OFFICE OF ENVIRONMENTAL SUSTAINABILITY

INSPECTOR'S REPORT ON AN APPLICATION FOR A CERTIFICATE OF AUTHORISATION FOR A CLOSED LANDFILL

TO:	Gerard O'Leary, Director
FROM:	Ewa Babiarczyk, Inspector, Environmental Licensing Programme
DATE:	18th June 2021
RE:	Application by **Kildare County Council** for a Certificate of Authorisation for a closed landfill at **Prusselstown, Athy, County Kidare**. Certificate of Authorisation Register Number **H0209-01**.

1. Application details

Type of facility:	Closed landfill as defined in the Regulations[1].
Original site ownership	Private ownership.
Current site ownership	Private ownership.
Operator of closed landfill	Kildare County Council has operated this site since 1981.
Proposed use post remedial works	The site is intended to continue to be used as a hotel, including an associated car park, and a grazing area for animals.
Risk category of closed landfill:	Moderate risk (class B) due to • Lateral and vertical landfill gas migration into the on-site and off-site buildings.
Section 22 register number:	S22-02508
Grid Reference	269761 E and 194740 N
Application received:	9th October 2020
AA screening determination:	14th January 2021
Regulation 7(4) notice:	14th January 2021

[1] Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations 2008 (S.I. No. 524 of 2008).

Additional information received:	Regulation 7(4) Reply received on 11th February 2021.
Name of Qualified Person:	Thomas Vainio-Mattila, Credentials provided by The Institute of Geologists of Ireland.
EPA site inspection:	No inspection was required.

2. Information on the closed landfill

Location of facility	The closed landfill is located in the townlands of Prusselstown and Gallowshill, 1.6km north-east of the centre of Athy town, County Kildare. The location of the landfill site is shown in Figure 1.
Period of landfilling	1st January 1981 to 2nd February 1982.
Surrounding area	Public roads run along the southern and western site boundary, as shown in Figure 2. Agricultural fields lie beyond these roads and to the north and east of the site. Residential dwellings are located 75m north-east, 150m north-west and 15m east of the site. There is also a residential estate 160m south-west of the site, a B&B 115m east of the site and a petrol station 160m south-west of the site. One of the buildings to the south-east of the site traverses the site boundary, as shown in Figure 2. The Athy Stream flows towards the north, 550m north-east of the site, as shown in Figure 1 and Figure 4.
Area of the closed landfill	The site covers an area of 4.4 ha.
Quantity of waste at the facility	Approximately 160,888 tonnes. 114,920 m^3.
Characterisation of waste deposited	The waste comprises municipal waste, construction & demolition (C&D) waste, commercial waste and industrial waste. The deposited waste includes gravelly clay and ashy soil mixed with red bricks, concrete, glass, wood, plastic, metal, cables, car parts, tyres, cloths, pieces of carpets and mattress, milk cartons, metal cans, lids, steel sheeting, supermarket bags and textiles. Asbestos fibre bundles were also detected, as outlined below in Section titled *Leachate and water quality*. The extent of the waste body is 1.71 ha. The waste was deposited in a few areas within the site, as shown in Figure 3. Two types of waste are delineated within the waste body, as also shown in Figure 3: • Type 1 consists of municipal waste, including organic and C&D waste. The maximum depth of this waste is 11.7m, located in the south and north-west of the site; and

	• Type 2 which includes C&D and municipal waste mixed with clay. The maximum depth of this waste is 11.9m.

3. Site investigations

Current condition and appearance of closed landfill:	Previously a gravel pit was located in the western area of the site. This pit has been infilled and now the site is slightly undulating in the north-west and mainly flat in the eastern area of the site. In the centre of the site lies the hotel. The applicant stated that no waste was deposited under the hotel. The car park is located to the west of the hotel. The grazing area is located in the south-eastern area of the site and is used for grazing sheep, horses and alpacas. There are underground services present on site, including a sewer system serving the hotel and Irish Water water pipes. It is not anticipated that any issues should occur in the event repairs are required to these services or the water main in the future, as repairs without excavation are possible for the underground pipework and in the event excavation is required, the integrity of the landfill cap can be restored once complete.
Site investigations	The site investigations carried out as part of Tier 1, 2 and 3 assessments established the following facts: • The waste body is covered with a layer of predominantly brown gravelly clay; • Landfill leachate is being generated; and • Landfill gas is being generated and was detected outside the waste body.
Monitoring and analysis of samples (water, gas, waste):	The following site investigations were carried out as part of Tier 1, 2 and 3 assessments: • Desk study (the study involved studying Geological Survey Ireland database, EPA Envision mapping and National Parks and Wildlife mapping); • Walkover survey was carried out on 13th November 2018; • Topographical survey was carried out 26th April 2019; • Geophysical survey of the site was carried out on 6th and 8th November 2018; • Trial pit investigation (seven trial pits were excavated on 7th January 2019); • Soil sampling (three soil samples were collected from three trial pits. The analysis of these samples, including soil leachate tests, was carried out on 17th January 2019); • Permeability testing on the existing landfill cover material (one soil sample GW04 was tested on 11th April 2019); • Leachate monitoring (two rounds at three monitoring wells were carried out on 25th April 2019 and 9th May 2019); • Groundwater monitoring (two rounds at three monitoring wells were carried out on 25th April 2019 and 9th May 2019. Also, the

	groundwater from a private well serving the hotel was sampled on 23rd October 2019); • Surface water monitoring (two rounds at two monitoring locations were carried out on 25th April 2019 and 9th May 2019); • Landfill gas monitoring (three rounds at six monitoring locations were carried out on 25th April 2019, 9th May 2019 and 29th May 2019); • Outdoor surface volatile organic compounds (VOC) emissions survey was carried out at 51 locations within and outside the site on 29th May 2019; and • Indoor VOC emissions monitoring was undertaken at 81 locations within the hotel on 19th December 2019.
Hydrology	The closed landfill is located within the catchment of the Barrow River (Catchment Identification Number: 14) and the Barrow_SC_080 sub-catchment (Sub-catchment Id: 14_2). The nearest waterbody to the landfill is the Athy Stream (waterbody code: IE_SE_14A060400). The Athy Stream flows in a northerly direction 550m north-east of the site, as shown in Figure 1 and Figure 4. The flow direction of the Athy Stream then changes to flow in a south-westerly direction where it joins the Barrow River. The Water Framework Directive (WFD) status of the Athy Stream from the river's source (7.8km north-east of the site) up to 935m north-east (IE_SE_14A060400) of the site is classified as Moderate. Downstream of this location the WFD status of the Athy Stream is unassigned. The Athy stream discharges into the Barrow River 1.6km south-west of the closed landfill. The WFD status of the Barrow River at the point of discharge from the Athy Stream is also unassigned. It is noted that the WFD status of the Barrow River is classified as Good 4 km upstream of the point of discharge from the Athy Stream. The Barrow River (waterbody code: IE_SE_14B011600) flows in a southerly direction. The Grand Canal flows into the Barrow River 660m downstream of the point of discharge of the Athy Stream, as shown in Figure 1. However, 1.6km downstream of this discharge, the WFD status of the Barrow River (waterbody code: IE_SE_14B011900) is classified as Poor. There is one storm water overflow into the Athy Stream at the confluence with the Barrow River, from a wastewater treatment plant which serves the Athy Agglomeration (Licence Reg. No. D0003-01) and there are number of discharges into the Barrow River between the monitoring points referenced above determining the Good and Poor status. These include one primary discharge and five storm water overflows from the above referenced wastewater treatment plant and two Section 4 trade effluent discharge points located 790m and 810m downstream of the discharge from the Athy Stream. There is also a closed landfill (Greenhills (Former Refuse Depot) Landfill, Application Register No. H0208-01) located along the Barrow River, opposite the discharge location of the Athy Stream.

Agriculture and hydromorphology are identified however as the only significant pressures contributing to the poor ecological status of the Barrow River. Therefore, the drop in the WFD status indicates that the identified factors (agriculture and hydromorphology), and not the closed landfills, may be impacting the water quality.

Two surface water samples, SW1A and SW2A, were collected from the Athy Stream on 25th April 2019 and 9th May 2019, as shown in Figure 4. SW1A is located 616m north-east of the site and SW2A is located 940m north of the site. It is noted however that both of these monitoring locations are located upstream of the landfill. It is also noted however that the nearest downstream monitoring location to the landfill, would have to be on the Barrow River, approximately 4km south-west of the site. Monitoring of downstream surface water quality at such a distance from the closed landfill is however not considered practical, particularly when taking into account the existing discharges to the river as outlined above. Accordingly, it is considered that the impact of the closed landfill can be monitored through the assessment of groundwater quality, as recommended in Section titled *Hydrogeology* below.

Notwithstanding the above, the table below shows the maximum parameter concentrations recorded at surface water monitoring locations SW1A and SW2A from both of the monitoring events.

Table 1: Surface water monitoring results

Parameter	**EQS** [1]	**Measured concentrations** [2]	
		Location SW1A	**Location SW2A**
Dissolved oxygen (lower limit) [%]	Above 80% saturation	88.24	98.96
BOD [mg/l]	2.2	<1	<1
Ammoniacal Nitrogen as N [mg/l]	0.04	<0.03	<0.03
Molybdate Reactive Phosphate as P [mg/l]	0.025	<0.03	<0.03
Fluoride [mg/l]	1.5	<0.3	<0.3
Cyanide [µg/l]	10	<0.01	<0.01
Arsenic [µg/l]	20	<2.5	<2.5
Chromium [µg/l]	0.6	**<1.5**	**<1.5**
Copper [µg/l]	5	**<7**	**<7**
Cadmium [µg/l]	0.2	**<0.5**	**<0.5**
Lead [µg/l]	1.3	**<5**	**<5**

[1] Environmental Quality Standard (EQS); 95% high status/ Annual average EQS (AA-EQS) as set out in European Communities Environmental Objectives (Surface Water) Regulations 2009, as amended.

[2] Monitoring results as stated in Table 5: *Surface Water Analytical Results* of the Risk Assessment.

Mercury [µg/l]	0.07	**<1**	**<1**
Nickel [µg/l]	8.6	<2	<2
Zinc [µg/l]	40	<3	<3
Tributyltin [µg/l]	0.0002	**<0.1**	**<0.1**
Dichlorvos [µg/l]	0.0006	**<0.01**	**<0.01**
Chloride [mg/l]	-	27.80	28.10
Total Alkalinity as $CaCO_3$ [mg/l]	-	274	284
Calcium [mg/l]	-	123.90	125.50
Magnesium [mg/l]	-	17.20	17.70
Potassium [mg/l]	-	2.10	2.30
Sodium [mg/l]	-	8.90	9.10
Fluoranthene [µg/l]	0.0063	**<0.5**	**<0.5**
Benzo(a)pyrene [µg/l]	0.00017	**<1**	**<1**
Benzo(bk)fluoranthene [µg/l]	0.017	**<1**	**<1**
Benzo(ghi)perylene [µg/l]	0.0082	**<0.5**	**<0.5**

The monitoring results show that most of the monitored parameters were within their environmental quality standards (EQS) set out in *European Communities Environmental Objectives (Surface Water) Regulations 2009, as amended*. It is noted however, that it cannot be determined whether the actual concentrations for Chromium, Copper, Cadmium, Lead, Mercury, Tributyltin, Dichlorvos and polycyclic aromatic hydrocarbons (PAHs, including, but not limited to, fluoranthene, benzo(a)pyrene, benzo(bk)fluoranthene and benzo(ghi)perylene), were within the relevant standards as the limit of detection for the monitoring methods utilised were above the EQS. Furthermore, the monitoring results show that the concentrations of a number of parameters at SW2A slightly exceed the concentrations at SW1A, indicating a slight deterioration in water quality. Considering however, that the groundwater beneath the site flows towards the south/ south-west, as shown in Figure 5, it is unlikely that the landfill could impact the water quality in the Athy Stream.

Condition 3.9(d) requires quarterly monitoring of the Athy Stream at the monitoring locations SW1A and SW2A. In addition, Condition 3.9(g) requires that the sensitivity of the monitoring methods utilised shall have an appropriate limit of detection to allow for comparison of pollutant concentrations against the relevant trigger levels and/or standard reference values.

Hydrogeology	The closed landfill lies within the Athy-Bagnelstown Gravels groundwater body (GWB Number: IE_SE_G_160). The status of this groundwater body is good. The site is underlain by a bedrock aquifer which is classified as a Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (Ll) and Regionally important gravel aquifer (Rg). The aquifer vulnerability beneath the site is High. Groundwater beneath the site flows towards the south/ south-west in the direction of the Barrow River, as shown in Figure 5. The closed landfill is located 1.6km north-east from the Inner Protection Area (SI) of the Groundwater Source Protection Zone for Athy Town Council Public Water Supply (PWS). Two of Athy Town Council's drinking water boreholes (abstraction Id: 1400PUB1050_3 and 1400PUB1050_2) are located approximately 1.7km west of the site and an associated infiltration gallery (abstraction Id. 1400PUB1050_1) is located 1.8km west of the site. The two boreholes and the infiltration gallery are however no longer in use, with water for Athy instead sourced from the Srowland Water Treatment Plant approximately 3.3km north-east of the closed landfill. There are a number of private water boreholes in all directions from the closed landfill. Due to the fact that groundwater beneath the site flows towards the south/ south-west in the direction of the Barrow River, there may be a potential impact on boreholes located in this direction. However, the appropriate capping will limit ingress of rainwater into the waste body thus limiting the generation of leachate which may impact groundwater. Additionally, Condition 3.9(e) requires monitoring on a quarterly basis of groundwater upstream and downstream of the waste and specifies the minimum parameters to be monitored. In addition, Condition 3.4 requires appropriate monitoring to be carried out on a biannual basis to identify any impact on the quality of water abstracted at wells downgradient of the landfill.

Leachate and water quality:	<u>Trial pit investigation</u> Seven trial pits (TPA, TPB, TPC, TPD, TPE, TPF, TPG) were excavated on 17th January 2019, as shown in Figure 2. No waste was encountered in locations TPC and TPD. The base of waste was not reached in the remaining five trial pits. The maximum depth of trial pits was 5mbg (at TPB). The sub-surface soil profile encountered during trial pitting comprised of a cover layer with a thickness ranging from 0.6mbgl to 1.4mbgl, generally comprised of dark brown gravelly clay with occasional cobbles. The imported waste beneath this layer was observed at a thickness of 0.6 to 5.0 meters. Waste encountered in the trial pits included red bricks, concrete, plastic, including supermarket bags, plastic bottles and plastic glasses, metal, including metal car parts, steel sheeting, hard metal, metal wires, metal milk formula cans and metal lids, cables, glass, including glass bottles and jars, oil can (oil type not specified), wood, coal, pieces of carpet, mattress, textiles and milk cartons. Odour from decomposing waste

and odour of "historical burning" was observed at the trial pits with waste.

Soil sampling

Three soil samples were collected from the trial pits TPA, TPF and TPG on 17th January 2019, as shown in Figure 2, and analysed against the waste limit values, as set out in the Waste Acceptance Criteria (WAC) in *Council Decision of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC*. The analysed parameters included, but were not limited to, total organic carbon, asbestos, heavy metals, PAHs, mineral oil, petroleum hydrocarbons, polychlorinated biphenyls (PCBs) and phenol. The analysis shows that the concentration of mineral oil exceeded the inert waste criteria and the concentrations of total organic carbon exceeded hazardous waste criteria, as shown in the table below. The orange highlight denotes the type of waste criteria exceeded for a particular parameter.

Table 2: Soil analysis results

Parameter	Landfill Waste Acceptance Criteria Limits [1]			Trial pits where WAC are exceeded
	Inert	Non-haz	Haz	
Mineral Oil (C10 to C40) [mg/kg]	500	-	-	**905** (TPF)
Total Organic Carbon [%]	3	5	6	**19.8** (TPA) **3.44** (TPF)

The sampling also detected chrysotile (white asbestos) fibre bundles at concentrations of less than 0.001% in the sample from trial pit TPG. The Tier 3 Assessment states that asbestos in such low concentrations poses no risk to human health or the surrounding environment considering the use of site.

Soil leachate

Soil leachate tests were carried out on the soil samples from trial pits TPA, TPF and TPG on 17th January 2019. The testing included dissolved antimony, arsenic, barium, boron, cadmium, chromium, copper, lead, molybdenum, nickel, selenium, zinc and mercury, total phenols, fluoride, ammoniacal nitrogen, sulphate, chloride, dissolved organic carbon and total dissolved solids. The leachate testing results show that the concentrations of dissolved molybdenum, antimony, sulphate and total dissolved solids exceeded the leaching limit values for waste acceptable at landfills for inert waste but remain within the values for waste acceptable at landfills for non-hazardous waste, as set out in the above Council Decision, as shown in the table below.

[1] Waste Acceptance Criteria (WAC) as set out in *Council Decision of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC*

Table 3: Soil leachate test results

Parameter	Landfill Waste Acceptance Criteria Limits			Trial pits where WAC are exceeded
	Inert	Non-haz	Haz	
Molybdenum [mg/kg]	0.5	10	30	**0.78** (TPG)
Antimony [mg/kg]	0.06	0.7	5	**0.1** (TPA) & **0.11** (TPG)
Sulphate [mg/kg]	1,000	20,000	50,000	**2,095** (TPF)
Total Dissolved Solids [mg/kg]	4,000	60,000	100,000	**4,210** (TPF)

Landfill leachate monitoring

Leachate monitoring was carried out at combined (leachate and gas) monitoring boreholes L1A, L2A and L3A within the waste body, as shown in Figure 2, on 25th April 2019 and 9th May 2019.

Leachate samples were retrieved from the monitoring location L1A only. No leachate samples could be retrieved from L2A or L3A because these monitoring locations were dry during both monitoring events. The waste encountered in the boreholes included plastic, red bricks, wood, cloths, concrete, metal, clothes, glass, half burnt tyre and refuse bags.

The table below shows the maximum parameter concentrations which exceed either surface water or groundwater standards from both monitoring events.

Table 4: Leachate monitoring results

Parameter	EQS/ Limit [1,2,3]	L1A within the waste body (Borehole depth 5.1mblg)	L2A within the waste body (Borehole depth 8.5mblg)	L3A within the waste body (Borehole depth 6.5mblg)
Ammoniacal Nitrogen as N [mg/l]	0.065 [1]	**39.03**	Dry	Dry
Arsenic [µg/l]	7.5 [1]	**17.1**	Dry	Dry
BOD [mg/l]	2.2 [2]	**10**	Dry	Dry
Calcium [mg/l]	200 [3]	**255.10**	Dry	Dry

[1] European Communities Environmental Objectives (Groundwater) Regulations, 2010, as amended.

[2] Environmental Quality Standard (EQS); 95% high status/ annual average value, as set out in European Communities Environmental Objectives (Surface Water) Regulations 2009, as amended.

[3] As set out in the EPA publication 'Towards setting guideline values for the protection of groundwater in Ireland – Interim Report', 2003.

Manganese [µg/l]	50 [3]	**1,331**	Dry	Dry
Potassium [mg/l]	5 [3]	**28.3**	Dry	Dry
Tributyltin [µg/l]	0.0002 [2]	**<0.1**	Dry	Dry
Benzo(a)pyrene [µg/l]	0.0075 [1]	**<1**	Dry	Dry
Benzo(bk)fluoranthene [µg/l]	Total PAHs 0.075 [1]	**<1**	Dry	Dry
Indeno(123cd)pyrene [µg/l]		**<1**	Dry	Dry
Benzo(ghi)perylene [µg/l]		**<0.5**	Dry	Dry
Anthracene [µg/l]		**<0.5**	Dry	Dry
Naphthalene [µg/l]		**<1**	Dry	Dry

The monitoring results show that a number of parameters in the landfill leachate exceeded the relevant standards. Furthermore, it cannot be determined whether the actual concentrations for benzo(a)pyrene and total PAHs were within the relevant standards as the limit of detection for the monitoring methods are above the EQSs.

Condition 3.9(b) requires leachate monitoring in the existing wells L1A, L2A and L3A on a quarterly basis and specifies the minimum parameters to be monitored, including PAHs, to ensure that the on-going levels are monitored.

Groundwater quality

Groundwater monitoring was carried out at three groundwater monitoring boreholes GW1A, GW2A and GW3A, as shown in Figures 2 and 5 and listed in the table below, on 25th April 2019 and 9th May 2019.

Table 5: Groundwater monitoring boreholes

Borehole	Depth (mbgl)	Static water level (mbgl)	Lithology
GW1A	17.3	12.6	Gravel. No bedrock encountered.
GW2A	14.3	12.4	Sand & gravel. No bedrock encountered.
GW3A	17.3	8.9	Sand & gravel. No bedrock encountered.

Considering that the groundwater flow beneath the site is towards the south/ south-west, it is noted that only monitoring borehole GW1A is

located downgradient of the waste body. The monitoring location GW3A is located outside the site boundary near the north-western corner of the site. Considering the direction of the groundwater flow, as shown in Figure 5, and the location of waste in this area of the site, it is noted that borehole GW3A may not be fully representative of downgradient ground water conditions. Accordingly, Condition 3.1(d) requires the installation of an additional groundwater monitoring borehole downgradient of the waste body (monitoring location GW4A).

The monitoring parameters included, but were not limited to, dissolved oxygen, electrical conductivity, total hardness, molybdate reactive phosphorous, ammoniacal nitrogen and nitrate, total organic carbon, total oxidised nitrogen and total dissolved solids, faecal coliforms, total coliforms, heavy metals, pesticides, organochlorine pesticides, organophosphorus pesticides, acid herbicides, total petroleum hydrocarbons, semi-volatile organic compounds and volatile organic compounds.

The table below shows the maximum concentrations of the parameters which exceeded the relevant standards/limits during both of the monitoring events.

Table 6: Groundwater monitoring results

Parameter	EQS [1,2]	Upgradient location GW2A	Downgradient location GW1A	Location GW3A near the north-western corner of the site
Dissolved Arsenic [µg/l]	7.5 [1]	<2.5	**8.10**	<2.5
Benzo(a)pyrene [µg/l]	0.0075 [1]	**<1**	**<1**	**<1**
Benzo(bk)fluoranthene [µg/l]	Total PAHs 0.075 [1]	**<1**	**<1**	**<1**
Indeno(123cd)pyrene [µg/l]		**<1**	**<1**	**<1**
Benzo(ghi)perylene [µg/l]		**<0.5**	**<0.5**	**<0.5**
Anthracene [µg/l]		**<0.5**	**<0.5**	**<0.5**
Naphthalene [µg/l]		**<1**	**<1**	**<1**
Faecal Coliforms [cfu/100ml]	0 [2]	**<1**	**<1**	**<1**
Total Coliforms [cfu/100ml]	0 [2]	**9.6**	**3.1**	**165.8**

[1] European Communities Environmental Objectives (Groundwater) Regulations, 2010, as amended.

[2] European Union (Drinking Water) Regulations 2014, S.I. 122 of 2014.

	The monitoring results show that the landfill is impacting groundwater quality. However, it is also noted that the exceedances of faecal and total coliforms and other parameters at the upgradient monitoring location may indicate that groundwater quality is also impacted by factors other than the landfill. Furthermore, it is noted that it cannot be determined whether the actual concentrations for benzo(a)pyrene and Total PAHs were within the relevant standards as the limit of detection for the monitoring methods are above the EQSs. Additionally, a sample of groundwater from the private well supplying the hotel was collected, via the hotel's kitchen tap, on 23rd October 2019. The sampling results show that the concentration for total hardness, measured at 394mg/l $CaCO_3$, exceeded the EPA Interim Guideline Value (IGV) of 200mg/l $CaCO_3$ for this parameter. No other exceedances were detected in the sample. It is noted however, that the sampling was carried out for a limited range of parameters and no exact location of this well was stated in the Risk Assessment. Condition 3.9(e) requires monitoring on a quarterly basis of groundwater from the existing wells GW1A, GW2A, GW3A and the additional borehole GW4A. Additionally, Condition 3.9(f) requires monthly monitoring of the untreated raw water from the private well serving the hotel. Condition 3.9(g) requires that the sensitivity of the monitoring methods utilised shall have an appropriate limit of detection to allow for comparison of pollutant concentrations against the relevant trigger levels and/or standard reference values. Condition 3.8 requires a drawing showing, amongst other elements, the location of the private well serving the hotel.
Landfill gas:	There is a risk of landfill gas migration into the hotel and off-site buildings. The most likely pathway for the migration of the landfill gas is through the underlying soils and the existing cover layer over the waste body. Landfill gas monitoring was carried out on 25th April 2019, 9th May 2019 and 29th May 2019. In total six boreholes were monitored; L1A, L2A, L3A, GW1A, GW2A and GW3A, as shown in Figure 2. The monitored parameters included methane (CH_4), carbon dioxide (CO_2), oxygen (O_2), carbon monoxide (CO) and hydrogen sulphide (H_2S). Also, gas flow rate and lower explosive limit (LEL) were measured. The following table shows the maximum concentrations of methane and carbon dioxide measured at the six locations during the three monitoring events. The orange highlight denotes the monitoring locations outside the waste body. *Table 7: Landfill gas monitoring results*

Borehole	Location description	Methane (% v/v)	Carbon dioxide (% v/v)
L1A	30m north of the hotel	**6.1**	**12.5**

L2A	25m south of the hotel	0.4	**7.9**
L3A	Car park, 70m west of the hotel	**1.4**	**9.2**
GW1A	75m south of the car park	0.1	0.4
GW2A	50m east of the hotel	0.1	**3.8**
GW3A	Outside the site boundary, 20m from the north-western corner of the site	0.1	**4.6**

The monitoring results show that landfill gas is being generated within the waste body and is also present at locations outside the waste body. No gas flow was observed at any of the monitoring locations.

The monitoring results showed that the methane level measured at L1A (6.1%) falls within the explosive range for methane: between 5% v/v (lower explosive limit) and 15% (upper explosive limit) v/v[1]. Condition 3.1(c) requires the installation a landfill gas management system for the venting of landfill gas.

VOC monitoring

Surface volatile organic compounds (VOC) emission monitoring was carried out at 51 locations within and outside the site boundary on 29th May 2019. The monitoring was carried out using an Inficon IRwin gas detector which is noted to monitor at a minimum methane, carbon dioxide and ethane gases. The Risk Assessment states that no elevated VOCs were detected at any of the locations monitored.

Indoor VOC emission monitoring was undertaken at 81 locations within the hotel on the 19th December 2019, using the same detector. The monitoring results show that the highest VOC level was recorded at 33ppm in the kitchen of the Shackleton Suite. The risk assessment states that the observed VOC readings at all surveyed areas are considered to be within the typical background concentration range. However, it is noted that the monitoring results do not provide specific levels for methane or carbon dioxide and are not compared to any relevant air quality standard. It is therefore considered that further monitoring for methane and carbon dioxide within the hotel buildings is appropriate to determine if landfill gas is migrating into the site buildings. Accordingly, Condition 3.10 requires indoor air monitoring for methane and carbon dioxide following the installation of the landfill cap and the gas management system. The condition further requires comparison of the monitoring results against a relevant air quality standard.

The applicant, in correspondence dated 10th February 2021, states that the monitoring demonstrated that "the imported material is not

[1] As outlined in EPA Landfill Manuals – Landfill Monitoring, 2nd Edition.

	actively generating landfill gas and it is therefore not migrating vertically or laterally" and hence would not affect any potential on-site or off-site receptors. It is considered however, that despite the absence of gas flow, the generated landfill gas constitutes a risk to human receptors. Also, as set out in the Agency Landfill Manuals - Landfill Monitoring, 2nd Edition, 2003, the trigger levels for monitoring emissions of methane and carbon dioxide outside the waste body are, respectively, 1% v/v or greater and 1.5% v/v or greater. The monitoring results show that these trigger levels in respect of carbon dioxide were exceeded at GW2A (3.8 %) and GW3A (4.6 %). Accordingly, Condition 3.1(c) requires a gas management system, as outlined below in Section titled *Proposed Remedial Actions*. In addition, Condition 3.9(c) requires gas monitoring to detect the presence and concentration of landfill gas on a quarterly basis. Furthermore, Condition 3.1(f) requires installation of gas vents and gas alarms in the on-site buildings and Condition 3.1(g) requires that the local authority ensures that recommendations in the guidance given in the Department of Environment 1994 publication "Protection of New Buildings and Occupants from Landfill Gas" and any subsequent revisions have been considered and applied to the on-site buildings.
Conceptual site model:	Tier 1 Assessment determined that the overall risk score for the closed landfill was High (Class A). This classification was due to the risk of landfill gas migration to off and on-site human receptors, the risk of leachate migration to the aquifer beneath the site, into private wells and to surface waters. Following Tier 2 and Tier 3 investigations this risk classification was reduced to Moderate (Class B) due to the risk of lateral and vertical landfill gas migration into the hotel and the adjacent off-site buildings. The conceptual site model is shown in Figure 6.

4. SPR linkages and remedial actions

SPR linkage scenarios (applicable ones only):	**Leachate and gas migration scores**: High scores: There are no pathways identified as High Risk. Moderate scores: Two pathways were identified as Moderate Risk: • Human health exposure pathway of off-site lateral migration of landfill gas into nearby buildings (SPR 10); and • Vertical landfill gas migration (SPR 11). Low scores: Four pathways were identified as Low Risk: • Migration of leachate, via groundwater flowing to water drainage/runoff, into surface waterbodies (SPR 1); • Migration of leachate to private wells (SPR 3);

	• Migration of leachate to the underlying aquifer (SPR 5); and • Migration of leachate, via groundwater migration, to surface water bodies (SPR 7). **Summary:** Upon the review of the monitoring data; • remedial action is warranted to address the risk of migration of landfill gas to the on-site and off-site buildings. • remedial action is warranted to address the risk of leachate migrating from the site into groundwater and surface water.
Proposed remedial actions:	No remedial measures, other than using the existing cover material as the landfill cap, were proposed by the applicant. The Tier 3 Assessment states that "the site, in its current status, does not require any further actions, hence no remedial measures are proposed". However, it is suggested that in the future should there be a change in land use or there are new developments in the vicinity of the site, then a reassessment of the risk should be carried out. Accordingly, Condition 1.6 requires that in the event of future developments or changes in land use of the site, the Risk Assessment for the site shall be re-evaluated. The Tier 3 Assessment states that the existing cover material ranges from 0.6mbgl to 1.4mbgl and comprises of brown gravelly clay. One undisturbed sample GW04, as shown in Figure 2, was collected from the cover layer on 11th April 2019 and sent for permeability testing. The sample was classified as a brown very gravelly very sandy clay at a depth of 0.45mbg and a permeability of $4.9x10^{-9}$m/s. The applicant states that the low permeability of this material will impede rainfall infiltration and therefore reduce the generation of leachate. However, due to the variable depth of the existing material and the fact that leachate is being generated, it is considered that rainwater ingress is not prevented by the existing cover material. Accordingly, Condition 3.1(b) requires a landfill cap that comprises of a minimum 1m thick mineral layer having a hydraulic conductivity of less than or equal to $1x10^{-9}$m/s or a 1mm thick geomembrane, or equivalent, to achieve the hydraulic conductivity of $1x10^{-9}$m/s. In addition, Condition 3.1(b) requires that the cap is placed over all areas where waste is deposited with the exception of the hardstanding areas. Furthermore, the measured landfill gas levels, as described above, indicate that there may be pockets of landfill gas within the waste body. Therefore, it is considered that gas vents are required in all areas where waste is deposited. Condition 3.1(c) requires the installation of gas vents and requires that spacing between the gas vent pipes shall be in accordance with the EPA Landfill Manuals – Landfill Site Design. Condition 3.8 requires a drawing showing the interpolated extent of the waste body, the areas capped in accordance with Condition 3.1(b) and the gas vents installed in accordance with Condition 3.1(c).

	Having regard to the monitoring results submitted in support of the application for a certificate of authorisation and the age of the closed landfill, the following remedial measures are considered appropriate and recommended in Condition 3.1: (a) Minimise the disturbance of deposited waste to the extent possible; (b) Install a low permeability landfill cap, minimum 1m, with 1mm thick low permeability geomembrane, or equivalent, to achieve a hydraulic conductivity of less than or equal to $1x10^{-9}$m/s. The cap shall be installed over all areas where waste is deposited excluding the hardstanding areas; (c) Install a gas management system in all areas where waste is deposited, within six months of the date of grant of this Certificate of Authorisation. The gas management system shall include the following elements: (i) Gas vent pipes with fans or cowls, as appropriate; (ii) The gas vent pipes shall not be perforated above the ground level; and (iii) Spacing between the gas vent pipes shall be in accordance with the EPA Landfill Manuals – Landfill Site Design. (d) Install one additional groundwater monitoring borehole downgradient of the waste body (monitoring borehole GW4A); (e) Reseed grass within the site; (f) Install continuous gas monitoring, gas vents and gas alarms in the on-site buildings; and (g) Ensure that recommendations in the guidance given in the Department of Environment 1994 publication "Protection of New Buildings and Occupants from Landfill Gas" and any subsequent revisions have been considered and applied to all buildings constructed on the facility. The proposed remedial actions are intended to break the SPR linkages by preventing: • migration of landfill gas to the on-site and off-site buildings; and • migration of leachate into the aquifer and groundwater, and subsequently, into surface water bodies. The recommended certificate of authorisation allows for the importation and use of soil and stone to complete the works.
Proposed aftercare monitoring and assessment:	Monitoring as specified in Condition 3.9 of the recommended certificate of authorisation. Validation report to be submitted within 30 months.
Adequacy of risk assessment:	Regulation 7(7) of the Regulations states that the EPA must be satisfied with the risk assessment before proposing to grant a certificate of authorisation. The risk assessment is adequate as it has

	identified, assessed and adequately addressed the associated risks inherent with the landfill site.

5. Appropriate assessment

There is one European Site within the vicinity of the facility, as listed in the Appendix 1.

A screening for Appropriate Assessment was undertaken to assess, in view of best scientific knowledge and the conservation objectives of the site, if the activity, individually or in combination with other plans or projects is likely to have a significant effect on any European Site. In this context, particular attention was paid to the European Site at River Barrow and River Nore SAC (site code: 002162).

The activity is not directly connected with or necessary to the management of any European Site and the Agency considered, for the reasons set out below, that it cannot be excluded, on the basis of objective information, that the activity, individually or in combination with other plans or projects, will have a significant effect on any European Site and accordingly determined that an Appropriate Assessment of the activity was required.

The reason for this determination is as follows:

- Landfill leachate is being generated within the site and there is a risk of its migration into the underlying sand & gravel aquifer.
- The Environmental Risk Assessment states that the groundwater flow direction beneath the site is to the south/ south-west towards the River Barrow. Hence, there is a hydrological connection between the closed landfill and the River Barrow and River Nore SAC (site code: 002162).

An Inspector's Appropriate Assessment has been completed and has determined, based on best scientific knowledge in the field and in accordance with the European Communities (Birds and Natural Habitats) Regulations 2011 as amended, pursuant to Article 6(3) of the Habitats Directive, that the activity, individually or in combination with other plans or projects, will not adversely affect the integrity of any European Site, in particular River Barrow and River Nore SAC (site code: 002162), having regard to its conservation objectives and will not affect the preservation of this site at favourable conservation status if carried out in accordance with the application, risk assessment and recommended certificate of authorisation and the Conditions attached hereto for the following reasons:

- specifically, the remedial works will be undertaken to minimise the potential for water pollution in the River Barrow and River Nore SAC (site code: 002162) and will ensure that there will be no significant impact on this European Site; and
- the project alone, which consists of the remediation of the closed landfill, or in-combination with other projects, will not adversely affect the integrity and conservation status of any of the qualifying interests of the River Barrow and River Nore SAC (site code: 002162).

In light of the foregoing reasons, no reasonable scientific doubt remains as to the absence of adverse effects on the integrity of the River Barrow and River Nore SAC (site code: 002162).

6. Recommendation

I recommend granting the certificate of authorisation as proposed.

Signed

Date 18th June 2021

Ewa Babiarczyk

Procedural Note

Any representations received by the Agency within 30 days of the draft certificate of authorisation being made available will be considered by the Agency.

As soon as practicable after the expiry of the 30-day period the Agency will determine the certificate of authorisation, which may vary from the draft certificate, and shall issue an appropriately validated certificate of authorisation in accordance with the Waste Management (Certificate of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations 2008.

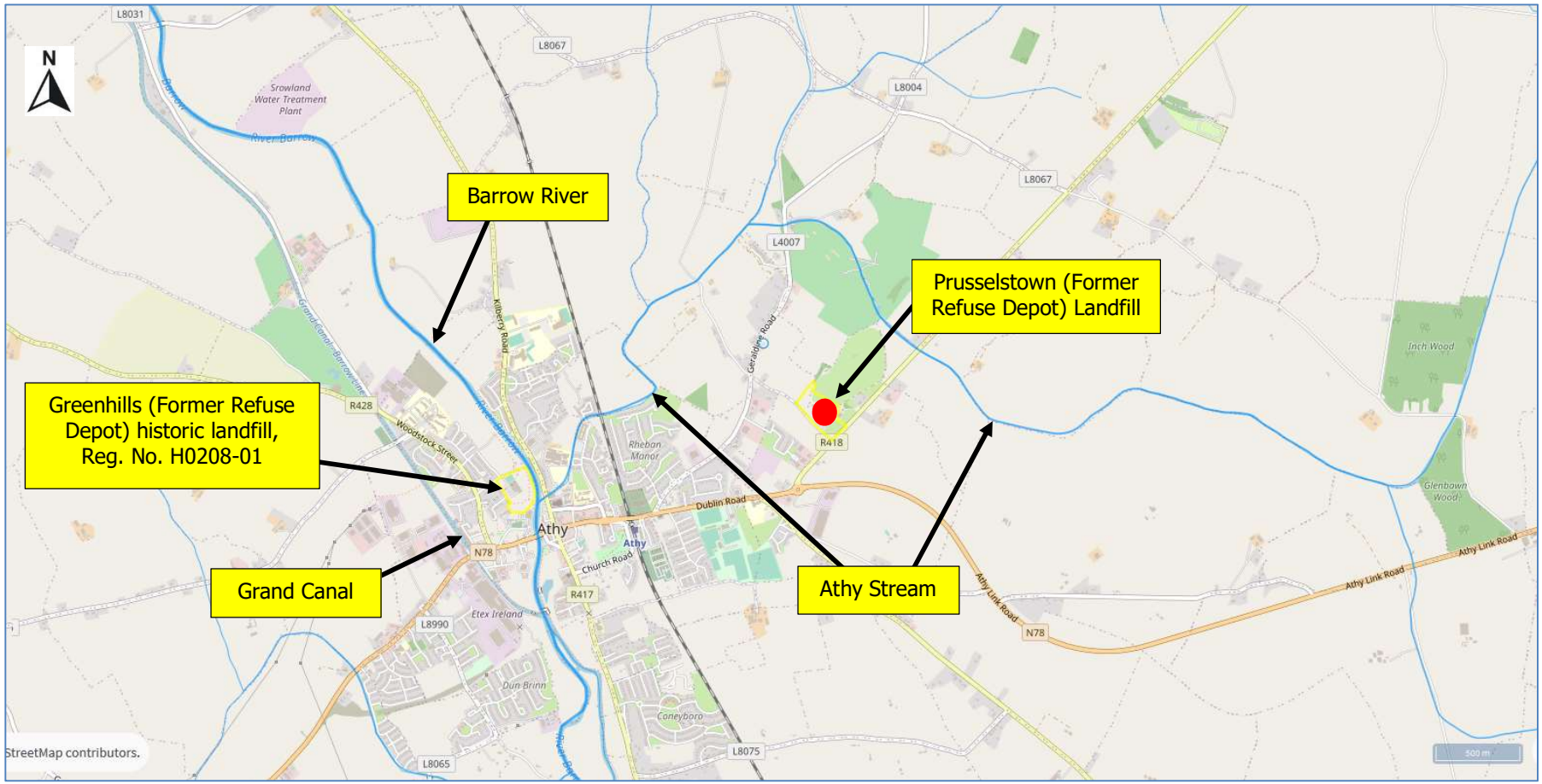

Figure 1: Location of Prusselstown (Former Refuse Depot) Landfill

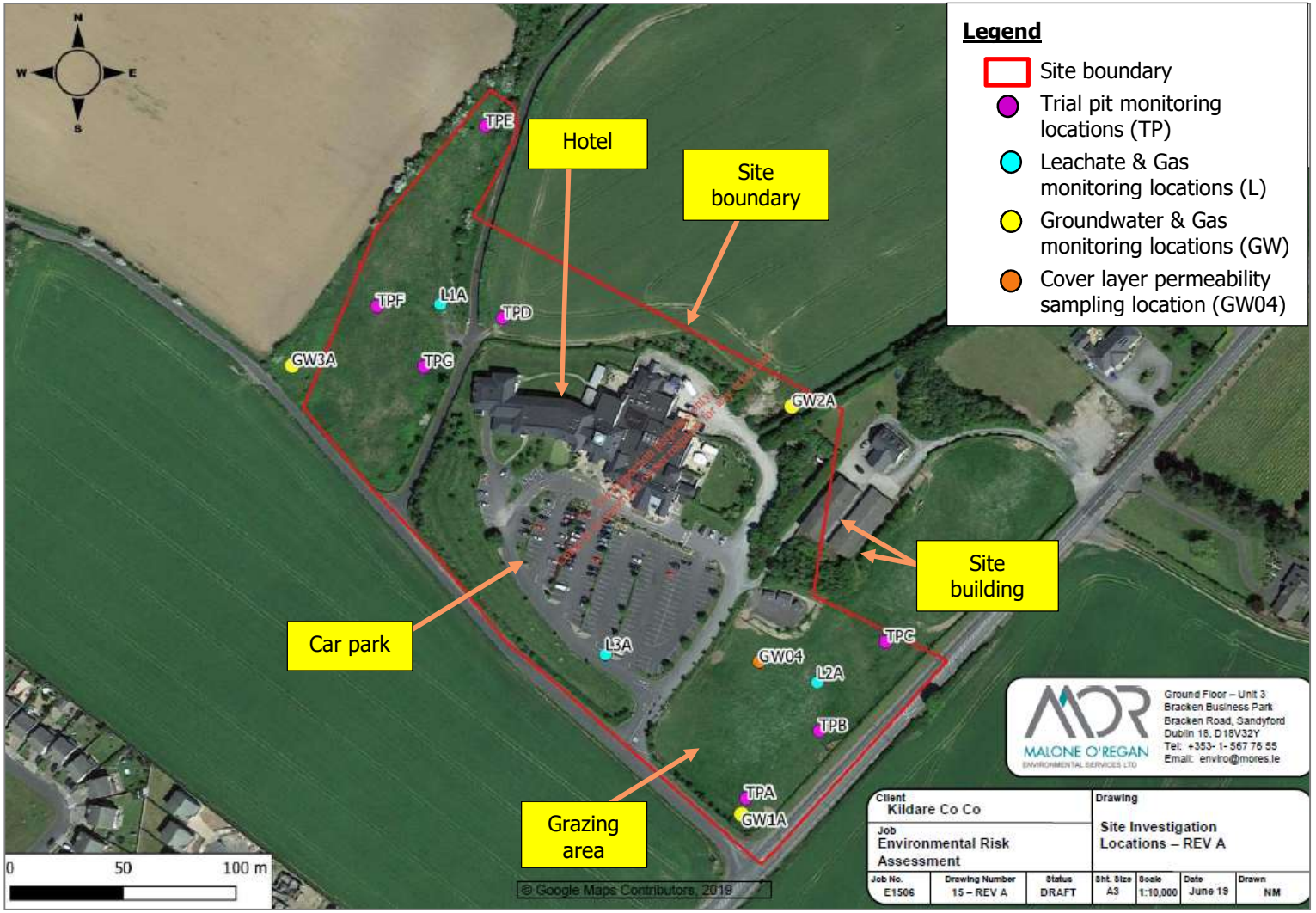

Figure 2: Site layout & surroundings and site investigation locations

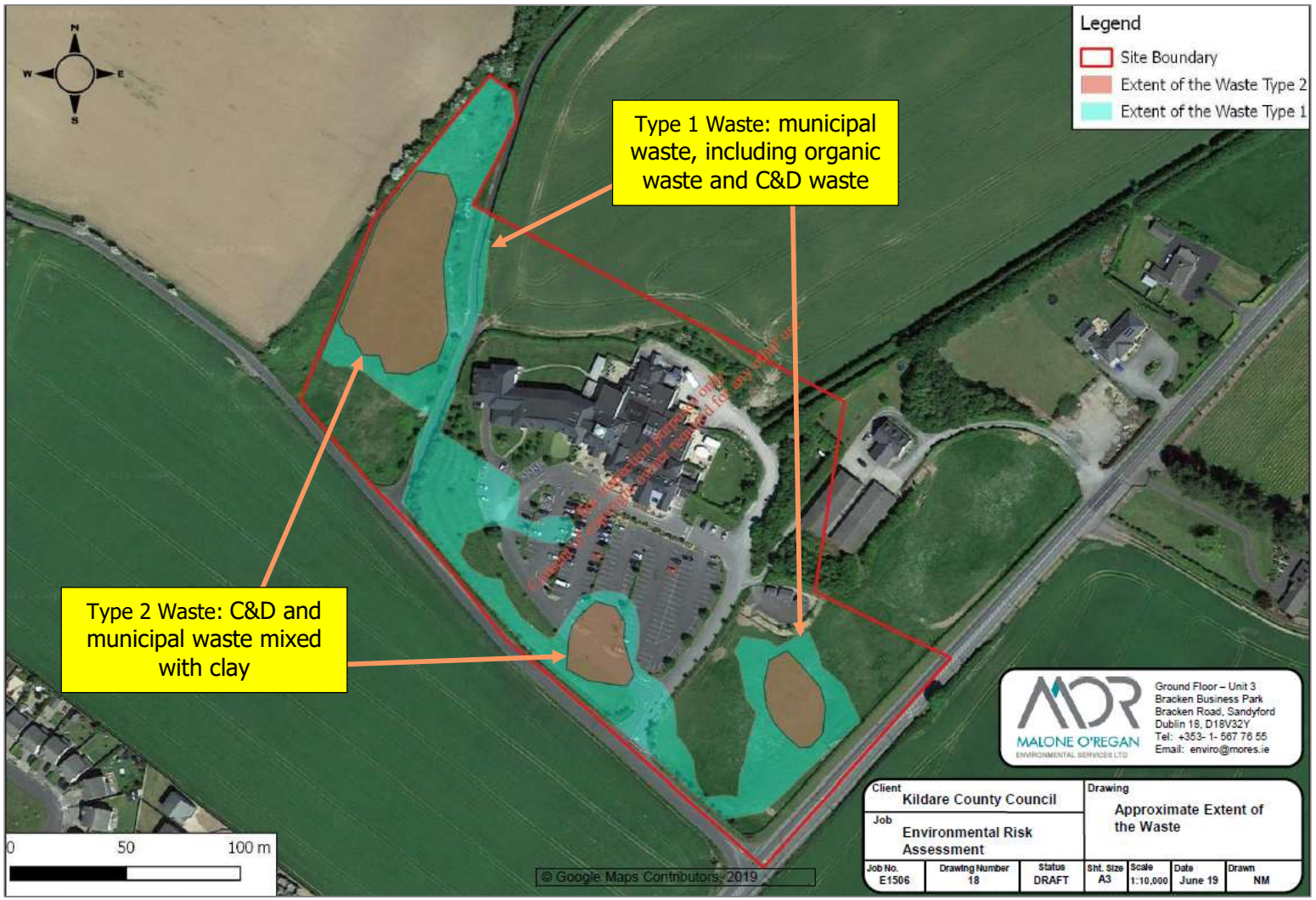

Figure 3: Approximate extent of deposited waste

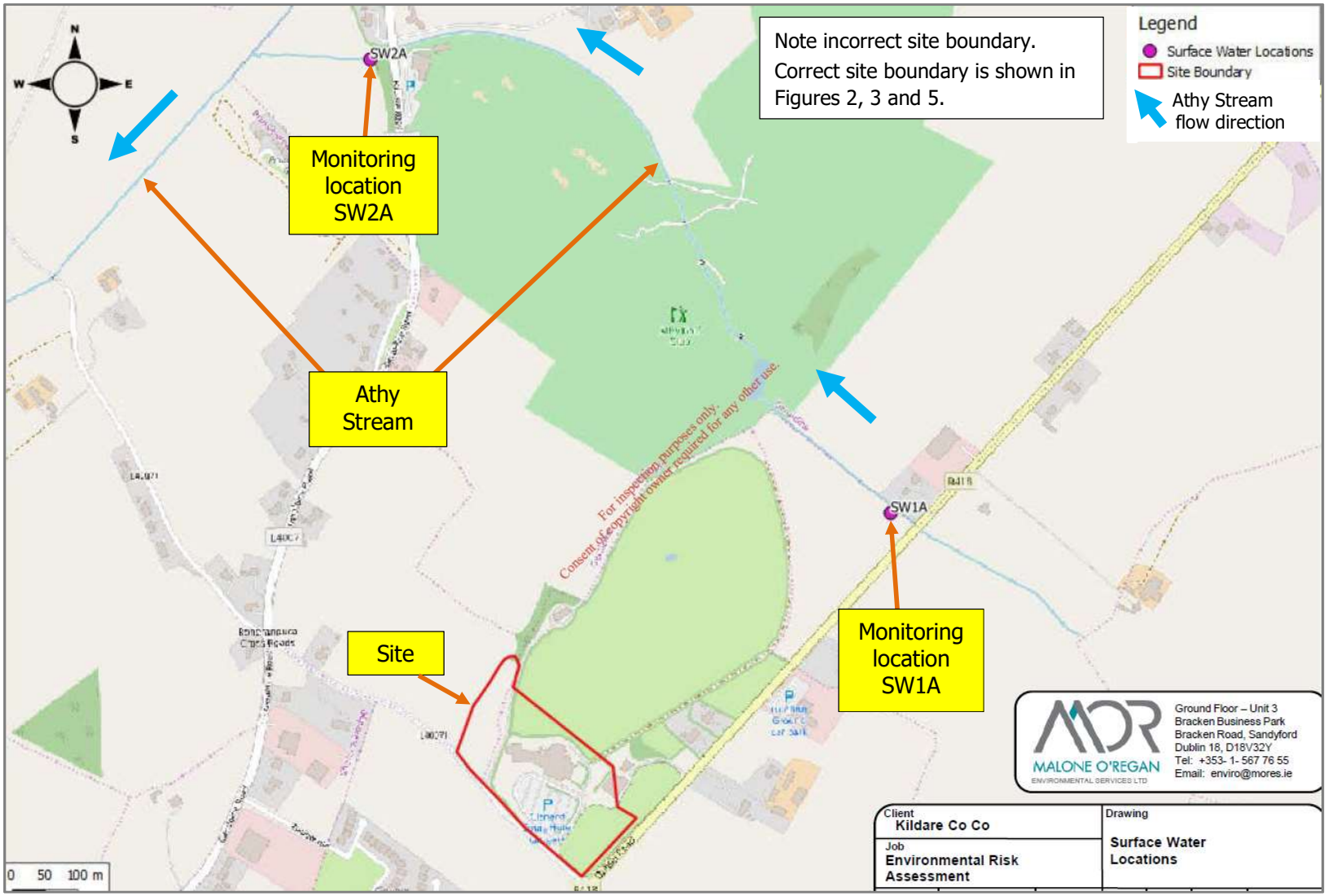

Figure 4: Surface Water Monitoring locations

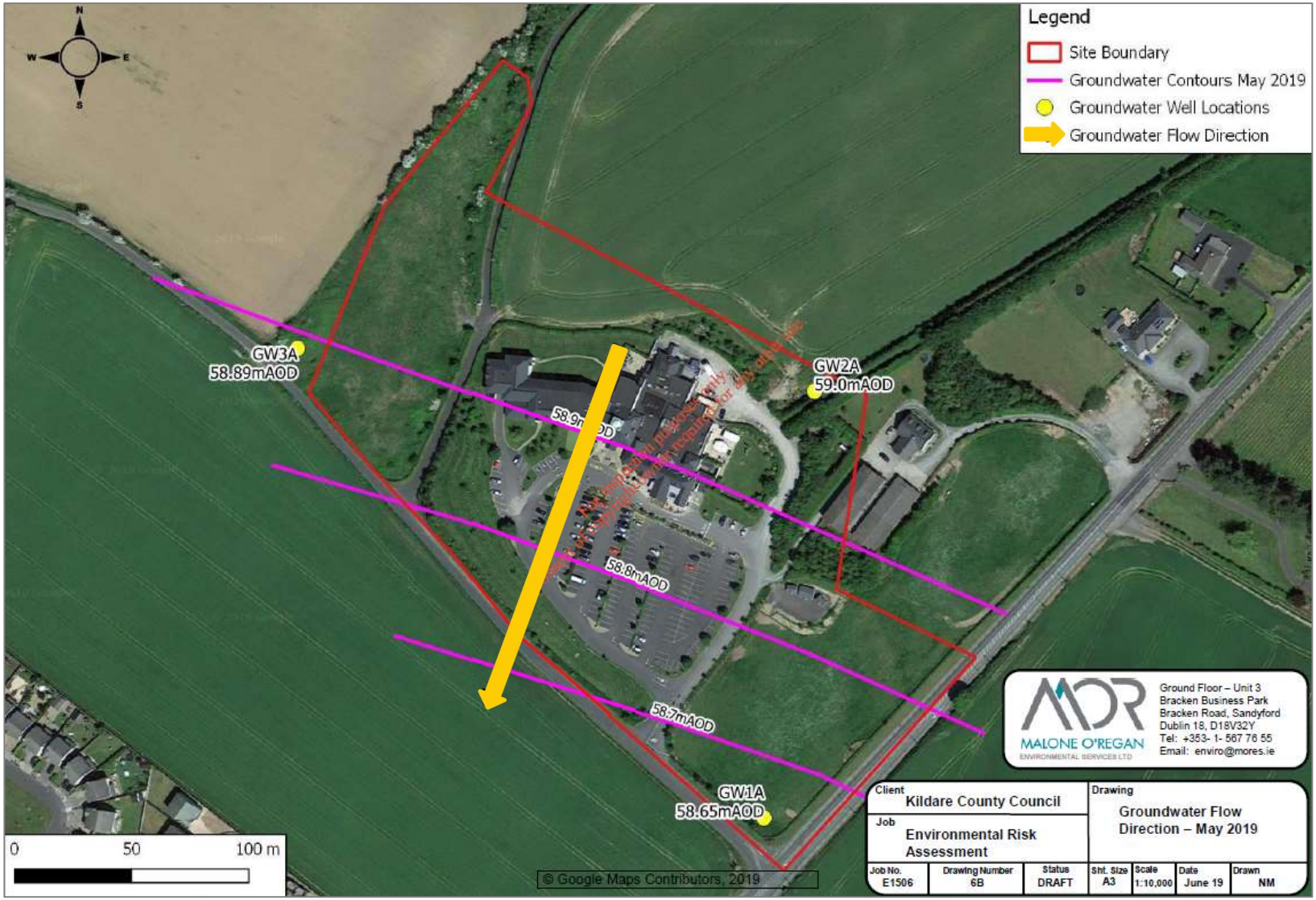

Figure 5: Groundwater flow direction

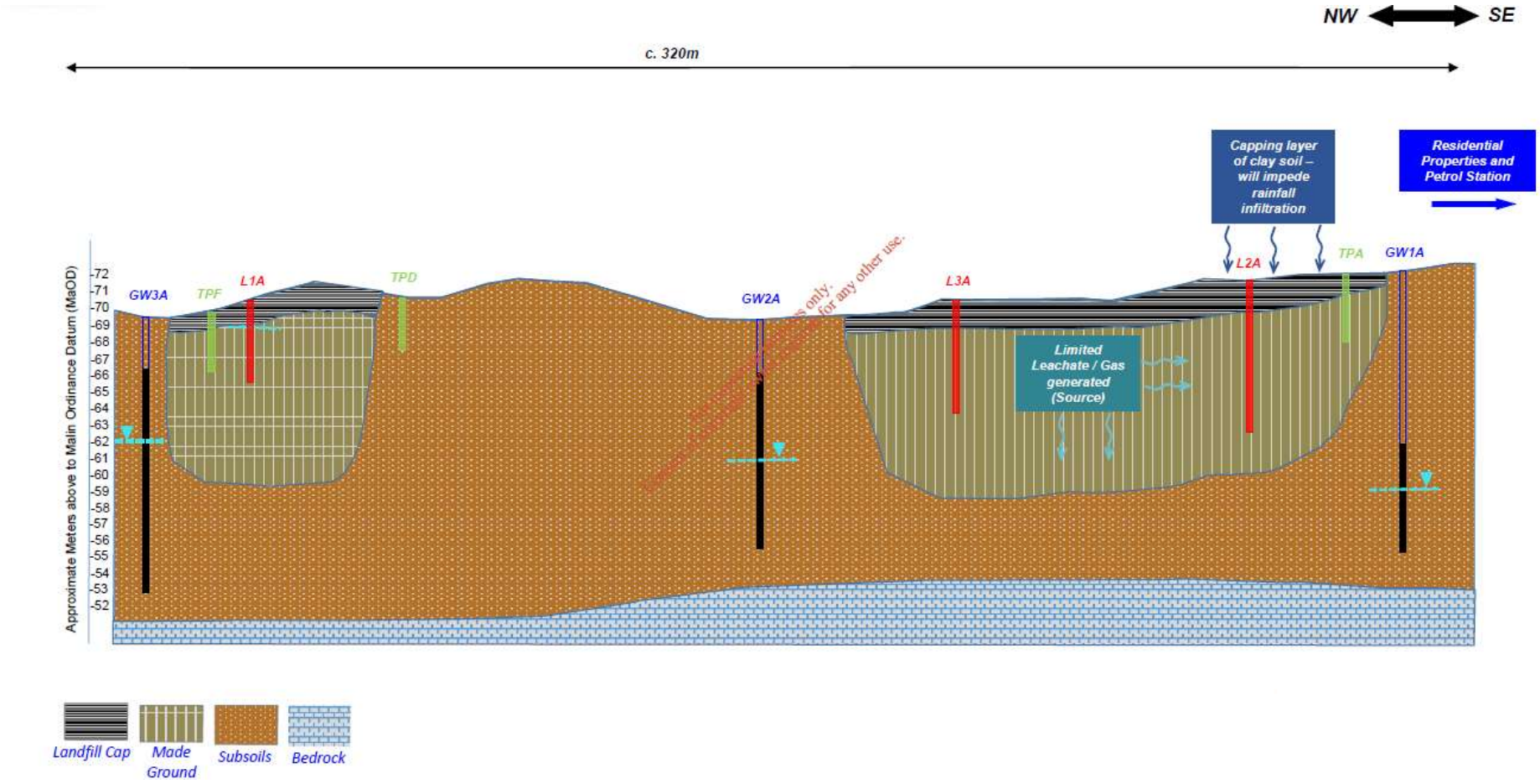

Figure 6: Conceptual site model for Prusselstown (Former Refuse Depot) Landfill

Appendix 1: Assessment of the effects of activity on European sites and proposed mitigation measures.

European Site	Distance from the facility (km)	Qualifying Interests (* denotes priority habitat)	Conservation Objectives	Assessment
River Barrow and River Nore SAC (site code: 002162)	1.6km west/ west-south from the site.	1016 Desmoulin's whorl snail *Vertigo moulinsiana* 1029 Freshwater pearl mussel *Margaritifera margaritifera* 1092 White-clawed crayfish *Austropotamobius pallipes* 1095 Sea lamprey *Petromyzon marinus* 1096 Brook lamprey *Lampetra planeri* 1099 River lamprey *Lampetra fluviatilis* 1103 Twaite shad *Alosa fallax* 1106 Atlantic salmon (*Salmo salar*) (only in fresh water) 1130 Estuaries 1140 Mudflats and sandflats not covered by seawater at low tide 1310 *Salicornia* and other annuals colonizing mud and sand 1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) 1355 Otter *Lutra lutra* 1410 Mediterranean salt meadows (*Juncetalia maritimi*)	NPWS (2011) Conservation Objectives: River Barrow and River Nore SAC [002162]. Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht [dated 19th July 2011].	<u>Emissions to Water</u> There will be no emissions from the landfill site to surface water. <u>Conclusion:</u> Condition 3.1 of the certificate of authorisation outlines the remedial actions required at the site. Condition 3.9 requires monitoring, sampling, analysis and characterisation of leachate. It also requires sampling, analysis and characterisation of groundwater upgradient and downgradient of the waste body. The controls in the recommended certificate of authorisation ensure the qualifying interests of this European site are protected. <u>Emissions to Air</u> Recommended certificate of authorisation requires installation of a landfill cap and gas venting system. <u>Conclusion:</u> The controls in the recommended certificate of authorisation ensure the qualifying interests of this European site are protected.

		1421 Killarney fern *Trichomanes speciosum* 1990 Nore freshwater pearl mussel *Margaritifera durrovensis* 3260 Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation 4030 European dry heaths 6430 Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels 7220 * Petrifying springs with tufa formation (*Cratoneurion*) 91A0 Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles 91E0 * Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)		