Validated

CERTIFICATE OF ANALYSIS

SDG: 211106-42 Report Number: 622047 Superseded Report:
Client Ref.: 5898 Location: Kilshane

CEN 10:1 SINGLE STAGE LEACHATE TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference		**Site Location**	Kilshane
Mass Sample taken (kg)	0.117	**Natural Moisture Content (%)**	29.2
Mass of dry sample (kg)	0.090	**Dry Matter Content (%)**	77.4
Particle Size <4mm	>95%		

Case	
SDG	211106-42
Lab Sample Number(s)	25288109
Sampled Date	
Customer Sample Ref.	TP 12
Depth (m)	0.50 - 0.50

Solid Waste Analysis	Result	Landfill Waste Acceptance Criteria Limits: Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
Total Organic Carbon (%)	0.65	3	5	6
Loss on Ignition (%)	4.71	-	-	10
Sum of BTEX (mg/kg)	-	-	-	-
Sum of 7 PCBs (mg/kg)	<0.021	1	-	-
Mineral Oil (mg/kg) (EH_2D_AL)	<5	500	-	-
PAH Sum of 17 (mg/kg)	-	-	-	-
pH (pH Units)	-	-	-	-
ANC to pH 6 (mol/kg)	-	-	-	-
ANC to pH 4 (mol/kg)	-	-	-	-

Eluate Analysis	C_2 Conc^n in 10:1 eluate (mg/l)		A_2 10:1 conc^n leached (mg/kg)		Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg		
	Result	Limit of Detection	Result	Limit of Detection			
Arsenic	0.000809	<0.0005	0.00809	<0.005	0.5	2	25
Barium	0.00162	<0.0002	0.0162	<0.002	20	100	300
Cadmium	<0.00008	<0.00008	<0.0008	<0.0008	0.04	1	5
Chromium	<0.001	<0.001	<0.01	<0.01	0.5	10	70
Copper	0.000526	<0.0003	0.00526	<0.003	2	50	100
Mercury Dissolved (CVAF)	<0.00001	<0.00001	<0.0001	<0.0001	0.01	0.2	2
Molybdenum	<0.003	<0.003	<0.03	<0.03	0.5	10	30
Nickel	<0.0004	<0.0004	<0.004	<0.004	0.4	10	40
Lead	0.000661	<0.0002	0.00661	<0.002	0.5	10	50
Antimony	<0.001	<0.001	<0.01	<0.01	0.06	0.7	5
Selenium	<0.001	<0.001	<0.01	<0.01	0.1	0.5	7
Zinc	0.0208	<0.001	0.208	<0.01	4	50	200
Chloride	<2	<2	<20	<20	800	15000	25000
Fluoride	<0.5	<0.5	<5	<5	10	150	500
Sulphate (soluble)	<2	<2	<20	<20	1000	20000	50000
Total Dissolved Solids	47.9	<10	479	<100	4000	60000	100000
Total Monohydric Phenols (W)	<0.016	<0.016	<0.16	<0.16	1	-	-
Dissolved Organic Carbon	4.47	<3	44.7	<30	500	800	1000

Leach Test Information

Date Prepared	08-Nov-2021
pH (pH Units)	6.78
Conductivity (µS/cm)	44.40
Temperature (°C)	21.20
Volume Leachant (Litres)	0.873

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and ALS Environmental cannot be held responsible for any discrepancies with current legislation

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CERTIFICATE OF ANALYSIS

SDG: 211106-42 | Report Number: 622047 | Superseded Report:
Client Ref.: 5898 | Location: Kilshane

CEN 10:1 SINGLE STAGE LEACHATE TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference		**Site Location**	Kilshane
Mass Sample taken (kg)	0.114	**Natural Moisture Content (%)**	26.6
Mass of dry sample (kg)	0.090	**Dry Matter Content (%)**	79
Particle Size <4mm	>95%		

Case	
SDG	211106-42
Lab Sample Number(s)	25288110
Sampled Date	
Customer Sample Ref.	TP 13
Depth (m)	0.50 - 0.50

Solid Waste Analysis	**Result**	**Landfill Waste Acceptance Criteria Limits**		
		Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
Total Organic Carbon (%)	0.58	3	5	6
Loss on Ignition (%)	4.38	-	-	10
Sum of BTEX (mg/kg)	-	-	-	-
Sum of 7 PCBs (mg/kg)	<0.021	1	-	-
Mineral Oil (mg/kg) (EH_2D_AL)	<5	500	-	-
PAH Sum of 17 (mg/kg)	-	-	-	-
pH (pH Units)	-	-	-	-
ANC to pH 6 (mol/kg)	-	-	-	-
ANC to pH 4 (mol/kg)	-	-	-	-

Eluate Analysis	**C_2 Conc^n in 10:1 eluate (mg/l)**		**A_2 10:1 conc^n leached (mg/kg)**		**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
	Result	Limit of Detection	Result	Limit of Detection			
Arsenic	0.00078	<0.0005	0.0078	<0.005	0.5	2	25
Barium	0.0274	<0.0002	0.274	<0.002	20	100	300
Cadmium	0.000152	<0.00008	0.00152	<0.0008	0.04	1	5
Chromium	<0.001	<0.001	<0.01	<0.01	0.5	10	70
Copper	0.0031	<0.0003	0.031	<0.003	2	50	100
Mercury Dissolved (CVAF)	<0.00001	<0.00001	<0.0001	<0.0001	0.01	0.2	2
Molybdenum	<0.003	<0.003	<0.03	<0.03	0.5	10	30
Nickel	0.00099	<0.0004	0.0099	<0.004	0.4	10	40
Lead	0.00216	<0.0002	0.0216	<0.002	0.5	10	50
Antimony	<0.001	<0.001	<0.01	<0.01	0.06	0.7	5
Selenium	<0.001	<0.001	<0.01	<0.01	0.1	0.5	7
Zinc	0.3	<0.001	3	<0.01	4	50	200
Chloride	2.5	<2	25	<20	800	15000	25000
Fluoride	<0.5	<0.5	<5	<5	10	150	500
Sulphate (soluble)	<2	<2	<20	<20	1000	20000	50000
Total Dissolved Solids	104	<10	1040	<100	4000	60000	100000
Total Monohydric Phenols (W)	<0.016	<0.016	<0.16	<0.16	1	-	-
Dissolved Organic Carbon	8.94	<3	89.4	<30	500	800	1000

Leach Test Information

Date Prepared	08-Nov-2021
pH (pH Units)	10.56
Conductivity (µS/cm)	152.00
Temperature (°C)	20.40
Volume Leachant (Litres)	0.876

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable
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CERTIFICATE OF ANALYSIS

SDG: 211106-42 | Report Number: 622047 | Superseded Report:
Client Ref.: 5898 | Location: Kilshane

CEN 10:1 SINGLE STAGE LEACHATE TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference		**Site Location**	Kilshane
Mass Sample taken (kg)	0.114	**Natural Moisture Content (%)**	26
Mass of dry sample (kg)	0.090	**Dry Matter Content (%)**	79.4
Particle Size <4mm	>95%		

Case	
SDG	211106-42
Lab Sample Number(s)	25288111
Sampled Date	
Customer Sample Ref.	TP 14
Depth (m)	0.50 - 0.50

Solid Waste Analysis	Result	Landfill Waste Acceptance Criteria Limits: Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
Total Organic Carbon (%)	0.682	3	5	6
Loss on Ignition (%)	4.76	-	-	10
Sum of BTEX (mg/kg)	-	-	-	-
Sum of 7 PCBs (mg/kg)	<0.021	1	-	-
Mineral Oil (mg/kg) (EH_2D_AL)	<5	500	-	-
PAH Sum of 17 (mg/kg)	-	-	-	-
pH (pH Units)	-	-	-	-
ANC to pH 6 (mol/kg)	-	-	-	-
ANC to pH 4 (mol/kg)	-	-	-	-

Eluate Analysis	C_2 Conc^n in 10:1 eluate (mg/l)		A_2 10:1 conc^n leached (mg/kg)		Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg		
	Result	Limit of Detection	Result	Limit of Detection			
Arsenic	<0.0005	<0.0005	<0.005	<0.005	0.5	2	25
Barium	0.00554	<0.0002	0.0554	<0.002	20	100	300
Cadmium	<0.00008	<0.00008	<0.0008	<0.0008	0.04	1	5
Chromium	<0.001	<0.001	<0.01	<0.01	0.5	10	70
Copper	0.00208	<0.0003	0.0208	<0.003	2	50	100
Mercury Dissolved (CVAF)	<0.00001	<0.00001	<0.0001	<0.0001	0.01	0.2	2
Molybdenum	<0.003	<0.003	<0.03	<0.03	0.5	10	30
Nickel	0.0013	<0.0004	0.013	<0.004	0.4	10	40
Lead	<0.0002	<0.0002	<0.002	<0.002	0.5	10	50
Antimony	<0.001	<0.001	<0.01	<0.01	0.06	0.7	5
Selenium	<0.001	<0.001	<0.01	<0.01	0.1	0.5	7
Zinc	<0.001	<0.001	<0.01	<0.01	4	50	200
Chloride	<2	<2	<20	<20	800	15000	25000
Fluoride	0.689	<0.5	6.89	<5	10	150	500
Sulphate (soluble)	<2	<2	<20	<20	1000	20000	50000
Total Dissolved Solids	118	<10	1180	<100	4000	60000	100000
Total Monohydric Phenols (W)	<0.016	<0.016	<0.16	<0.16	1	-	-
Dissolved Organic Carbon	4.53	<3	45.3	<30	500	800	1000

Leach Test Information

Date Prepared	08-Nov-2021
pH (pH Units)	8.04
Conductivity (µS/cm)	147.00
Temperature (°C)	20.50
Volume Leachant (Litres)	0.876

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable
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CERTIFICATE OF ANALYSIS

SDG: 211106-42 Report Number: 622047 Superseded Report:
Client Ref.: 5898 Location: Kilshane

CEN 10:1 SINGLE STAGE LEACHATE TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference		**Site Location**	Kilshane
Mass Sample taken (kg)	0.112	**Natural Moisture Content (%)**	22.9
Mass of dry sample (kg)	0.090	**Dry Matter Content (%)**	81.4
Particle Size <4mm	>95%		

Case	
SDG	211106-42
Lab Sample Number(s)	25288112
Sampled Date	
Customer Sample Ref.	TP 16
Depth (m)	0.50 - 0.50

Solid Waste Analysis	Result	Landfill Waste Acceptance Criteria Limits: Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
Total Organic Carbon (%)	0.478	3	5	6
Loss on Ignition (%)	3.16	-	-	10
Sum of BTEX (mg/kg)	-	-	-	-
Sum of 7 PCBs (mg/kg)	<0.021	1	-	-
Mineral Oil (mg/kg) (EH_2D_AL)	<5	500	-	-
PAH Sum of 17 (mg/kg)	-	-	-	-
pH (pH Units)	-	-	-	-
ANC to pH 6 (mol/kg)	-	-	-	-
ANC to pH 4 (mol/kg)	-	-	-	-

Eluate Analysis	C_2 Conc^n in 10:1 eluate (mg/l)		A_2 10:1 conc^n leached (mg/kg)		Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg		
	Result	Limit of Detection	Result	Limit of Detection			
Arsenic	<0.0005	<0.0005	<0.005	<0.005	0.5	2	25
Barium	0.00768	<0.0002	0.0768	<0.002	20	100	300
Cadmium	<0.00008	<0.00008	<0.0008	<0.0008	0.04	1	5
Chromium	<0.001	<0.001	<0.01	<0.01	0.5	10	70
Copper	0.00197	<0.0003	0.0197	<0.003	2	50	100
Mercury Dissolved (CVAF)	<0.00001	<0.00001	<0.0001	<0.0001	0.01	0.2	2
Molybdenum	<0.003	<0.003	<0.03	<0.03	0.5	10	30
Nickel	<0.0004	<0.0004	<0.004	<0.004	0.4	10	40
Lead	0.00028	<0.0002	0.0028	<0.002	0.5	10	50
Antimony	<0.001	<0.001	<0.01	<0.01	0.06	0.7	5
Selenium	<0.001	<0.001	<0.01	<0.01	0.1	0.5	7
Zinc	0.00564	<0.001	0.0564	<0.01	4	50	200
Chloride	<2	<2	<20	<20	800	15000	25000
Fluoride	<0.5	<0.5	<5	<5	10	150	500
Sulphate (soluble)	<2	<2	<20	<20	1000	20000	50000
Total Dissolved Solids	43.2	<10	432	<100	4000	60000	100000
Total Monohydric Phenols (W)	<0.016	<0.016	<0.16	<0.16	1	-	-
Dissolved Organic Carbon	3.09	<3	30.9	<30	500	800	1000

Leach Test Information

Date Prepared	08-Nov-2021
pH (pH Units)	8.49
Conductivity (µS/cm)	44.00
Temperature (°C)	20.20
Volume Leachant (Litres)	0.879

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable
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Table of Results - Appendix

Method No	Reference	Description
PM024	Modified BS 1377	Soil preparation including homogenisation, moisture screens of soils for Asbestos Containing Material
PM115		Leaching Procedure for CEN One Stage Leach Test 2:1 & 10:1 1 Step
TM018	BS 1377: Part 3 1990	Determination of Loss on Ignition
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) by Headspace GC-FID (C4-C12)
TM090	Method 5310, AWWA/APHA, 20th Ed., 1999 / Modified: US EPA Method 415.1 & 9060	Determination of Total Organic Carbon/Total Inorganic Carbon in Water and Waste Water
TM104	Method 4500F, AWWA/APHA, 20th Ed., 1999	Determination of Fluoride using the Kone Analyser
TM116	Modified: US EPA Method 8260, 8120, 8020, 624, 610 & 602	Determination of Volatile Organic Compounds by Headspace / GC-MS
TM123	BS 2690: Part 121:1981	The Determination of Total Dissolved Solids in Water
TM132	In - house Method	ELTRA CS800 Operators Guide
TM151	Method 3500D, AWWA/APHA, 20th Ed., 1999	Determination of Hexavalent Chromium using Kone analyser
TM152	Method 3125B, AWWA/APHA, 20th Ed., 1999	Analysis of Aqueous Samples by ICP-MS
TM168	EPA Method 8082, Polychlorinated Biphenyls by Gas Chromatography	Determination of WHO12 and EC7 Polychlorinated Biphenyl Congeners by GC-MS in Soils
TM181	US EPA Method 6010B	Determination of Routine Metals in Soil by iCap 6500 Duo ICP-OES
TM183	BS EN 23506:2002, (BS 6068-2.74:2002) ISBN 0 580 38924 3	Determination of Trace Level Mercury in Waters and Leachates by PSA Cold Vapour Atomic Fluorescence Spectrometry
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers
TM218	Shaker extraction - EPA method 3546.	The determination of PAH in soil samples by GC-MS
TM259	by HPLC	Determination of Phenols in Waters and Leachates by HPLC
TM410	Shaker extraction-In house coronene method	Determination of Coronene in soils by GCMS
TM414	Analysis of Petroleum Hydrocarbons in Environmental Media – Total Petroleum Hydrocarbon Criteria	Determination of Speciated Extractable Petroleum Hydrocarbons in Soils by GCxGC-FID
TM415	Analysis of Petroleum Hydrocarbons in Environmental Media.	Determination of Extractable Petroleum Hydrocarbons in Soils by GCxGC-FID

NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Life Sciences Ltd Hawarden.

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CERTIFICATE OF ANALYSIS

SDG: 211106-42 Report Number: 622047 Superseded Report:
Client Ref.: 5898 Location: Kilshane

Test Completion Dates

Lab Sample No(s)	25288105	25288106	25288113	25288107	25288108	25288109	25288110	25288111	25288114	25288115
Customer Sample Ref.	TP 03	TP 04	TP 06	TP 07	TP 10	TP 12	TP 13	TP 14	TP 14	TP 15
AGS Ref.										
Depth	0.50 - 0.50	0.50 - 0.50	1.00 - 1.00	0.50 - 0.50	0.50 - 0.50	0.50 - 0.50	0.50 - 0.50	0.50 - 0.50	1.00 - 1.00	1.00 - 1.00
Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
Anions by Kone (w)	15-Nov-2021	15-Nov-2021		15-Nov-2021	15-Nov-2021	15-Nov-2021	15-Nov-2021	15-Nov-2021		
CEN 10:1 Leachate (1 Stage)	10-Nov-2021	10-Nov-2021		10-Nov-2021	09-Nov-2021	09-Nov-2021	09-Nov-2021	09-Nov-2021		
CEN Readings	13-Nov-2021	13-Nov-2021		13-Nov-2021	13-Nov-2021	13-Nov-2021	13-Nov-2021	13-Nov-2021		
Chromium III	12-Nov-2021	12-Nov-2021		12-Nov-2021	15-Nov-2021	15-Nov-2021	15-Nov-2021	15-Nov-2021		
Coronene	12-Nov-2021	12-Nov-2021		12-Nov-2021	12-Nov-2021	12-Nov-2021	12-Nov-2021	12-Nov-2021		
Dissolved Metals by ICP-MS	15-Nov-2021	15-Nov-2021		15-Nov-2021	12-Nov-2021	15-Nov-2021	15-Nov-2021	12-Nov-2021		
Dissolved Organic/Inorganic Carbon	17-Nov-2021	18-Nov-2021		18-Nov-2021	18-Nov-2021	18-Nov-2021	18-Nov-2021	18-Nov-2021		
EPH by GCxGC-FID	11-Nov-2021	11-Nov-2021		11-Nov-2021	12-Nov-2021	12-Nov-2021	12-Nov-2021	11-Nov-2021		
EPH CWG GC (S)	11-Nov-2021	11-Nov-2021		11-Nov-2021	12-Nov-2021	12-Nov-2021	12-Nov-2021	11-Nov-2021		
Fluoride	12-Nov-2021	12-Nov-2021		12-Nov-2021	12-Nov-2021	12-Nov-2021	12-Nov-2021	12-Nov-2021		
GRO by GC-FID (S)	15-Nov-2021	15-Nov-2021		15-Nov-2021	15-Nov-2021	15-Nov-2021	15-Nov-2021	15-Nov-2021		
Hexavalent Chromium (s)	12-Nov-2021	12-Nov-2021		12-Nov-2021	12-Nov-2021	12-Nov-2021	12-Nov-2021	12-Nov-2021		
Loss on Ignition in soils	12-Nov-2021	12-Nov-2021	15-Nov-2021	12-Nov-2021	15-Nov-2021	15-Nov-2021	15-Nov-2021	15-Nov-2021	15-Nov-2021	15-Nov-2021
Mercury Dissolved	12-Nov-2021	15-Nov-2021		12-Nov-2021	15-Nov-2021	12-Nov-2021	12-Nov-2021	12-Nov-2021		
Metals in solid samples by OES	12-Nov-2021	12-Nov-2021		12-Nov-2021	15-Nov-2021	15-Nov-2021	15-Nov-2021	15-Nov-2021		
Moisture at 105C	08-Nov-2021	08-Nov-2021		08-Nov-2021	08-Nov-2021	08-Nov-2021	08-Nov-2021	08-Nov-2021		
PAH by GCMS	11-Nov-2021	11-Nov-2021		11-Nov-2021	11-Nov-2021	11-Nov-2021	11-Nov-2021	11-Nov-2021		
PCBs by GCMS	12-Nov-2021	12-Nov-2021		12-Nov-2021	12-Nov-2021	12-Nov-2021	12-Nov-2021	12-Nov-2021		
Phenols by HPLC (W)	12-Nov-2021	12-Nov-2021		12-Nov-2021	11-Nov-2021	12-Nov-2021	12-Nov-2021	11-Nov-2021		
Sample description	08-Nov-2021	08-Nov-2021	08-Nov-2021	08-Nov-2021	08-Nov-2021	08-Nov-2021	08-Nov-2021	08-Nov-2021	08-Nov-2021	08-Nov-2021
Total Dissolved Solids on Leachates	15-Nov-2021	12-Nov-2021		12-Nov-2021	15-Nov-2021	12-Nov-2021	12-Nov-2021	15-Nov-2021		
Total Organic Carbon	15-Nov-2021	15-Nov-2021		15-Nov-2021	15-Nov-2021	15-Nov-2021	15-Nov-2021	15-Nov-2021		
TPH CWG GC (S)	15-Nov-2021	15-Nov-2021		15-Nov-2021	15-Nov-2021	15-Nov-2021	15-Nov-2021	15-Nov-2021		
VOC MS (S)	16-Nov-2021	16-Nov-2021		16-Nov-2021	12-Nov-2021	12-Nov-2021	16-Nov-2021	16-Nov-2021		

Lab Sample No(s)	25288112
Customer Sample Ref.	TP 16
AGS Ref.	
Depth	0.50 - 0.50
Type	Soil/Solid (S)
Anions by Kone (w)	15-Nov-2021
CEN 10:1 Leachate (1 Stage)	09-Nov-2021
CEN Readings	13-Nov-2021
Chromium III	15-Nov-2021
Coronene	12-Nov-2021
Dissolved Metals by ICP-MS	15-Nov-2021
Dissolved Organic/Inorganic Carbon	17-Nov-2021
EPH by GCxGC-FID	11-Nov-2021
EPH CWG GC (S)	11-Nov-2021
Fluoride	12-Nov-2021
GRO by GC-FID (S)	15-Nov-2021
Hexavalent Chromium (s)	12-Nov-2021
Loss on Ignition in soils	15-Nov-2021
Mercury Dissolved	12-Nov-2021
Metals in solid samples by OES	15-Nov-2021
Moisture at 105C	08-Nov-2021
PAH by GCMS	11-Nov-2021
PCBs by GCMS	12-Nov-2021
Phenols by HPLC (W)	12-Nov-2021
Sample description	08-Nov-2021
Total Dissolved Solids on Leachates	12-Nov-2021
Total Organic Carbon	15-Nov-2021
TPH CWG GC (S)	15-Nov-2021
VOC MS (S)	12-Nov-2021

Appendix

General

1. Results are expressed on a dry weight basis (dried at 35°C) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICs and SVOC TICs.

2. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

3. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

4. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

5. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

6. NDP - No determination possible due to insufficient/unsuitable sample.

7. Results relate only to the items tested.

8. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

9. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

10. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

11. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

12. For dried and crushed preparations of soils volatile loss may occur e.g volatile mercury

13. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

14. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

15. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

16. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

17 Data retention. All records, communications and reports pertaining to the analysis are archived for seven years from the date of issue of the final report.

18. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjecte to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as "mixed hydrocarbons". Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

19. **Sample Deviations**

If a sample is classed as deviated then the associated results may be compromised.

1	Container with Headspace provided for volatiles analysis
2	Incorrect container received
3	Deviation from method
4	Matrix interference
♦	Sample holding time exceeded in laboratory
@	Sample holding time exceeded due to late arrival of instructions or samples
§	Sampled on date not provided

20. **Asbestos**

When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining.

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

Respirable Fibres

Respirable fibres are defined as fibres of <3 µm diameter, longer than 5 µm and with aspect ratios of at least 3:1 that can be inhaled into the lower regions of the lung and are generally acknowledged to be most important predictor of hazard and risk for cancers of the lung.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

APPENDIX TO SECTION 8

WATER & HYDROLOGY

APPENDIX 8

HYDROLOGY IMPACT RATING AND ASSESSMENT CRITERIA

Appendix 8 - NRA Criteria for Rating the Magnitude and Significance of Impacts at EIA Stage National Roads Authority (NRA, 2009)

Table 1 Criteria for Rating Site Attributes – Estimation of Importance of Hydrological Attributes (NRA)

Importance	Criteria	Typical Examples
Extremely High	Attribute has a high quality or value on an international scale	River, wetland or surface water body ecosystem protected by EU legislation e.g. 'European sites' designated under the Habitats Regulations or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988.
Very High	Attribute has a high quality or value on a regional or national scale	River, wetland or surface water body ecosystem protected by national legislation – NHA status. Regionally important potable water source supplying >2500 homes. Quality Class A (Biotic Index Q4, Q5). Flood plain protecting more than 50 residential or commercial properties from flooding. Nationally important amenity site for wide range of leisure activities.
High	Attribute has a high quality or value on a local scale	Salmon fishery. Locally important potable water source supplying >1000 homes. Quality Class B (Biotic Index Q3-4). Flood plain protecting between 5 and 50 residential or commercial properties from flooding. Locally important amenity site for wide range of leisure activities.
Medium	Attribute has a medium quality or value on a local scale	Coarse fishery. Local potable water source supplying >50 homes. Quality Class C (Biotic Index Q3, Q2- 3). Flood plain protecting between 1 and 5 residential or commercial properties from flooding.
Low	Attribute has a low quality or value on a local scale	Locally important amenity site for small range of leisure activities. Local potable water source supplying <50 homes Quality Class D (Biotic Index Q2, Q1). Flood plain protecting 1 residential or commercial property from flooding. Amenity site used by small numbers of local people.

Table 2 Criteria for Rating Impact Significance at EIS Stage – Estimation of Magnitude of Impact on Hydrological Attribute (NRA)

Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute	Loss or extensive change to a waterbody or water dependent habitat. Increase in predicted peak flood level >100mm. Extensive loss of fishery. Calculated risk of serious pollution incident >2% annually. Extensive reduction in amenity value.
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Increase in predicted peak flood level >50mm. Partial loss of fishery. Calculated risk of serious pollution incident >1% annually. Partial reduction in amenity value.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Increase in predicted peak flood level >10mm. Minor loss of fishery. Calculated risk of serious pollution incident >0.5% annually. Slight reduction in amenity value.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	Negligible change in predicted peak flood level. Calculated risk of serious pollution incident <0.5% annually.
Minor Beneficial	Results in minor improvement of attribute quality	Reduction in predicted peak flood level >10mm. Calculated reduction in pollution risk of 50% or more where existing risk is <1% annually.
Moderate Beneficial	Results in moderate improvement of attribute quality	Reduction in predicted peak flood level >50mm. Calculated reduction in pollution risk of 50% or more where existing risk is >1% annually.
Major Beneficial	Results in major improvement of attribute quality	Reduction in predicted peak flood level >100mm

Table 3 Rating of Significant Environmental Impacts at EIS Stage (NRA)

Importance of Attribute	Magnitude of Importance			
	Negligible	**Small Adverse**	**Moderate Adverse**	**Large Adverse**
Extremely High	Imperceptible	Significant	Profound	Profound
Very High	Imperceptible	Significant/moderate	Profound/Significant	Profound
High	Imperceptible	Moderate/Slight	Significant/moderate	Profound/Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight/Moderate

APPENDIX TO SECTION 9

AIR QUALITY & CLIMATE

APPENDIX 9.1

Description of the AERMOD model

APPENDIX 9.1: DESCRIPTION OF THE AERMOD MODEL

The AERMOD dispersion model has been developed in part by the U.S. Environmental Protection Agency[1][2]. The model is a steady-state Gaussian model used to assess p ollutant concentrations associated with industrial sources. The model is an enhancement on the Industrial Source Complex-Short Term 3 (ISCST3) model which has been widely used for emissions from industrial sources.

Improvements over the ISCST3 model include the treatment of the vertical distribution of concentration within the plume. ISCST3 assumes a Gaussian distribution in both the horizontal and vertical direction under all weather conditions. AERMOD with PRIME, however, treats the vertical distribution as non-Gaussian under convective (unstable) conditions while maintaining a Gaussian distribution in both the horizontal and vertical direction during stable conditions. This treatment reflects the fact that the plume is skewed upwards under convective conditions due to the greater intensity of turbulence above the plume than below. The result is a more accurate portrayal of actual conditions using the AERMOD model. AERMOD also enhances the turbulence of night-time urban boundary layers thus simulating the influence of the urban heat island.

In contrast to ISCST3, AERMOD is widely applicable in all types of terrain. Differentiation of the simple versus complex terrain is unnecessary with AERMOD. In complex terrain, AERMOD employs the dividing-streamline concept in a simplified simulation of the effects of plume-terrain interactions. In the dividing-streamline concept, flow below this height remains horizontal, and flow above this height tends to rise up and over terrain. Extensive validation studies have found that AERMOD (precursor to AERMOD with PRIME) performs better than ISCST3 for many applications and as well or better than CTDMPLUS for several complex terrain data sets(3).

Due to the proximity to surrounding buildings, the PRIME (Plume Rise Model Enhancements) building downwash algorithm has been incorporated into the model to determine the influence (wake effects) of these buildings on dispersion in each direction considered. The PRIME algorithm takes into account the position of the stack relative to the building in calculating building downwash. In the absence of the building, the plume from the stack will rise due to momentum and/or buoyancy forces. Wind streamlines act on the plume leads to the bending over of the plume as it disperses. However, due to the presence of the building, wind streamlines are disrupted leading to a lowering of the plume centreline.

When there are multiple buildings, the building tier leading to the largest cavity height is used to determine building downwash. The cavity height calculation is an empirical formula based on building height, the length scale (which is a factor of building height & width) and the cavity length (which is based on building width, length and height). As the direction of the wind will lead to the identification of differing dominant tiers, calculations are carried out in intervals of 10 degrees.

In PRIME, the nature of the wind streamline disruption as it passes over the dominant building tier is a function of the exact dimensions of the building and the angle at which the wind approaches the building. Once the streamline encounters the zone of influence of the building, two forces act on the plume. Firstly, the disruption caused by the building leads to increased turbulence and enhances horizontal and vertical dispersion. Secondly, the streamline descends in the lee of the building due to the reduced pressure and drags the plume (or part of) nearer to the ground, leading to higher ground level concentrations. The model calculates the descent of the plume as a function of the building shape and, using a numerical plume rise model, calculates the change in the plume centreline location with distance downwind.

The immediate zone in the lee of the building is termed the cavity or near wake and is characterised by high intensity turbulence and an area of uniform low pressure. Plume mass captured by the cavity region is re-emitted to the far wake as a ground-level volume source. The volume source is located at the base of the lee wall of the building, but is only evaluated near the end of the near wake and beyond. In this region, the disruption caused by the building downwash gradually fades with distance to ambient values downwind of the building.

AERMOD has made substantial improvements in the area of plume growth rates in comparison to ISCST3[1][4]. ISCST3 approximates turbulence using six Pasquill-Gifford-T

urner Stability Classes and bases the resulting dispersion curves upon surface release experiments. This treatment, however, cannot explicitly account for turbulence in the formulation. AERMOD is based on the more realistic modern planetary boundary layer (PBL) theory which allows turbulence to vary with height. This use of turbulence-based plume growth with height leads to a substantial advancement over the ISCST3 treatment.

Improvements have also been made in relation to mixing height[(1)(4)]. The t reatment of mixing height by ISCST3 is based on a single morning upper air sounding each day. AERMOD, however, calculates mixing height on an hourly basis based on the morning upper air sounding and the surface energy balance, accounting for the solar radiation, cloud cover, reflectivity of the ground and the latent heat due to evaporation from the ground cover. This more advanced formulation provides a more realistic sequence of the diurnal mixing height changes.

AERMOD also has the capability of modelling both unstable (convective) conditions and stable (inversion) conditions. The stability of the atmosphere is defined by the sign of the sensible heat flux. Where the sensible heat flux is positive, the atmosphere is unstable whereas when the sensible heat flux is negative the atmosphere is defined as stable. The sensible heat flux is dependent on the net radiation and the available surface moisture (Bowen Ratio). Under stable (inversion) conditions, AERMOD has specific algorithms to account for plume rise under stable conditions, mechanical mixing heights under stable conditions and vertical and lateral dispersion in the stable boundary layer.

AERMOD also contains improved algorithms for dealing with low wind speed (near calm) conditions. As a result, AERMOD can produce model estimates for conditions when the wind speed may be less than 1 m/s, but still greater than the instrument threshold.

REFERENCES

(1) USEPA (1995) User's Guide for the Industrial Source Complex (ISC3) Dispersion Model Vol I & II
(2) USEPA (1998) Human Health Risk Assessment Protocol, Chapter 3: Air Dispersion and Deposition Modelling, Region 6 Centre for Combustion Science and Engineering
(3) Paine, R & Lew, F. "Results of the Independent Evaluation of ISCST3 and ISC-PRIME" Prepared for the EPRI, ENSR Document No. 2460-026-3527-02 (1997).
(4) USEPA (2000) Seventh Conference on Air Quality Modelling (June 2000) Vol I & II

APPENDIX 9.2

AERMET

APPENDIX 9.2: AERMET

AERMOD incorporates a meteorological pre-processor AERMET (version 16216)[1]. AERMET allows AERMOD to account for changes in the plume behaviour with height. AERMET calculates hourly boundary layer parameters for use by AERMOD, including friction velocity, Monin-Obukhov length, convective velocity scale, convective (CBL) and stable boundary layer (SBL) height and surface heat flux. AERMOD uses this information to calculate concentrations in a manner that accounts for changes in dispersion rate with height, allows for a non-Gaussian plume in convective conditions, and accounts for a dispersion rate that is a continuous function of meteorology.

The AERMET meteorological preprocessor requires the input of surface characteristics, including surface roughness (z0), Bowen Ratio and albedo by sector and season, as well as hourly observations of wind speed, wind direction, cloud cover, and temperature. A morning sounding from a representative upper air station, latitude, longitude, time zone, and wind speed threshold are also required.

Two files are produced by AERMET for input to the AERMOD dispersion model. The surface file contains observed and calculated surface variables, one record per hour. The profile file contains the observations made at each level of a meteorological tower, if available, or the one-level observations taken from other representative data, one record level per hour.

From the surface characteristics (i.e. surface roughness, albedo and amount of moisture available (Bowen Ratio)) AERMET calculates several boundary layer parameters that are important in the evolution of the boundary layer, which, in turn, influences the dispersion of pollutants. These parameters include the surface friction velocity, which is a measure of the vertical transport of horizontal momentum; the sensible heat flux, which is the vertical transport of heat to/from the surface; the Monin-Obukhov length which is a stability parameter relating the surface friction velocity to the sensible heat flux; the daytime mixed layer height; the nocturnal surface layer height and the convective velocity scale which combines the daytime mixed layer height and the sensible heat flux. These parameters all depend on the underlying surface.

The values of albedo, Bowen Ratio and surface roughness depend on land-use type (e.g., urban, cultivated land etc) and vary with seasons and wind direction. The assessment of appropriate land-use types was carried out in line with USEPA recommendations[2] and using the detailed methodology outlined by the Alaska Department of Environmental Conservation[3]. AERMET has also been updated to allow for an adjustment of the surface friction velocity (u*) for low wind speed stable conditions based on the work of Qian and Venkatram. Previously, the model had a tendency to over-predict concentrations produced by near-ground sources in stable conditions..

Surface Roughness

Surface roughness length is the height above the ground at which the wind speed goes to zero. Surface roughness length is defined by the individual elements on the landscape such as trees and buildings. In order to determine surface roughness length, the USEPA recommends that a representative length be defined for each sector, based on geometric mean of the inverse distance area-weighted land use within the sector, by using the eight land use categories outlined by the USEPA. The area-weighted surface roughness length derived from the land use classification within a radius of 1km from Dublin Airport is shown in Table 9.2.1.

Table 9.2.1 Surface Roughness based on an inverse distance area-weighted average of the land use within a 1km radius of Dublin Airport

Sector	Area Weighted Land Use Classification	Spring	Summer	Autumn	Winter[Note 1]
340-100	0% Water, 100% Urban, 0% Grassland	1	1	1	1
100-340	0% Water, 0% Urban, 100% Grassland	0.05	0.1	0.01	0.01

Note 1 Winter defined as periods when surfaces covered permanently by snow whereas autumn is defined as periods when freezing conditions are common, deciduous trees are leafless and no snow is present (Iqbal (1983)). Thus for the current location autumn more accurately defines "winter" conditions at the proposed facility.

Albedo

Noon-time Albedo is the fraction of the incoming solar radiation that is reflected from the ground when the sun is directly overhead. Albedo is used in calculating the hourly net heat balance at the surface for calculating hourly values of Monin-Obuklov length. The area-weighted arithmetic mean albedo derived from the land use classification over a 10km x 10km area centred on Dublin Airport is shown in Table 9.2.2.

Table 9.2.2 Albedo based on an area-weighted arithmetic mean of the land use over a 10km x 10km area centred on Dublin Airport

Area Weighted Land Use Classification	Spring	Summer	Autumn	Winter[Note 1]
2% Water, 49% Urban, 31% Grassland, 19% Cultivated Land	**0.152**	**0.173**	**0.185**	**0.185**

Note 1 For the current location autumn more accurately defines "winter" conditions at the proposed facility.

Bowen Ratio

The Bowen ratio is a measure of the amount of moisture at the surface of the earth. The presence of moisture affects the heat balance resulting from evaporative cooling which, in turn, affects the Monin-Obukhov length which is used in the formulation of the boundary layer. The area-weighted geometric mean Bowen ratio derived from the land use classification over a 10km x 10km area centered on Dublin Airport is shown in Table 9.2.3.

Table 9.2.3 Bowen Ratio based on an area-weighted geometric mean of the land use over a 10km x 10km area centred on Dublin Airport

Area Weighted Land Use Classification	Spring	Summer	Autumn	Winter[Note 1]
2% Water, 49% Urban, 31% Grassland, 19% Cultivated Land	**0.63**	**1.23**	**1.36**	**1.36**

Note 1 For the current location autumn more accurately defines "winter" conditions at the proposed facility.

REFERENCES

(1) USEPA (2004) User's Guide to the AERMOD Meteorological Preprocessor (AERMET)
(2) USEPA (2005) Guidelines on Air Quality Models, Appendix W to Part 51, 40 CFR Ch.1
(3) Alaska Department of Environmental Conservation (2008) ADEC Guidance re AERMET Geometric Means (http://dec.alaska.gov/air/ap/modeling.htm)

APPENDIX 9.3

A comparison of future carbon emissions within the SEM with and without the Kilshane GT

AFRY

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A comparison of future carbon emissions within the SEM with and without the Kilshane GT

Kilshane Energy Limited, 12 July 2022

ANDY KELLY, DIRECTOR
TOM INGELSE, SENIOR CONSULTANT

AFRY
ÅF POYRY

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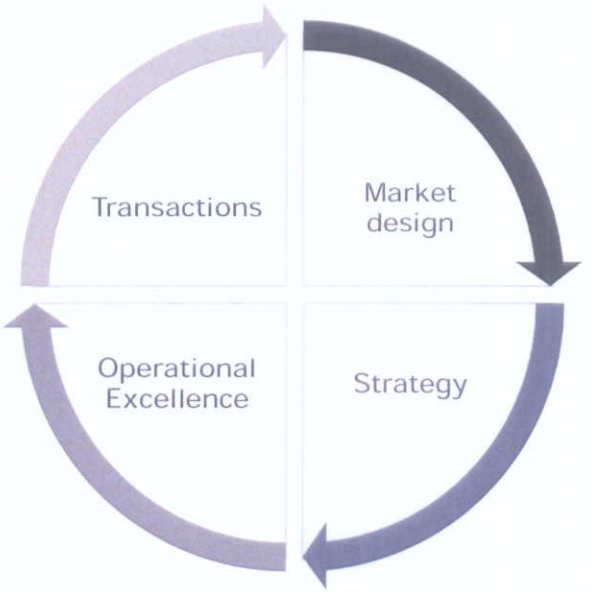

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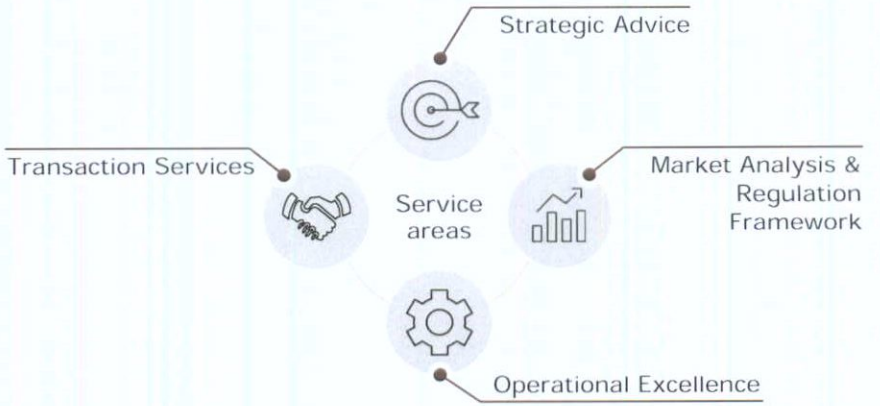

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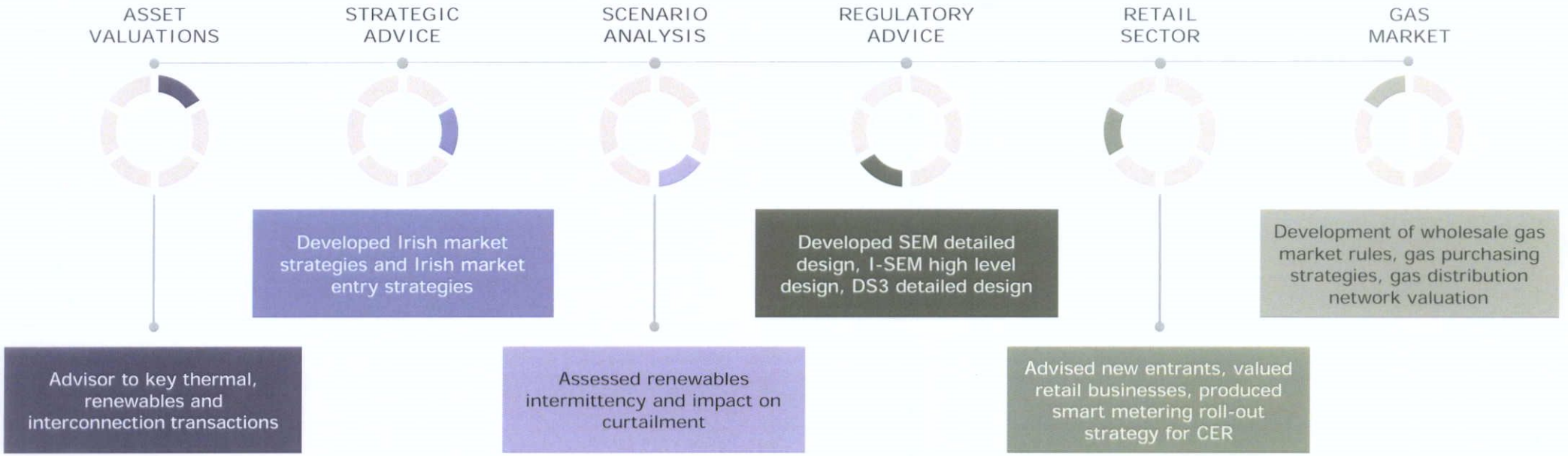
We have over twenty five years' experience in the Irish market, covering transactions, strategy, regulation, retail and gas markets



ABOUT AFRY MANAGEMENT CONSULTING IN IRELAND

We advise much of the Irish energy industry in the energy transition

Selected Irish Market References

With over 25 years experience in the Irish market, AFRY is dedicated to supporting clients in the energy transition.

Independent assessment and public report on value of energy storage to Irish electricity system, and identification of barriers to address

Services: Comprehensive cost-benefit analysis of energy storage in Irish system; production of report, 'The Missing Link' and presentation of findings to stakeholders including DECC, CRU, EirGrid

Lenders Market Advisor, Greenlink Interconnector

Services: Comprehensive modelling of future SEM and GB markets; assessment of future revenues for proposed interconnector. Provision of detailed Lenders Market Advisor report to support debt financing for the project, enabling FID and progress to construction

RESS-2 auction merit order analysis, Developer

Services: Competitor analysis on onshore renewable projects for RESS-2 auction, establishing merit order and expected bidding levels, supporting developer who successfully awarded several contracts from auction

Asset modelling services, Irish and GB market

Services: Provision to major utility of ongoing market and asset-specific modelling services on range of renewable, storage and thermal generating assets in Irish and GB markets

Capacity Adequacy Support, EirGrid

Services: AFRY are currently supporting EirGrid in a wide range of activities including understanding future capacity adequacy challenges

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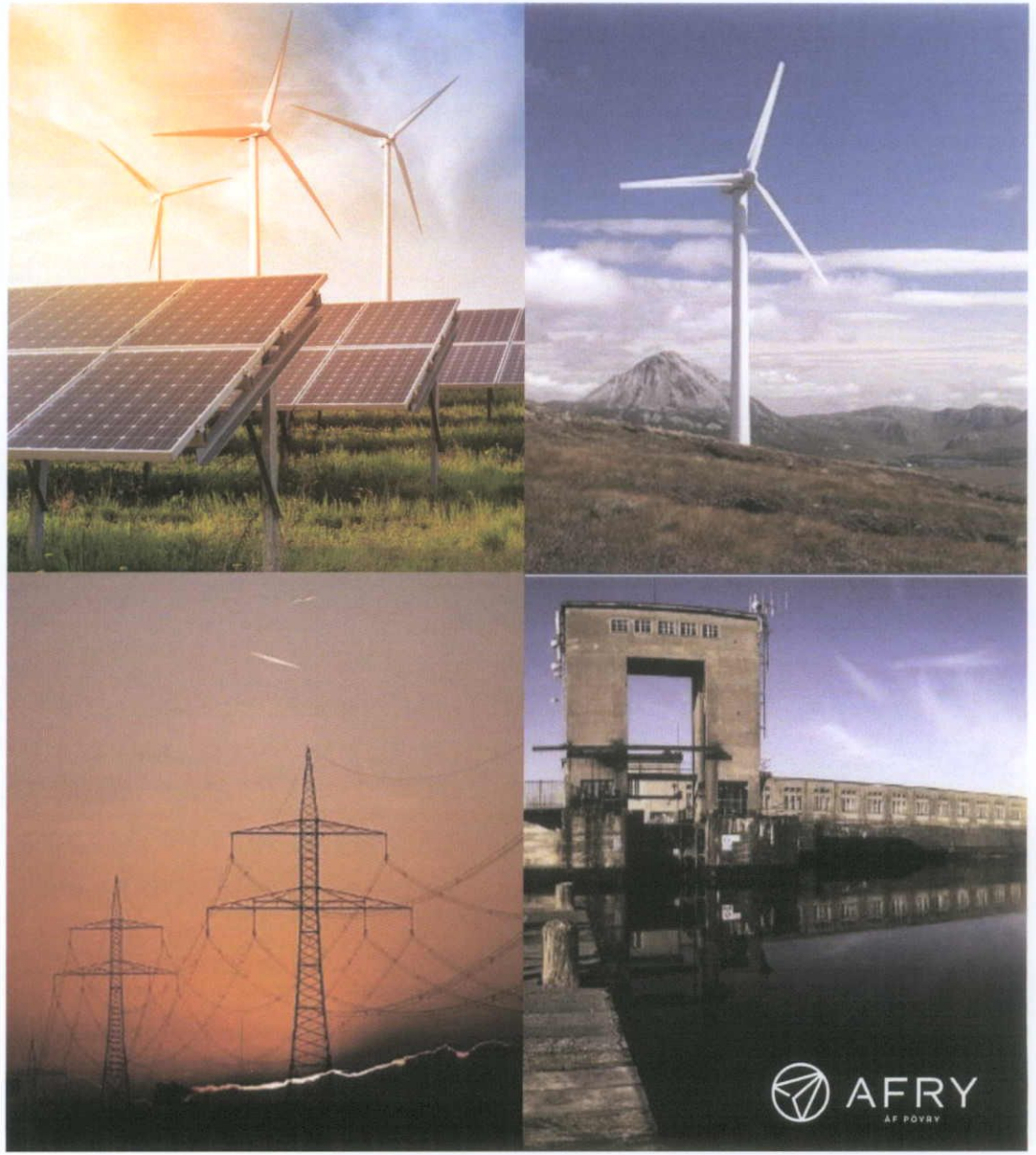


INTRODUCTION

What impact does the Kilshane GT have on CO_2 emissions in the SEM?

Background

- EirGrid, CRU and the Irish government have issued statements that the Irish electricity system will face system tightness in the near future; and therefore, that c. 2GW of new Gas Turbines (GTs) are required to support a high penetration renewable electricity system expected by 2030[1].
- Consequently, the Kilshane GT was one of the new GTs that successfully cleared in the 2024/25 T-3 Capacity Remuneration Mechanism (CRM) auction.

Rationale for this report

- AFRY has been engaged by Kilshane Energy Ltd to independently assess the expected impact of the proposed Kilshane Energy GT on the overall level of carbon emissions from the Irish power generation sector.

Key Question

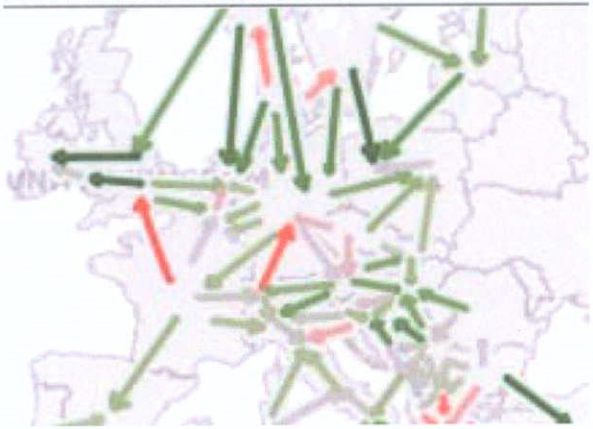
- What impact does the Kilshane GT have on carbon emissions in the SEM?

[1] Source: DECC, Climate Action Plan 2021, 4 November 2021

APPROACH

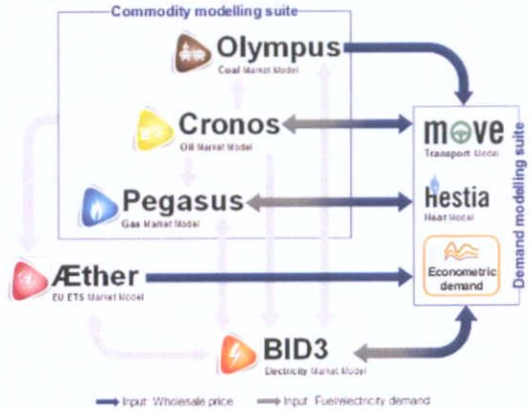
This assessment has used the outputs of AFRY's detailed modelling, which is designed to analyse the energy decarbonisation challenge

PAN-EUROPEAN MODELLING



- All European countries are modelled simultaneously in the same level of detail by considering the interconnection capacity and the flows between modelled countries.
- Pan-European analyses of interactions on the electricity and CO2 markets and global analyses of interactions on gas, oil and coal markets.

MODELLING PLATFORM



- Designed to meet the analytical needs of our clients, BID3 lies at the heart of our modelling suite working in an iterative manner with all our commodity and demand models.
- Internally developed suite of models (and sub-models) covering Europe and global commodities.
- Used by utilities, regulators and TSOs across Europe.

LIVE DATABASE OF MARKET INFORMATION

- A wealth of information and data feed into the modelling process.
- Our experts maintain on an ongoing basis a live database of market information, such as characteristics of every generation units in Europe, weather-related data, interconnections, technology costs, etc.

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