10th Anniversary Conference, Dublin, September 2022

IBN The Ireland Brownfield Network

Encouraging the appropriate and sustainable redevelopment of brownfield land in Ireland

Welcome


IBN
The Ireland Brownfield Network
Encouraging the appropriate and sustainable redevelopment of brownfield land in Ireland


wsp


RSK


INSTITUTE of GEOLOGISTS of IRELAND


JACKSON
REMEDIATION


ies


IGSL


SOCOTEC

House Keeping

- Fire Escapes
- Toilets
- No Smoking
- Mobile phones switched off/on silent
- Punctual
- Finish by 4:45

Welcome

- Brief introduction to the IBN
- Current committee
- What have we been up to?
- Introduction to the conference
- Agenda

Brief introduction to the IBN

Welcome

Ireland Brownfield Network

- The IBN was established in 2012 by a group of environmental professionals from both jurisdictions on the island of Ireland
- The aim of the IBN is to promote the appropriate assessment and sustainable reuse of brownfield land.
- In 2013 the committee comprised 14 members
- 146 members on LinkedIn

Welcome

Ireland Brownfield Network

- Current committee is still 14 (5 of which were on the original list)
- Current membership +600 via Linked in
- Now offering full membership +50 as full members with options to join subgroups and sit on the committee
- We are on a journey and welcome all new members….
  (Forms available at the desk)

Current IBN committee

Committee Members (2022)

IBN The Ireland Brownfield Network
Encouraging the appropriate and sustainable redevelopment of brownfield land in Ireland


Christopher Newton
(Chairperson)


Anne Marie Casey
(Membership Coordinator)


Dr. Chaosheng Zhang
(Academic Advisor)


David Kerr
(Website Coordinator)


Claire Clifford
(Technical Advisor)


Olivia Holmes
(Policy Coordinator)


Dr. Siobhan Cox
(Treasurer)


Dr. Olivia Hall
(Secretary)


Owen Williams
(Events Coordinator))


Dr. Rory Doherty


Rebekka McIlwaine


Rory Devlin


Amy Turner


Matteo Viganotti

Committee Members (2022)

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Brownfield **D**evelopment **S**ervices

AECOM

ESB NETWORKS

TETRA TECH

QUEEN'S UNIVERSITY BELFAST

Enviroguide CONSULTING

Malachy Walsh and Partners
Engineering and Environmental Consultants

ARUP

NUI Galway
OÉ Gaillimh

Committee Members

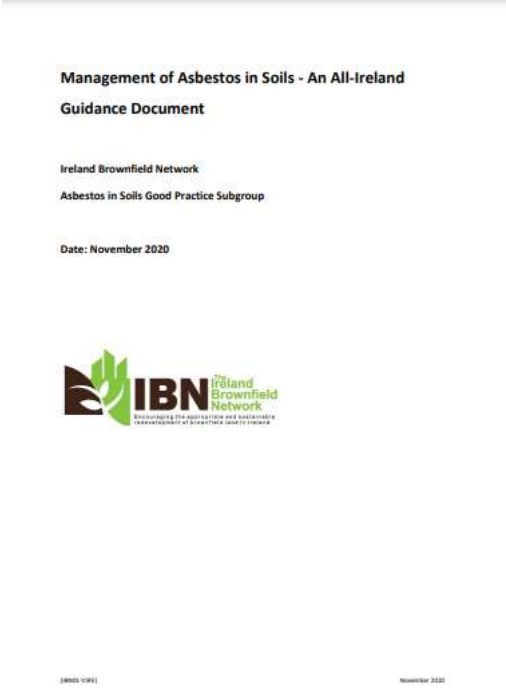
Sub-groups

- **Early Careers - (Rebekka McIlwaine)**
  - See the LinkedIn page
- **Ground Gas – (Owen Williams)**
- **Soil – (Claire Clifford)**
- **Emerging Contaminants – (Christopher Newton)**
- **Competency**
- ***… What next?***

What have we been up to?

What have we been up to?

- Organise events e.g. Soil Waste webinar (2021)
- Various consultations on numerous public documents for NI and ROI
- Asbestos signposting document



Management of Asbestos in Soils - An All-Ireland Guidance Document

Ireland Brownfield Network

Asbestos in Soils Good Practice Subgroup

Date: November 2020

What have we been up to?

- Speak at conferences e.g. Remediate 2018 and Belfast Brownfield and Contaminated Land 2019

- Publish position papers e.g. Demonstrating Competency in Contaminated Land Management


Demonstrating Competency in Contaminated Land Management
An IBN Position Statement

Ireland Brownfield Network

Professional Competency Good Practice Subgroup

Date: January 2021

Introduction to the conference

Introduction to the conference

- Soil reuse & chemistry
  - Chair – Claire Clifford

- Ground Gas
  - Chair – Owen Williams

- Emerging Contaminants
  - Chair – Amy Turner

  Intro

  Leila Bowe & Clare Crossan

Introduction to the conference

The Ireland Brownfield Network
IBN
Encouraging the appropriate and sustainable redevelopment of brownfield land in Ireland

- Sustainability, Climate Change and Carbon Counting
- Chair – Siobhan Cox




Agenda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Agenda - Morning

Time	Speaker	Title
09:00 – 09:20		Arrival, registration and networking
09:20 – 09:30	IBN Chair	Welcome address from the IBN's chair (Christopher Newton)
09:30 – 09:40	Cian O' Hora (IGI)	Introduction to the IBN's working groups
09:40 – 09:45	Claire Clifford (IBN)	Introduction to the IBN's Soil Waste working group
09:45 – 10:10	Caitríona Collins (EPA)	Update on EPA's work relating to waste soils and Article 27
10:10 – 10:40	Ray Scanlon (GSI)	Baseline Geochemical Surveys and the Tellus Programme; Applications in Practice and Policy
10:40 – **10:50**	Questions & Answers chaired by an IBN Claire Clifford	
10:50 – 11:00	Comfort Break	
11:00 – 11:05	Owen Williams (IBN)	Introduction to IBN's ground gas working group
11:05 – 11:30	Prof Quentin Crowley (TCD)	Ireland's Updated Radon Map
11:30 **– 11:50**	Sophie McDowell (QUB)	New methods for monitoring methanogenic sources of ground gas
11:50 – 12:00	Leila Bowe (Arup) and Clare Crossan (WSP)	Introduction to PFAS
12:00 – 12:30	Dr Blánaid White (DCU)	PFAS in the Irish Environment
12:30 – 13:00	Dr Luca Fagiuoli (SGS)	PFAS – Next Level Analysis: Unique Overall Concept for PFAS Research
13:00 **– 13:15**	Questions & Answers chaired by Owen Williams and Amy Turner	

Agenda - Afternoon

Time	Speaker	Title
14:15 – 14:45	Michael Goan (Land Development Agency)	The place and importance of brownfield redevelopment in sustainable cities
14:45 – 15:15	Alex Lee (WSP)	Considerations of Climate Change Impacts and Adaptation for Waste Deposit, Landfill and Land Contamination
15:15 – 15:45	Roisin Lindsay (WSP)	Guidance on Assessing Risks to Ground and Surface Waters Under Conditions of Future Climate Change
15:45 – 16:15	Robert Dadzie (Delta Simons)	Carbon Counting Tool for Brownfield Redevelopment
16:15 **– 16:30**	Questions & Answers and final summary of the day's events chaired by Who	
16:30 – later	**Networking and Social Event**	

LOCATION FOR NETWORKING EVENT

Begin…


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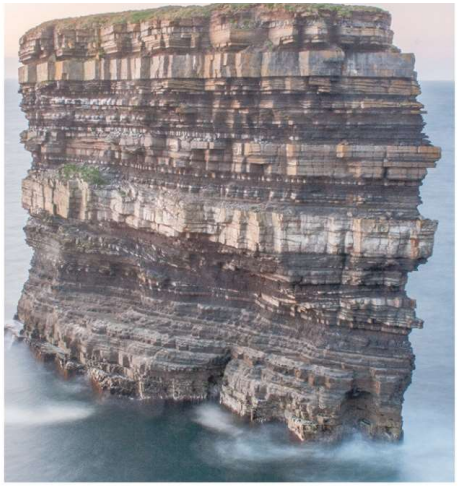
The Institute of Geologists of Ireland

EurGeol **Cian O'Hora** PGeo CSci MSc



Who are IGI?

- Established in 1999 to promote and advance geosciences in Ireland
  - Facilitate the exchange of information and ideas
- Professional titles for Geoscientists in Ireland
  - PGeo – Professional Geologist
  - EurGeol – European Geologist
- Registered Charity
  - Run by members with the aid of Executive Secretary
  - Voluntary Board with an additional c. 100 members working on other initiatives
- Committees & Working Groups
- Continual Professional Development (annual requirement)
- Articles of Association & Code of Ethics
- Sponsoring bodies – IAH, IMQS, GAI, IAEG, GeoTech EI

Our Members

- Total 360 members
  - Professional (c. 260), Members in Training (c. 70), Retired, Student and Associate
- Working across range of sectors, public and private
  - Mining & Exploration c. 30%
  - Environmental/Contaminated Land c. 20%
  - Hydrogeology c. 20%
  - Engineering Geology, Geophysics, Education, Geochemistry, GIS, Energy
- Largest professional body for scientists in Ireland

Why Join?

- Professional Title
  - Specialist Registers – Competent person with respect to EPA Code of Practice Unregulated Waste/Contaminated Land Risk Assessments
- Membership Benefits
  - Training and Courses
  - Mentoring Scheme
  - Networking
  - News & Publications (MIWG factsheets, EIAR Guidelines, Well Drilling Guidelines)
  - Representations (Consultations, Advisory Groups, IGN, HOGGs)
- Mutual Recognition Agreements
  - Six in place (USA, UK, Canada, Australia, S. Africa, Europe)
- Committees and Working Groups
  - Contaminated Land, Equity Diversity and Inclusion, Governance
  - Minerals Information, Energy, Education and Outreach

Application Pathways

- Open to All who meet acceptance criteria
- No longer obligatory – beard, glasses, socks with sandals, pure geology degree
- Qualification + Experience
- Application Form
- Sponsor Statements
  - 3 Professional Members (can be from other organisations)
- Fees
  - PGeo: Application (€50 + €35 EFG) with Annual (€175 + €38)
  - MIT: Application (€20) with Annual (€40)
  - Student: free
- Professional Interview

	Primary Degree	Masters Degree	Doctorate	Required Professional Geo-Science Experience (Years)	Comment
Geo-Science Degree	Yes	-	-	5	4 Years Primary Degree Course with >50% Geo-Science Content
Geo-Science Degree	Yes	Yes	-	4	4 Years Primary Degree Course with >50% Geo-Science Content
Geo-Science Degree	Yes	-	Yes	4	4 Years Primary Degree Course with >50% Geo-Science Content
Non Geo-Science Degree	Yes	-	-	10	
Non Geo-Science Degree	Yes	Yes	-	6	Taught Degree (Minimum Geo-Science Content >50%)
Non Geo-Science Degree	Yes	Yes	-	6	Degree by Research (Geo-Science Content >75% validated by Supervisor)
Non Geo-Science Degree	Yes	-	Yes	5	Research (Geo-Science Content >75% validated by Supervisor)
	Primary Diploma				
Geo-Science Diploma	Yes	-	-	8	3 year Course with Geo-Science Content >50% validated by Course Director

- http://igi.ie/assets/uploads/2022/02/The-Institute-of-Geologists-of-Ireland-Application-Guidelines.pdf

Thank you

Institute of Geologists of Ireland
Tel: 01 662 4914
Email: info@igi.ie
www.igi.ie

@IGI_PGeo

Soils Group

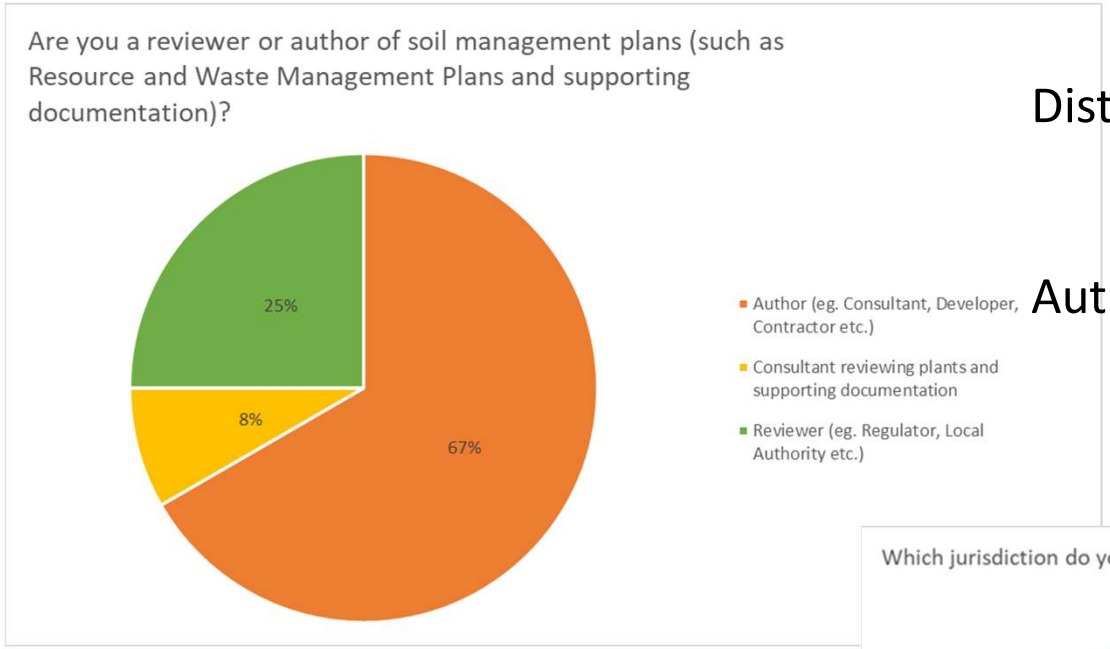
Identifying and addressing current and emerging issues in the sustainable re-use of soil.

Current Members: Owen Williams, Matteo Viganotti, Rory Devlin, Christopher Newton and Claire Clifford (Chair)

Soils Group
What have we being doing?

- Events, webinars, publications
- Current initiative: framework of signposting documents for the sustainable management of excavated soils during construction
- Consultation ongoing – have your say!

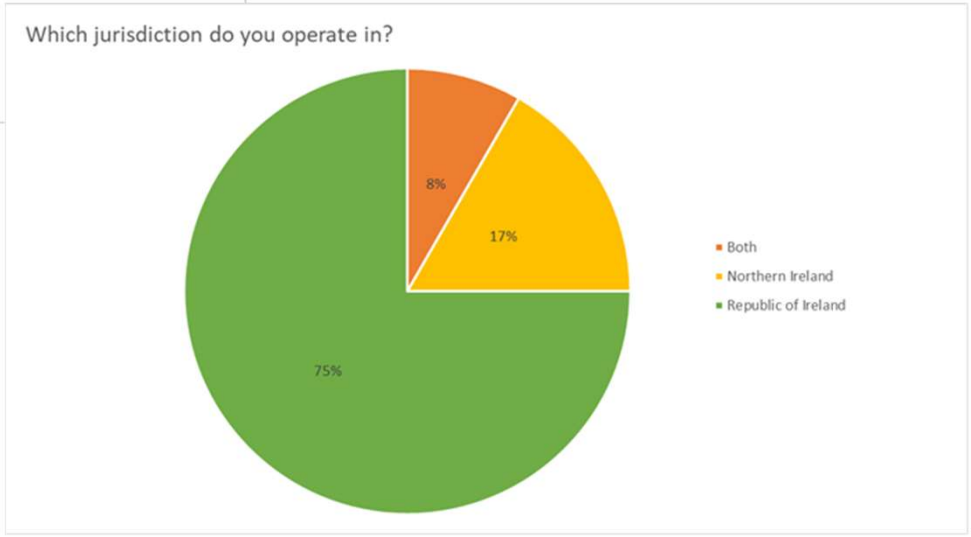
Feedback to date



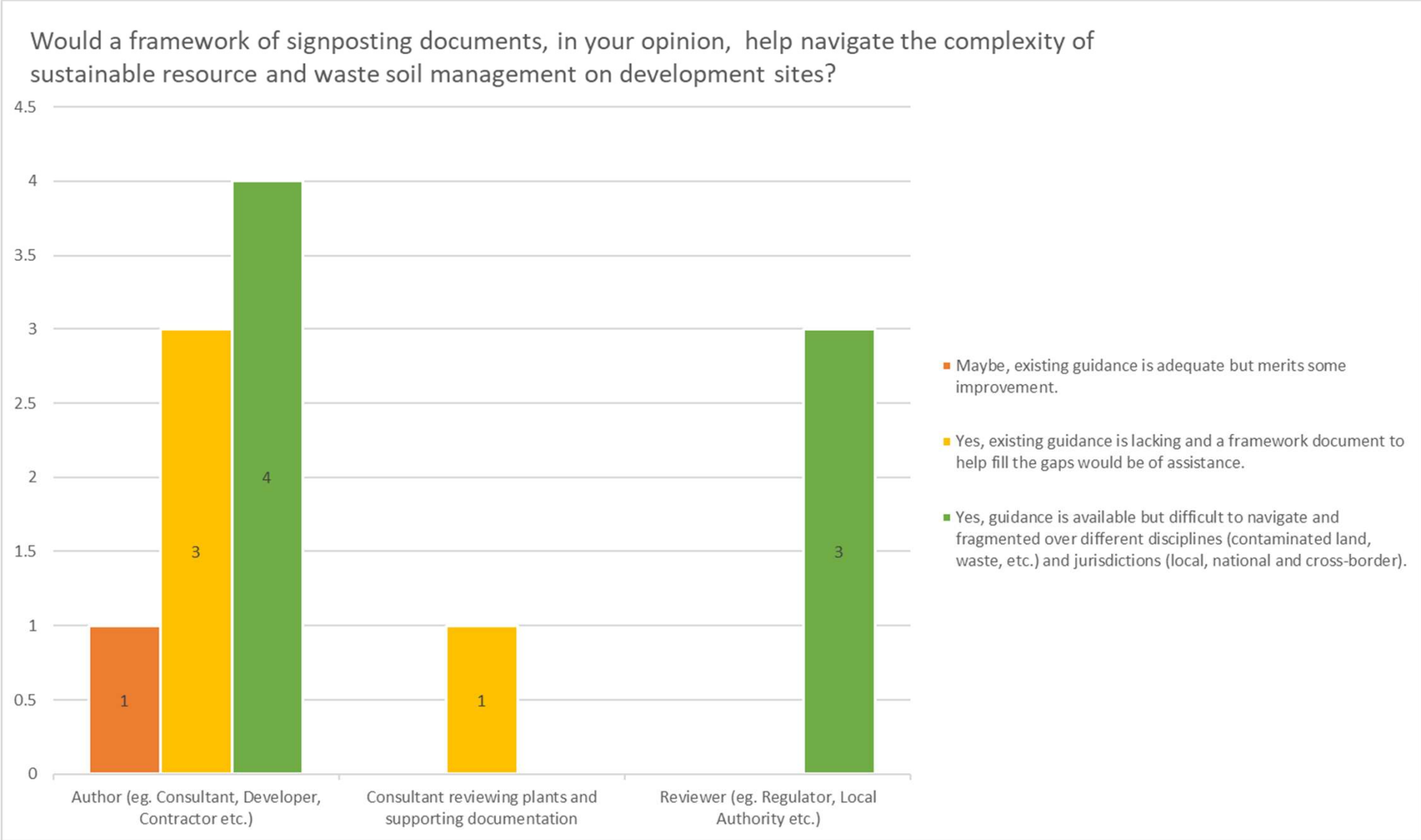
Distribution of responses

Author v Reviewer

ROI v NI



Available Guidance



Speakers

Update on EPA's work relating to waste soils and Article 27

Caitríona Collins.

Caitríona is a Senior Manager in the Environmental Protection Agency's new Circular Economy Programme with responsibility for the management of circular economy regulation.

Baseline Geochemical Surveys and the Tellus Programme

Ray Scanlon

Ray is a Principal Geologist in Geological Survey Ireland, a Division of Department of the Environment, Climate and Communications. Ray currently leads the Tellus, Minerals and Information Management Programmes in GSI.

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10th Anniversary Event
Dublin, 15th September 2022

epa Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

An EPA update on Soil and Stone By-products

15 September 2022

Caitríona Collins
Senior Manager
Circular Economy Programme

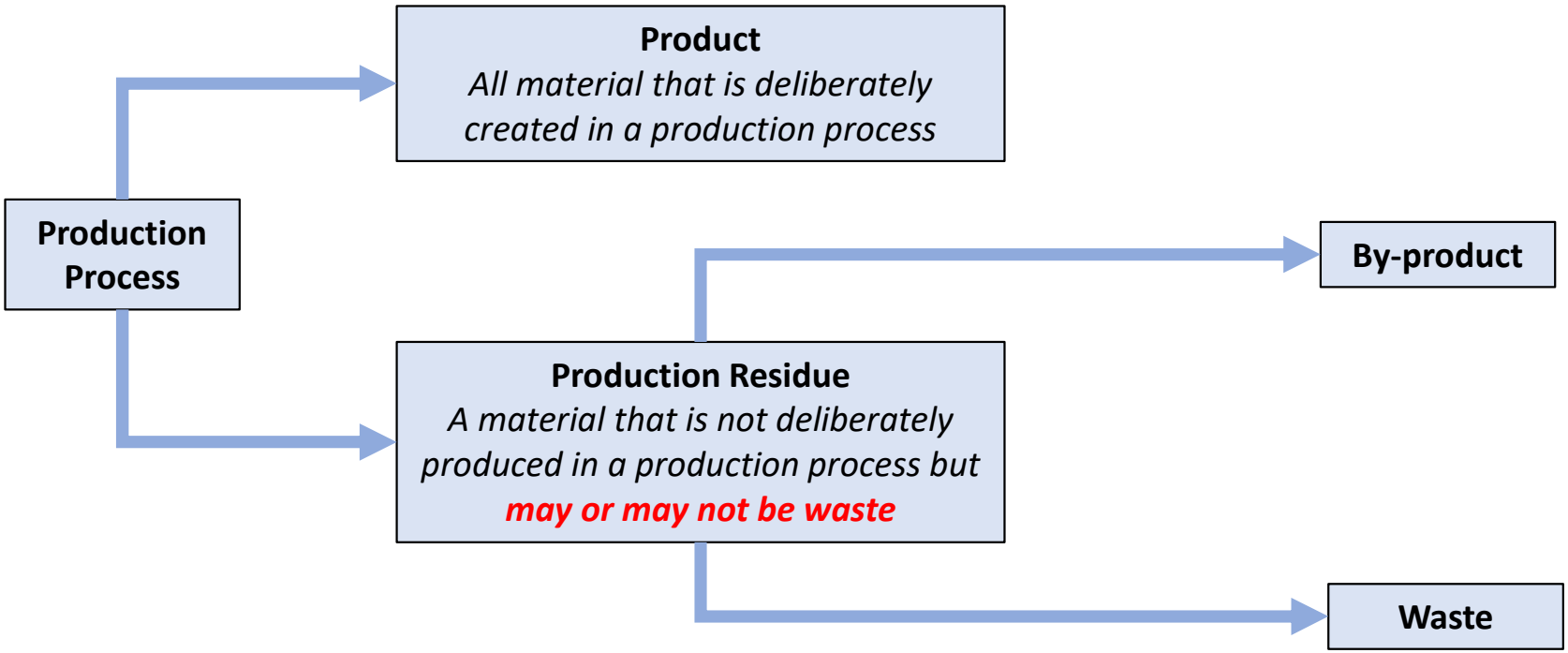
OVERVIEW

- By-product 101
- Current situation
- Progress to date
- System improvements 2022
- Strategic direction
- Next steps

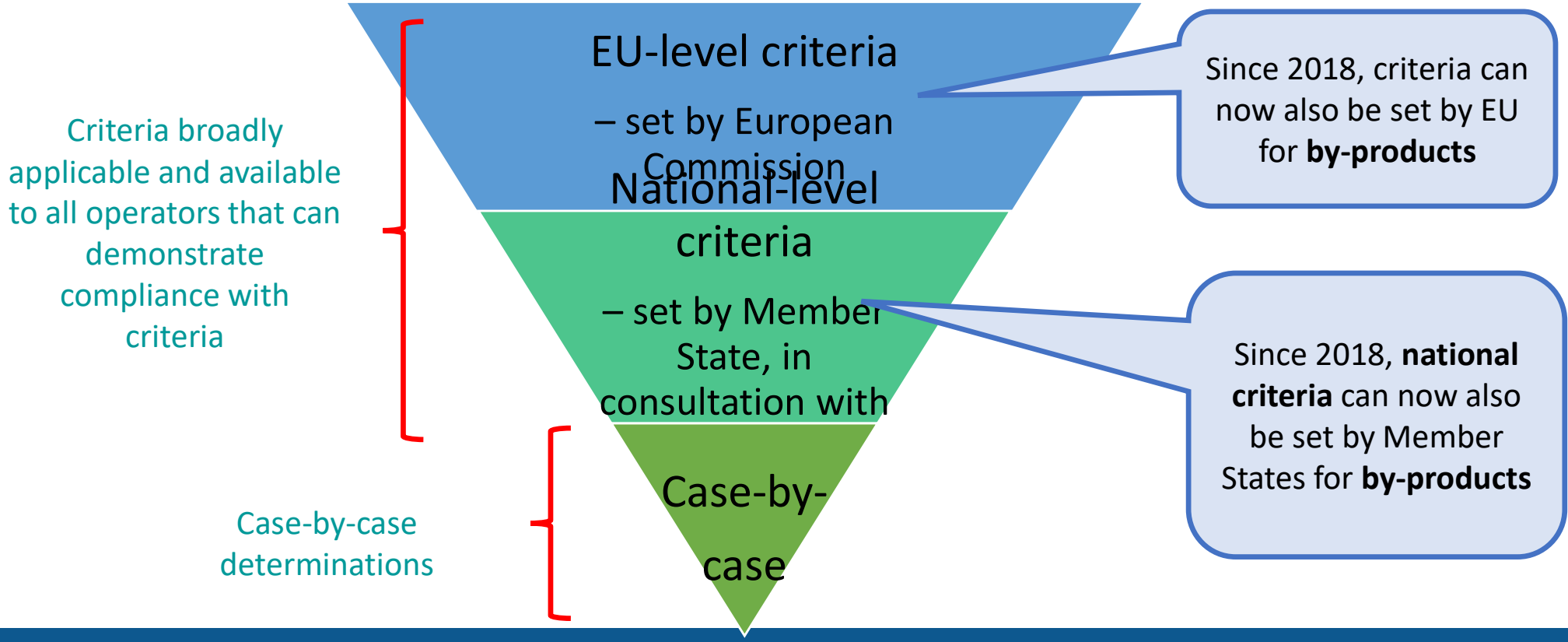
BY-PRODUCT 101

- By-product → never a waste
- Waste prevention
- Most preferable position on the Waste Hierarchy

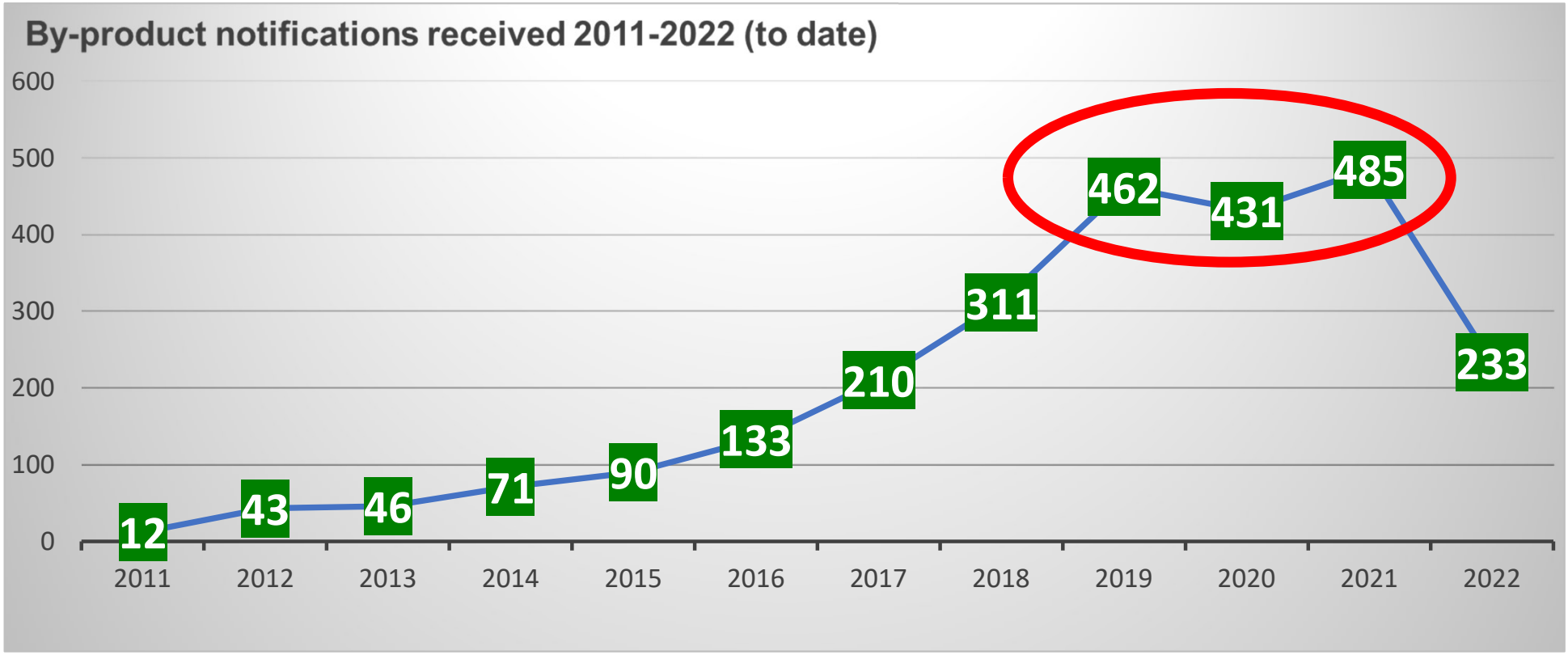
BY-PRODUCT 101



3 DECISION LEVELS

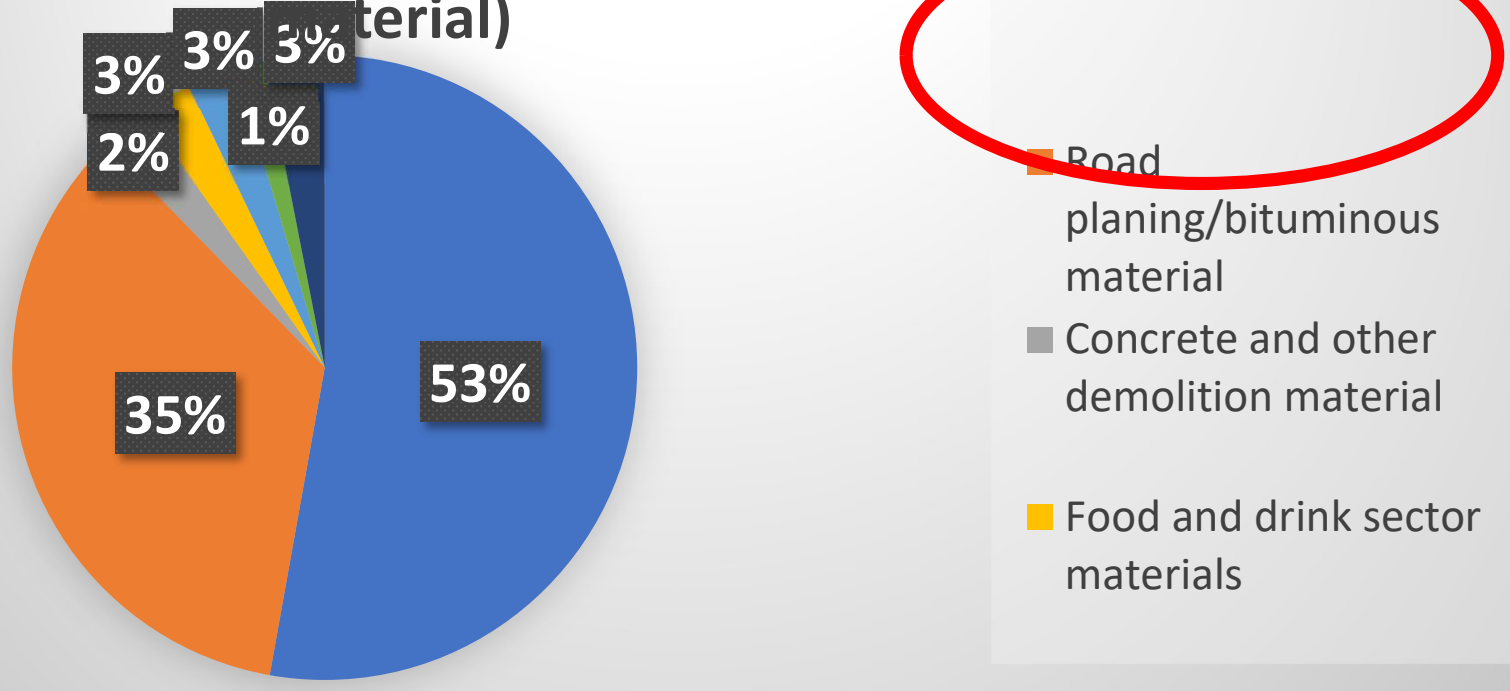


CURRENT SITUATION

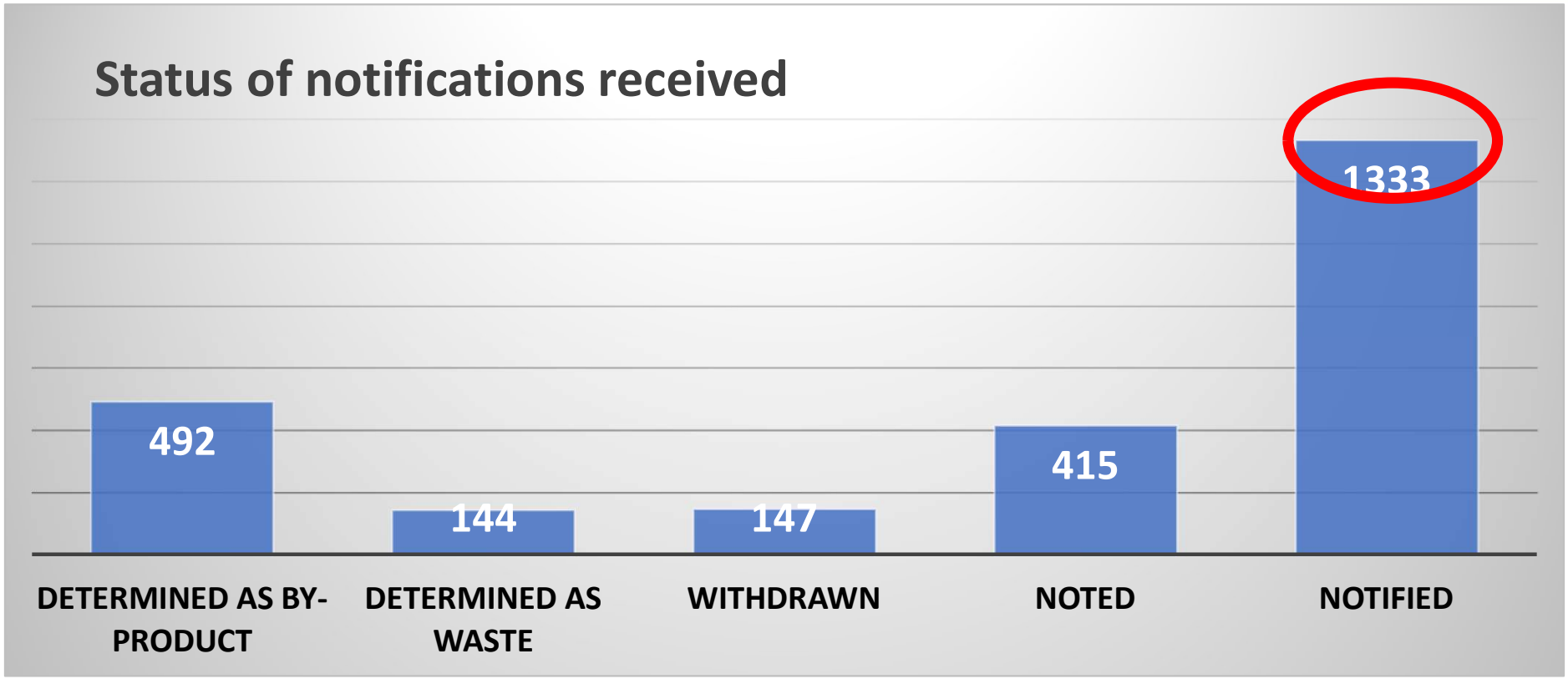


CURRENT SITUATION

Notifications on hand awaiting determination (by terial)



PROGRESS TO DATE



SYSTEM IMPROVEMENTS 2022

- Online notification system was improved in 2022
- Access is still via Eden Portal www.edenireland.ie
- *First time users* must request access to By-product Module. Guidance is available on how to register for Eden.
- Further information on EDEN is available in the 'Frequently Asked Questions' and in the EDEN Portal 'Help' section
- If you have queries or issues in relation to EDEN, send to eden@epa.ie
- Detailed user guidance: https://www.epa.ie/publications/licensing--permitting/waste/by-product-notification-form-guidance.php

SYSTEM IMPROVEMENTS 2022

- In-built data validation to improve quality of incoming notifications
- Improved automatic alerts to local authorities
- RSS feeds available to follow activity on notifications of interest; **Signing up to the RSS feed** is the **ONLY mechanism** to be **alerted of submissions** related to a notification
- All correspondence now issued via Eden Portal
- Display of status (stage of assessment/ determination) of a notification

SYSTEM IMPROVEMENTS 2022

- Full public access to documentation provided via By-Product Register – Contains a link to each notification
- Local authorities, third parties and members of the public can:
  - view notification information and documents
  - make submissions
  - follow the progress of individual notifications via RSS feeds
- Includes a feature to download the register into Excel (CSV) format and manipulate data accordingly
- https://www.epa.ie/byproduct

STRATEGIC DIRECTION

The focus has changed in 2022 towards national criteria…

1. **National end-of-waste criteria for recycled aggregates**

2. **National by-product criteria for road planings and asphalt materials**

3. **National by-product criteria for greenfield soil and stone**

BY-PRODUCTS – NATIONAL CRITERIA

Legislative basis:

- Article 5(3) of Waste Framework Directive
- Regulation 27(7) of Irish Regulations

Technical assessment remains the same as for any case-by-case notification

Benefits include:

- Provide more certainty to industry
- Reduce the regulatory burden
- Reduce the incoming flow of notifications to allow more timely determinations
- Eliminate the need for case-by-case notification and determination
- Provide a standardised set of criteria

BY-PRODUCTS – NATIONAL CRITERIA

Key stages:

- Review of significant batches of previous by-product determinations
- Preparation of consultation paper
- Engagement with local authority sector
- Engagement with key stakeholders
- Review of consultation responses
- Preparation of draft national criteria

GREENFIELD SOIL & STONE

Current status:

- Consultation paper issued 2nd September
- Open for submissions until 30th September – email byproduct@epa.ie
- Use the standard submission template in the consultation paper
- Direct stakeholder engagement will take place

GREENFIELD SOIL & STONE

Development project

- Producer e.g. developer, site owner or contractor
- Uncontaminated/ equivalent to virgin soil
- Statement of Conformity
- Approved supplier

End user

- End-user Declaration
- Proof of planning permission or planning exemption

NEXT STEPS

Key milestone	***Timeframe***
- Ongoing engagement with stakeholders	Underway
- Development of draft by-product national criteria	Underway
- Engagement with stakeholders to ensure draft national criteria are reasonable and achievable	Q1 2023
- Approval of draft national criteria by EPA Board	Q2 2023
- **Notification of draft national criteria to European Commission**	**Q2 2023**
- Assessment of any submissions received from other Member States	Q3 2023
- Finalisation of national by-product criteria and publication	Q3 2023

THANK YOU

Contact us:

byproduct@epa.ie

Check the By-product Register:

https://www.epa.ie/byproduct

Rialtas na hÉireann
Government of Ireland

Geological Survey
Suirbhéireacht Gheolaíochta
Ireland | Éireann
175 years | bliain 1845-2020

Baseline geochemical surveys and the Tellus Programme; applications in practice and policy

Ray Scanlon
Mairéad Fitzsimons

Geological Survey Ireland

Department of the Environment, Climate and Communications

15th February 2022

What role do geological surveys play?

The physical and chemical properties of soil – activities at GSI

Subsoil permeability
Groundwater Protection

Quaternary sediments mapping
3D modelling

Geohazards mapping
Ground motion, landslide risk

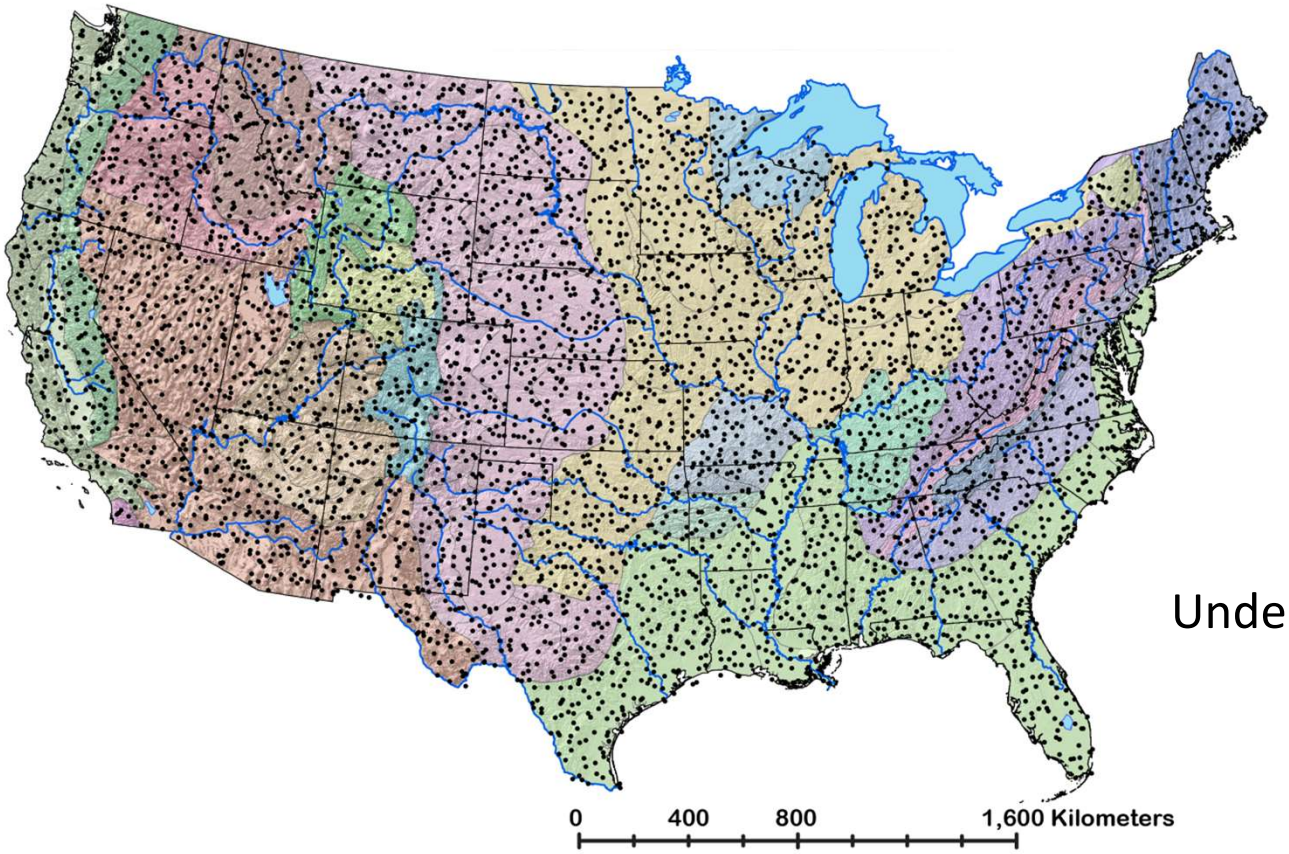
National Geotechnical Borehole Database
Geotechnical properties
Rockhead/depth to bedrock

Terra Soil
Tellus-Teagasc research for soil agricultural properties

Topsoil geochemistry, including organic matter
Tellus
Dublin SURGE project

Soil chemical characterisation
GSI-EPA project on Soil Recovery Facilities

Baseline geochemical surveys

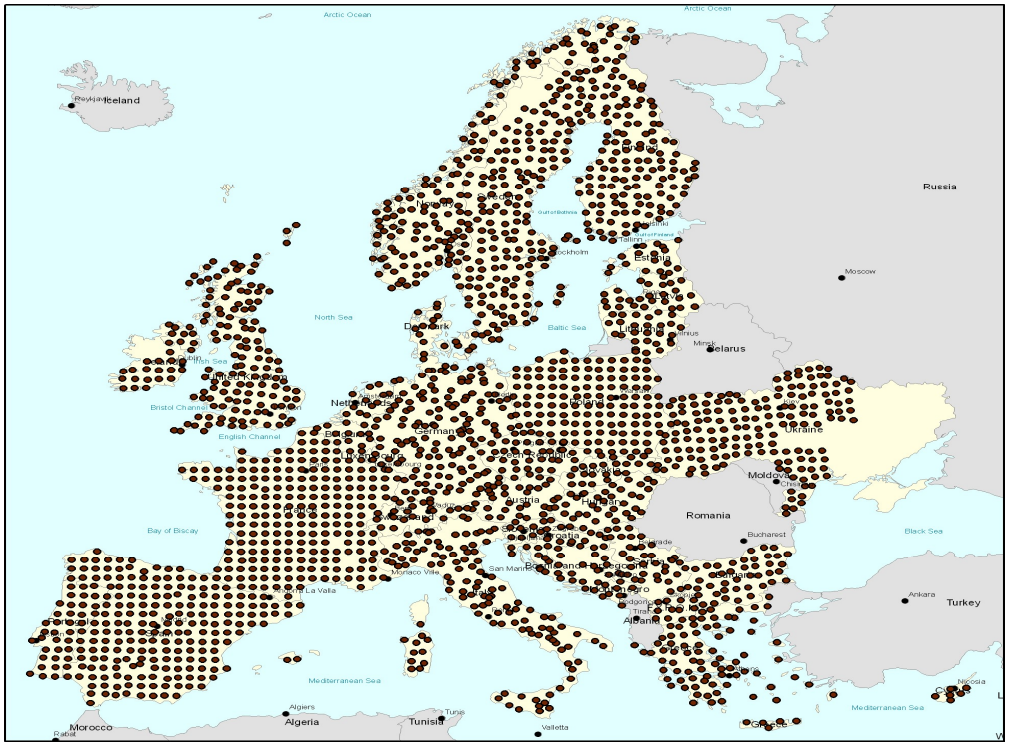


Undertaken at all scales!

Smith, D.B., et al.., 2013, *Geochemical and mineralogical data for soils of the conterminous United States*. U.S. Geological Survey Data Series 801, 19 pp., http://pubs.usgs.gov/ds/801/

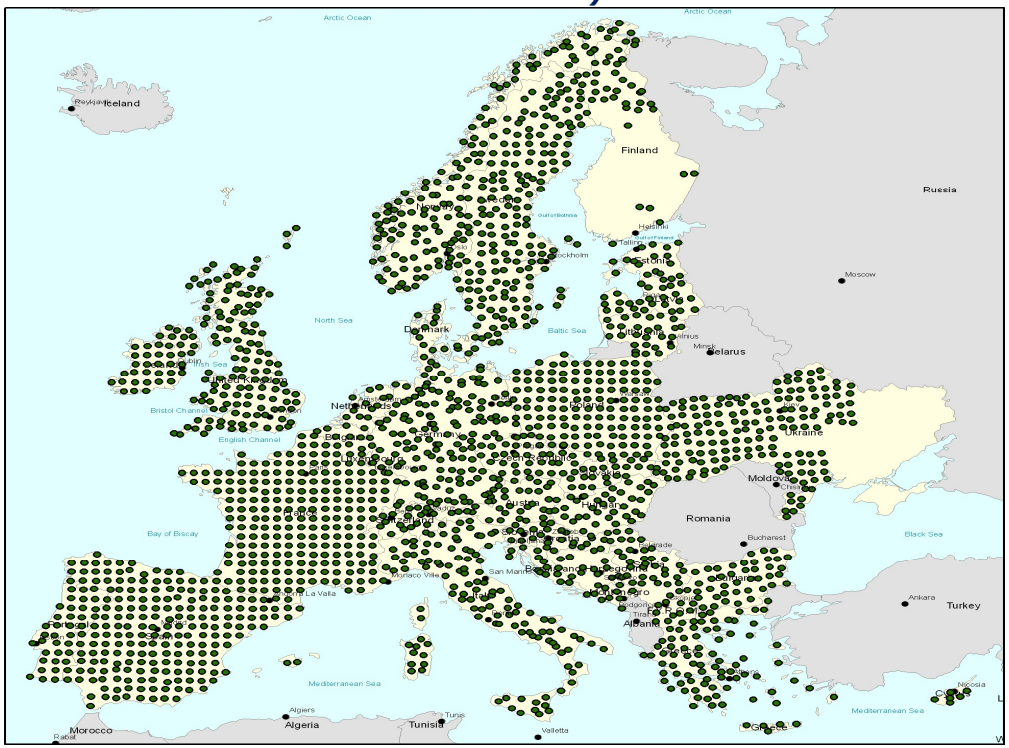
GEMAS - 2008

Agricultural soil (A_p) 0-20 cm (N = 2108)



(From Reimann et al., 2009, Fig. 1, p.9)

Grazing land soil (Gr) 0-10 cm (N = 2024)

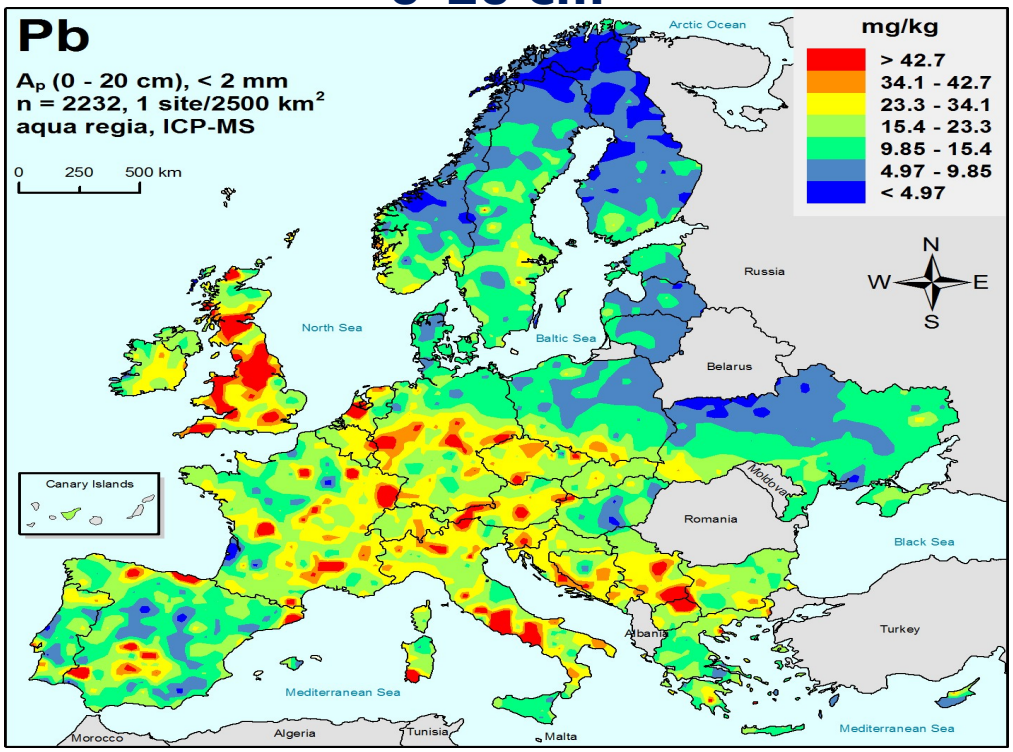


(From Reimann et al., 2009, Fig. 2, p.9)

33 countries - 5.6 million km^2 - 4132 soil samples in total

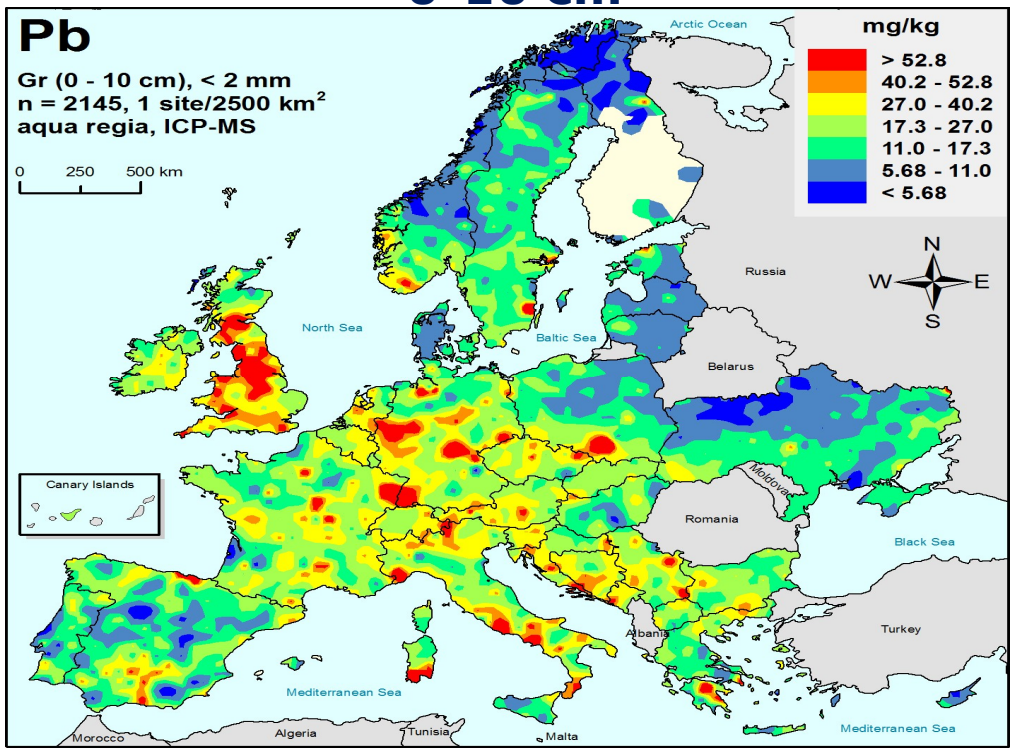
GEMAS 2009

Agricultural soil (A_p) 0-20 cm



(From Reimann et al., 2014, Fig. 11.41.5, p.339)

Grazing land soil (Gr) 0-10 cm



(From Reimann et al., 2014, Fig. 11.41.5, p.339)

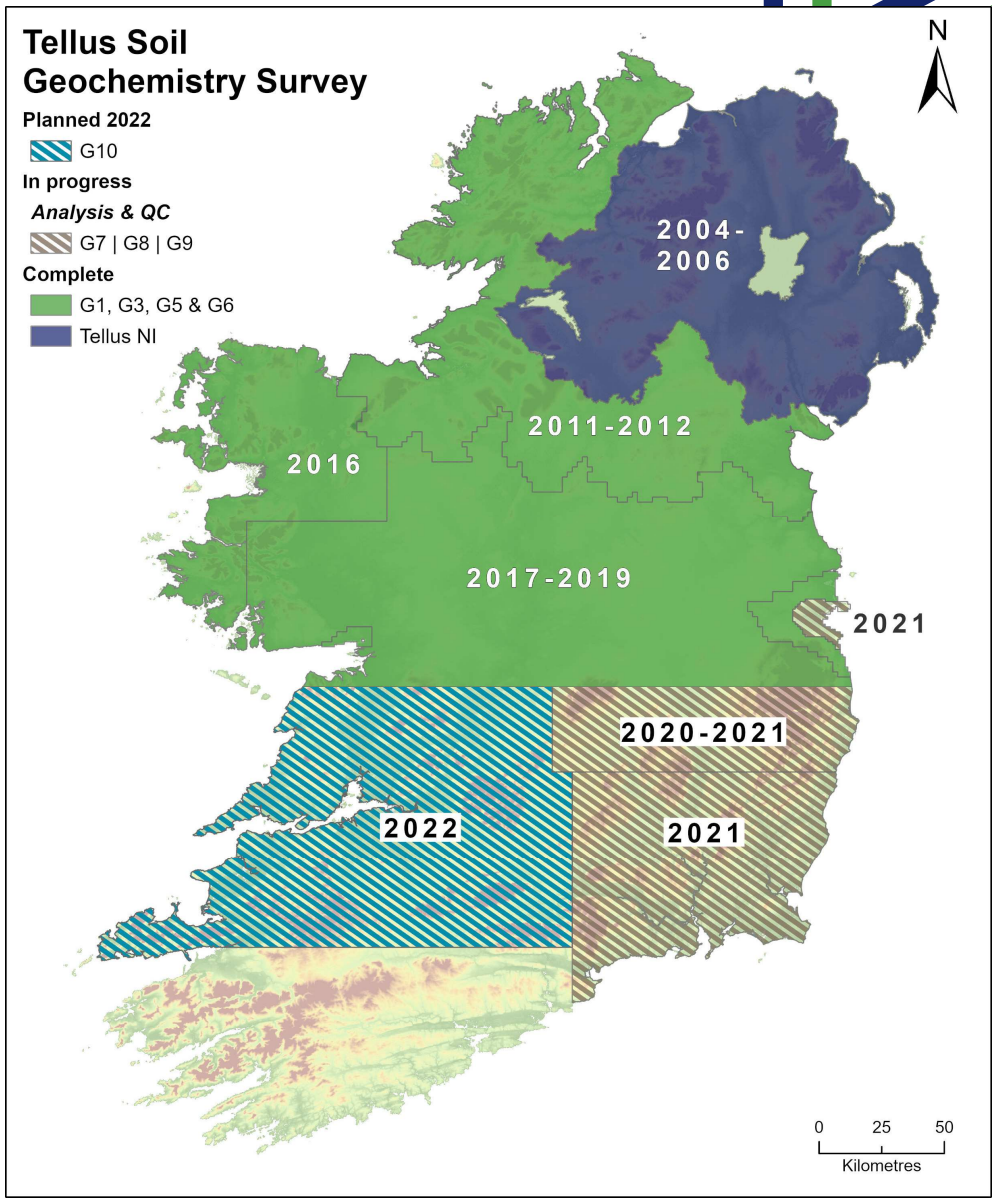
Lead: Two independent sample materials show comparable patterns. Large difference between North and South Europe

Baseline Geochemical Survey: Tellus programme

- Coupled national geochemical (soil, stream water, stream sediment) and airborne geophysical survey
- Supporting mineral exploration, environmental assessment and agriculture

Soil survey:

- 50,000 samples at 25,000 sites
- 1 sample per 4 km^2.
- Includes >50 chemical elements, pH, organic matter
- Planned completion date: end 2023 for collection, 2025/2026 for publication
- High quality, high resolution (x10 resolution of existing National Soil Database)



The Tellus soil survey - process

1. Sampling

- Composite sample: 20 m x 20 m square
- 1 sample/4 kmsq sample grid
- 2 samples collected by hand auger at 5-20 cm and 35-50 cm depths
- ~2,500 samples per season

2. Preparation

- Drying
- Disaggregation
- Milling to fine powder
- Different splits for different analytical tests

The Tellus soil survey - process

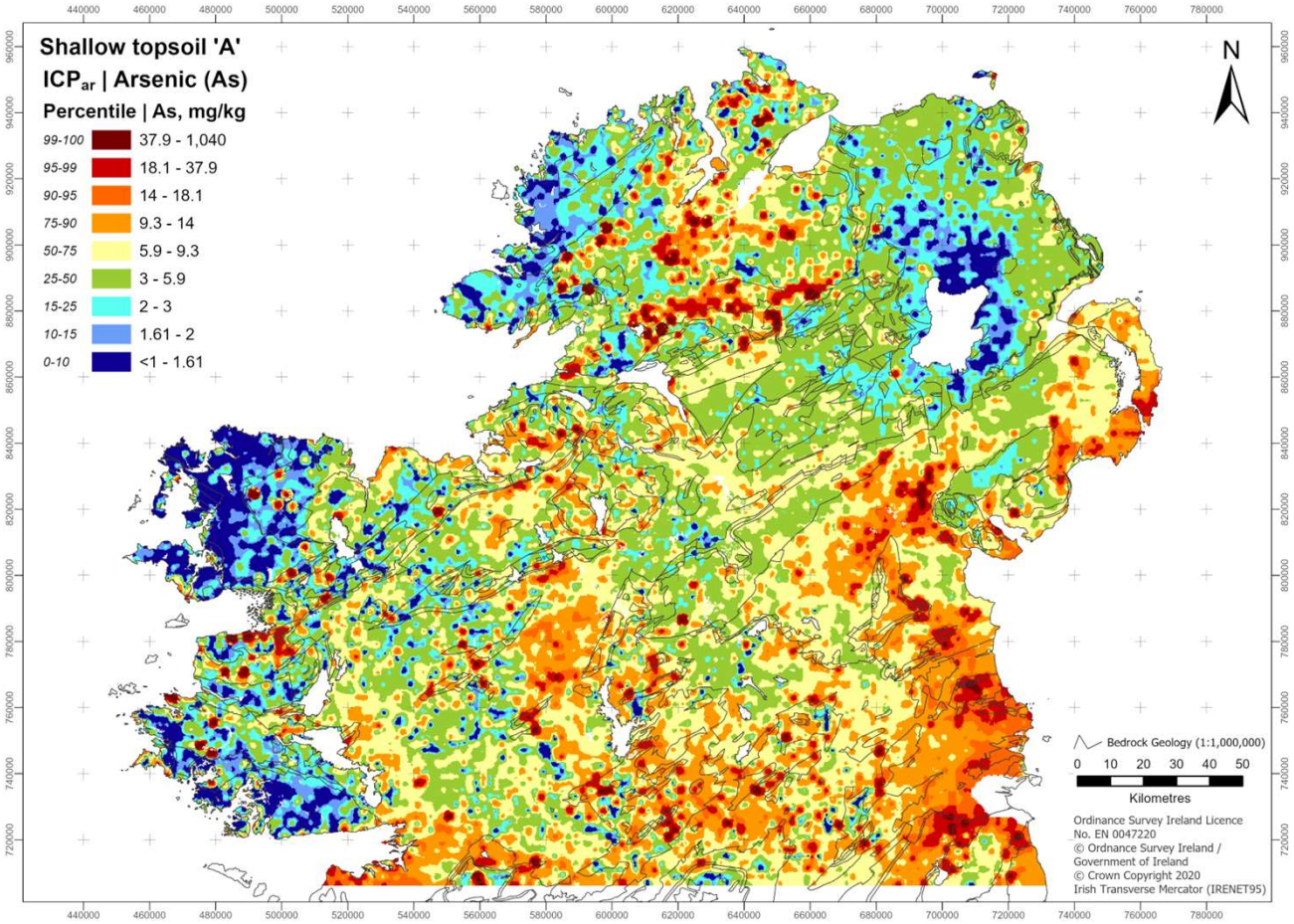
3. Laboratory analysis

- Blind insertion & randomisation of QC standards
- Multi-element ICP-MS (56 elements)
- Multi-element XRFS (53 elements)
- pH and organic matter (by loss-on-ignition)

4. Data processing

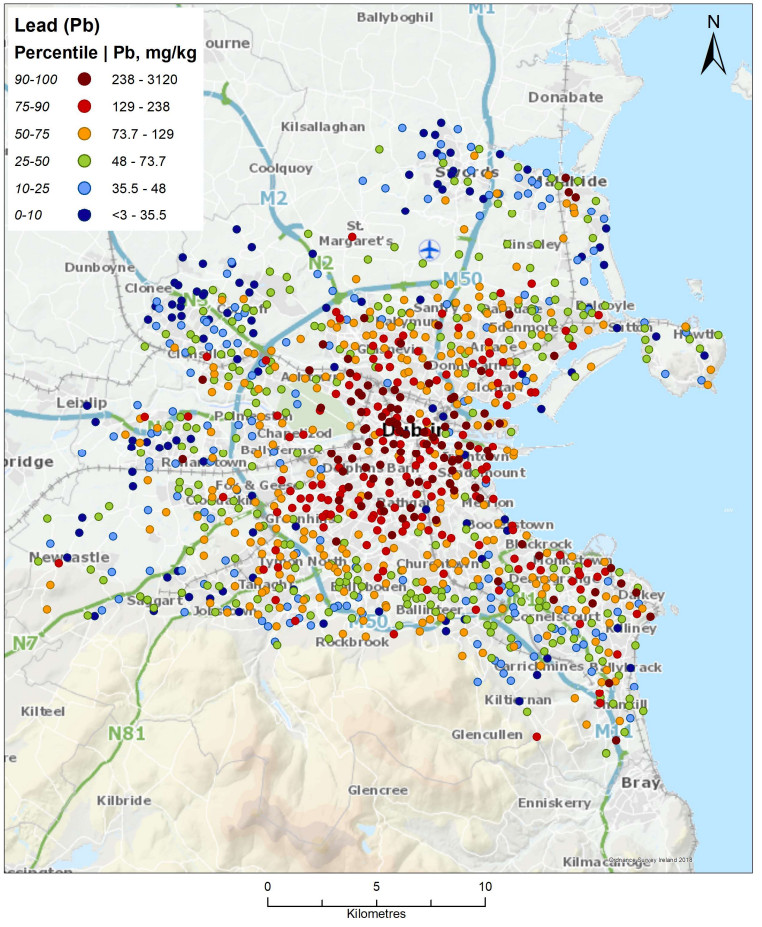
- Quality control
- Statistical analysis
- Mapping
- Expert interpretation

50% coverage published



Urban topsoil geochemistry

- Shallow urban soil acts as a sink for urban contaminants, NB metals and POPs
- 63% of population now lives in cities
- Baseline levels measured in Dublin SURGE project in 2009, revealed strong human influence on lead and mercury in shallow soil
- Used as evidence for Smoky Coal bans, Minimata Convention reporting on mercury and local area planning (DCC 2011)
- **Tellus urban Dublin phase** – sampled 2021, to be released 2023

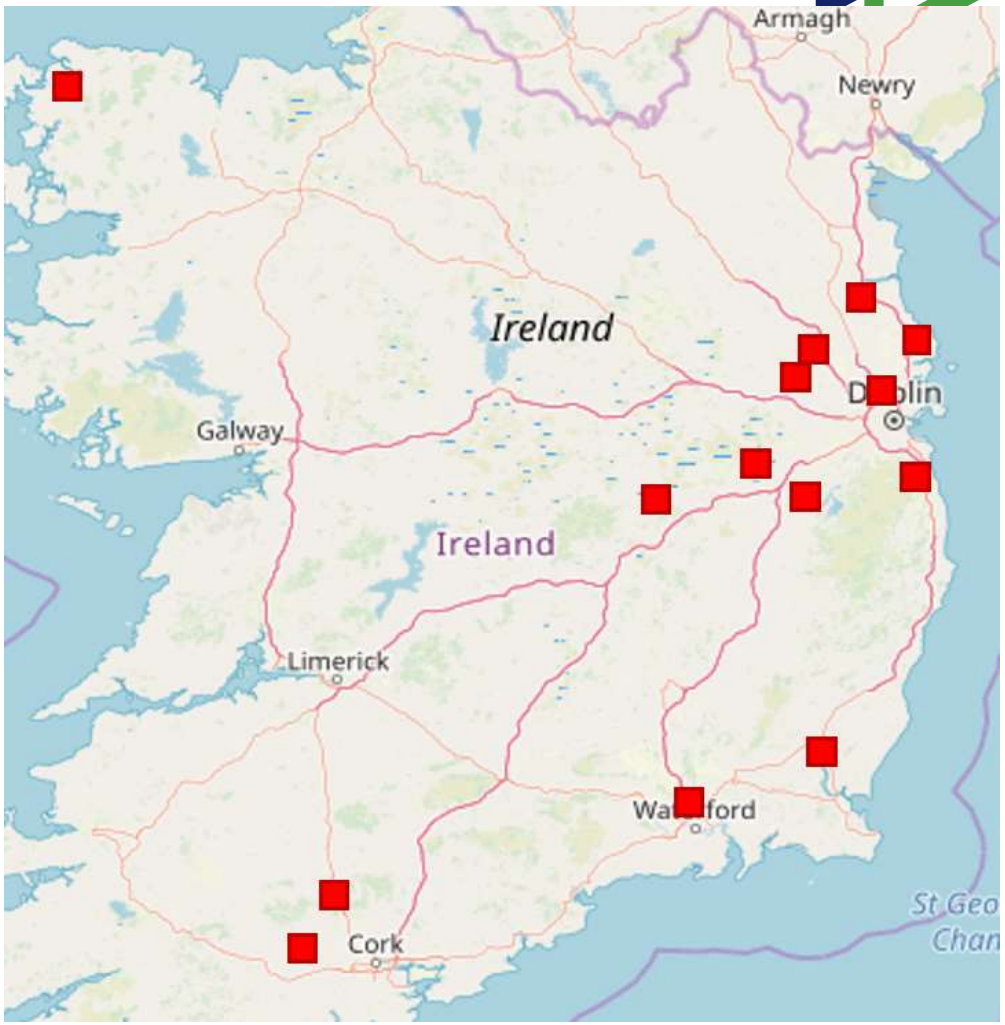


Application to Policy: soil waste classification

- In Ireland there is extensive, commonly deep subsoil due to glacial deposition
- Building/infrastructure development can produce large amounts of excavated soil
- Failure to understand the chemical composition of subsoil can result in soil going to landfill – expensive and inefficient use of resources
- Uncontaminated soil and stone should be reused where possible

Dublin Port Tunnel –'Dublin boulder clay'. Photo: Mike Lo

- Soil Recovery Facilities (SRFs) are not required to have a basal liner or engineered cap like a landfill
- Imported subsoil and stone must be **uncontaminated** to prevent impacts on groundwater
- 14 are licenced by Environmental Protection Agency; >400 smaller facilities permitted by Local Authorities



The problem

- In 2017 the EPA published draft Waste Acceptance Criteria for Soil Recovery Facilities:
  - To prevent contaminated material being accepted.
  - The blanket levels proposed were not practical for operators, given natural variation in soil chemistry (would have screened out many natural soils).

The EPA sought assistance from the GSI on:

- What levels of metals are considered ‘normal’ for uncontaminated Irish subsoil in different parts of the country?
- **What levels of naturally occurring metals in soil should be allowed into Soil Recovery Facilities?**

Task 1: Data review

We looked at available soil geochemical data in Ireland

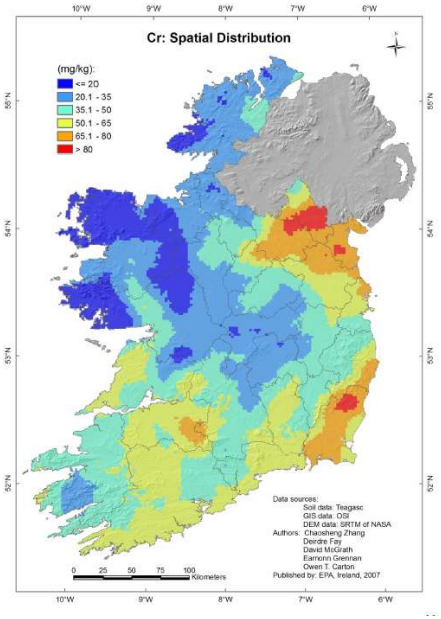
- National Soil Database (Fay *et al.* 2007):

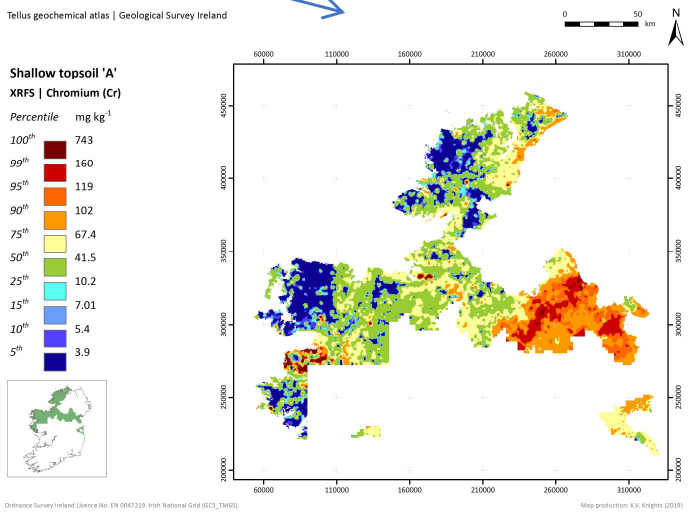
  Topsoil (0–10 cm depth), density of one sample per 50 km^2 (1310 samples nationwide)

- GSI's Tellus geochemistry (27% complete at time of study)

  Topsoil at two depth levels ('A' 5–20 cm and 'S' 35–50 cm) at a density of one sample per 4 km^2.

  No regional subsoil data is available. Some questions arose:





Can we use existing topsoil data as a proxy for deeper subsoil geochemistry?

How do we account for regional variation in geochemical baselines?

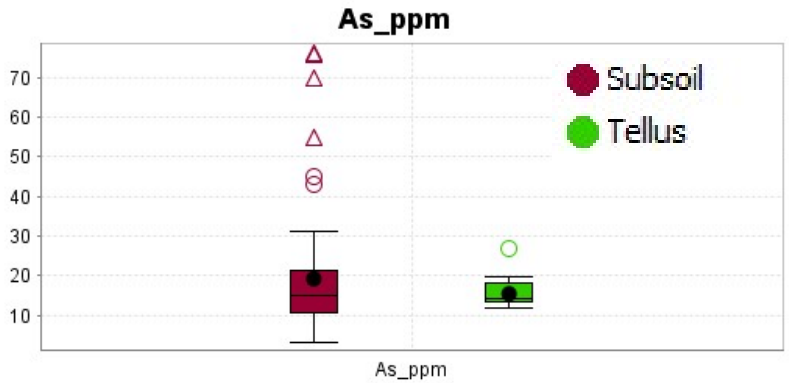
Task 2: Site investigation

To inform the answers to these questions, we decided to drill boreholes around the perimeters of two sites, a disused limestone quarry and an active sand/gravel pit

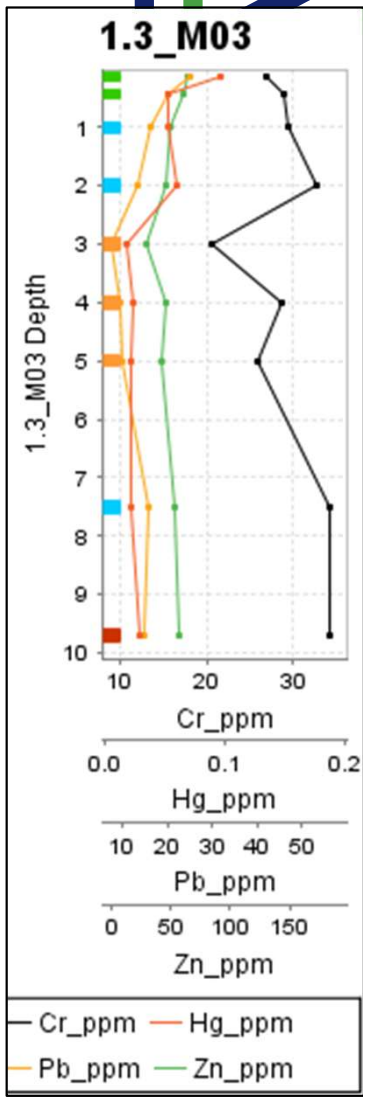
- Cable percussion drilling to a nominal depth of 10m bgl, 12 holes at each site
- Detailed subsoil logging with respect to Quaternary geology and BS 5930
- 175 geochemical (topsoil and subsoil) and 96 particle size samples taken at regular intervals. ‘Tellus’ style topsoil sample taken at top of each hole before drilling
- Geochemical samples analysed for 53 elements by ICP-MS (ALS Loughrea, Ireland)

Task 2: Site investigation – analytical results

Subsoils had some anomalously high concentrations of certain elements compared to topsoil



- **There was a weak trend for lower concentrations down-hole**
- These do not affect the conclusion that topsoils and subsoils share a broadly similar geochemistry.
- These data would support the use of topsoil data as a proxy for subsoil data, in the absence of baseline subsoil geochemical data.



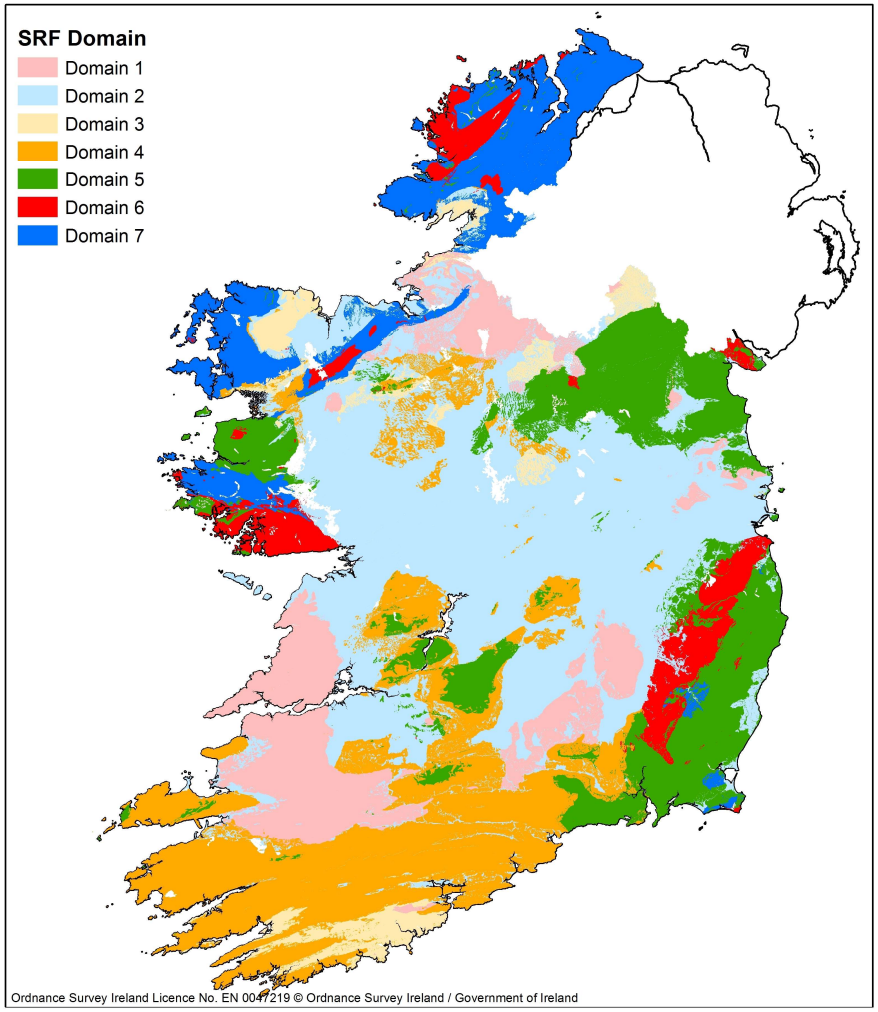
Task 3: Geochemical domains

How do we account for regional variation in geochemical baselines?

There is natural geochemical variation in soils and subsoils in Ireland arising from variation in rock types

We divided the country into 7 zones or domains based on similar subsoil and bedrock composition

- Subsoil map reclassified into geochemical zones based on parent material
- Areas with no mineral subsoil (peat, outcrop) filled in with bedrock geology map classification
- Domains applied to National Soil Database



Rialtas na hÉireann
Government of Ireland

Geological Survey
Suirbhéireacht Gheolaíochta
Ireland | Éireann

Final Geochemical Domain map and names

Final Domain map class	Primary Lithology
Domain 1	Namurian shale and sandstone
Domain 2	Carboniferous limestone and related rocks
Domain 3	Devonian to Carboniferous sandstone and shale
Domain 4	Devonian sandstone and shale
Domain 5	Lower Palaeozoic sandstone, shale and igneous rock
Domain 6	Granitic rocks
Domain 7	Schist, quartzite and gneiss

Task 4: Trigger level setting

Geochemical background and threshold setting is an accepted way of identifying areas with unusually high or low concentrations of potentially toxic elements[1,2]

- Intended to screen out samples with unusually high concentrations

- Here we need to strike a balance between being conservative (protective of the environment) and permissive (allowing the acceptance of material with naturally high concentrations)

We chose the 98th percentile level of National Soil Database samples generated for each domain, due to small sample size in some domains

- Proposed trigger levels for arsenic, cadmium, chromium, copper, mercury, lead, nickel and zinc

[1] e.g. Reimann *et al.* 2005; Ander *et al.* 2013; McIlwaine *et al.* 2014; Reimann *et al.* 2018
[2] Use of geochemical baselines for soil waste characterisation in Finland: http://gtkdata.gtk.fi/TapirEN/index.html

Geochemically Appropriate Levels

Domain	n	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Domain 1	166	15.6	1.50	85.9	51.2	0.254	47.8	48.3	137
Domain 2	431	24.9	3.28	83.9	63.5	0.360	61.9	86.1	197
Domain 3	55	38.1	1.60	79.2	56.9	0.457	54.4	81.3	237
Domain 4	278	32.3	0.97	86.2	80.4	0.285	50.3	91.4	155
Domain 5	205	41.5	1.42	122	77.6	0.302	65.7	109	224
Domain 6	64	85.8	2.38	90.0	40.0	0.527	28.2	108	168
Domain 7	111	30.9	0.542	96.0	83.1	0.262	35.7	61.1	122
NSDB 90th percentile (Draft guidelines)	1310	16	1.3	75	35	0.2	42	48	126
NSBD 98th (all) percentile	1310	33.6	2.28	99.9	65.1	0.299	58.8	86.9	183

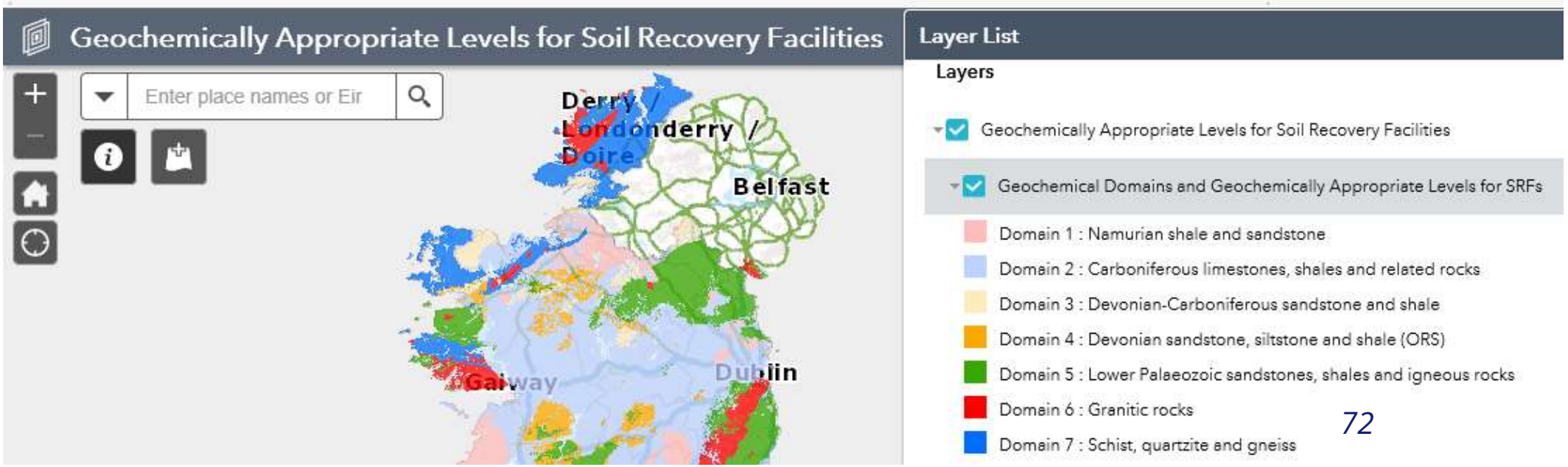
Calculated GALs (98th percentile) for defined geochemical domains. n = number of samples. Units are mg kg^{-1}

There is wide variation in Geochemically Appropriate Levels in different parts of the country

Outcomes

The EPA incorporated Geochemically Appropriate Levels and Geochemical Domains as part of its Guidance on Waste Acceptance Criteria at Authorised Soil Recovery Facilities in February 2020.

Geological Survey Ireland's Geochemically Appropriate Levels for Soil Recovery Facilities web pages host the full technical report and an spatial viewer for interrogating geochemical domains and geochemically appropriate levels.



Charecterisation of Dublin Glacial Tills

- The SRF geochemical domains project identified the need for geochemical characterization of the deep, stiff lodgement tills across the Greater Dublin area, known colloquially as the Dublin Boulder Clay (DBC).
- Geochemistry is poorly understood; reports of anomalously high concentrations of some elements, NB molybdenum (Mo), antimony (Sb) and selenium (Se).
- Difficulties for the disposal and reuse of the material with inert WAC (leachate tests) and SRF GALs (dry weight determination) exceedances for those elements.

Questions we addressed

Is it possible/sensible to characterise the geochemistry of the DBC?

Is the DBC geochemically different from other subsoils?

What this project **doesn't** do:

- Doesn't claim that the DBC is one coherent geological material with definitive characteristics.
- Doesn't provide a definitive reference for the geochemistry of the Dublin Boulder Clay due to the above, and the quality of the data available.
- Doesn't provide direction on the treatment of DBC in the waste management regime, but it provides some evidence to bolster decision making at consultancy and regulatory levels.

(1) Data compilation

1. GSI National Geotechnical Database **(n = 2)**
   - Limited useable data; primarily geotechnical data with some historical geochemical data
2. Private sector data **(n = 174)**
   - Environmental consultancies, geotechnical site investigation and soil waste management companies invited to share data
   - Specification: uncontaminated soil, dry weight determination, <1m depth, soil description provided, georeferenced.
   - Causeway Geotech Ltd, Geosyntec Consultants, Inc., Malone O'Regan Consulting Engineers, Minerex Environmental Ltd and Verde Environmental Group.
3. Publicly available Environmental Impact Assessment Reports (EIARs) and Environmental Impact Statements (EISs) **(n = 305)**

(2) Quality assessment

1. No usual QC samples available: reference materials, duplicates, etc.
2. Censored values
   - No. of observations below the lower limit of detection (LLD), reported as % censored (not useable)
   - Can be attributed to a detection limit that is high compared to the observed range of the element in question
   - Related to the analytical method offered by a lab
3. Assessment of bias across 8 labs
   - No bias trends with particular labs, but limited sample size.

	As (mg/kg)	Ba (mg/kg)	Cd (mg/kg)	Cr (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Mo (mg/kg)	Ni (mg/kg)	Pb (m/kg)	Sb (mg/kg)	Se (mg/kg)	V (mg/kg)	Zn (mg/kg)
DBC													
n (Total)	214	177	214	214	214	214	206	214	214	192	214	40	214
n (Censored)	1	0	0	0	0	194	16	0	0	78	30	0	0

(3) Data analysis

Range of concentrations

	As (mg/kg)	Ba (mg/kg)	Cd (mg/kg)	Cr (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Mo (mg/kg)	Ni (mg/kg)	Pb (m/kg)	Sb (mg/kg)	Se (mg/kg)	V (mg/kg)	Zn (mg/kg)
n (Total)	214	177	214	214	214	214	206	214	214	192	214	40	214
% censored	0.5	0	0	0	0	91	8	0	0	41	14	0	0
Min	0.01	30.00	0.39	2.90	7.90	0.002	0.01	12.70	5.50	0.00	0.00	5.00	29.00
Max	94.00	582.00	7.70	79.70	108.00	4.600	11.20	121.00	16710	37.00	12.00	46.00	541.00
Median	17.0	76.0	1.70	28.1	25.0	-	3.60	40.1	22.5	-	1.40	24.0	84.0
90 %ile	27.5	162	2.95	53.6	42.5	-	5.70	64.5	48.0	-	3.00	37.9	162
95 %ile	30.0	213	4.20	60.0	54.2	-	6.50	74.9	89.2	-	3.85	45.6	200
98 %ile	46.9	290	5.30	71.8	64.8	-	8.50	95.5	219	-	6	46.0	366
Upper whisker	39.6	199	3.70	79.4	50.0	-	7.10	66.5	54.1	-	4	44.6	178

- Stopped short of defining ‘baseline’ or ‘background’ concentration as data quality not robust enough for that approach
- We can present min, max, median, upper percentiles and Upper Whisker as an indicative range of concentrations for most elements

(4) Comparison to reference datasets

Comparison to SRF geochemical domains

- Although the DBC overlies Domain 2 (Lower Carboniferous limestone of the Lucan Formation/tills derived from limestone), boxplots suggest that some of the elements in the DBC (NB Ba, Cr and Cu) resemble those of the Lower Palaeozoic sandstone, shale and igneous rock of Domain 5.
- Cd in DBC resembles that in Domain 2 while there is little difference between DBC and Domains 2 and 5 for Pb, Zn and Ni.
- The DBC is compositionally similar in some respects to Irish Sea Tills – these tills contain a component of Lower Palaeozoic material so the overlap in composition between DBC and Domain 5 is unsurprising

Conclusions

Is there potential for determining baseline concentrations of naturally-occurring elements in the DBC?

- As no detailed geochemical study of the DBC with a comprehensive quality control programme has been undertaken to date, it is not possible to define specific background values for naturally-occurring elements in the DBC, however a range of concentrations is presented.

Conclusions

Is the DBC is geochemically distinct from neighbouring soil and subsoil deposits?

- The geochemistry of the DBC (in this data), most closely resembles that of made ground and Tellus soils classified as Irish Sea till (particularly IrSTLs) and till with dominant limestone clast composition.
- The similarity of the DBC geochemistry suggests that its composition is also largely geogenic in origin.
- The quality of Sb, Se and Hg data in the DBC database is not sufficient to determine if these elements are present in excess of concentrations typical of soils in the region.
- Cd and Mo higher than other regional soils, limestone parent material.

Thank you

Contact

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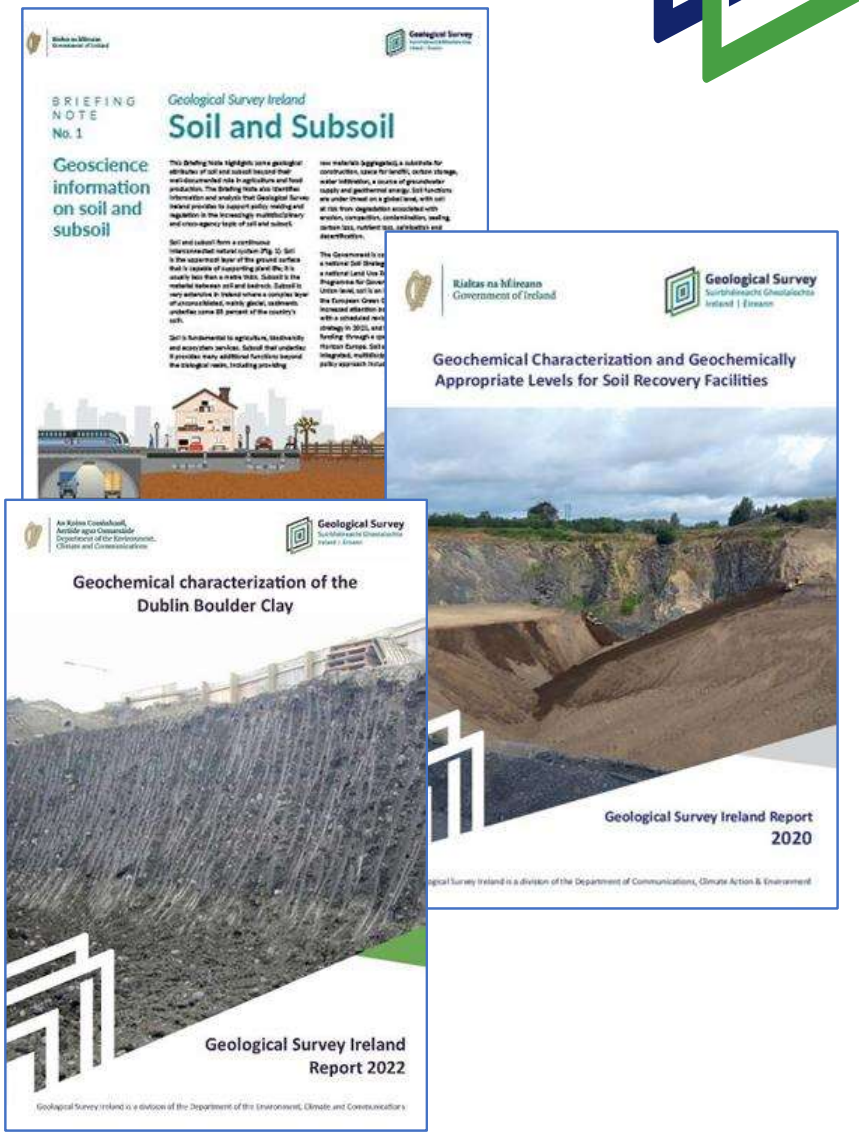
Mairead.Fitzsimons@gsi.ie | Senior Geologist

www.gsi.ie/tellus



1. https://www.gsi.ie/en-ie/publications/Pages/GSI-Briefing-Note-No1-Soil-and-Subsoil.aspx
2. https://www.gsi.ie/en-ie/publications/Pages/Geochemical-Characterization-and-Geochemically-Appropriate-Levels-for-Soil-Recovery-Facilities.aspx
3. https://www.gsi.ie/en-ie/publications/Pages/Geochemical-characterization-of-the-Dublin-Boulder-Clay.aspx

Question & Answers

Comfort Break

Ground Gas Sub-group

Objective:

To produce an Ireland-wide all-ground gas guidance document that builds on existing good practice by incorporating Ireland-specific characteristics

New members to the group always welcome

Ground Gas Sub-group

Aim:

To produce a series of Position Statements that cover various aspects of ground gas management that, when combined, will serve as the all-Ireland all-ground gas guidance good practice guidance document

New members to the group always welcome

Ground Gas Sub-group

Position Statements:

1. Ground Gas Conceptual Site Models
2. Monitoring approaches, techniques and considerations
3. Risk assessment procedures
4. Risk management design
5. Verification requirements and procedures

Each Position Statement will be reviewed by Executive Committee and then made available for public consultation
– so please get involved and be sure to contribute your experience

Once all Positions Statements completed and agreed by all they will be amalgamated into the **All-Ireland All-ground Gas Guidance Good Practice Guidance Document**

New members to the group always welcome

Ground Gas Sub-group

Position Statements:

1. Ground Gas Conceptual Site Models

Draft version completed and currently being reviewed by Executive Committee, aim to have out for public consultation for December 2022

Each Position Statement will be reviewed by Executive Committee and then made available for public consultation
– so please get involved and be sure to contribute your experience

Once all Positions Statements completed and agreed by all they will be amalgamated into the **All-Ireland All-ground Gas Guidance Good Practice Guidance Document**

New members to the group always welcome

Ground Gas Sub-group

Ground Gas CSM Position Statement:

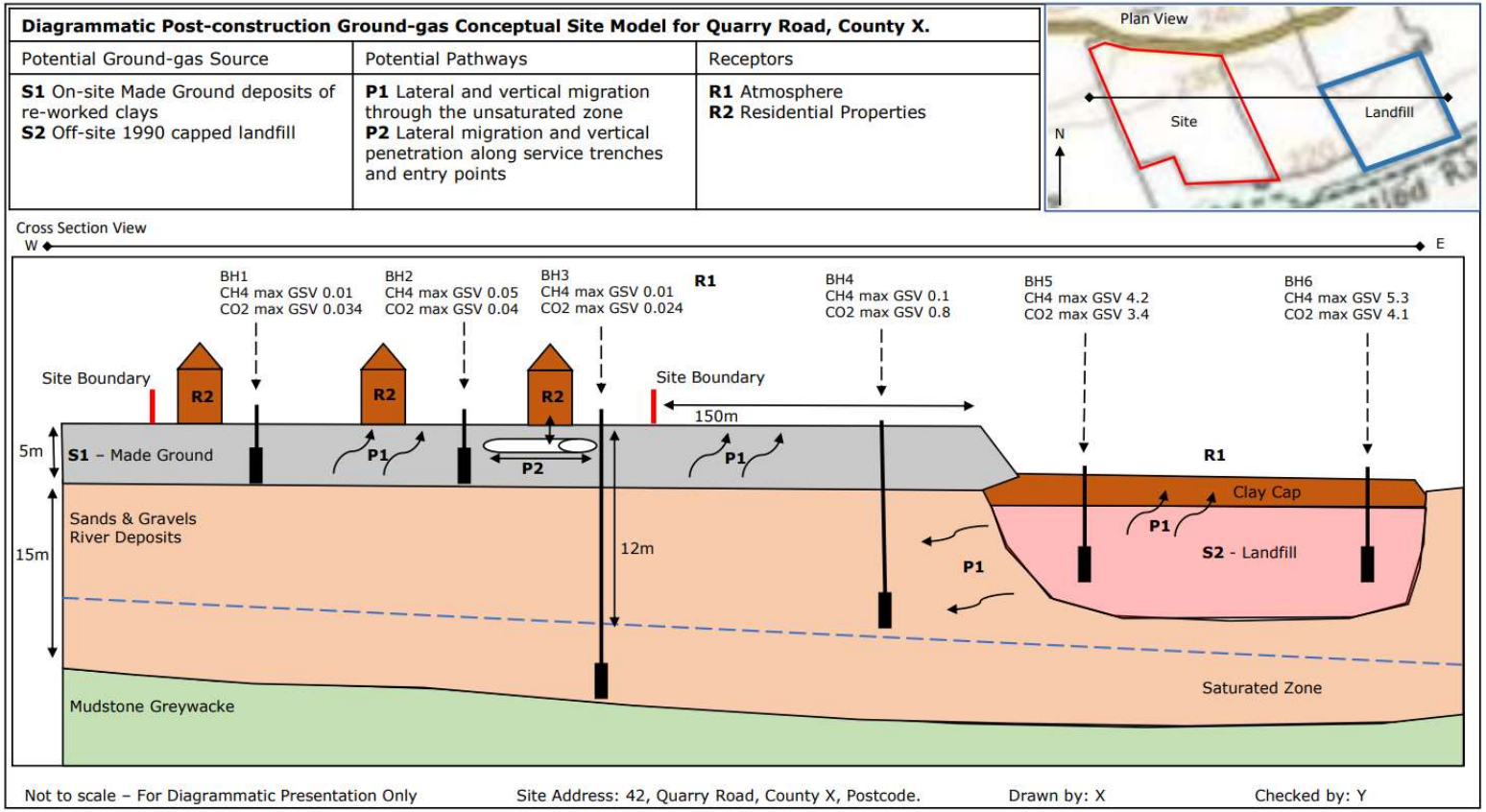
- Normative reference: *ISO 21365:2020 Soil quality. Conceptual site models for potentially contaminated sites*
- When applicable, encourages the development of stand-alone Ground Gas Conceptual Site Models (GGCSM)
- Encourages the use of graphical GGCSMs that incorporate cross sections
- Sign posts the users to Ireland-specific CSM constituent sources relating to:
  - Legal Frameworks (both ROI and NI)
  - Sources (radon, coal mine, peat, etc)
  - Pathways (geology, permeability rates, etc)
  - Receptors (build types, foundation design, etc)
  - Foreseeable Events (climate change, land-use change, etc)

New members to the group always welcome

Ground Gas Sub-group

Ground Gas CSM Position Statement:

- Anonymised examples of graphical GGCSMs:



New members to the group always welcome

Ground Gas Sub-group

The Ireland Brownfield Network
Encouraging the appropriate and sustainable redevelopment of brownfield land in Ireland

Objective: to produce an Ireland-wide all-ground gas guidance document that builds on existing good practice by incorporating Ireland-specific characteristics

Thank you and if you have an interest in ground gas, then please do get involved – new members always very welcome !

RSK

wsp

Institute of Geologists of Ireland

IGSL

JACKSON REMEDIATION

SOCOTEC

suez

New members to the group always welcome

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

IBN The Ireland Brownfield Network
Encouraging the appropriate and sustainable redevelopment of brownfield land in Ireland
10th Anniversary Event
Dublin, 15th September 2022

Ireland's Updated Radon Map

The Ireland Brownfield Network 10th Anniversary Event

Quentin G. Crowley
Associate Professor Geology & Director Trinity Centre for the Environment
15/09/2022

Talk Outline

IBN 10th Anniversary Event 15th September 2022

This presentation will provide an overview of recent updates to the national radon map of Ireland, highlighting the need for reliable digital geodata, and the importance of interdisciplinary collaboration & research.

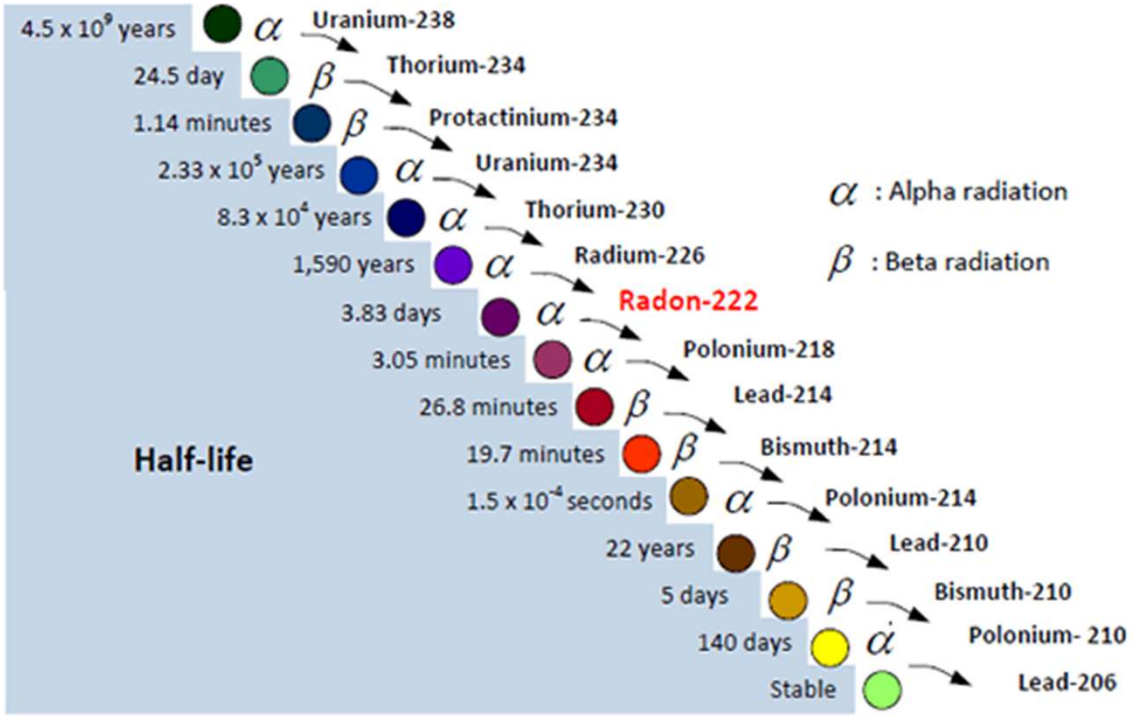
- Introduction to radon: basic concepts and uncertainties
- Links with health protection and policy
- Methodology for the new radon map
- Radon and brownfield sites
- Summary & conclusions

IBN The Ireland Brownfield Network
Encouraging the appropriate and sustainable redevelopment of brownfield land in Ireland
10th Anniversary Event
Dublin, 15th September 2022

Radon

General Introduction

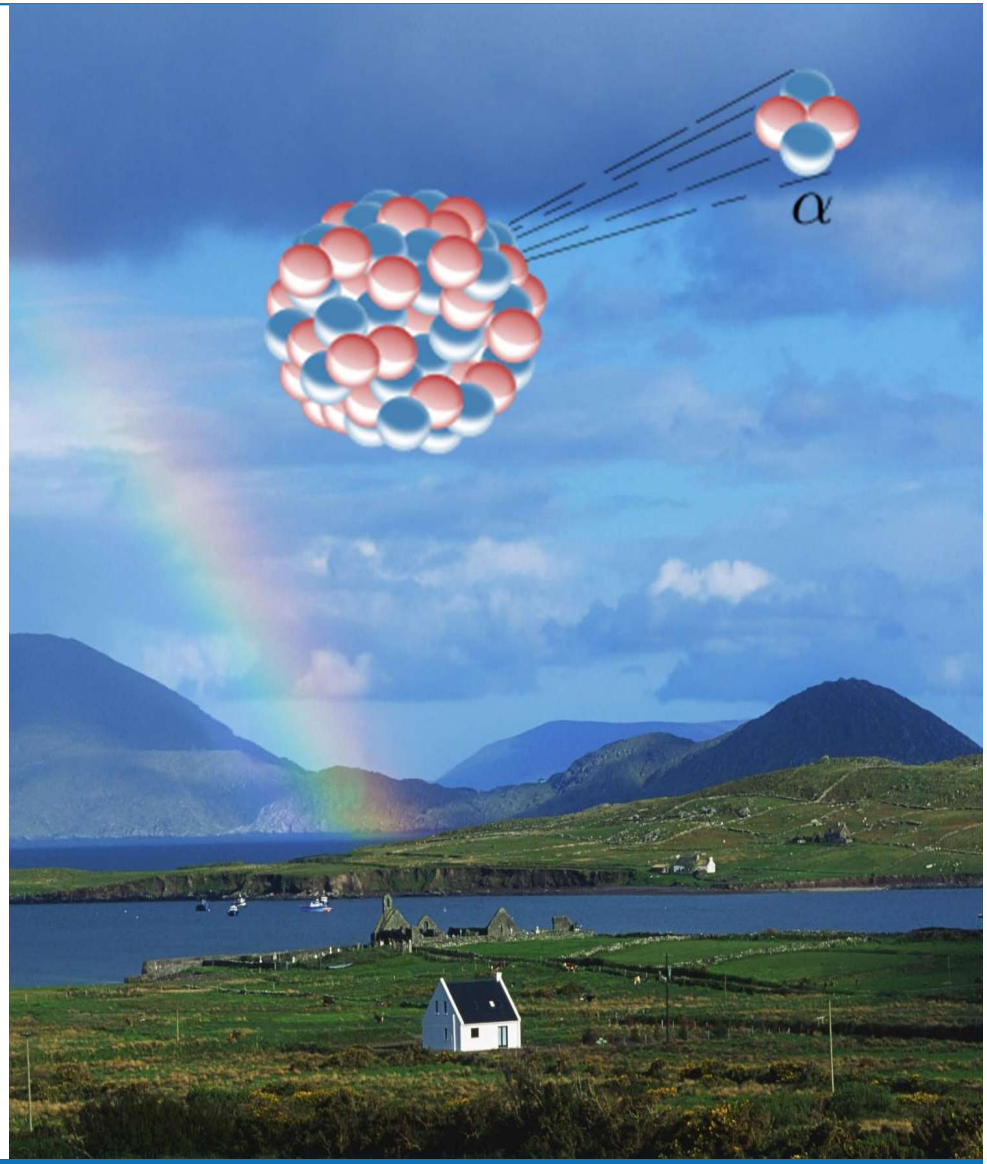
- Radon (^{222}Rn) is a **"ground gas"** which emanates from rocks, sediments, soil and water. It is an intermediate daughter product in the ^{238}U decay chain and is radioactive.
- It is a **dense, colourless, odourless gas**. It can only be detected using specialised equipment.
- It can accumulate indoors. Exposure to radon and daughter products (e.g. ^{210}Po, ^{218}Po) is associated with an **elevated risk of developing lung cancer**.
- It is classified by the WHO as a Class I carcinogen. Globally it is the second most common cause of lung cancer after tobacco smoking **(#1 cause of lung cancer in non-smokers**).



Radon

Radon in Ireland (population 5.01M, land area 84,421 km^2)

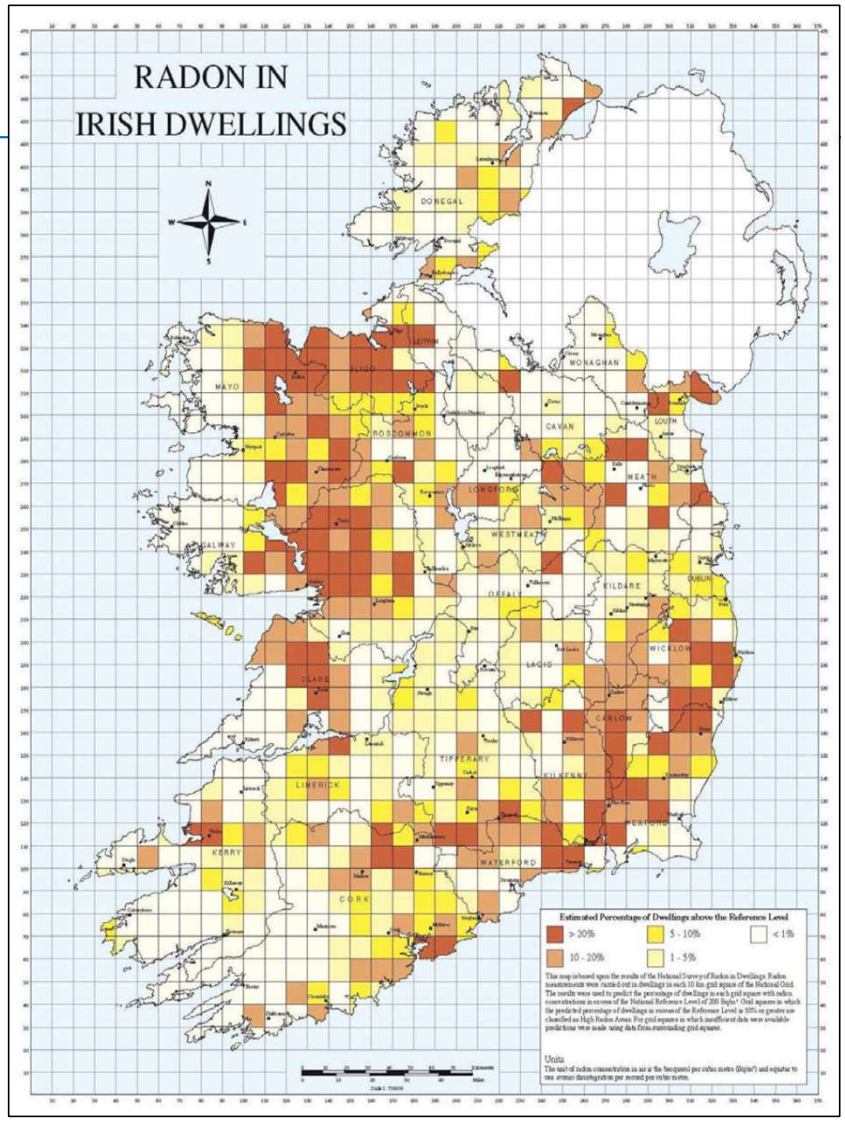
- Ireland has a population weighted average indoor radon concentration of **98 Bq/m^3**, which is considerably higher than the global average of around 40 Bq/m^3.
- Domestic radon exposure causes approximately **350 lung cancer cases** in Ireland per annum, with an estimated economic cost > €460M p.a. (estimate includes health care costs and loss of earnings).
- In Ireland, testing for radon in peoples homes is encouraged, but **not legally required**.
- Around **10% of Ireland's population** is thought to be exposed to high radon, but fewer than 4% of homes are tested.

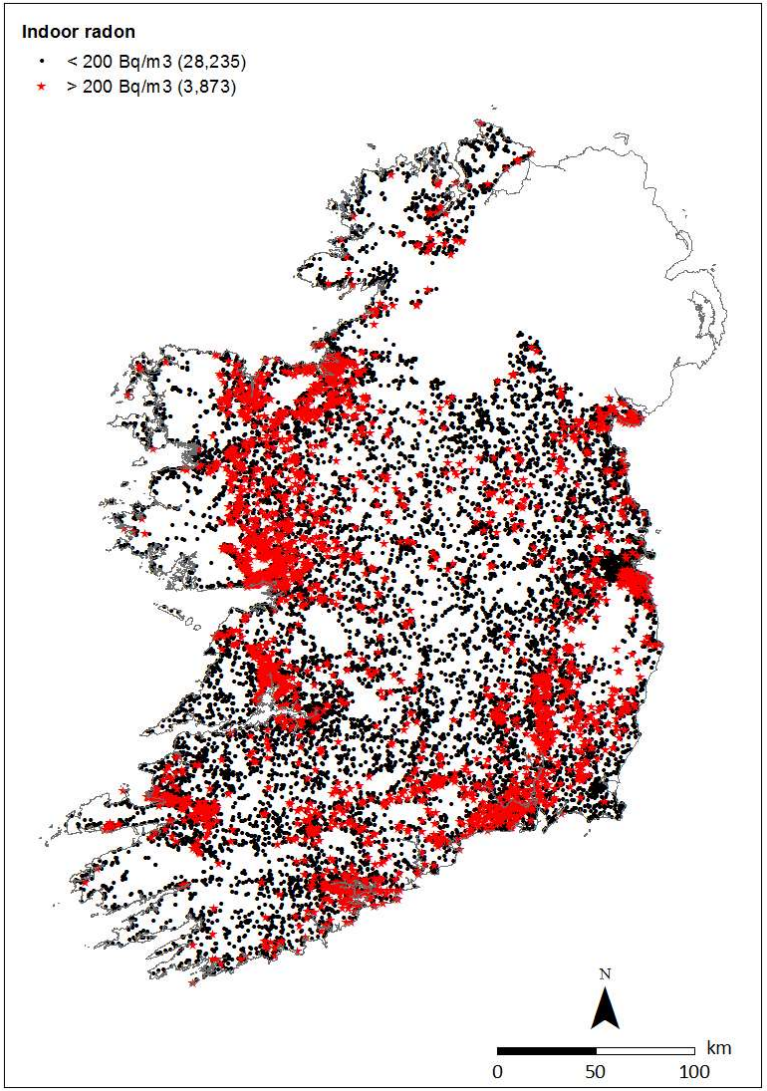


Legislative Radon Map

Building Regulations, 1997

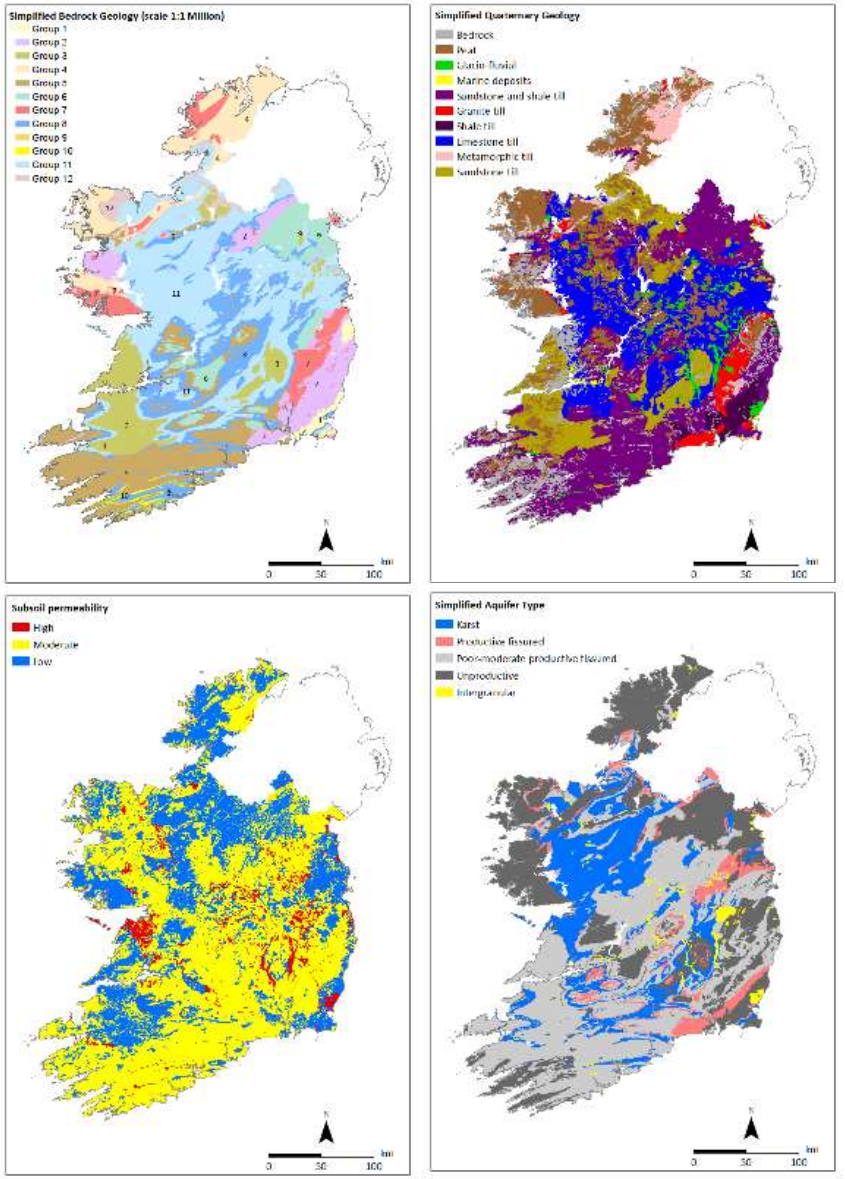
1. Legislative map, uses this specific map to define "high risk areas" – any 10 x 10 km grid >10% of homes expected to exceed 200 Bq/m^3, with direct implications for new builds.
   - Limited spatial resolution.
   - Uneven spatial distribution of measurements.
   - No geogenic or population information included.
2. Based exclusively on a relatively small dataset of indoor radon measurements, performed pre-1997.





Elío et al, 2017

Indoor radon (EPA)



Geological Parameters (GSI)

Radon Mapping & Modelling

Logistic regression: estimate probability of indoor radon > 200 Bq m^{-3}

1. Dependent variable:

Indoor Radon

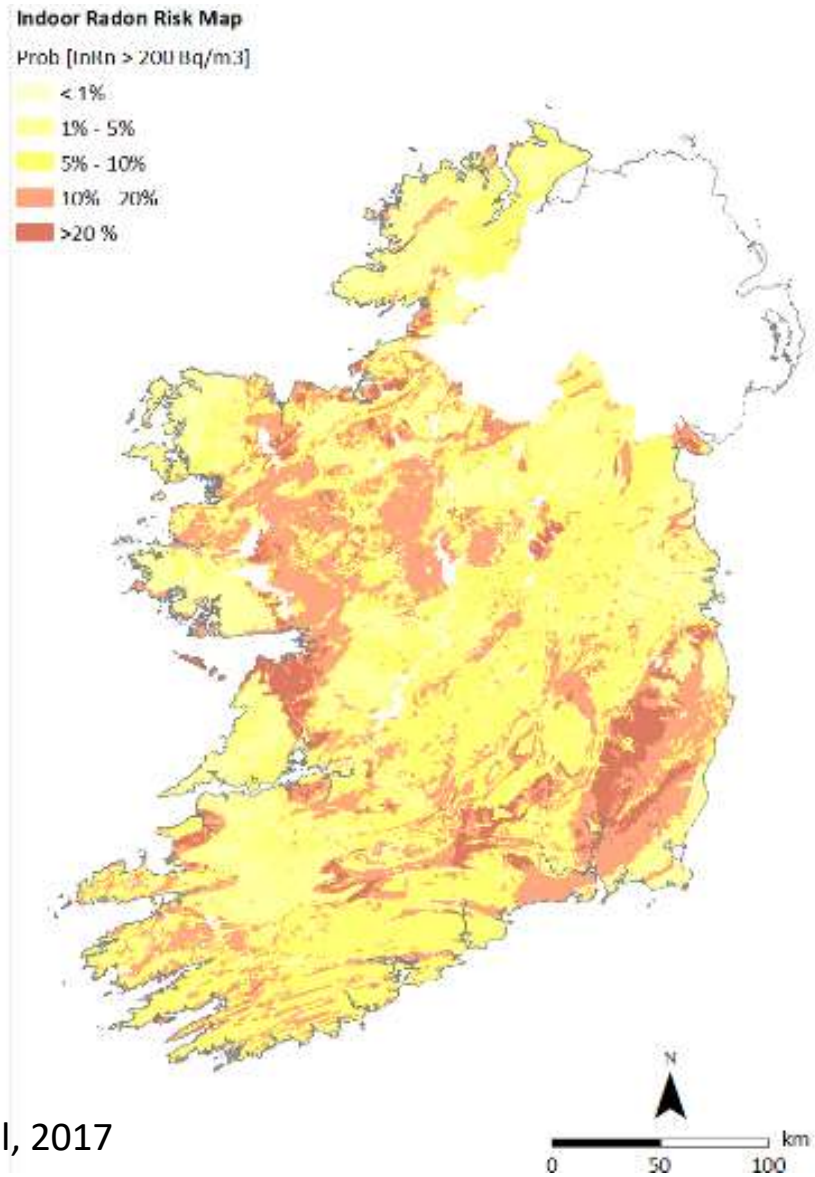
- High (InRn > 200 Bq m^{-3}) = 1
- Low (InRn < 200 Bq m^{-3}) = 0

2. Explanatory variables:

- Bedrock geology
- Quaternary geology
- Aquifer type
- Sub-soil permeability

3. Predicted probability:

Estimate the probability of having an indoor radon concentration above the reference level (200 Bq m^{-3})



Elío et al, 2017

Logistic Regression Modelling of Indoor Radon

Top 5 Combinations of Geogenic Parameters (Elío et al, 2017)

)

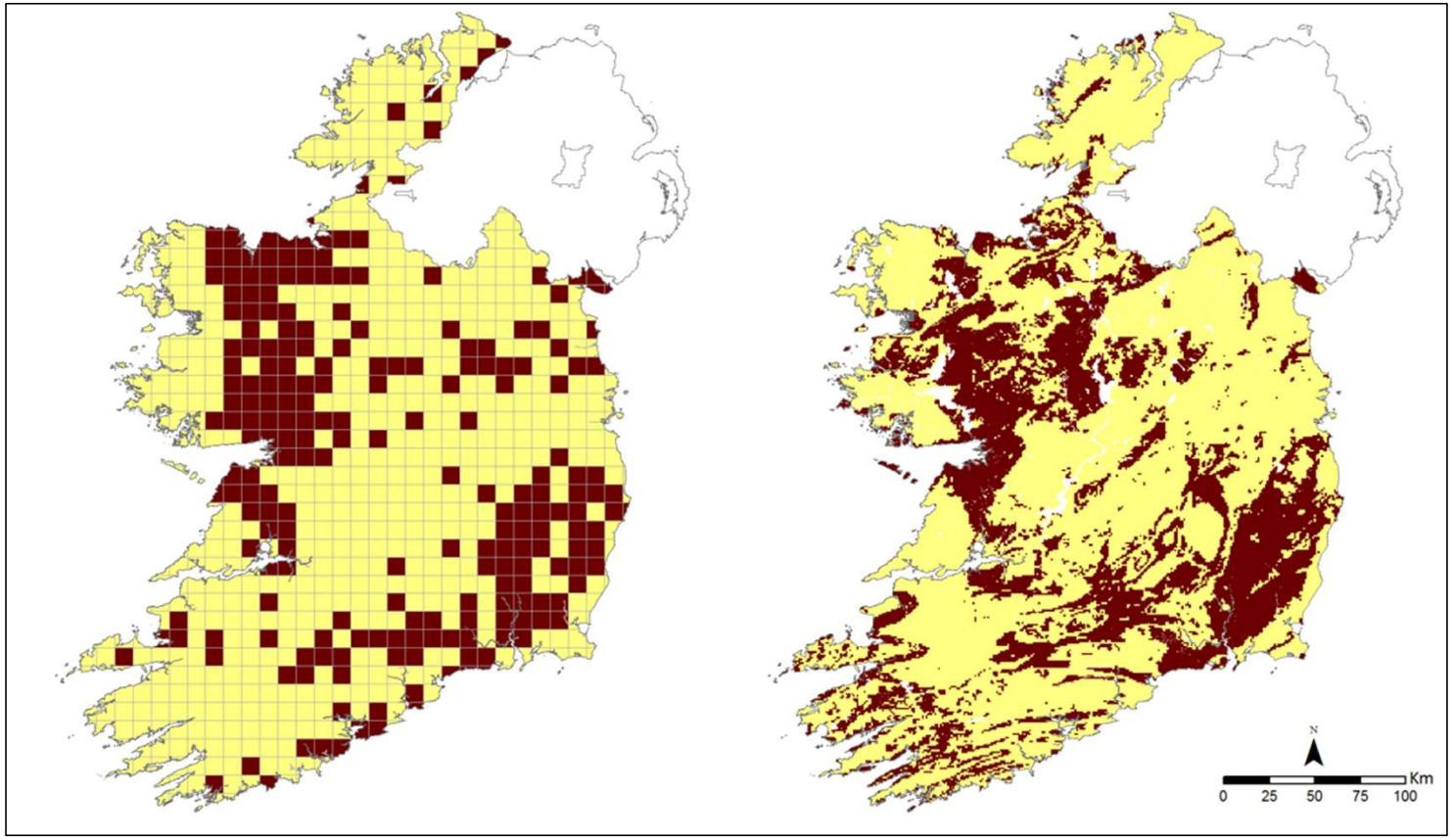
Bedrock	Quaternary	SSP	Aquifer	Prob >TL	Area Km^2	% Area
Visean limestone & shale	Sandstone till	Medium	Karst	27.94	812	1.19
Visean limestone & shale	Limestone till	Medium	Karst	18.40	4202	6.15
Old Red Sandstone	NA (bedrock)	Medium	Productive Fissured	13.34	1482	2.17
Old Red Sandstone	NA (bedrock)	Medium	Unproductive	9.77	807	1.18
Visean limestone & shale	Limestone till	Medium	Productive Fissured	9.39	2289	3.35

Radon Mapping & Modelling

Improving spatial resolution by adding geogenic par t

High indoor radon less likely

High indoor radon more likely



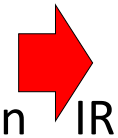
Comparison of radon designation (HRA: 21,238 km^2 EPA; 21,962 km^2 Adapted from Elío et al, 2017)

Development of New Radon Map

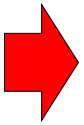
Timeline and Milestones

Radon Map
RPII
1997

Linear Regression
GSI
2015?

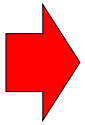


IRC Fellowship
TCD-GSI
2016-2017

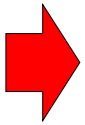


Logistic Regression Map
TCD-GSI-EPA (STOTEN)
2017

Project report
GSI & EPA
2017

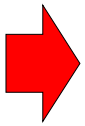


Map “Validation”
Compass Informatics
2018

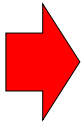


Testing & Modelling
EPA Data Analytics
2019-2021

User Testing
ESRI
2021-2022



Launch of new map
EPA
2022

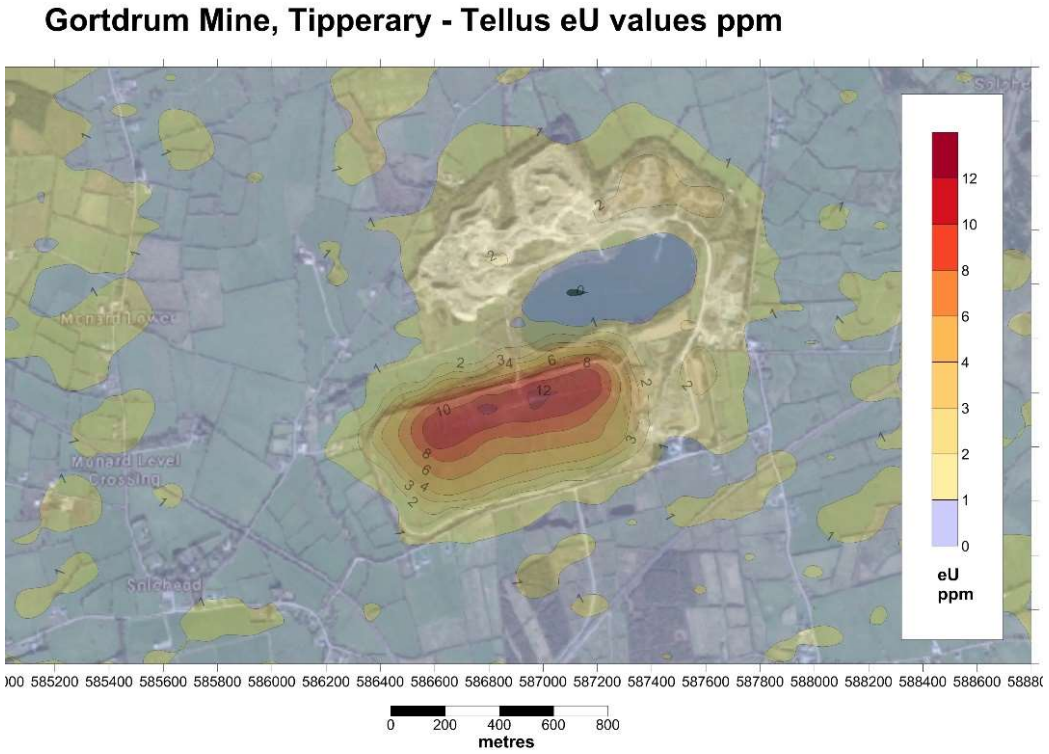


Incorporation into legislation
Workplaces, Residential
????

Radon and Brownfield Sites

NORMS and TE-NORMS

- Radon and other products the U decay chain, are classified as Naturally Occurring Radioactive Materials (NORMS).
- Anthropogenic process can (intentionally or not) increase concentrations of NORMS.
- These are known as Technologically Enhanced NORMS (TE-NORMS).
- An example includes the former Gortdrum mine site (Monard, Co. Tipperary), an open-cast copper mine discovered in 1963 and worked between 1967-1975.
- Mercury was produced as a by-product.



Radon (^{222}Rn) & Thoron (^{220}Rn) in Soil Gas

Field-based & laboratory-based measurements

- ^{222}Rn part of the ^{238}U decay chain ($T_{1/2}$ 3.8 d).
- ^{220}Rn part of the ^{232}Th decay chain ($T_{1/2}$ 55.6 s).
- Radon-JOK used to measure sub-soil permeability in the field.
- RM-2 device (ionization chamber), used to measure ^{222}Rn in the field. Soil gas samples usually measured 15 minutes. Measurement takes 2 minutes.
- RAD7 (lucas cell) radon detector, used to measure both ^{222}Rn and ^{220}Rn. Very sensitive device, measurement of exhalation rates from soil 10's of hours.

Field-based Gamma Ray Spectrometry

Rapid measurements for U, Th, K

- GT-40, multifunctional (BGO) gamma ray spectrometer for rapid determination of activities of gamma emitters in field-based or laboratory-based measurements. Can be used for point measurements, or traverses in continuous measurement mode.
- D230A lightweight mini-detector, for drone based measurements. Novel technology, very new to the market. Two detectors, rapid mapping of small areas.
- Both use the ^{214}Bi gamma energy peak as a proxy for uranium (equivalent uranium; eU).

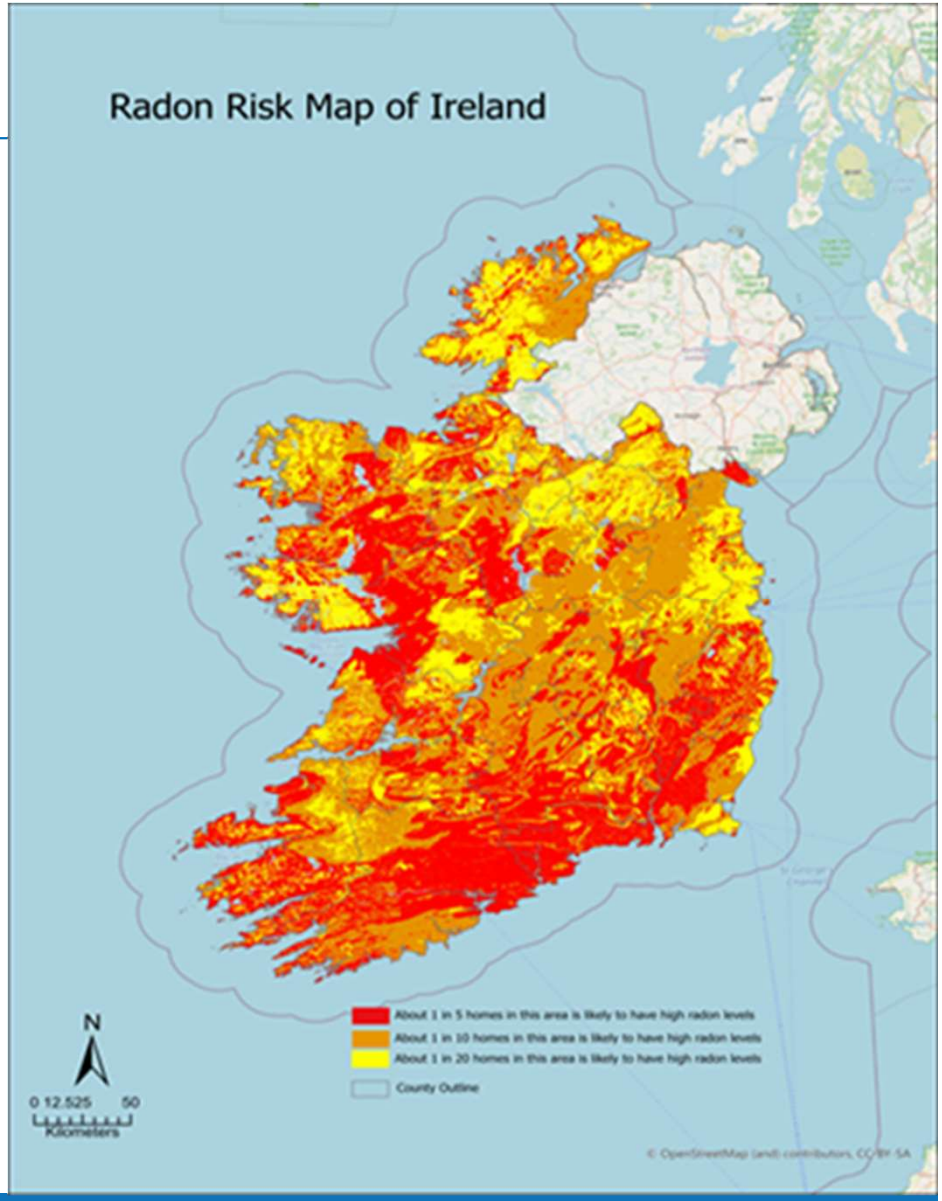

GT-40


D230A & DJI Matrice 300

Summary & Conclusions

Some take home messages

- Radon is complex in its spatial distribution.
- Although naturally occurring, radon may be concentrated due to anthropogenic processes.
- Radon is Ireland's #1 natural hazard (ca. 350 lung cancer cases per year).
- Developing the new radon map took several years and relied on collaboration between academia, government agencies & industry.
- The interdisciplinary nature of this topic poses challenges for researchers, especially in terms of funding and also for policy makers as it cuts across different Departments.



Want to know more?

Email me (crowleyq@tcd.ie for copies of publications)

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

IBN The Ireland Brownfield Network
Encouraging the appropriate and sustainable redevelopment of brownfield land in Ireland

10th Anniversary Event
Dublin, 15th September 2022

Thank You

An Roinn Comhshaoil, Aeráide agus Cumarsáide
Department of the Environment, Climate and Communications

Geological Survey
Suirbhéireacht Gheolaíochta
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IRISH RESEARCH COUNCIL
An Chomhairle um Thaighde in Éirinn

epa
Environmental Protection Agency

Department for the Economy
www.economy-ni.gov.uk
Geological Survey of Northern Ireland

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iCRAG
IRISH CENTRE FOR RESEARCH IN APPLIED GEOSCIENCES

Ireland Brownfield Network
15th September 2022

New methods for monitoring methanogenic sources of ground gas

BY SOPHIE MCDOWELL

MSC STUDENT QUEEN'S UNIVERSITY BELFAST

GRADUATE ENVIRONMENTAL CONSULTANT, AECOM BELFAST

AECOM

Introduction

- MSc project
- Environmental Engineering at QUB
- Graduate Environmental consultant at AECOM
- Supervised by David Kerr and Rory Doherty

Introduction

- Agenda:
  - Characteristics of methane
  - Sources of methane in the ground
  - Current approach to ground gas risk assessment
  - New approach to ground gas risk assessment
  - Findings and further research

Characteristics of methane

- Odourless, colourless gas
- Occurs abundantly in nature
- Greenhouse gas 20 times more potent than carbon dioxide
- Explosive mixture created by combining a concentration of methane within a certain range with air
- Lower explosive limit of 5% and an upper explosive limit of 15%
- Ignition source required
- Therefore, vital that protective measures which prevent accumulation of methane within buildings are designed and put in place

Sources of methane in the ground

- Landfills
- Made ground
- Mine workings
- Groundwater
- Peat bogs

Landfills

- Organic materials from wastes deposited at landfill sites are broken down
- Depending on:
  1. Age and composition of landfill waste
  2. Physical parameters, particularly volume and depth of waste
  3. Environmental factors which influence the gas regime, such as temperature, moisture content and pH
- Loscoe, Derbyshire - house destroyed by a methane gas explosion which caused serious injuries to 3 people
- Associated with historical landfill in proximity to site and gas migration pathways through ground

Made ground

- Made ground on brownfield sites
- May include degradable material such as vegetation, wood, papers, and rags
- Only if made ground contains higher quantities of carbon rich matter will methane concentrations will be higher
- Low generation potential - lack of driving force

Mine workings

- Formation of methane relates to coal measure deposits
- Ancient organic matter trapped within rocks is decomposed anaerobically
- Anthropogenic features such as shafts along with natural structures like fractured rock provide migration pathways to the surface
- Along with rising groundwater and potential flooding of mine workings, trapped methane and carbon dioxide is released into the atmosphere

- Abbeystead disaster – methane gas explosion at waterworks' valve house, killing 16 people
- Methane from coal deposits 4000ft below ground built up in a pipe

Groundwater

- Methane is a common trace component of groundwater
- Typically resulting from the associated geology
- Release of methane from groundwater through wells or to overlying soils can cause an explosion hazard in well houses or structures underground

Peat

- Decomposition of organic matter in peatland
- Accumulation of methane occurs
- Anaerobic degradation process is slow
- Carried out by specific microorganisms
- Final step being completed by methanogens
- Substrates that these microorganisms produce are the key factor in methane production

Current approach to ground gas risk assessment

- Current approach is an iterative risk assessment approach, as outlined in LCRM
- Specific gas risk assessment and mitigation guidance CIRIA C665, BS 8576:2013 and BS 8485:2015+A1:2019
- Most commonly - Preliminary Risk Assessment, intrusive site investigation and Quantitative Risk Assessment.
- Within the PRA, a preliminary conceptual site model is developed to identify potential sources of ground gas on the investigation site
- Site will then undergo an intrusive site investigation where 'spot monitoring' is the most common method used for ground gas monitoring
- Spot monitoring is defined as 'Discrete periodic monitoring usually carried out using hand-held equipment by suitably qualified technicians who visited a site to take monitoring well readings at prescribed intervals" (CL: AIRE, 2019)

Current approach to ground gas risk assessment

- Limitations to spot monitoring
  - High groundwater levels resulting in flooded boreholes
  - Pressure, flow rates and gas concentrations that are measured in the headspace of the well are not always illustrative of conditions in the surrounding area
  - Pressure changes associated with changes in groundwater levels - known as the 'piston effect'

New approach to ground gas monitoring

- Study site background
  - Development proposal for an extension to an existing commercial property
  - Geology underlying the site consisted of superficial tidal flat deposits and bedrock of the Wilmslow Sandstone formation
  - General potential sources of contamination identified in the CSM as diesel tanks and chemical stores located on site and off-site industrial properties in close proximity
  - No evidence of leakage from the chemical store nor the diesel tanks
  - CSM identified potential sources of ground gas as made ground and tidal flat deposits

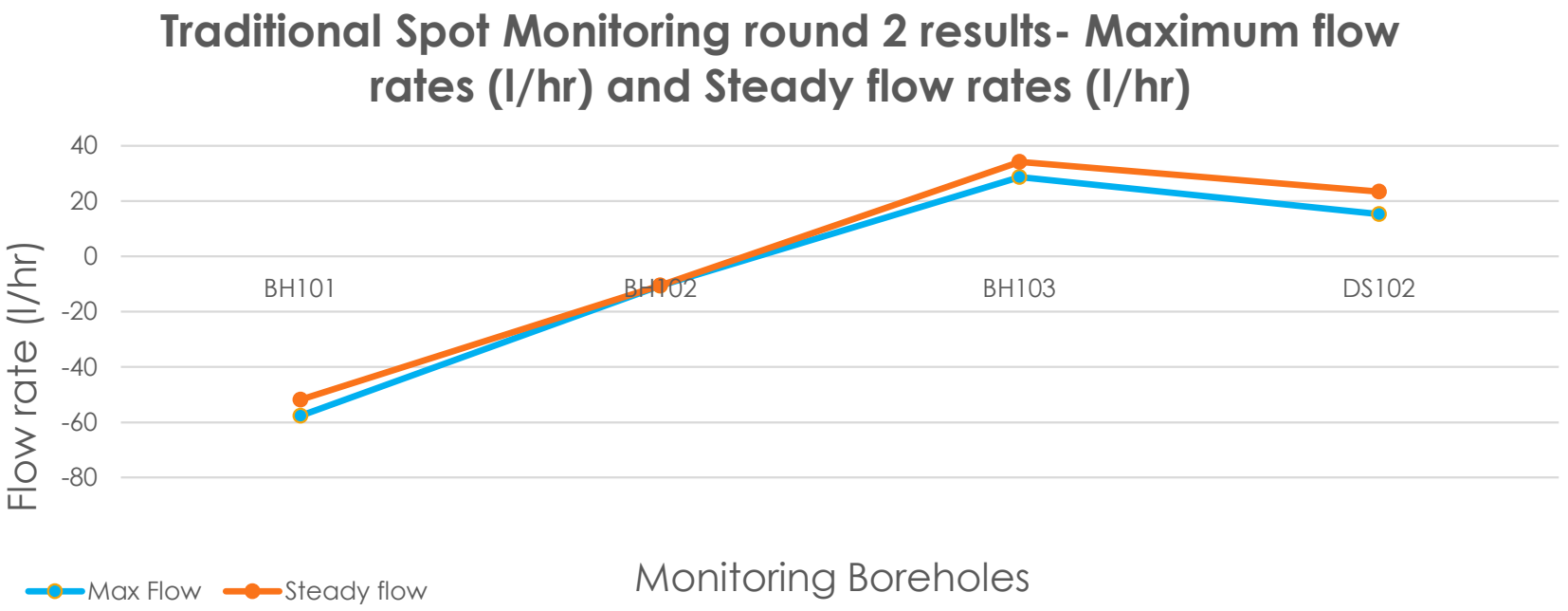
New approach to ground gas monitoring

- Site investigation completed with 4 rounds of traditional spot monitoring for ground gases
- Results indicated very high flow rates along with some elevated methane concentrations
- From the CSM, it was unclear why some of the flow rates in particular were so high
- Concerns the flow rates were being compounded by high groundwater levels causing response zones to be flooded
- To understand the potential impact of differential pressure within the well headspace (resulting from groundwater level changes in a sealed borehole), the flooded boreholes were discounted, and another round of monitoring completed

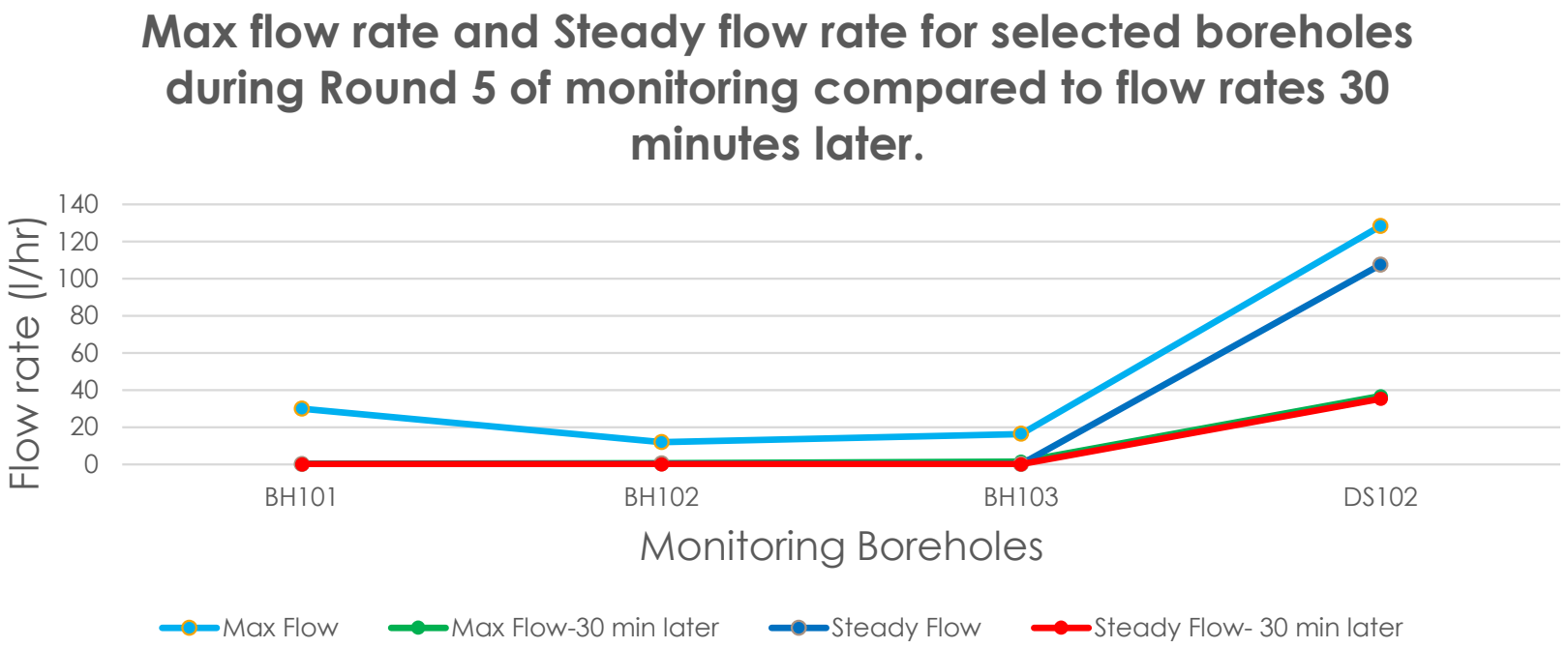
New approach to ground gas monitoring

- However, after the fifth traditional spot monitoring round, the gas taps were left open for 30 minutes to allow the monitoring well conditions to stabilise with the atmospheric pressure
- Monitoring then took place at the same locations and the steady flow and maximum flow rates were recorded once again
- This was considered to give a more representative picture of actual ground gas risk on this site

Findings


Traditional Spot Monitoring round 2 results- Maximum flow rates (l/hr) and Steady flow rates (l/hr)
40
20
0
-20
-40
-60
-80
Flow rate (l/hr)
BH101
BH102
BH103
DS102
Max Flow
Steady flow
Monitoring Boreholes

Findings


Max flow rate and Steady flow rate for selected boreholes during Round 5 of monitoring compared to flow rates 30 minutes later.
Flow rate (l/hr)
140
120
100
80
60
40
20
0
BH101
BH102
BH103
DS102
Monitoring Boreholes
Max Flow
Max Flow-30 min later
Steady Flow
Steady Flow- 30 min later

Findings

- Substantial difference in flow rates following the 30 minutes in which the gas taps were left open, and stabilization was allowed to occur
- BH103 had a maximum flow rate of 16.4 l/hr during the 5th traditional spot monitoring round but when the tap was left open for 30 minutes, BH103 maximum flow rate was only <0.01 l/hr
- High flow rates recorded in the traditional spot monitoring visits were likely to be affected by the fluctuating groundwater levels causing differential pressure within the well headspace to change
- Huge impact on the overall risk assessment as the CS value which is worked out using the Modified Wilson and Card (1999) method depends on the flow rate measured
- If the wrong CS value is estimated this can lead to over-engineering, a waste of resources, and is not a cost-effective or sustainable approach

Further research

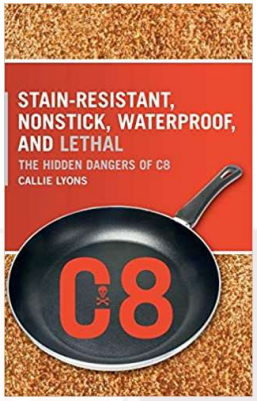
- Similar studies to this to build evidence
- Investigations that avoid spot monitoring all together- Gas generation potential through methanogenesis
- Use QPCR to quantify these methanogens in made ground

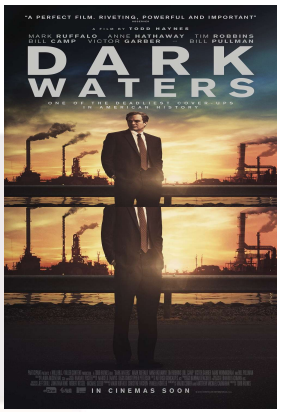
Introduction to PFAS

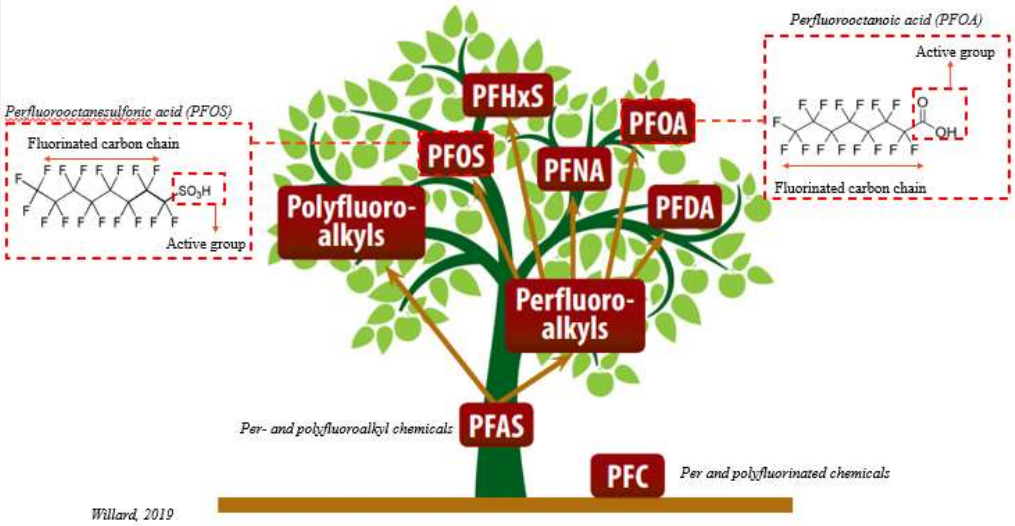
1. *Background*
2. *Origins and Properties*
3. *Sampling Procedures and Considerations*
4. *Screening Limits and Considerations*

Introduction

- PFAS is an abbreviation for per- and poly-fluoroalkylated substances.
- PFAS are a broad group of over 5,000 man-made organic chemicals that do not occur naturally in the environment.
- PFAS contains a very stable fully fluorinated carbon chain.
- The European Food Safety Authority (EFSA) concluded that a considerable portion of the European population is expected to consume PFAS compounds, from food and water, at concentrations higher than the 'tolerable weekly intake'.







PFAS Uses

Non-stick cookware

Firefighting Foam

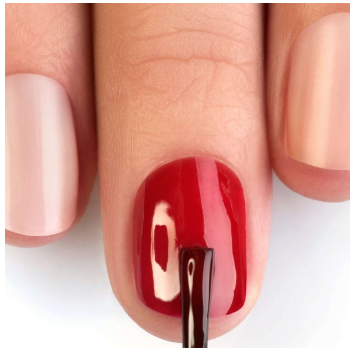
Water resistant coating

Food packaging

Personal care/cleaning products

Hydraulic Fluids

Pesticides

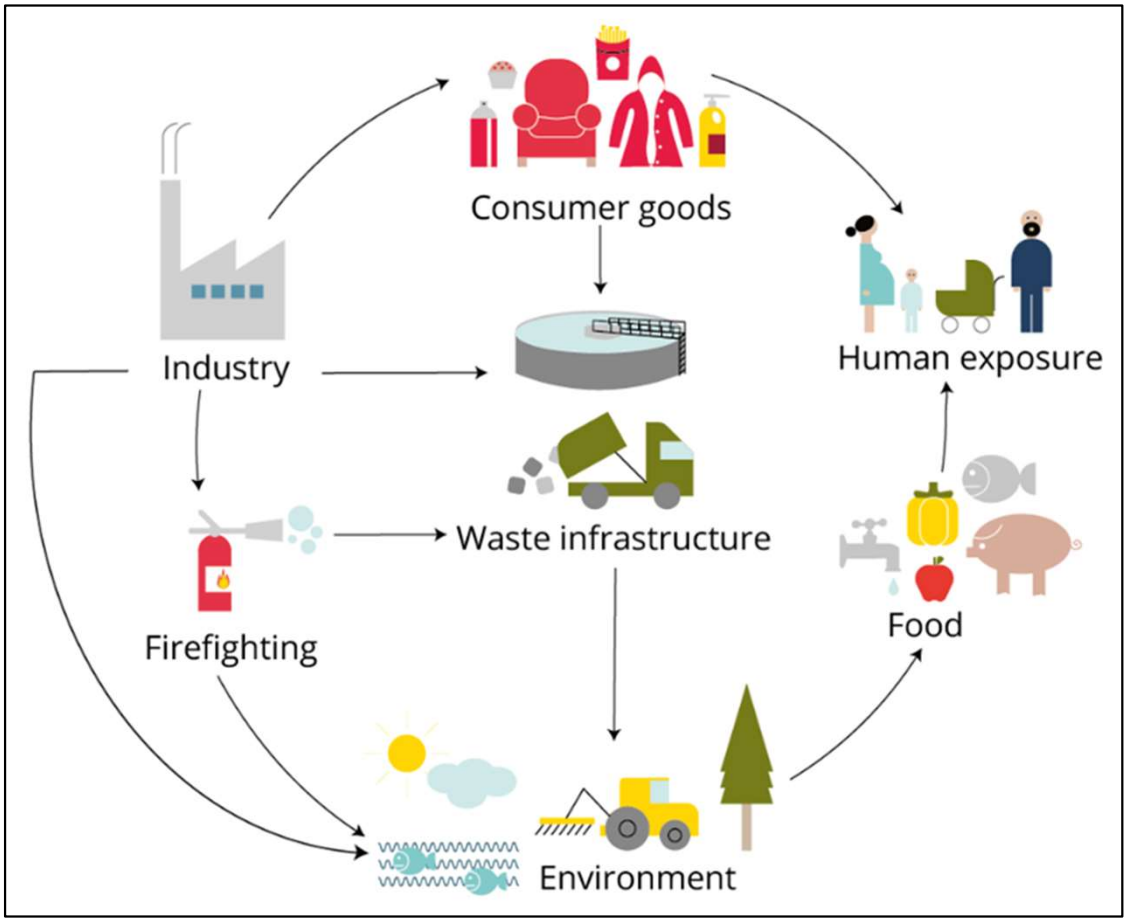


Ink, varnish, paints

Exposure Pathways

•For humans, the main PFAS exposure pathways are:

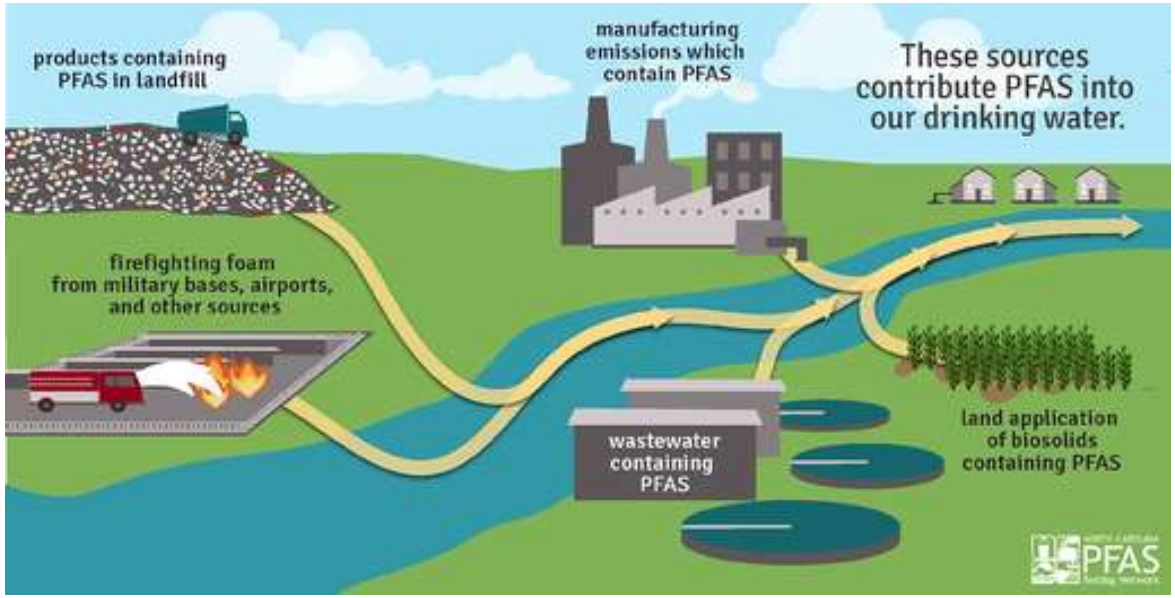
- Food (fish meat, fruit and eggs contribute the most);
- Consumer products:
  - direct exposure from creams,
  - inhalation of sprays,
  - emissions from PFAS-coated cookware
  - dust from PFAS-coated textiles
- Drinking water.



V. Di Battista, R. Kerry Rowe, D. Patch, K. Weber. 2020.

Origin

Source
Airports
Military sites
Civil fire training areas and fire stations
Large industrial facilities, such as petrochemical plants, refineries, and other bulk chemical storage terminals
Upholstery manufacture and other textile industries
Chemical facilities where PFAS manufactured or used during production e.g. Teflon.
Landfills
Wastewater treatment works (WwTW) and land spreading



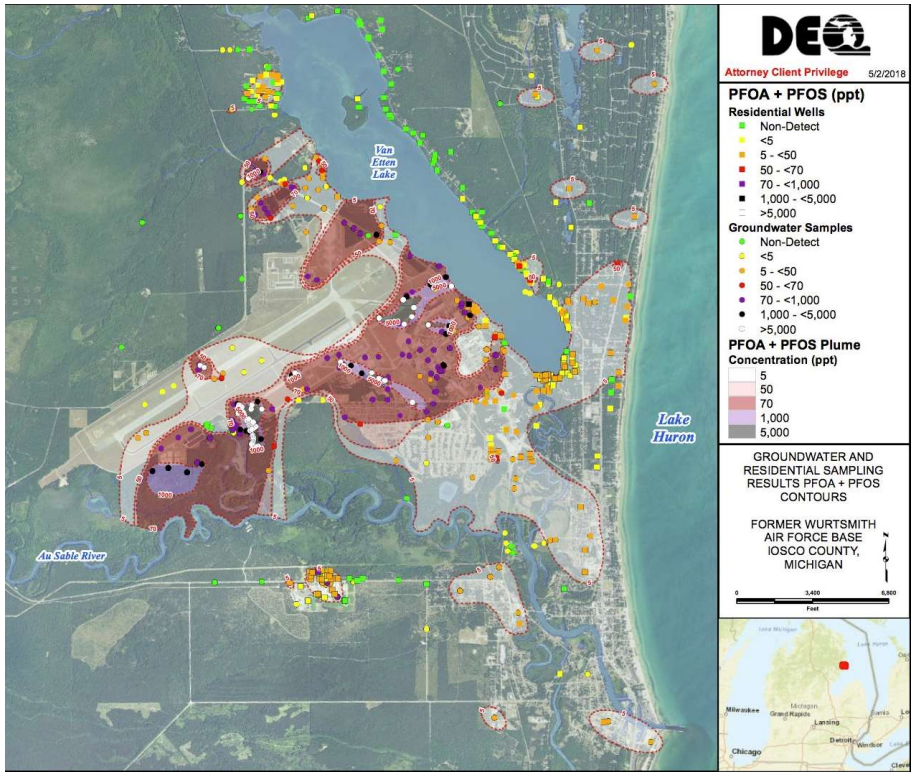
Properties

Mobility

- Some PFASs are highly soluble, (solubility increasing in short chain PFAS a low sorption potential to mineral
- Plumes have been reported in groundwater/surface water systems that are kilometres long.
- Volatile PFAS are mobile in air and can be transported to remote areas

Persistence

- Do not breakdown under normal environmental conditions.
- Half-lives for PFASs in the environment are very long once ingested they can take a long time for the body to remove (3+ years)
- PFAS in the soil unsaturated zones can continue to be a source to the underlying groundwater for many decades, as precursors in the soils biotransform into more mobile PFAAs.



Strategy

- First step is always a desk study prior to designing a ground investigation, and a preliminary Conceptual Site Model (CSM) to inform the assessor of any environmental risks from carrying out the work.
- Locations at risk are not necessarily going to appear on a historical map.
- Instead, we should look for evidence of its potential use on a site e.g. Fire extinguishers and storage areas and evidence of fire training areas or chemical storage areas/disposal areas.
- One of the best sources remains local knowledge.

Sampling for PFAS

Currently no Ireland specific guidance, however United States and Australia have long standing published PFAS Sampling Guidance:

- Michigan Department of Environmental Quality (2018), 'General PFAS Sampling Guidance'.
- Heads of EPA Australia and New Zealand (HEPA), *PFAS National Environmental Management Plan (2020)*

Sampling for PFAS

Key sample media:

- Soil
- Groundwater
- Fresh and marine surface water
- Sediment
- Biota (flora and fauna)
- Air (not routine)
- Foam, concrete, landfill leachate etc.

Key Issues:

1. **High risk of cross contamination**

PFAS is ubiquitous in the modern day environments and there are numerous opportunities for cross contamination. Detailed quality control plan including rinsate, field blanks and trip blanks required.

2. **Low environmental guidance values**

PFOS 0.00013 µg/L (*European Union Environmental Objectives (Surface Waters) Regulations (S.I No. 77 as amended in 2019))*

PFOS 0.014 mg/kg (Environment Agency, Derivation and use of soil screening values for assessing ecological risks, report – ShARE id26 (revised), March 2020.)

Sampling for PFAS

Michigan Department of Environmental Quality provides a 'traffic light' system for prohibited, allowable and need screening materials on PFAS sampling programs.

Prohibited:

- Decon 90®
- Any materials that contain fluropolymers (Teflon® and Hostaflon® etc.)
- New / unwashed clothing / Gor-Tex.
- No food should be consumed in staging or sampling area

Allowable:

- Alconox®, Liquinox®, or Citranox®
- HDPE / LDPE / Silicon tubing
- Powdered nitrile gloves
- Well – laundered synthetic or 100% cotton clothing

Need screening:

- Drinking water for decontamination
- Tyvek suits / boiler suits / water proof jackets
- Sunscreens / insect repellents
- Marker pens / water field note books / plastic clipboards

Regulatory Guidelines

- Two PFAS compounds (PFOS / PFOA) currently restricted under the international Stockholm Convention on POPs.
- Other PFAS compounds are being evaluated for restriction.
- Requirement to notify the EPA annually if you have stockpiles of PFOA or PFOS related substances onsite with a aggregate volume of >50kg.

- Numerous guidance values available for USA, Australia, Europe, continually being updated.

Institiúid Uisce DCU
DCU Water Institute

Dr. Blánaid White
Associate Professor

15th September 2022

MISSION

Our mission is to inspire and nurture talent to carry out multi- and transdisciplinary research and generate innovative solutions to global water challenges.

VISION

Our vision is to be globally recognised for innovations in water research and education.

Research Themes

POLICY, GOVERNANCE & RESEARCH INTEGRITY

THEMES

WATER AND HEALTH	MARINE	ENERGY AND AGRICULTURE	GOVERNANCE AND SOCIETY

SOME PROJECTS

— Emerging Contaminants — Micro & Nano Plastics — Environmental DNA — Water reuse	— Biofouling & Antifouling — Ocean Sensing — Earth Observation Integration — Smart Bay Dublin — Renewable Energy	— Hydrogen Energy — Water Treatment — Circular Economy — Net zero carbon — Nutrients	— Policy Impact — Societal Engagement — Valuing Water Initiative — Corporate Social Responsibility — Water Management

DCU

DCU

Institiúid Uisce DCU
DCU Water Institute

In Uganda, Operation and Maintenance (O&M) of rural water facilities is largely centred on the Community Based Maintenance System (CBMS). The high non-functionality rate of rural water facilities is undermining the efforts to increase access to improved water sources

WHAT MEMBERSHIP MEANS

Water-Share Ireland's collaboration with GOAL has added considerable value to GOAL's WASH programming in 2019.

The success of GOAL's WASH programming is enhanced by having meaningful engagement with Water-Share Ireland companies and by tapping into the talent, commitment and generosity of their employees.

By joining the Water-Share partnership, companies not only offer their employees an opportunity to help GOAL deliver essential WASH programmes to people in need, but members also experience a tangible connection between their businesses and GOAL's development work , which can not only fulfill corporate social responsibility objectives, but can also help enrich staff member's work experiences.

Dublin City University

Water Institute

Expertise snapshot of Water Institute Academic Researchers for Water-Share GOAL Partnership

DCU

Water-Share Irela

- Operation and Maintenance (O&M) of rural water facilities (hand pumps).
  - Jamming of the flow meter and flow control (shut off) valve. Small particulate matter is being carried along with the pumped ground water.
  - GOAL is hopeful that with some dedicated design research and development could help it find simple low cost solutions to address these issues.

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Other projects

- Solar powered LEDs for UV disinfection of lake water.
- Investigation of GIS based mapping of latrine locations and access points for effluent recovery


UN Sustainable Development Goals
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS
Water
Water is central to many of the UN SDGs

Every drop of water counts:

The **availability of affordable**, **clean water** represents the greatest global challenge of our time.

Throughout the journey **from source to sea** water management meets many challenges such as **infrastructure failures**, the need for treatment innovations.

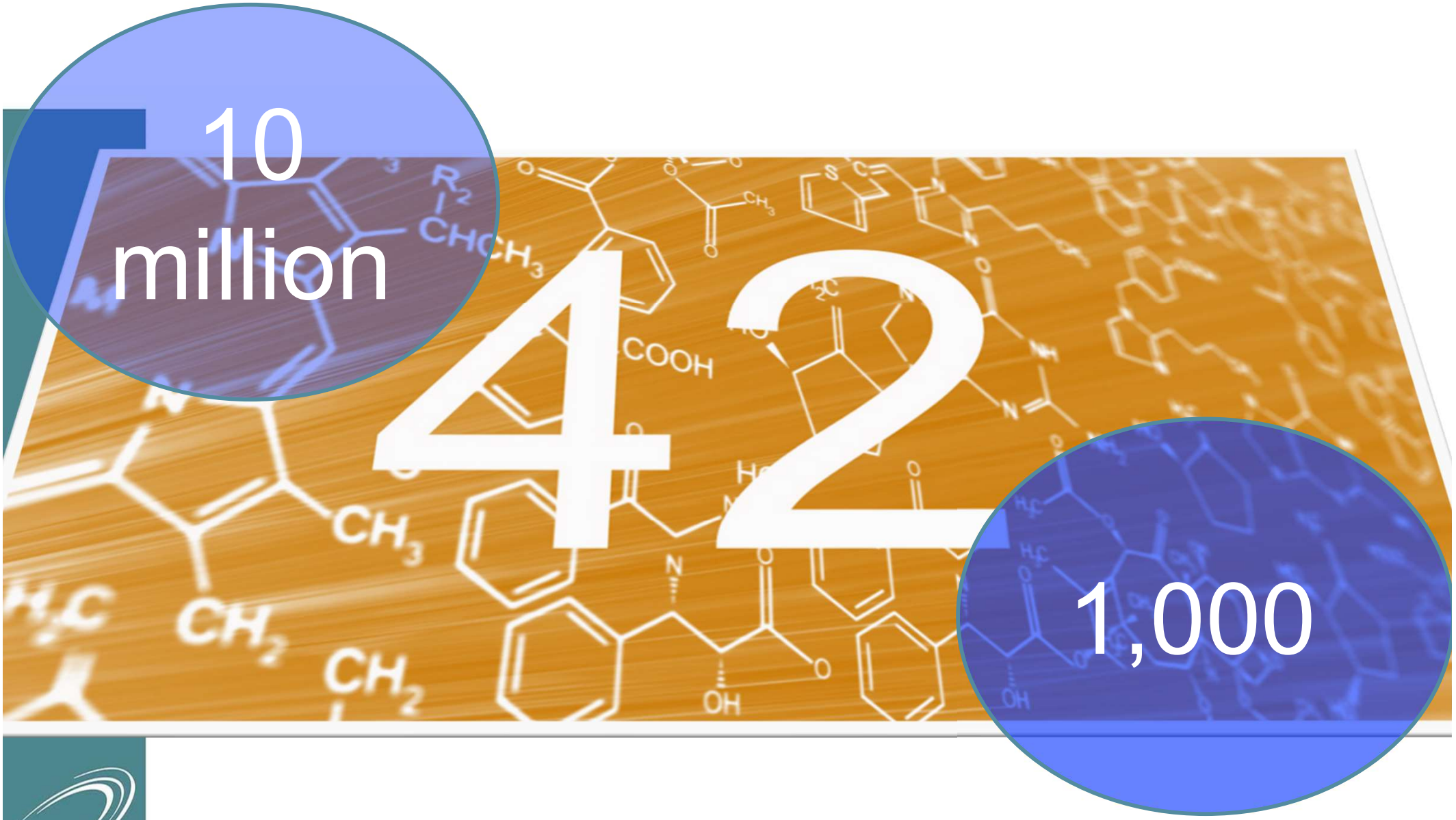
A Chemical Cocktail

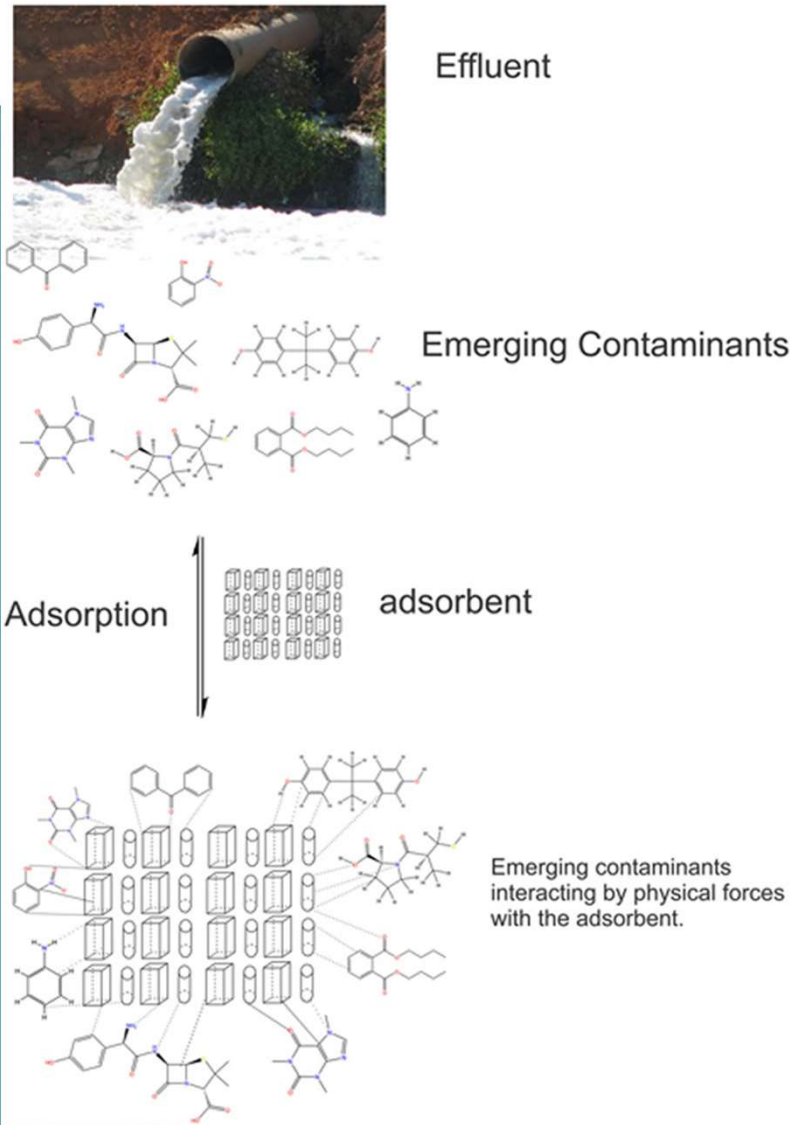
In the 1960s, Rachel Carson's *Silent Spring* sounded the alarm on the environmental dangers of synthetic chemicals – The problem has not gone away, it is as relevant today as it was then.

Synthetic chemicals

- Pharmaceuticals
- Petroleum hydrocarbons
- *Per*fluorinated chemicals
- Pesticides
- Phthalates

DCU

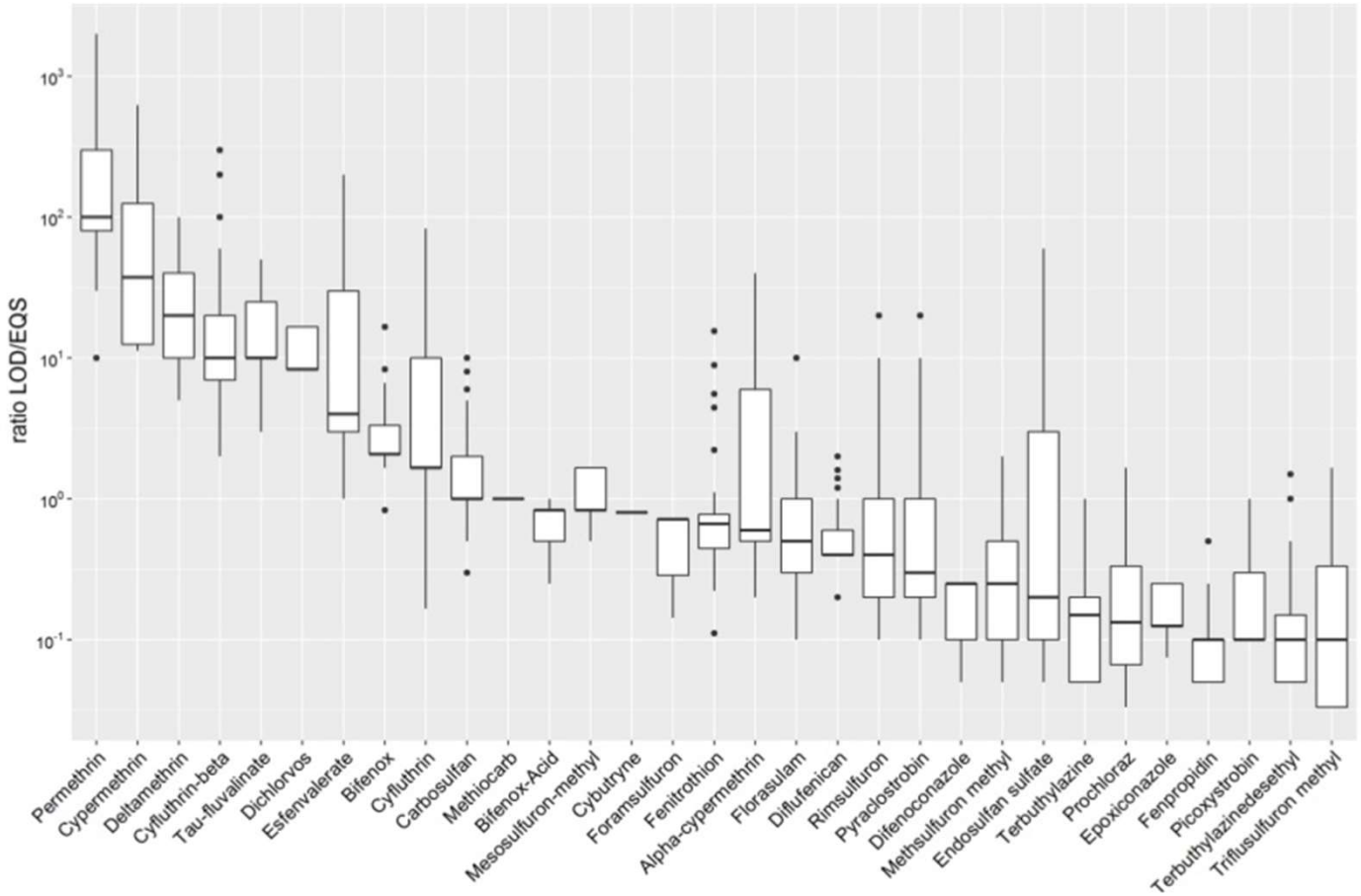

10
million
42
1,000
DCU



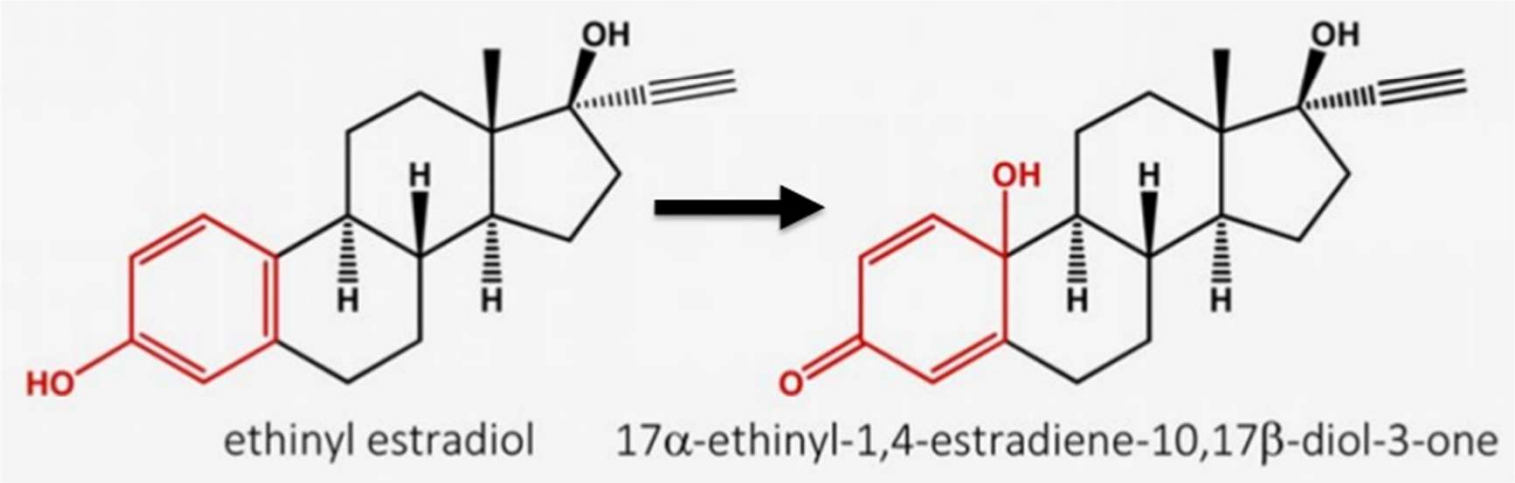
Emerging contaminants – what are they?

- Emerging contaminants (EC's) are pollutants of growing concern.
- They are mainly organic compounds such as: pesticides, pharmaceuticals and personal care products, hormones, plasticizers, food additives, wood preservatives, laundry detergents, surfactants, disinfectants, flame retardants, and
- other organic compounds that were found recently in natural wastewater stream generated by human and industrial activities.

Analytical challenge



Gustavsson, et al. (2017) *Pesticide mixtures in the Swedish streams: Environmental risks, contributions of individual compounds and consequences of single-substance oriented risk mitigation*, Science of the Total Environment. 973–983.



Oxidation of Ethinylestradiol

Transformation product has a higher estrogenicity than the parent compound

Cwiertny, et al. (2014) 'Environmental designer drugs: When transformation may not eliminate risk', *Environmental Science and Technology*, 48(20), pp. 11737–11745.

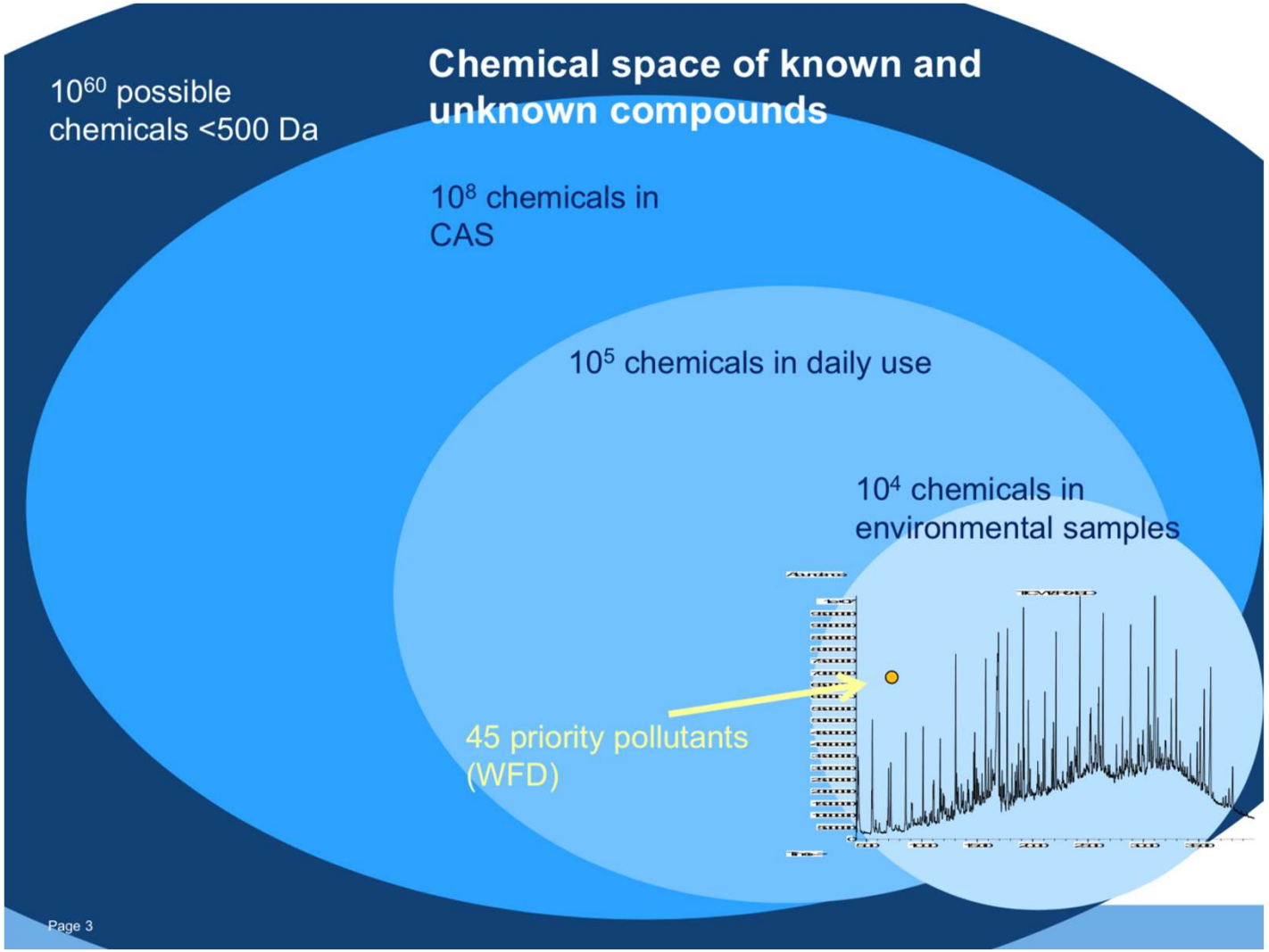
Watch list – what is that?

DCU

The main criteria for inclusion:

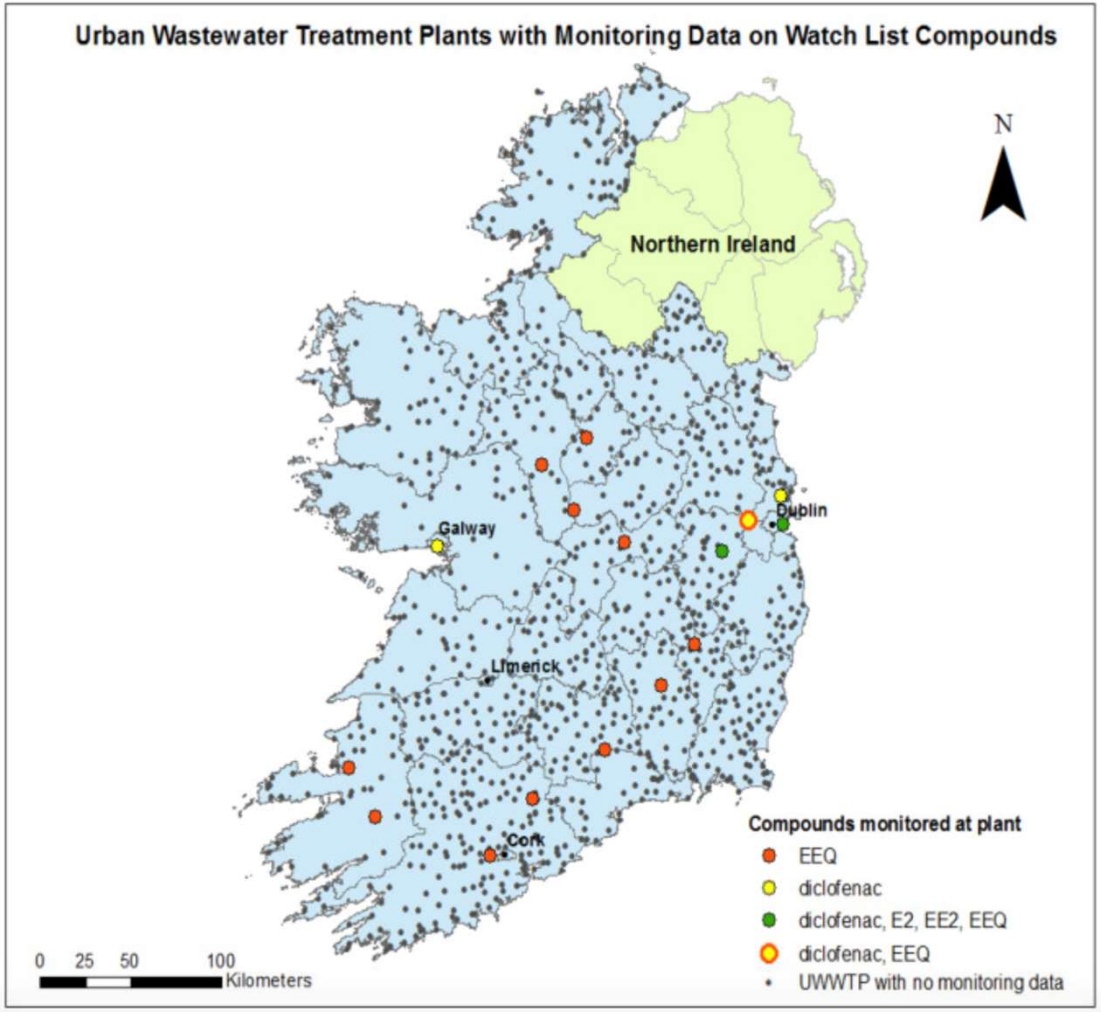
i) the substance is suspected of posing a significant risk to, or via, the aquatic environment, meaning there is reliable evidence of hazard and of a possible exposure to aquatic organisms and mammals, but

ii) there is not enough information to assess the EU-wide exposure for the substance, i.e. insufficient monitoring data or data of insufficient quality, nor sufficient modelled exposure data to decide whether to prioritise the substance.



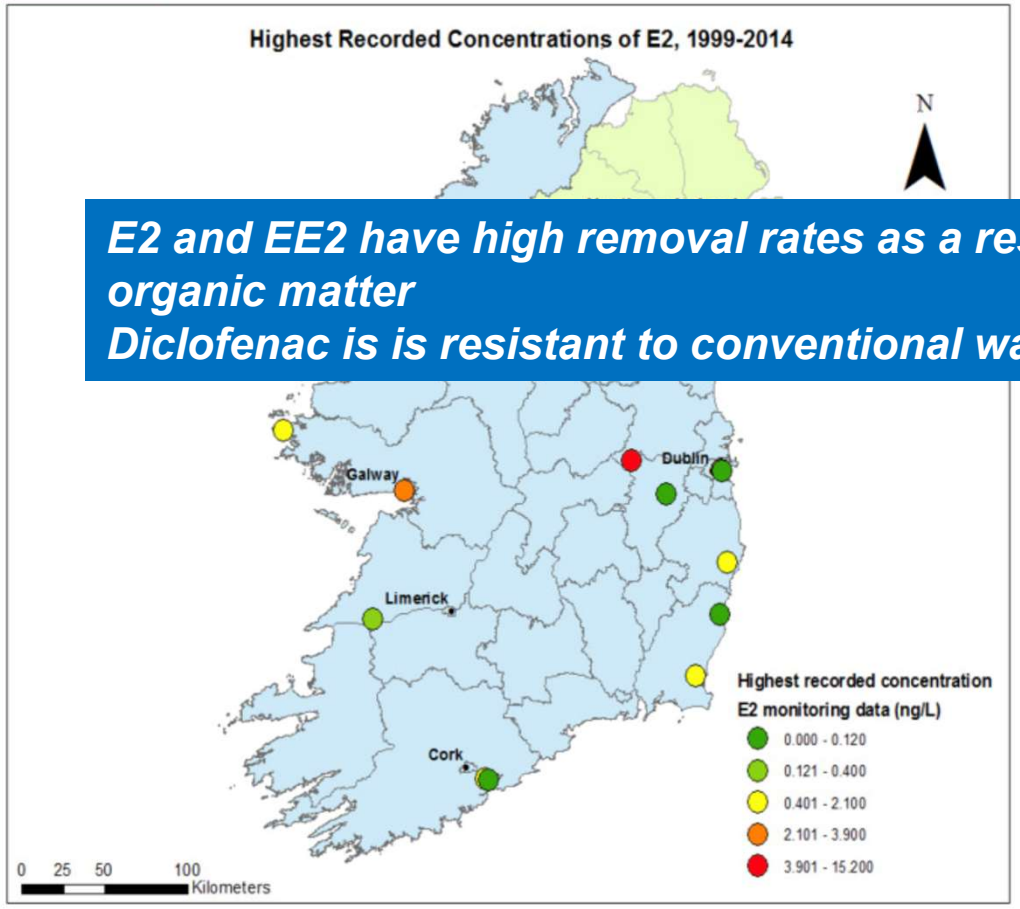
www.solutions-project.eu

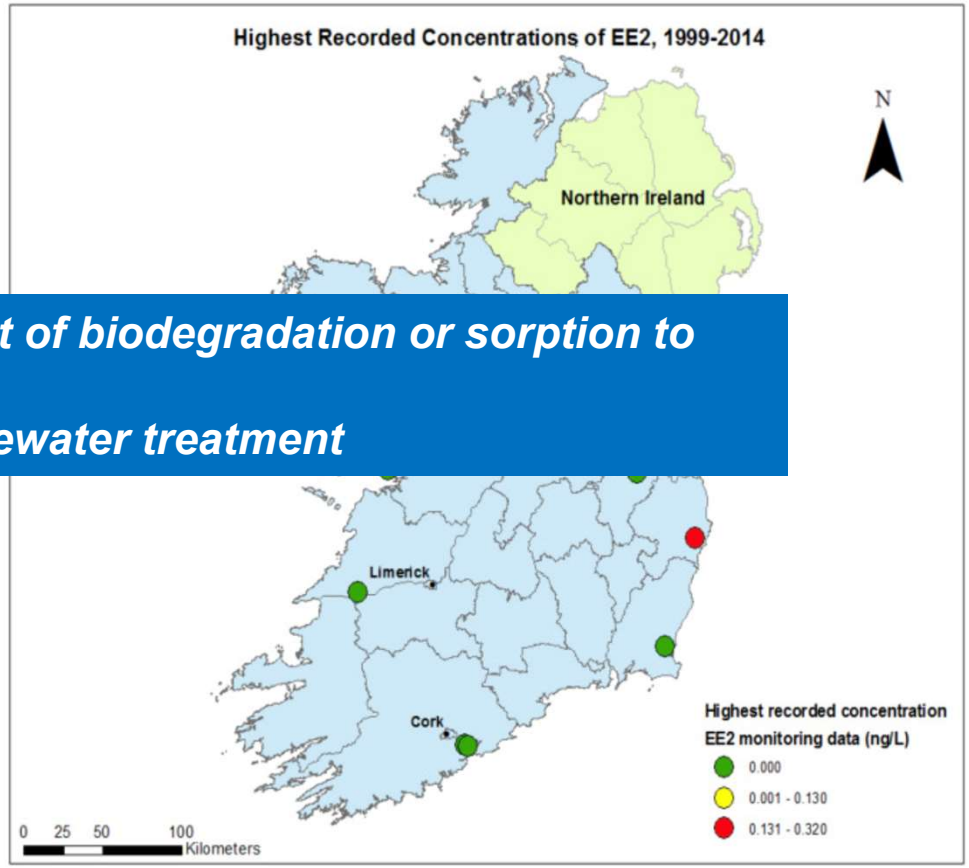
Ireland and CECs – what do we know?



Tahar, A et al. Sci Total Environ (2018) 616-617:187

Ireland and CECs – what do we know?



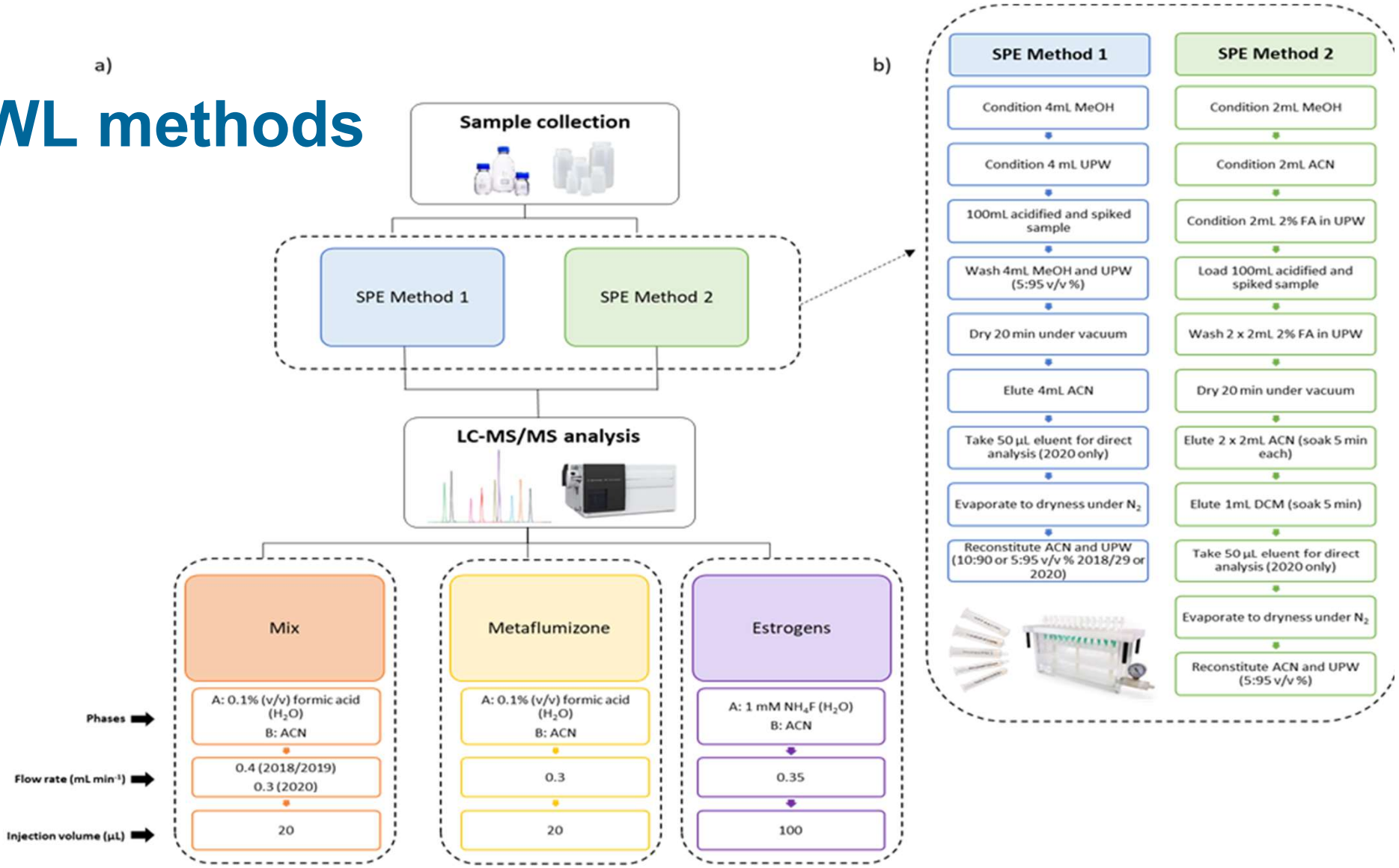


E2 and EE2 have high removal rates as a result of biodegradation or sorption to organic matter
Diclofenac is is resistant to conventional wastewater treatment

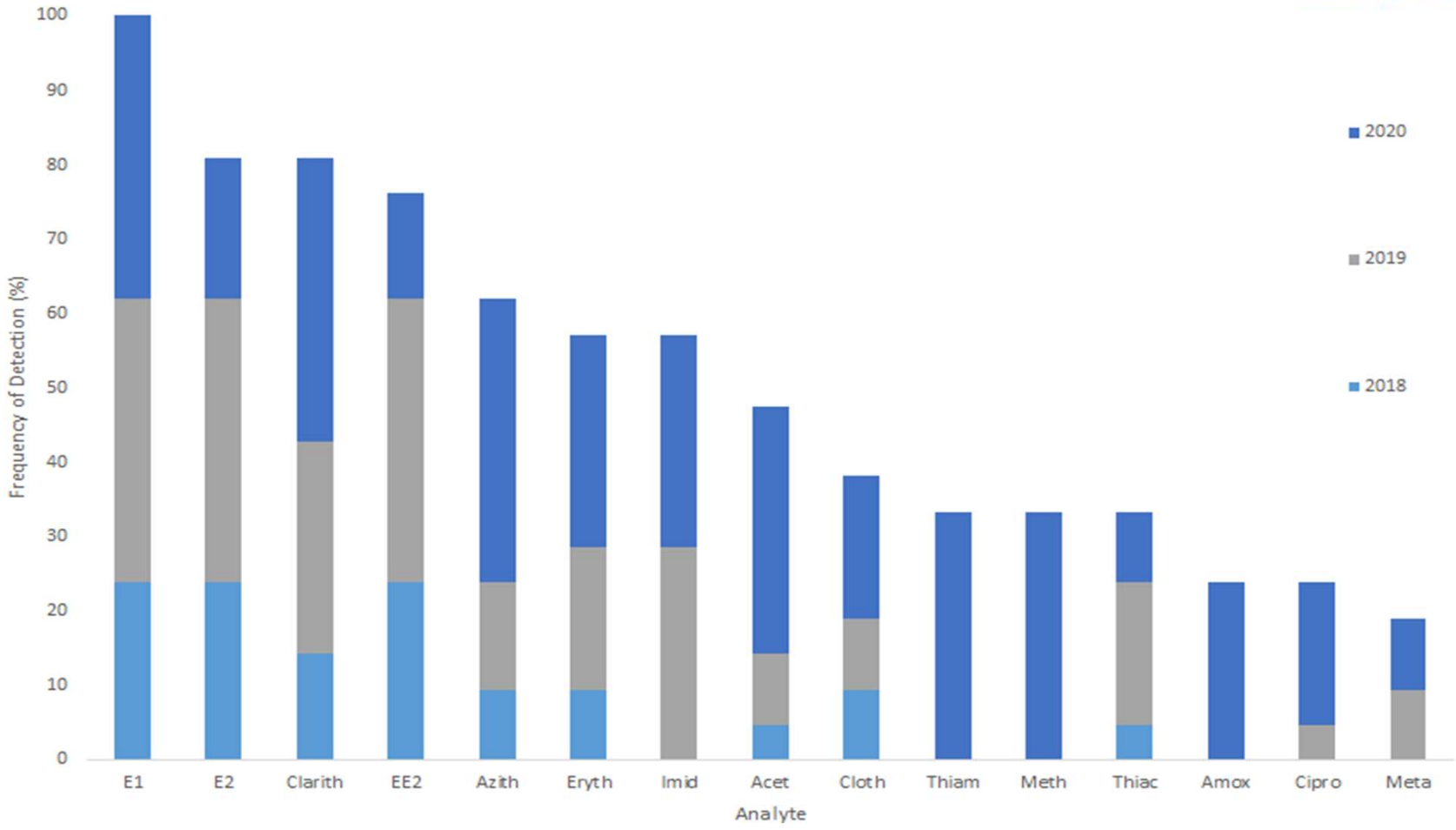
Tahar, A et al. Sci Total Environ (2018) 616-617:187

DCU

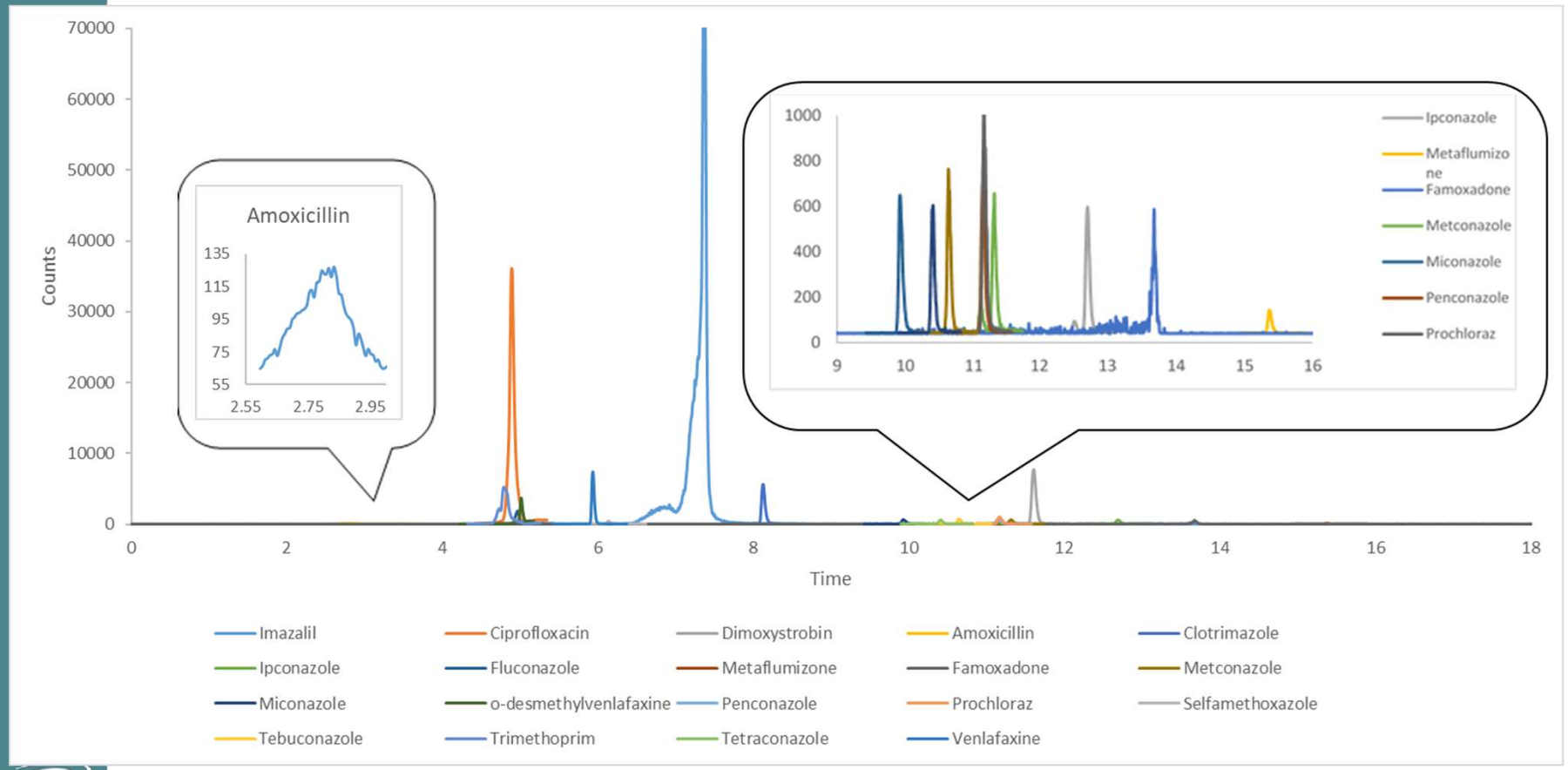
2nd WL methods



WL analyte detections 2018-20



Separation of 3rd Watch List Chemicals



Pharmaceuticals

The pharmaceutical sector exists to improve the wellbeing and health of billions of people globally.

World Economic Forum tells us that pharmaceutical pollution of the world's rivers is so extensive - that it now poses a global threat to environmental and human health.

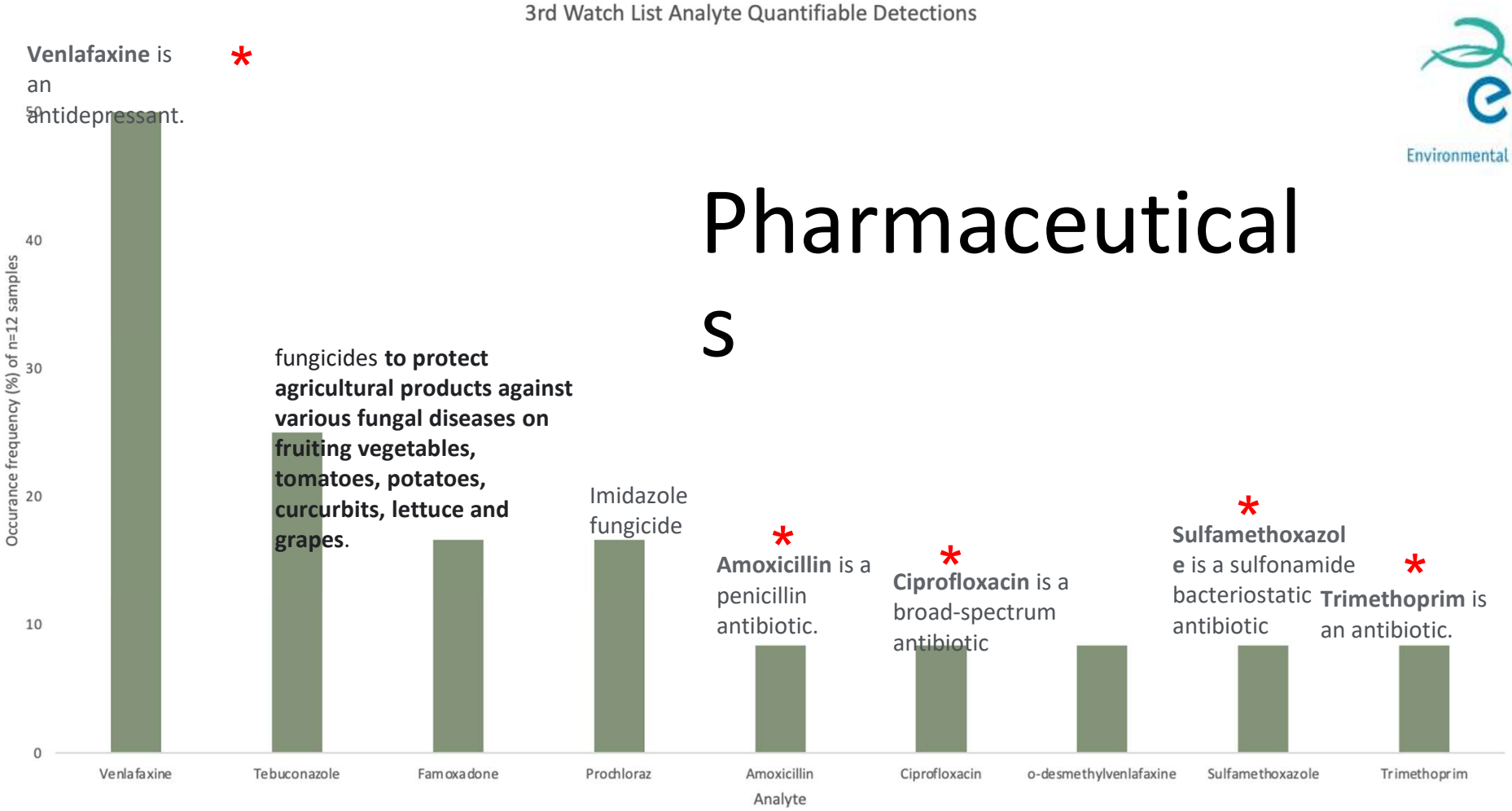
*The level of **pharmaceuticals in rivers** poses a threat to the world's ability to deliver on the UN Sustainable Development Goal to provide clean drinking water and sanitation for all by 2030.*

***Antibiotic resistance** may cause 10 million deaths per year by 2050. (*John L. Wilkinson *et al.,* PNAS 2022 Vol. 119 No. 8 e2113947119)

https://www.weforum.org/agenda/2022/02/pharmaceutical-pollution-health-drugs-rivers/

DCU

Pharmaceuticals



Venlafaxine is an antidepressant. *

fungicides **to protect agricultural products against various fungal diseases on fruiting vegetables, tomatoes, potatoes, curcurbits, lettuce and grapes**.

Imidazole fungicide

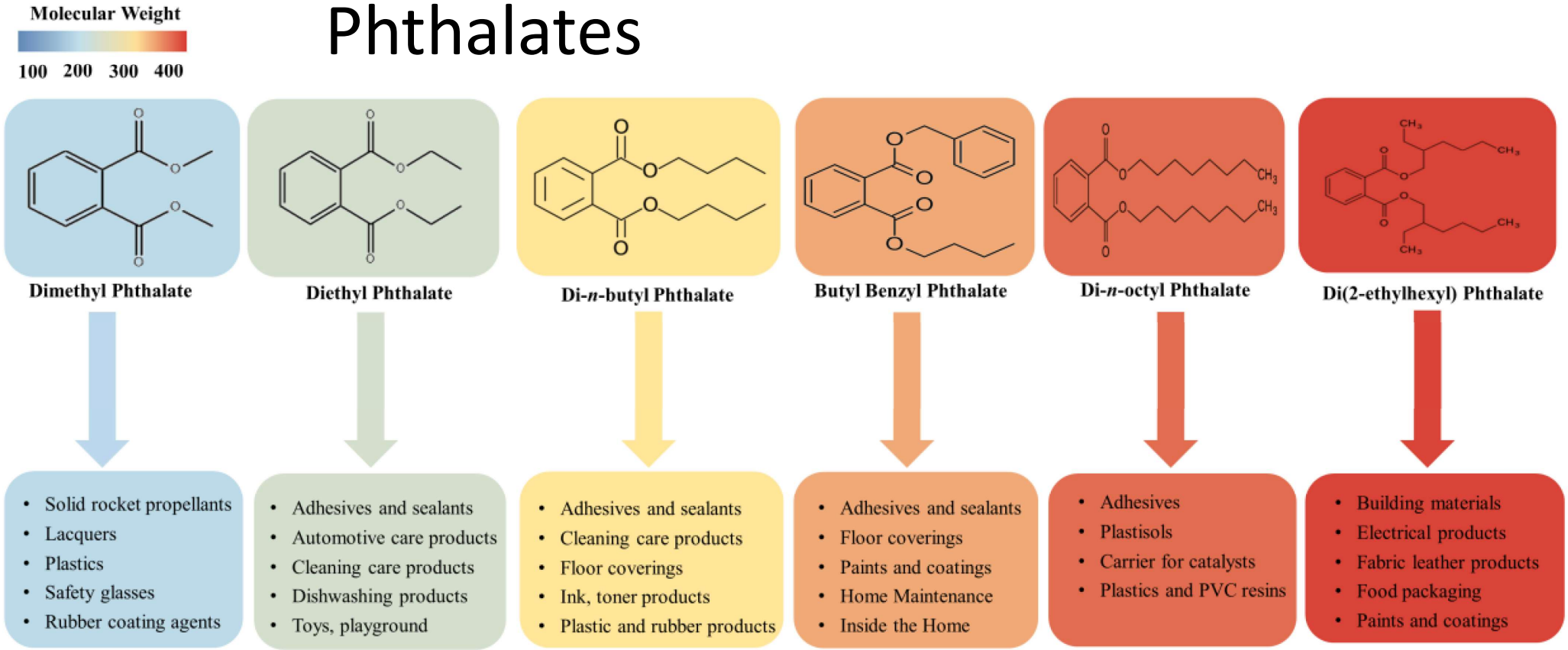
*
Amoxicillin is a penicillin antibiotic.

*
Ciprofloxacin is a broad-spectrum antibiotic

*
Sulfamethoxazole is a sulfonamide bacteriostatic antibiotic

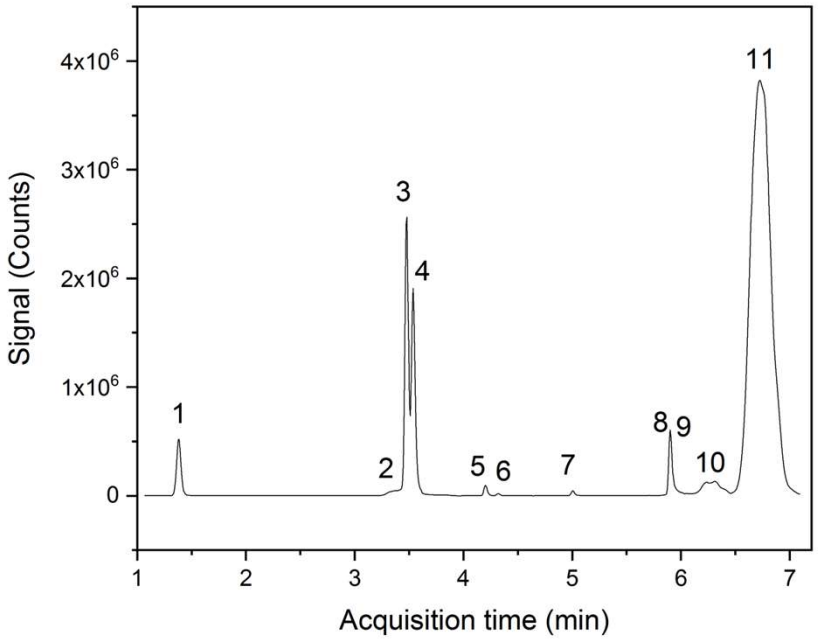
*
Trimethoprim is an antibiotic.

Phthalates



Toxins **2021**, *13*, 495. https://doi.org/10.3390/toxins13070495

Phthalate determination



Column: 2.1 x150 mm, 2.7 μm internal diameter Poroshell, temperature 60^{O} C
Mobile Phase: Water 50:50 MeOH:ACN
Gradient: 0 min 60%B, 2.0 min 80% B, 5.0 min 100%B, 9.1 min 60% B
Flow Rate: 0.4 mL/min
Injection Volume: 2 μL

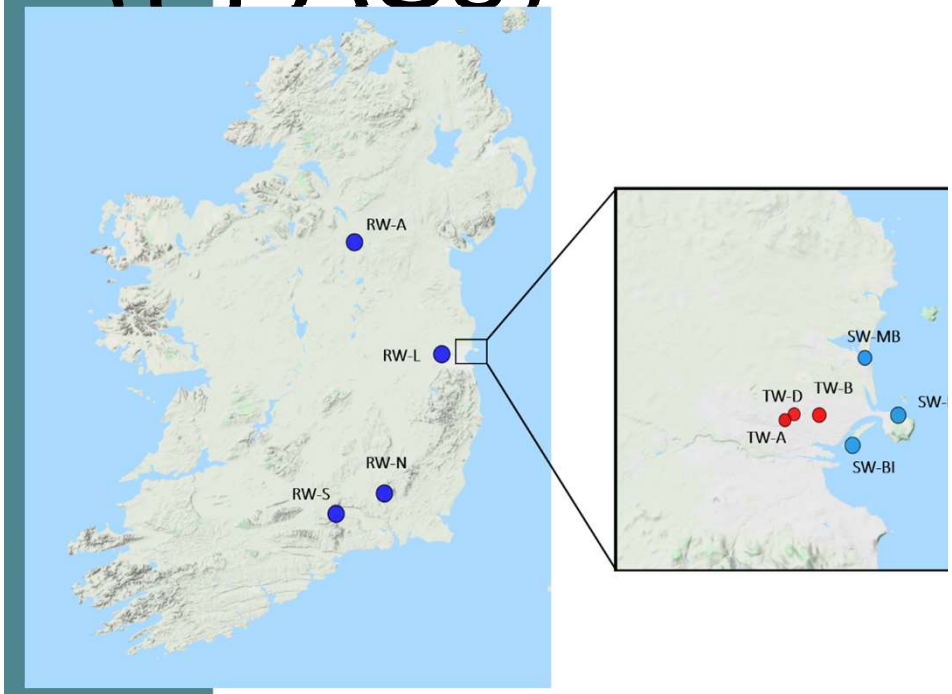
Peak No.	Compound	Precurser Ion	Product Ion	Fragmentor Energy	Collision Energy
1	Dimethylphthalate (DMP)	195.1	162.9	62	8
		195.1	77	62	40
2	Benzylbutylphthalate (BBP)	313.2	91	1	77
		313.2	148.9	1	77
3	Diisobutylphthalate (DIBP)	279.2	205.1	1	90
		279.2	149	1	90
4	Dibutylphthalate (DBP)	279.2	205	50	4
		279.2	148.9	50	12
5	Diisopentylphthalate (DIPP)	307.18	149	96	20
		307.18	77.1	96	12
6	Dipentylphthalate (DNPP)	307.2	219	96	4
		307.2	148.9	96	20
7	Dihexylphthalate (DHP)	335.2	233	80	4
		335.2	148.9	80	12
8	Diethylhexylphthalate (DEHP)	391.3	279	115	12
		391.3	148.9	115	28
9	Di-n-octylphthalate (DNOP)	391.3	166.9	99	12
		391.3	148.9	99	32
10	Diisononylphthalate (DINP)	419.31	148.9	96	24
		419.31	71.1	96	20
11	Diisodecylphthalate (DIDP)	447.3	141.1	99	8
		447.3	85.1	99	16

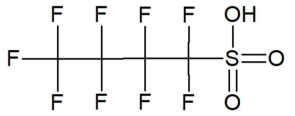
Phthalate occurrence

	Analyte (n=3, ±2SD)										
Sample Type	DMP	BBP	DiBP	DBP	DiPP	DPP	DHP	DEHP	DnOP	DiNP	DiDP
Surface Water (µg/L)	117.35 (±1.20)	64.23 (±1.97)	252.75 (±2.89)	428.27 (±13.76)	12.82 (±0.30)	49.67 (±3.30)	10.84 (±0.80)	83.35 (±1.79)	3.86 (±0.05)	2.67 (±0.09)	49.83 (±2.21)
Household Waste (µg/g)	0.62 (±0.06)	2.09 (±0.14)	6.05 (±0.68)	1 (±0.10)	0.15 (±0.02)	1.55 (±0.16)	0.62 (±0.06)	0.3 (±0.02)	0.03 (±0.002)	0.25 (±0.02)	2.08 (±0.06)
Soil (µg/g)	1.596 (±0.145)	1.055 (±0.152)	3.501 (±0.325)	5.006 (±0.558)	0.245 (±0.019)	1.595 (±0.166)	0.668 (±0.051)	0.553 (±0.076)	0.095 (±0.008)	0.271 (±0.042)	0.143 (±0.030)
Sludge (µg/g)	6.76 (±0.78)	3.22 (±0.44)	48.84 (±5.74)	34.33 (±4.60)	0.51 (±0.06)	4.06 (±0.56)	1.51 (±0.30)	14.78 (±0.70)	0.22 (±0.04)	12.40 (±0.01)	6.23 (±0.54)
Waste water outfall (µg/L)	179.21 (±4.39)	137.58 (±2.48)	945.26 (±12.64)	941.70 (±12.85)	141.40 (±1.87)	27.27 (±0.64)	10.31 (±0.77)	178.96 (±6.09)	129.19 (±3.10)	1.01 (±0.05)	59.27 (±3.68)

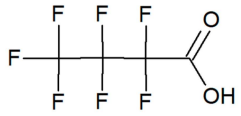
DCU

Poly- and perfluoroalkyl substances (PFASs)

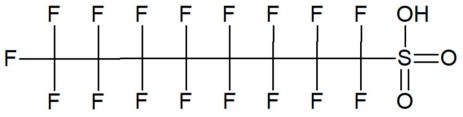




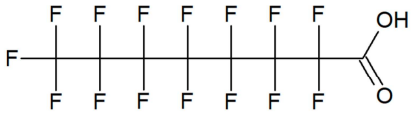
PFBS



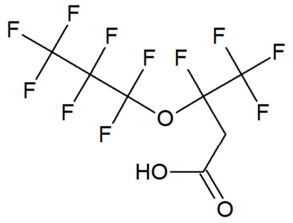
PFBA



PFOS

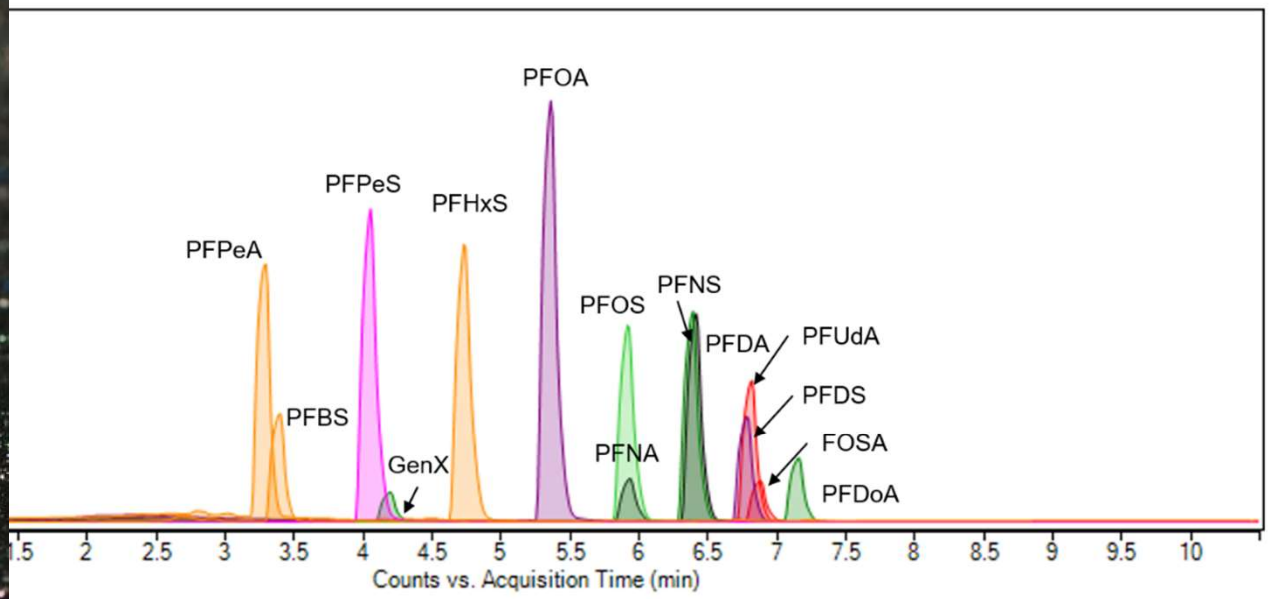


PFOA

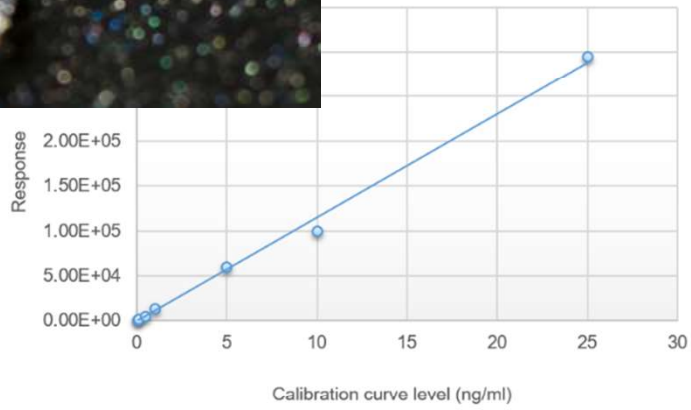


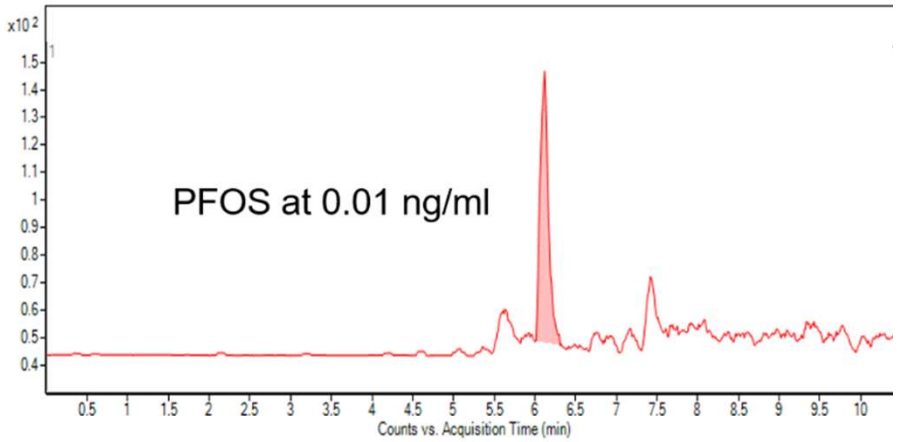
GenX

Forever chemicals


PFOA
PFPeS
PFHxS
PFPeA
PFOS
PFNS
PFDA
PFUdA
PFBS
PFDS
GenX
FOSA
PFNA
PFDoA
1.5 2 2.5 3 3.5 4 4.5 5 5.5 6 6.5 7 7.5 8 8.5 9 9.5 10
Counts vs. Acquisition Time (min)

c)


Response
2.00E+05
1.50E+05
1.00E+05
5.00E+04
0.00E+00
0 5 10 15 20 25 30
Calibration curve level (ng/ml)


x10 2
PFOS at 0.01 ng/ml
0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 5.5 6 6.5 7 7.5 8 8.5 9 9.5 10
Counts vs. Acquisition Time (min)

DCU

	Matrix	PFPeA	PFBS	PFHxA	GenX	PFOA	PFNA	PFDA	PFUdA
BLK 1	Blank H_2O	<MLQ	<MLQ	<MLQ	<MQL	<MLQ	<MLQ	<MLQ	<MDL
BLK 2	Blank SPE	<MLD	<MDL	<MDL	<MQL	<MDL	<MQL	<MQL	<MDL
TW-A	Drinking Water	<MLQ	<MDL	<MDL	<MQL	5.3	<MQL	<MQL	<MDL
TW-B	Drinking Water	<MLQ	<MDL	10.7	<MQL	7.3	<MQL	<MQL	<MDL
TW-D	Drinking Water	5.3	4.1	6.6	15.6	6.8	<MQL	<MQL	<MDL
SW-MB	Seawater	<MLQ	<MQL	<MQL	<MQL	<MQL	<MQL	<MQL	<MDL
SW-H	Seawater	6.7	34.0	<MQL	<MQL	<MQL	<MDL	<MQL	<MDL
SW-BI	Seawater	13.5	45.3	7.0	<MQL	<MQL	<MQL	<MQL	<MDL
RW-N	River Water	301.2	49.5	134.6	39.1	172.9	43.0	22.2	6.9
RW-S	River Water	424.1	68.9	173.3	44.7	205.4	46.5	24.1	5.5
RW-L	River Water	250.2	64.0	122.7	33.4	138.2	30.8	15.8	6.9
RW-A	River Water	269.5	35.2	132.6	32.0	197.5	56.4	23.7	8.8

Sampling point

FUdA
FDA
FNA
FOA
enX
FHxA
FBS
FPeA

Zero Pollution – *A Pipe Dream*

Fig. 1 Map showing the sampling sites (1–10) along the river Liffey. Map shows urban landcover in the study area, as well as the water courses that run through the city.

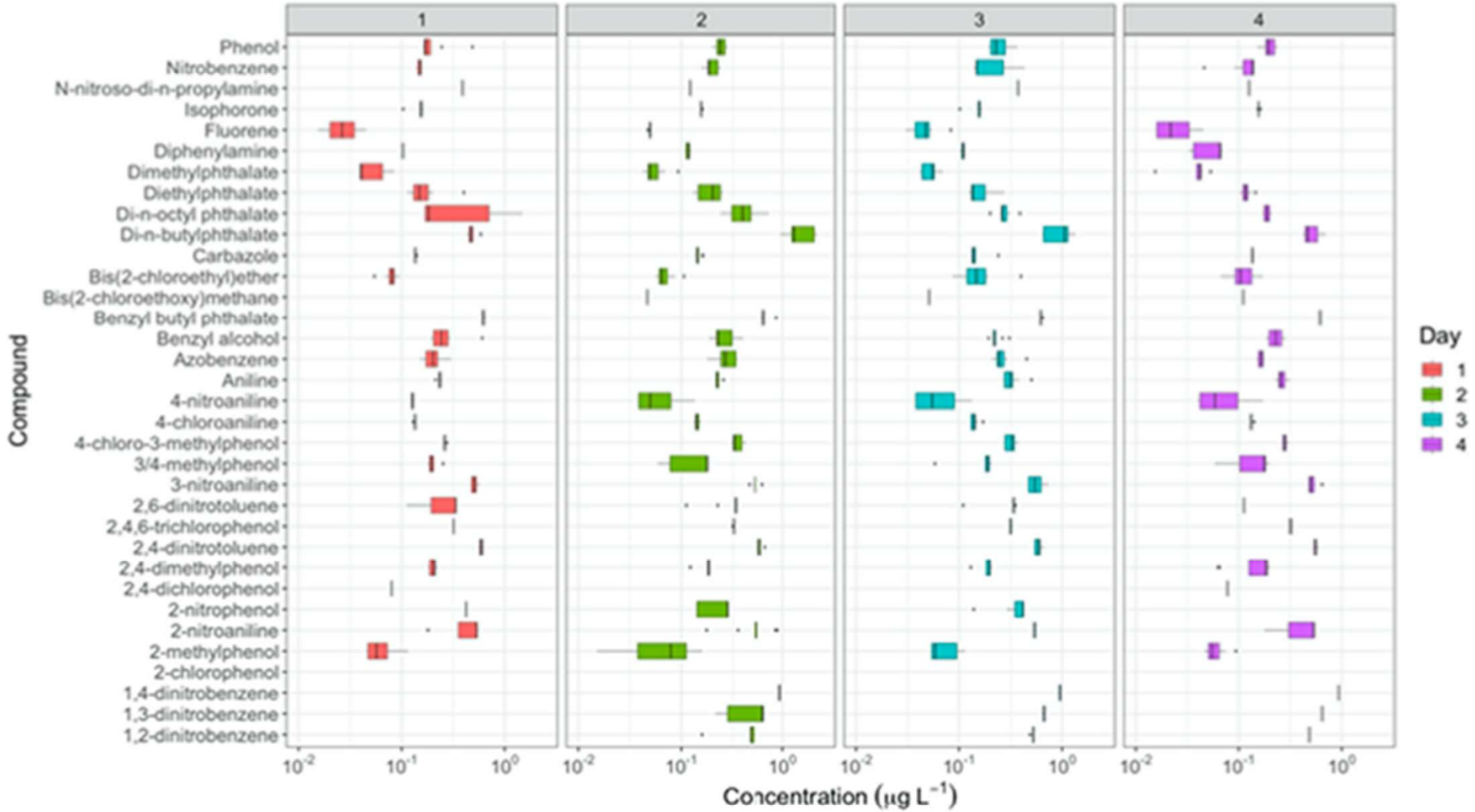
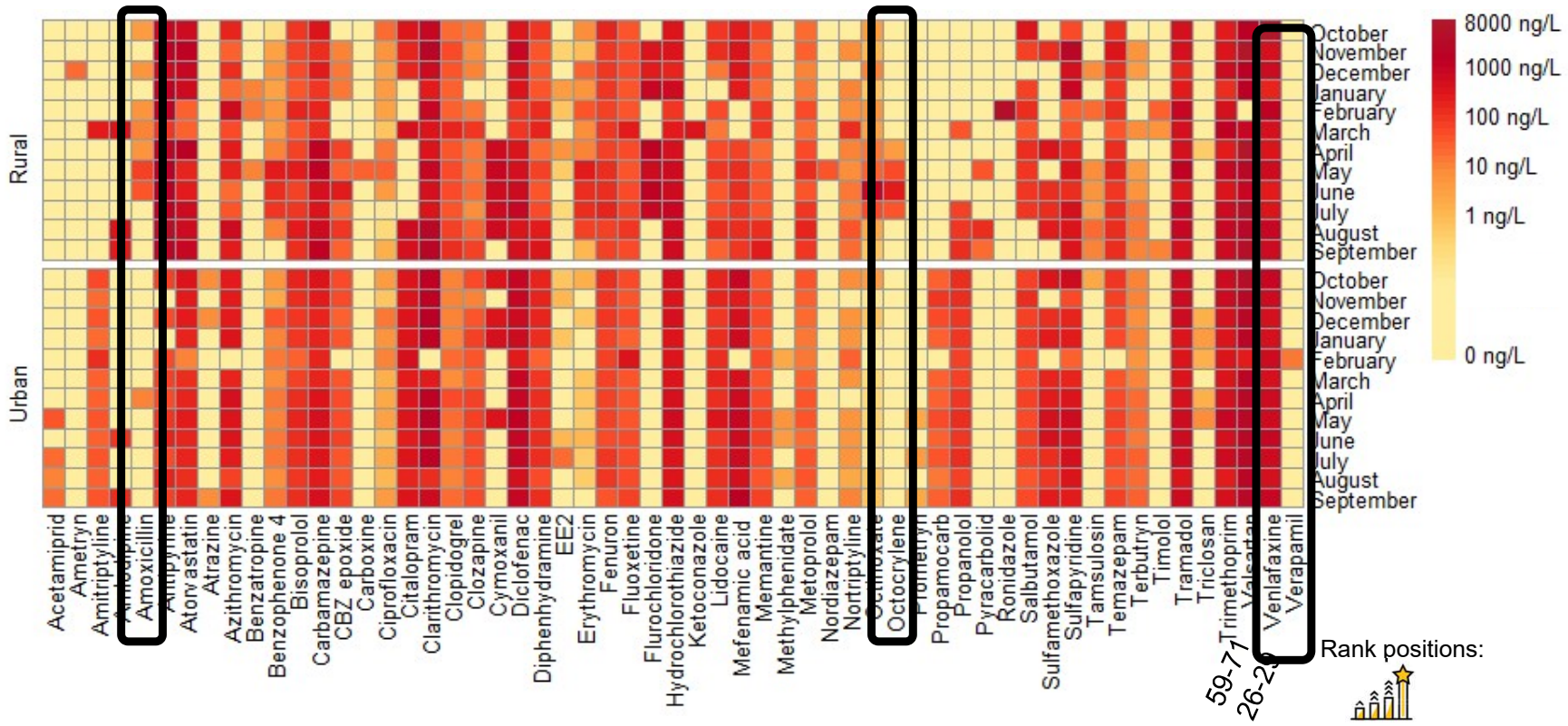


Fig. 2 Concentrations (µg L^{-1}) of target chemicals measured in water samples on each of the four sampling days (1–4). There were two outliers for dimethylphthalate; Day 2 for sampling locations 4 (105.01 ug/L) and 8 (48.09 ug/L). N = 3 which have not been plotted for reasons of clarity

CEC detections in Ireland in a one year study



Risk: Effect Based Methods

Analytical Methods

ROYAL SOCIETY OF CHEMISTRY

CRITICAL REVIEW

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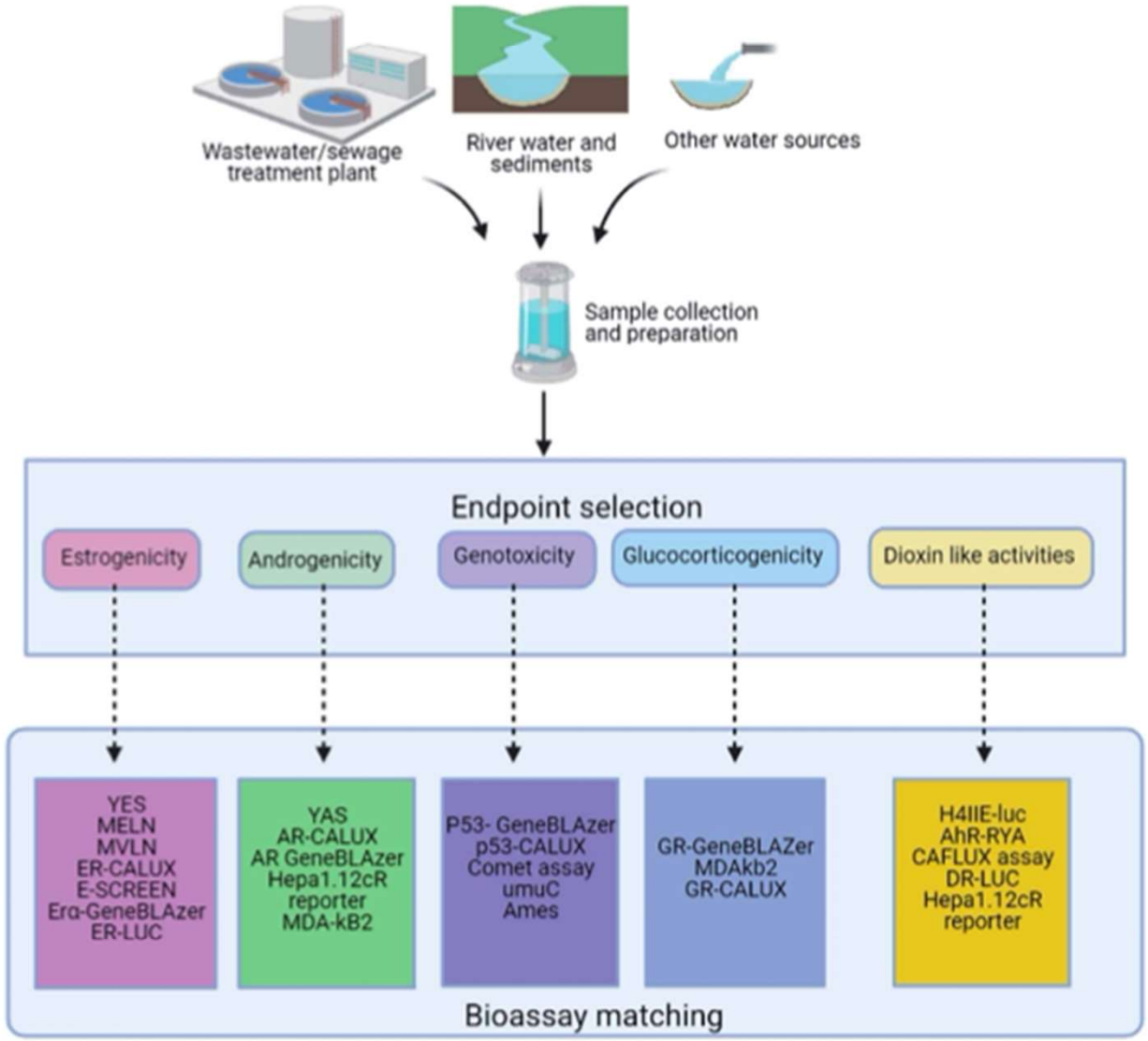
Cite this: *Anal. Methods*, 2021, **13**, 5120

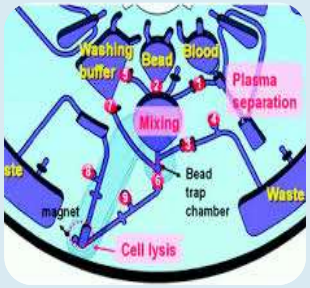
Monitoring of emerging contaminants of concern in the aquatic environment: a review of studies showing the application of effect-based measures

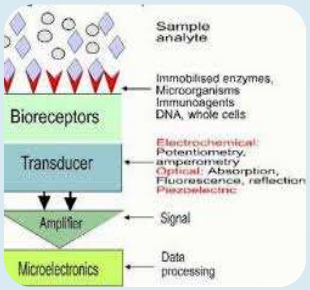
Azeez Yusuf, [ac] Dylan O'Flynn, [bc] Blanaid White, [bc] Linda Holland, [ac] Anne Parle-McDermott, [ac] Jenny Lawler, [acd] Thomas McCloughlin, [ac] Denise Harold, [a] Belinda Huerta [bc] and Fiona Regan *[bc]

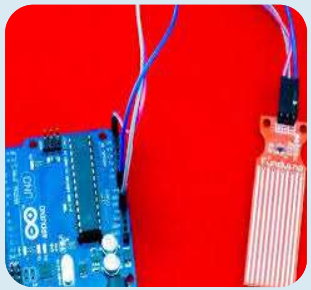
DCU


Wastewater/sewage treatment plant
River water and sediments
Other water sources
Sample collection and preparation
Endpoint selection
Estrogenicity
Androgenicity
Genotoxicity
Glucocorticogenicity
Dioxin like activities
YES
MELN
MVLN
ER-CALUX
E-SCREEN
Erα-GeneBLAzer
ER-LUC
YAS
AR-CALUX
AR GeneBLAzer
Hepa1.12cR reporter
MDA-kB2
P53- GeneBLAzer
p53-CALUX
Comet assay
umuC
Ames
GR-GeneBLAZer
MDAkb2
GR-CALUX
H4IIE-luc
AhR-RYA
CAFLUX assay
DR-LUC
Hepa1.12cR reporter
Bioassay matching

Key Messages







Informed decision making → need to manage & protect	Be open to **new ways of monitoring** water for emerging contamin	**Novel technology** can play a role and we need to see significan	**Integrate technology with data analytics** – work with stakehol	**Better approach to management** of a scarce & valuable resource with limited

DCU

chemicals

research

Acknowledgements

- Lisa Jones
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- Ivan Maguire.
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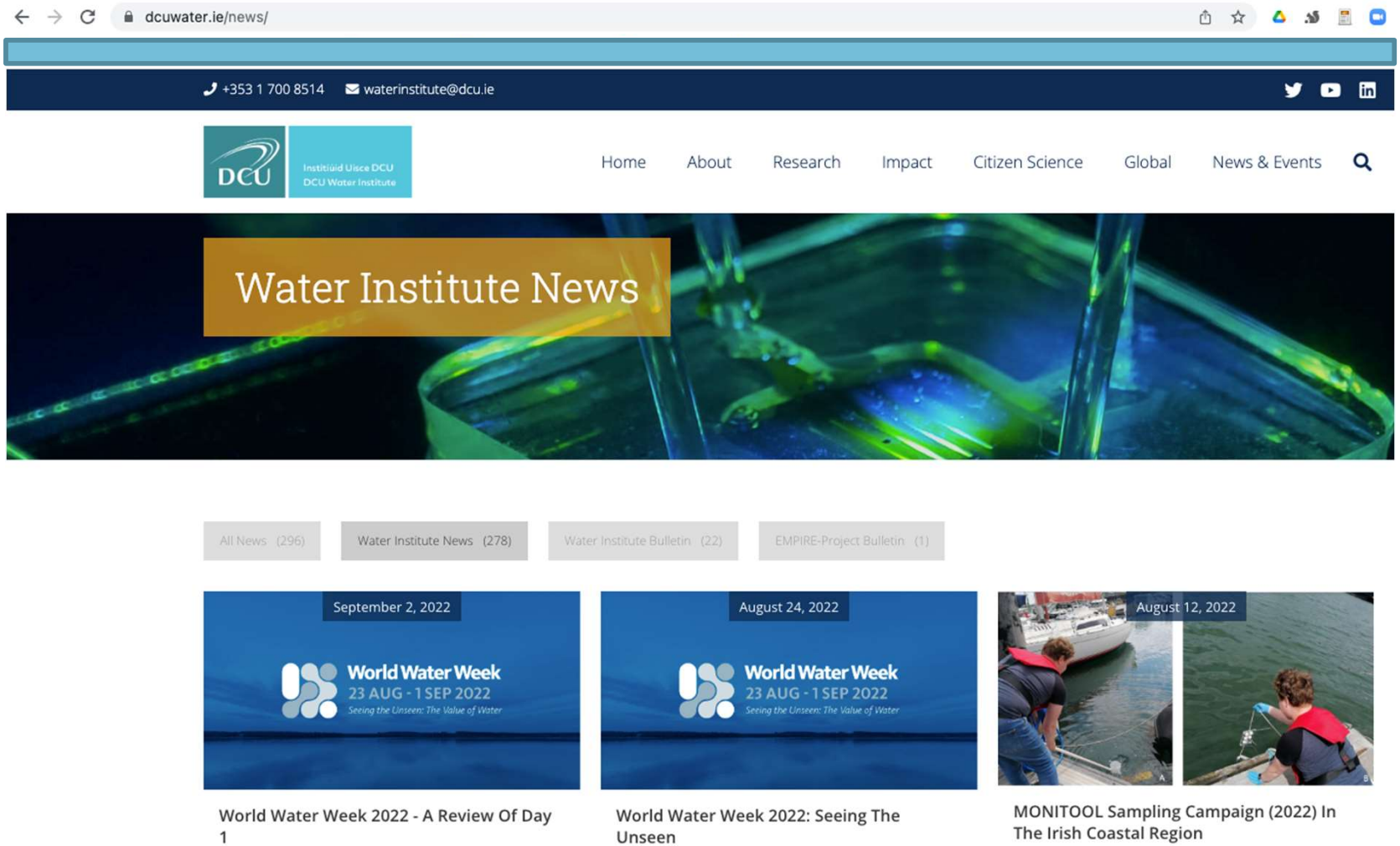
- Leon Barron
- Blanaid White
- Jenny Lawler
- Linda Holland

Thank you! Questions?



Ollscoil Chathair
Bhaile Átha Cliath
Dublin City University

EPA Research Project "IMPACT" - Innovative Monitoring to Prioritise Contaminants of Emerging Concern (CECs) for Ireland

CECs

Contaminants of Emerging Concern (CECs) refer to any chemical not currently being regularly monitored, but which has the potential to enter the environment and cause harm to human, animal and plant life.

CECs can enter the environment through a number of processes including human excretion, agricultural run off, and sewage

Some classes of CECs

Pharmaceuticals | Personal Care Products | Pesticides

Factors to consider to prioritise CECs

- Is there enough data about toxicity to make a risk assessment?
- Is there a risk of exceeding the predicted concentration for no effect to be observed?
- How well is the CEC currently being monitored?
- Can we measure the concentration of the CEC with current analytical tools?
- Can we use innovative technologies to improve the analyses of CECs?

Pharmaceuticals

72% of 398 people surveyed in Galway and Cork disposed of pharmaceuticals in an improper way.

15 of 20 pharmaceuticals studied were detected at trace levels in samples in a WWTP in Dublin

Personal Care Products

PCPs improve daily quality of life and include personal healthcare and cosmetics.

For example, benzophenone-4 is a common UV filter in sunscreen, but low levels can bioaccumulate and have endocrine disrupting effects.

Consumption of these products is growing, so their environmental impact needs to be investigated

Pesticides

Many pesticides, such as MCPA and glyphosate, have toxic effects at low levels on wildlife, including birds and fish.

IN 2013, OVER **247,000 KG**

OF THE HERBICIDE MCPA WAS APPLIED TO AGRICULTURAL LAND IN IRELAND

IMPACT will develop innovative passive sampling technologies to monitor CECs and provide a detailed insight into the occurrence, fate and impact of CECs in Irish receiving waters.

@IMPACT_DCU

imogen.hands2@mail.dcu.ie blanaid.white@dcu.ie
helena.rappwright2@mail.dcu.ie fiona.regan@dcu.ie

Want to find out more?

CEC prioritising factors: *Environ. Sci. Eur.* 30, **2018**, 5
Pharmaceuticals in TTWP samples: *Talanta* 75, **2008**, 1089
Pharmaceutical disposal in Galway and Cork: *Sci. Total Environ.* 478, **2014**, 98
Benzophenone-4 effects: *Toxicol. Appl. Pharmacol.* 250, **2011**, 137
Pesticide effects: *Environ. Sci. Technol.* 37, **2003**, 4617.
Pesticide usage in Ireland: *Grassland and Fodder Crops Survey Report* **2013**, DAFM
CECs in Ireland: *Sci. Total Environ.* 616-617, **2018**, 187

DCU Water Institute

This project is funded under the EPA Research Programme 2014-2020

epaResearch Climate - Water - Sustainability

Industries & Environment

REMTECH EXPO
21 - 23 SETTEMBRE 2022

PFAS - Next Level analysis

SGS Group

RemTech Expo | Luca FAGIUOLI | September 2022

SGS

Speaker

Luca Fagiuoli

Global Key Account Developer Building & Infrastructure

SGS

Luca.Fagiuoli@sgs.com

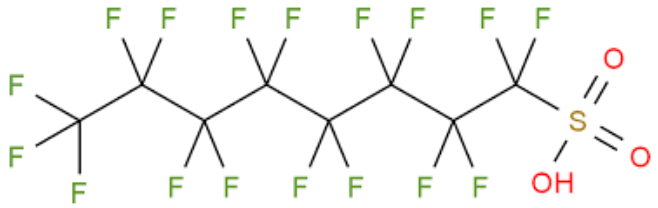
SGS Group:

- *92000 professionals at your service, more on www.sgs.com*
- *We can share more than 15 years of experience on the topic and benefit from the strength and knowledge of the group.*
- *We have a global solution and local expertize.*

What are PFAS substances?

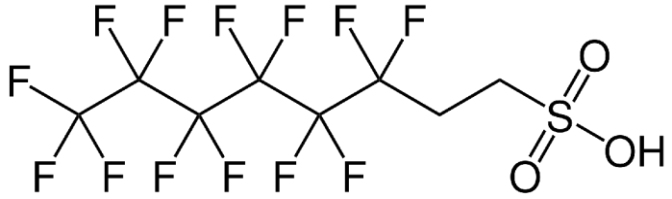
- **PFAS** = **P**oly & **P**er **F**luorinated **A**lkyl **S**ubstance
  - PFAS substances are
    - synthetize “Man Made”
    - “For ever chemicals”
    - There are about (estimated) 4000 – 6000 different comp.
  - They have in common the C-F bond. This the strongest bond in the organic chemistry.
  - PFAS have **surfactant**-related **properties** : water and oil repellent , surface tension reducing capacity.

- PFOS : **P**er **F**luoro **O**ctane **S**ulfonic acid



- PFOA : **P**er **F**luoro **O**ctanoic **A**cid

- PFAS: **P**oly **F**luorinated **A**lkyl **S**ubstances



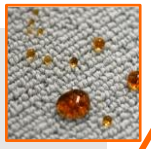
Problem?

Perfluorinated compounds - PFCs

Nonstick cookware

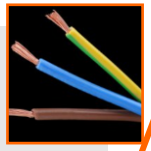
Fire-fighting foam

Waterproof and stain resistant carpets & textile

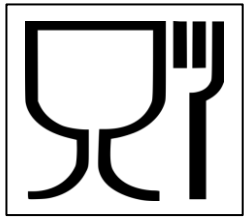


Fast food wrappers & pizza boxes (grease-proof)

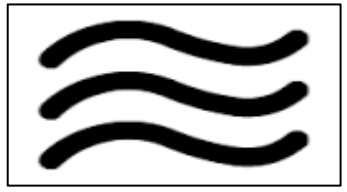
Electric wire insulators



Personal care products

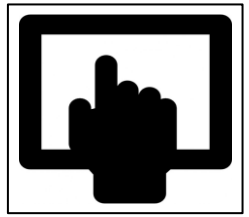


Food



Water (surface/drinking)

Soil



Direct contact

Inhalation

PFASafe Next Level analysis

Screening parameter EOF/AOF	Target analysis	TOP Assay
C.I.C. technique	*LC/MSMS technique*	*Oxydation -LC/MSMS technique*
Result < 0,5 µg/l or < 10 µg/kg (No PFAS risk)	PFAS = EOF/AOF (confirmation of PFAS potential)	No PFAS increase (no additional PFAS risk)
Result > x µg/l or kg (Possible PFAS risk)	PFAS <<< EOF/AOF (Possible PFAS underestimation)	**Significant PFAS increase** (identification of PFAS risk)

Conclusion

- Soil samples (EOF)
  - Only solvable molecules
  - No polymers
- Water samples (AOF)
  - Adsorbent on charcoal
  - Allow polymers

Conclusion

- Limited list of parameters
- Limited availability of referent molecules on the market
- Quantitative measures only on specific molecules

Conclusion

- Oxydation effect: acceleration of the time
- Oxydation cut carbon chain increasing the value from Poly- to Per-
- PFOA & PFOS are highly suspected as carcinogen

SGS IAC methods (LC-MS/MS) – stand September 2022

	FOOD	SOIL	WATER		Fire-fighting foam (AFFF)	Air / Emission	
			Surface/drinking	Waste		OTM-45 Train	Filters
Sample volume	1 gram	5 gram	50 mL (250 ml)	25 mL	1 gram	90 cubic feet	90 cubic feet
Extraction method	Sonication	Sonication	Solid Phase Extraction (SPE)	Solid Phase Extraction (SPE)	Dilution	OTM-45 method	Sonication
Typical LOQ per compound	5 – 10 µg/kg PFOS: 5 µg/kg PFOA: 5 µg/kg	1 – 10 µg/kg DM PFOS: 0,5 µg/kg DM PFOA: 0,5 µg/kg DM	20 ng/L (0.5 ng/L)	100 ng/L	100 µg/kg	2-10 ng/train	5 ng

Please remember…

…analytical results are interpreted under the conditions of the test/method

…pragmatism

Thank you!

Do you have any questions?

Luca.Fagiuoli@sgs.com

(+49) 151 234 755 96

www.sgs.com

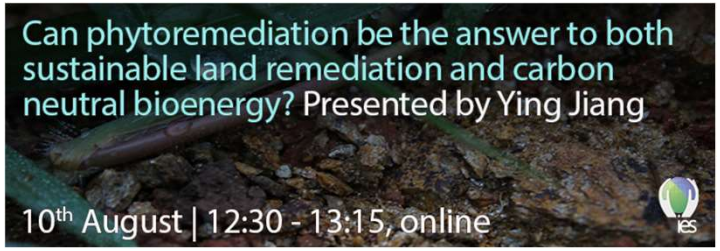
Question & Answers

Lunch and Networking

The institution of environmental sciences

Professional recognition with the IES

- Acoustics
- Air Quality Management
- Archaeology
- Built Environment
- Climatology
- Conservation and Ecology
- Education and Training
- Energy
- Environmental Management
- Forestry and Landscaping
- Hydrology
- Impact Assessment
- Land condition
- Marine Science
- Odour
- Sustainability
- Transport
- Waste Management

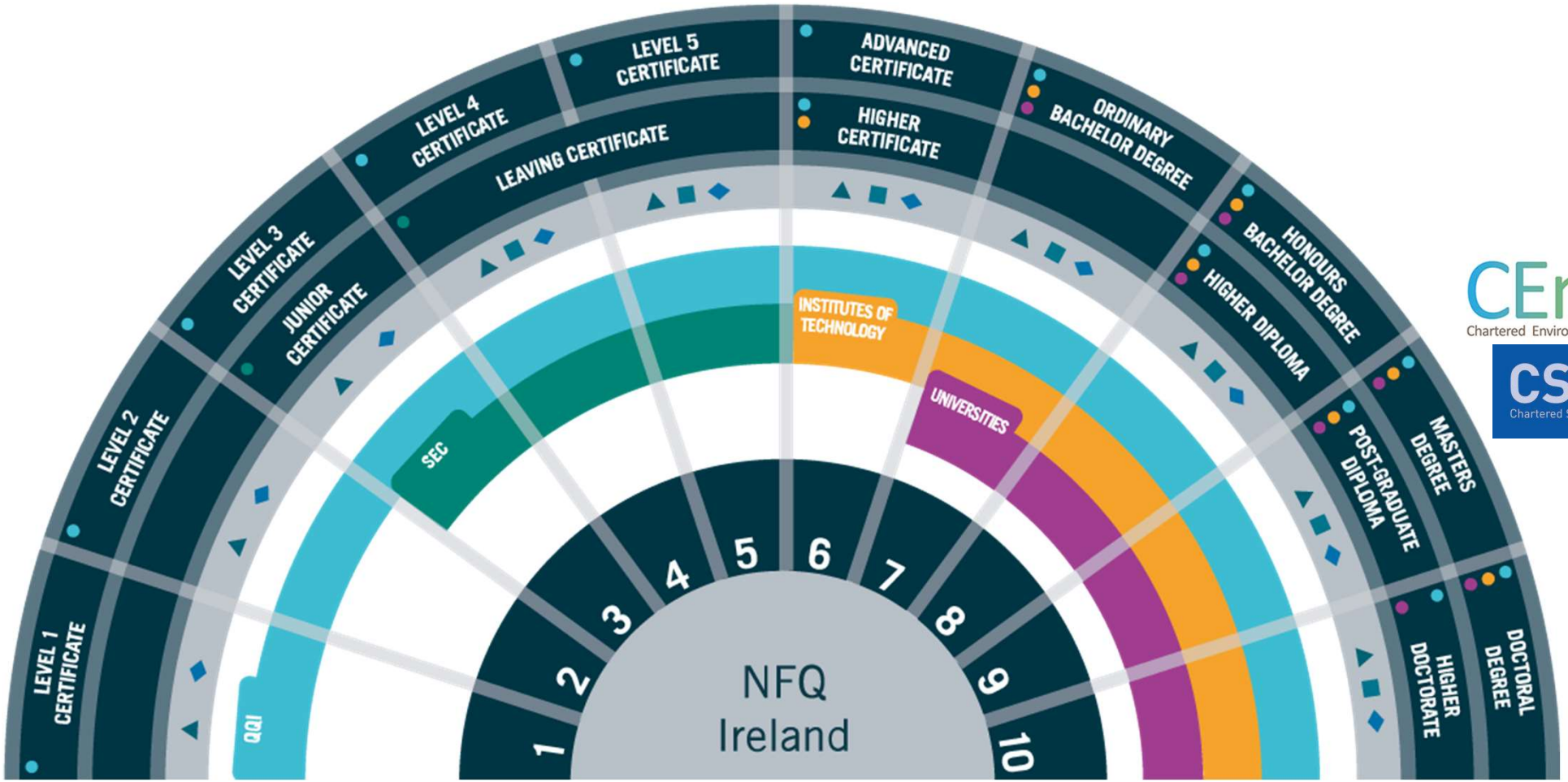


REnv Tech

REnvP
Registered Environmental Practitioner

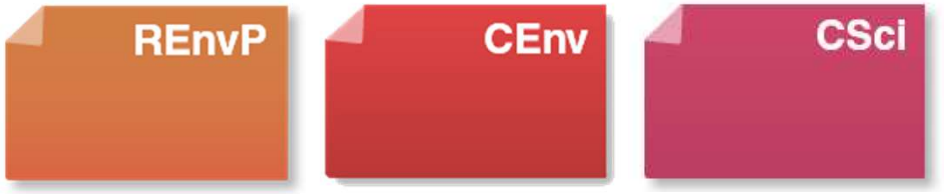
CEnv
Chartered Environmentalist

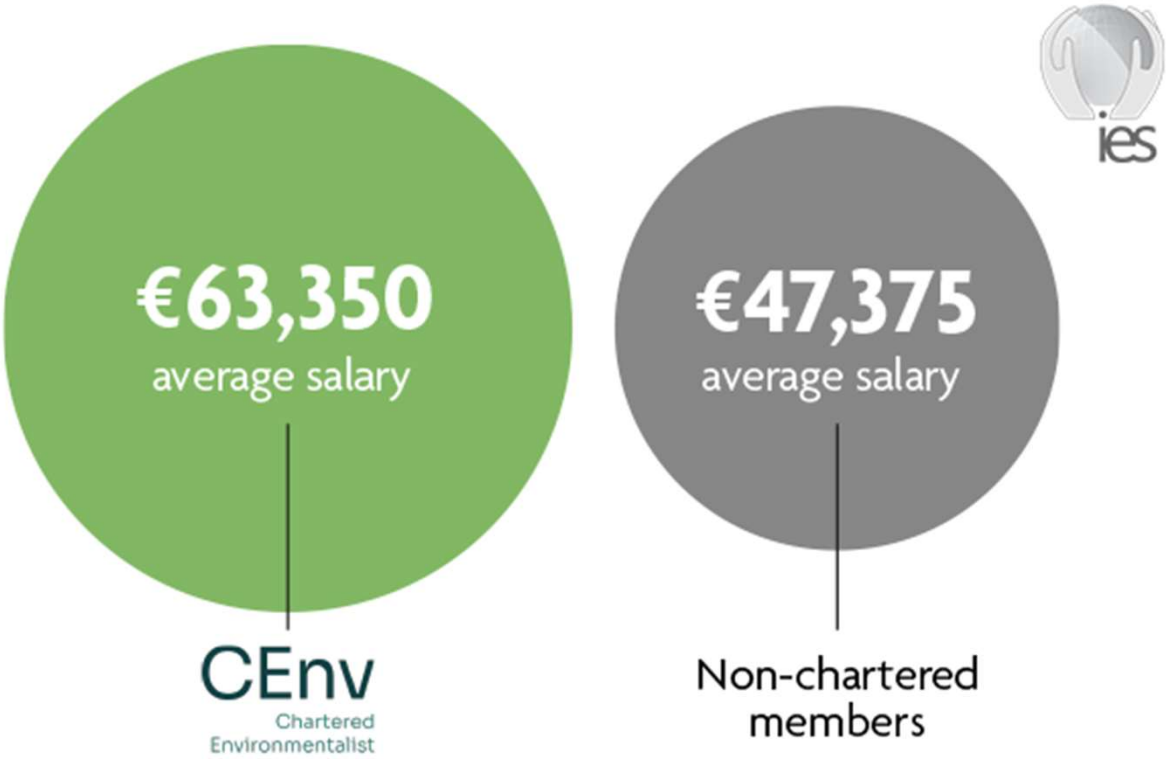
CSci
Chartered Scientist



Why become Chartered or Registered?

- Proof of quality of your skills
- Helps you stand out
- Evidence of commitment to CPD
- Improves career prospects and boosts employability




€63,350
average salary
CEnv
Chartered
Environmentalist
€47,375
average salary
Non-chartered
members
ies

CEnv

CSci

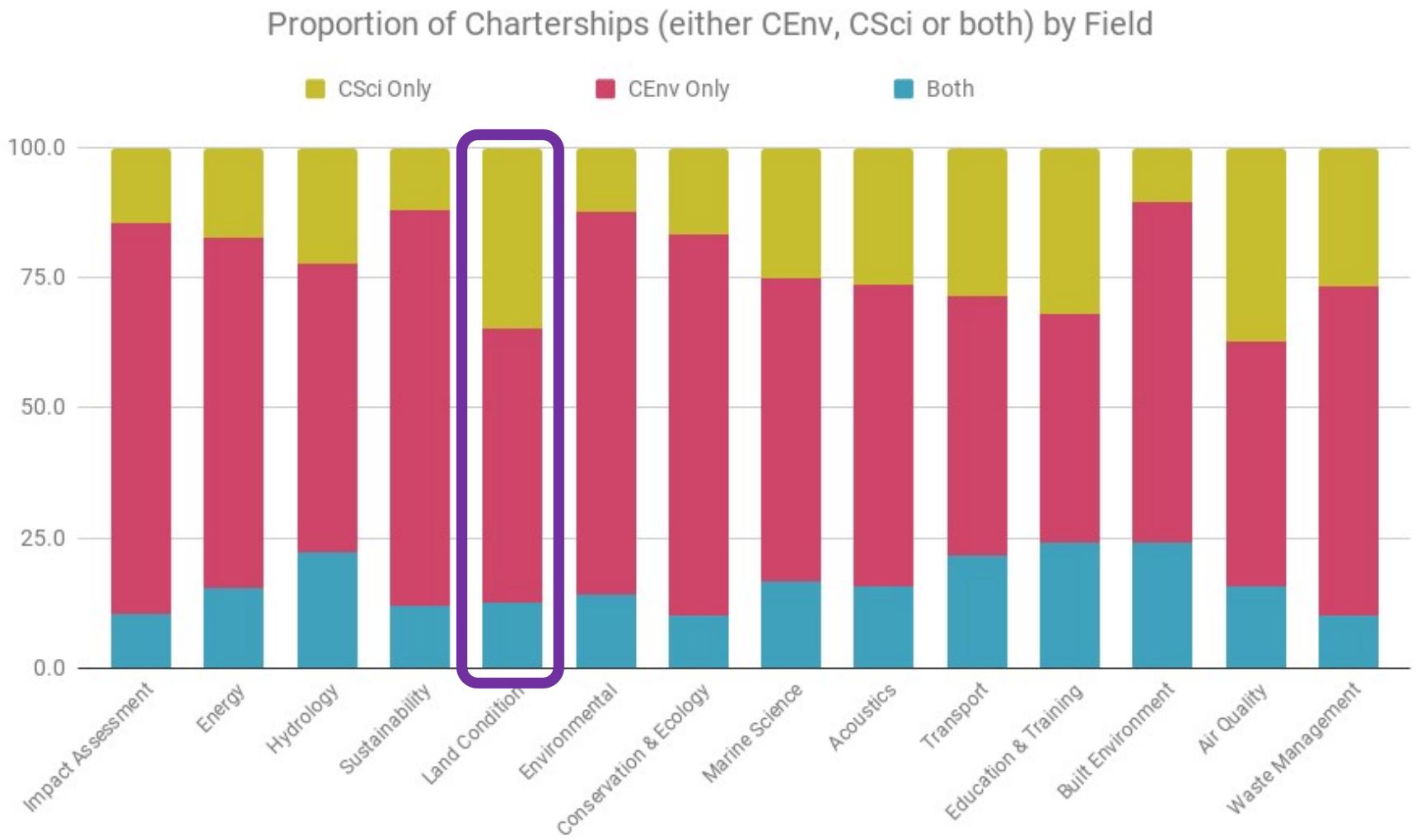
SPECIALIST IN LAND CONDITION

CEnv v CSci

Chartered Environmentalist

Chartered Scientist

Factors	CEnv	CSci
Emphasis	Sustainability	Science
IES Membership grade	Full or Fellow	Full or Fellow
Experience	~6 years	~6 years
Application process	Report, long-form CV & Interview	Report, long-form CV, CPD record & interview (if required)
Number registered	Over 7,500 | 699	Over 11,500 | 345
CPD	Annual submission	Annual submission
Workshop	CEnv in a Day	CSci Accelerated
Code of Ethics	Yes	Yes
Competencies	12	15


Proportion of Charterships (either CEnv, CSci or both) by Field
CSci Only
CEnv Only
Both
100.0
75.0
50.0
25.0
0.0
Impact Assessment
Energy
Hydrology
Sustainability
Land Condition
Environmental
Conservation & Ecology
Marine Science
Acoustics
Transport
Education & Training
Built Environment
Air Quality
Waste Management

Why become Chartered/Registered through the IES?

CEnv

CSci

Your route to Chartership

- Pre-workshop documents
- One-day workshop – complete the written report
- 5 candidates per workshop
- Professional Review Interview
- Evidence of ongoing learning

Self-guided

- Information pack
- Complete & submit written report
- Professional Review Interview
- Evidence of ongoing learning

Questions?

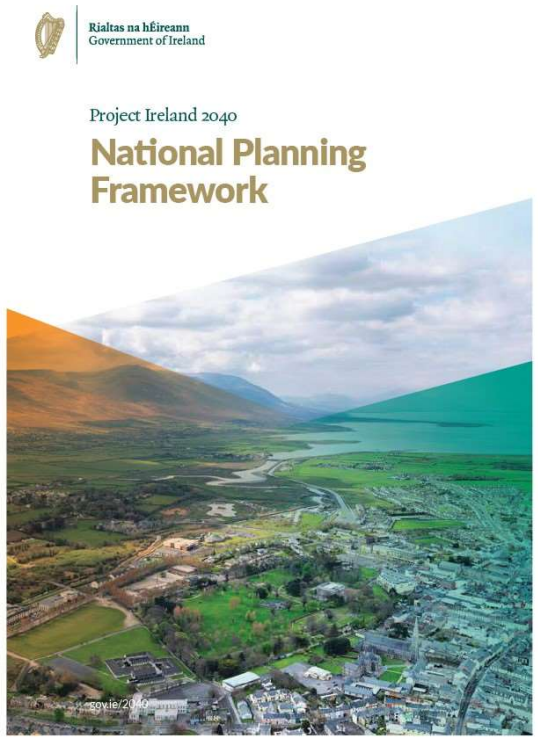
Get in touch:
adam@the-ies.org
+44 203 862 7484
www.the-ies.org/charterships

93% of members rate their interaction with the IES office highly.

The Place and Importance of Brownfield Redevelopment in Sustainable Cities

LDA
Land Development Agency

The National Planning Framework (NPF)

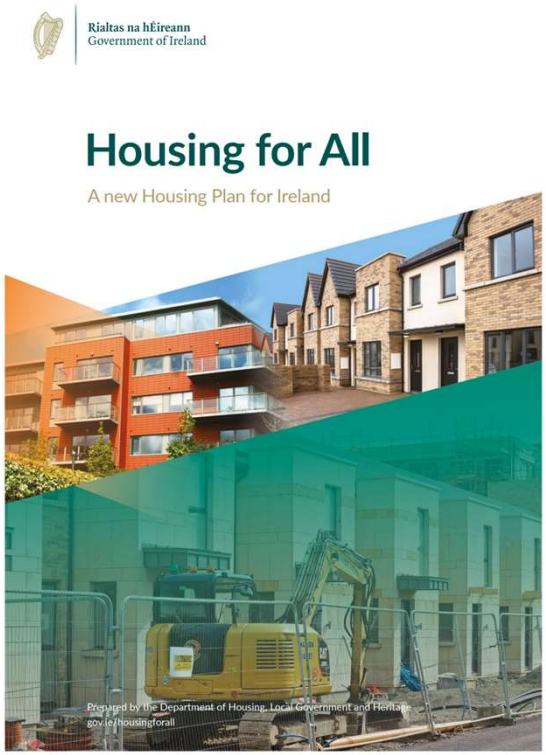


NPO 12: to support implementation of the National Planning Framework, a new national Regeneration and Development Agency will be established

National Strategic Outcome 1 - Compact Growth: Targeting a greater proportion (40%) of future housing development to be within and close to the existing 'footprint' of built-up areas. Making better use of under-utilised land and buildings, including 'infill', 'brownfield' and publicly owned sites and vacant and under-occupied buildings, with higher housing and jobs densities, better serviced by existing facilities and public transport. Linking regeneration and redevelopment initiatives to climate action.

"meeting Ireland's development needs on mainly greenfield locations will cost at least twice that of a compact growth-based approach."

Housing For All (HFA)



Over 250 Hectares of state lands identified for transfer to LDA

7 sites in Dublin

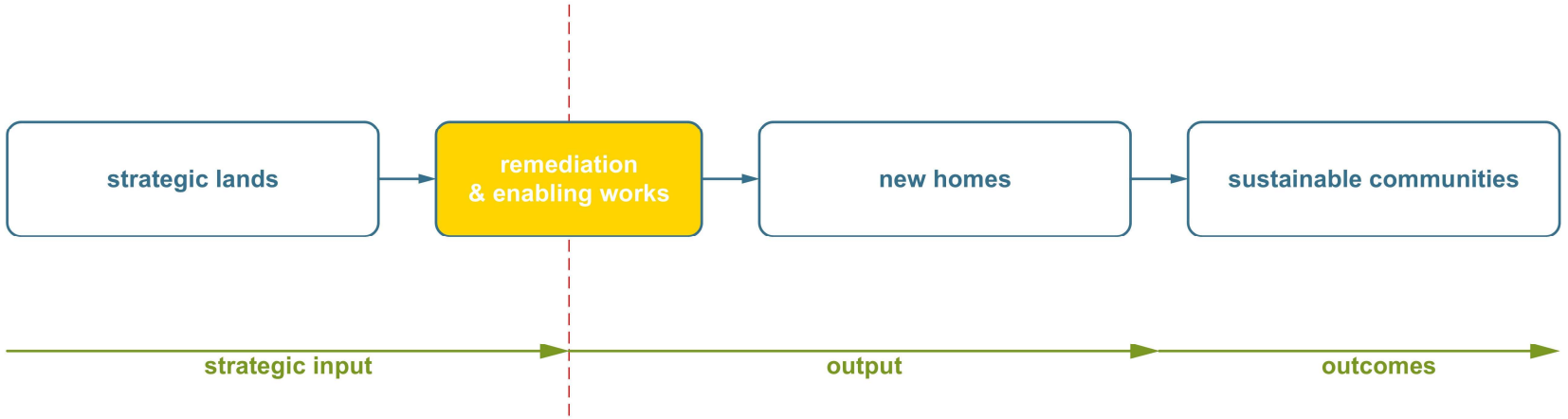
1 site in Galway

4 sites in Cork

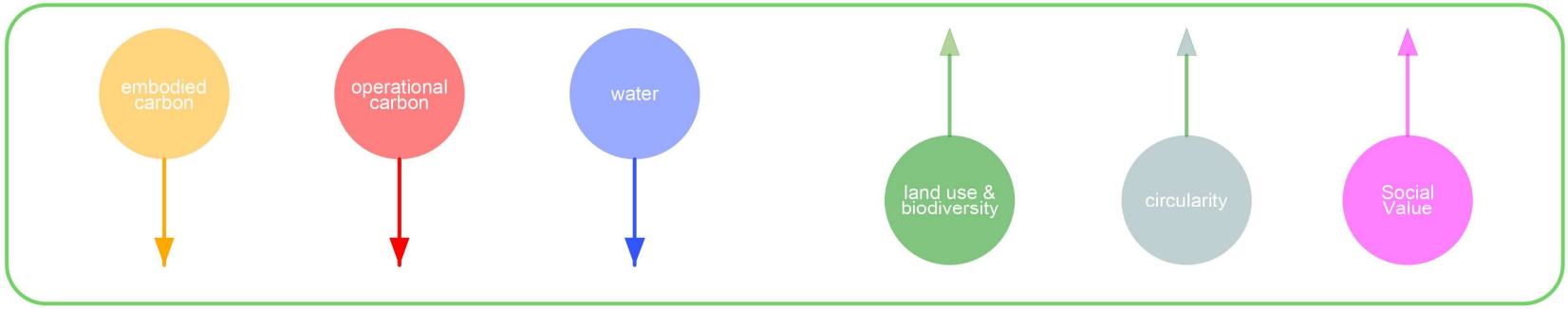
2 sites in Limerick

78% of this land is comprised of brownfield sites within existing urban footprints
with capacity to deliver approximately approx. 15,000 homes. This will support the delivery of 88% of the anticipated yield, more than double the stated ambition of the NPF.

Strategic Inputs – Supporting Outputs, Supporting Outcomes



Sustainability



Outcome focused…..plan-led, some examples

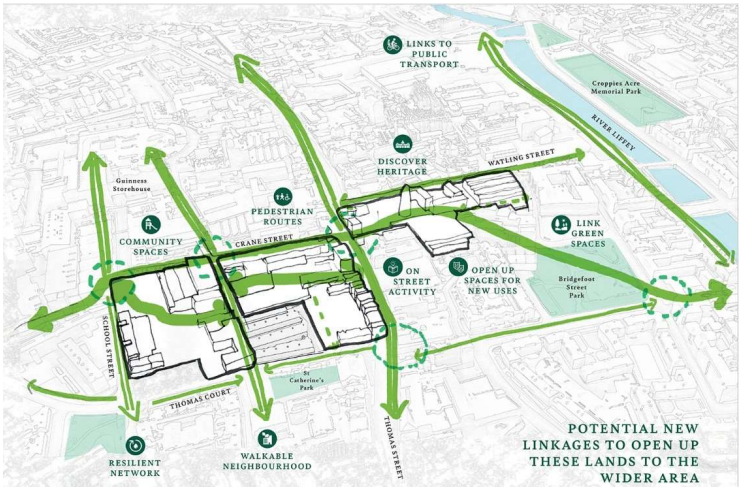
compact, mixed-use, transit-orientated regeneration project in a very central location in London, close to one of its principal transport hubs. It has transformed a 27-hectare obsolete industrial and rail-oriented brownfield into a vibrant and thriving area. As of 2021, King's Cross development is carbon neutral. Sustainable mobility is provided through public transport while active transport modes are integrated into the site area. Energy comes from renewable sources and substantial investments have been made into the district energy network.

"Prioritising brownfield areas makes it easier to integrate the transportation system and technologies for water and energy (electricity, district heating and cooling) into the existing city infrastructure. Soil remediation is key to infill development and maintaining an urban growth boundary. It is also strategic because infill development is often in places that are closer to city centres or mass transit, which is consistent with transit-oriented development."

"A city of sustainable mobility Nordhavn will spearhead the adoption of sustainable transport solutions. The natural choice for people should be to walk, cycle or use public transport rather than travel by car."

LDA Strategic Projects

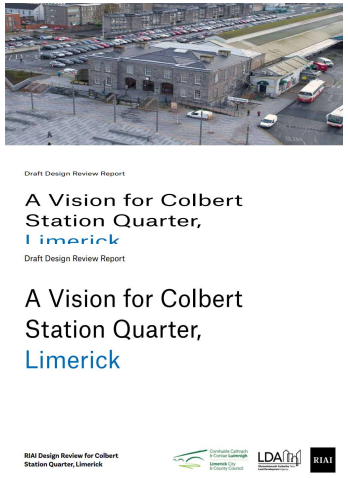
Sandy Road Design Review, published in October 2020. Masterplan commissioned in 2021 and Currently being progressed for consultation in 2022

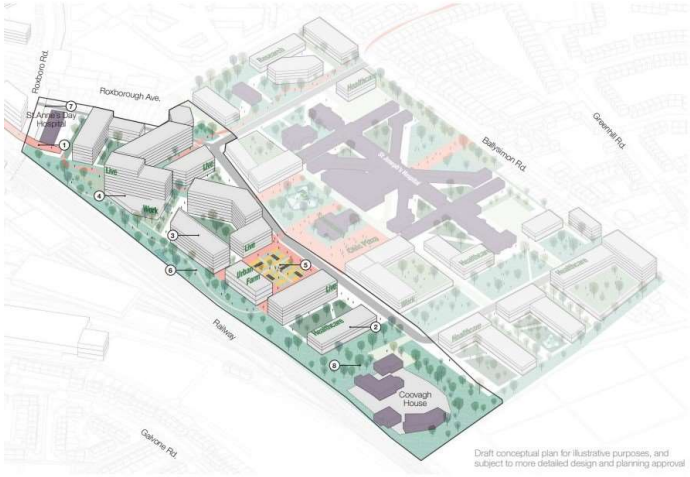


Digital Hub Draft Masterplan for Consultation to be launched in October 2022

"…to achieve the best possible social and economic return from the use of public land"

LDA Strategic Projects



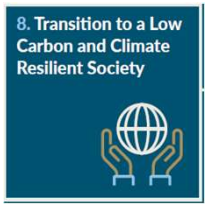


Colbert Quarter Design Review, published in October 2020. Framework Plan published as a Draft for consultation 2021 and is noted in the New City Development Plan. Final Framework plan to be published in October 2022. First masterplan area and IDDP are currently being progressed.

Inchicore Design Review commissioned in 2022 for publication in early 2023

"…to achieve the best possible social and economic return from the use of public land"

Brownfield Redevelopment in Sustainable Cities



- Urban regeneration on brownfield sites presents an opportunity for towns & cities to address the rising demand for land by densifying existing urban cores and creating more vibrant & sustainable urban centres.

- Higher Density, transport-orientated sites in cities which support sustainable modes means lower carbon emissions and less pollution.

- Sensitive integration of more compact and efficient built forms, higher densities and the adaptive re-use of heritage structures and industrial buildings can reduce the embodied carbon intensity of providing new homes and communities within existing urban footprints.

- New public amenity spaces associated with brownfield infill development and the introduction of green infrastructure can contribute to net biodiversity gain, counteract the urban heat island effect, improve air quality and reduce noise..

- Urban Regeneration on brownfield sites leverages the value which can be created through the transformation from underused areas to higher use areas. This value may be capitalised e.g. through LVC and contribute to offsetting some of the costs associated with Urban Regeneration infrastructure investments.

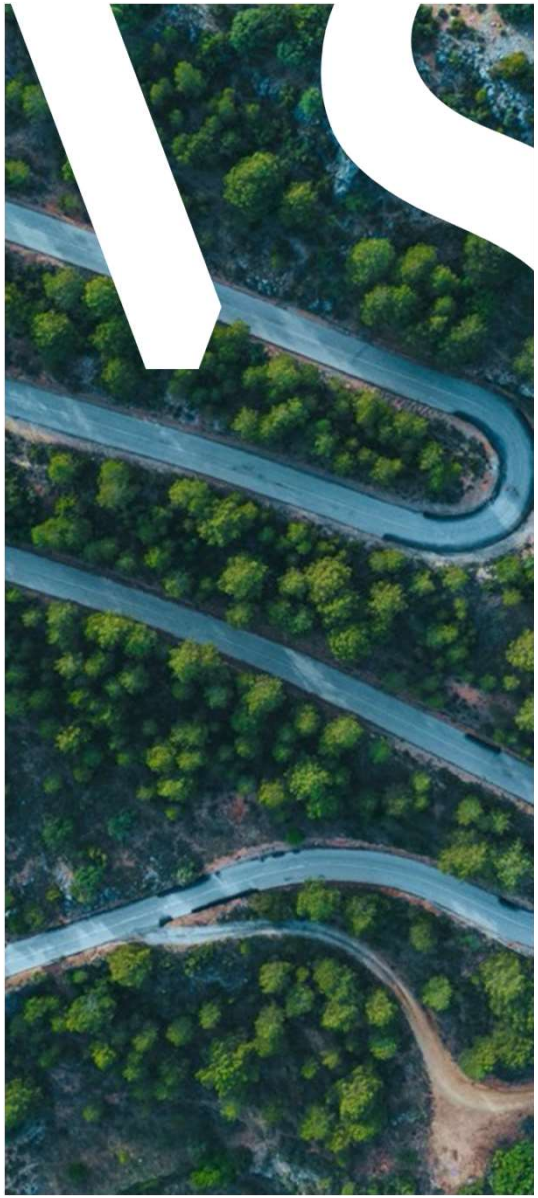
Thank You

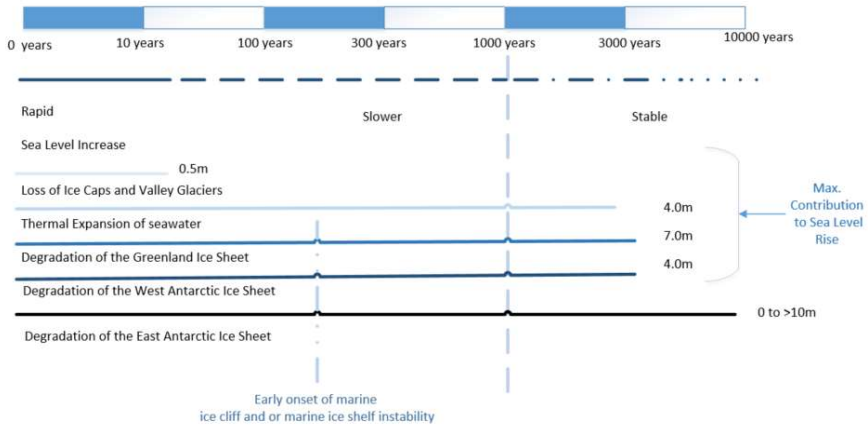
contact: mgoan@lda.ie

Regulatory Considerations of Climate Change

A report to the Environment Agency from WSP UK Ltd

A Lee and M C Thorne Associates Ltd





A Taster.....Do you know

- Contamination may be subject to increased mobility-solubility , viscosities henrys laws etc
- MNA timings, pathway interuption PRB, EBS etc
- Clay caps, overlying soils vulnerable to desiccation, fissuring reducing hydraulic performance
- Cover soils exposed to increased erosion = exposure of membranes more rapid (oxidation, shrinkage etc)
- 1200 coastal landfills in England
- 10% could start to erode by 2055
- Seawater intrusion – mobilise inorganic contamination?
- Limited assessememt or eroded mass

Etc Etc Etc

Introduction (1)

- WSP instructed to generate an evidence based synthesis report to

  'Inform regulatory considerations of climate change impacts and adaptation for waste deposit, landfill and land contamination.'

- The Environment Agency (EA2025) to be a leader on climate adaptation and resilience.
- The Environment Agency to take an informed and consistent approach.
- The work is to, support assessments and contribute to the Environment Agency's
  - Nuclear Decommissioning and Clean-up programme,
  - Nuclear Outcome Plan
  - Water Quality, Groundwater and Land Contamination.

Introduction (2)

- This report is a 'starting point'
- Future phases will be needed.
- Geographical domain has been England.
- Intended to assist decisions to address timescales of up to 1000 years.
- The land systems under consideration
  - Contaminated land
  - Waste recovery on land, or deposit for recovery, when a party users waste material instead of non-waste material to perform a function.
  - Landfill sites, areas of land in or on which waste is deposited as a disposal.
- All are presumed to be at or near surface. i.e., located at the surface or at depths down to several tens of metres.
- In respect to near-surface deposits, facilities and landfills they may use the geology (rock structure) to provide an environmental safety function, but some may rely on Engineered Barrier Systems (EBS).

The Parties

Environment Agency

Cyfoeth Naturiol Cymru
Natural Resources Wales

BGS British Geological Survey

Magnox

Dounreay

SoBRA
The Society of Brownfield Risk Assessment

ciria

SEPA
Scottish Environment Protection Agency
Buidheann Dìon Àrainneachd na h-Alba

LITHOS CONSULTING

LLW Repository Ltd

NDA

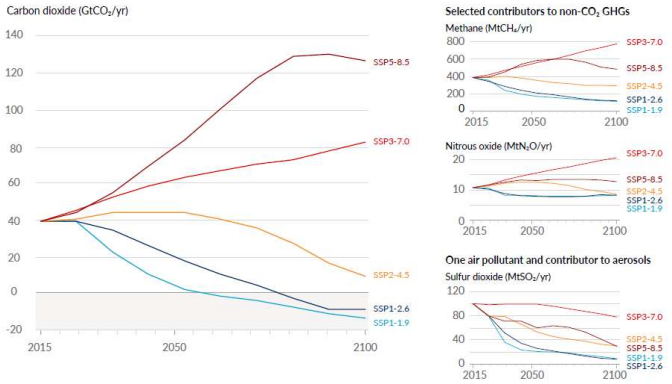
Sellafield Ltd

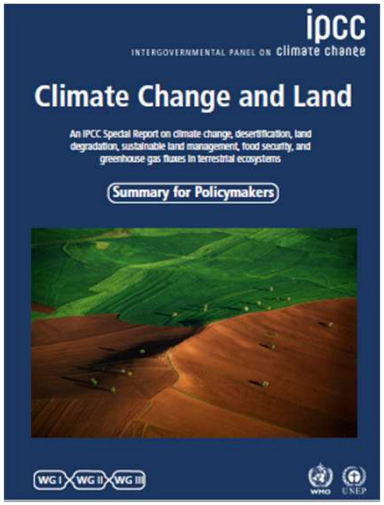
Ford Environmental Services

Todays Presentation

- To share an overview of the reports content
- To present some bite size learning

- Specific topics will include
  - Timelines
  - A systematic approach (amongst others)
  - Something practical





- Not going to talk about.....
  - Climate models /scenarios
  - Sela level change details Specific vulnerabilities
  - Modelling solutions
  - Coastal change and response
  - Engineered barrier response

The Simple (1)

Emissions of GHGs have continued to rise at an average of 1.5% per year in the last decade (UNEP, 2019).

IPCC has presented dire warning that the world faces unavoidable multiple climate hazards over the next two decades with global warming of 1.5°C (2.7°F)

Environmental regulation is not yet ready for a changing climate.

Climate change will **exacerbate** risks from (and to) regulated industries.

Environment Agency in its 3rd Adaptation Report .

'high severity' and **'high urgency'** threats identified including to waste deposit, landfill and legacy contaminated land

Environment Agency in its 3rd Adaptation Report.

The Simple (1)

Inevitably transformational changes in society will be required

An understanding of scale needed and **timescales**

An understanding of **vulnerability** needed

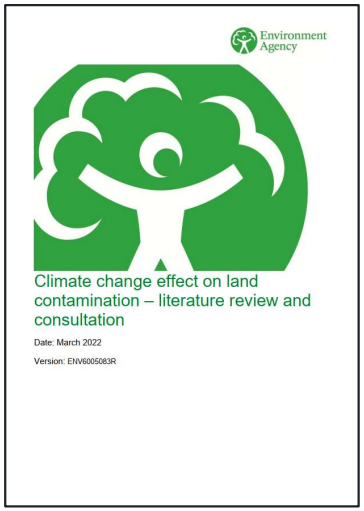
Need to be able to identify, prioritise and develop a framework change in the **regular** assessment of risks for adaptation

An ‘impact-specific’ is based on the logic of planning. Given a set of needs, what actions are needed, and which have highest priority?

The Report

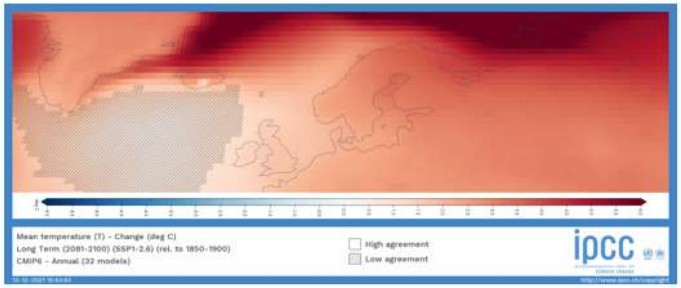
Runs to 500 pages, 34 recommendations (grouped and scored)

- What are the timescales that we should be considering and why?
- What climate change projections and models are available over this same period and how can they be accessed?
- Are reliable coastal change models available, and what are the next steps?
- Can we apply case studies to identify current learning and vulnerabilities to climate change?
- By interrogating current models can we identify sensitivities and how they may be pragmatically managed?
- Can we propose a systematic approach to deliver better consistency to the assessment and identification of vulnerabilities?
- What do we consider to be the priority vulnerabilities/adverse impacts?
- How may we handle uncertainties in future assessments?
- What should the assessment cycle maybe look like?
- The development of modelling practices
- In respect of adaptation what are the likely impacts on Engineered Barrier Systems and liners?
- Coastal adaptation

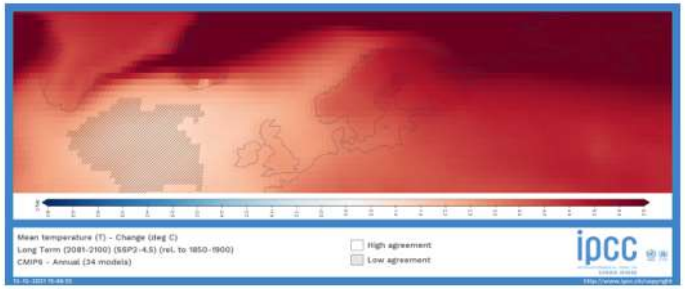


The Unexpected..... (maybe).....(1)

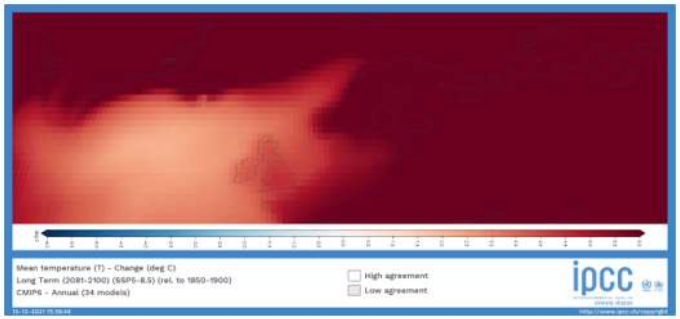
- Not everyone may agree on the degree of urgency.
    - But protracted decision making may dilute the urgency, inertia and on occasion the need to act as appropriate.
- A failure to convey clear expectations of industry, operators and developers is inviting stagnation, inconsistent and potentially unprincipled decisions.
- Plans need credibility and a workforce with an awareness to the practices that they should adopt otherwise execution will stall.



a) Results for SSP1-2.6



b) Results for SSP2-4.5

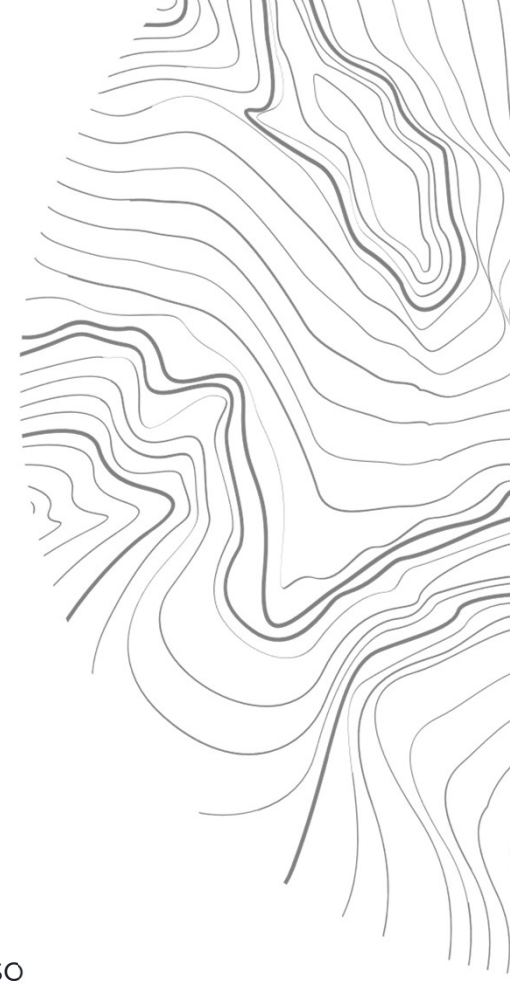


c) Results for SSP5-8.5

The Unexpected (maybe).....(2)

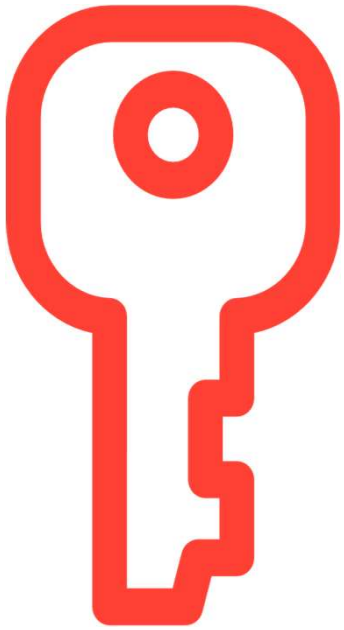
- Existing approaches to CC assessment are generally limited.
- Radioactive waste disposal operators tend to quantify future changes to pollutant linkages using site-specific detailed models more than operators of conventional landfill or owners of land contamination problems.
- The project did not identify an assessment of land contamination that took account of climate change.
- No evidence has been uncovered suggestive of routine assessment to periods beyond 2100.
- No singular repository/listing of potential adverse effects has been identified to guide assessors or reviewers, with the responsibility for identifying potential adverse impacts placed again on the assessor.
- No direction given towards which climate scenario an assessor should consider?

But....



- Common elements do exist and include advocating for a **risk-based, proportionate** process culminating in adaptive management and ongoing reviews.
- A **tiered approach** already forms the basis of the UK risk assessment doctrine. It would be consistent and logical that a tiered approach also be followed when addressing climate change impacts
- Focus should not be upon reinvention but rather **orchestrating** change and marketing the expectation of its urgent inclusion in assessments – A policy requirement

A Key Point



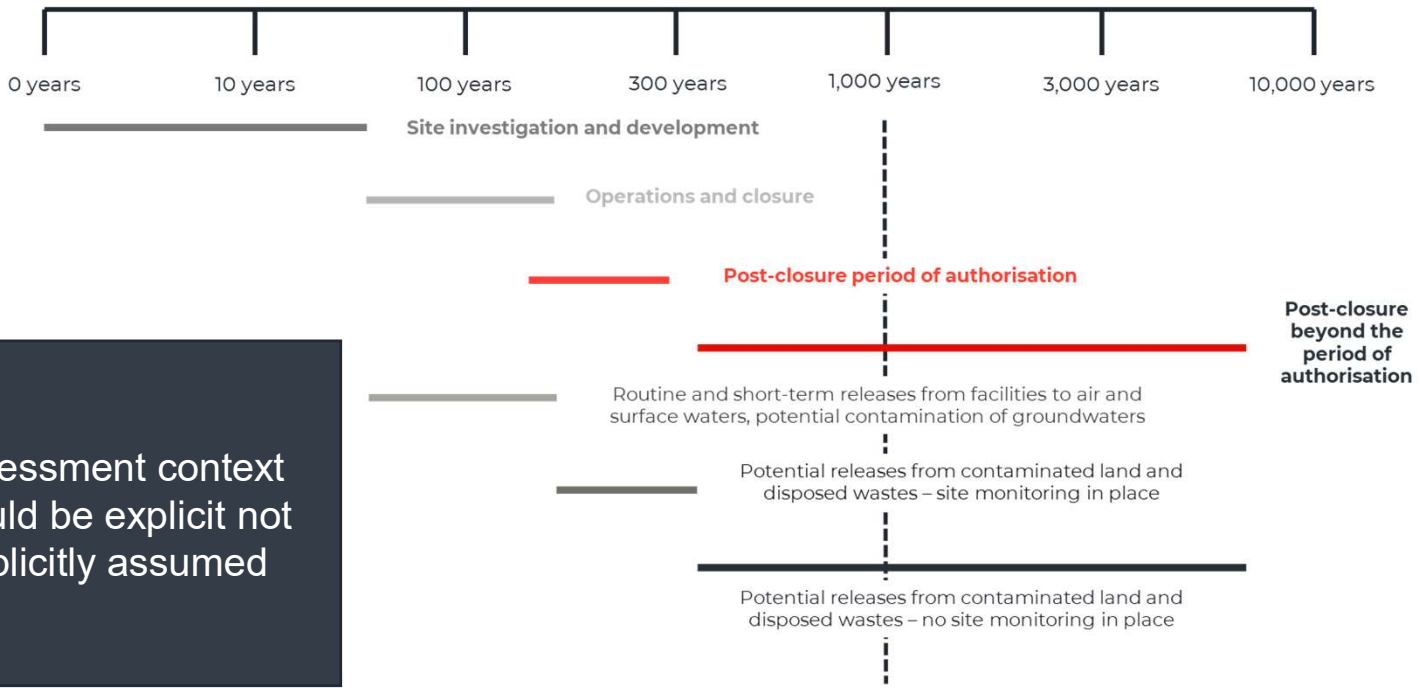
An aspiration must be to avoid a future of overly precautionary regulation and undue cost burden on problem holders.

An assessor should not seek to overengineer a site at the cost of an unstainable environmental footprint in fear of an inflated risk; decisions should be based on a scientific examination of the issue.

EVOLVING AREA of GUIDANCE AND POLICY

So Something Credible (1) today.....Timescales

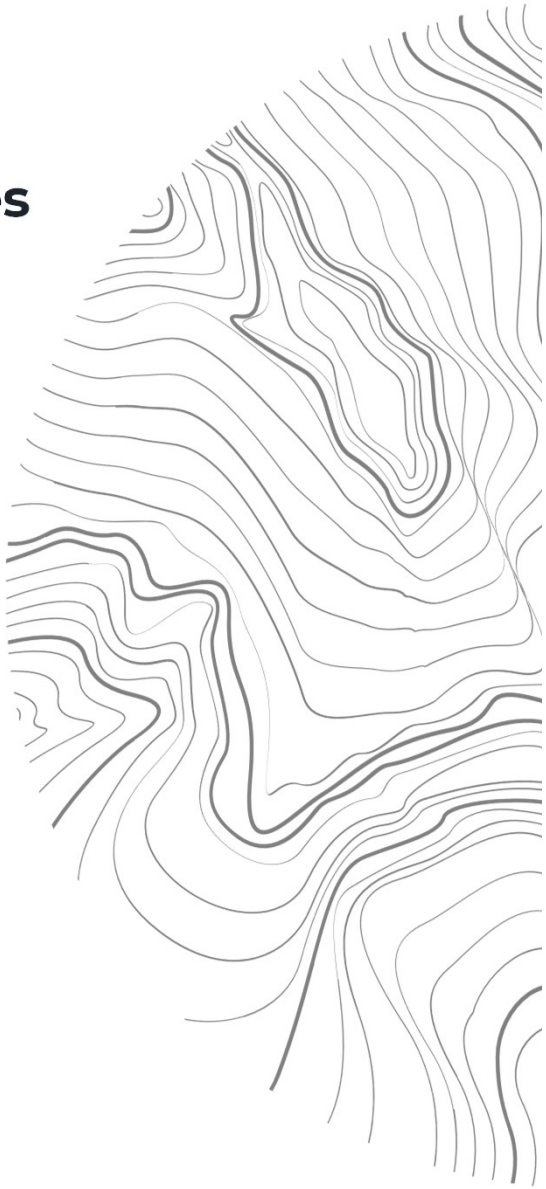
- Timescales should not be prescriptive – context driven.
- They should be based on the nature of the hazard i.e., led by scale and magnitude of the problem.



Assessment context should be explicit not implicitly assumed

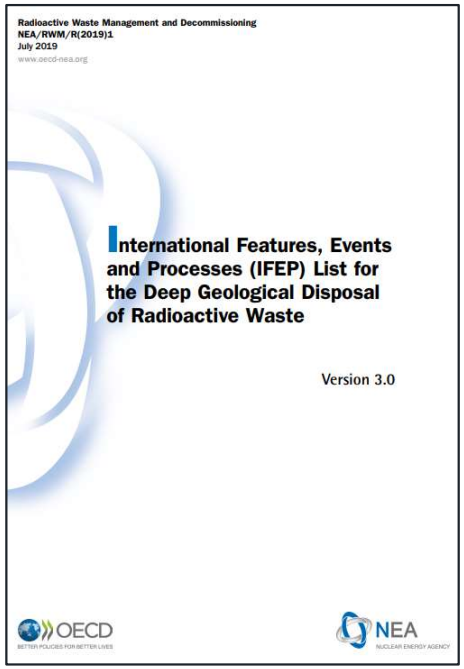
So Something Credible (2) ..... Vulnerabilities

- The responsibility and onus for identifying relevant adverse impacts is placed on the assessor.
- Inconsistent approaches may evolve without the delivery of informed direction.
- **A starting point and way forward for the development of individual impact assessments is required.**
- Such a framework must not be onerous but proportionate and flexible to the scale, setting and complexity of a site (see assessment context).
- A modified FEP list **ONE** such starting point for both assessors and regulators.



So Something Credible (1) today.....FEPS

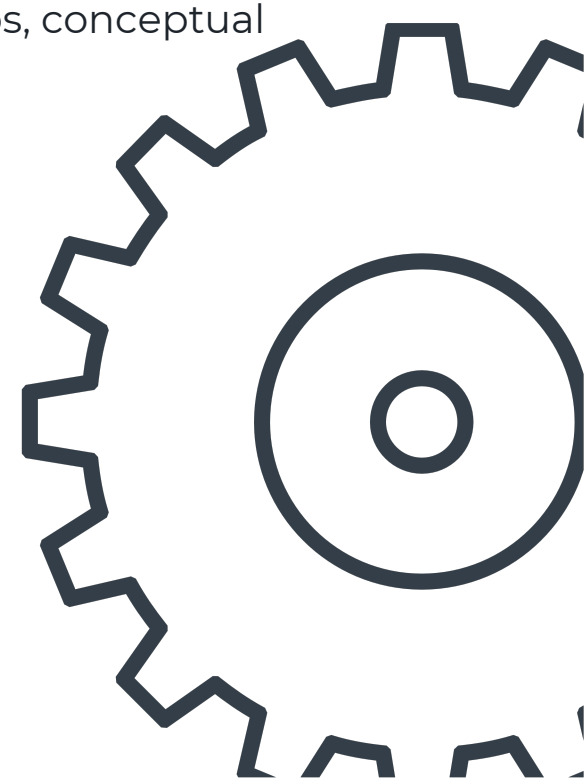
- NEA compiled lists and databases features, events and processes (FEPs) that may affect safety performance
  - “Features” are physical components of a system and or environment being assessed.
  - “Events” are dynamic interactions among features that occur over time periods e.g., coastal disruption of a landfill or co contaminated soils
  - "Processes" are issues or dynamic interactions among features that generally occur over a significant proportion of the assessment timeframe and may occur over the whole of this timeframe e.g., climate change.
- Events and processes may be coupled to one another (i.e., may influence one another) e.g., climate change may influence infiltration and groundwater flows.



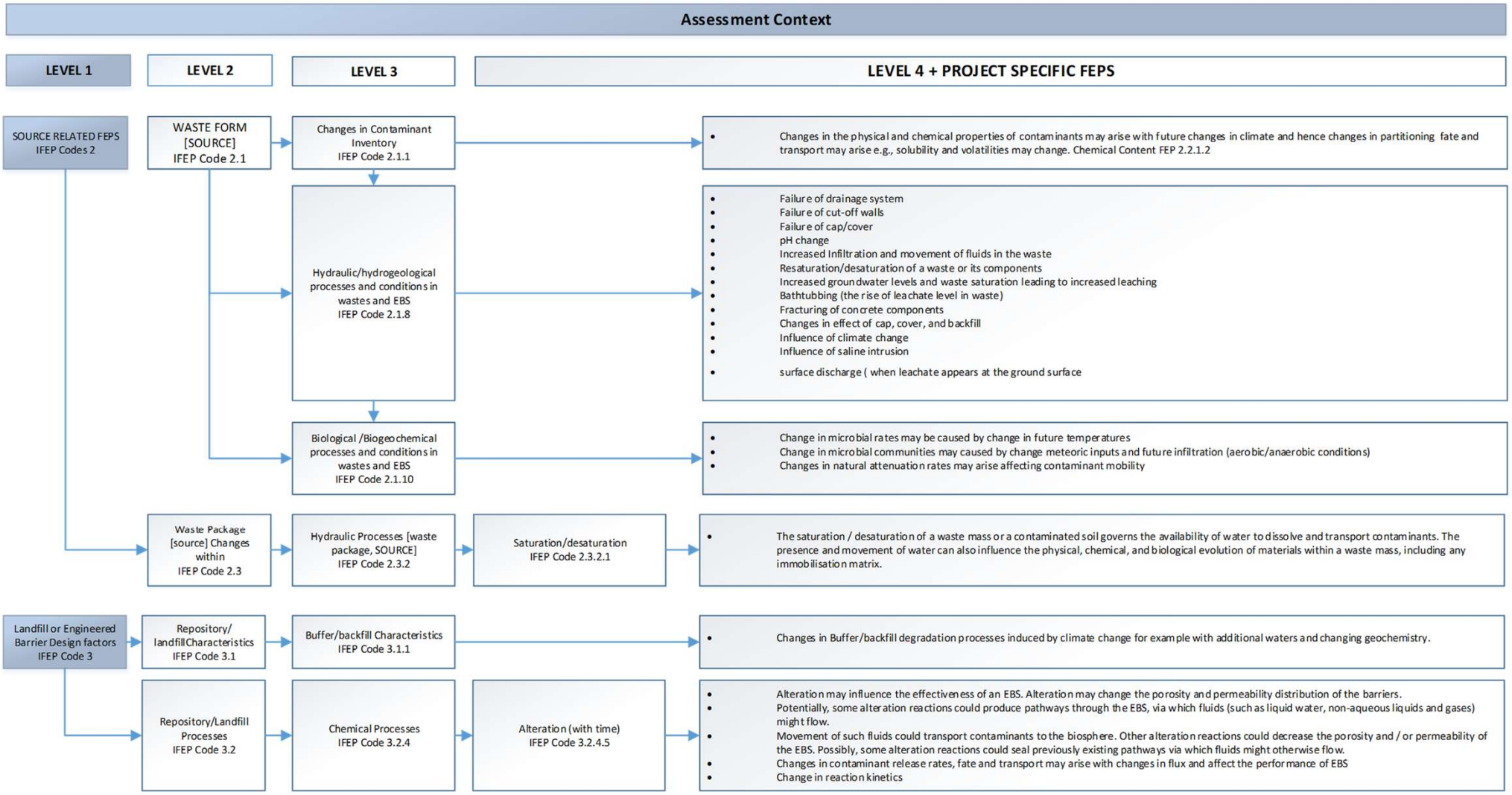
So Something Credible (1) today.....FEPS

- 268 FEPs (including FEP groups and subgroups) are contained within version 3.0 of the IFEP List.
- But they are a further starting point
  - relevant to land contamination, near surface waste deposit and landfill on the timescales of <1000yrs
  - provide an audit to check the completeness of scenarios, conceptual models
  - Tiered approach Level 1 categories into 3+

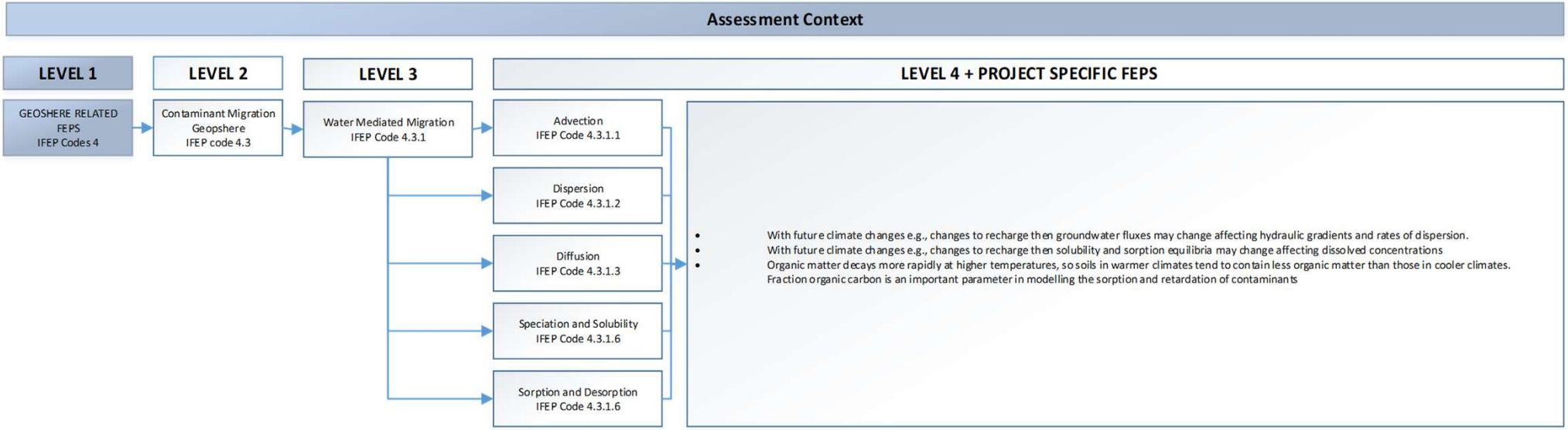
Not a HOT landing



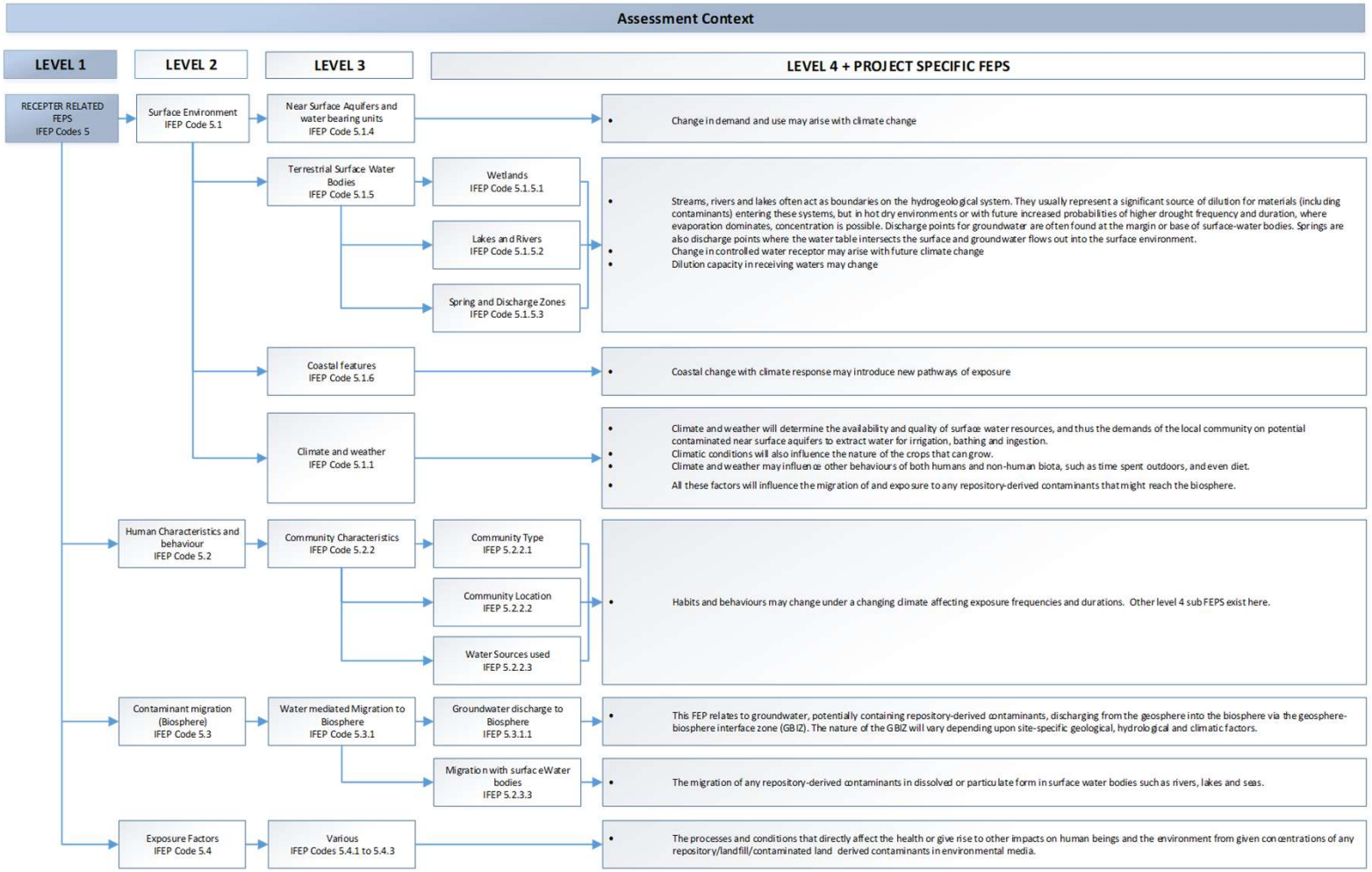
Example Source FEPS



Example Pathway FEPS

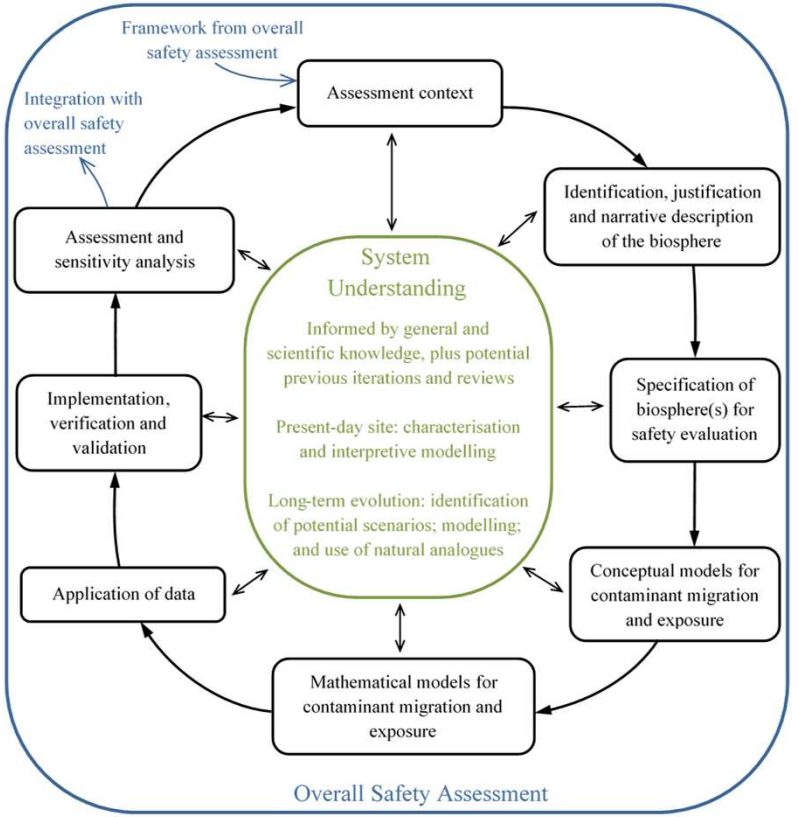


Example Recepter FEPS



FEPS or other……

- Reduced list could be developed further
- Application should be proportionate to the problem – an audit tool
- Simply part of an overall assessment cycle



Something more concrete for NOW….

ConSim

LANDSIM

GASSIM 2.5

Contaminant Fluxes from Hydraulic Containment Landfills

The Remedial Targets Methodology (RTM):

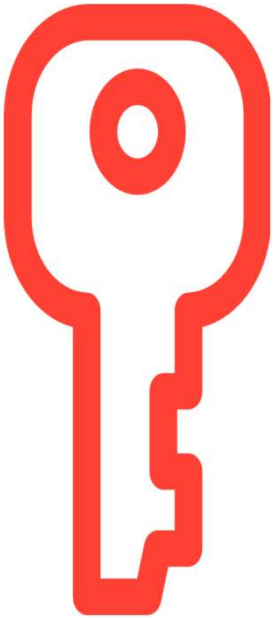
- In delivery of any risk assessments foremost is to ensure model describes and reflects the CSM
- BUT can a commonality be identified to direct interim and next steps

Key Points on Existing Model Sensitivity (extract)

Model	Model Parameter Name	Sensitivity in Current Models	Sensitive and Vulnerable	Can we include some account into current models?
ConSim	Infiltration rate	Order of Magnitude	Yes	**Parameter 1:** Yes, such can be derived from future Rainfall Projections i.e., calculations of Hydrologically Effective rainfall (HER)
ConSim	Run off recharge	Order of Magnitude	Yes	
RTM	Infiltration	Order of Magnitude	Yes	
LandSim	Infiltration to open waste	Within Order of magnitude	Yes	
ConSim	Unsaturated zone thickness	Order of Magnitude	Yes	**Parameter 2**: Yes, such can be estimated from delivered BGS Future Groundwater Level projections
LandSim	Head of leachate when surface water breakout occurs	Within Order of magnitude	Yes	
LandSim	Unsaturated zone pathway length	Order of Magnitude	Yes	
HCW	Groundwater head outside landfill	Order of Magnitude	Yes	
RTM	Fraction of organic Carbon, (FoC)	Order of Magnitude	Yes	**Parameter 3:** No, this parameter is traditionally field measured, and any rate of future change is uncertain. Whilst it is not possible to incorporate a time varying FoC into the models, sensitivity analyses may wish to take account of a lower FoC in shallow soils.
ConSim	Fraction of organic carbon (FoC)	Order of Magnitude	Yes	

Model	Model Parameter Name	Sensitivity in Current Models	Sensitive and Vulnerable	Comment
ConSim	Air Filled Porosity	Within Order of magnitude	Uncertain	The available volume of air within a soil in a contaminant source dictates the available air for volatilisation of organic substances. Air filled porosity may reduce at times of increased infiltration. Next, changing water filled porosity and Moisture content have an impact within the models on travel times across the unsaturated zone. Moisture content, air and water filled porosity again related to future potential changes in infiltration. Sensitivity analyses should seek to take account of a wider range in these parameters or relationship and guidance be identified to relate them to infiltration.
RTM	Air Filled Porosity	Within Order of magnitude	Uncertain	
RTM	Water Filled Porosity	Within Order of magnitude	Uncertain	
Consim	Moisture Content	Within Order of magnitude	Uncertain	
ConSim	Contaminant half Life	Order of Magnitude	Uncertain	An increase in infiltration can change the redox potential of soil and groundwaters by: 1) filling pore spaces and reducing air circulation; or 2) flushing oxygenated water into the subsurface system Risk may either increase or decrease depending on the oxidation state of the contaminant in the soil. Temperature changes near surface may also accelerate biological activity.
LandSim	Contaminant half Life	Order of Magnitude	Uncertain	
LandSim	Contaminant half Life	Order of Magnitude	Uncertain	
GasSim	Biological Oxidation of surface emissions in soil	Within Order of magnitude	Uncertain	
ConSim	Maximum Solubility	Within Order of magnitude	Uncertain	Higher temperatures may enable higher rates of dissolution. Solubility curves could be compared against projected temperature changes and included for consideration in model sensitivity if identified as sensitive during a typical sensitivity analysis .

Key Points on Existing Model sensitivity

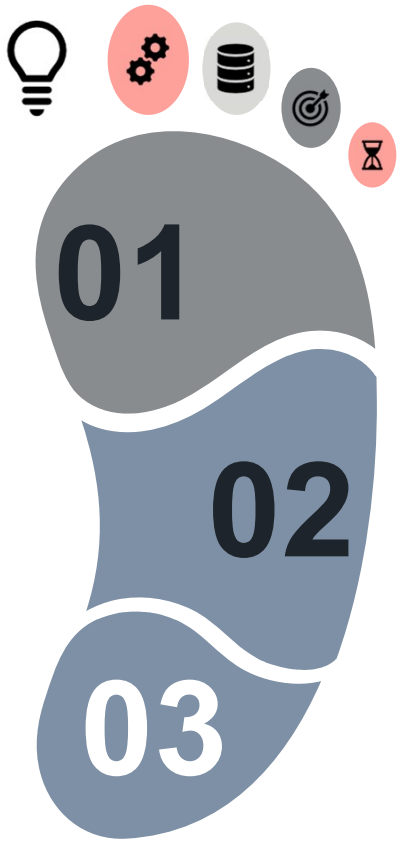


- 3 parameters exert order of magnitude
  - infiltration, groundwater levels, and fraction organic carbon
- Probability Density Functions of mean monthly temperature and precipitation values are available from UKCP18 for any location in the UK and can be readily downloaded from the UKCP18 website

Next Steps

01

Thirty-four areas that require consideration have been identified.



02

Each area is discussed in terms of:

- Problem characteristics
- Potential action
- Importance (5-point scale)
- Ease with which it can be addressed (5-point scale)

03

Burning prerogative Policy and guidance Change

The Bottom Line

Consideration of adverse climate change is a topic of acute industry interest.

A lack of both a framework and details on delivery is evident.

Expectation arises for the regulator to orchestrate existing initiatives and galvanise an expectation that all assessments must start to include potential future of adverse climate impacts in their environmental assessments.

Strong regulatory leadership and policy change needed including

- A clear explicit statement of regulatory expectation/requirements
- A framework and guidance in which operators and problem holders may work
- Direction to datasets and how to apply them
- Areas of priority research

This journey is only just starting

Thank you

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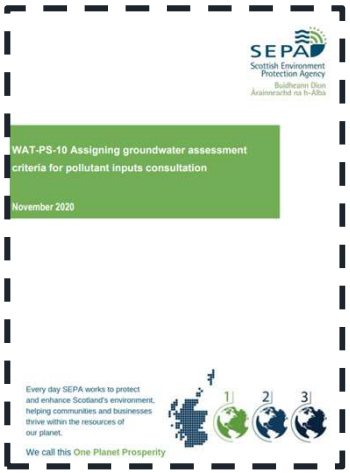
Guidance on Assessing Risks to Ground and Surface Waters Under Conditions of Future Climate Change

Róisín Lindsay BSc MSc CEnv
Associate
WSP
Member of SoBRA Subgroup – Controlled Waters and Climate Change

The Sub-Group

Contents

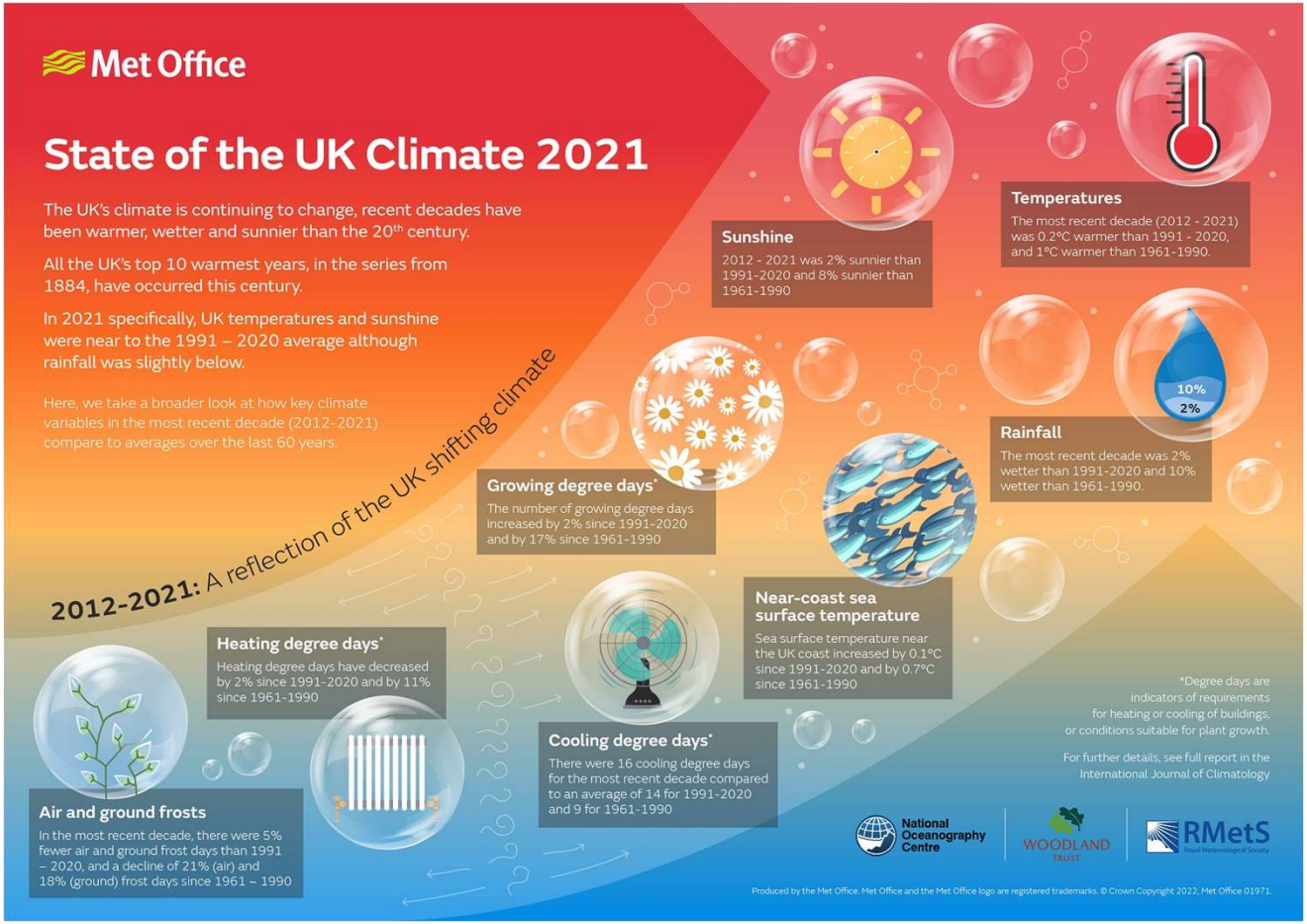
Background



Published

Consultation

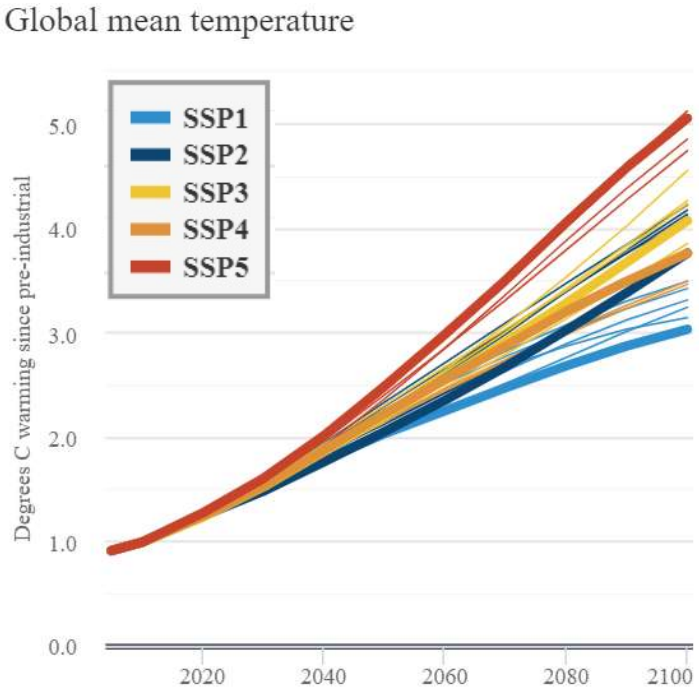
Climate Change in the UK – General Overview

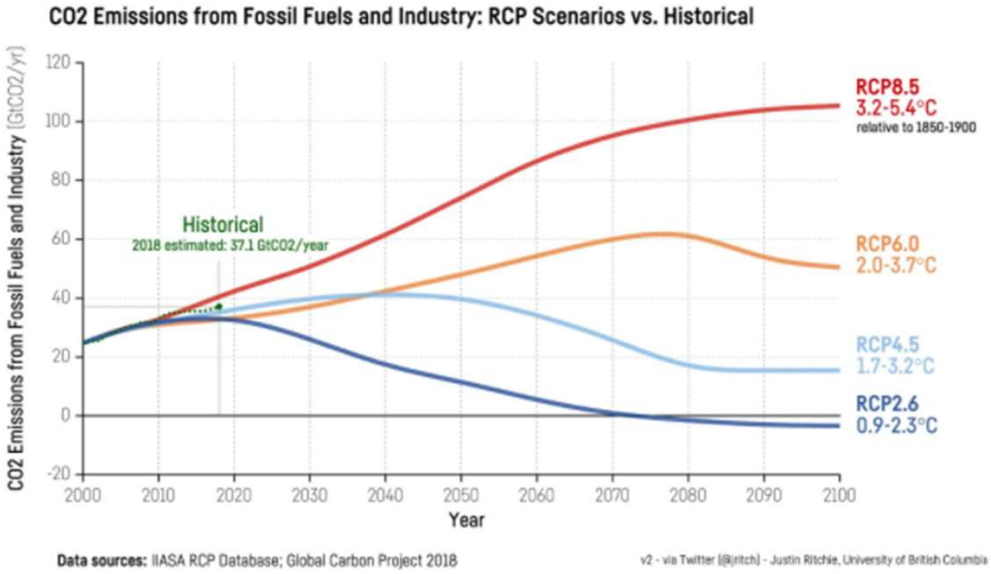


Climate change is the large-scale, long-term shift in average weather patterns and average temperatures and is assessed by averaging data over a 30-year period.

Future UK Climate Change Projections

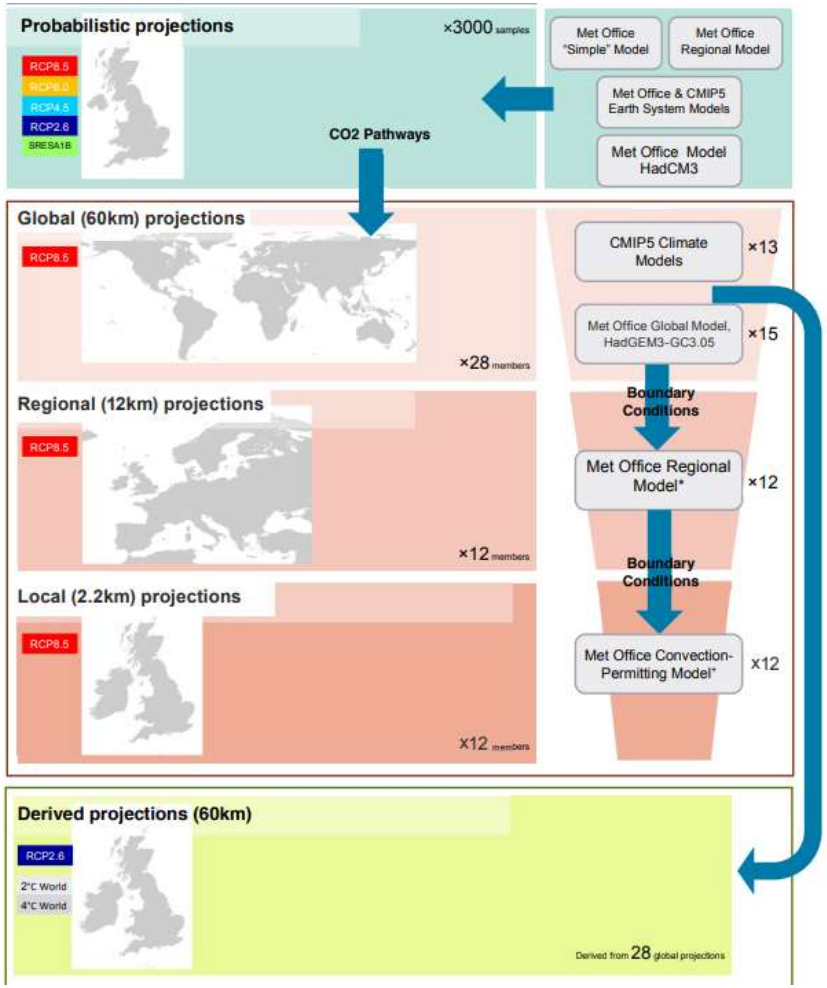
Intergovernmental Panel on Climate Change (IPPC) → **Global Greenhouse Emission Standards (SRES > RCP > SSPs)** → **UK Climate Projections (UKCP18)**



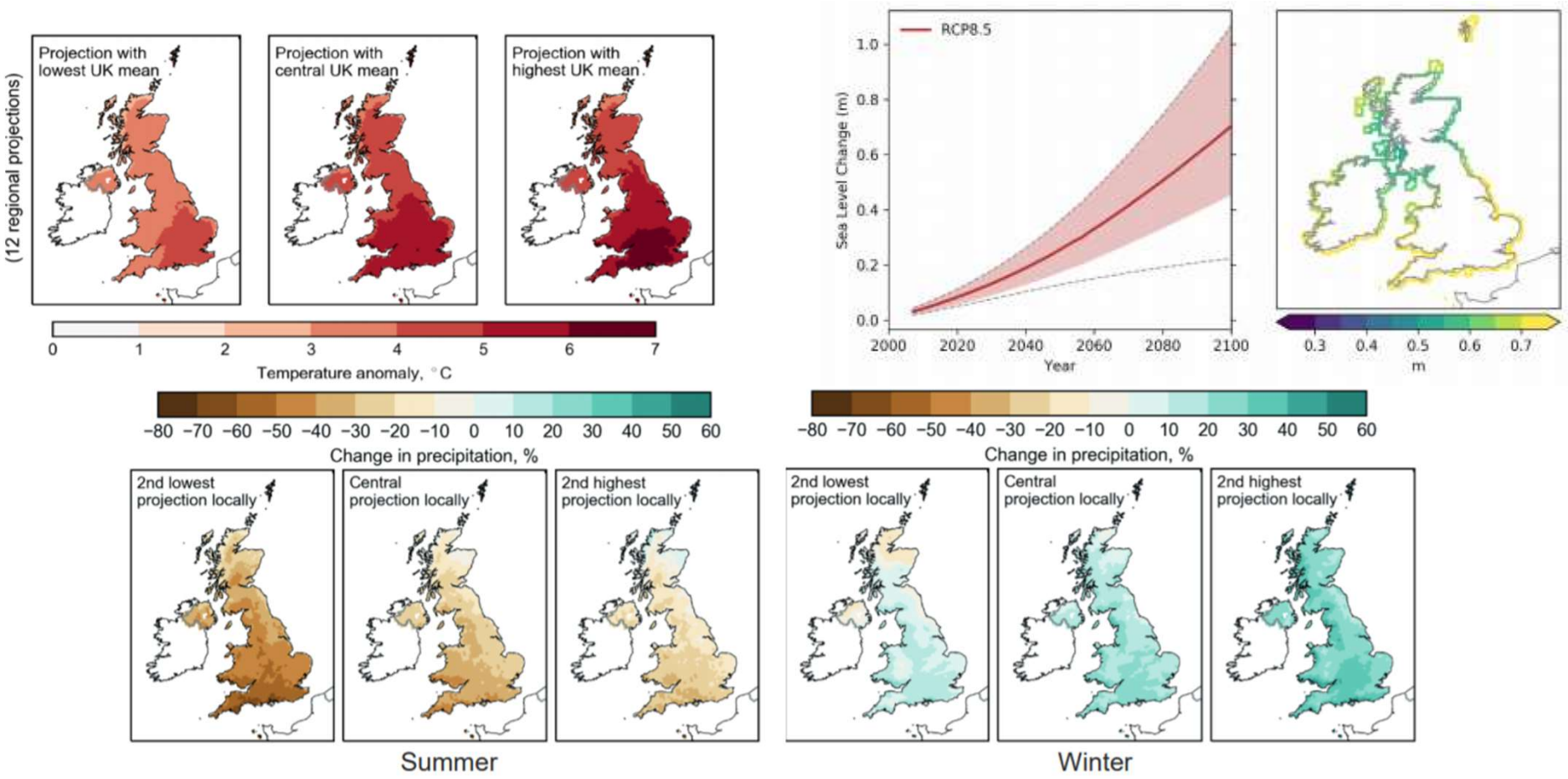


Future UK Climate Change Projections

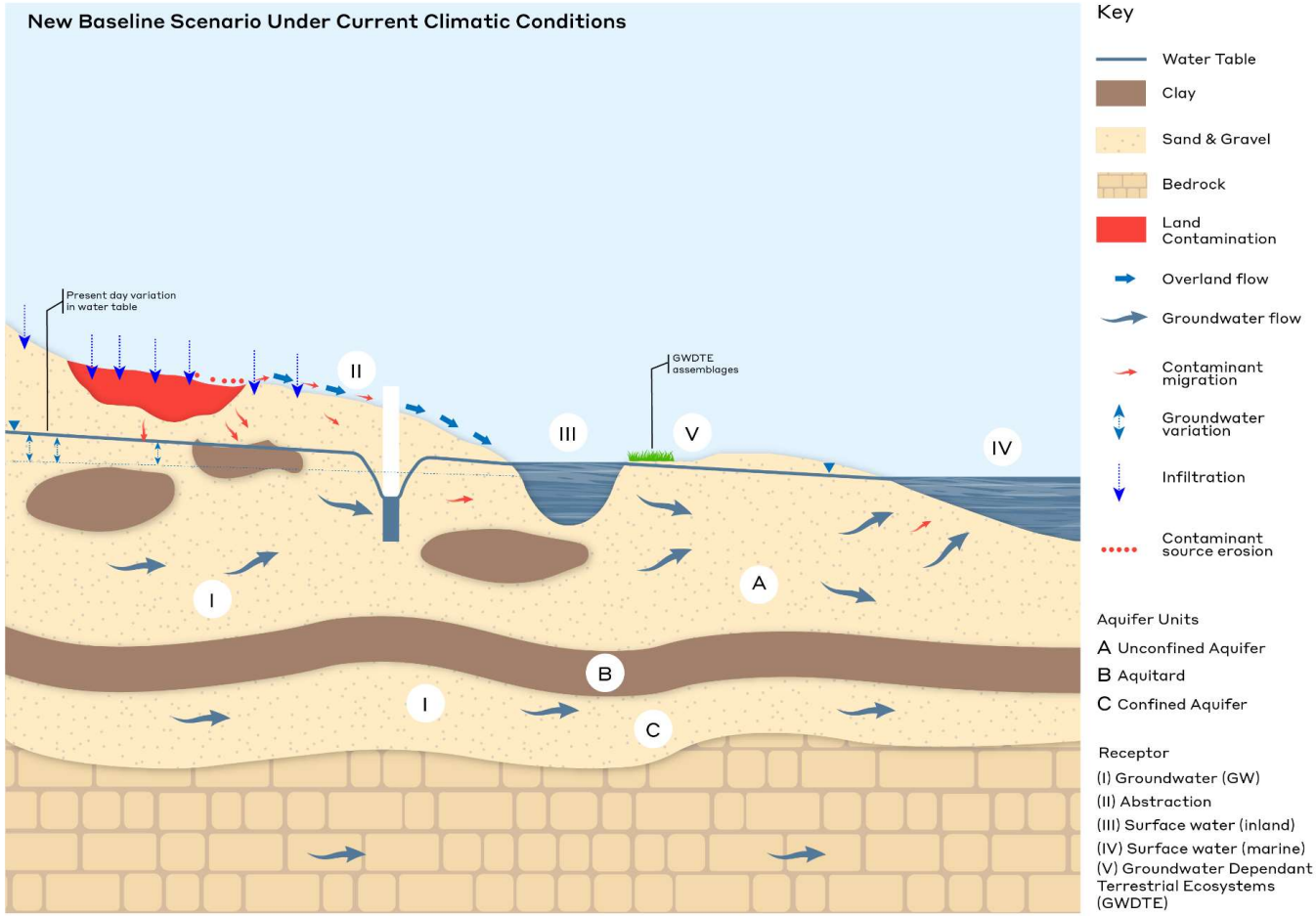
Scale		Global (60 km)	Regional (12 km)	Local (2.2 km)
Baseline period		1961 – 1990 1981 – 2000 1981 - 2010	1981 – 2000 1981 - 2010	1981 - 2000
Projection time period		2010 – 2100 (20yr timeslices)	2010 –2080 (20yr timeslices)	2021 – 2040 2061- 2080
Projections		28	12	12
Emissions Scenario	RCP8.5 (4.3 °C)	√	√	√
	RCP6.0 (2.8 °C)			
	RCP4.5 (2.4 °C)			
	RCP2.6 (1.6 °C)	√		



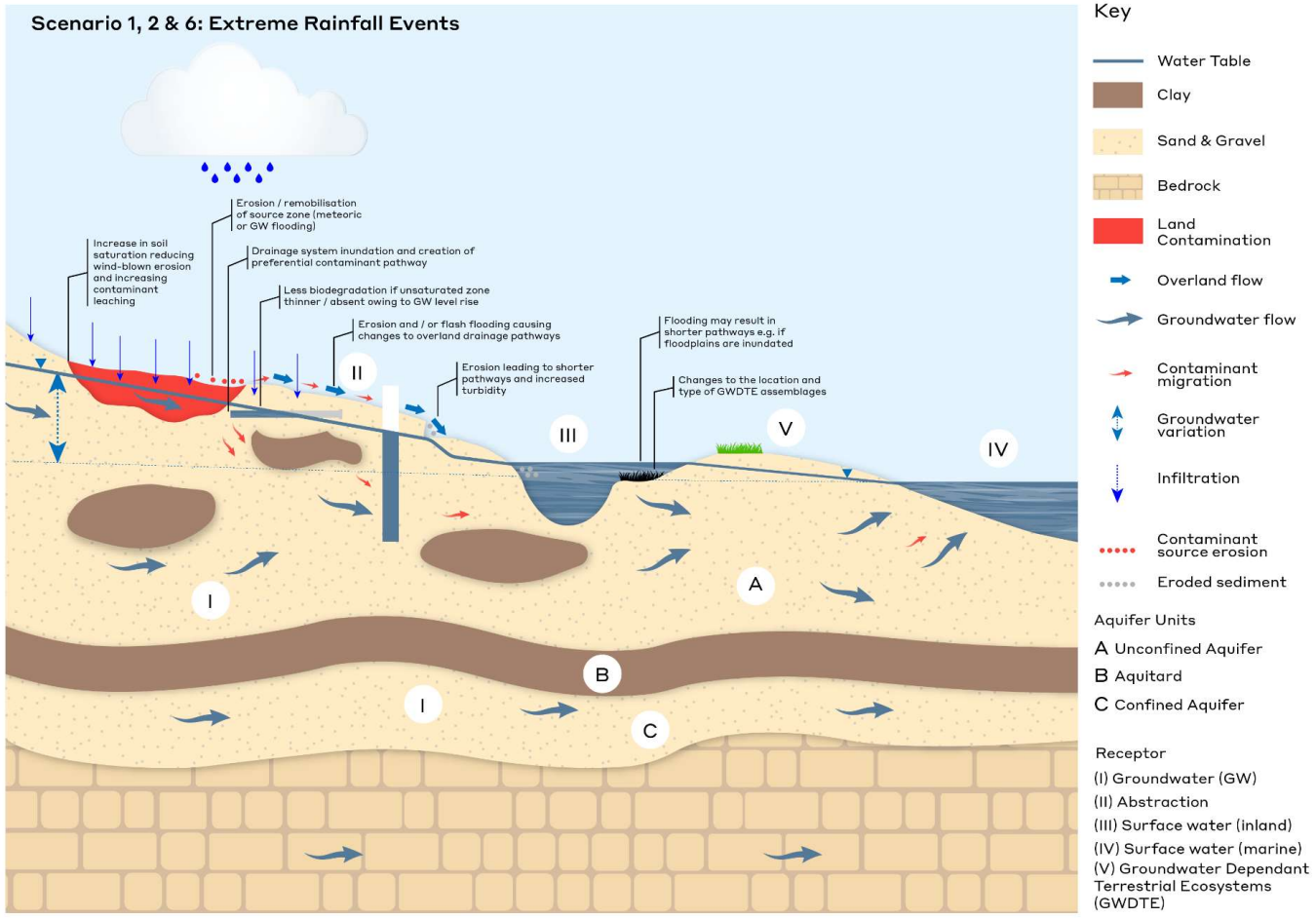
Climate change in UK – regional variation



Baseline Conceptual Site Model

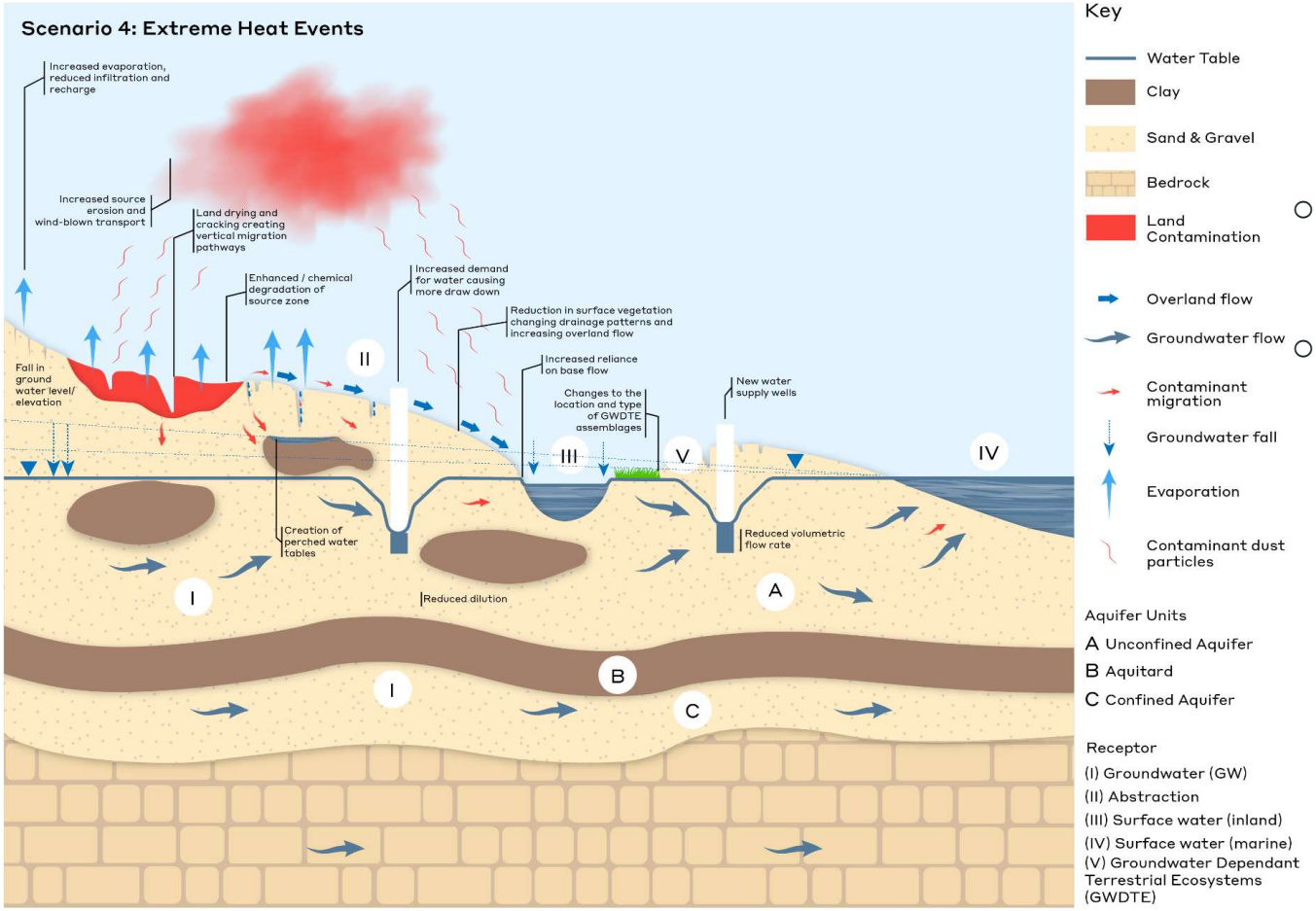


CSM Considerations – Extreme Rainfall Events



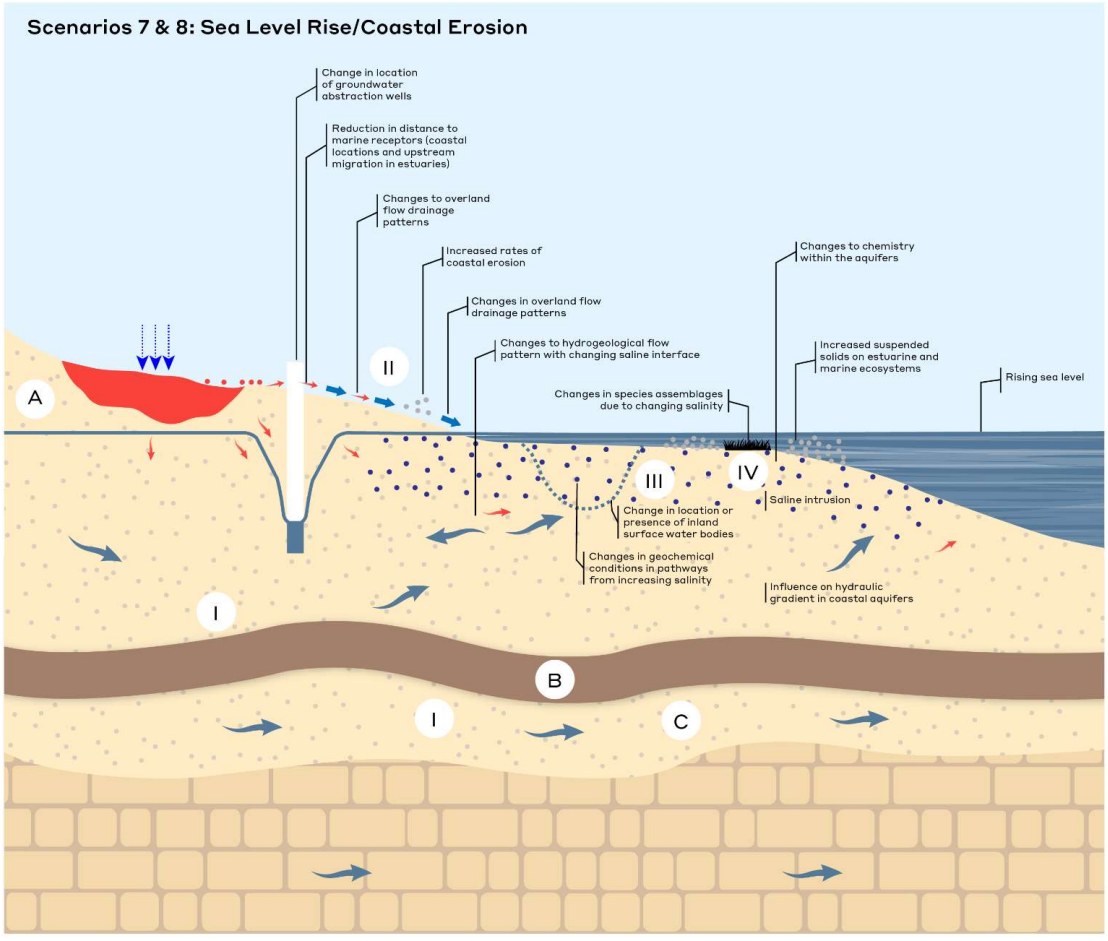
- Increase in precipitation (inc. extreme weather events)
- Rise in groundwater levels causing groundwater flooding
- Increase in precipitation causing land based erosion or changes to the geomorphology of surface waters (changes to S-P-R)
- Long term/seasonal changes to groundwater levels

CSM Considerations – Extreme Heat Events



- Fall in groundwater levels
- Changes to contaminant properties:
  - Solubility
  - DO
  - Volatility
  - NAPL viscosity
  - Microbial activity
  - Reaction kinetics

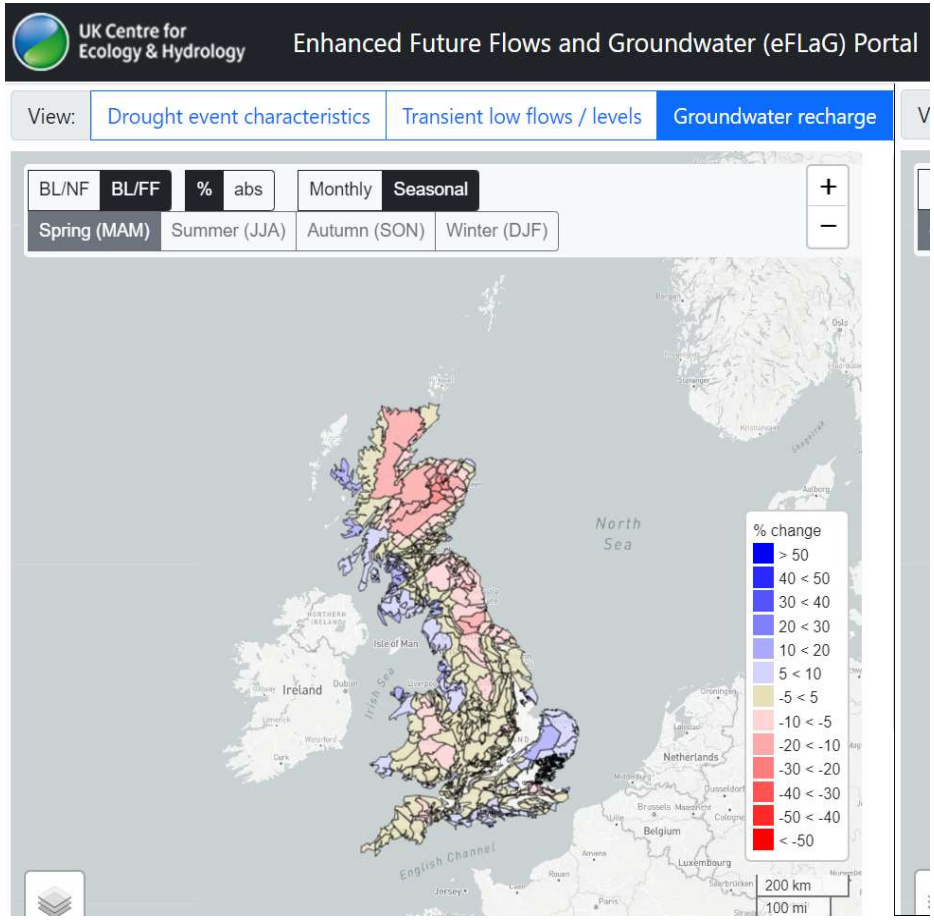
CSM Considerations – Sea Level Rise



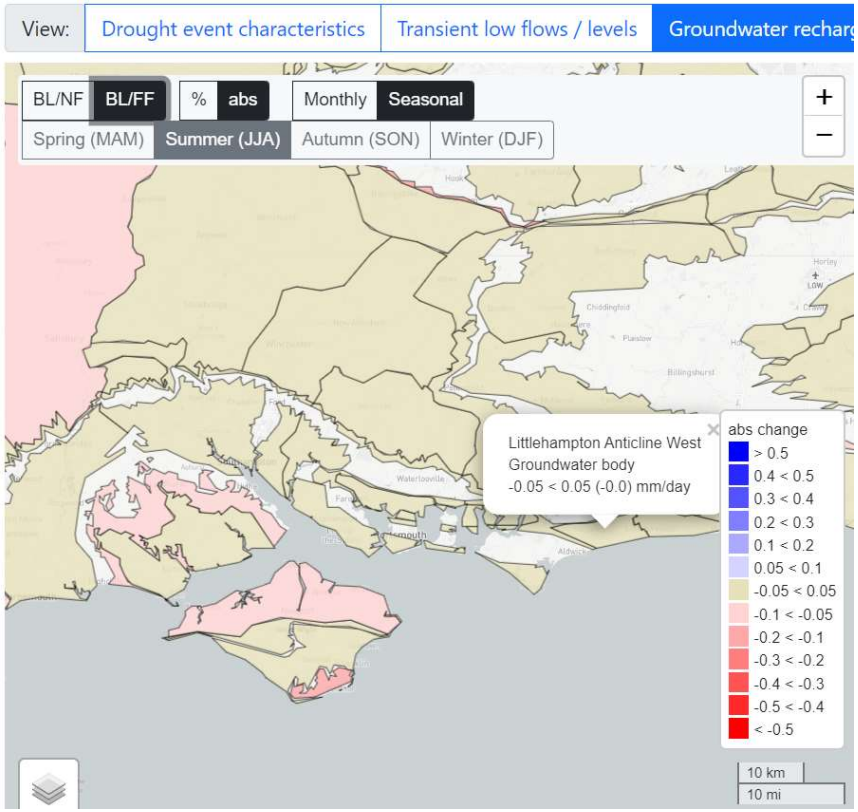
- Tidal limit on estuaries/rivers moves upstream
- Influence on hydraulic gradients in coastal aquifers
- Increased risk of coastal/tidal flooding
- Increased rates of coastal erosion
- Saline intrusion

Phase 1 Risk Assessment Climate Change Considerations

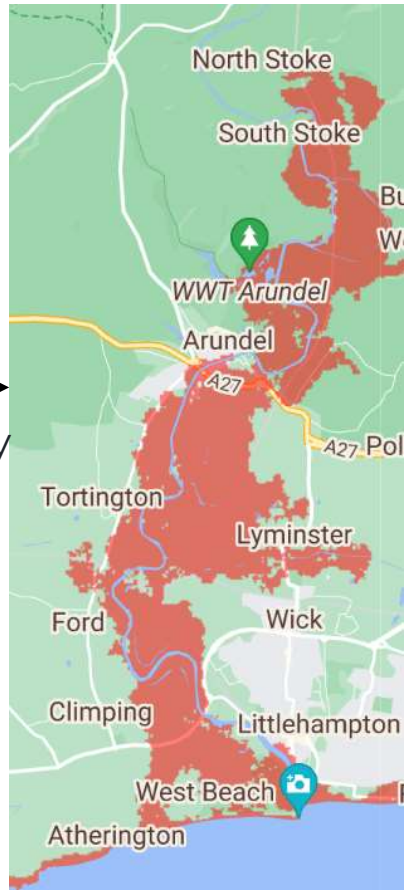
- Design life of proposed development.
- Location and elevation of the site in relation to the sea, tidally influenced rivers and projected increased flooding extents.
- The projected changes to groundwater recharge and changes to regional groundwater level for defined time slices (e.g. near future to 2049 or far future to 2079)(UKCP18, eFLaG).

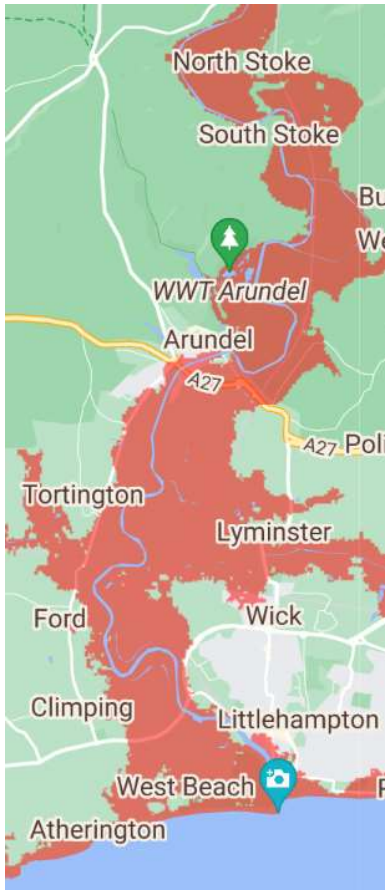


Does it matter?.....Yes, but not always.



Today

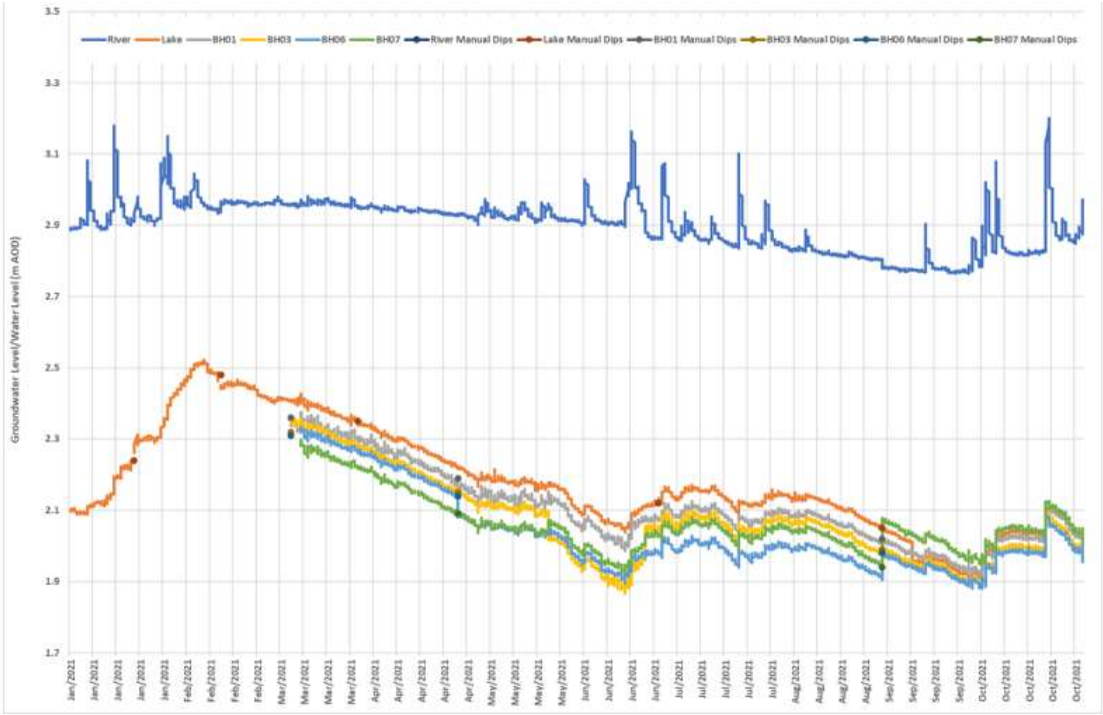




+1m

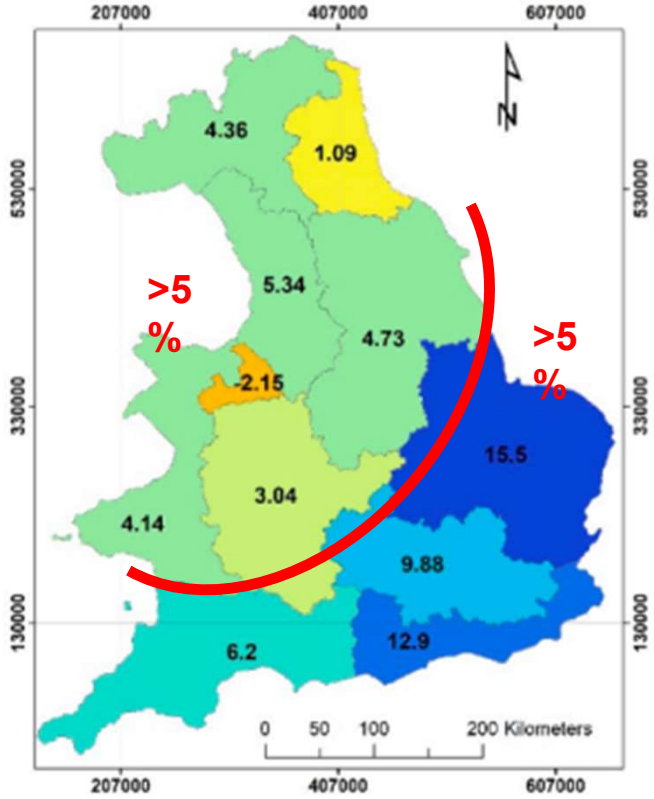
Phase II Risk Assessment Climate Change Considerations

- Source delineation (lateral and vertical)
- Preferential flow pathways e.g. subsurface infrastructure
- Understanding of groundwater bodies:
  - unconfined or confined
  - unsaturated zone thickness
  - variation in groundwater level (seasonality)
  - transmissivity
  - hydraulic connection with surface water



Detailed Quantitative Risk Assessment Climate Change Considerations

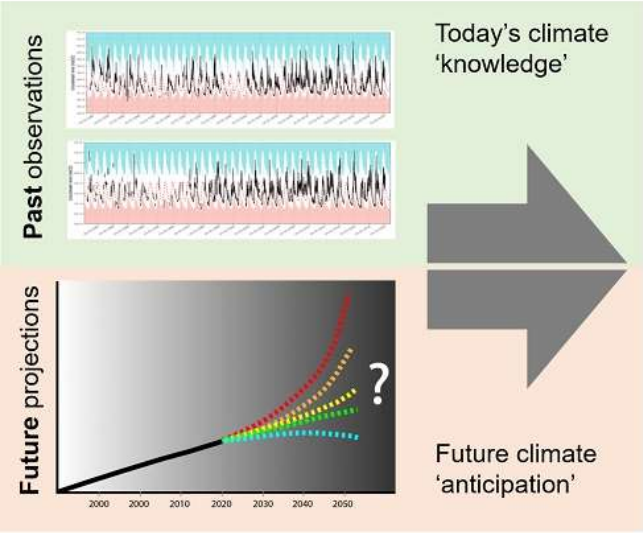
- Climate change is transient (median in flux) but commercially available models are not
- Long term changes can be modelled but not extremes
- Sensitive parameters:
  - recharge
  - groundwater elevation => unsaturated/ saturated thickness
  - hydraulic gradient
- Nature of hazard / longevity of risk
- ± 5% change within reasonable uncertainty assumptions for input parameters within DQRA

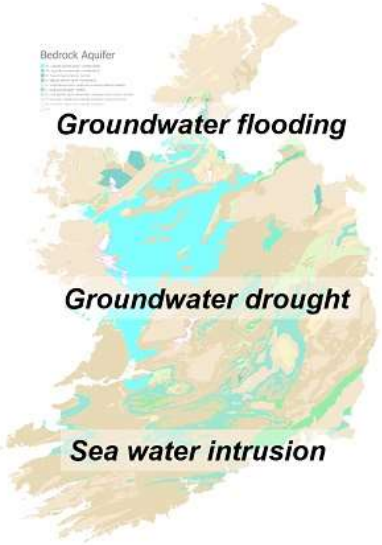


% change in mean recharge 2080s
Source: A Hughes et al Journal of Hydrology 598 (2021)
Scenario: SRES A1B ≈ between RCP4.5 and RCP6.0

Climate Change in Ireland – Data Sources

- Climate change projections are currently being standardised though Met Éireann's Translate project – Outputs available from early 2023

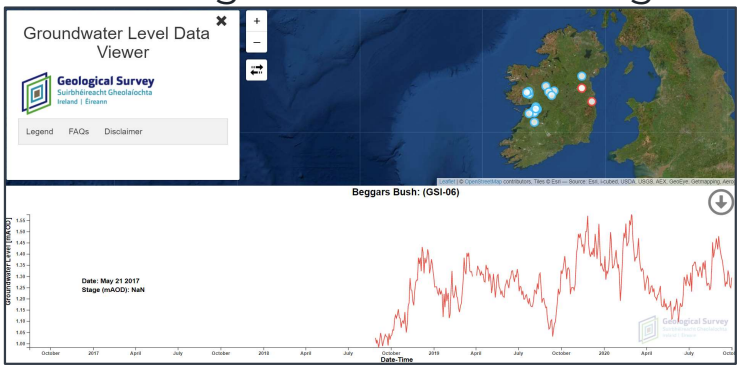




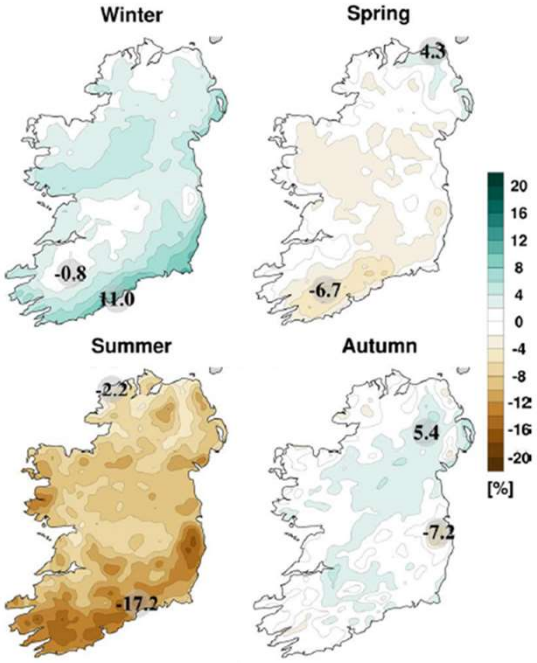
- GSI's GWClimate project (1st phase 2020-2022).
- Developed the models and demonstrated the feasibility of hindcasting/ forecasting/climate change analysis.
- Future phases to develop products and operational services.

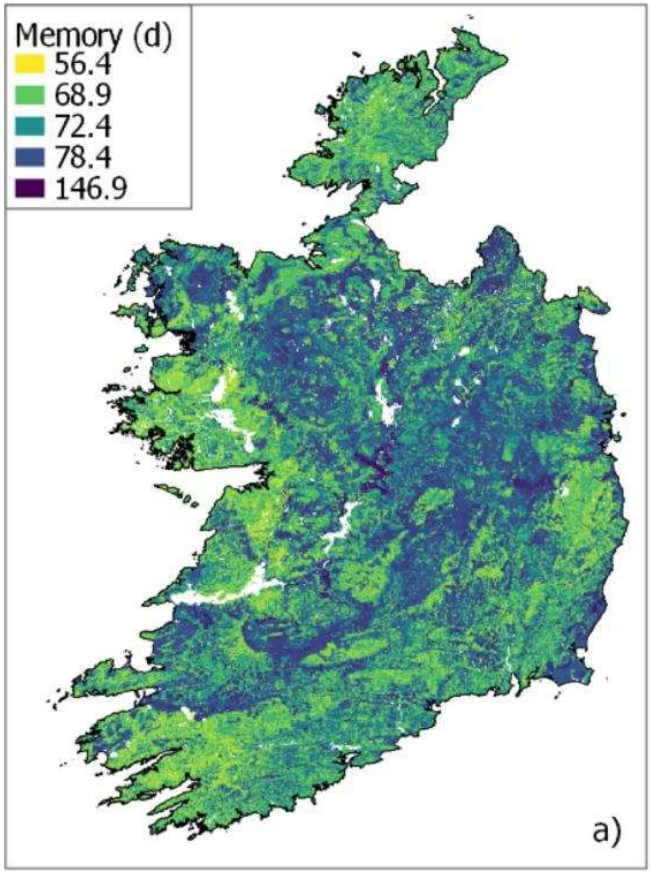
Climate Change in Ireland – Data Sources

- Groundwater memory mapping for drought susceptibility – the slower the better for groundwater resilience.
- Extend current national groundwater monitoring capacity to capture long-term dynamics with regard to climate change



- Projected changes to regional rainfall





https://www.sciencedirect.com/science/article/pii/S0022169422008496

Conclusions

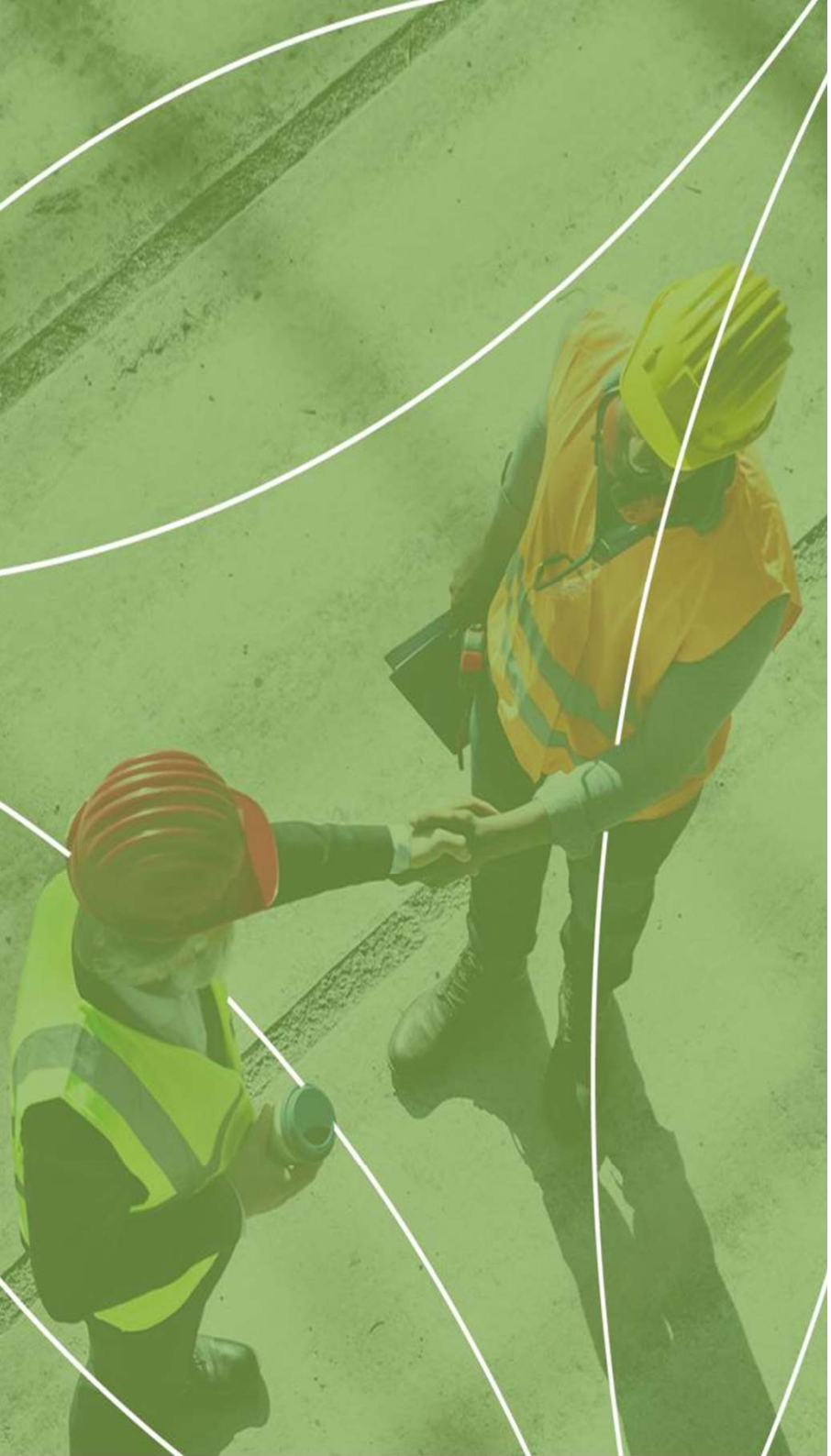
- It's complicated!
- Climate change effects may fundamentally change the S-P-R linkages being considered:
  - source/contaminant behaviour
  - active pathways
  - proximity to / type of receptor
- Consideration of regional variability and site specific conditions
- Needs to be considered at outset from Phase I stage
- Incorporate climate change projections and explore consequences within risk assessment
- Guidance currently planned to be updated in 2 years.

SoBRA Guidance https://sobra.org.uk/climate-change/controlled-waters-and-climate-change/

Delta Simons

Carbon Accounting Tool for Brownfield Redevelopment

Protecting people and planet



Overview

Who are Delta-Simons?

INOGEN ALLIANCE

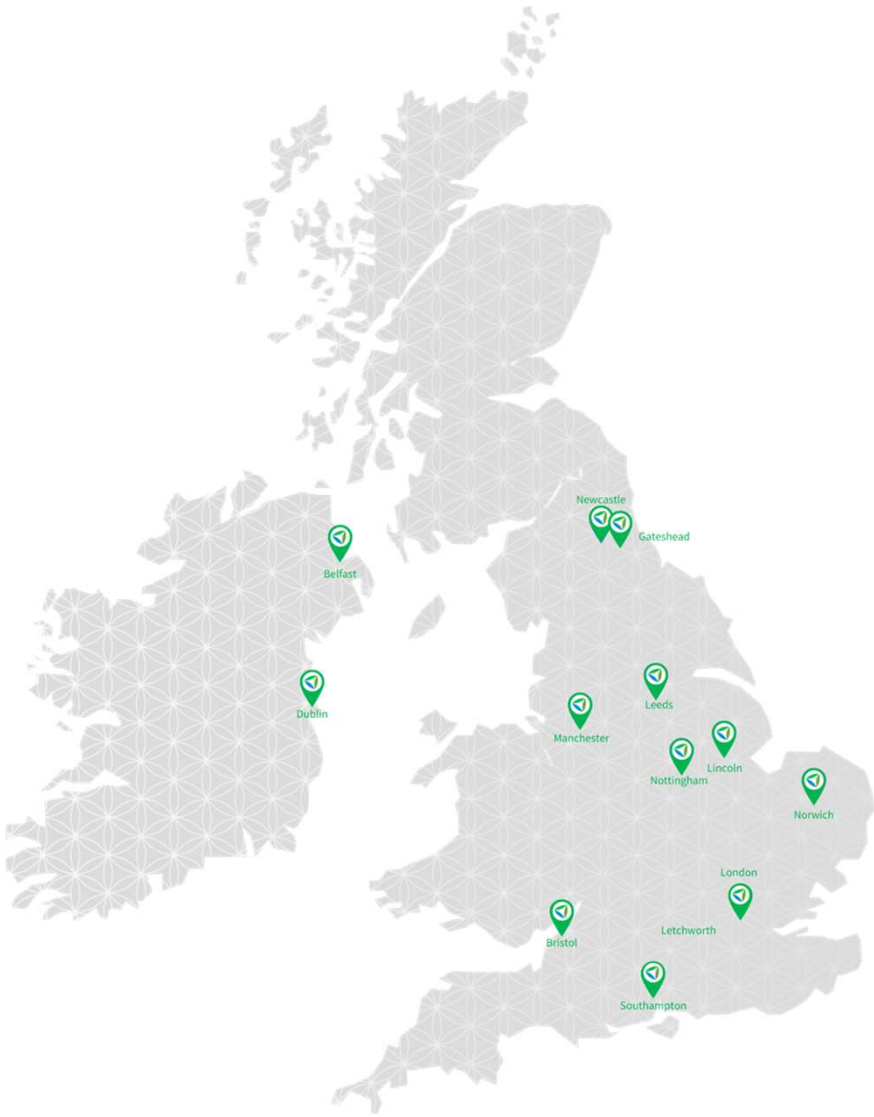
Protecting people and planet

Introduction to Delta-Simons

Delta-Simons is a multi-disciplinary environmental and health and safety consultancy providing trusted advice and solutions to '**Protect People and Planet**' through facilitating sustainable development.

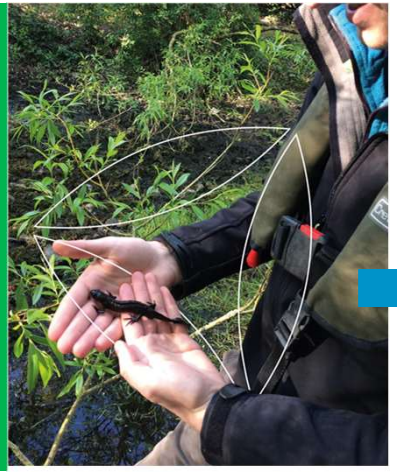
Overview

- Founded in 1992
- Offices through the UK
- 250 team members
- Actively Acquiring



Our Divisions

Environmental Planning Division



Geo-Environmental Division

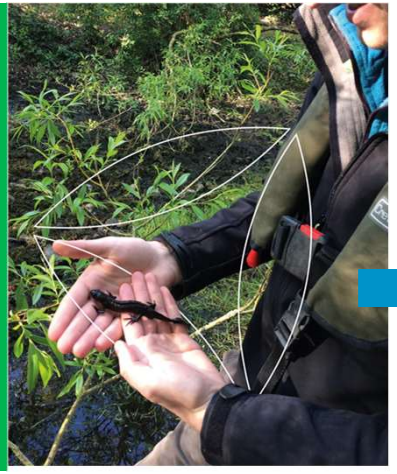
Environmental, Transactional Services Division

Environmental, Health, Safety & Sustainability Division

Our Divisions

EP

- Ecology
- Arboriculture
- Air Quality
- Noise
- Water Testing



GEOPS

- Geo-Environmental
- Geotechnical
- Site Investigations
- Trial Pits
- Bore Holes
- Phase 1 Desktop

ETS

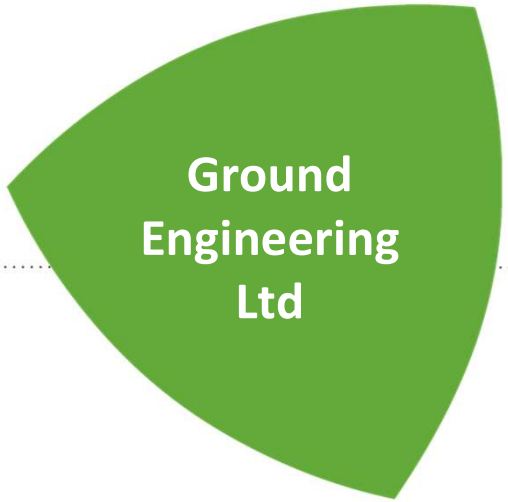
- Environmental Due Diligence
- Corporate M&A Transactions
- Post Transaction Support

EHS&S

- CDM
- Fire Safety
- Health & Safety
- ESG

Specialist, Environmental Consultancy

Delta-Simons is a multi-disciplinary environmental and health and safety consultancy providing trusted advice and solutions to 'Protect People and Planet' through facilitating sustainable development.



DeltaSimons

GROUND ENGINEERING LIMITED

Sustainability Services

DeltaSimons

Environmental Consultancy Services:

- Geo-environmental
- Geotechnical
- Waste & Resources
- Environmental Transaction Support
- ESG & Sustainability Services
- Environmental Planning & Impacts
- Ecology
- Air Quality
- Noise
- CDM Advisory & Support
- Fire Safety
- Health & Safety
- Expert Witness
- Training

GROUND ENGINEERING LIMITED

Geotechnical and geo-environmental ground investigation and professional services:

- Phase I Desk Studies
- Machine excavated trial pits
- Hand excavated foundation inspection pits, specialising in deep, fully shored excavations
- Cable percussion boreholes, including restricted access and low headroom rigs
- Rotary boreholes
- In-situ testing and specialist sampling, including borehole shear vane, piston sampling, peat sampling
- Installation of instrumentation, including conventional, pneumatic and hydraulic piezometers, inclinometer tubes, settlement and load cells, datum bars, gas monitoring probes
- Hand auger boreholes
- Driven continuous sampling and dynamic probing
- Dynamic cone penetration testing
- Static cone testing
- Over water work
- Laboratory Testing

Project Carbon Accounting

What, why and how?

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Why Develop a Carbon Counting Tool?

- Will enable the project manager to understand the carbon impact of a project.
- Can be used to show the projected vs actual emissions.
- Can provide insight into the embodied carbon of preferred materials and their cleaner alternatives.
- Emissions data is becoming an increasingly more common item during the project tender process.
- Can help a project manager realise the potential cost of making a project ‘carbon neutral’.

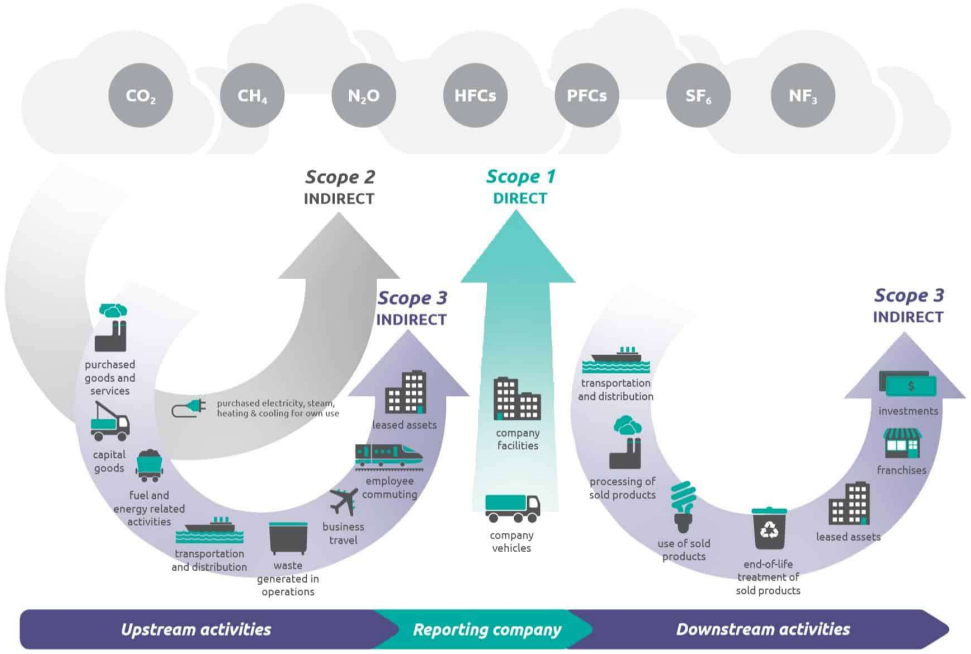
Key Drivers Behind Our Approach

Our tool is carried out in accordance with 'PAS2050:2001 and the 'GHG Protocol'. This includes all mandatory Scope 1 (directly combustible fuels) and Scope 2 (purchased electricity) emissions sources; as well as all material Scope 3 emissions.

Wider Standards

- ✓ 'PAS2050:2001 Specification For LCA Emissions Of Goods And Services';
- ✓ GHG Protocol;
- ✓ ISO14064-1:2006 Greenhouse Gases.

This methodology allows us to amend the carbon calculator boundaries depending on the client's requirements.



Scope 3 – Inclusions and Exclusions

- Which sources of scope 3 emissions should be accounted for and why?
- Are inclusions material? Are exclusions justified?
- Minimum scope 3 requirements exist for accounting and reporting under the GHG protocol.

Upstream or downstream	*Scope 3 category*
Upstream scope 3 emissions	**1.** Purchased goods and services **2.** Capital goods **3.** Fuel- and energy-related activities (not included in scope 1 or scope 2) **4.** Upstream transportation and distribution **5.** Waste generated in operations **6.** Business travel **7.** Employee commuting **8.** Upstream leased assets
Downstream scope 3 emissions	**9.** Downstream transportation and distribution **10.** Processing of sold products **11.** Use of sold products **12.** End-of-life treatment of sold products **13.** Downstream leased assets **14.** Franchises **15.** Investments

Carbon Accounting Tool

Brownfield Remediation Example

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Client Brief

The client brief was to create a calculation tool which could be used at project design stage to assess the potential carbon impact/savings from a range of different remediation options.

It could also be used as a verification tool throughout and upon completion of any remediation project.

Delta-Simons worked with the Client to develop the bespoke tool which is in line with industry standards, but also takes into account the Client's own operating practices.

Tool Structure

- Imported Materials
- Timber
- Concrete, Mortars and Cement
- Plastics
- Glass
- Metals
- Site Waste
- Personnel Travel to and from Site
- Material Transport
- Finishings, Coating and Adhesives
- Plant and Equipment Items
- Portable Site Accommodation

- The tool requires basic input from the user.
- Data input may be:
  - Weight of material;
  - Litres of fuel;
  - kWh consumed;
  - Mileage; or
  - Cost.
- Carbon conversions are derived from the DEFRA emissions factor for 2022.

< SITE / PROJECT NAME >

105.23 tonnes

Project Revenue	£1,500,000
Emissions per £100,000 of Project Revenue	7.02 tonnes
Emissions per ___	105.23 tonnes

Imported Materials	Consumption (tonnes)	Total tCO_2e
Aggregate	10	0.08
Recycled Aggregate	0	0.00
Incinerator Bottom Ash Aggregate	0	0.00
Topsoil	10	0.01
Subsoil	0	0.00
Compost	10	1.15
Bentonite	10	2.13
Asphalt	10	0.39
Sand	10	0.07
Powdered Gypsum (Plasterboard)	10	1.20
	70	**3.83**

Timber	Consumption (tonnes)	Total tCO_2e
MDF	10	8.56
Plywood	0	0.00
	10	**8.56**

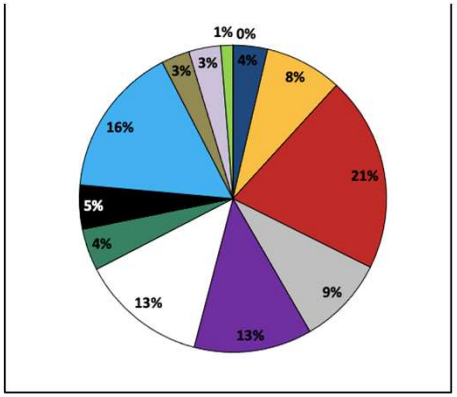
Concrete, Mortars & Cement	Consumption (tonnes)	Total tCO_2e
Concrete	10	1.32
Lime	10	7.40
OPC	10	9.12
PFA	0	0.00
Ground Granulated Blast Furnace Slag	10	3.00
Cement Kiln Bypass Dust	1	0.83
	41	**21.67**

Plastic	Consumption (tonnes)	Total tCO_2e
HDPE	2	6.54
HDPE Piping	2	6.54
	4	**13.08**

Glass	Consumption (tonnes)	Total tCO_2e
Glass	10	14.03
	10	**14.03**

Waste	Consumption	Total tCO_2e
Landfill (please use waste input sheet)	60	3.51
Recycling (please use waste input sheet)	140	11.95
Incineration (please use waste input sheet)	40	0.85
Treated Soil (please use waste input sheet)	30	0.20
Site Wastewater (m3)	1,000	0.27
Landfill for Use as Aggregate (tonnes)	0	0.00
	1,270	**16.79**

Personnel Travel	Consumption	Total tCO_2e
Mileage	1,000	0.18
Diesel (litres)	1,000	0.27
Petrol (litres)	1,000	2.56
Public Transport (please use transport input sheet)	6,000	0.51
	3,000	**3.53**



Material Transport	Consumption (tonne.km)	Total tCO_2e
To Site (please use material transport input sheet)	10,000	0.28
From Site (please use material transport input sheet)	10,000	1.06
	20,000	**1.34**

Metals	Consumption (tonnes)	Total tCO_2e
Sheet Piling	2	5.78
Rebar	2	3.98
	4	**9.76**

Finishings, Coating & Adhesives	Consumption	Total tCO_2e
Finishings (£s spent)	£100.00	0.68
Coatings (£s spent)	£100.00	0.05
Adhesives (tonnes)	1	3.91
	201	**4.64**

Plant & Equipment	Consumption	Total tCO_2e
Electricity (kWh)	10,000	1.93
LPG (tonnes)	1	2.94
Red Diesel (litres)	1	0.00
Biodiesel (litres)	0	0.00
HVO (litres)	0	0.00
Gas Oil (litres)	1	0.00
	10,003	**4.88**

Portable Site Accommodation	Consumption	Total tCO_2e
Electricity (kWh)	1,000	0.19
Water (m3)	100	0.00
LPG (tonnes)	1	2.94
Natural Gas (kWh)	1	0.00
	1,102	**3.13**

Miscellaneous	Consumption	Total tCO_2e
Membranes (tonnes)	0	0.00
Chemicals (£s spent)	£0	0.00
	0	**0.00**

Total Project Emissions

Key Performance Indicators

Emissions Categories

Source - As Chosen By The Client

Unit - Input Manually Or Via Tabs

tCO_2e - Uses DEFRA Factors

Totals Then Link To The Pie Chart

< SITE / PROJECT NAME >

105.23 tonnes

Project Revenue	£1,500,000
Emissions per £100,000 of Project Revenue	7.02 tonnes
Emissions per ___	105.23 tonnes

Imported Materials	Consumption (tonnes)	Total tCO_2e
Aggregate	10	0.08
Recycled Aggregate	0	0.00
Incinerator Bottom Ash Aggregate	0	0.00
Topsoil	10	0.01
Subsoil	0	0.00
Compost	10	1.15
Bentonite	10	2.13
Asphalt	10	0.39
Sand	10	0.07
Powdered Gypsum (Plasterboard)	10	1.20
	70	3.83

Timber	Consumption (tonnes)	Total tCO_2e
MDF	10	8.56
Plywood	0	0.00
	10	8.56

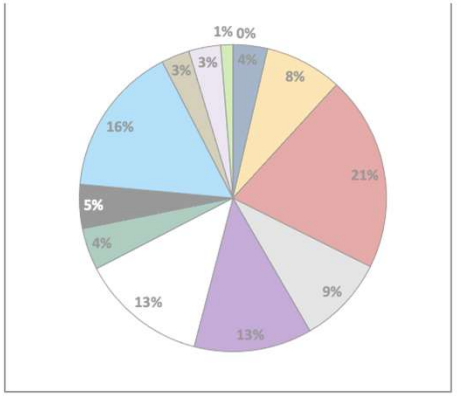
Concrete, Mortars & Cement	Consumption (tonnes)	Total tCO_2e
Concrete	10	1.32
Lime	10	7.40
OPC	10	9.12
PFA	0	0.00
Ground Granulated Blast Furnace Slag	10	3.00
Cement Kiln Bypass Dust	1	0.83
	41	21.67

Plastic	Consumption (tonnes)	Total tCO_2e
HDPE	2	6.54
HDPE Piping	2	6.54
	4	13.08

Glass	Consumption (tonnes)	Total tCO_2e
Glass	10	14.03
	10	14.03

Waste	Consumption	Total tCO_2e
Landfill (please use waste input sheet)	60	3.51
Recycling (please use waste input sheet)	140	11.95
Incineration (please use waste input sheet)	40	0.85
Treated Soil (please use waste input sheet)	30	0.20
Site Wastewater (m3)	1,000	0.27
Landfill for Use as Aggregate (tonnes)	0	0.00
	1,270	16.79

Personnel Travel	Consumption	Total tCO_2e
Mileage	1,000	0.18
Diesel (litres)	1,000	0.27
Petrol (litres)	1,000	2.56
Public Transport (please use transport input sheet)	6,000	0.51
	3,000	3.53



Material Transport	Consumption (tonne.km)	Total tCO_2e
To Site (please use material transport input sheet)	10,000	0.28
From Site (please use material transport input sheet)	10,000	1.06
	20,000	1.34

Metals	Consumption (tonnes)	Total tCO_2e
Sheet Piling	2	5.78
Rebar	2	3.98
	4	9.76

Finishings, Coating & Adhesives	Consumption	Total tCO_2e
Finishings (£s spent)	£100.00	0.68
Coatings (£s spent)	£100.00	0.05
Adhesives (tonnes)	1	3.91
	201	4.64

Plant & Equipment	Consumption	Total tCO_2e
Electricity (kWh)	10,000	1.93
LPG (tonnes)	1	2.94
Red Diesel (litres)	1	0.00
Biodiesel (litres)	0	0.00
HVO (litres)	0	0.00
Gas Oil (litres)	1	0.00
	10,003	4.88

Portable Site Accommodation	Consumption	Total tCO_2e
Electricity (kWh)	1,000	0.19
Water (m3)	100	0.00
LPG (tonnes)	1	2.94
Natural Gas (kWh)	1	0.00
	1,102	3.13

Miscellaneous	Consumption	Total tCO_2e
Membranes (tonnes)	0	0.00
Chemicals (£s spent)	£0	0.00
	0	0.00

Baseline Emissions	**105.23 tonnes**
Optioneering Emissions	**99.64 tonnes**
Emissions Savings	**5.60 tonnes**

Emissions per £100,000 of Project Revenue	6.64 tonnes
Emissions per ___	99.64 tonnes

Imported Materials	Consumption (tonnes)	Total tCO_2e
Aggregate	0	0.00
Recycled Aggregate	5	0.02
Incinerator Bottom Ash Aggregate	0	0.00
Topsoil	0	0.00
Subsoil	10	0.01
Compost	10	1.15
Bentonite	10	2.13
Asphalt	10	0.39
Sand	10	0.07
Powdered Gypsum (Plasterboard)	10	1.20
	65	3.77

Timber	Consumption (tonnes)	Total tCO_2e
MDF	0	0.00
Plywood	10	6.81
	10	6.81

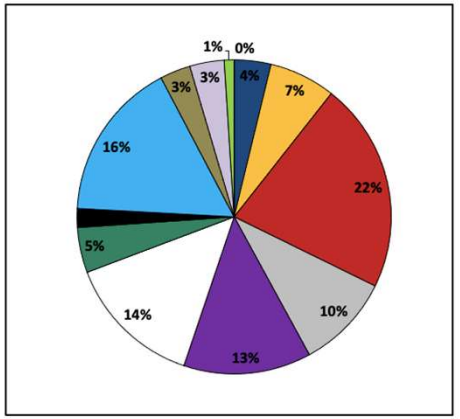
Concrete, Mortars & Cement	Consumption (tonnes)	Total tCO_2e
Concrete	10	1.32
Lime	0	0.00
OPC	10	9.12
PFA	10	7.29
Ground Granulated Blast Furnace Slag	10	3.00
Cement Kiln Bypass Dust	1	0.83
	41	21.56

Plastic	Consumption (tonnes)	Total tCO_2e
HDPE	2	6.54
HDPE Piping	2	6.54
	4	13.08

Glass	Consumption (tonnes)	Total tCO_2e
Glass	10	14.03
	10	14.03

Waste	Consumption	Total tCO_2e
Landfill (please use waste input sheet)	20	2.88
Recycling (please use waste input sheet)	160	11.97
Incineration (please use waste input sheet)	50	1.06
Treated Soil (please use waste input sheet)	30	0.20
Site Wastewater (m3)	1,000	0.27
Landfill for Use as Aggregate (tonnes)	5	0.00
	1,265	16.39

Personnel Travel	Consumption	Total tCO_2e
Mileage	1,000	0.18
Diesel (litres)	1,000	0.27
Petrol (litres)	1,000	2.56
Public Transport (please use transport input sheet)	6,000	0.51
	3,000	3.53



Material Transport	Consumption (tonne.km)	Total tCO_2e
To Site (please use material transport input sheet)	7,500	0.21
From Site (please use material transport input sheet)	7,500	0.80
	15,000	1.00

Metals	Consumption (tonnes)	Total tCO_2e
Sheet Piling	2	5.78
Rebar	2	3.98
	4	9.76

Finishings, Coating & Adhesives	Consumption	Total tCO_2e
Finishings (£s spent)	£100.00	0.68
Coatings (£s spent)	£100.00	0.05
Adhesives (tonnes)	1	3.91
	201	4.64

Plant & Equipment	Consumption	Total tCO_2e
Electricity (kWh)	10,000	1.93
LPG (tonnes)	0	0.00
Red Diesel (litres)	0	0.00
Biodiesel (litres)	1	0.00
HVO (litres)	2	0.00
Gas Oil (litres)	0	0.00
	10,003	1.93

Portable Site Accommodation	Consumption	Total tCO_2e
Electricity (kWh)	1,000	0.19
Water (m3)	100	0.00
LPG (tonnes)	1	2.94
Natural Gas (kWh)	1	0.00
	1,102	3.13

Miscellaneous	Consumption	Total tCO_2e
Membranes (tonnes)	0	0.00
Chemicals (£s spent)	£0	0.00
	0	0.00

Brownfield Remediation Carbon Tool

- Allows the client to easily assess the carbon impact of a project and communicate the results to the end client.
- Can be used to show the projected vs actual emissions.
- Can also identify the emissions savings that could be achieved via:
  - changes in the materials used;
  - sourcing materials from local suppliers;
  - altering how workers travel to and from site; and
  - ensuring that zero waste is disposed of via landfill.
- Allows for project comparisons through flexible KPI metrics.
- Can be used to support upcoming project tenders.
- Can inform the level of offsetting required to achieve project carbon neutrality.

Presented by:

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INOGEN ALLIANCE

Protecting people and planet

Question & Answers

10th Anniversary Conference, Dublin, September 2022

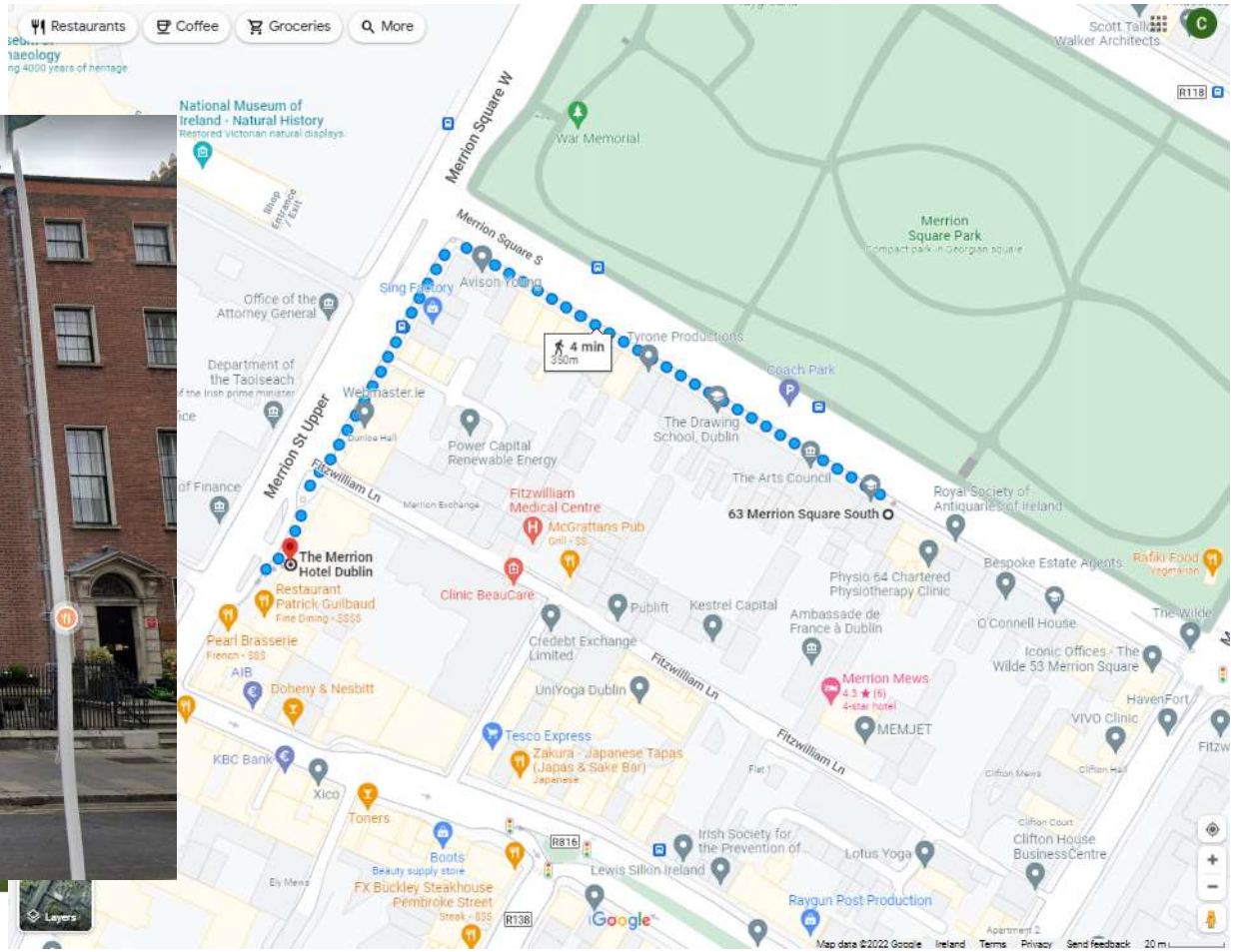
IBN The Ireland Brownfield Network

Encouraging the appropriate and sustainable redevelopment of brownfield land in Ireland

Thanks

- All on the organising committee
- Royal Society of Antiquaries and the IGI
- All our Sponsors

Networking


Restaurants
Coffee
Groceries
More
National Museum of Ireland - Natural History
Merrion Square W
Merrion Square S
War Memorial
Merrion Square Park
Office of the Attorney General
Sing Factory
Avison Young
4 min
350m
Tyrone Productions
Coach Park
Department of the Taoiseach
Webmaster.ie
Merrion St Upper
Power Capital Renewable Energy
The Drawing School, Dublin
The Arts Council
Fitzwilliam Ln
Fitzwilliam Medical Centre
McGrattans Pub
63 Merrion Square South
Royal Society of Antiquaries of Ireland
The Merrion Hotel Dublin
Restaurant Patrick Guilbaud
Clinic BeauCare
Physio 64 Chartered Physiotherapy Clinic
Bespoke Estate Agents
Pearl Brasserie
AIB
Doheny & Nesbitt
Credebt Exchange Limited
Publift
Kestrel Capital
Ambassade de France à Dublin
O'Connell House
Iconic Offices - The Wilde 53 Merrion Square
UniYoga Dublin
Merrion Mews
MEMJET
HavenFort
VIVO Clinic
Tesco Express
Zakura - Japanese Tapas (Japas & Sake Bar)
KBC Bank
Xico
Toners
Boots
FX Buckley Steakhouse Pembroke Street
Irish Society for the Prevention of
Lewis Silkin Ireland
Lotus Yoga
Clifton House BusinessCentre
Raygun Post Production
R816
R138
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