European Union Network for
the Implementation and Enforcement
of Environmental Law

Reinforcement programme on inspection skills according to the Landfill Directive in IMPEL member countries

Report: March 2015

Introduction to IMPEL

The European Union Network for the Implementation and Enforcement of Environmental Law (IMPEL) is an international non-profit association of the environmental authorities of the EU Member States, acceding and candidate countries of the European Union and EEA countries. The association is registered in Belgium and its legal seat is in Brussels, Belgium.

IMPEL was set up in 1992 as an informal Network of European regulators and authorities concerned with the implementation and enforcement of environmental law. The Network's objective is to create the necessary impetus in the European Community to make progress on ensuring a more effective application of environmental legislation. The core of the IMPEL activities concerns awareness raising, capacity building and exchange of information and experiences on implementation, enforcement and international enforcement collaboration as well as promoting and supporting the practicability and enforceability of European environmental legislation.

During the previous years IMPEL has developed into a considerable, widely known organisation, being mentioned in a number of EU legislative and policy documents, e.g. the 7th Environment Action Programme and the Recommendation on Minimum Criteria for Environmental Inspections.

The expertise and experience of the participants within IMPEL make the network uniquely qualified to work on both technical and regulatory aspects of EU environmental legislation.

Information on the IMPEL Network is also available through its website at: www.impel.eu

Title report: Reinforcement programme on inspection skills according to the Landfill Directive in IMPEL member countries	**Number report:** 2014/04
Project manager: John Visbeen, Netherlands Romano Ruggeri, Italy	**Report adopted:** Written procedure, March 2015
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Executive summary

During 2011, 2012, 2013 and 2014 we have been working on the project 'Reinforcement programme on inspections skills according to the Landfill Directive'. The Council Directive 1999/31/EC on the landfill of waste and the Council Decision of May 2002 establishing criteria and procedures for the acceptance of waste at landfills (2003/33/EC) set standards for the authorisation, design, operation, closure and aftercare of landfills.

Improving implementation of EU law is a high priority objective of both the European Commission and IMPEL. Recent reports on implementation of EU waste legislation have shown that *"implementation and enforcement of EU waste law remain poor particularly regarding the waste framework directive, the landfill directive and the waste shipment regulation".*

The project Landfill inspection started in 2011. The objectives of the project:

- identification of good inspection practices, developing guidance;
- improve cooperation between IMPEL member countries to work towards a consistent regulatory and enforcement regime;
- to give feedback to policy makers on (effectiveness) of the various approaches and practices in the field of permitting and inspection of landfill sites in the IMPEL member countries.

In 2011 an information exchange forum was organised in basecamp and a workshop was organised in Sardinia (Italy). The aim of the project in 2012, 2013 and 2014 has been to improve inspections skills for landfills by:

- Joint inspections in Sardinia (2011), Slovenia and Romania (2012), Czech Republic, Croatia and Poland (2013), England and Portugal (2014). Guidance and inspection tools that are available from the different EU member states have been used and checklists to be used during the inspections were developed. During a workshop in October 2012 the joint inspections were evaluated and the practicability of guidance's and tools used was discussed. Results of the joint inspections in 2013 and 2014 will be added to the guidance.
- In 2013 and 2014 also an inspector from the water board participated in the joint inspections in Czech Republic, Croatia, England and Portugal.
- The inspection in England (Birmingham) was also a training session based on guidance documents from the Environment Agency. Inspectors from England exchanged their knowledge and experience with the inspectors according to:
    - procedures for the acceptance of waste,
    - hazardous waste classification,
    - sampling plans for waste,
    - monitoring trigger level of groundwater,
    - requirements on the conditions of top layers and bottom liners,
    - biogas monitoring,
    - water management (groundwater and leachate)

As an inspection at a landfill has to cover different subjects, the inspection team decided to choose certain subjects to focus on during the joint inspections. The results of the 2011 workshop, of the executed joint inspections, the training session and the information exchange forum showed that the activities, on which the project will focus, to begin with, are:

(1) Criteria and procedures for the acceptance of waste.
(2) Gas control.
(3) Protection of soil and water (underground water).
(4) Water control and leach ate management.

In 2014 we also worked on an inventory according to waste acceptance, sampling plan, groundwater trigger level, treatment of waste, stable non reactive waste, leachate management, requirements on top and bottom layers, meteoric and surface water and monitoring report. The inventory now gives and overview from inspectorates from England, Italy, Austria, Sweden, Netherlands and Czech republic. The questions are clear, for instance: “Who and how perform sampling of waste before land filling”, “How to define trigger and control levels for groundwater”, “How top and bottom layers can be inspected”. This inventory gives detailed and valuable information.

This report contains the reports of the joint inspections 2014 in England and in Portugal and the results of the inventory. The guidance document is a separate document. This document will be revised in 2015.

Contents

1 Scope

1.1 Project Background

Improving implementation of EU law is a high priority objective of both the European Commission and IMPEL. Recent reports on implementation of EU waste legislation have shown that “implementation and enforcement of EU waste law remain poor particularly regarding the Waste Framework Directive, the Landfill Directive and the Waste Shipment Regulation” (See Commission note for IMPEL Board/Clusters on EU Waste Legislation: consolidated summary of main implementation gaps, August 2010).

A questionnaire that was sent out in December 2010 to national IMPEL coordinators showed that there are countries (50%) who have a lack of knowledge to fulfil inspection requirements, especially with regard to new-to-build landfill sites, (but also new build on existing locations). There are also several countries who can offer the required technical knowledge. It was also shown that there was significant support for the exchange of knowledge and experiences because the inspections of landfill sites are complex and challenging. (see annex one for results of questionnaire)

Some countries, (for instance Romania), say that the best moment for support for inspection landfill sites they need is now, because these sites are being built at this moment,

On European projects of landfill construction (based on European funding) it is obligatory to have special technical assistance (TA) by an independent consultant. However often public administration lacks the required expertise. As a result the European Commission has organised significant assistance in recent years. Nevertheless there is still need for training measures to reach a certain minimum level of expertise in order to guarantee a good standard and quality of inspections (and also to verify or check the work of the independent consultants). IMPEL is in a position to organise knowledge exchange platforms, training measures and inspection tools for inspectors (and also permitters).

1.2 Objectives

The main objectives of the current project are:

- Identification of good inspection practices
- Cooperation (and helping each other) between IMPEL member countries to work towards a consistent regulatory and enforcement regime
- Feedback to policy makers on the (effectiveness of) the various approaches and practices in the field of permitting and inspection of landfill sites in IMPEL Member countries,

A core team to achieve these main project objectives worked together during 2011, 2012, 2013 and 2014. We managed to organise the training session and joint inspections in England and Portugal by using basecamp. The guidance document and developed preparation documents were used by the captain and experts of the inspection teams.

1.3 Activities 2014

The objectives will be achieved by:

- Extending the use of Basecamp under the IMPEL website for experts in all IMPEL member countries as an exchange platform for information and specific questions, discussions etc.
- Carrying one training sesssion and two joint inspections to exchange experiences and knowledge,

- Drafting of project report containing findings, conclusions and recommendations of the two joint inspections and proposal for ToR 2015.

1.4 Organisation of the project

We choose to use the Basecamp for the preparations of the joint inspection. Travels and accommodation were arranged by project leader. Project leader also pointed out team captain for each joint inspection. Together with hosting country he/she was responsible for the preparation of the joint inspection. The inspection team together was responsible for drafting the report of the inspection.

1.5 Inspection teams

Training class/Inspection team England (Birmingham)

- Inspector Italy: Romano Ruggeri (team captain)
- Inspector Netherlands: Stuart Gunput
- Inspector Poland: Tandek Lukasz
- Inspector Romania: Amelia Maria Nadescu
- Inspector Sweden: Nina Henson
- Inspector Malta: Darren Cordina
- Inspector Slovenia: Jana Miklavcic
- Inspector Portugal: António Figueiredo
- Inspector Austria: Franz Waldner
- Inspector Croatia: Zoran Bošnjak
- Waterboard Inspector Netherlands: Ronald Smallenburg
- Waterboard Inspector Netherlands: Ronald van Tunen

The Environment Agency was represented by the following experts:

- Max Folkett: Advisor – Landfill and Inert Waste
- Bob McIntyre: Technical Advisor, Hazardous Waste
- Darren Legge: Technical Advisor – Landfill Engineering
- Dave Browell: Environment & Business Waste Technical Services National Technical Advisor (Landfill Gas)
- Nicola Ingrey: Environment & Business Waste Technical Services, Technical Advisor (landfill)
- Peter Elliott: Technical Advisor, Landfill
- Sarah Dennis: PPC Officer
- Lee Horrocks: Sector Coordinator, Landfill
- Will Fawcett: EU and International Relations Advisor

Inspection team Portugal

- Inspector Italy: Romano Ruggeri (team captain)
- Inspector Austria: Franz Waldner
- Inspector Netherlands: Ronald Smallenburg

- Inspector Czech Republic: Vojtech Hamernik
- Inspector Malta: Georgesam Mizzi
- Inspector Sweden: Nina Hansson
- Inspector Portugal: Antonio Henrique Figueiredo
- Inspector Portugal: Marco Candeias
- Inspector Portugal: Susana Pimpao

1.6 Conclusions and recommendations

1.6.1. Main achievements of the training session and joint inspection in England

For the survey question and main achievements according to procedures for the acceptance of waste, hazardous waste classification, sampling plans for waste, monitoring trigger level of groundwater, requirements on the conditions of top layers and bottom liners, biogas monitoring and water management (groundwater and leachate) see the added report from the training session and inspection in Birmingham.

Conclusions and recommendations:

- Waste acceptance: basic characterization and Compliance Testing. A difference in the interpretation of the Directive, of the different obligations for waste producer and landfill operator and different leaching tests.
- Methods in MS: L/S10-2-0.1
- Sampling plan: necessary but not mandatory
- Hazardous properties in case of mirror code waste: lab bulletin not clear enough. Detailed report of the laboratory with calculated properties. Consultant for analysis interpretation. Priority steps to be followed to set the correct waste code
- Stable and non-reactive waste: is the required treatment (long term behaviour) clear?
- Trigger levels for groundwater: different interpretation of Directive. Hydro geological risk assessment (site specific thresholds).
- Top and bottom layers inspections: test and report analysis. Quality standards required (CQA)
- Monitoring and management of meteoric and surface water
- Biogases diffuse emissions detection. Tools used.
- Waste stream approach (upstream/downstream): planning of inspections.

Next steps

- Preparation for Portugal Inspection (2nd week of September)
- Review of Guidance and Checklist (with best practice learned)
- Analysis of the Survey
- Report for European Commission

Further work in 2015

- End of Waste and re-used/recycled materials: how to check. From landfill to recovery plants?
- Training for inspectors

1.6.2 Main achievements by Technical discussion joint inspection Portugal

1. Trigger levels for groundwater

Not a unique interpretation in the MS; some use to fix thresholds for the concentration of pollutant in the groundwater (i.e. Italy), some determine the allowed concentration as a consequence of a site specific risk assessment (i.e. UK). In most of MS no threshold limit is set for GW concentrations, therefore no infringements can be punished in case of a change of the water quality; it indeed represents an alarm that the landfill is not performing as it would have to, following the authorization. Usually, monitoring of groundwater is performed to check the downstream and upstream differences and the trend along the time of pollutant concentrations, in order to identify possible lack of leachate from the bottom of the landfill and promptly take the emergency actions.

Recommendations:

a) Use a site specific risk assessment before and meanwhile the operation of the landfill; so long as it is possible use real data and not literature one. Environment Agency guidelines are recommended.

b) Use the data collected from the boreholes to check for trends of groundwater quality downstream and upstream; a progressive change of water quality is an alarm to investigate on the causes (lack of leachate) and promptly take the emergency actions before the change produces significant environmental effects. Emergency actions have to be pre-defined in the Environmental Management System (EMS) procedures. The landfill operator should have a map with the location of the different boreholes; the Health Risk Assessment (HRA) points out the location of the boreholes.

c) In consultation with the landfill operator control levels (alarm levels) should be determined. If an alarm level is reached, the operator is obliged to inform the competent authority and explain the reason of exceeding the level.

d) Inspectors needs training on risk assessment principles and software (i.e. use of LandSim) to be able to properly evaluate the company reports.

e) Inspection authority should take GW samples (by means of certified companies in case it doesn't have its own lab) for a check, or there must be a system which shows the necessary information directly online.

2. Meteoric water management

The management of meteoric water shows many differences among MS in terms of required monitoring, treatment, used terms and solutions to intercept it. First it was necessary to define the meaning of surface water, run-off water, meteoric water, raining water and start from there an equal base of the different terms.

Definitions and recommendations:

a) Surface water: it is commonly found in the direct surrounding of the landfill. Not contaminated water coming from the landfill is discharged In the surface water. In most MS surface water is monitored by taking samples upstream and downstream in the natural recipient bodies. Taking samples in surface water on a good and representative way is very difficult. The competent authority should get more insight about the sampling method.

b) Run-off-water: this water originates from the covered parts of the landfill and is therefore not contaminated by the waste. The runoff water is often collected in the ditches around the landfill and this water is discharged in the surface water in one or more points. Runoff water, according to some MS, can be:

- considered as a not contaminated water (in case of final closure of the landfill) and no monitoring measurements are required; in case recycle waste is used for final coverage the water could be contaminated and has to be monitored;

- treated as leachate in case of temporary closure (monitoring and treatment required).

c) Meteoric water or raining water: this water ends up on the parts of the landfill which is not yet covered. We can think of on paved roads and storage parts of the landfill. It is possible that this water could become polluted through contact with the waste. In most MS this water has to be monitored and treated. In some other MS this water doesn't require any monitoring and treatment or just a light one.

3. Waste characterization

In most of MS (with the exception of Italy and Czech Republic), Basic characterization (BC) and Compliance Testing (CT) are both performed by the producer of the waste. BC has to highlight the most critical parameters; if nothing changes in the production process of the waste, the following years the producer will perform a simplified analysis (CT), once per year, focusing only on the critical parameters, that are peculiar of the production process. Operator has to perform a visual inspection on the waste entering the landfill and a check on the correctness of the transport documents.
When CT is performed by the operator, the analysis replies the BC and it is intended to be a further check of the characteristic of the waste. In Czech Republic BC is not performed (after the first time) at least once per year, but only when a change in the production process occurs.

4. Mirror code waste

All inspectors agree that lab bulletins have to give evidence of the hazardous properties calculation. The lab bulletin has to give evidence of the presence of the amount of hazardous chemical compounds and not of the single element. A deeper knowledge is needed about CLP (Regulation on classification, labelling and packaging of substances and mixtures) to define when a waste can be considered as dangerous. Inspectors share the same doubts about:

- How to present the lab bulletin results concerning the hazardous properties of a waste, to correctly choose between the hazardous or non hazardous waste code? The risk properties calculation has to be presented (R and H codes).
- When a waste can be considered as hazardous?
- How to assess the H14 property?

5. Sampling plan

Most of MS usually don’t check the presence and correctness of the sampling plan (Austria and Sweden do it), as a consequence of a common lack of knowledge. Inspectors need to go into real practice experiences of sampling applying the EN14899, in order to be able to evaluate a sampling plan. Waste assessment certificate has to include a sampling plan. To draw up a common format for sampling plan is seen as a useful tool.

Valorsul landfill in brief

Strengths	***Weaknesses***
Detailed Monitoring system	Waste accepted (fornitures, wood ecc)
Leachate treatment plant	Basic characterization missing
Surface water interception and treatment	Sampling plan missing
Recovery plant for bottom ash	Waste code for inertized fly ash (99 code)

Conclusions and further steps for the project in 2015

1. The guidance and checklist need to be updated according to the amount of new information and experiences collected in the last meeting and especially in UK.

2. The Survey has to be filled in by all participants, and the main results can be contained in a note for the Commission or in the final Report.

3. A practice experience in sampling plan is considered to be a priority in the next meetings. How to take samples of groundwater and calculation to give evidence of the hazardous/non hazardous properties of mirror code wastes are also commonly perceived as topics to be deepened

4. Analysis of the Survey

5. Report for European Commission

6. Training for inspectors

European Union Network for the Implementation and Enforcement of Environmental Law

ANNEX 1

Reinforcement Programme on inspection skills according to Landfill sites in IMPEL Member Countries

Training at the Environment Agency England (EA)
Birmingham 2 - 4 June 2014

Preface: Results of Utrecht meeting (December 2013) about training

Training is needed for waste inspectors concerning sampling protocols and hazardous properties assessment in order to be able to supervise the classification of waste as well as the acceptance procedures and monitoring results of landfills.

The interpretation of the monitoring results from landfills (groundwater, leach ate, surface water, landfill gas) requires specific knowledge. When a landfill is only inspected once a year it is very difficult to gain this specific knowledge. More information is needed on how the different member states evaluate the results of monitoring by the landfill operator.

The Environment Agency was chosen as the skilled Inspection Authority

Schedule of the Birmingham meeting:

1st full day: Lecture and training

2nd full day: Inspection at the landfill; focus on the topics debated in the previous day

3th ½ day: Results of the inspection, update checklist and guidance, conclusions

Preparation of the meeting

- Definition of the main topics of the training going through the conclusions/recommendations indicated in the Inspection guidance book for Landfill inspection and come out from the Utrecht meeting.
- Identification of a landfill operator adopting best available technologies (BAT).
- Collection of information about the landfill (Permit, website ecc.).
- Draw up of the agenda of the meeting.
- Delivery of a survey containing open questions on the critical points of the Council Decision of 19 December 2002 and Council Directive 1999/31/EC.
- Analysis of the first results of the survey.
- Preparation of the starting presentation (PPT) about the IMPEL network and the previous steps of the project.
- Stimulating discussion and preparation of the group on Basecamp.

Definition of the topics of the training

TOPIC	TRAINING NEEDED	ENVIRONMENT AGENCY GUIDELINE
Procedure for the **acceptance of waste**: Basic characterization (producer of the waste), compliance testing (acceptance of the waste) and **hazardous waste classification** (mirror code waste, including hazardous property assessment).	How to determine if a mirror entry is hazardous or non-hazardous: what the inspectors should focus on? Which data do the lab bulletins have to include? Stable non reactive waste: what are the requested minimum criteria?	- Technical guidance WM2: Hazardous waste. Interpretation of the definition and classification of hazardous waste (3rd Edition 2013) http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/LIT_5426_acd22f.pdf - Waste acceptance at landfills (PDF, 456KB) - Waste sampling and testing for disposal to landfill (PDF, 942KB) - Treatment of waste for landfill (PDF, 325KB)
Sampling plans for waste	Inspectors need to acquire knowledge on waste sampling plan: how to perform it, what to ask to the company. How the topic is checked by UK inspectors?	- Appendix D : Waste Sampling. A supplement to Hazardous waste: Interpretation of the definition and classification of hazardous waste (3rd Edition 2013) http://www.doeni.gov.uk/niea/supplement_appendix_d__july_.pdf - Waste sampling and testing for disposal to landfill (PDF, 942KB)
Monitoring **trigger level of groundwater** (sampling, monitoring and trigger levels). Actions to be taken in case of exceeding the trigger levels.	Groundwater control levels and compliance limits: differences and how to determine them. What is the meaning and importance to carry out the hydrological risk assessment?	- Horizontal guidance Note H1, Annex J 3. Additional guidance for hydrogeological risk assessments for landfills and the derivation of groundwater control levels and compliance limits. http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/geho0212bulu-e-e.pdf - Groundwater trigger levels, minimum reporting values (MRVs) and limits of detection (PDF, 260KB) - Hydrogeological risk assessment for landfill - template for 4-yearly review (PDF, 83KB)
The requirements on the conditions of **top layers and bottom liners** of landfills.	What (and how) do the inspectors have to check to supervise the reliability of bottom and top liners realisation (in situ test)?	- LFE 1 - Our approach to landfill engineering (version 1) (PDF, 10KB) - LFE 2 - Cylinder testing geomembranes and their protective materials (version 2, updated July 2011) (PDF, 161KB) - LFE 3 - Using geosynthetic clay liners in landfill engineering (version 3) (PDF, 260KB) - LFE 4 - Earthworks in landfill engineering (updated February 2011) (PDF, 1.2MB) - LFE 5 - Using geomembranes in landfill engineering (version 1) (PDF, 30KB) - LFE 6 - Guidance on using landfill cover materials (version 1) (PDF, 20KB) - LFE 7 - Using nonwoven protector geotextiles in landfill engineering (version 2, updated July 2011) (PDF,188KB) - LFE 8 - Geophysical testing of geomembranes used in landfills (version 1) (PDF, 20KB) - LFE 9 - Compliance testing earthworks on landfill sites using nuclear density gauges (version 1) (PDF, 20KB) - LFE 10 - Using bentonite enriched soils in landfill engineering (version 1) (PDF, 30KB)
Biogas monitoring.	How to assess the good performance of the extraction pumping system? Monitoring techniques of surface gas emissions (flux box ecc).	- TGN 03 Guidance on the management of landfill gas (PDF, 1MB) - TGN 04 Guidance on monitoring trace components in landfill gas (version 2, updated March 2011) (PDF, 444KB) - TGN 05 Guidance for monitoring enclosed landfill gas flares (version 2, updated March 2011) (PDF, 444KB) - TGN 06 Guidance on gas treatment technologies for

TOPIC	TRAINING NEEDED	ENVIRONMENT AGENCY GUIDELINE
		landfill gas engines (version 2, updated March 2011) (PDF, 1.3MB) - TGN 07 Guidance on monitoring landfill gas surface emissions (version 2, updated March 2011) (PDF, 830KB) - TGN 08 Guidance for monitoring landfill gas engine emissions (version 2, updated March 2011) (PDF, 688KB) - Guidance on landfill gas flaring (PDF, 800KB)
Water management (groundwater and leachate).	Which are the minimum criteria requested for leachate treatment and monitoring and groundwater monitoring?	- TGN02 Monitoring landfill leachate, groundwater and surface water (PDF, 1.9MB)

Agenda of the joint inspection

Time	Activity	Location	Apparatus	Who
Sunday 01/06/2014 arrival of : Copthorne Hotel Birmingham http://www.millenniumhotels.co.uk/copthornebirmingham				
Monday 2 June 2014				
Time	**Activity**	**Location**	**Apparatus**	**Who**
9.00 9.30	Breakfast	Copthorne Hotel Birmingham		
9.30 9.45	Overview of the Environment Agency roles and responsibilities • The role of the Environment Agency • Implementation of the Landfill Directive in England and Wales	Copthorne Hotel Birmingham	Laptop and beamer (ppt)	Max Folkett (EA)
9.45 10.00	Overview and aims of the IMPEL project	Copthorne Hotel Birmingham	Laptop and beamer (ppt)	John Visbeen/Romano Ruggeri
10.00 10.45	*Training: TOPIC Top and bottom layer inspection*. Assessing suitability of top/bottom liners • The Construction Quality Assurance (CQA) process • Testing and test house accreditation	Copthorne Hotel Birmingham	Laptop and beamer; Environment Agency UK guidelines	Darren Legge (EA)
10:45 11:30	*Training: TOPIC Hazardous waste classification and Treatment of waste* • Hazardous waste assessment	Copthorne Hotel Birmingham	Laptop and beamer; Environment Agency UK guidelines	Bob McIntyre (EA)
11.30 11.45	Coffee break	Copthorne Hotel Birmingham		
11:45 12:30	*Training: TOPIC Waste acceptance (basic characterization, stable non-reactive waste), and sampling plan* • Brief overview of background/ European legislation covering WAC (to establish common understanding) • Best practice guidance for sampling plans in England • How we regulate WAC in England.	Copthorne Hotel Birmingham	Laptop and beamer; Environment Agency UK guidelines	Peter Elliott (EA)
12.30 13.30	Lunch	Copthorne Hotel Birmingham		
13:30 14:15	*Training: TOPIC Water management* Groundwater monitoring and trigger levels. • Best practice guidance on setting groundwater control and compliance limits in	Copthorne Hotel Birmingham	Laptop and beamer; Environment Agency UK guidelines	Nicola Ingrey (EA)

Time	Activity	Location	Apparatus	Who
	environmental permits • HRA assessments and reviews • Compliance review process – assessing best practice			
14:15 15:00	*Training: TOPIC Water management* • Best practice design of leachate monitoring wells • Lifecycle of groundwater monitoring requirements	Copthorne Hotel Birmingham	Laptop and beamer; Environment Agency UK guidelines	Nicola Ingrey/Darren Legge (EA)
15:00 15:15	Coffee break	Copthorne Hotel Birmingham		
15:15 16:00	*Training: TOPIC Landfill gas system audit and gas monitoring* • Technical review process – assessing best practice • Use of the TDL_GPS gazomats for walkovers surface emission surveys • Other emission measurement methods	Copthorne Hotel Birmingham	Laptop and beamer; Environment Agency UK guidelines	Dave Browell (EA)
16:00 16:30	An introduction to Wingmoor Landfill	Copthorne Hotel Birmingham	Laptop and beamer	Sarah Dennis (EA)
16.30 17.30	Open discussion time and further questions	Copthorne Hotel Birmingham		All
20.00	Dinner and informal discussion	Restaurant Location (to be defined)		
Tuesday 3 June 2014				
Time	**Activity**	**Location**	**Apparatus**	**Who**
8.00 8.30	Breakfast	Copthorne Hotel Birmingham		
8.30 10.00	Appointment at 8.30 at the lobby of Hotel Transport to Grundon Waste Management Ltd. Wingmoor Farm, Stoke Orchard Road, Bishops Cleeve, Cheltenham, Gloucestershire, GL52 7DG	Copthorne Hotel Birmingham	from Birmingham New Street to Cheltenham Spa by train Possible trains: Dep Birmingham New Street 09:17, Arrive Cheltenham Spa 09:58. Return journey, depart Cheltenham 16:01 and arrive 16:45 (Departures every 30 mins)	Inspection team EA: Sarah Dennis, Will Fawcett, Dave Browell, Lee Horrocks
10.15 10.30	Overview and aims of the IMPEL project	Landfill meeting room	Laptop and beamer (ppt)	Romano Ruggeri
10.30 10.45	Presentation of the landfill	Landfill meeting room	Laptop and beamer	Landfill representative
10.45 12.30	Joint inspection on landfill Main focus on the topics debated in the previous day. Use of checklist	Visit of the landfill	Checklist	Inspection team (personal safety equipment) and landfill operator
12.30 13.30	Lunch			

Time	Activity	Location	Apparatus	Who
13.30 15.30	Joint inspection on landfill. Main focus on the topics debated in the previous day: *WAC, sampling, HW assessment, GW, biogas, tob&bottom*. Use of checklist	Landfill conference room	Checklist	Inspection team and landfill operator
16.01 16.45	Transport back to hotel		from Cheltenham Spa to Birmingham New Street by train	Inspection team
20.00	Dinner			
Wednesday 4 June 2014				
Time	**Activity**	**Location**	**Apparatus**	**Who**
8.00 8.30	Breakfast	Copthorne Hotel Birmingham		
8.30 10.00	Inspection evaluation • What has been observed; • Experience with checklist • Experience of inspectors Input for report	Copthorne Hotel Birmingham	Checklist and notes	Inspection team Environment Agency inspectors
10.00 10.15	Coffee break			
10.15 11.15	Inspection evaluation • What has been observed; • Experience with checklist • Experience of inspectors Input for report	Copthorne Hotel Birmingham	Checklist and notes	Inspection team Environment Agency inspectors
11.15 12.00	Discussion, conclusions and further steps. Input for final report	Copthorne Hotel Birmingham	Laptop and beamer (ppt)	Inspection team Environment Agency inspectors
12.00 13.00	Lunch	Copthorne Hotel Birmingham		

Inspection team

The inspection group has been composed by:

- Inspector Italy: Romano Ruggeri (team captain)
- Inspector Netherlands: Stuart Gunput
- Inspector Poland: Tandek Lukasz
- Inspector Romania: Amelia Maria Nadescu
- Inspector Sweden: Nina Henson
- Inspector Malta: Darren Cordina
- Inspector Slovenia: Jana Miklavcic
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The Environment Agency was represented by the following experts:

- Max Folkett: Advisor – Landfill and Inert Waste
- Bob McIntyre: Technical Advisor, Hazardous Waste
- Darren Legge: Technical Advisor – Landfill Engineering
- Dave Browell: Environment & Business Waste Technical Services National Technical Advisor (Landfill Gas)
- Nicola Ingrey: Environment & Business Waste Technical Services, Technical Advisor (landfill)
- Peter Elliott: Technical Advisor, Landfill
- Sarah Dennis: PPC Officer
- Lee Horrocks: Sector Coordinator, Landfill
- Will Fawcett: EU and International Relations Advisor

Fig. 1: Inspection group

DAY 1: TRAINING WITH THE EXPERTS OF THE ENVIRONMENT AGENCY (ENGLAND)

Along the first day, the experts of the Environment Agency deepened the chosen topics by means of ppt presentations. Results of the Landfill Impel project have been presented as well as an explanation of the Impel network.


Fig. 2: First day training meeting

Below, the main findings of discussion are presented:

TOPIC N.1: The regulation of top and bottom liners
Darren Legge (Technical Advisor – Landfill Engineering)

Survey question:

How can top and bottom layers be inspected? Requirements on the conditions of top and bottom layers seems to be different in MS. Difficulties are met by inspectors to assess the compliance with top and bottom criteria.

Main achievements:

The engineering design is justified through groundwater, stability and landfill gas risk assessments, as part of an application for a landfill permit. The permit application will refer to Environment Agency landfill engineering specific guidance. The permit template contains a number of engineering related conditions that require:

- the submission of construction proposals;
- the submission of a validation report on completion of the works.

Both require confirmation from the EA that it is satisfied with the information provided prior to any waste being deposited.

- The construction proposals (landfill project) include;
- Construction Quality Assurance Plan
- Specifications
- Drawings
- Validation Report - On completion of the works

All are assessed by EA technical officers who have experience and training in the field of landfill engineering. Non compliances result in an increase in the annual fees paid by the site.

The construction works are supervised by an independent third party Construction Quality Assurance Engineer, Independent from the landfill operator; details of the CQA personnel are provided to the EA for agreement. This person checks if the under layer and all relevant components such as the leachate and biogas collection system, are constructed according to declared and approved specifications

All installers of the Artificial Sealing Layer, where this is a geomembrane, need to be experienced and must have an appropriate accreditation; similarly, all laboratory testing of conformance samples required in order to ensure compliance with the CQA Plan/Specification, needs to be undertaken at a laboratory which has the required United Kingdom Accreditation Service (UKAS) accreditation for each individual test.

EA inspects the works to ensure compliance with CQA Plan/best practice/permit conditions and can check all site documentation to ensure that correct conformity testing/remedial works have been undertaken.

Furthermore EA can observe on-site based testing to ensure compliance with the CQA Plan/Specification and has the ability to remove and replace the CQA Engineer; if EA concerns regarding the quality standards, it might not provide validation and no placement of waste is allowed.

TOPIC N.2: **Waste acceptance & sampling plans**
Peter Elliott (Technical Advisor – Landfill Engineering)

Survey question:

Who perform sampling of waste before landfilling and how? Different approaches in Member States have been identified. In Netherlands and Italy 3 steps of checking exist: waste producer (basic characterization), landfill operator (compliance testing), and inspection authority (taking samples). In Czech no compliance testing is performed by the operator. In Sweden BC and CT are performed by the waste producer. In Austria BC is performed by an Independent Expert/Institute and compliance testing by a Landfill Supervisor (on behalf of the Competent Authority).

How to determine if a mirror entry is hazardous or non-hazardous: what the inspectors should focus on? Which data do the lab bulletins have to include?

Stable non reactive waste: what are the minimum criteria requested?

Inspectors need to acquire knowledge on waste sampling plan: how to perform sampling, what to ask the company. How is the topic checked by inspectors? Protocols of sampling are mentioned in the Council Decision, but usually the sampling plan is not presented and inspection authorities do not perform inspections on sampling.

Main achievements

Waste acceptance criteria: Landfill Directive and Council Decision set out 3 levels of waste assessment:

- Basic characterisation (Level 1)
- Compliance testing (Level 2)
- On-site verification (Level 3)

Basic characterisation (Level 1): it is the first step in the acceptance procedure and constitutes a full characterisation of the waste by gathering all the necessary information for a safe long term disposal of the waste. Basic characterisation is required for each type of waste. As a general rule waste must be tested to obtain the required information.

Compliance testing (Level 2): when waste has been deemed acceptable for a landfill class on the basis of a basic characterisation... it shall subsequently be subject to compliance testing to determine if it complies with the results of the basic characterisation and the relevant acceptance criteria. The function of compliance testing is to periodically check regularly arising waste streams.

On-site verification (Level 3): each load of waste delivered to a landfill shall be visually inspected by the owner of the plant, before and after unloading. The required documentation shall be checked. The waste maybe accepted at the landfill, if it is the same as that which has been subjected to basic characterisation and compliance testing and which is described in the accompanying documents. If this is not the case, the waste must not be accepted.

In England waste producers are responsible for basic characterisation and compliance testing; they know most about their waste and are responsible for deciding the best route for recovery or disposal. Furthermore, waste producers must carry out leaching tests when their waste is sent to landfill and must also assess whether their waste is hazardous.

Landfill operators must inspect the waste they accept at the site entrance or at the tip face to confirm that the waste is the same as described in accompanying paperwork. Landfill permits do not require operators to sample their waste, but it is good practice. Where operators take samples, they must retain them for 1 month and keep results for 2 years.

EA has found that leaching test results are highly variable with very high degree of uncertainty; therefore they only use leaching test results to identify the class (or cell) of landfill that may accept the waste; a statistical analysis of test results to exclude 'outliers' is allowed. EA assesses the risks a landfill poses to the wider environment based on leachate quality.

Stable non-reactive hazardous waste (SNRHW) maybe accepted in a landfill for non-hazardous waste in a cell that does not accept biodegradable waste; it must meet relevant waste acceptance criteria (WAC). Stable non-reactive means that the leaching behaviour of the waste in the long-term will not change adversely/negatively, according to landfill design conditions or foreseeable accidents:

- in the waste alone (e.g. by biodegradation),
- under the impact of long-term ambient conditions (e.g. water, air, temperature, mechanical constraints),
- by impact of other wastes (including waste products such as leachate and gas).

Sampling Plan is required by the Council Decision, annex, section 3. In England EA applies the British Standard (BS) EN 14899 (2005), Characterization of waste - Sampling of waste materials - Framework for the preparation and application of a sampling plan. A Sampling Plan is composed by eight subsequent steps:

1. Identify involved parties: who is relevant to the testing programme? producer, sampler, laboratory, regulator?
2. Set the objectives of the testing programme: to obtain practical and achievable goals to account for the physical state, accessibility and quantity of material
3. Testing level: types and frequency of investigation; level of uncertainty
4. Constituents to be tested: what are the key components of the waste that need to be tested?
5. Background information on material: site details – location and any access restrictions; process or nature of material – general description of the process and/ or nature of the material; material type and dimensions – liquid, solid, known physical and chemical properties.
6. Health and Safety: precautions for the sampler
7. Sampling approach: variability of the material; probabilistic sampling – where each sample will be representative of the whole 'population' or judgemental sampling – where consistency of the waste is not known. Samples taken of a sub-population deemed to represent the whole population; define the approach – when, where and by whom samples are taken to meet the objectives.
8. Identify sampling techniques: techniques to collect the sample and consequences of deviation from this specific technique; procedures for sub-sampling in the field – will the sampler take composites (bulk) samples, or sub-sample materials? Procedures for packaging, preservation, storage transport and delivery – how the sample will be handled prior to delivery to the laboratory.

EA does not routinely review sampling plans for waste destined for landfill; they may review sampling plans when they have concerns about WAC results or as part of an enforcement activity.

TOPIC N.3: **Groundwater monitoring - Regulation, Assessment and Compliance**

Nicola Ingrey: Environment & Business Waste Technical Services Technical Advisor (landfill)

Survey question:

How to define trigger and control levels for groundwater? In MS there is a misunderstanding and different interpretations of trigger levels, as indicated in the Council Directive. No examples are available of the Directive's assumption are available. Trigger levels are not usually determined. Groundwater control levels and compliance limits: what are the differences and how to determine them? What is the meaning and importance of carrying out Hydrological Risk Assessment? What actions are to be taken in case of exceeding the trigger levels? How to monitor trigger levels?

Main achievements

In the Assessment phase, the requirements regarding groundwater are the following:

- Technical Guidance (EA publications)
- Hydrogeological Risk Assessment (HRA)
- Control and Compliance limits (trigger levels) part 2

During the operational phase, compliance has to be achieved by means of:

- Monitoring & reporting
- Data management
- Data portals

Groundwater trigger levels are mentioned in the Landfill Directive:

With regards to groundwater control levels and compliance limits, Annex III (4)(C) of the LFD states that:

> "Significant adverse environmental effects, as referred to in Articles 12 and 13 of this Directive, should be considered to have occurred in the case of groundwater, when an analysis of a groundwater sample shows a significant change in water quality. A trigger level [compliance limit] must be determined taking account of the specific hydrogeological formations in the location of the landfill and groundwater quality. **The trigger level [compliance limit] must be laid down in the permit whenever possible.**"

Annex III (4)(C) of the LFD also states that:

> "The observations must be evaluated by means of control charts with established control rules and levels for each down gradient well. The 'Control Levels' must be determined from local variations in groundwater quality."

EA Guidance comprises a list of groundwater related key documents:

- Hydro geological Risk Assessments for landfills and the derivation of groundwater control levels and compliance limits (trigger levels).
- Guidance on monitoring of landfill leachate, groundwater and surface water.
- Groundwater protection: policy and practice.

In order to determine the Trigger levels or Compliance levels, as it is called in the UK, it is important to carry out a Hydrological Risk Assessment (HRA). The operator of the landfill is responsible for the content and quality of this HRA; it preferably has to be performed using the software Landsim.

Control levels and compliance limits have to be set, and to this aim, substance (chemical parameter), level (concentration) and location (of the monitoring point) have to be determined.

Compliance Limits (trigger levels):

- A pollutant concentration has exceeded either an environmental standard or Minimum Reporting Value (MRV) at a specified compliance point (receptor) and has caused pollution.
- Is a value (expressed as a concentration) and must be specified in the permit.
- If the value is exceeded it requires immediate notification to EA as a "significant adverse environmental effect".

Control Levels

- Specific assessment criteria
- Take account of local hydro geological conditions (historical contamination / poor natural groundwater quality)
- Test of the significance of a deviation from baseline groundwater conditions
- Determine whether landfill is performing as designed
- Acts as a early warning system

The following requirements are usually part of the permit:

> **3.2 Emissions to groundwater**
>
> 3.2.1 There shall be no emission from the Activities into groundwater of any substance in List I (as defined by the Groundwater Regulations) contrary to those Regulations.
>
> 3.2.2 There shall be no emission from the Activities into groundwater of any substance in List II (as defined in the Groundwater Regulations) so as to cause pollution (as defined in those Regulations).
>
> 3.2.3 The trigger levels for emissions into groundwater for the parameter(s) and monitoring point(s) set out in Table S4.3 of Schedule 4 shall not be exceeded.
>
> 3.2.4 The Operator shall submit to the Agency a review of the Hydrogeological Risk Assessment:
>
> (a) between 9 and 6 months prior to the fourth anniversary of the granting of the Permit, and
>
> (b) between 9 and 6 months prior to every subsequent 4 years after the fourth anniversary of the granting of the Permit.

The HRA is carried out in order to determine where the boreholes must be placed. Hydrological modelling plays an important role in this matter. At least one borehole has to be placed upstream the landfill and 2 boreholes downstream. The Compliance levels are generated from the HRA as well. In the UK generally 5 to 6 standard parameters such as pH, chloride and undissolved components are determined. These parameters are checked once a month. There might also be general parameters specified for a certain location. These specific parameters have to be checked once every 3 months.

The analyses are carried out on behalf of the owner of the landfill. In case of non compliance with the permit, the operators are obligated to inform the Environment Agency. The results of the analysis are sent yearly to the EA. The analysis can also be checked on site by the inspector. The EA does not

take samples on their own initiative. This is only done when they suspect non compliance with the permit. Groundwater monitoring has the following purposes:

- to assess compliance against permit conditions;
- to demonstrate the landfill is behaving as predicted;
- to validate the HRA modelling and engineering; to track waste degradation processes and ensure that emission control features are effective

EA in the UK has done a great effort in creating an environmental database where all necessary data of specific landfills are uploaded by the landfill operators and stored. EA has also developed software to store the uploaded data from different formats in one specific format.

Every 6 years the landfill permit is checked whether the risk assessment is still valid and whether it is necessary to update the permit. If during these 6 years no significant changes in characteristics have been observed, the operator can request to take fewer samples or a smaller number of parameters.

TOPIC N.4: Water Management and Leachate

Darren Legge (Technical Advisor – Landfill Engineering) and Nicola Ingrey Environment & Business Waste Technical Services Technical Advisor (Landfill)

Survey question:

How is leachate managed and monitored? Different approaches in leachate treatment (technologies) and management have been observed in MS. Monitoring and management of raining and surface (runoff) water. Different interpretations about water from precipitation and surface water management apply in MS. Which are the minimum criteria requested for leachate treatment and water monitoring?

Main achievements

Leachate levels are determined at the application stage and are based on the findings of the groundwater, landfill gas and stability risk assessments. Leachate removal and monitoring is performed principally through vertical monitoring wells or side slope collectors.

Leachate removal can be controlled by an automatic control mechanism; an action level is set below the compliance level when removal has to start.

As far as leachate treatment is concerned, measures are required to treat leachate prior to discharge. Treatment will depend on:

- site specific sectors – point of discharge/discharge consent;
- availability of sewer connection;
- availability of local treatment facilities.

The runoff water is sampled at the discharge point into the surface water. The EA does not take samples because they are not equipped to take samples. If an excess of permit regulations is suspected, samples are taken by a certified consultant commissioned by the EA.

The parameters to be sampled are a number of standard parameters and a certain number of parameters are also determined on the conclusions of the HRA. It can be asked in the permit to take samples in the receiving water body (stream/river) upstream and downstream.

TOPIC N.5: Landfill Gas Monitoring

David Browell: Environment & Business Waste Technical Services National Technical Advisor (Landfill Gas)

Survey question:

How to assess the good performance of the extraction pumping system? Monitoring techniques of surface gas emissions (flux box etc).

Main achievements

A technical review process is implemented to look at three main aspects:

- Assess Landfill Gas (LFG) production
- Assess effectiveness of gas extraction system
- Assess monitoring well coverage & performance

Starting point is to foresee LFG production at the site: to reach this aim GasSim modelling has been developed by EA to assist in LFG Risk assessments. This modelling system is able to predict methane generation based on cellulose & hemi cellulose content of waste and assigns degradation factors. The system also covers surface emissions and engine flare emissions.

Results of modelling (waste input data) have to be checked versus reality. Using the data collected, in a second step the capacity installed has to be looked on:

- Engines – limited by power grid connection?
- Flares – adequate standby capacity
- Pipework (quantity or flow rate of gas controlled by pipe diameter, suction pressure, velocity ecc)

The review process is necessary to underline the extraction well coverage, to identify areas of poor extraction, to assess the performance of wells detecting the air ingress risks.

EA looks at monitoring data from gas fields, collected under permit condition earlier. A spreadsheet to analyse the following relevant data was developed:

- Methane production: carbon dioxide ratio
- Oxygen concentration
- Nitrogen & free nitrogen concentrations and ratio
- Applied suction
- How operator has adjusted gas extraction well.

Several months data are gathered to obtain a good performance record and build up picture over time.

Common Findings are:

- Areas without gas extraction or capping (notably flanks & active areas)
- Poor extraction coverage due to well maintenance and/or air influx
- Pressure loss or undersized pipework
- Condensate management restricting flow
- Flooding caused by perched leachate
- Conflict between operations & gas management

Following the review, some actions are taken such as:

- Report detailing findings and recommendations
- Discussion with Operator

- Agreed Action Plans and timescales for improvements
- Non-compliance scored in accordance with CCS
- Enforcement Notices

Walkover surveys can be made using GPS data logging and handheld instruments to record surface concentrations of methane; this system does not quantify flux but enables areas of high methane concentration or emissions to be identified.

Dial Survey can take cross sections through atmosphere along multiple lines of site from one location. This method can subtract upwind signal from downwind and calculate contribution from different areas of the site; using wind speed can generate plume and calculate flux into air.

DAY 2: VISIT TO THE GROUNDON LANDFILL

GRUNDON Waste Management Ltd, Wingmoor Quarry landfill
Stoke Orchard Road, Bishops Cleeve
Cheltenham, Gloucestershire, GL52 7DG

The inspection started with a preliminary short presentation of the landfill carried out by Ms. Toni Robinson BSc (GRUNDON Compliance Manager) and with a description of the Landfill IMPEL project by the Team captain Mr. Romano Ruggeri.

Fig. 3: Landfill presentation and visit

Wingmore Farm, Bishops Cleeve, Gloucestershire is to the north of Cheltenham, Glos. It is a large landfill site where the Company is continually producing high quality blue Lias clay extensively used in the lining of landfill sites, construction of ponds and lakes, and engineering works.

Fig. 4: Air sight

Fig. 5: Blue clay

The Wingmoor Farm East landfill area covers 54 hectares, of which over 40% has been restored to the approved landform. Some 22 hectares have yet to be filled. The site operates under four separate environmental permits:

1. Non hazardous landfill
2. Hazardous landfill
3. Hazardous waste Treatment Plant
4. Materials Recovery Facility.

1. Non hazardous landfill – Wingmoor Quarry Landfill

This landfill accepts commercial and industrial non-hazardous waste. It is permitted to accept 250.000 tonnes of waste per annum but during 2013 it accepted 52.000 tonnes. The permit specifies the monitoring and controls in relation to groundwater, landfill gas, leachate and surface water. A 1MW landfill gas engine is operated at the site, with a gas flare available when the engine is not operational. Leachate from the site is either treated through the on-site treatment plant or exported to a sewage treatment works for disposal.

2. Hazardous landfill – Wingmoor Farm Landfill

This landfill accepts hazardous waste; this is primarily treated APC residues, asbestos and contaminated soils. It is permitted to accept 120.000 tonnes of hazardous waste per annum plus 30.000 tonnes of inert material that can be used for cover but during 2013 it accepted 40.000 tonnes. The permit specifies the monitoring and controls in relation to groundwater, landfill gas, leachate, surface water, particulate matter and asbestos fibre count. Particulate monitoring has been carried out at 6 locations around the site since 2001; this provides real time monitoring with trigger points set.

3. Hazardous Waste Treatment Plant

This site treats air pollution control (APC) residues by mixing them with leachate from the adjacent landfill or from other imported aqueous liquids. The treated APC is discharged into a dump truck and then transferred to the adjoining hazardous landfill. The facility is permitted to accept 75.000 tonnes of hazardous waste per annum but during 2013 accepted 35.000 tonnes.

4. Materials Recovery Facility

This is a new facility and allows mixed recyclable materials to be brought into site, be separated and then exported for re-use, recovery or disposal. The site is allowed to accept up to 50.000 tonnes per annum.

Fig. 6: Restored area

Fig. 7: Treatment plant

Wastes currently imported to the site with the appropriate permit of the Environment Agency include:

- Construction, demolition and excavation wastes
- Commercial and industrial waste (non hazardous)
- Contaminated soils, asbestos and Air Pollution Control (APC) residues and other waste classified as hazardous
- Liquid wastes used in treatment process

Authorized activities included in the Permit are listed in the following chart:

Table S1.1 Activities		
Activity listed in Schedule 1 of the EPR Regulations	**Description of specified activity**	**Limits of specified activity**
Section 5.2 Part A(1) (a) , The disposal of waste in a landfill.	Landfill for non-hazardous waste and landfill restoration	Receipt, handling, storage and disposal of wastes, consisting of the types and quantities specified in condition 2.8, as an integral part of landfilling.
Directly Associated Activity		
Leachate management	Collection and storage of leachate pre discharge	Leachate arising from the landfill.
Landfill gas utilisation	Utilisation of landfill gas for energy recovery in a appliance <3 MW rated thermal input	Landfill gas arising from the landfill.
Landfill gas flaring	Flaring of landfill gas for disposal in an appliance.	Landfill gas arising from the landfill.
Water discharges to controlled waters	Discharges of site drainage from the landfill.	From surface water management system to point of entry to controlled waters.
Fuel storage	Storage of fuel for operation of plant and equipment.	Fuel storage tank.

Fig. 8: Landfill gas flare and engine

The annual waste input limits are listed below:

Table S1.5 Annual waste input limits	
Category	Limit Tonnes/ Year
Non-hazardous waste	250,000
Inert waste including inert waste used for daily / intermediate cover material	125,000
Inert waste for restoration of closed areas	125,000
Total	250,000

The landfill was previously authorized to accept stable non reactive hazardous waste and asbestos, that were both included in the permit, but the landfill of either types of waste had never been carried out. Hazardous wastes were accepted with an annual limit of 120.000 tonns, including EWC 19 03 04* (treated residues arising from APC conditioning plant). The hazardous cells are on a closure phase.

The Grundon Landfill has in progress 1 cell in which the incoming waste is landfilled. Such a cell is during 18 months in use to be filled. After that period the cell is closed directly and meanwhile a new cell is created. In this way the landfill produces a small amount of leachate.

Fig. 9: cell in construction

Fig. 10: cell in progress

Fig. 11: cell in closing phase

From the landfilled cells which already have been closed, a small quantity of leachate is produced. There is always a certain level of leachate in these cells that is kept to enhance the biogas production. The cells are constructed in such way that most leachate moves to two central leachate basins. The collected leachate is mixed with polluted soil which serves as an inter layer in order to stabilize the landfilled waste. In this way the leachate is efficiently recycled. It is also used for creating a suitable pH which makes the heavy metals captured in the polluted soil.

No leachate is discharged to the sewer or the surface water. In case the leachate is discharged at the sewer, they need a permit of the organization that manages the Waste Water Treatment Plant (WWTP). The WWTP who discharges the treated water into surface water needs a permit of the EA. The water sewer sets the parameters (water quality) for the landfill operator (volume to be discharged, parameters to be analysed, annual report)

Leachate level is checked and samples are taken to monitor the quality (once a month).

Fig. 12: Leachate monitoring wells

The landfill for hazardous waste such as fly ash, bottom ash, contaminated soil and asbestos creates no leachate because these substances contain no organic matter and can hold a relatively high amount of water. As there are no organic substances subsequently no biogas is produced on the location of hazardous waste.

At the Grundon landfill, runoff water from the finished cells is collected in two reservoirs. This run of water is considered as slightly contaminated waste water, due to possible contact with waste. This runoff water is also used for dust control. Runoff water collected in the reservoirs is discharged into a nearby pond, with no connection to running water.

Surface water at Wingmoor Quarry is monitored from two surface water discharge points on a monthly basis. The EA itself does not take samples. If they suspect exceeding of permit regulations, samples are taken by a certified consultant commissioned by the EA. The parameters to be sampled are a number of standard parameters and a number of parameters are also determined on the conclusions of the HRA.

Groundwater is currently monitored at 20 boreholes at the site; groundwater levels are monitored on a monthly basis.

Landfill gas concentrations are monitored at 32 boreholes around the perimeter of the site. Monitoring of dust is undertaken at six dust monitoring installations around the site.

Fig. 13: Dust monitoring installation

DAY 3: DISCUSSION - CONCLUSIONS AND RECOMMENDATION

The third day has been dedicated to comments and discussion concerning the training day and the landfill visit.

Fig. 14: Conclusions

What did we learn? Conclusions and recommendations:

- Waste acceptance: basic characterization and Compliance Testing. Different interpretation of Directive and different obligations for waste producer and landfill operator. Different leaching test methods in MS: L/S10-2-0.1
- Sampling plan: necessary but not mandatory
- Hazardous properties in case of mirror code waste: lab bulletin not clear enough. Detailed report of the laboratory with calculated properties. Consultant for analysis interpretation. Priority steps to be followed to set the correct waste code
- Stable and non-reactive waste: is the required treatment (long term behaviour) clear?
- Trigger levels for groundwater: different interpretation of Directive. Hydrogeological risk assessment (site specific thresholds).
- Top and bottom layers inspections: test and report analysis. Quality standards required (CQA)
- Monitoring and management of meteoric and surface water
- Biogas diffuse emissions detection. Tools used.
- Waste stream approach (upstream/downstream): planning of inspections.

Next steps

- Preparation for Portugal Inspection (2nd week of September)
- Review of Guidance and Checklist (with best practice learned)
- Analysis of the Survey
- Report for European Commission

Further work:

- End of Waste and re-used/recycled materials: how to check. From landfill to recovery plants?
- Training for inspectors

Attachment 1: Survey that has been hand out to the MS

European Union Network for the Implementation and Enforcement of Environmental Law

ANNEX 2

Reinforcement Programme on inspection skills according to Landfill sites in IMPEL Member Countries

Joint inspection Lisbon (Portugal) 08/09 September 2014

General Inspectorate of the Ministries of Environment, Spatial Planning and Energy and Agriculture and the Sea of Portugal (IGAMAOT)

Preparation of the inspection

- Draw up of the agenda of the meeting and update of the checklist.
- Definition of the main topics to be inspected in the landfill visit.
- Analysis of the results of the Survey distributed among MS.
- Translation of the permit of the VALORSUL landfill.
- Preparation of the starting presentation (PPT) containing presentation of IMPEL network, and of the previous steps of the project.
- Stimulating the discussion and preparation of the group on Basecamp; sharing of checklist, landfill permit, survey results and useful documents in Basecamp.

Definition of the topics of the inspection

The Survey spread among MS asked to answer to questions concerning the following topics:

1. Waste acceptance
2. Sampling plan
3. Groundwater trigger levels
4. Treatment of waste
5. Stable non reactive waste
6. Leachate management
7. Requirements on top and bottom layers
8. Meteoric and surface water
9. Monitoring report

Along the in situ visit of the landfill, all the management and technical aspects related to these topics have been checked. Following discussion has been focused on the results of the Survey, pushing discussion on the observed differences among MS.

During the inspection visit, the Checklist attached to the Guidance has been used.

Agenda of the joint inspection

Time	Activity	Location	Apparatus	Who
Monday 8 September 2014				
8.30 9.00	Breakfast	Hotel Excelsior		
9.00 9.45	Appointment at 9.00 at the lobby of Hotel Excelsior	Hotel Excelsior	Transport to Landfill by cars IGAMAOT. Landfill Mato da Cruz	Inspection team
10.15 10.30	Welcome	Landfill conference room		Landfill operator
10.30 10.45	IMPEL project in 2014: Guideline and checklist. Organization of the inspection	Landfill conference room	Laptop and beamer (ppt)	Romano Ruggeri
10.45 11.15	Presentation of landfill	Landfill conference room	Laptop and beamer	Landfill operator
11.15 13.00	Joint inspection on landfill Use of checklist : main focus on following items: - pre-treatment of waste before land filling; - sampling and classification of waste; - ground water monitoring; - leachate treatment	Landfill and conference room	Checklist	Inspection team (personal safety equipment)
13.00 14.30	Lunch			
14.30 17.30	Use of checklist : main focus on following items: - pre-treatment of waste before land filling; - sampling and classification of waste; - ground water monitoring; - leachate treatment	Landfill conference room	Checklist	Inspection team
17.30 18.15	Transport back to hotel		Transport to Landfill by cars IGAMAOT	
20.30	Social Dinner			
Tuesday 9 September 2013				
8.30 9.00	Breakfast	Hotel Excelsior		
9.00 9.15	Appointment at 9.00 at the lobby of Hotel Excelsior. Walk to IGAMAOT office.			
9.30 10.00	Presentation of IGAMAOT inspection organisation in Portugal and legislation basis	IGAMAOT meeting room	Laptop and beamer	Isabel Santana
10.00 11.30	Presentation of Survey results. Discussion	IGAMAOT meeting room	Laptop and beamer	Romano Ruggeri
11.30 11.45	Coffee break	IGAMAOT meeting room		

Time	Activity	Location	Apparatus	Who
11.45 13.00	Inspection evaluation - What has been observed; - Experience with checklist - Experience of inspectors Input for report	IGAMAOT meeting room	Checklist and notes	Inspection team
13.00 14.00	Lunch	Restaurant		
14.00 17.30	Discussion, conclusions and further steps. Input for final report	IGAMAOT meeting room	Laptop and beamer (ppt)	Inspection team

Inspection team

The inspection group has been composed by:

- Inspector Italy: Romano Ruggeri (team captain)
- Inspector Austria: Franz Waldner
- Inspector Netherlands: Ronald Smallenburg
- Inspector Czech Republic: Vojtech Hamernik
- Inspector Malta: Georgesam Mizzi
- Inspector Sweden: Nina Hansson
- Inspector Portugal: Antonio Henrique Figueiredo
- Inspector Portugal: Marco Candeias
- Inspector Portugal: Susana Pimpao

Fig.1:

Inspection group

IGAMAOT

The meeting has been hosted by the General Inspectorate of the Ministries of Environment, Spatial Planning and Energy and Agriculture and the Sea (IGAMAOT), which has the following mission:

- assess the performance and management of services and bodies of the Ministry of Environment, Spatial Planning and Energy (MAOTE) and Ministry of Agriculture and the Sea (MAM), or subject to the supervision of the respective ministers, through actions of audit and control;
- measure the correct allocation of natural community financial support and ensure continuous monitoring and assessment of compliance with the law.

IGAMAOT proceeds, inter alia, the following responsibilities:

- Perform inspections of public and private entities on matters of environmental impact, imposing measures to prevent or eliminate situations of danger to the health and safety of persons, property and the environment.

Inspected landfill

Landfill Mato da Cruz, Calhandriz, municipality of Vila Franca de Xira.
Operator: VALORSUL - Treatment and disposal of wastes

Fig.2: Valorsul landfill view

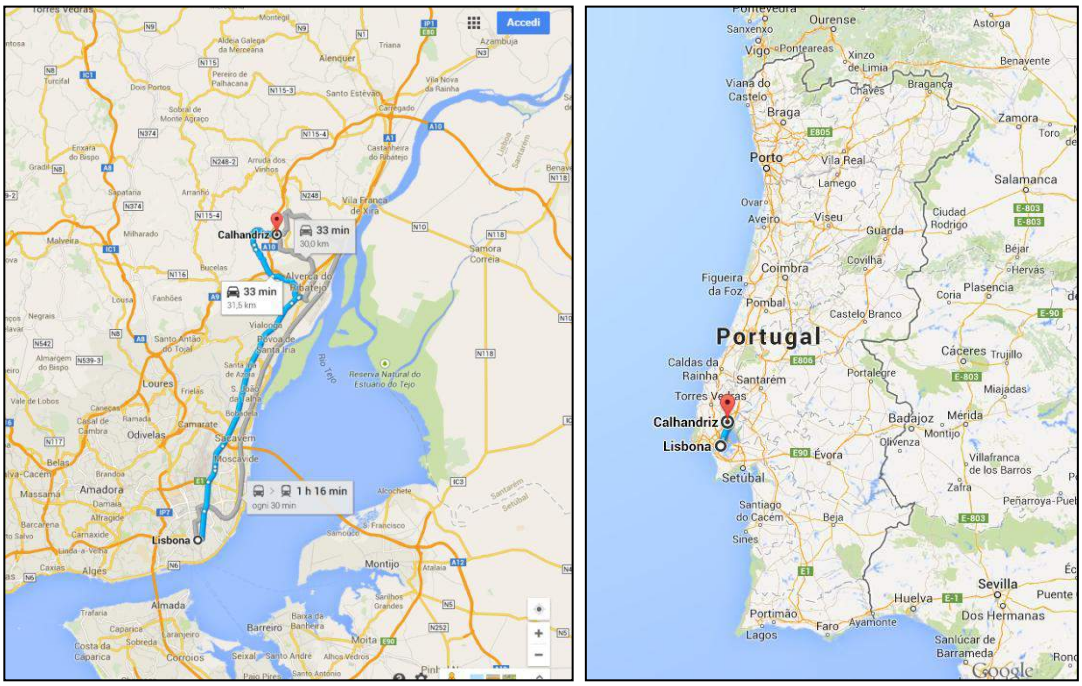

Fig.3: Valorsul landfill location

The landfill is a non hazardous one and accepts MSW and inertized fly ash.
Area and capacity of the landfill are the following:

Cells 1 and 2: MSW - active
Area: 13,8 ha
Volume: 2.934.926 m^3
Capacity: 4.153.080 t

Cells 3: MSW
Area: 1,45 ha
Volume: 249.300 m^3
Capacity: 249.300 t

Urban waste Cell of Vila Franca de Xira - sealed
Area: 8,0 ha
Volume: 825.000 m^3
Capacity: 811.820 t

Cells 1and 2: inertized fly ash (incineration plant residue) - active
Area: 4,5 ha
Volume: 600.210 m^3
Capacity: 797.683 t

Further installations are:

- Leachate pre-treatment plant
- Treatment and Recovery plant of bottom ash, with processing capacity of 106.400 ton / year
- Platform Receiving and Storage of Batteries and Accumulators (code 200133)
- Biogas recovery: energy production: 12.856 MWh (2 engines, 834 kW each)

First day

First day has been dedicated to the inspection of the landfill; before starting the inspection, two ppt presentation in the Landfill conference room have been performed, by the operator (plant description),

and the team captain (objectives of IMPEL and of the Landfill project).

Fig.4: Landfill operator presentation

At the landfill, the following installations have been observed:

- Leachate pre-treatment plant and automatic leachate monitoring device
- Biogas plant
- Surface water drainage system
- Bottom ash recovery plant
- Inertized fly ash and MSW cells
- Batteries and additive storage areas

Fig.5: Leachate treatment plant

Fig.6: Biogas plant

Fig.7: Inertized fly ash cell

Fig.8: Bottom ash Recovery plant

Second day

Second day meeting was opened by Isabel Santana, who presented the structure and mission of IGAMAOT and the inspection activities. Roughly, the number of IED installations in Portugal is 700, supervised by 25 inspectors. Inspection activity is regulated by an Inspection Plan based on a risk assessment.

Afterwards, the Team Captain presented the first results of the Survey and discussion started on observed differences among MS and evidence of the Valorsul visited landfill. Discussion mainly focused on the following items:

- Trigger levels for groundwater
- Meteoric water management
- Waste characterization procedures
- Waste acceptance: mirror code waste
- Sampling plan

Fig.9: Discussion in IGAMAOT

Main achievements by Technical discussion

A list of the results of the discussion is here summarized:

1. Trigger levels for groundwater

Not a unique interpretation in the MS; some use to fix thresholds for the concentration of pollutant in the groundwater (i.e. Italy), some determine the allowed concentration as a consequence of a site specific risk assessment (i.e. UK). In most of MS no threshold limit is set for GW concentrations, therefore no infringements can be punished in case of a change of the water quality; it indeed represents an alarm that the landfill is not performing as it would have to, following the authorization.

Usually, monitoring of groundwater is performed to check the downstream and upstream differences and the trend along the time of pollutant concentrations, in order to identify possible lack of leachate from the bottom of the landfill and promptly take the emergency actions.

Recommendations:

a) Use a site specific risk assessment before and meanwhile the operation of the landfill; so long as it is possible use real data and not literature one. Environment Agency guidelines are recommended.

b) Use the data collected from the boreholes to check for trends of groundwater quality downstream and upstream; a progressive change of water quality is an alarm to investigate on the causes (lack of leachate) and promptly take the emergency actions before the change produces significant environmental effects. Emergency actions have to be pre-defined in the Environmental Management System (EMS) procedures. The landfill operator should have a map with the location of the different boreholes; the Health Risk Assessment (HRA) points out the location of the boreholes.

c) In consultation with the landfill operator control levels (alarm levels) should be determined. If an alarm level is reached, the operator is obliged to inform the competent authority and explain the reason of exceeding the level.

d) Inspectors needs training on risk assessment principles and software (i.e. use of LandSim) to be able to properly evaluate the company reports.

e) Inspection authority should take GW samples (by means of certified companies in case it doesn't have its own lab) for a check, or there must be a system which shows the necessary information directly online.

2. Meteoric water management

The management of meteoric water shows many differences among MS in terms of required monitoring, treatment, used terms and solutions to intercept it.

First it was necessary to define the meaning of surface water, run-off water, meteoric water, raining water and start from there an equal base of the different terms.

Definitions and recommendations:

a) Surface water: it is commonly found in the direct surrounding of the landfill. Not contaminated water coming from the landfill is discharged in the surface water. In most MS surface water is monitored by taking samples upstream and downstream in the natural recipient bodies. Taking samples in

surface water on a good and representative way is very difficult. The competent authority should get more insight about the sampling method.

b) Run-off-water: this water originates from the covered parts of the landfill and is therefore not contaminated by the waste. The runoff water is often collected in the ditches around the landfill and this water is discharged in the surface water in one or more points. Runoff water, according to some MS, can be:

   - considered as a not contaminated water (in case of final closure of the landfill) and no monitoring measurements are required; in case recycle waste is used for final coverage the water could be contaminated and has to be monitored;
   - treated as leachate in case of temporary closure (monitoring and treatment required).

c) Meteoric water or raining water: this water ends up on the parts of the landfill which is not yet covered. We can think of on paved roads and storage parts of the landfill. It is possible that this water could become polluted through contact with the waste. In most MS this water has to be monitored and treated. In some other MS this water doesn't require any monitoring and treatment or just a light one.

3. Waste characterization

In most of MS (with the exception of Italy and Czech Republic), Basic characterization (BC) and Compliance Testing (CT) are both performed by the producer of the waste. BC has to highlight the most critical parameters; if nothing changes in the production process of the waste, the following years the producer will perform a simplified analysis (CT), once per year, focusing only on the critical parameters, that are peculiar of the production process. Operator has to perform a visual inspection on the waste entering the landfill and a check on the correctness of the transport documents.

When CT is performed by the operator, the analysis replies the BC and it is intended to be a further check of the characteristic of the waste. In Czech Republic BC is not performed (after the first time) at least once per year, but only when a change in the production process occurs.

4. Mirror code waste

All inspectors agree that lab bulletins have to give evidence of the hazardous properties calculation. The lab bulletin has to give evidence of the presence of the amount of hazardous chemical compounds and not of the single element. A deeper knowledge is needed about CLP (Regulation on classification, labelling and packaging of substances and mixtures) to define when a waste can be considered as dangerous. Inspectors share the same doubts about:

- How to present the lab bulletin results concerning the hazardous properties of a waste, to correctly choose between the hazardous or non hazardous waste codes? The risk properties calculation has to be presented (R and H codes).
- When a waste can be considered as hazardous?
- How to assess the H14 property?

5. Sampling plan

Most of MS usually don’t check the presence and correctness of the sampling plan (Austria and Sweden do it), as a consequence of a common lack of knowledge. Inspectors need to go into real practice experiences of sampling applying the EN14899, in order to be able to evaluate a sampling

plan. Waste assessment certificate has to include a sampling plan. To draw up a common format for sampling plan is seen as a useful tool.

Valorsul landfill in brief

Strengths	Weaknesses
Detailed Monitoring system	Waste accepted (furniture, wood etc)
Leachate treatment plant	Basic characterization missing
Surface water interception and treatment	Sampling plan missing
Recovery plant for bottom ash	Waste code for inertized fly ash (99 code)

Conclusions and further steps

Guidance and checklist need to be update according to the amount of new information and experiences collected in the last meeting and especially in UK.

Survey has to be filled in by all participants, and the main results can be contained in a note for the Commission or in the final Report.

A practice experience in sampling plan is considered to be a priority in the next meetings. How to take samples of groundwater and calculation to give evidence of the hazardous/non hazardous properties of mirror code wastes are also commonly perceived as topics to be deepened.