

# Environmental Sensitivity Mapping



## ESM Webtool

*Bringing environmental assessment  
to your fingertips*

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# Collaborative partners

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**Infrastructural Support: Ordnance Survey Ireland**



Oifig an  
Rialaitheora Pleanála  
Office of the  
Planning Regulator



**GeoHive**



**Ordnance  
Survey  
Ireland**

# Relevance: SEA and Spatial Planning



- Population and human health
- Biodiversity, flora, fauna
- Air and climate
- Soils and geology
- Water
- Landscape
- Cultural heritage
- Material assets
- Inter-relationships

**Multiple considerations,  
spatial implications, consultation**

## **Spatial evidence-base for SEA and planning decisions**

- ✓ Assessment consistency and transparency
- ✓ Intrinsic environmental conditions > susceptible to change
- ✓ Early-warning of potential land-use conflicts



# Data Viewer

## Access, Visualisation, Discovery

The screenshot displays the GeoHive Environmental Sensitivity Mapping (ESM) interface. At the top, the header includes the GeoHive logo, the text "Environmental Sensitivity Mapping", and a search bar with the placeholder "Find address or place". The main map area shows Ireland with several layers overlaid, including ancient woodlands and natural heritage areas. Key locations like "Derry/Londonderry/Doire" and "Belfast" are labeled. A "Layer List" panel on the left shows various layers, with "Biodiversity Flora Fauna", "Ancient Woodlands", and "Natural Heritage Areas" checked. A "Layer Info" popup window is open, providing details for the "Ancient Woodlands" layer, including its source (National Parks and Wildlife Services), last update (June 2012), and integration date (January 2018). The popup also contains a descriptive paragraph about ancient woodlands and a definition of Possible Ancient Woodland (PAW) and Long Established Woodlands (LEW). A "Legend" panel on the right lists the symbols for different types of woodlands and heritage areas. The interface includes navigation controls on the left and bottom, and logos for partner organizations like EPA, OPR, and AIRO in the top right. A scale bar for 60km is visible in the bottom left, and the Esri logo is in the bottom right.

**GeoHive Environmental Sensitivity Mapping** Find address or place

**Layer List**

- Biodiversity Flora Fauna
- Ancient Woodlands
- Annex 1 Habitats
- BirdWatch Sensitivity
- Coastal Habitats-Saltmarshes
- Contributions to Potential Ecological Networks
- Dublin Bay Biosphere
- Forest Inventory
- Legally Protected and Policy Relevant Species
- Margaritifera Sensitive Areas
- Natural Heritage Areas

**Layer Info**

Source: National Parks and Wildlife Services  
Last data update by Source: June 2012  
Integration date within ESM: January 2018

The data displayed represent the national ancient and long established woodland inventory undertaken by the National Parks and Wildlife Service. Ancient woodland refers to those woods that have had a continuous history of cover since before the period when planting and afforestation became common practice (mid 1600s). These woodlands are important in terms of their biological and cultural value.

Possible Ancient Woodland (PAW) is defined as stands which have been continuously wooded since 1660. Long Established Woodlands (LEW) are those which have been continuously wooded since 1830. (LEW (I) - no evidence of antiquity found in older documentation, LEW (II) - there is

**Legend**

**Biodiversity Flora Fauna**

- Ancient Woodlands
  - Ancient Woodland
  - Long-established Woodland (No antiquity evidence)
  - Long-established Woodland (Not ancient)
  - Possible Ancient Woodland
- Natural Heritage Areas
- Proposed Natural Heritage Areas
- Special Areas of Conservation
- Special Protection Areas

**Material Assets**

- Current Wind Farms

60km

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# Over 130 SEA-relevant Geospatial datasets

## Air and Climate

- Air zones
- Coal restricted areas
- Historical flood extents
- Soil carbon (eco serv)
- Vegetation carbon (eco serv)
- Water retention (eco serv)
- Wind speeds

## Biodiversity, Flora & Fauna

- Ancient woodlands
- Annex I habitats (Habitats Direct)
- Birdwatch sensitivity (to windfarms)
- Coastal habitats – Saltmarshes
- Contributions to pot. ecological networks (eco serv)
- Forest inventory
- Legally protected and policy relevant species (eco serv)
- Margaritifera sensitive areas
- Natural Heritage Areas (NHAs)
- Proposed NHAs
- Salmonid waters
- Special Areas of Conservation (SACs)
- Special Protection Areas (SPAs)
- Terrestrial biodiversity (eco serv)
- Woodland habitats

## Cultural Heritage

- Irish landmark trust
- Museums, collections and archives
- NIAH
- Sites and Monuments Record
- Walled towns
- World Heritage Sites

## Landscape

- Landscape character areas
- Seascape character areas
- Seascape visual resource assessment

## Material Assets

- Active quarries
- Airfields and airports
- Broadband access
- Current wind farms
- Discharge licences
- Extractive industries register
- Historic mine districts
- IPPC licences
- Landfill sites
- Licensed waste facilities
- Ports
- Railway network
- Road network
- Settlements
- Waste water treatment plants and status

## Population and Human Health

- Disability
- General health
- Pobal HP Deprivation Index
- Housing stock (vacant & holiday homes)
- Travel to work >30min and >1hr
- Labour force unemployed
- Population change (percentage and total)
- Population density per Km<sup>2</sup>
- WFD RPA Drinking water (lakes, rivers and groundwater)

## Soils and Geology

- Bedrock
- CORINE landcover
- Geoparks
- Geosites
- Landslide events and susceptibility
- Mineral locations
- Outcrops
- Peat bogs
- Soil permeability
- Soils

## Water

- Aquifer vulnerability
- Bedrock aquifer
- Biological Q values
- Hydrometric areas
- Groundwater source protection areas
- Wetlands
- Water abstraction points
- WFD high status objectives
- WFD risk
- WFD status
- WFD RPA: Nutrient sensitive WFD RPA: Recreational waters
- WFD RPA: Shellfish areas
- WFD RPA: Water dependent habitats (SACs, SPAs)
- Water management Units

# ESM Widget

Bespoke geoprocessing tool

**GeoHive Environmental Sensitivity Mapping** Find address or place

**ESM SEA Tool**

Theme: Biodiversity Flora and Fauna

- Ancient Woodlands
- Annex I Habitats
- Coastal Habitats-Saltmarshes
- Contribution to Potential Ecological Networks
- Forest Inventory
- Margaritifera Sensitive Areas
- Natural Heritage Areas
- Proposed Natural Heritage Areas
- Salmonid Waters (S.I 293 Only)
- Special Areas of Conservation
- Special Protection Areas
- Terrestrial Biodiversity
- Woodland Habitats

Weight: 1

Add a theme

**Legend**

**Biodiversity Flora Fauna**

- Ancient Woodlands
  - Ancient Woodland
  - Long-established Woodland (No antiquity evidence)
  - Long-established Woodland (Not ancient)
  - Possible Ancient Woodland
- Natural Heritage Areas
- Proposed Natural Heritage Areas
- Special Areas of Conservation
- Special Protection Areas

**Material Assets**

- Current Wind Farms

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# ESM Widget Methodology

## Multi-criteria spatial analysis

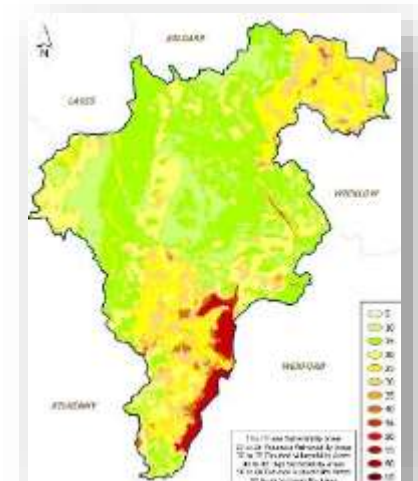
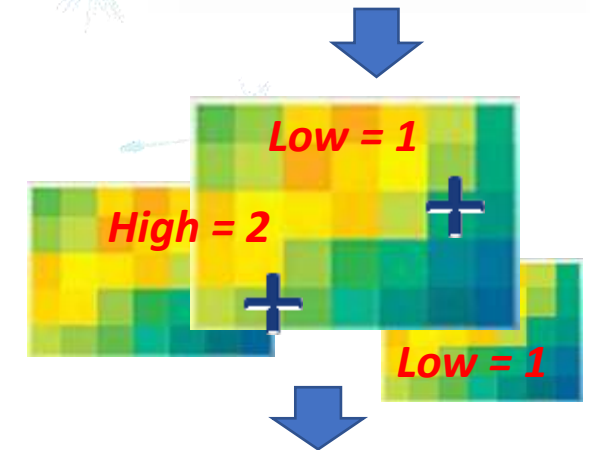
- Aggregation of multiple criteria
- Incorporation of stakeholders concerns or importance values in the form of weights

$$ES = \sum_{j=1}^n W_j V_j$$

where ES = Environmental Sensitivity

$W_j$  = Environmental susceptibility of factor  $j$  according to scientific scores

$V_j$  = Environmental significance of factor  $j$  according to public/stakeholder opinion



# Scientific Scores

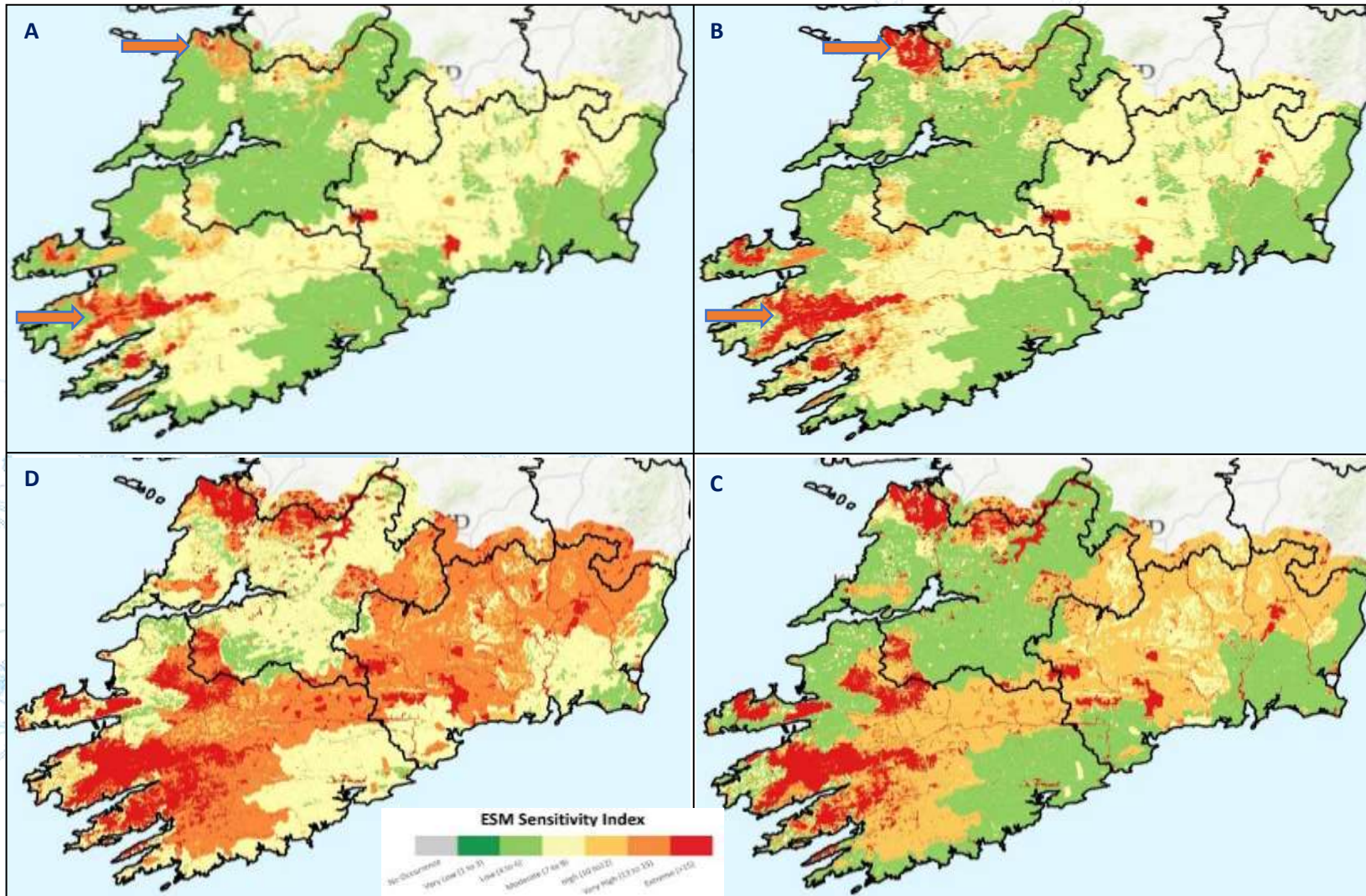
- Based on conservation status, quality and risk
- Extensive consultation
- 3 stakeholder workshops – development and testing of the webtool
- Over 40 stakeholders from government, local authorities, consultancies...SEAI, NPWS, NIEA, EirGrid...



Sensitivity Scores 1=Low, 2=Medium, 3=High	1	2	3
<b>Population and Human Health</b>			
% Population change 2006-2011 EDs			
• Decreasing			
• Increasing			
Population density per sq km 2011 SAs			
• High			
• Low			
Total population 2011			
WFD RPA Groundwater drinking water			X
WFD RPA Surface water drinking water (Lakes)			X
WFD RPA Surface water drinking water (Rivers)			X
<b>Biodiversity, Flora and Fauna</b>			
Ancient woodlands			
• Ancient Woodland			X
• Possible Ancient Woodland			X
• Long-established Woodland (LEW I)		X	
• Long-established Woodland (LEW II)		X	
Habitat Directive Annex I Habitats			X
BirdWatch sensitivity (to wind energy dev.)			
Coastal habitats (Saltmarshes)		X	
Forest Inventory and Planning System			
• Deciduous	X	X	
• Coniferous			
Margaritifera sensitive areas			
• Catchments of SAC populations listed in S.I. 296 of 2009			X
• Catchments of other extant populations			X
• Catchments with previous records of Margaritifera but current status unknown		X	
Natural Heritage Areas			X
Proposed Natural Heritage Areas		X	



# Contextualising Sensitivity



(a) biodiversity, flora and fauna and water sensitivities; (b) sensitivities associated biodiversity, water, cultural heritage and soils where all have the same weight/importance; (c) sensitivities associated with biodiversity, water, cultural heritage and soils where the biodiversity themes is given greater importance (i.e. a weight of 2); and d) sensitivities associated with biodiversity, water, cultural heritage and soils where the biodiversity and water themes are given greater importance (i.e. a weight of 2).

# ESM Output

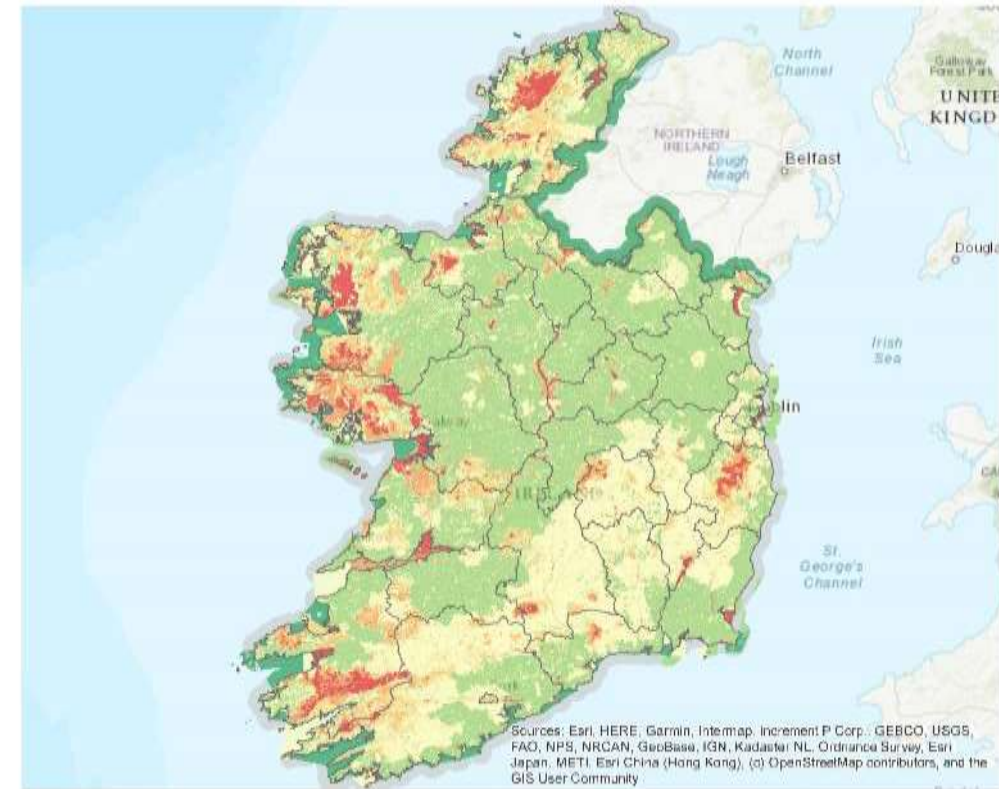
## Transparency

- Map creator
- Date
- Selected datasets
- Applied weights

## Comparability

- Transboundary
- When selecting same criteria and weights

## National SEA Analysis (NPF)



Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community



### ESM Sensitivity Index



Date: 9/22/2019 Time: 2:16:21 PM Author: AIRO

\*This map is an aggregate result based on the variables and user defined weights listed below.  
Warning: Please note that weights are only to be used to emphasize the relative significance of an environmental aspect - applying weights to more than two themes would magnify, and possibly overstate, the overall sensitivity.

**Air & Climatic Weight: 1 Variables:** Air Zones, Historical Flood Extents

**Biodiversity, Flora and Fauna Weight: 1 Variables:** Ancient Woodlands, Areas of Interest, Inventory, Marginalized Scientific Areas, National Heritage Areas, Protected Natural Heritage Areas, Special Areas of Conservation, Special Protection Areas

**Cultural Heritage Weight: 1 Variables:** National Inventory of Architectural Heritage (NIAH), Sites and Monuments Record

**Population and Human Health Weight: 1 Variables:** WFD RPA Groundwater Drinking Water, WFD RPA Surface Water Drinking Water (Lakes), WFD RPA Surface Water Drinking Water (Rivers)

**Soils and Geology Weight: 1 Variables:** Peat Bogs

**Water Weight: 1 Variables:** Aquifer Vulnerability, Groundwater Source Protection Areas, Wetlands, WFD RPA Recreational Waters (Coastal and Transitional Water Bodies), WFD RPA Recreational Waters (Lakes), WFD RPA Water Dependent Habitats (SACs), WFD RPA Water Dependent Habitats (SPAs)

# Quality of good practice...Game changer?

- **SEA and planning support tool**
- **Evidence-based assessments and decisions**
- **Efficiency**...time and cost savings
- **Removal of IT barriers**...no need for specialised GIS skills...data at your fingertips
- **Exploratory and participatory** rather than definitive answers...data limitations, subjective but not arbitrary weights influencing outputs
- **Good landscape governance - consistency, transparency, comparability**



**Advancing practice by fostering participative, informed and transparent decisions**

# Evidence of Success: Real Life Applications

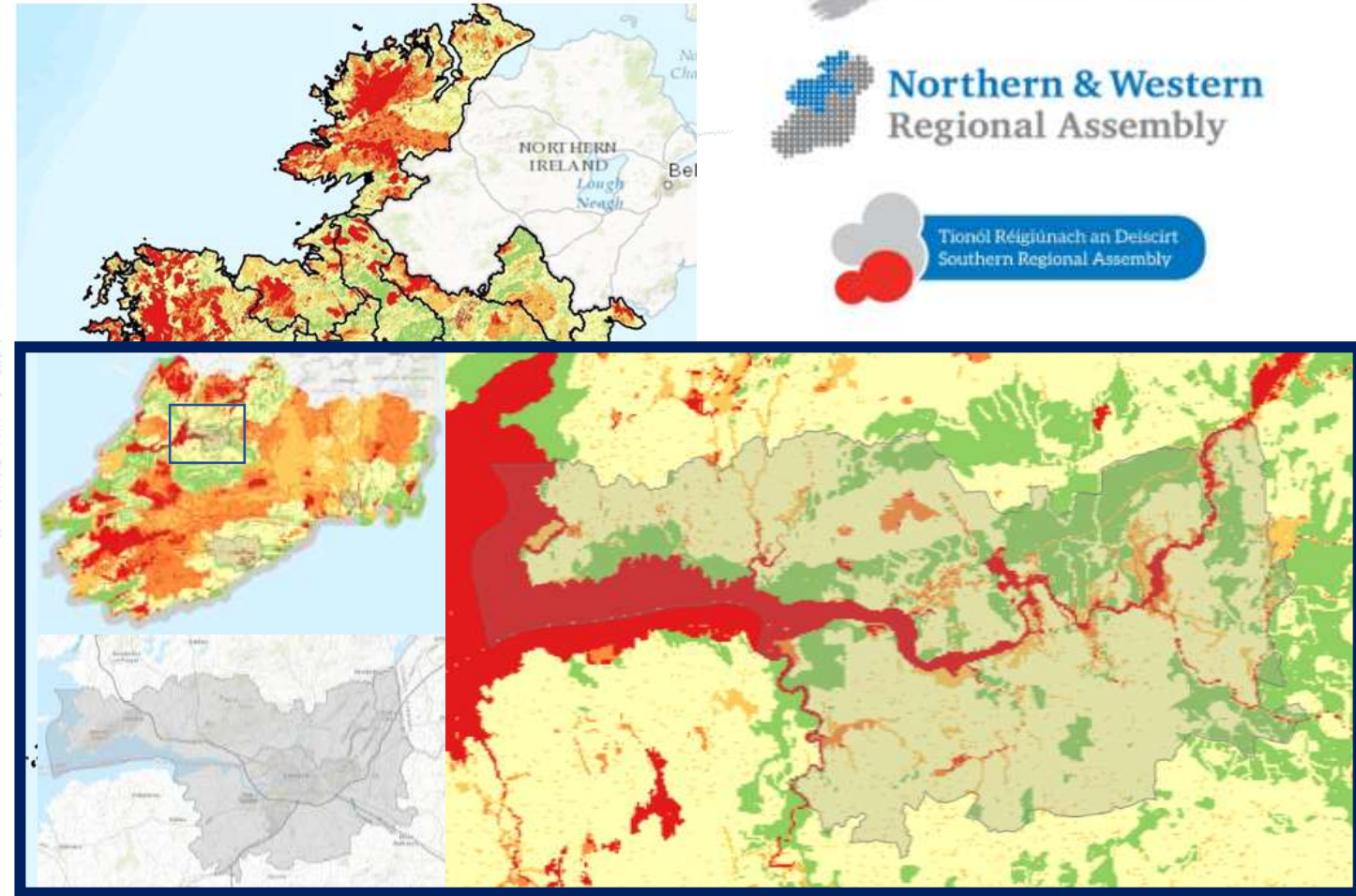
## National and regional spatial plans

Table 5.16 – Data Variables used in the ESM Mapping

Theme	Weight	Variables
Biodiversity, Flora and Fauna	2	Special Areas of Conservation, Special Protection Areas, Natural Heritage Areas, Proposed Natural Heritage Areas, <i>Margaritifera</i> Sensitive Areas, Ancient Woodlands, Annex I Habitats, Coastal Habitats - Saltmarshes, Forest Inventory Planning System, Salmonid Waters, Woodland Habitats
Population and Human Health	1	WFD RPA Surface Water Drinking Water (Lakes), WFD RPA Surface Water Drinking Water (Rivers)
Soils and Geology	1	Geoparks and Geosites, Peat Bogs, Soil Permeability
Water	1	Aquifer Vulnerability, Bedrock Aquifer Susceptibility, Groundwater Source Protection Areas, Wetlands, WFD Groundwater Status, WFD Lake Status, WFD River Status, WFD RPA Nutrient Sensitive Areas (Lakes), WFD RPA Nutrient Sensitive Areas (Rivers), WFD RPA Recreational Waters Coastal, WFD RPA Recreational Waters Lakes, WFD RPA Water Dependant Habitats (SPAs), WFD RPA Water Dependant Habitats (SACs)
Air and Climate	1	Historical Flood Extents
Cultural Heritage	1	National Inventory of Architectural Heritage, Record of Monuments and Places



Figure 5.23 – ESM for Ireland



**"In preparing the NPF, an Environmental Sensitivity Mapping (ESM) tool was used in the SEA and environmental assessments. ESM is a method for identifying at a strategic level, environmentally sensitive areas and to help inform cumulative and in-combination effects on the environment. It also provides a visual overview of the relative sensitivity of areas, particularly where they overlap, in order to provide a more strategic and informed approach to planning" (NPF, Chapter 11.1, p.15).**



# Evidence of success - Real Life Applications:

Socio-economic profiles  
Land parcel assessment  
Quarry assessment

Quarry Name: QRA-28-004  
Coordinates: 53.1238, -6.8038

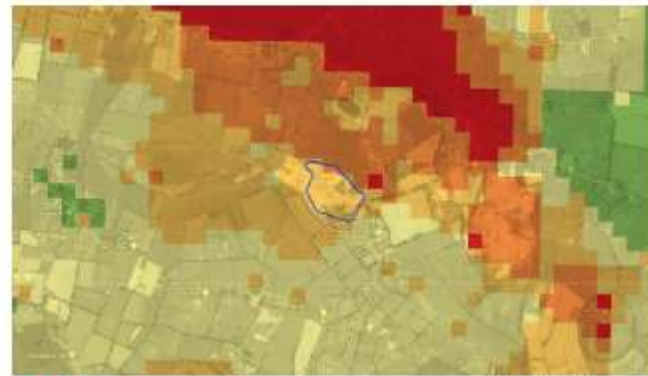
Inactive Limited Activity **Active**

Quarry Name: QRA-28-004  
Coordinates: 53.1238, -6.8038

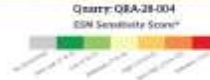
Inactive Limited Activity **Active**



## ESM Results



0 250 500 750 m



## Site Summary

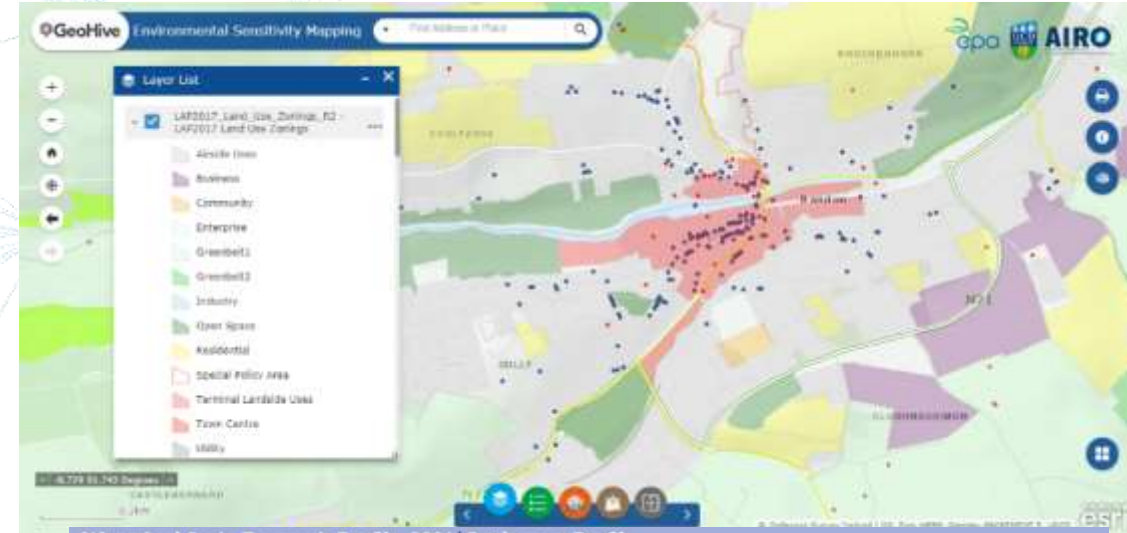
### Site Details

### Activity Overview

### ESM Summary

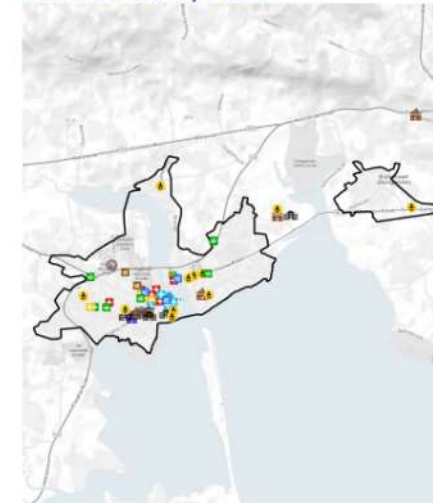
### Comments

Sand and gravel pit  
Vehicles, classification machinery, active extraction as indicated by increased extent of quarry towards the north west.  
Predominantly "High" environmental sensitivity score recorded throughout site. One small portion to the north scoring "Very High".



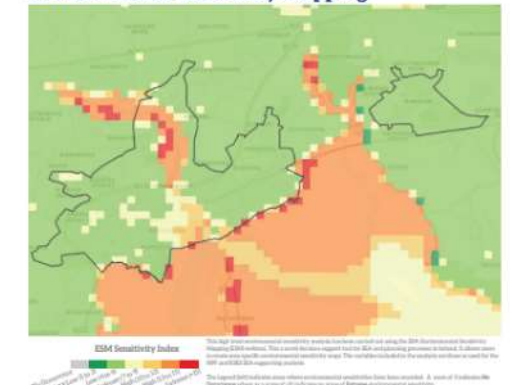
Waterford Socio-Economic Profile, 2021 | Settlement Profile  
Dungarvan/Ballinroad

## Settlement Facility Profile



- Train Station
- Bus Station
- Bus Road
- Bus Stop
- Test Bed
- Post Primary School
- Primary Modern School
- Primary Special School
- Crèche
- Daycare
- GP
- Health Centre
- Shop
- Pharmacy
- Pavilion
- Pit Station
- Garage Station
- Supermarket
- Discount Supermarket
- Convenience Store
- Post Office
- Library

## Environmental Sensitivity Mapping



### ESM Model Input Criteria (as per NPF criteria)

Theme	Variable
Air & Climate	Air Zones, Historical Flood Extents
Biodiversity Flora and Fauna	Ancient Woodlands, Annex 1 Habitats, FIPS, Marginalia Sensitive Areas, NHAs, Proposed Natural Heritage Areas, Special Areas of Conservation, Special Protection Areas
Cultural Heritage	National Inventory of Architectural Heritage, Record of Monuments and Places
Population and Human Health	WFD RPA Groundwater Drinking Water, WFD RPA Surface Water Drinking Water, WFD RPA Surface Water Drinking Water (River)
Soils and Geology	Peat Slips
Water	Aquifer Vulnerability, Bedrock Aquifer, Groundwater Source Protection Areas, Wetlands, WFD RPA Recreational Waters Coastal, WFD RPA Recreational Waters Lakes, WFD RPA Water Dependent Habitats (SPA), WFD Water Dependent Habitats (SAC)

# Transferability



- **European SEA legislative framework**
- **Transferable to any region with local data**
  - **Data availability/limitations can affect comprehensiveness**
- **Spin-off developments**
  - Support tool for the preparation of Local Area Renewable Energy Strategies – Sustainable Energy Authority of Ireland
  - Offshore cumulative effects assessment (marine data) – Marine Institute

**SEA and planning support tool**



# ESM Webtool

*Bringing environmental assessment  
to your fingertips*

[www.enviromap.ie](http://www.enviromap.ie)

[ainhoa.gonzalez@ucd.ie](mailto:ainhoa.gonzalez@ucd.ie)



# Scientific Input and Scrutiny: Consultation and peer-review



- ✓ González, A, Gilmer, A, Foley, R, Sweeney, J and Fry, J (2011). Applying geographic information systems to support strategic environmental assessment: Opportunities and limitations in the context of Irish land-use plans. *Environmental Impact Assessment Review*, 31(3), 368-381
- ✓ González, A (2017). A conceptualisation framework for building consensus on environmental sensitivity. *Journal of Environmental Management*, 200: 114-122.
- ✓ González, A (2017). Mapping environmental sensitivity: A systematic online approach to support environmental assessment and planning. *Environmental Impact Assessment Review*, 66, 86-98.
- ✓ González, A, Gleeson, J and McCarthy, E (2019). Designing and developing a web tool to support Strategic Environmental Assessment. *Environmental Modelling & Software*, 111: 472-482
- ✓ González, A, Kelly, C and Rymaszewicz, A (2019). Advancements in web-mapping tools for land use and marine spatial planning. *Transactions in GIS*, 0:1-15.

