FEHILY TIMONEY

CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

DUBLIN AIRPORT

2021 - 2023 ENVIRONMENTAL MONITORING NON-TECHNICAL SUMMARY

Prepared for:

daa plc

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Abstract: Fehily Timoney (FT) was retained by daa plc (daa) to prepare an environmental monitoring report for the airport site. This Non-Technical Summary (NTS) has been produced following the completion of environmental monitoring within the curtilage of the airport and its environs.

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1. INTRODUCTION

1.1 Introduction

In 2021, Fehily Timoney (FT) was retained by daa plc (daa) to conduct surface water monitoring, groundwater monitoring, site investigations, and to prepare an environmental monitoring report for the Dublin Airport site. The report has been produced to interpret the results of the environmental monitoring programme conducted within the curtilage of the airport and its environs for per- and poly-fluoroalkylated substances (herein referred to as PFAS).

This report is a non-technical summary (NTS) of the environmental monitoring report.

1.2 Background

1.2.1 PFAS

PFAS are an extremely large group of long-lasting, manmade chemicals. Approximately 4,700 PFAS compounds have been identified but this may be in the millions[1]. PFAS are present in almost every country across the world in water, soil, air, plant and animal life.

PFAS have a number of physical and chemical properties including water and oil resistance, and chemical and heat stability, which made them ideal for industrial, commercial and consumer products. They have been used in many different industries, including aerospace, automotive, food processes, pharmaceutical, the manufacture of clothing, construction, household products, and firefighting since the 1950s. Some typical sources of PFAS contamination include textiles, paper and painting/printing facilities[2], oil extraction and mining facilities and facilities which produce medical devices, pharmaceuticals and pesticides[3]. PFAS chemicals can be found in many everyday products, including textiles, furniture, paints, food packaging, non-stick coatings on cookware, and polishing and cleaning agents and creams.

Historically, PFAS chemicals were used globally in firefighting foams since the initial development of aqueous film-forming foam (AFFF) materials in the mid-1960's[4]. The main function and advantage of the use of PFAS in AFFF is as an effective fire suppressant. The foams are stored and used in automated and handheld fire suppression systems, as well as in flammable vapour suppression. These types of foams were used in fire training at sites including refineries, bulk storage facilities, chemical manufacturing plants and airports. Of the thousands of PFAS compounds, two are most commonly found in AFFF. These are Perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA). Many of the PFAS substances present in AFFF dissolve easily in water and can be transported via surface water and groundwater discharges.

[1] Emma L. Schymanski, Jian Zhang, Paul A. Thiessen, Parviel Chirsir, Todor Kondic, and Evan E. Bolton. Environmental Science & Technology 2023 57 (44), 16918-16928. https://pubs.acs.org/doi/10.1021/acs.est.3c04855?ref=pdf
[2] Danish EPA, 2014, Screeningsundersøgelse af udvalgte PFAS forbindelser som jord- og grundvandsforurening i forbindelse med punktkilder, Miljøprojekt No 1600
[3] Krafft, M. P. and Riess, J. G., 2015, 'Per- and polyfluorinated substances (PFASs): Environmental challenges', Current Opinion in Colloid & Interface Science 20(3), pp. 192-212 (DOI: 10.1016/j.cocis.2015.07.004)
[4] Place, Benjamin J.; Field, Jennifer A. (3 July 2012). "Identification of Novel Fluorochemicals in Aqueous Film-Forming Foams (AFFF) Used by the US Military". Environmental Science and Technology. 46 (13): 7120–7127. doi:10.1021/es301465n. ISSN 0013-936X.

1.2.2 Emerging Pollutant on a Global Scale

PFAS chemicals are categorised as Persistent Organic Pollutants (POPs) which are organic substances that persist in the environment and can be absorbed in the body at a rate that is greater than the ability to remove the substance (bioaccumulative). PFAS are present across industrialised areas of North America, Europe and Asia[5].

In Europe it is estimated that there are potentially 100,000 sites across the continent which are contaminated with PFAS[6]. Le Monde, a French daily newspaper, along with 17 cross-border investigation partners has contributed towards The Forever Pollution Project[7]. The Project focuses on the extent of PFAS within Europe. According to the Project, in Europe there are:

- 20 PFAS producers.
- Nearly 23,000 sites across Europe with PFAS contamination.
- 232 PFAS users/industrial sites which use PFAS to manufacture products.
- Over 21,500 locations classified as "presumptive contamination sites", where there is documented historical or current activity of both using and emitting PFAS but environmental sampling has not been undertake to confirm PFAS contamination.
- Over 2,100 estimated hotspots.

The project identifies 67 locations across Ireland with either known PFAS users, or with known or presumptive PFAS contamination.

[5] Houde, M., et al., 2006, 'Biological Monitoring of Polyfluoroalkyl Substances: A Review', Environmental Science & Technology 40(11), pp. 3463-3473 (DOI: 10.1021/es052580b)
[6] Nordic Council of Ministers, 2019, The cost of inaction - A socioeconomic analysis of environmental and health impacts linked to exposure to PFAS, TemaNord No 516.
[7] The Forever Pollution Project – Journalists tracking PFAS across Europe. https://foreverpollution.eu/

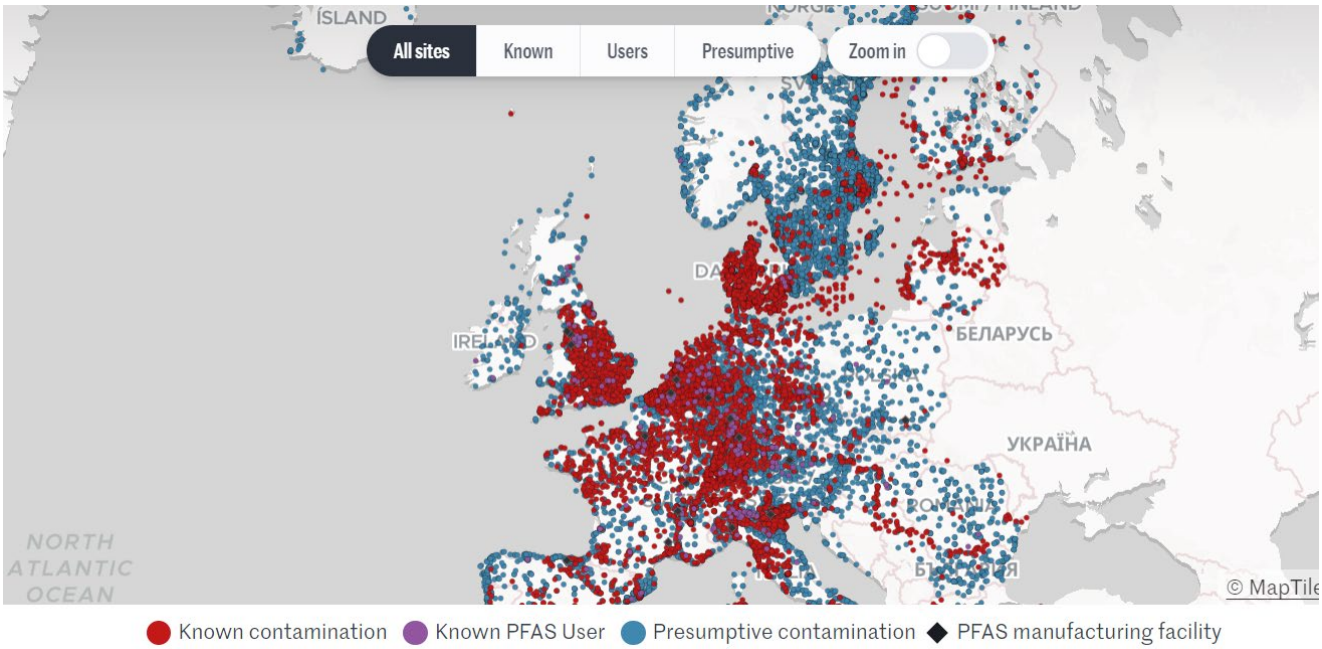

Figure 1-1: Known and Presumptive PFAS Contamination Locations in Europe Error! Bookmark not defined.

In the United States, PFAS contamination has been identified in over 5,000 sites across 50 states, the District of Columbia and four territories[8]. This includes 1,245 public water systems.

1.2.3 PFAS at Dublin Airport

In 2017, PFAS was detected at Dublin Airport during previous site investigations. In response daa commissioned an environmental monitoring programme.

In June, 2021 daa collected surface water samples from manholes, refer to Section 4.3.3.5 and Figure 4-5 of the main report. The samples confirmed PFAS was present. In August 2021, FT commenced an environmental monitoring programme. The results of the environmental monitoring between August 2021 and November 2023 (28 months) are presented and interpreted in this report.

The environmental monitoring programme consisted of:

- Groundwater and surface water monitoring within and external to the curtilage of the airport. Monitoring was undertaken at four suspected PFAS source locations within the airport namely, the North Apron, the North Runway, Castlemoate House, and current fire station and associated firefighting training ground.
- Soil and/or concrete sample collection and analysis from site investigations associated with current or planned construction projects.

The source of PFAS on site is likely from the historical use of firefighting foams. AFFF containing PFAS, which was globally used for firefighting since the mid-1960s, was used for firefighting exercises at Dublin Airport until 2013, similar to airports and other comparable sites worldwide. The Dublin Airport Fire Service ceased use of AFFF containing PFAS in 2013. Suppressants now used by the Dublin Airport Fire Service are PFAS free.

[8] https://www.ewg.org/interactive-maps/pfas_contamination/

1.2.4 Thresholds for PFAS in Groundwater, Surface Water and Soils/Concrete in Ireland

The interpretation of groundwater and surface water results within this Non-Technical Summary (Section 4) use thresholds known as Generic Assessment Criteria (GAC). The GAC represents the threshold at which PFAS concentrations are highly unlikely to cause impacts to receptors[9]. The use of GAC helps to contextualise the magnitude of the results and to screen out locations that are not elevated.

There are currently no limits for PFAS in groundwater in legislation in Ireland or Europe. In the absence of groundwater limits and in consideration of the precautionary principle[10], it is appropriate to apply drinking water limits if they exist as the GAC. Drinking water limits for PFAS will become effective in Ireland on 11 January 2026 in accordance with the European Union (Drinking Water) Regulations 2023 (S.I. No. 99 of 2023). These Regulations set out a list of 20 PFAS compounds of most concern which cumulatively have a limit of 100 nanograms per litre (ng/l). Although this drinking water limit is not effective in Ireland until 2026, this 100ng/l limit has been selected as the groundwater GAC for this report.

The Water Framework Directive (WFD) (Directive 2000/60/EC) as amended by Directive 2013/39/EC and the European Union Environmental Objectives (Surface Waters) Regulations (S.I. No. 77, as amended) include limits for Perfluorooctane sulfonic acid (PFOS) in surface water in Europe, including Ireland. PFOS is one type of PFAS. PFOS is currently the only regulated PFAS in surface water in Ireland and Europe. The limits referred to as Environmental Quality Standards (EQS) in the Surface Water Regulations are set for water to meet a 'Good' status under the WFD. In this report, the following surface water EQS is used as the GAC:

- 0.65ηg/L PFOS Annual Average(AA)[11]
- 36,000ηg/L PFOS MAC (maximum admissible concentration[12])

There are currently no limit values present for PFAS in soil or concrete in Ireland, therefore soil/concrete GAC were not used in this case. In this report, PFAS in soils/concrete is reported as detected or not detected, i.e. above or below the laboratory Limit of Detection (LOD).

1.3 Purpose of Report

The purpose of this report is to provide a summary in non-technical language of the key findings of the 2021 - 2023 Environmental Monitoring report completed by FT on behalf of daa. The 2021 - 2023 Environmental Monitoring report interprets environmental monitoring completed for PFAS during the period of June 2021 to November 2023 and provide recommendations based on the findings.

[9] EPA. 2013. Guidance On The Management Of Contaminated Land And Groundwater At EPA Licensed Sites.

[10] "The "precautionary principle" is a risk assessment strategy which supports taking "protective actions" before there is complete scientific proof of a genuine risk". Science Direct, https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/precautionary-principle

[11] The AA-EQS of 0.65 ng/L is based on the potential for secondary poisoning in humans due to fish consumption. It is a guideline limit and defined as "the level at which no harmful effects are expected, based on annual average concentrations". The limit is often criticized for being very low. Several researchers across the EU (e.g., Cousins et al, 2022; Ahrens 2013; MacLachlan et al 2007) have noted that concentrations of PFOS in freshwaters regularly exceed the EQS, even in rainwater in urban environments.

[12] The maximum for any single measurement, i.e. peak concentration.

2. HISTORICAL USE AND STORAGE OF PFAS AT DUBLIN AIRPORT

2.1 Introduction

This section describes historic, current and future operations at Dublin Airport where the historic use of PFAS containing products may have environment effects within or external to the airport site boundary, and/or affect future development within the airport campus.

Known locations of historical use of PFAS containing products and/or storage of PFAS chemicals are outlined in Section 2.2. These locations have been identified as some of the potential sources of PFAS in groundwater and surface water within the airport campus, based on a review of available information at this time.

2.2 Historic Site Operations

In 1940, airfield operations commenced with the development of Dublin Airport. The airport has developed terminals, runways, taxiways, hangars and support infrastructure during its lifetime. The former fire station, as detailed in the following section, was developed to provide firefighting services to the airport.

2.2.1 Former Fire Station within the North Apron

The original fire station (herein referred to as the Former Fire Station) likely operated from the opening of Dublin Airport in 1940. Operations at the Former Fire Station ceased c. 2000. This fire station was located within the North Apron. It is understood PFAS containing AFFF may have been stored at the original fire station. PFAS may have been historically released to ground during fire training or fire suppression activities. The location of the North Apron and Former Fire Station is shown on Figure 2-1.

2.2.2 East Area of North Apron

Environmental monitoring undertaken by FT during the monitoring programme indicates there is a potential second source of PFAS within the eastern area of the North Apron.

2.2.3 North Runway Development /Former Firefighting Training Ground – APEC 5

The original firefighting training ground (FFTG) site, also referred to as APEC 5 likely operated from the opening of Dublin Airport until ceasing use in c. 2000. In 2017, PFAS was identified at this location during the North Runway Development. Following the cessation of firefighting training at APEC 5 no other activity prior to the construction of the North Runway Development was undertaken at this location. The location of the North Runway Development and APEC 5 are shown on Figure 2-1.

2.2.4 Castlemoate House – Historic Unregulated Waste Disposal Site

Environmental monitoring identified PFAS in groundwater at a historic unregulated waste disposal site at Castlemoate House. PFAS is commonly present in unregulated waste disposal leachate in Ireland[13].

in 2008, buried material comprising of a mix of historical general waste and historical aircraft catering waste[14] was encountered during site works. The Regulators, consisting of Fingal County Council, Environmental Protection Agency and Dept of Agriculture were notified. Intrusive investigations were undertaken in consultation with Fingal County Council as the lead Regulator. It was estimated the waste was emplaced at the site between 1975 and 1984. No waste has been buried at the site since the mid-1980's.

An environmental risk assessment undertaken by RPS[14] determined there was a low to moderate[15] risk to groundwater quality from ammonia in leachate. In consultation with Fingal County Council, it was recommended to undertake a groundwater monitoring programme to monitor groundwater quality. daa continue to undertake groundwater monitoring twice yearly.

The location of Castlemoate House is shown on Figure 2-1.

2.3 Current Site Operations

2.3.1 Current Fire Station and FFTG

daa developed the current fire station and an engineered FFTG in the early 2000's at a new location within the airport complex. It is located adjacent to the West Apron and south of the Control Tower Building. As AFFF was used at this location it is a potential source of PFAS. Tanks where AFFF was stored may contain residual PFAS.. The location of the Current Fire Station and FFTG is shown on Figure 2-1.

2.4 Future Site Operations

Where present within future site developments at Dublin Airport, PFAS containing soils and water will require management during the construction and operational phases. This may include on site management, remediation or removal to an approved facility.

FT recommended site investigations undertaken for the below projects include for the sampling of PFAS in soils to identify if PFAS was present. In the event PFAS is identified, the design options for those developments must consider the presence of PFAS and that management techniques/remediation measures are integral to the design. Results of these site investigations are discussed in Section 4.4.1.

[13] https://www.epa.ie/publications/research/environment--health/Research_Report_345.pdf
[14] RPS. 2010. Investigation at Unregulated Waste Disposal Site at Castlemoate House Dublin Airport.
[15] As defined in EPA. 2007. Code of Practice Environmental Risk Assessment for Unregulated Waste Disposal Sites.

2.4.1 Proposed Apron 5H Development Area

Due to the historic placement of soils and concrete generated from across the airport and the presence of PFAS in surface and sub-surface soils, the proposed Apron 5H Development Area has been identified as a source of PFAS. In the Source-Pathway-Receptor (SPR) model used for contaminated site assessments, the source is defined as the location of a contaminant, i.e. in this instance PFAS in soils/concrete within Apron 5H. The location of the proposed Apron 5H Development Area is shown on Figure 2-1. Works are currently underway at this site.

2.4.2 Departures Road Project

At the time of the investigations, the proposed Departures Road upgrade works included signage, road upgrades and EV charging points to facilitate the continued passenger growth through the airport. The location of the Departures Road Project is shown on Figure 2-1. We understand this project is not proceeding at present.

2.4.3 West Apron Underpass Project

daa have applied for planning permission to develop the West Apron Underpass Project. The project will consist of a 1.1km subterranean tunnel under the airport's crosswind runway to enable airport vehicles to shuttle between the eastern and western campus following the commencement of operations at the North Runway. The location of the West Apron Underpass Project is shown on Figure 2-1. An appeal to the planning permission was made to An Bord Pleanála and a decision is currently awaited.

2.4.4 North Apron South Apron Hub

The North Apron South Apron Hub (NASAH) Project comprises a series of transformation projects at both the North Apron and South Apron to facilitate operational efficiency improvements and capacity enhancement at Dublin Airport. The locations of the NASAH Project is shown on Figure 2-1.

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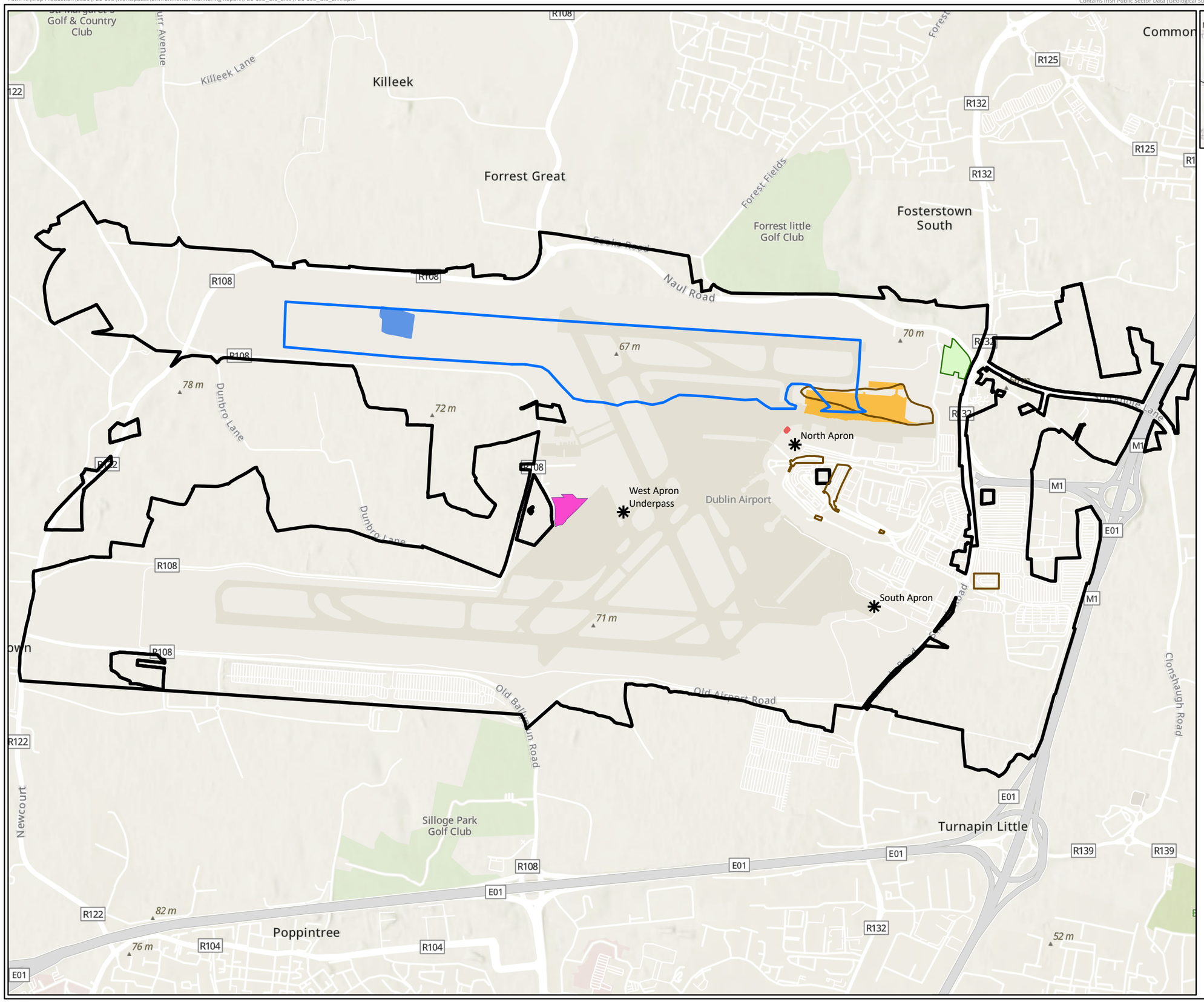

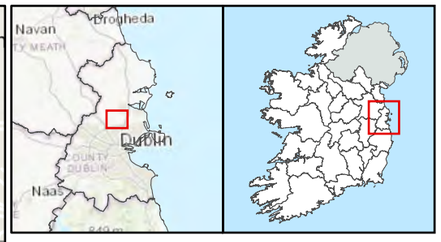

Legend

- Apron Locations
- Dublin Airport Boundary
- North Runway
- Departures Road Project
- Castlemoate House Boundary
- Proposed Apron 5H Development Area
- Current Fire Station & FFTG
- Former Fire Station
- APEC5 – Former Fire Fighting Training Ground

N W E S

0 0.25 0.5 1 Kilometers

TITLE:	Site Layout		
PROJECT:	Environmental Monitoring Report		
FIGURE NO:	2.1		
CLIENT:	daa		
SCALE:	1:20,000	**REVISION:**	0
DATE:	26/02/2024	**PAGE SIZE:**	A3

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3. ENVIRONMENTAL CHARACTERISTICS WITHIN AND EXTERNAL TO DUBLIN AIRPORT

This section describes the site setting of the environmental monitoring programme study area including its location, the regional geology, hydrogeology and hydrology.

3.1 Site Location

Dublin Airport campus is located approximately 7km north of Dublin City centre, between the M50, M1 and M2 roads. The airport complex is located within 19 townlands, namely Kingstown, Barberstown, Forrest Great, Forrest Little, Cloghran, Millhead, Sandyhill, Dunbro, Pickardstown, Shanganhill, Harristown, Portmellick, Coultry, Ballymun, Hunstowns, Collinstown, Rock, Corballis and Commons.

The airport complex is located at an elevation of between approximately 55m OD and 80m OD, orientating in a west to east direction. On a regional scale, elevation generally decreases to the east towards the Irish Sea and south towards the River Liffey. There are numerous streams, rivers and artificial land drains at and surrounding Dublin Airport.

Outside of Dublin Airport, the predominant land use in the area is agricultural, with pastures and arable land being the primary land uses in the region according to the COPERNICUS pan-European (Corine) 2018 landcover mapping.

Dublin Airport is served by a mains water supply from Uisce Eireann, which provides drinking water for the campus. A groundwater abstraction well, referred to as Gardener's Well is located at Corballis Avenue and is used only for watering plants and flowers, not for human consumption.

3.2 Hydrogeology

Dublin Airport is located within three groundwater bodies (GWBs); Swords, Dublin and Industrial Facility (P0480-02). The Geological Survey of Ireland (GSI) describe all three GWBs as poorly productive bedrock aquifers., These aquifers do not provide suitable volumes of groundwater for abstraction from wells for domestic or agricultural use, with alternative sources often required. Regional groundwater flow is expected to be generally towards the coast (east) and overlying rivers, including the River Liffey. However, groundwater flows may vary on a localised scale.

Based on GSI classifications it is expected that subsoil thickness, and depth to groundwater at the airport will vary from 0m to 10m in the northern and western airport extents to greater than 10m in the southern extent.

3.3 Hydrology

Dublin Airport is located within two catchments, the Nanny-Delvin (northwest portion) and Liffey and Dublin Bay catchment (southeast portion). All surface waters within the Nanny-Delvin will flow into the Broadmeadow Estuary, Malahide Bay and Irish Sea.

All surface waters within the Liffey and Dublin Bay catchment will flow into the North Bull Island Estuary before entering the Irish Sea.

3.4 Geology

The soil type at Dublin Airport and in the region is predominately classified by the GSI as being till derived from limestones. Pockets of gravels derived from limestones and bedrock outcrop are present throughout the region, with alluvium present along the vicinity of rivers and streams.

The GSI 1:100,000 scale bedrock geology map shows Dublin Airport and surrounding lands of the airport are underlain by carboniferous limestone consisting of the following four formations, from oldest to youngest:

- Malahide Formation
- Waulsortian Limestones
- Tober Colleen Formation
- Lucan Formation

There are several bedrock structural faults and small pockets of bedrock outcrop located within the airport.

4. ENVIRONMENTAL MONITORING PROGRAMME, SITE INVESTIGATIONS AND RESULTS

4.1 Introduction

The following environmental monitoring activities were undertaken during the programme:

a) Groundwater sampling of monitoring boreholes, groundwater reservoir and supply well.
b) Surface water sampling of surface water bodies, manholes and drains.

Soil and/or concrete sampling during site investigations were completed at:

- Dublin Airport Departures Road Project
- West Apron Underpass Project
- Proposed Apron 5H Development
- North Apron South Apron Hub (NASAH)

The results identify where PFAS has been recorded as present within the airport complex and its environs.

4.2 Groundwater Monitoring

16 groundwater monitoring wells, a water supply well and an offsite reservoir location were included as part of the monitoring programme to determine if PFAS was present in groundwater. Groundwater monitoring was undertaken at the following locations:

- North Apron – 9 groundwater monitoring wells
- Castlemoate House (Historic Unregulated Waste Disposal Site) - 7 groundwater monitoring wells
- Reservoir (Offsite Reservoir) - 1 location.
- Water supply well (Gardener's Well) – 1 well

Gardener's Well is used by daa for the purposes of watering plants and flowers. Water abstracted from the supply well is not used for human consumption.

The private Offsite Reservoir is used for the abstraction of groundwater, therefore, this location was included as part of the groundwater monitoring programme. The results of this programme have been shared with the owners.

Sampling was undertaken in accordance with a methodology developed by FT for PFAS in groundwater.

4.2.1 Results

In the absence of a legal limit, the threshold of 100ng/L for Sum of 20 PFAS is used as the groundwater GAC for this report.

4.2.1.1 North Apron

A number of groundwater monitoring locations are installed as part of groundwater monitoring requirements under IE Licence reg. no. P0480-02 issued by the Environmental Protection Agency (EPA). These locations were monitored by FT, separate to the requirements of the IE Licence, to confirm if PFAS is present in groundwater at the North Apron.

Monitoring results indicate there are two potential sources of PFAS within the North Apron; the Former Fire Station and within the eastern area of the North Apron.

The highest Sum of 20 PFAS concentrations in groundwater at the North Apron is within the eastern area of the North Apron. During the monitoring period, Sum of 20 PFAS concentrations in groundwater ranged between 91.2ng/l to 3,180ng/l, with an average of 766ng/l.

The next highest Sum of 20 PFAS concentrations in groundwater at the North Apron were detected within the western area adjacent to the Former Fire Station, which based on available information was a source of PFAS. During the monitoring period, Sum of 20 PFAS concentrations in groundwater ranged from below the laboratory limit of detection (LOD) of 0.65ng/l to 2,206ng/l, with a maximum average of 398ng/l. Sum of 20 PFAS concentrations in groundwater decrease with distance from the Former Fire Station.

The results indicate that PFAS has mobilised through groundwater, however due to the characteristics of the soil and bedrock which restrict the movement of that groundwater, the extent of the groundwater plumes at the Former Fire Station and in the eastern area of the North Apron are largely confined to these areas .

However, the local extent of the plumes are not confirmed. Further site investigations are required to determine the extent of the plumes. The investigations are anticipated to be undertaken in 2024.

In 2021, a CCTV survey of the storm and foul sewer lines at Hangar 2 and Hangar 3 at the North Apron were carried out. The survey identified ingress of groundwater flow through pipe defects and unsealed joints. This potentially includes groundwater passing beneath the Former Fire Station. Groundwater seepage from the Former Fire Station is entering the storm and sewer lines and is discharge to surface water external to the airport site.

In summary, trends of Sum of 20 PFAS in groundwater are relatively stable to overall decreasing in most monitoring locations across the North Apron.

4.2.1.2 North Runway/APEC 5

A network of groundwater monitoring locations was installed as part of the North Runway development. Residual PFAS in bedrock and soil remains as it was not possible to fully remove all PFAS containing material during the construction phase.

The results indicate the highest concentrations of Sum of 20 PFAS remain within the original source, i.e. within the APEC 5 boundary, with the plume primarily extending west and north. During the monitoring period, Sum of 20 PFAS concentrations in groundwater from the original source area ranged between 811ng/l to 4,111ng/l, with an average of 1,573ng/l. Sum of 20 PFAS concentrations in groundwater decrease significantly over distances of approximately 150m from the original source area, ranging from 6.0ng/l to 1,712ng/l, with an average of 527ng/l.

The lateral extent of the plume indicates it is largely confined to its source location, but additional site investigations are required to confirm extent of the plume boundary.

In general, trends of Sum of 20 PFAS in groundwater are assessed as relatively stable to overall decreasing in the majority of monitoring locations across APEC 5.

4.2.1.3 Castlemoate House (Historic Unregulated Waste Disposal Site)

In 2008, 9 groundwater monitoring boreholes were installed at Castlemoate House as part of a groundwater investigation at the historic unregulated waste disposal site. The wells monitored were selected from the outer extent of the unregulated waste disposal site to determine if PFAS was entering or exiting the site.

During the monitoring period, 69% of samples did not detect Sum of 20 PFAS. Two locations reported results above the GAC (100ng/l). During the monitoring period, Sum of 20 PFAS concentrations in groundwater ranged from below the limit of detection (LOD) (0.65ng/l) to 642ng/l. There was no exceedance of the GAC at any of the five remaining monitoring boreholes.

The average Sum of 20 PFAS groundwater concentrations in all monitoring locations were below the GAC ranging from below the laboratory LOD (0.65ng/l) to 56.2ng/l.

Based on the historic unregulated waste disposal which took place within Castlemoate House, it is considered that the presence of PFAS is likely associated with the deposition of waste materials. Concentrations of PFAS is very low in all monitoring locations for the majority of the monitoring events.

Trends in five of the seven monitoring locations show noticeable variations and fluctuations in Sum of 20 PFAS concentrations from below LOD to their maximum reported concentrations. One location, in the northwest corner of the Castlemoate House site shows an increasing trend in Sum of 20 PFAS concentrations. The reason for this increasing trend cannot be confirmed at this time, however average Sum of 20 PFAS concentrations are below the 100ng/l GAC at 56.2ng/l.

4.2.1.4 Water Supply Well and Private Offsite Reservoir

One private reservoir and onewater supply well are used for the abstraction of groundwater and were included as part of the groundwater monitoring programme. The results of the monitoring programme have been shared with the owners.

Sum of 20 PFAS concentrations in the private Offsite Reservoir has been noted at concentrations above and below the laboratory limit of detection over the course of the reporting period, with no apparent discernible trends. The maximum Sum of 20 PFAS concentration of 2.47ng/l is below the GAC (100ng/l).

Sum of 20 PFAS concentrations in Gardener's Well were below the laboratory limit of detection during the monitoring programme in 2022, the first (and only) detection was in August 2023 (3.33ng/l) but was below the GAC.

4.3 Surface Water Monitoring

Twenty-four landside and seventeen airside surface water locations were included as part of the surface water monitoring programme. The landside locations are all situated downstream of the boundary of the airport and in all orientations (i.e., north, east, south, west) surrounding the airport.

The surface water drainage system for the airport is connected by a series of manholes and discharges via oil interceptors to surface water at various outfall points around the perimeter of the site.

Sampling was undertaken in accordance with a methodology developed by FT for PFAS in surface water.

4.3.1 Results

The following surface water GAC are used:

- 0.65ηg/L PFOS Annual Average
- 36,000ηg/L PFOS MAC (maximum admissible concentration)

PFOS is one type of PFAS. In Ireland, PFOS is currently the only regulated PFAS in surface water.

The Annual Average is the maximum average concentration of PFOS at a surface water sampling location across a period of one year. The MAC is the maximum concentration for any single measurement reported at a surface water sampling location. All surface water monitoring results reported over the monitoring period were below the 36,000ng/l PFOS MAC. Therefore all surface water monitoring locations were in compliance with the MAC which is one of two GAC results are compared against. The Annual Average (AA) is discussed as the GAC in the following sections.

4.3.1.1 Landside Surface Water Monitoring

Except for three monitoring locations, PFOS was detected in each surface water monitoring location. The average PFOS concentrations in each surface water monitoring location were elevated above the GAC.

The highest average PFOS concentrations in surface waters are located to the east of the airport in the Sluice, Cuckoo Stream and Kealy's Stream. Average PFOS concentrations at these locations range from 8.1ng/l to 22.1ng/l. The highest PFOS concentration was detected on the Cuckoo Stream at 50.6ng/l (May 2023).

Monitoring results indicate PFOS concentrations are being diluted in the Sluice, with concentrations in the downstream monitoring location generally half of those reported in the upstream monitoring location. In the Cuckoo Stream, PFOS concentrations in surface water generally decrease downstream as dilution occurs, but not to a significant extent.

Tributaries of the River Ward generally contain low levels of PFOS concentrations but are elevated above the 0.65ng/l AA GAC. During the monitoring period, PFOS concentrations ranged from below the limit of detection (LOD) (0.65ng/l) to 9.6ng/l.

PFOS concentrations in the Mayne and the Santry may be from an external source to the airport. PFOS concentrations were equal or lower in upstream monitoring locations adjacent to the airport than in downstream monitoring locations:

- In the Mayne:
  - Upstream concentrations adjacent to the airport boundary - August 2023: 1.37ng/l; November 2023: <0.65ng/l
  - Downstream concentrations - August 2023: 2.2ng/l; November 2023: 0.996ng/l
- In the Santry:
  - Upstream concentrations adjacent to the airport - <0.65ng/l in August and November 2023
  - Downstream concentrations (two locations) - August 2023: 1.99ng/l and <0.65ng/l; November 2023: <0.65ng/l and 0.79ng/l

Three landside monitoring locations demonstrated an overall slight upward trend. All other surface water monitoring locations indicated stable or downward trends, or no overall discernible trends.

4.3.1.2 Airside Surface Water

PFOS concentrations were detected above the GAC during each monitoring event in most monitoring locations. The highest PFOS concentration (1,430ng/l in March 2022) was recorded in a manhole to the north of the North Apron. Based on the current understanding of the drainage network at Dublin Airport, surface water at this manhole likely drains to the Sluice.

Based on the results to date, PFOS concentrations in surface water across the airside surface water monitoring network appear to be overall steadily decreasing or remaining relatively stable. There is no increasing trend in PFOS concentrations across the monitoring period in these monitoring locations.

4.3.1.3 North Apron Manholes

The drainage system for the airport is connected by a series of manholes and discharges via oil interceptors to surface water at various outfall points around the perimeter of the site. Four manhole locations which discharge to nearby surface waters were initially selected to confirm if PFOS was present in surface water at the North Apron.

PFOS concentrations were detected in surface water above the GAC at each manhole monitoring location when monitored. During the monitoring period, concentrations of PFOS in surface water in the manhole monitoring locations ranged from 2.9ng/l to 136ng/l.

As discussed in Section 4.2.1.1 of this report, a CCTV survey of the North Apron drainage system was undertaken where MH1 – MH4 are located. The survey identified ingress of groundwater flow through pipe defects and unsealed joints indicating this as a potential source for PFAS (including PFOS) discharge into surface water. Concentrations of PFOS detected in the manhole monitoring locations are likely attributed to PFAS containing groundwater present at the North Apron where the source is indicated to be the Former Fire Station.

No discernible PFOS trends were observed within the monitoring locations.

4.3.1.4 Current Fire Station and Current Fire Fighting Training Ground (FFTG)

In 2022 three surface water locations in the area of the current fire station and FFTG were monitored. These locations were included to determine if any of the firefighting activities carried out prior to 2013 when PFAS containing foam was confirmed to be used has impacted the surface water in the area.

PFOS was reported above the GAC (0.65ng/l AA) in two of the surface water locations; the interceptor and the ACO drain. Highest PFOS concentrations (ranging between 38.5 to 116ng/l) were reported within the ACO drain. PFOS concentrations in surface water in the interceptor ranged from 12.3ng/l to 16.5ng/l.

4.3.2 EPA Monitoring of Surface Water

The EPA have undertaken surface water monitoring for PFOS and PFOA in the Ward and the Sluice at locations adjacent, upstream or downstream of FT monitoring locations.

During 2023, no elevated concentrations of PFOS above the GAC Limit Value (0.65ng/l AA) were reported by the EPA in surface water in the Ward. Maximum concentrations of PFOS reported by the EPA were 0.44ng/l and <0.65ng/l (the AA GAC). A comparison between concentrations of PFOS reported by the EPA and FT indicates there is a potential other source of PFOS downstream of Dublin Airport, noting the EPA levels of detection are lower.

During 2023, elevated concentrations of PFOS above the GAC Limit Value were reported in surface water in the Sluice. The EPA reported concentrations ranging from 7.8ng/l to 21.1ng/l. The concentrations reported by the EPA are comparable to those reported by FT.

PFOA was detected in surface water in the Ward and Sluice but there are currently no legal limits for PFOA in surface water or applicable GAC.

4.4 Site Investigations

The site investigations completed to date across the airport curtilage has been on a project-by-project basis as directed by daa. Where soil/concrete disturbance works are proposed, it is the intention of daa to determine if the soils/concrete in these areas have been impacted by PFAS because of historic operations at the site.

The following ground investigations were completed across the airport curtilage as part of the environmental monitoring programme.

- Dublin Airport Departures Road Project;
- West Apron Underpass Project; and
- Proposed Apron 5H Development.
- North Apron South Apron Hub (NASAH)

Sampling was undertaken in accordance with a methodology developed by FT for PFAS in soils/concrete.

4.4.1 Results

There are currently no limit values present for PFAS in soil/concrete in Ireland, therefore soil/concrete GAC were not used. In this report, PFAS in soils/concrete is reported as detected or not detected.

4.4.1.1 Departures Road Project

Two slit trench locations, determined by daa, were excavated and sampled for PFAS in soil. PFAS was not detected in soil within either slit trench.

4.4.1.2 West Apron Underpass

Soil samples were collected from nine boreholes completed as part of the West Apron Underpass. PFAS was not detected in soil within any of the nine boreholes.

4.4.1.3 Proposed Apron 5H Development Area

In 2008, soil and crushed concrete from construction projects across the airport campus was placed in the Proposed Apron 5H Development area. This stockpiling activity created a land raise of approximately 2m above the natural ground level. An intrusive ground investigation within the proposed Apron 5H development area was undertaken. Made Ground consisting of topsoil, reworked clay and gravels with concrete intermixed with construction and demolition (C&D) waste was observed to a depth of 2.0m below the surface of the stockpile.

As part of the ground investigation, thirteen trial pit locations were excavated and sampled for PFAS in soil and/or concrete. The locations were determined by FT prior to works commencing.

PFAS was detected in soil/concrete across the Proposed Apron 5H Development area, with maximum reported concentrations of 141µg/kg for individual PFAS constituents.

Between October 2022 and March 2023, WSP, on behalf of SISK/LAGAN Joint Venture who are carrying out the construction of the Apron 5H works, completed site investigations in stockpiles (containing soils and concrete) and shallow soils within the Apron 5H works area to confirm the presence and distribution of PFAS[16]. Concentrations of PFOS recorded in the samples recovered during these investigations ranged from non-detectable to 568µg/kg. In August 2023, WSP undertook further testing of stockpiles, soil and concrete cover within the Apron 5H works area for potential reuse or disposal[17].

PFAS was detected in the majority of soil samples collected by WSP. The distribution of PFAS in soil across the Apron 5H works area was widespread.

4.4.1.4 North Apron South Apron Hub (NASAH)

Soil samples were collected from thirty-nine trial pits and three boreholes which were excavated across the North Apron and South Apron of the NASAH Project. Ground investigation locations were determined by daa.

PFAS in soil was detected across the North Apron. The highest reported individual PFAS concentrations (up to 113µg/kg) in soil were in locations closest to the Former Fire Station.

PFAS was not detected in soil within the South Apron.

[16] WSP Reference 40000208.R1.A0
[17] WSP Reference 40000208.L03.A0

4.5 Conceptual Site Model

A conceptual site model (CSM) is a written and/or illustrative representation of the current site conditions. The CSM for Dublin Airport uses all available information and reported results from the environmental monitoring programme and site investigations.

The CSM is used to identify all possible sources (S) of PFAS, pathways (P) to mobilise PFAS and receptors (R) as well as the processes that are likely to occur along each of the source-pathway-receptor (S-P-R) linkages and uncertainties. The CSM will be modified to continually evaluate the relationship between sources of PFAS, migration pathways, and receptors as new data become available.

4.5.1 Sources

There are six potential sources of PFAS at Dublin Airport. These include:

1. The FFTG/APEC 5. Residual PFAS remains in soil and bedrock following the construction of the North Runway.
2. The Former Fire Station within the North Apron. Groundwater monitoring and site investigations have identified PFAS in groundwater and soil. PFAS could also be present in concrete.
3. Apron 5H. Site investigations undertaken by FT and WSP confirm PFAS is present within stockpiles, concrete and made ground.
4. A second location at the North Apron separate to the area within the Former Fire Station. PFAS is present in soil and groundwater. PFAS could also be present in concrete.
5. The current fire station. PFAS is present in surface water within the drainage infrastructure.
6. Castlemoate House. Groundwater monitoring has identified PFAS in groundwater.

4.5.2 Pathways

Identified pathways across the site include:

- Vertical and horizontal migration of PFAS via groundwater. PFAS is present in groundwater at two locations within the North Apron with decreasing concentrations away from the likely sources.
- Preferential pathways within the drainage systems. Ingress of groundwater flow of the storm and foul sewer lines at Hangar 2 and Hangar 3 at the North Apron was confirmed during a CCTV survey. The drainage system conveys water away from the site and via oil interceptors to surface water at various outfall points around the perimeter of the site.
- Leaching of PFAS from soils and concrete via rainwater infiltration.
- Migration of PFAS downstream of the airport campus via surface waters. Monitoring has identified PFOS (currently the only regulated PFAS in surface water) in surface waters.

4.5.3 Receptors

The main receptors will arise from interactions with surface water, with all surface waters ultimately discharging into the Irish Sea. Potential receptors downstream of Dublin Airport include Special Areas of Conservations (SACs) and Special Protection Areas (SPAs), designated to safeguard flora and fauna in Ireland. Dilution of PFOS is occurring in surface waters downstream of Dublin Airport, however, the extent of dilution at the SACs and SPAs requires further investigating.

5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary and Conclusions

Between June 2021 and November 2023, a comprehensive environmental monitoring programme consisting of groundwater, surface water and soil sampling has been undertaken within and external to Dublin Airport.

The 2021 - 2023 Environmental Monitoring report for Dublin Airport confirms that varying concentrations of PFAS were detected in groundwater (Sum of 20 PFAS), surface water (PFOS), and soil/concrete (individual PFAS constituents), with highest groundwater concentrations detected closer to areas where PFAS firefighting foam was used historically. The highest concentrations of Sum of 20 PFAS (groundwater), PFOS (surface water) and individual PFAS constituents (soil/concrete) reported during the monitoring period are summarised below.

- Groundwater:
  - The highest Sum of 20 PFAS concentrations in groundwater were detected at the site of a former firefighting training ground, where maximum concentrations of 4,111ng/l were reported.
- Surface Water:
  - The highest PFOS concentration in surface water was detected in the Cuckoo Stream at 50.6ng/l (May 2023).
  - The highest PFOS concentration in airside surface water (1,430ng/l in March 2022) was recorded in a manhole to the north of the North Apron. The source of PFOS is indicated to be from the Former Fire Station at the North Apron.
- Soil/Concrete:
  - The highest concentrations of individual PFAS constituents in soils/concrete were 568µg/kg in Apron 5H.

5.1.1 Groundwater

PFAS is detected in groundwater within the North Apron, Castlemoate House and APEC 5 (North Runway).

Two localised groundwater sources of PFAS were detected during monitoring conducted at the North Apron, namely the Former Fire Station and in the eastern area of the North Apron. The highest Sum of 20 PFAS concentrations in groundwater were in the eastern area of the North Apron. The highest Sum of 20 PFAS concentrations in the vicinity of the Fire Station were in monitoring locations closest to the Fire Station. The results indicate PFAS has mobilised but owing to the low permeability overburden and poorly productive bedrock, the extent of the plume appears to be localised.

Historic unregulated waste disposal took place at Castlemoate House, it is considered that the presence of PFAS is likely associated with the deposition of waste materials and not related to firefighting activities. Sum of 20 PFAS concentrations are very localised in this area.

At APEC 5, results indicate the highest groundwater concentrations of Sum of 20 PFAS remain within the original source, i.e. within the APEC 5 boundary.

5.1.2 Surface Water

In 2021, a CCTV survey of the storm and foul sewer lines at Hangar 2 and Hangar 3 at the North Apron was undertaken. The survey identified ingress of groundwater flow through pipe defects and unsealed joints. Concentrations of PFOS detected in the manhole monitoring locations are likely attributed to PFAS containing groundwater present at the North Apron where the source is indicated to be the Former Fire Station.

The highest average PFOS concentrations in landside surface waters are located to the east of the airport in the Sluice, Cuckoo Stream and Kealy's Stream. Surface water in the vicinity of the North Apron is directed to the Sluice. New drainage constructed beneath the North Runway and APEC 5 also discharges to the Sluice.

Tributaries of the River Ward contain low levels of PFOS concentrations but are elevated above the GAC.

Firefighting training commenced at the current FFTG at Dublin Airport in the early 2000's. Current firefighting training practices are carried out on an impermeable concrete base surrounded by ACO open channel grating. The ACO Drain surface water monitoring location consistently recorded the highest concentrations of PFOS of the three sampling locations at the current FFTG. Surface water from the Fire Station and FFTG discharges via the Dublin Airport drainage network to the Cuckoo Stream.

5.1.3 Site Investigations

Site investigations completed as part of the Departures Road Project, West Apron Underpass and South Apron of the NASAH Project did not report any detectable concentrations of PFAS in soil.

PFAS in soil was detected across the North Apron. The highest reported PFAS concentrations in soil were in locations closest to the Former Fire Station.

The distribution of PFAS in soil across the Apron 5H works area was widespread.

5.2 Recommendations

Based on the findings of this report, it is recommended to quantify the risk from PFAS present in soil, concrete, groundwater and surface water at the airport and further investigations should be carried out having regard to the process outlined in the EPA's Guidance on the Management of Contaminated Land and Groundwater at EPA Licensed Sites. This is likely to include further site investigations to assist in the further development of the Conceptual Site Model (CSM) to assess potential source, pathway and receptor linkages, together with a Detailed Quantitative Risk Assessment (DQRA) to inform future mitigation options, if required.

It is recommended that engagement with the regulators (Fingal County Council and EPA) continues to assist in informing the scope of the further studies and investigations.

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