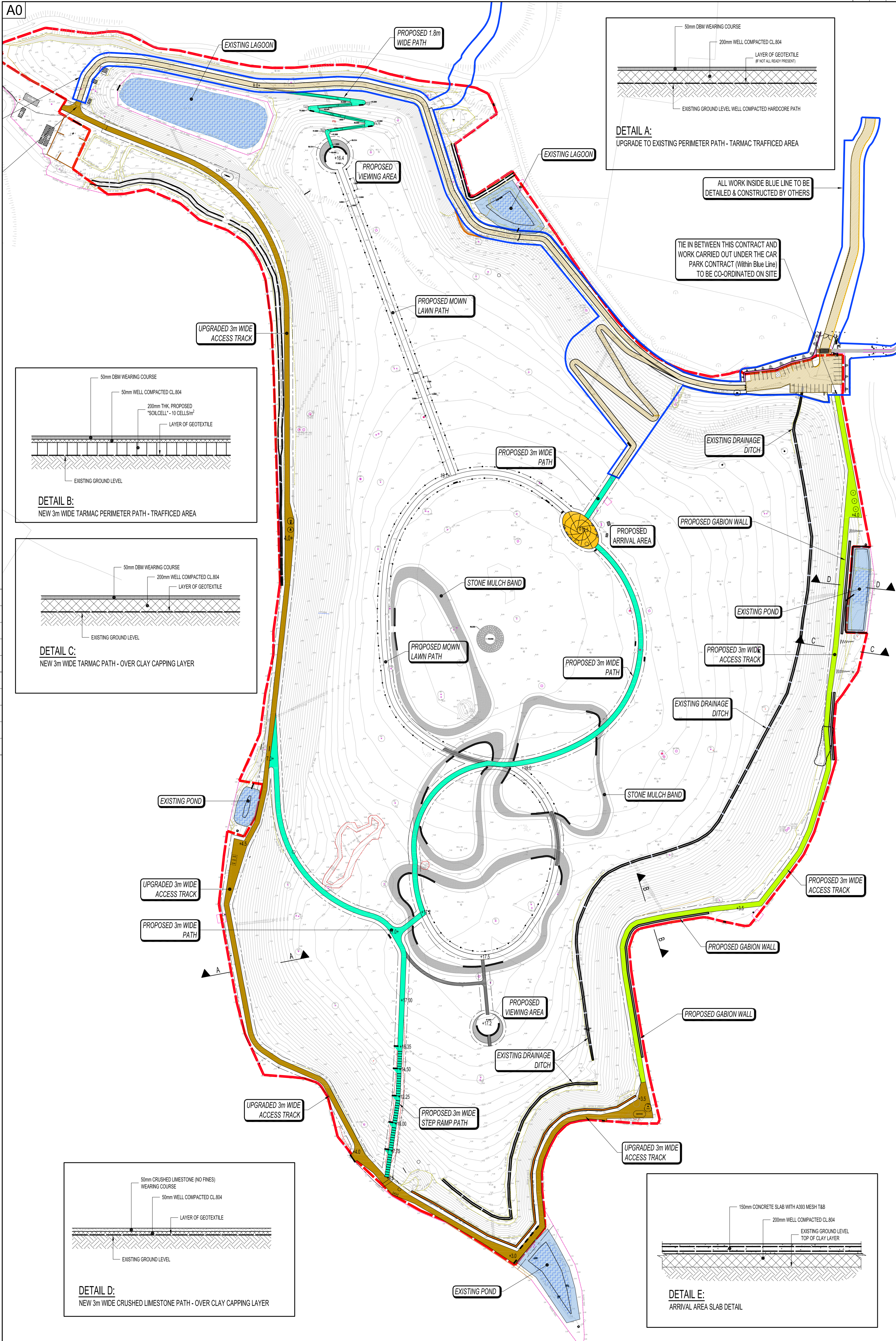
Drawing Number
MCW0568/02

Rev
B01



D01	Mar.'10	JM	CD	DRAFT ISSUE	KPOS
No.	Date	Dr	Chk	Amendment / Issue	App

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	06	D01	
Project	KILBARRY LANDFILL - WASTE LICENCE REVIEW		
Client	WATERFORD CITY COUNCIL		
Title		SURFACE WATER MANAGEMENT SYSTEM.	
Drawing Status	Sheet Size	Drawing Scale	Drawn By Checked By Approved By Date
Draft	A3	-	JM CD KPOS Jan. 2010



NOTES:

- EXISTING TOPOGRAPHICAL SURVEY CARRIED OUT BY FOCUS SURVEY LIMITED. ALL LEVELS RELATE TO MAIN HEAD O.D.
- THIS DRAWING MUST BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL DRAWINGS AND SPECIFICATIONS.
- REFER TO ARCHITECTS DRAWINGS FOR SETTING OUT DETAILS OF ALL PATHWAYS.
- DO NOT SCALE THIS DRAWING IF IN DOUBT ASK.

LEGEND:

- PROPOSED SITE BOUNDARY
- ALL WORKS WITHIN BLUE LINE CARPARK CONTRACT TO BE DETAILED & CONSTRUCTED BY OTHERS
- TARMAC SURFACE - DETAIL A
- TARMAC SURFACE - DETAIL B
- TARMAC SURFACE - DETAIL C
- CRUSHED LIMESTONE SURFACE - DETAIL D
- STONE MULCH BAND BY ARCHITECTS
- MOWN LAWN PATH BY ARCHITECT

T1	ISSUED	J.B.	ISSUED FOR TENDER	JMacC
Rev.	Date	By	Description	Date

TENDER

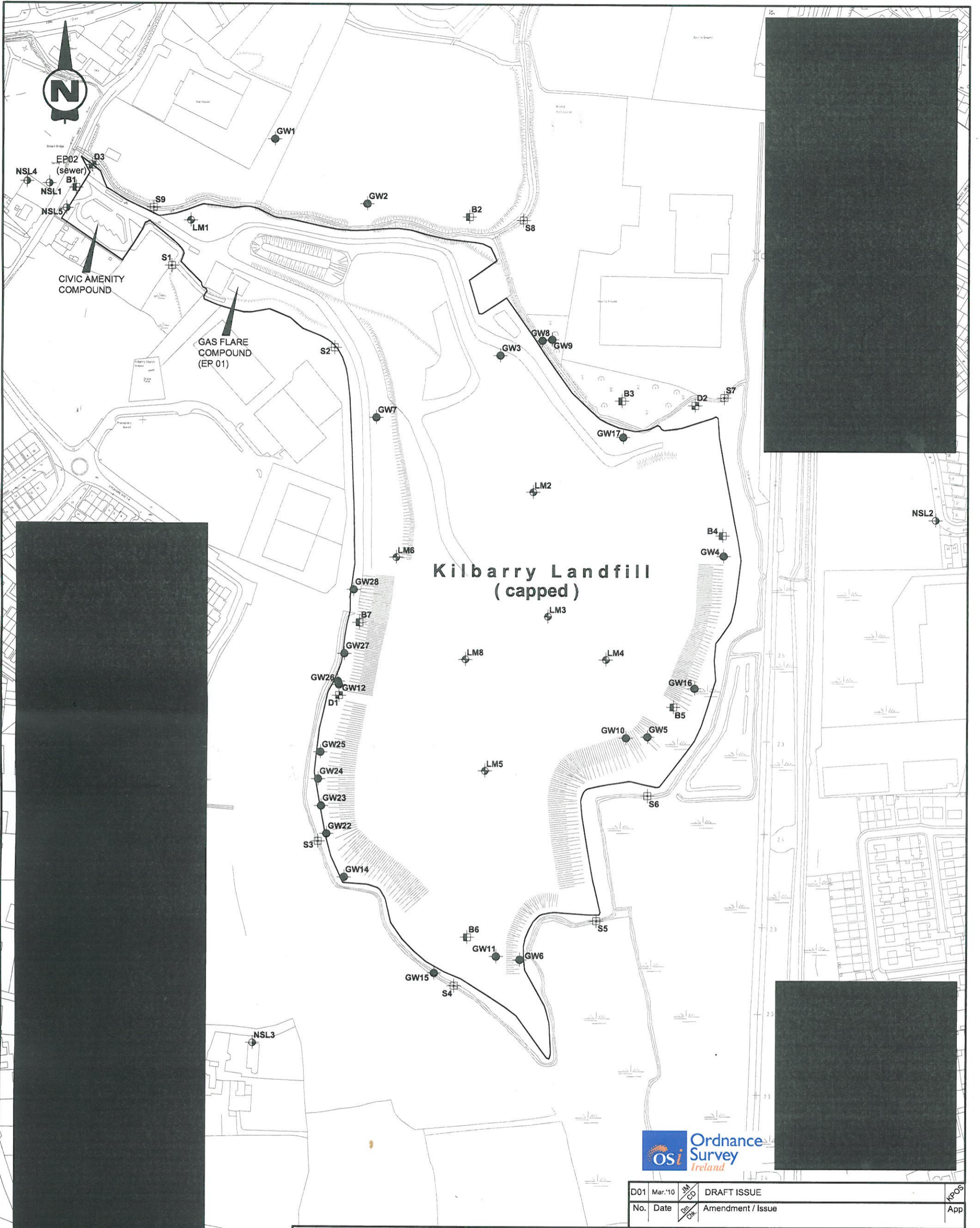
LANDSCAPE REMEDIATION WORK AT KILBARRY LANDFILL

PROPOSED SITE LAYOUT

ARUP

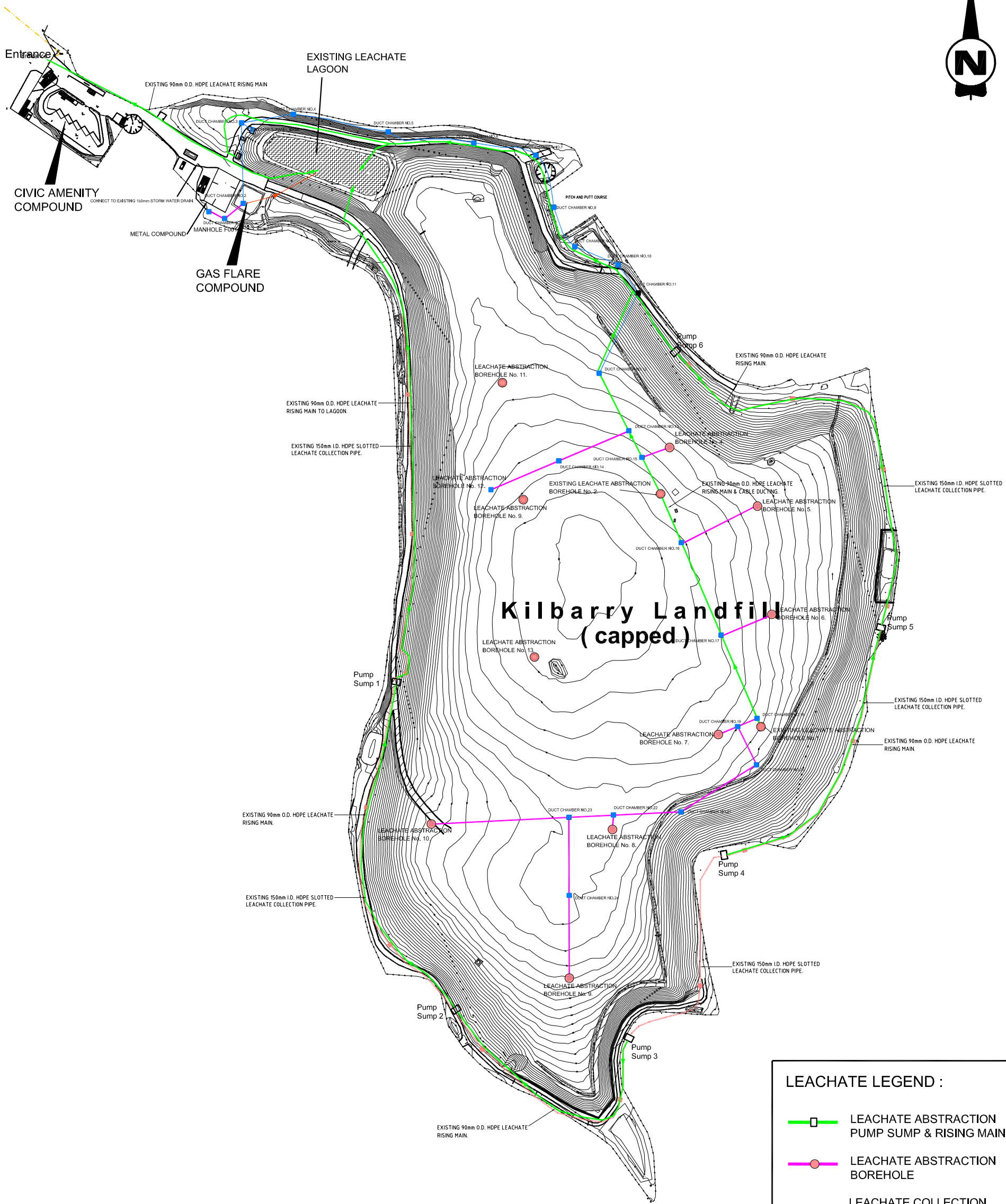
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Email: arup@arup.com
DUBLIN: COLM LIMERICK
Scale: 1:1000 (Plan), 1:50 (Sections), 1:25 (Details) © ARUP 2016
Checked: JMacC Approved: JMacC Date: 05/09/16

C2474.10 C001 T1



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			10	D01		
Project			Title			
KILBARRY LANDFILL - WASTE LICENCE REVIEW			MONITORING LOCATIONS PLAN			
Client						
WATERFORD CITY COUNCIL						
Drawing Status	Sheet Size	Drawing Scale	Drawn By	Checked By	Approved By	Date
Draft	A3	-	JM	CD	KPOS	Jan. 2010



LEACHATE LEGEND :

- LEACHATE ABSTRACTION PUMP SUMP & RISING MAIN
- ● LEACHATE ABSTRACTION BOREHOLE
- LEACHATE COLLECTION PIPEWORK.

D01	Mar.'10	JM	CD	DRAFT ISSUE	KPOS
No.	Date	Dr	Chk	Amendment / Issue	App

Innishmore Ballincollig Co. Cork Ireland	T +353 21 4665900 F +353 21 4873742 W www.rpsgroup.com/ireland E ireland@rpsgroup.com	Drawing Number	Rev
		09	D01
Project KILBARRY LANDFILL - WASTE LICENCE REVIEW		Title LEACHATE MANAGEMENT SYSTEM	
Client WATERFORD CITY COUNCIL			
Drawing Status Draft	Sheet Size A3	Drawing Scale -	Drawn By JM Checked By CD Approved By KPOS Date Jan. 2010