Comhairle Contae Chorcaí
Cork County Council

Environmental Directorate,
Inniscarra, Co. Cork.
Tel. No. (021) 4532700 • Fax No. (021) 4532727
Web: www.corkcoco.ie
An Stiúrthóireacht Comhshaoil,
Inis Cara, Co. Corcaigh.
Fón: (021) 4532700 • Faics: (021) 4532727
Suíomh Gréasáin: www.corkcoco.ie

Mr. Brian Meaney,
Senior Inspector,
Office of Climate Change, Licensing and Resource Use,
Environmental Protection Agency,
PO Box 3000
Johnstown Castle Estate,
Co. Wexford.

ENVIRONMENTAL PROTECTION AGENCY
29 JUN 2009

26 June 2009.

Our Ref: BRL075

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Re: WL W0161-01 Bottlehill Landfill:
Application for Technical Amendment to Waste Licence

Cork County Council hereby applies to the Environmental Protection Agency for a Technical Amendment to Waste Licence W0161-01, in respect of Bottlehill Landfill. The technical amendment, if granted, would alter the conditions of the Waste Licence for Bottlehill Landfill such that the option to accept baled or unbaled waste would then be at the discretion of the facility operator.

At the time of the Licence application for Bottlehill Landfill in July 2001, baling of waste prior to landfill was seen as an innovative method of gaining higher levels of compaction of waste. This process was pioneered in Arthurstown Landfill in Kill, Co. Kildare. Therefore, Cork County Council offered the baling of waste as part of the application to operate Bottlehill Landfill. However, since this application, no other landfill operator in Ireland has proposed the use of baling nor has the Agency imposed this condition on any other landfill in Ireland.

Cork County Council engaged the services of Fehily Timoney & Co, Environmental Consultants, to examine and compare the features of baled waste and unbaled waste. This report is attached for your consideration. The report concludes:

> *"..that whilst management practices may need to be altered to accommodate the differing operational requirements, there should be no detrimental environmental impacts as a consequence of introducing transfer and placement of un-baled residual waste in Bottlehill as long as best available technology and practices are employed."*

Fehily Timoney & Co, while examining the features of baled and unbaled waste, covered a wide range of topics including the following:

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- Planning Permission and Waste Licence Conditions,
- Impacts on Regional Waste Management Plan,
- Literature review of relevant published papers,
- Bulk transfer of waste and associated logistics,
- Movement of waste within the site prior to landfilling,
- Placing of waste at the working face, site plant and machinery,
- Compaction and settlement of waste,
- Litter management,
- Attraction of vermin, insects and scavenging birds,
- Landfill gas infrastructure,
- Case studies of other facilities accepting baled waste.

Cork County Council therefore recommends the following amendments to be made to Waste Licence W0161-01 for Bottlehill Landfill.

Proposed Amendements to WL W0161-01

The licence states in the introduction that:

"Waste will be delivered to the site, primarily in baled form,"

It is recommended that the introduction be changed to:

"WASTE WILL BE DELIVERED TO THE SITE, IN BALED OR LOOSE FORM,"

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Class 13

Class 13 states:

"Storage prior to submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where the waste concerned is produced."
"This activity is limited to the temporary storage of baled waste at the baled waste marshalling yard in sealed containers prior to haulage to the working face of the landfill."

It is recommended that the Class 13 be changed to:

"STORAGE PRIOR TO SUBMISSION TO ANY ACTIVITY REFERRED TO IN A PRECEDING PARAGRAPH OF THIS SCHEDULE, OTHER THAN TEMPORARY STORAGE, PENDING COLLECTION, ON THE PREMISES WHERE THE WASTE CONCERNED IS PRODUCED."

"THIS ACTIVITY IS LIMITED TO THE TEMPORARY STORAGE OF BALED OR LOOSE WASTE AT THE WASTE MARSHALLING YARD PRIOR TO HAULAGE TO THE WORKING FACE OF THE LANDFILL."

Condition 1.5.3

Condition 1.5.3 states:

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"Only baled residual waste shall be accepted for disposal at the facility. Notwithstanding, in exceptional circumstances, particular wastes, where baling is not technically feasible, may also be accepted for disposal at the facility, subject to agreement by the Agency."

It is recommended that the Condition 1.5.3 be changed to:

"ONLY RESIDUAL WASTE SHALL BE ACCEPTED FOR DISPOSAL AT THE FACILITY."

Condition 5.5.1

Condition 5.5.1 states:

"Unless the prior agreement of the Agency is given, the following shall apply at the landfill:
a) Only one working face shall exist at the landfill at any one time for the deposit of baled waste other than the deposit of cover or restoration materials;
b) Prior to the commencement of waste activities the licensee shall submit a report to the Agency for its agreement as to the size of the working face for the deposit of baled waste;....."

It is recommended that the Condition 5.5.1 be changed to:

"UNLESS THE PRIOR AGREEMENT OF THE AGENCY IS GIVEN, THE FOLLOWING SHALL APPLY AT THE LANDFILL:
A) ONLY ONE WORKING FACE SHALL EXIST AT THE LANDFILL AT ANY ONE TIME FOR THE DEPOSIT OF WASTE OTHER THAN THE DEPOSIT OF COVER OR RESTORATION MATERIALS UNLESS OTHERWISE AGREED WITH THE AGENCY;
B) PRIOR TO THE COMMENCEMENT OF WASTE ACTIVITIES THE LICENSEE SHALL SUBMIT A REPORT TO THE AGENCY FOR ITS AGREEMENT AS TO THE SIZE OF THE WORKING FACE FOR THE DEPOSIT OF WASTE;....."

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SCHEDULE G: Content of the Annual Environmental Report

Schedule G states:

".....Waste activities carried out at the facility. Quantity and composition of waste received, disposed of and recovered during the reporting period and each previous year including the quantity of waste accepted in baled form....."

It is recommended that the Schedule G be changed to:

".....WASTE ACTIVITIES CARRIED OUT AT THE FACILITY. QUANTITY AND COMPOSITION OF WASTE RECEIVED, DISPOSED OF AND RECOVERED DURING THE REPORTING PERIOD AND EACH PREVIOUS YEAR INCLUDING THE QUANTITY OF WASTE ACCEPTED ....."

Cork County Council consulted with the local community prior to submitting this application by the following means:

1.0 The proposal was notified to the Bottlehill Environmental Monitoring Committee (BEMC) on 16 December 2008, 21 January, 18 March and 24 June 2009.

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2.0 Members of the BEMC travelled to Knockharley landfill, Co Meath and Kill landfill, Co Kildare on the 16 January 2009 with senior staff members of Cork County Council. The objective of the trip was to enable the committee members to examine the practices of handling baled waste (Kill) and unbaled waste (Knockharley).

3.0 Cork County Council conducted two open days at the Bottlehill landfill facility on the 18 and 21 February 2009.

4.0 Cork County Council conducted a Public meeting on the 17 June 2009, in Carrignabhfear, primary school, which is located within the Bottlehill community.

Cork County Council presented their case as outlined in the attached Position Paper and advised that there was no environmental difference or impact arising from the proposed revision to the baling condition on the operation of the facility. Cork County Council addressed their immediate concerns with respect to wind blown litter, odour, traffic / transportation route, leachate, birds and pest control, daily cover, etc and gave a commitment to implement strict environmental management procedures and controls to ensure compliance with the waste license.

Cork County Council has tendered an Interim Waste Processing Services (IWPS) contract to pre-treat the local authority controlled residual waste stream prior to disposal in Bottlehill and will be ready to award subject to the outcome of this request. Our current plan to open the Bottlehill landfill facility and commence operations is February 2010. This is contingent upon the orderly closure of Youghal landfill and the transfer of operations to Bottlehill landfill. The IWPS contractor will require 27 weeks to procure equipment and upgrade the proposed IWPS facility in order to pre-treat the waste prior to disposal in Bottlehill. It would therefore be necessary to plan for an award date between 7 -14 August 2009 to meet the proposed opening date of February 2010 for Bottlehill.

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Cork County Council would therefore be obliged if you could meet with us to discuss this proposal at your earliest convenience. This office will be in contact with you in due course to arrange this meeting.

In the meantime, should you have any queries, please do not hesitate to contact Michael Ryan at 021-4532700.

Yours Sincerely

Louis Duffy,
Director of Services,
Environment & Emergency Services,
Cork County Council

cc Mr. Peter Cunningham, Senior Inspector, Office of Environmental Enforcement.
Tim Lucey, Divisional Mgr, CCC, Mary Ryan, Director of Services, CCC.
M J Ryan, SE , CCC, N O'Callaghan, ASEE, CCC, G O'Beirne, Cork City Council

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WASTE LICENCE REG. N0. W0160-01
BOTTLEHILL LANDFILL

POSITION PAPER ON WASTE BALING

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Prepared for:

Cork County Council
Environment Section
Inniscarra Waterworks
Inniscarra
Co Cork

Prepared by:

Fehily Timoney & Company
Core House
Pouladuff Road
Cork

March 2009

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DRAFT

WASTE LICENCE REG. N0. W0160-01
BOTTLEHILL LANDFILL

POSITION PAPER ON WASTE BALING

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Rev. Nr.	Description of Changes	Prepared By:	Checked By:	Approved By:	Date:
2	revised and updated	DOS			18-03-09

Client: Cork County Council

Keywords: Bottlehill facility, baling, un-baled waste, environmental impacts, technical amendment, waste licence.

Abstract: The Bottlehill landfill for non-hazardous waste is licensed to accept baled waste and other waste where baling is not technically feasible. This report reviews the impacts of allowing the deposition of un-baled waste in addition to or in place of baled waste.

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EXECUTIVE SUMMARY

Bottlehill Landfill was designed on the basis of baled waste being the primary mechanism to deliver waste to the facility. At the time of planning the landfill project, baling was seen as best practice with respect to void utilisation (particularly for large landfills.

Subsequent to this the practice in Ireland and elsewhere has changed in favour of un-baled-waste facilities. At present Arthurstown landfill, Co Kildare is the only baled MSW facility in Ireland or the United Kingdom.

This report has reviewed the An Bord Pleanála planning conditions, oral hearing references, waste licence W0161-01 conditions and environmental impacts associated with baling. In addition the impacts of baling and un-baled waste placement for all operations starting from the waste transfer station through handling and placement to eventual waste breakdown and settlement have also been reviewed.

From a **commercial perspective** the report concludes that baling imposes an additional cost on waste suppliers that may encourage these suppliers to seek alternate disposal options. The baling requirement may therefore prevent waste being delivered to the Bottlehill facility.

From a **planning perspective** the report concludes there is no impediment to allowing un-baled waste to be placed in Bottlehill as long as overall vehicle movements do not increase beyond those required to fill the facility.

From a **waste licence** perspective the report concludes there is a requirement to mitigate environmental impacts as defined under respective licence conditions. Analysis has shown that whilst management practices may need to be altered to accommodate the differing operational requirements, there would be no detrimental environmental impacts as a consequence of introducing transfer and placement of un-baled residual waste in Bottlehill as long as best available techniques are employed.

From an **environmental and nuisance** perspective, the report concludes that there are no significant environmental differences between placing baled or un-baled waste

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1. INTRODUCTION

Cork County Council has constructed the Bottlehill Waste Management Facility to accept non-hazardous waste.

The facility will be operated under Waste Licence W0161-01, issued by the EPA in June 2004.

The facility received planning permission from An Bord Pleanala in February 2004 (ABP Ref 04.EL2016)

This report, prepared by Fehily Timoney & company,will discuss environmental and other impacts of accepting un-baled and or baled waste.

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2. HISTORICAL CONTEXT

2.1. Original Reason for Selecting Baling as a Pre-Treatment to Facilitate Delivery and Placement of Waste to the Bottlehill Non-Hazardous Facility

At the time that the EIS was prepared, baling was (and is) carried out in Ireland at Arthurstown, Kill Co Kildare, a municipal waste facility with a licensed capacity of 600,000 tonnes per annum.

Baling was also carried out historically in the United Kingdom in Glasgow. In 2003, Glasgow City Council reverted to delivering un-baled waste to the waste facility. Baling was practiced in Glasgow both for ease of transport and to achieve maximum compaction in the landfill. It was also practiced to minimise nuisances such as litter blow. The reason that Glasgow City Council moved away from baled waste was that modern landfill compactors are significantly more effective than older models and the council found that better compaction was achieved using the landfill compactor and un-baled waste. The Council's practice in latter years was to break the bales on delivery and spread and compact the waste as per normal waste.

Baled waste was originally perceived as an innovative way of delivering waste to a landfill site.

In recent years, Cork, in line with most of the country has practiced separate collection of mixed dry recyclables. The effect is a measureable reduction in litter potential at landfill sites. As more upstream activities come on stream (such as the Cork MRF and other MBT activities) the potential for litter will further reduce.

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2.2. Waste Licence W0161-01

Cork County Council applied for a waste licence on 1st August 2001. The final decision was issued by the Agency on 25th June 2004.

References to baling in the licence are replicated below for convenience.

The licence states in its introduction that:

*"Waste will be delivered to the site, **primarily in baled** form,"*

Class 13 states:

"Storage prior to submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where the waste concerned is produced."

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*This activity is limited to the temporary storage of **baled** waste at the **baled** waste marshalling yard in sealed containers prior to haulage to the working face of the landfill."*

Condition 1.5.3 states:

*"Only **baled** residual waste shall be accepted for disposal at the facility. Notwithstanding, in exceptional circumstances, particular wastes, where **baling** is not technically feasible, may also be accepted for disposal at the facility, subject to agreement by the Agency."*

Condition 5.5.1 states:

"Unless the prior agreement of the Agency is given, the following shall apply at the landfill:
*a) Only one working face shall exist at the landfill at any one time for the deposit of **baled** waste other than the deposit of cover or restoration materials;*
*b) Prior to the commencement of waste activities the licensee shall submit a report to the Agency for its agreement as to the size of the working face for the deposit of **baled** waste;....."*

SCHEDULE G: Content of the Annual Environmental Report states:

*".....Waste activities carried out at the facility. Quantity and composition of waste received, disposed of and recovered during the reporting period and each previous year including the quantity of waste accepted in **baled** form....."*

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2.3. Planning Process

A planning application and supporting environmental impact statement under section 175 of the Planning and Development Act, 2000 was lodged with An Bord Pleanala on the 23rd May 2003, for a proposed landfill facility for the disposal of residual non-hazardous waste at Bottlehill.

Section 3.13.3 of the EIS envisions both un-baled and baled waste being placed at the landfill with the un-baled waste being compacted with a 30-40 tonne compactor.

Planning permission was granted in February 2004. baled waste is referenced only at Condition 2 (f) and only in the context of traffic.

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3. TECHNICAL COMPARISON OF BALED AND UN-BALED WASTE PLACEMENT

3.1. Overview

The perceived advantages of baling are:

- Structured mechanism to handle and transport residual waste from transfer stations
- Development of a structured open face and waste body
- Reduced risk of wind blown litter
- Reduced risk of scavenging birds
- High density of placed waste

The primary disadvantages associated with baling are:

Achievement of standardised size and density of bales can be difficult resulting in a less-stable waste mass.

There is a significant additional cost imposed on suppliers of baled waste such that waste hauliers are encouraged financially to travel further afield to landfill sites where baling is not required.

Impact on the operator's ability to market/sell void space because of the premium attached to baling.

The double-handling of the material and its associated impacts (including energy use) is less sustainable.

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This section will examine both baled and un-baled waste transfer and subsequent placement in the non-hazardous Bottlehill facility under the following headings:

- Planning permission and waste licence
- Regional waste management plan
- Literature review of baling related papers
- Bulk transfer of waste and associated logistics
- Movement of waste within the site prior to landfilling
- Placing of waste at the working face, site plant and machinery
- Compaction and settlement of waste
- Litter management
- Attraction of vermin, insects and scavenging birds
- Landfill gas infrastructure
- Case studies in Arthurstown and Glasgow

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3.2. Planning Permission and Waste Licence

As discussed in Section 2 above, the waste licence makes reference to baling at a number of conditions. The planning permission is relatively silent on the matter and refers to baling only in the context of traffic.

3.3. Regional Waste Management Plan

The Cork Waste Management Plan covers both the County and City areas. The Revised Plan was published in 2004 and covers the period 2004 - 2009. The region has a total population of 480,909 (2006 Census). At present a 2-bin system is in operation throughout the County for the collection of dry recyclables and residual waste. The residual waste is largely landfilled within the region at the Council's Youghal and Kinsale Road Landfills. Bottlehill residual landfill has been constructed for both the City and Council to serve the disposal needs of both for the next 20 years.

There is no separate organic collection within the City or County. The preferred strategy for the region is for the Councils to establish a 150,000 tpa mechanical separation plant (or similar facility treating mixed municipal solid waste) as well as a composting facility with a capacity of 65,000 tpa (or similar facility treating separated wet organic fraction).

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The Council's strategy is in keeping with Ireland's compliance with EU Landfill Directive targets that nationally by 2010, just 75% of the total biodegradable waste going to landfill in 1995 will be landfilled. That means that approximately 650,000 tonnes of biodegradable waste will be diverted from landfill in 2010. From 2016 the proportion is 35% and the amount is 941,981 tonnes. Assuming that the reduction is evenly spread across all landfills a reduction in biodegradable waste being deposited at Bottlehill will result in a consequent reduction in landfill gas production.

The waste management plan makes a number of references to the disposal of residual waste such as "*The Cork Region Waste Management Strategy proposed that a site for a new landfill for residual materials to serve the Cork Region be identified and developed in the immediate future. This new landfill is proposed to serve the needs of the region following the closure of all other landfills in Cork*".

The plan does not make any specific reference to a preferred policy of landfilling baled waste only at Bottlehill. In relation to the pre-treatment of waste prior to landfilling the plan states "*Cork County Council will endeavour to provide for treatment for waste arisings prior to the final disposal of the unrecoverable residue as required by the EU Council Directive on the Landfill of Waste which requires that only waste which has been subject to treatment is landfilled. The first major step towards this goal will come with the material recovery facility, where all recoverable municipal waste will be separated out for recovery, with the residue being landfilled*". Furthermore, the council has recently advertised for county-wide services to operate its refuse recycling service.

Baling of waste solely affects the conveyance and placing of residual waste in the landfill and does not influence the Cork Region's achievement of its diversion targets.

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3.4. Literature Review

Literature reviews of published papers and web based searches have yielded little new information in relation to the benefits of baling.

The following papers were reviewed, it was however difficult to find any references, directly relevant to what is proposed at Bottlehill because landfilling of baled residual municipal solid waste is not commonly practiced. Many references are for wrapped bales, generally regarded as an interim waste storage mechanism and not a waste disposal system.

1. **Environmental performance review and cost analysis of MSW landfilling by baling-wrapping technology versus conventional system**
   ***Waste** Management, Volume 23, Issue 9, 2003, Pages 795-806*
   J. M. Baldasano, S. Gassó, C. Pérez

2. **Temporal variation of leachate quality from pre-sorted and baled municipal solid waste with high organic and moisture content**
   ***Waste** Management, Volume 22, Issue 3, June 2002, Pages 269-282*
   M. El-Fadel, E. Bou-Zeid, W. Chahine, B. Alayli

3. **A comparison of small-scale, pilot-scale and large-scale tests for predicting leaching behaviour of landfilled wastes**
   Waste Management, Volume 23, Issue 1, 2003, Pages 45-59
   K. Kylefors, L. Andreas, A. Lagerkvist

4. **Long-term behaviour of baled household waste**
   Bioresource Technology, Volume 72, Issue 2, April 2000, Pages 125-130
   Fabian Robles-Martínez, Rémy Gourdon

5. **Effect of baling on the behaviour of domestic wastes: laboratory study on the role of pH in biodegradation**
   Bioresource Technology, Volume 69, Issue 1, July 1999, Pages 15-22
   Fabián Robles-Martínez, Rémy Gourdon

6. **Municipal solid waste landfill daily cover alternatives**
   Geotextiles and Geomembranes, Volume 11, Issues 4-6, 1992, Pages 629-635
   D.A. Carson

7. **Mass balance to assess the efficiency of a mechanical–biological treatment**
   ***Waste** Management, Volume 28, Issue 10, 2008, Pages 1791-1800*
   J. de Araújo Morais, G. Ducom, F. Achour, M. Rouez, R. Bayard

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A summary of the issues highlighted are presented below.

- Transport of waste i[1]
- Fire hazard[2]
- Gas production
- Fly and rodent infestation[2]
- Daily cover[2]
- Odours[2]
- Bird activity [2]
- Impact of strong winds[3]

The literature review produced no new information beyond that already available to the design team.

The critical parameter with respect to waste transport seems to be the permissible axle loads as against the density of waste in the transfer vehicle,

There are arguments that increase and decrease fire risk at baled waste landfills. The core issue is placement density. More dense placement of waste will reduce the air-content of waste and thus the fire risk.

Fly and rodent infestation are a function of density at placement and daily cover, again, modern equipment achieves as high or higher density at placement of un-baled waste.

Literature studies from baled waste landfill sites produced conflicting information in relation to landfill gas production. Experience in Iceland[4] showed an increase in actual gas yield over model predictions where as other references[2] predict lower actual gas yield than predicted when compared to bulk waste placement. Bales can be compacted to differing densities and this may explain some of the anomalies in relation to gas yields. Furthermore observations in relation to settlement and density were carried out over different time periods. In reality, it is the content of biodegradable waste that influences gas production. The rate of gas production will be influenced by the moisture content of the waste.

In general the primary reasons for selecting baling at a landfill site appear to be ease of handling, litter management and reduced bird activity.

All references appear to agree that bales are more expensive to produce albeit that the handling plant on site may be cheaper to operate. However the necessary double–handling of the waste upstream of the landfill outweighs any on-site advantages and leads to a less sustainable operation.

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1 Chapter 2 Handbook of Environmental Engineering 1980 By Lawrence K. Wang, Norman C. Pereira

2 www.dem.ri.gov/programs/ombuds/outreach/integsw/pdf/balefill.pdf

3 Álfsnes Landfill In Iceland: 12 Years Experience Of A Baled Waste Landfill B.H. Halldórsson And Ö. Einarsson SORPA Waste Management Company, Gufunesvegi, 112 Reykjavík, Iceland

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3.5. Bulk Transfer of Waste to Site and Associated Logistics

Waste in the Cork region is typically collected in 2-bin systems by refuse trucks operated by private or local authority operators and deposited in one or more waste transfer stations.

Thereafter waste materials that can be recycled are separated with the residual fraction going to landfill. For Bottlehill, it is envisioned that all waste will arrive in bulk and will be pre-treated in accordance with the EPA consultation document Municipal Solid Waste – Pre-treatment & Residuals Management

At the transfer station (or the county's proposed central MBT facility) two options exist:

- Load baled residual waste into sealed waste trucks and transfer by road to Bottlehill
- Transfer un-baled residual waste into sealed waste trucks and transfer by road to Bottlehill

Because the payload in either event will be similar, the truck movements will be the same. Bulk transfer of un-baled waste would avail of vehicles that are readily available to all waste contractors.

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3.5.1. Baled Waste Transfer to the Bottlehill Site

Baled waste requires

- A transfer area where refuse collection vehicle can tip waste onto a floor in an enclosed building
- A hopper, typically fed by a front end loader into which waste is placed
- A baling unit which compresses, bales and ties the waste into *cubic* shape. Wire is typically used to tie the bales
- A bale storage area
- A loading facility where bales are loaded into sealed articulated 20-tonne capacity trailers
- Leachate collection and disposal facilities

Upon completion of this operation waste can be hauled along designated routes to the Bottlehill landfill facility.

3.5.2. Un-baled Waste Transfer to the Bottlehill Site

Un-baled waste transfer requires:

- A transfer area where refuse collection vehicles can tip waste onto a floor in an enclosed building
- A loading facility where waste is loaded, typically by a front end loader or purpose designed grab machine into sealed articulated 20-tonne capacity trailers
- Leachate collection and disposal facilities

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Both transfer mechanisms allow for waste inspection prior to transport to the landfill.

3.5.3. Summary of Environmental Impacts

Good operational practices will ensure no negative impacts will arise during waste transfer whether either operation is exercised.

The potential for litter when handling baled or un-baled waste will be offset by all trucks being fully-enclosed.

3.6. Movement of Waste within the Site and Associated Logistics

When waste will be delivered to the landfill will travel over a weighbridge where data will be recorded in relation to source, type and weight. The weighbridge operator will then allow the vehicle to enter the site and proceed either to:

- The quarantine area if waste needs to be analysed or checked or
- Directly to the waste face

Given that virtually all of the waste will have been loaded in a licensed or permitted facility, the use of the quarantine area is likely to me minimal.

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3.6.1. Summary of Environmental Impacts

There is no significant difference in environmental impacts between baled or un-baled transfer of waste within the site to the face. In the baled-waste scenario there is likely to be a need for more equipment than in the un-baled scenario (see below).

3.7. Placing Of Waste at the Working Face and Associated Site Plant and Machinery

Waste placement at the face requires development of a working face to a limited height and width. This condition applies to both baled and un-baled waste options.

3.7.1. Baled Waste

When placing baled waste, bales will be delivered to the base of the waste face.

Handling of bales requires a 20 to 30 tonne tracked excavator with a grab to pick up and place bales. Compaction of the waste is typically effected by subsequent trafficking during delivery of waste however the Glasgow experience would favour the use of a landfill compactor because landfill compactors are designed to maximise wheel loads whereas tracked excavators are designed to achieve the exact opposite. The licence already permits the deposition of un-baled waste (Condition 1.5.3) where baling is not technically feasible. thus a landfill compactor will be required in any event.

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The advantages in placing baled waste include:

- Definition of a clean working face that can be easily covered with vertical plastic sheeting that does not impact on future recirculation if left in place
- A clean upper edge that facilitates daily cover placement which becomes an advantage where waste rates are very low, i.e. less than 25,000 tonnes per annum
- The ability to work from the bottom face allows separation of gas management operations and waste placement daily cover such that it does not interfere with the waste placement operation.

The disadvantages of baled waste are:

- By definition. There has to be a vertical face. It is not possible to place odour-absorbing daily cover on vertical face.
- Initially the waste density is lower than un-baled waste compacted by 40 to 60 tonne compactors. There will be gaps between bales thus rainfall can short-circuit the waste leaving it un-hydrated and reducing biological breakdown.
- Differential settlement can be more pronounced giving rise to long-term stability issues and the need to re-visit and re-engineer the restored cap.

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Un-baled Waste

When placing un-baled waste tipping can also be effected from either the top or the bottom. The preferred method is however to tip and blade waste into position from the top of the waste face.

Placement of un-baled waste requires a compactor (typically 40 to 60 tonnes) with a blade to push waste.

The advantages in placing un-baled waste are

- The system is better suited to immediate placement of soil, compost or wood chip daily covers
- Waste density following placement is greater

The disadvantages in placing un-baled waste are:

- The face is less defined
- There is a need for rigorous litter-control measures including netting both at the cell perimeter and close to the working face however the litter control measures are already in place at Bottlehill.
- There may be disruption when filling is suspended during high wind events

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3.8. Compaction and Settlement of waste

Bales will have a greater density than un-baled waste during transport However, in practice the limiting constraint is the permissible axle loads on public roads. Thus, whether waste is transported baled or un-baled, the number of truck movements will not differ.

Following placement and compaction in the landfill, un-baled waste will be more dense in the short term than baled because it will be bladed and pushed into position using waste compaction plant.

Baled waste is positioned by a grab and is not normally compacted by a dedicated machine. Furthermore the gaps left during placement between bales will be closed only once significant surcharge is applied from subsequent layers over an extended time period.

Long term settlement of both baled and un-baled waste will be similar. Accordingly there is no significant long term environmental impact on compaction or settlement. From an engineering perspective, the achievement of higher density in the short-term is an advantage with respect to placement of the final cap. It will be possible to cover the waste with an engineered cap including barrier layers, subsoil and topsoil, earlier in the case of un-baled waste.

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3.9. Litter Management

Bales are less susceptible to litter nuisance than un-baled waste however litter fencing at the perimeter is designed to capture wind blown litter. Nets located at the cell perimeter are designed to capture all litter escaping from either baled or un-baled placed waste.

The use of perimeter and 'close-in' litter netting is a proven measure to mitigate any risk of litter nuisance. Modern landfills (including Bottlehill) have weather stations that are used to inform the staff as to when adverse wind conditions warrant temporary closure or movement of the working face to a lower elevation within the landfill.

3.10. Attraction to Vermin, Insects and Scavenging Birds

There is no evidence to suggest that vermin or insect infestation is influenced more by baling or un-baled-waste management practices

With respect to bird control, if daily cover is effected using best practice then the two placement systems are very similar. One potential disadvantage, as stated earlier, on a baled site is the inability to implement immediately daily cover at the vertical face which can, depending on daily cover material selected, be more restrictive and so lead to operational issues.

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Assuming that modern landfill compaction and daily cover are employed there is no additional attraction to birds to a well managed un-baled MSW landfill. Indeed the increased potential for compaction reduces the availability of food that is the primary attraction for birds

In summary baling and un-baled waste placement have similar environmental impacts in relation to vermin, insects and scavenging birds.

Vermin control and the measures adopted will be similar for both baled and un-baled waste.

3.11. Landfill Gas Infrastructure and Decomposition of Waste

Decomposition of waste

Decomposition of waste under anaerobic conditions is impacted by availability of moisture and its ability to reach all waste.

Once the waste is placed its method of deposition has little influence on how it behaves in the landfill. It can be argued that the 'preferential pathways' arising by virtue of the 'joints' between the bales cause short-circuiting of leachate and rainfall directly to the base of the cells. However, the action of machinery surcharge from overlying waste will tend to close the 'joints'. In the case of Arthurstown (see below) it is evident that decomposition has not been influenced negatively by the use of baling.

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In either case, decomposition of the waste will be influenced and managed by controlled recirculation of leachate under the cap as permitted in accordance with Condition 5.11.6 of the licence.

An inevitable consequence of decomposition of waste under anaerobic conditions is the production of landfill gas including methane, carbon dioxide and trace odorous compounds. Gas is managed by landfill gas infrastructure including collection wells, collection pipework, gas transport pipework, gas pumps, flares and gas utilisation engines.

Gas collection pipework and gas wells are easier to install in the case of a baled waste landfill, that is because gas pipework can follow the horizontal and vertical grid network that results from the placement of bales however, the landfill industry and its support services is geared-up to install such infrastructure in un-baled landfills.

3.12. Case Studies in Glasgow and Arthurstown

Glasgow City Council[4] shut down the last baling plant in 2002.

The landfill operations are now serviced by a fleet of ejector trailers with an average pay load of 21 tonnes.

[4] Ian Galbraith Waste Management Operations Manager email to Declan O'Sullivan 19 Feb 08

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Glasgow changed from baled to un-baled waste placement for two reasons[5]:

- When baling was first implemented in Glasgow it was to maximise compaction of placed waste in the landfill. At the time that the decision was made, landfill compactors were typically 20 to 30 tonne loading shovels adapted to landfill compactor use by fitting steel wheels. With the availability of 50 tonne+ compactors it is now possible to achieve higher compaction densities than that with bales.
- The payloads of un-baled waste in ejector trailers are higher than that possible with baled waste trailers.

Arthurstown is now the only baled landfill facility in the UK and Ireland (research has not discovered a baled waste landfill anywhere else in Europe).

Arthurstown and its associated operations show that baling is an effective mechanism by which to place waste. Nuisance from litter and bird-scavenging are also mitigated which corroborates findings in the literature

An impact of baling in Arthurstown has been odour associated with a very high gas production which was not anticipated. High landfill gas production rates indicate accelerated waste breakdown which is environmentally advantageous however because this accelerated gas production was not anticipated, consequent odour issues resulted. The negative impacts of associated odours should not be attributed to baling as a concept but to the inability to accurately model and plan for increased gas production. The fact that odour-absorbing daily cover cannot be applied to vertical faces is also a contributor to the odour problem.

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[5] Tel Conversation Ian Galbraith Waste Management Operations Manager and Declan O'Sullivan 25 Feb 08

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4. CONCLUSION

This report has reviewed the An Bord Pleanála planning conditions, Waste Licence W0161-01 conditions and environmental impacts associated with baling. In addition the impacts of baling and un-baled waste placement for all operations starting from the waste transfer station through handling and placement to eventual waste breakdown and settlement have also been reviewed.

From a commercial perspective baling imposes an additional cost on waste suppliers without any significant benefit to the environment.

From a planning perspective there is no impediment to allowing un-baled waste to be placed in Bottlehill as long as overall vehicle movements do not increase beyond those required to fill the facility assuming 20 tonne capacity conveyance trailers.

From a waste licence perspective there is a requirement to mitigate environmental impacts as defined under respective licence conditions. Specifically, whether waste is delivered as bales or not.

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There would be a requirement to re-word some conditions of the licence with the agreement of the EPA. Clearly, references to waste being delivered and deposited *primarily in baled form* would be addressed. However, with respect to protection of the environment:

- Leachate, landfill gas, surface water and groundwater management will not change
- Ecological protection measures will not change
- Vermin, bird and fly controls will be required
- Traffic to and from the site will be the same
- Litter control measures will be employed but more so for un-baled waste
- Daily cover will be employed but it will be more effective in the case of un-baled waste
- Noise and disturbance will not differ.

The analysis has shown that whilst management practices may need to be altered to accommodate the differing operational requirements, there should be no detrimental environmental impacts as a consequence of introducing transfer and placement of un-baled residual waste in Bottlehill as long as best available technology and practices are employed.

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APPENDIX 1

Summary Matrix Comparing Landfilling of Baled and Un-baled Waste

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	Issue*	Baled Waste	Un-baled waste
1	Bulk transfer of waste to site	Transported via a baling station in ca. 20-tonne fully-enclosed vehicles.	Loaded and transported in ca. 20-tonne vehicles
2	Movement of waste within the site	Road-going trailers will be weighed and moved to waste face using where waste bales will be off-loaded using grab	Road-going trailers will be weighed and moved to waste face using where waste will be ejected
3	Waste placement	Waste placed with grab and compacted both by unloading plant and waste compactor	Waste spread and compacted using a waste compactor, likely to be in excess of 50-tonne weight.
4	Litter control	Less likelihood of litter blow however netting is nonetheless in place	Litter blow needs to be controlled using nets, and specific practices in high winds
5	Landfill gas	The quantity and nature of landfill gas will depend on the putrescible nature of the waste and its moisture content, not on whether it is baled.	The quantity and nature of landfill gas will depend on the putrescible nature of the waste and its moisture content, not on whether it is baled.
5	Surface water emissions	No influence	No influence
6	Groundwater Emissions	No influence	No influence
7	Leachate management	No influence	No influence
8	Vermin	Compaction-related issue, during transport and placement, less access to vermin.	Compaction-related issue, immediate and effective compaction vital
9	Dust	Transport-related dust the same, construction-related dust same, less likely to be dust blown from waste face.	Transport-related dust the same, construction-related dust same, possible dust blow as waste is placed in windy conditions. Mitigation easy using fine-mist spray if required
10	Birds	Compaction-related issue, during transport and placement, less access to birds. Daily cover vital, may be more difficult because of vertical faces	Compaction-related issue, immediate and effective compaction vital to reduce attractiveness to birds. Daily cover vital.
11	Noise	No influence, if there was no baled waste, possibly one less machine	No influence, waste compacter will be largest plant item.
12	Compaction and settlement	More difficult than with un-baled waste	Compaction more effective

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