

Chapter 5

Land and Soil





Land and Soil

1. Introduction

Our soils and land are precious resources that need to be managed carefully. They have a variety of uses including food production, forestry, development of national and commercial infrastructure, housing and leisure activities. Policies and practices linked with land and soils can directly impact on biodiversity, climate change, air quality and our aquatic environment. Sustainable land use and spatial planning are therefore extremely important. This chapter summarises the functions of soils and the main land cover and land use types in Ireland and examines the current trends in land cover change.

2. Functions of Soils

Healthy soils that are properly managed support farming and environmental protection.

Soils consist of a biologically active, complex mixture of weathered minerals, organic matter, organisms, air and water. They form over long periods of time and are limited resources needing careful management. Our soils, land use and landscape are shaped by natural processes and human interventions.

About a quarter of all living species, such as fungi, bacteria and insects, live in our soils. Healthy soils provide us with clean air, food and water. They also support plant and animal growth and provide the foundations for human habitats, buildings and infrastructure. They provide important ecosystem services including agricultural food production, flood alleviation, water filtration and storage, carbon sequestration, pollution control and development of pharmaceuticals. Many widely used antibiotics have come from soil. Penicillin, for example, came from a fungus (*Penicillium*) found in soil. Seven of the United Nations Sustainable Development Goals have direct links to soils, while a further two depend indirectly on healthy soils (Tóth *et al.*, 2018).



Carbon stored in soils plays an important role in maintaining soil functionality, in water and air quality and in climate change. Proper land use management is essential to prevent carbon stored in soil from being released into the atmosphere and further contributing to greenhouse gas emissions and climate change. Measured in pH units, the acidity or alkalinity of soil plays a role in supporting its fertility. The increased use of lime is resulting in increased levels of soil fertility, leading to better soil pH management (Teagasc, 2019). Teagasc has indicated that the optimal soil pH for agriculturally productive grasslands is at or above pH 6.3. This optimal soil pH leads to improved grass yields and more efficient application of fertilisers. In the period from 2017 to 2019, 57 per cent of Teagasc soil samples had an optimum pH (Simo *et al.*, 2019). This was a significant improvement on the value of 34 per cent for the period from 2014 to 2016.

Before deciding on what constitutes 'optimal' soil pH, or indeed other soil parameters such as nutrient levels, it is wise to decide the best primary use for a piece of land. The parts of the country with higher levels of agricultural productivity are generally the areas with productive soils, a conducive climate and a history of agricultural intensification. Many other areas support land that is better suited to providing low or modest levels of agricultural productivity, coupled with other hugely valuable services such as high nature value farming. Such services include supporting biodiversity, delivering wildlife habitats for pollinators and others, and providing for carbon sequestration and storage, better water quality or water attenuation.

In the coming years, farming support schemes will be targeted at these areas of high nature value farmland, with lots of semi-natural habitats. Land management can then be better planned across a range of services and not solely focused on agricultural production.

Teagasc has indicated that targeted improvements in soil quality should lead to better nutrient uptake from applied fertiliser and organic manures. Fewer losses of nutrients to water and air should, in turn, result in reductions in agriculture-related emissions to water and air.



Soils, Land Management and Carbon Sequestration

In Ireland, land use, land use change and forestry (LULUCF) is a net source of CO₂, but this needs to be reversed so that land is used to store carbon to meet greenhouse gas and carbon neutrality targets.

Healthy soils play a role in carbon sequestration from the atmosphere. Land management activities can help or hinder carbon sequestration in soils. Overall, LULUCF in Ireland is a net source of CO₂, with net emissions of 3.3 million tonnes CO₂ equivalent in 2018 (EPA, 2020a). Previous Environmental Protection Agency (EPA)-funded research has suggested that there is significant potential for carbon sequestration by soils used for growing crops and grasses (Kiely, *et al.*, 2017). More recently, Teagasc indicated that much of our grassland soil is already high in carbon, with little change in this carbon stock in recent years. Teagasc also highlighted the importance of protecting the carbon already sequestered and indicated that the largest potential for increased carbon sequestration is in the rewetting of organic agricultural soils (Lanigan and Donnellan, 2019).

Peat-rich soils, such as in bogs, for example, are usually good at sequestering and storing carbon; however, if they are drained and dried out, this process is reversed, and they emit carbon back into the atmosphere. A recent EPA-funded research project, the Soil Organic Carbon and Land Use Mapping (SOLUM) project,¹ combines high-resolution spatial data, Teagasc's Soil Information System and remote sensing tools with the aim of providing a verifiable land use and soils inventory for Ireland. Additionally, recent research from Teagasc is assessing the importance of subsoils for carbon sequestration (Simo *et al.*, 2019).

In a special report on climate change and land (IPCC, 2019), the Intergovernmental Panel on Climate Change affirmed that sustainable land management helps to prevent and reduce land degradation. It also maintains land productivity and may contribute to reversing the negative impacts of climate change. Sustainable land management can be progressed by integrating climate- and land-related policies and fostering engagement and collaboration between different sectors, thus saving resources, improving social resilience and supporting ecological restoration. While effective land management is one element that can contribute to climate mitigation, reducing greenhouse gas emissions across all sectors is needed if global warming is to be kept below 2°C, if not 1.5°C. This is discussed in more detail in Chapter 2. Responding to climate

change and reducing greenhouse gas emissions involves many different sectors working together. It is therefore important that land use and sectoral planning become more integrated and coordinated across multiple sectors, in a national effort to address environmental challenges consistently.

Soil and Water Management

Properly managed soils can act as a trap to hold on to nutrients and as a sponge to hold back water flows, minimising flooding risks.

Soils play an important role in filtering water as it travels through the ground. Soils also hold onto nutrients and store them for release later. Wetland areas help store, move and filter water at the surface. They are also able to remove excess nutrients, such as nitrogen and phosphorus, and sediments, and play an important role in natural flood management, by slowing the movement and release of flood waters.

Water pollution can be reduced by using and maintaining urban and rural sustainable drainage systems and limiting nutrient run-off from soils and surfaces in rural areas. Nutrients and soils that enter our waters can impact on water quality by chemically or physically changing water body conditions, which in turn can affect aquatic plants and animals, particularly those that are sensitive to changes in their environment. Chapters 6 and 7 provide more information on land use pressures affecting nature and water quality.



¹ <https://epasolumproject.wixsite.com/solum>



Pressures on Soils as a Result of Land Management Practices

Urbanisation and building account for some of the biggest losses of soil areas in Ireland.

The European Environment Agency recognises that soil degradation is not well monitored, and often remains hidden, but its effects can be widespread and diverse in nature (EEA, 2019a). It also recognises that there is increasing evidence that land and soil degradation have major economic consequences, whereas the cost of preventing damage is significantly lower. Without careful management and monitoring measures, the negative impacts of intensive land use, coupled with climatic events, may result in irreversible land degradation (EEA, 2019b). Intensive land management can lead to negative impacts on soil biodiversity, which is the key driver of terrestrial ecosystem carbon and nutrient cycling.

There are six overarching degradation processes that can impact on soils. These are soil sealing (where soils are closed off from the surface of the land, e.g. road and building developments close off soils from the land surface by building on top of it), erosion, organic matter decline, compaction, salination and landslides. The CORINE (Co-ordinated Information on the Environment) data series, produced by the European Environment Agency for the European Union, compiles geospatial environmental data in a standardised and comparable manner across Europe. The latest CORINE land cover data (2018) for Ireland supports previous research findings (Kiely, *et al.*, 2014) that the main soil quality pressure in Ireland relates to soil sealing. One of the reasons for this is the presence of a dense road network in what is a sparsely populated country (Prokop *et al.*, 2011). Artificial areas with sealed soil surfaces have increased by 65 per cent since 1990, although there has been little change since 2012. The sealing of soils impacts their ability to absorb pollutants, reduces their biodiversity and productivity and can also increase flooding in built areas by affecting natural drainage patterns. This in turn may lead to pollutants more easily entering our waters, potentially causing more widespread pollution. In urban areas, sustainable urban drainage systems, if correctly maintained, prevent pollutants entering our waters.

Soil compaction is also a recognised key threat to the quality of Irish soils. It can lead to increased surface run-off, flooding, erosion and transport of nutrients and agrochemicals to open water (EC JRC, 2016a).

Recently, the *Global Assessment Report on Biodiversity and Ecosystem Services* (IPBES, 2019) reported some startling findings. The assessment showed that, globally, about 75 per cent of the land surface has already been significantly altered and over 85 per cent of the wetland area has been lost. It stated that 'nature across most of

the globe has now been significantly altered by multiple human drivers, with the great majority of indicators of ecosystems and biodiversity showing rapid decline' (p. 11).

Human activity is a significant driver of degradation through poor or inappropriate land management practices. Practising sustainable land management and soil conservation principles at the heart of the planning process means shifting away from a reliance on zoning of greenfield lands towards more brownfield development opportunities in and around our major cities and towns. For example, for every 20,000 dwellings completed each year in Ireland, there could potentially be a loss of around 1150 hectares of greenfield agricultural land.² Typically, greenfield lands around Ireland's major cities and towns contain high-quality, highly productive soils that, once sealed under new developments, are lost forever.

Ireland must adopt a more proactive approach both nationally and locally in addressing this decline in nature. Better land management is an important step in this approach. The publication of the National Planning Framework in 2018, which introduced the first brownfield development target to deliver at least 40 per cent of all new homes nationally within the built-up footprint of existing settlements (Government of Ireland, 2018, p. 29), is an important first step. Clear definitions of what does and does not constitute brownfield development in mandatory planning guidelines, the widening of brownfield targets to embrace the increasingly greenfield nature of new business parks and employment locations, and effective monitoring of the implementation of targets using geographical information systems data will be essential.



² Assuming that 20% (4000 homes) of the 20,000 dwellings are constructed annually as one-off dwellings in countryside settings and require a site area of a minimum of 0.5 acres (total 809 hectares) under the EPA Code of Practice for Wastewater Treatment Systems for Single Houses (2010); 20% (4000 homes) of the housing provision is brownfield development, i.e. redevelopment of formerly developed lands; and 12,000 homes are constructed at an average density (minimum under planning guidelines) of 35 dwellings per hectare, resulting in a land area requirement of 340 hectares.



More widely, notwithstanding the policy advances here in Ireland, the European Union (EU) currently lacks a comprehensive and coherent policy framework for protecting land and soil resources (EEA, 2019b). There is no European legislation that focuses exclusively on soil, which has contributed to the continuous degradation of many soils within Europe (Günaş *et al.*, 2015; Virto *et al.*, 2015). The underlying drivers of soil degradation are not projected to change favourably, so the functionality of soils is under even more pressure. Consistent and representative soil monitoring is needed to establish early warning systems for exceedances of critical thresholds and to guide sustainable soil management.

The European Environment Agency produces indicator-based assessments on a range of topics, including land use and soils. These cover aspects such as land take (the amount of land used for a specific use), imperviousness, contaminated sites, soil moisture, soil erosion and soil organic carbon. Further indicators on fragmentation and land recycling are planned.

Soils and Construction and Demolition Wastes

Excavated soil and construction and demolition waste must be managed properly to comply with legal and environmental requirements.

Uncontaminated soil and other naturally occurring excavated materials from development activities can be used as backfill material on the same site, or on other sites, when certain requirements are met. In some cases, uncontaminated excess soil and other naturally occurring excavated materials can be managed as by-products rather than waste, and the EPA has produced guidance to help with compliance with the legal and environmental requirements. Waste prevention through reusing these materials as by-products is in line with the objectives of the circular economy. Where these materials are contaminated, they need to be remediated before being reused. This remediation can take place on-site or off-site (usually abroad) depending on the level of treatment needed. Table 5.1 shows the different treatment destinations and volumes of contaminated soils sent for treatment between 2009 and 2018.

Table 5.1 Treatment of contaminated soil, 2009-2018 (Source: EPA, 2020b)

CONTAMINATED SOIL	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Treated in Ireland (tonnes)	12,428	6260	7094	4426	4830	1630	5938	682	608	18,733
Exported for treatment (tonnes)	476	2590	10,203	3638	7659	5701	14,329	79,591	101,440	74,912
Total	12,904	8850	17,297	8064	12,489	7331	20,267	80,273	102,048	93,645

Contaminated soils may come from old industrial sites and are often contaminated with hazardous chemicals. Soil contamination can also occur from unauthorised waste-related activities, leakages and accidental spillages of chemicals. When sites licensed by the EPA close, they require aftercare to remove any remaining contamination, according to the closure, restoration and aftercare requirements laid out in individual licences.

Research carried out by Cahill and Plant (2017) has investigated converting suitable closed landfill sites into parkland amenities and nature conservation areas. It found that no national policy prescribes the after-use of landfill sites once they close and recommended that this be addressed. For example, former landfill sites may be used as amenity areas once the proper steps are taken to protect environmental infrastructure, such as gas and leachate wells. These sites need ongoing monitoring and management after they close. One example of a restored landfill site (the Kinsale Road landfill site) that has been developed for public access and amenities is Tramore Valley Park in Cork City. Similar restoration works have been carried out at Rogerstown Park in Fingal, previously the Balleally landfill site. More recently, restoration works are progressing at the East Tip on Haulbowline Island (Cork Harbour).



Governance Covering Soil Management

In Ireland, there is little specific legislation to protect soils, apart from legislation on key habitats/ecosystems associated with peat soils and site-specific regulation linked to industrial and waste facilities.

The EU Seventh Environment Action Programme commits Member States to increase efforts to reduce soil erosion, increase soil organic matter and remediate contaminated sites by 2020. The Environmental Liability Directive (2004/35/EC) and related national regulations set out a framework for environmental liability assessment based on the 'polluter pays' principle. This includes preventing environmental damage to soils. The European Commission is engaged in a review programme to evaluate whether the Environmental Liability Directive is fit for purpose.

In Ireland, apart from the National Planning Framework targets described above, there are few specific legislative or policy mechanisms to protect soils, apart from legislation on key habitats/ecosystems associated with peat soils and site-specific regulation linked to industrial and waste facilities. There is also no specific contaminated land policy in Ireland and, as a result, there is no legislation dealing specifically with the remediation of contaminated soils.



3. Land Cover

Land cover describes what is visible on the land surface, such as grassland or urban areas. Land use describes the use the land has been put to from a human perspective, such as pasture or residential housing.

The interactions between different types of human activity, such as farming, forestry and town and country planning, shapes our environment, landscape and biodiversity. Land is often subjected to competing demands from different sectors. National policies for forestry, agriculture, peatlands and the built environment influence land use change, land and soil resources. Figure 5.1 shows the main land cover types in Ireland.

The Current Situation

The latest CORINE land cover mapping information for 2018 shows the recent changes in land use patterns in Ireland. Of particular concern is the long-term downward trend in wetland areas.

Currently, the most complete national land cover dataset is the CORINE dataset. This pan-European dataset was produced in 1990, 2000, 2006, 2012 and 2018 for the European Environment Agency under the Copernicus Land Monitoring Service (Topic Box 5.2). It is a low-resolution dataset at 25 hectares that can be used as a high-level indicator of land cover changes.

Topic Box 5.1 Copernicus Land Monitoring Service

Copernicus is the name of the EU's Earth Observation Programme. It provides data from satellites, called Sentinels, which monitor the Earth's surface. These data are analysed to provide information on the environment. The Copernicus land, marine, atmosphere and climate services are free and open to public access. This is also the case for the Sentinel satellite imagery.

The Copernicus Land Monitoring Service aims to provide frequent and detailed information on land cover and land use. The data range from low-resolution pan-European data (e.g. CORINE) to high-resolution data but with a lower spatial distribution (e.g. an urban atlas for all major cities). The aim is to improve the resolution, distribution and frequency of all data produced by the Copernicus programme.

In combination with national land mapping activities, the Copernicus programme will provide significant benefits in terms of monitoring land cover and land use and understanding the wider environmental impacts of these changes. Further information on Copernicus is available at <https://www.copernicus.eu/en>.



Figure 5.1 CORINE land cover types

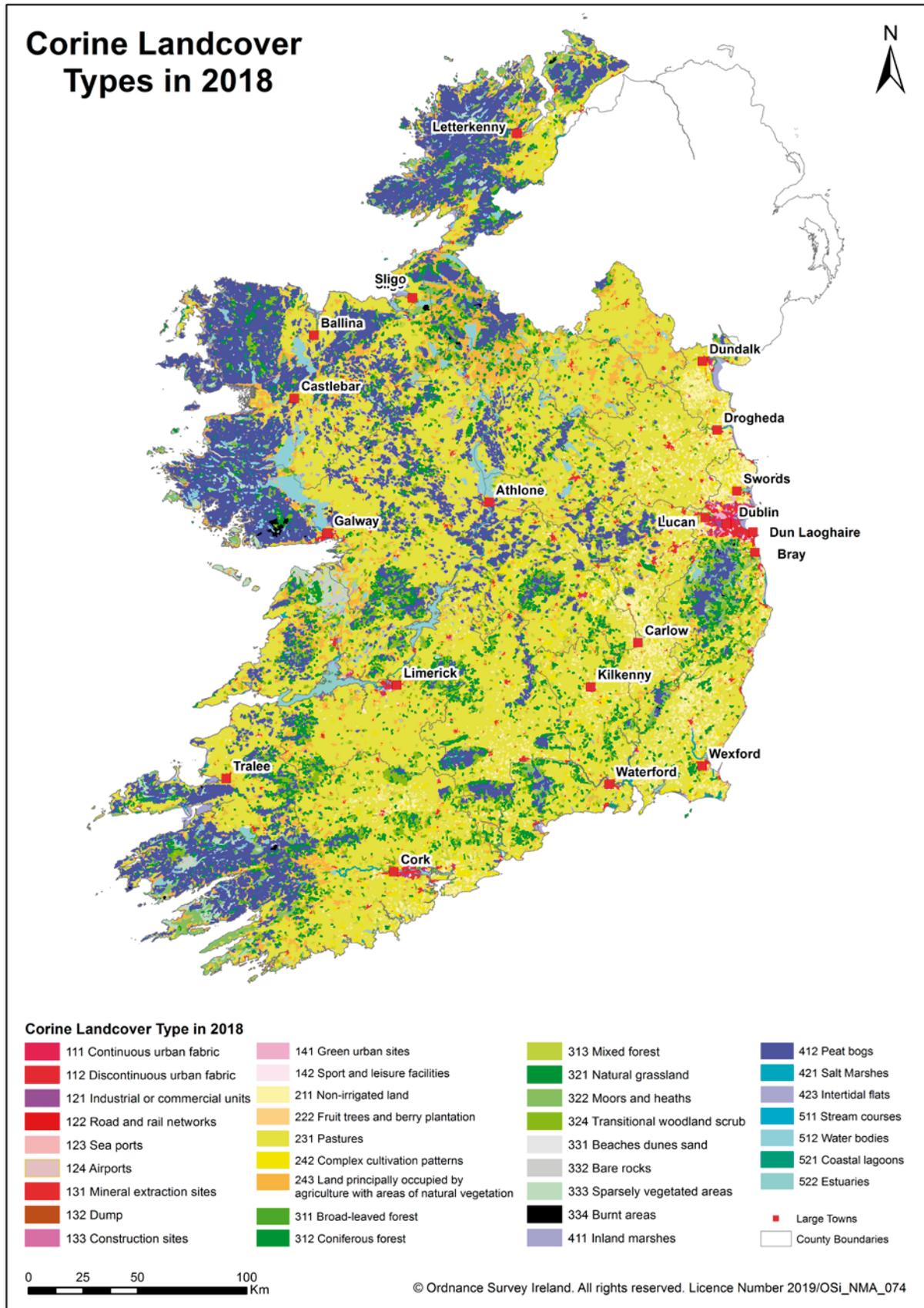
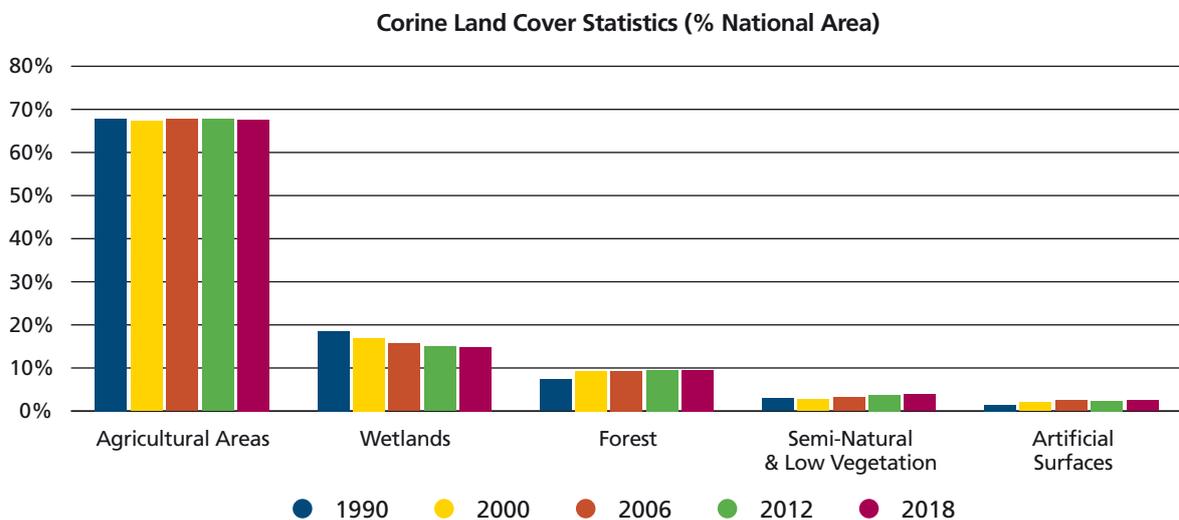




Figure 5.2 Summary of CORINE land cover and trend statistics from 1990 to 2018 (Source: EPA analysis of CORINE data time series)

CORINE 2018 SUMMARY		
Land cover class	2018 % of national area	% change since 2012
Agricultural areas	67.6	-0.10
Wetlands	14.9	-0.06
Forests	9.5	0.02
Semi-natural and low vegetation	3.8	0.10
Artificial surfaces	2.4	0.03



Analysis of CORINE data as an indicator of land change

The latest CORINE information available for 2018 is summarised in Figure 5.2. It shows that agriculture is the dominant national land cover type, representing 67.6 per cent of the national area in 2018. While this represents a small decrease since 2012, there is an overall downward trend, with a reduction of 8230 hectares since 1990. The main change in land cover has been from agriculture to forestry and artificial areas.

In 2018, wetlands represented 14.9 per cent of the national area, a moderate decrease since 2012. However, in 1990, wetlands represented 18.6 per cent of the national area. There has therefore been a 20 per cent reduction in this important land cover type since 1990, with a loss of 258,800 hectares. The primary change was from peat bogs to transitional woodland scrub and coniferous planting in the 1990s. This transition in land cover type usually happens after peat is extracted or on peats that have been reclaimed for agricultural use. Other reductions in wetlands relate to recently burnt areas and the re-mapping of intertidal mudflats. In summary; there has been a definite long-term downward trend in the percentage of the national area covered with wetlands.



In 2018, forestry represented 9.5 per cent of the national area. There has been a general upward trend in the percentage of the national area covered with forestry since 1990, with a 0.02 per cent increase since 2012. Most of this growth relates to an increase in commercial coniferous plantations. The aim is to increase forest cover to 18 per cent by the year 2050. There is clearly a need to accelerate afforestation levels to meet this target. It is important, however, that the right types of forest are planted in the right places and are managed correctly.

Semi-natural and low vegetation areas have increased in area by about 7030 hectares since 2012. The summers were particularly dry in 2017 and 2018, with many forest and peatland fires during this period. These burnt areas represent the major change of land cover to the semi-natural and low vegetation class.

While artificial surfaces accounted for only 2.4 per cent of the 2018 national land cover, they have increased in area by 65 per cent since 1990. Most of this increase occurred between 1990 and 2006, with it slowing between 2006 and 2012 (probably linked to the economic recession) and showing signs of increasing again in 2018. The primary changes have been increases in discontinuous urban development, commercial/industrial areas, transport infrastructure, and sports and leisure facilities. These changes have mainly resulted in losses of agricultural areas, with some smaller losses of forestry and wetland areas.

Improving Data and Knowledge

A high-resolution mapping project is under way in Ireland to produce more detailed land cover maps that could be used for a range of environment work, including on climate change, biodiversity, air quality and water quality.

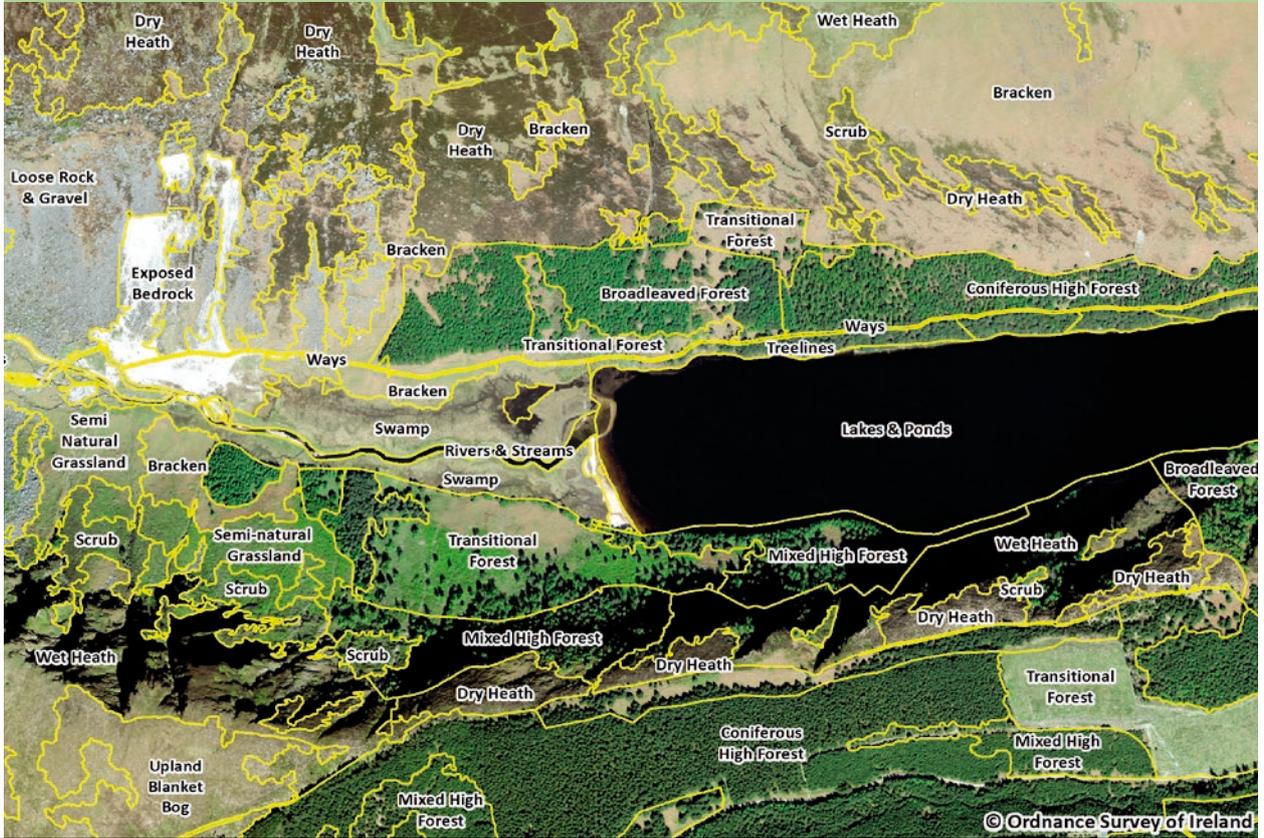
The quality of the CORINE data varies significantly. This is because of its poor resolution (25 hectares) and the varied data mapping methods used over the time series. Often more detailed sectoral data exist, and these should be used ahead of the CORINE data, as previously documented for the forestry sector (Black *et al.*, 2008).

Previous EPA state of the environment reports for Ireland have highlighted the need for more detailed data on land. In response, a national land cover mapping programme has begun. Since 2018, Ordnance Survey Ireland has been developing a high-resolution land cover map in partnership with the EPA. The project will present baseline data for 2018 and is due to be delivered in 2021. Integration of sectoral data will allow for a more consistent representation of national land cover and land use. Additionally, the EPA aims to develop a national land use map for application in reporting under the LULUCF regulations [Regulation (EU) 2018/841]. This will be directly related to the outputs of the national land cover mapping programme.

The importance of the programme to produce more detailed land cover maps cannot be overstated. Once complete, it will transform our understanding of national land cover and land use. High-resolution data, at a minimum of land parcel scale, will provide detailed information on the status of the land. It will form the basis for assessing past and future changes and will enable detailed environmental assessments and research. From an environmental perspective it will directly improve our understanding of climate change, biodiversity, air quality and water quality and responses to these challenges. County Wicklow is the first area to be mapped using this approach and the detail and quality of the data are very encouraging, as outlined in Figure 5.3.



Figure 5.3 Initial land cover map of Wicklow highlighting the more detailed information that will be available nationally





4. Sectoral Overview of Land Cover and Spatial Plans

Land cover describes the physical land type on the Earth's surface, such as wetlands or forests. This section provides an overview of the main land cover sectors and the key plans within each sector that are helping to address the environmental pressures and challenges. Commentary is also provided on wider interactions within spatial planning processes and opportunities to bring land cover matters more deeply into these processes. Where more detailed sectoral land cover data exist, they are presented instead of the lower resolution CORINE data.

Development by relevant government departments and agencies and wider stakeholders of an integrated national land cover strategy, supported by detailed mapping, monitoring and reporting, would be highly beneficial. It would ensure that sectoral policies for extensive categories of land cover, such as forestry, peatlands and agriculture, align with national-level environmental policy commitments. It would also help inform both higher level spatial planning strategies, such as the National Planning Framework, and spatial planning at regional and local levels. Coordination of the management of land cover, discussed in more detail in the following sections for agriculture, peatlands, wetlands and forestry is particularly important to allow us to manage and coordinate Ireland's response to climate change, in both a sectoral and a complementary manner. Chapter 2 provides more information on Ireland's climate change response and sets out some key recommendations.

Agriculture

Agriculture is the dominant land use type in Ireland, accounting for over 65 per cent of national land cover.

Farming in Ireland is closely linked to the EU Common Agricultural Policy and associated schemes. These encourage the maintenance of soil fertility and organic matter levels in farming practices. It is also worth noting that grasslands in Ireland are a net source of CO₂ as a result of the drainage of organic soils. This is discussed in more detail in Chapter 13.

Correct soil management forms part of farm 'cross-compliance' activities and Good Agricultural and Environmental Conditions regulations. These activities and regulations provide for the protection and maintenance of soil organic matter, the prevention of the deterioration of habitats and water protection. In general, this involves farming in a more sustainable way. Soil nutrient testing helps identify the nutrient concentrations in agricultural soils and the nutrient requirements to allow crop growth in an environmentally sustainable manner. Examples of activities considered under cross-compliance include poaching, eco-schemes such as GLAS (Green, Low-Carbon Agri-Environment Scheme), nutrient management planning and mandatory liming to increase soil pH. In 2018, the European Commission published its proposals for the Common Agricultural Policy beyond 2020. It set out ambitious requirements including protecting wetlands and peatlands to preserve carbon-rich soils and the use of specific nutrient management tools.





One important positive initiative to note in relation to land use is 'high nature value' farming. This differs from 'regular' farming as it tends to have a wealth of biodiversity associated with it and can support important species and habitats. Teagasc-funded research (the Ideal-HNV project)³ has produced a high nature value farming map.

High nature value farming mostly occurs in the west of Ireland and in upland areas. It often coincides with locations of high status water areas (Moran and Sullivan, 2017). Poor land management in these areas can greatly impact sensitive habitats, species and waters. This EPA research identified the need to support more of these locally driven initiatives, which have multiple environmental benefits and also support sustainable farming practices and local communities. For more information on agriculture in Ireland, see Chapter 13.

Topic Box 5.2 Progress in Soils Management Research

The Terra Soil project⁴ was launched by the Geological Survey Ireland and Teagasc in 2018. Using thousands of soil samples combined with geochemical data, the project aims to support better farming efficiencies by helping farmers make more targeted and science-based decisions.

Teagasc's SQUARE project continues to develop a toolbox for farmers to assess soils and the impacts of soil degradation (Bacher *et al.*, 2018, 2019; Bondi *et al.*, 2018; Emmet-Booth *et al.*, 2018, 2019). Teagasc recommends that soil-specific management measures based on soil type are needed. Teagasc has also published a soil management manual to assist farmers in this regard (Teagasc, 2013).

The DANÚ Farming Group,⁵ a European Innovation Partnership project for Agricultural Productivity and Sustainability (EIP-AGRI) funded by the Department of Agriculture, Food and the Marine, combines the best practices of conventional and organic farming. This project places an emphasis on having productive soils that display high levels of biological activity.

The outcomes of these projects, if implemented correctly, should result in smarter agriculture, fewer environmental impacts and fewer wasted resources.

Peatlands

Currently, many peatlands, including those protected under national and European legislation, are in an unfavourable state, but if they were restored, they could play a key role as carbon sinks and provide a space for nature.

Peatlands provide many important ecosystem services, including maintaining biodiversity, carbon storage, supporting agriculture and forestry, water regulation and flood attenuation. Intact peatlands play an important role in sequestering and storing CO₂ from the atmosphere. If, however, they are degraded or dried out, peatlands become oxidised, which leads to CO₂ being released into the atmosphere.

A report from the Joint Committee on Climate Action, *Climate Change: A Cross-party Consensus for Action* (Houses of the Oireachtas, 2019), acknowledged that our peatlands are currently a large net source of carbon emissions. This is because we have already drained and degraded most of our peat bogs. Our peatlands continue to be impacted by land drainage for agricultural purposes, afforestation and peat extraction. The latest national emissions inventory for Ireland (EPA, 2020a) reported total peat-related greenhouse gas emissions of 1.15 million tonnes CO₂ equivalent in 2018. In April 2018, peatland restoration was highlighted as a priority by the Citizen's Assembly (Citizen's Assembly, 2018). Peat extraction for use as fuel within power generation and domestic heating, and its use within horticulture, are unsustainable. Any plans to halt peat extraction must, however, include services and resources to support local communities once peat extraction operations cease. In this context, it is worth noting that Bord na Móna has stopped the extraction of peat for electricity generation purposes and Coillte has also engaged in peatland restoration in recent years.

Currently, it is government policy that domestic turf cutters are permitted to cut turf if there is no impact on the conservation objectives of bogs. The Department of Culture, Heritage and the Gaeltacht has reported a slight decrease in turf cutting within the current network of 62 Special Areas of Conservation (SACs) and 36 retained Natural Heritage Areas (NHAs); however, activity at raised bogs continued at 22 SACs and 6 NHAs in 2018. Active raised bogs (an Annex I priority habitat) continue to have an overall 'bad' conservation status, with a continuing deteriorating trend; similarly, the overall conservation status of blanket bogs is described as 'unfavourable to bad', with a continuing deteriorating trend (DCHG, 2019a).

³ <https://ideahnv.wordpress.com/>

⁴ <https://www.gsi.ie/en-ie/programmes-and-projects/tellus/activities/tellus-product-development/smart-agriculture/Pages/Terra-Soil.aspx>

⁵ <https://ec.europa.eu/eip/agriculture/en/find-connect/projects/dan%C3%BA-farming-group-project-plan-biological-farming>



Ireland's Climate Action Plan 2019 (Government of Ireland, 2019) includes actions to implement peatland conservation measures. It aims to restore 22,107 hectares of raised bog habitat to directly reduce or halt carbon loss. It is due for delivery by 2035.

The National Peatlands Strategy (DAHG, 2015a) is the key national plan responsible for the management and conservation of peatlands. It estimates that our peatlands store approximately 1566 million tonnes of carbon, representing about 64 per cent of the total soil organic carbon stock present in Ireland. It aims to restore, protect and manage our peatlands and the benefits they provide us. It reports that only 10 per cent of the original raised bogs and 28 per cent of the original blanket peatlands are deemed suitable for conservation (as natural peatlands). However, even where restoration is not possible, it is important to improve the management of peatlands to reduce or eliminate carbon losses and to restore at least some of their other ecosystem services.

The EPA-funded VAPOR project (Renou-Wilson and Wilson, 2018) has improved our understanding of the links between the climate, hydrology, ecology and greenhouse gas interactions of peatlands. This research identified a need for a national plan to manage and maintain water table levels in natural and rewetted peatlands. Doing so could help sustain the ecosystem and climate-related services provided by peatlands, even in circumstances where full restoration is not practicable. Drained peatlands, previously used for agriculture and peat extraction, could

be targeted for rewetting to prevent greenhouse gas emissions in the future. The need to rewet our peatlands, where feasible, was also acknowledged by the Joint Committee on Climate Action (Houses of the Oireachtas, 2019).

Bord na Móna Peatland Rehabilitation/ Restoration Activities

Rehabilitation works are required for licensed Bord na Móna extraction activities, as part of their EPA licences.

As part of Bord na Móna's peatland restoration programme, the company reports having restored over 1200 hectares of raised bog at 12 different sites, including areas that had not been fully brought into peat production. A further 1000 hectares of restoration works are also under way, although not all cutaway bogs are suitable for restoration. Other land uses may be considered in these cases, for example wind or solar farms. In 2016, Bord na Móna launched its Biodiversity Action Plan 2016-2021 to support ongoing restoration, rehabilitation and management activities (BNM, 2016). The company reviews this plan's progress every year. The 2018 review noted its progress in rehabilitating former peat production areas: 15,000 hectares had been rehabilitated, with a further 1250 hectares in the process of being rehabilitated.



Topic Box 5.3 Living Bog Project

The Living Bog project,⁶ launched in 2016, is the largest single raised bog restoration project that has been undertaken in Ireland. It is funded by the EU's LIFE programme and the Department of Culture, Heritage and the Gaeltacht.

Under this project, restoration works across 12 raised bog SACs are being carried out in seven different counties. Over 200 km of drainage channels will be blocked, using almost 14,000 peat and plastic dams. The blocking of these channels will help raise the water table and recreate the hydrological and ecological conditions under which new peat forms.

The aim is to improve over 2500 hectares of critically endangered raised bog habitat and add 750 hectares of active raised bog habitat to the relatively small amount of living bog left. Restoring and protecting this important habitat will help conserve and protect many endangered species, such as the red grouse and curlew, rare insects, spiders and amphibians, and many plant species.

Other activities carried out include the infilling of drains, scrub removal, fencing and walkway improvements, the development of fire plans, a comprehensive schools outreach programme and amenity provision. Community engagement is central to the project, and community-led amenities at the bogs, such as new walking trails, boardwalks and signage, will be developed to facilitate outdoor educational and recreational use.

In other related positive developments, restoration plans are now in place for 53 raised bog SACs to be developed further in consultation with local stakeholders. Restoration plans for the raised bog NHAs and drainage management plans for the raised bog SACs are also in development. The National Parks and Wildlife Service of the Department of Culture, Heritage and the Gaeltacht has also published a best practice manual for raised bog restoration (Mackin *et al.*, 2017).





Topic Box 5.4 Some Developments in Protecting and Managing Peatlands

- The Wildlife (Amendment) Bill 2016 was proceeding through the Houses of the Oireachtas. The bill lapsed on 14 January 2020 with the dissolution of the Dáil and Seanad.
- The Department of Culture, Heritage and the Gaeltacht is restoring active raised bogs at 12 SACs⁷ and plans to restore over 1800 hectares at up to nine raised bog-designated sites across seven counties in 2020, with funding in the 2020 budget for peatland restoration increased to €5 million.
- The Department of Culture, Heritage and the Gaeltacht has completed restoration measures on state lands at a further three raised bog SACs and one raised bog NHA since 2018, with the restoration of state-owned land within a number of other protected raised bogs currently being planned.
- Restoration plans for the network of raised bog NHAs are due for completion in 2020.
- Bogs where peat extraction activities licensed by the EPA are currently under way will be rehabilitated when extraction has ceased.
- In September 2019, the High Court ruled that the 2019 European Union (Environmental Impact Assessment) (Peat Extraction) Regulations and the Planning and Development Act 2000 (Exempted Development) Regulations 2019 should be set aside, following a successful legal challenge. The decision means that peat cannot be extracted from areas larger than 30 hectares.
- The Department of Housing, Local Government and Heritage is preparing regulations for smaller scale peat extraction activities.
- The SWAMP project⁸ is aiming to improve water quality in managed peatlands.
- The Smart Bog project⁹ is assessing the impacts of human activities on greenhouse gas emissions and removals from peatlands ecosystems, using high-quality imagery and satellite data.
- The NEROS project (Renou-Wilson *et al.*, 2018) involves the monitoring of rewetted and restored peatlands for climate and biodiversity benefits (for both raised and blanket bogs).
- The Raised Bog EU LIFE project has been under way since 2016.
- The AUGER project¹⁰ is currently assessing peatland properties influencing greenhouse gas emissions/removals.

Forestry

Forests are expected to play a bigger role as carbon reservoirs in the future, but environmental assessments are necessary to ensure that the right types of forest are planted and developed in the right places and are managed correctly, to avoid wider impacts on our environment.

Forests provide us with renewable sources of fuel and raw materials. In addition to supporting our economy, they have many important environmental functions, including water regulation, biodiversity conservation, recreation, and improved health and wellbeing. They play an important role in climate change by removing CO₂ from the atmosphere. Ireland's national forest estate is an important carbon reservoir, amounting to over 3.82 million tonnes of CO₂ in 2018 (EPA, 2020a). Ireland's forests and wood products have removed, on average, 4.26 million tonnes of CO₂ per year from the atmosphere since 1990

and are expected to contribute significantly to meeting Ireland's 2030 greenhouse gas emissions reduction target under the Effort Sharing Regulations and the Climate Action Plan 2019.

Ireland's Climate Action Plan (Government of Ireland, 2019) commits to increasing afforestation to an average of 8000 hectares each year, to reach a national forestry land cover target of 18 per cent by the second half of this century. The target for new forestation is to plant about 440 million trees over the next 20 years. The plan also includes several actions covering the forest sector, including implementing the Forestry Programme 2014-2020 in line with the recommendations and targets of the mid-term review of the programme (DAFM, 2018a). Other actions aim to increase the productivity and resilience of the national forest estate and tree species, to deliver additional carbon sequestration potential.

7 www.raisedbogs.ie

8 <https://www.ucd.ie/swamp/>

9 <http://www.smartbog.com/>

10 <https://www.ucd.ie/auger/>



The Department of Agriculture, Food and the Marine has identified climate change mitigation, the need for sustainable increases in wood production and the need to contribute to renewable energy source production as key drivers for continued afforestation (DAFM, 2014). It also reports that our forest cover continues to be at its highest level in over 350 years, with the level of forest cover estimated at 11 per cent of the total land area (c.773,229 hectares); 65.5 per cent of the forest stock is conifer forest, 20.5 per cent is broadleaf forest and 14 per cent is mixed forest. Since 1990, Ireland has had the highest rate of forest expansion (as a percentage of total forest cover) of all EU Member states. We still, however, have one of the lowest afforestation levels in the EU (DAFM, 2018a).

It is important that forward planning and forestry management activities within the sector, at all levels, are supported by the proper environmental assessments, to ensure that the right forests are planted and developed in the right places and are managed correctly, to avoid impacts on our environment. The mid-term review of the current forestry programme was carried out in 2018 and introduced several enhancements, including targeted

broadleaf afforestation and increased financial support for planting of more diverse species. Additional measures such as support for deer tree shelters, continuous cover forestry and the second thinning of broadleaf forests were also developed in 2018 and introduced in early 2019.

Afforestation and harvesting can impact negatively on natural vegetation, soils, biodiversity and the landscape. They can cause water quality issues through acidification and nutrient mobilisation. Tree felling, planting and replanting activities can also allow soils to enter water courses if not carefully managed and monitored. When planted on peaty soils, forestry can also act as a source of carbon emissions.

Ireland's Forestry Programme (2014-2020) is an important national plan for the forestry sector. In 2018, a review of this programme showed that the overall planting level was about 7 per cent less than the government target. The shortfall in the planting target for native woodlands, agroforestry and forestry for fibre combined was much greater, however, at 74 per cent (Table 5.2). Annual afforestation has decreased from over 20,000 hectares in 1996 to only 3550 hectares in 2019 (adapted from DAFM, 2018a).

Table 5.2 Targets and actual afforestation (hectares) between 2015 and 2019

FOREST TYPE	2015		2016		2017		2018		2019	
	Target	Actual								
Overall target	6000	6293	6660	6500	7140	5536	7205	4026	8115	3550
Native woodland	300	138	300	159	300	266	340	374	350	310
Agroforestry	10	0	20	1	25	5	40	1	50	7
Forestry for fibre	100	3	200	1	500	0	500	1	1000	4

Source: adapted from DAFM (2018e).

This review identified four specific needs to address: increase the level of forest cover; provide for species diversification and seek commitments to meet the 30 per cent broadleaf planting target; contribute to national efforts to meet environmental obligations associated with climate, water and biodiversity; and support private forest holders in actively managing their forests, including increasing the supply of forest-based biomass.

Positive Developments in Managing and Restoring Native Woodlands

The Woodlands of Ireland charity, in partnership with government bodies and native woodland stakeholders, prepared the national Native Woodland Strategy 2016-2020. It aims to promote woodland-related ecosystem services, protect native woodlands near watercourses, integrate climate change into forest management and advocate for non-timber uses, including those associated with biodiversity, health, recreation, eco-tourism and landscapes.



The national Forestry Programme 2014-2020 includes targets to restore 2000 hectares of existing native woodland and create 2700 hectares of new native woodland. It also provides measures and commitments to protect our natural environment while supporting sustainable sectoral growth (DRCD, 2019). In 2016, the Department of Agriculture, Food and the Marine established environmental requirements for afforestation. In 2018, it published a draft plan to help sustainably manage forest activities in priority freshwater pearl mussel catchment areas (DAFM, 2018b). Recently, in efforts to help achieve planting targets, it also approved funding for an additional 15 proposals for sustainable forest management activities in 2019 and 2020. The Department of Culture, Heritage and the Gaeltacht has also reported that broadleaf planting levels have increased from 21 per cent to 27 per cent compared with 2017 levels.

Built Environment

Our cities, towns and villages need to be developed in a sustainable, planned and integrated manner.

Good planning is good for our environment. As highlighted in the National Planning Framework, 'a major new policy emphasis on renewing and developing existing settlements will be required, rather than continual expansion and sprawl into the countryside, at the expense of town centres and smaller villages' (Government of Ireland, 2018, p. 11). More compact urban centres and efficient resource use reduces the tendency towards sprawl and a reliance on mainly carbon-intensive greenfield development, which leads to biodiversity loss, soil loss and increased soil sealing, with potential impacts on water quality.

Population and settlement growth are drivers of land use change in urban areas. These changes have implications for soil quality, climate change, biodiversity integrity, air quality, flood risk and water quality. Soil sealing relates to the covering of natural surfaces by impermeable materials and is one of the main causes of soil degradation within the EU. It often affects fertile agricultural lands, puts biodiversity at risk, increases the risk of flooding and water scarcity, and contributes to global warming.

The Seventh Environment Action Programme (EU, 2013) proposed having policies in place by 2020 to achieve 'no net land take by 2050'. It also set targets for reducing soil erosion and loss of soil organic matter. Now that the government has published the National Planning Framework with initial targets for compact brownfield development, the next challenge for Ireland will be in measuring and monitoring how these targets are being met, the factors that are key to their success and what scope there should be for their enhancement.

An important issue in this regard relates to the form and location of future housing provision, particularly in the extensive rural parts of Ireland beyond the 1.7 per cent of the country that was under settlement in 2017, as reported by the Central Statistics Office (CSO).¹¹

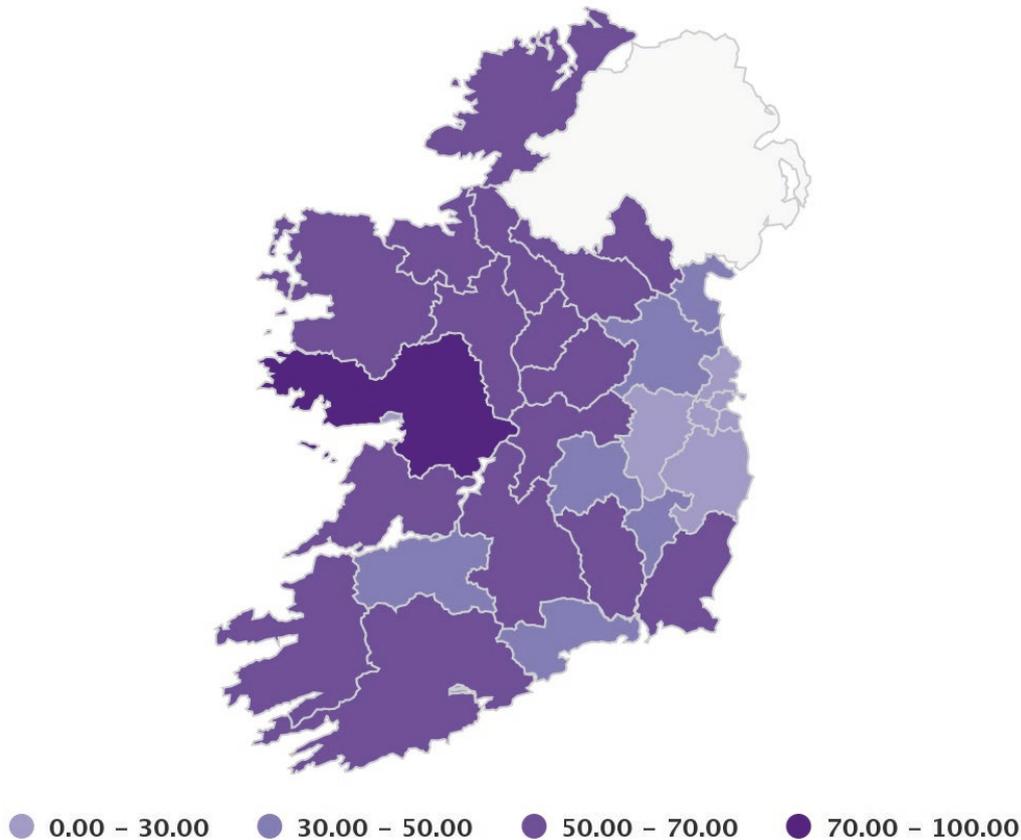
Ireland's population could reach about 6 million by 2051 (CSO, 2018). The CSO reported that there were 442,669 one-off houses (defined by the CSO as 'occupied detached houses with individual sewerage systems') in 2016 (CSO, 2016). This represents 26 per cent of all occupied dwellings, with almost 40 per cent of all homes constructed between the 2011 and 2016 census periods being one-off houses (Figure 5.4). The darker coloured areas in Figure 5.4 represent greater levels of one-off housing. For 17 counties, one-off housing comprised over half of all dwellings built since 2011. For example, over 60 per cent of households in County Galway were one-off houses, the highest in the country. Counties Roscommon (56%) and Leitrim (52%) also had a large proportion of this type of housing.

This type of housing depends on further on-site wastewater systems and the use of private cars for travel to places of work and learning and for leisure and services. Implementing robust policies in relation to rural settlements is very important to secure shared positive environmental outcomes.

11 <https://www.cso.ie/en/releasesandpublications/ep/p-eii/eii19/landuse/>



Figure 5.4 Percentage of homes constructed since 2011 that are one-off houses in 2016 (Source: CSO, 2016)



Providing housing in rural settings in a carefully planned, designed and environmentally sustainable way that meets the needs of rural communities and economic activities, can be achieved. For example, clustered rural housing close to or within rural villages, micro-generation of electricity using renewable technologies such as solar, wind and heat pumps, and adherence to strict standards for wastewater treatment and disposal all have a part to play in sustainable rural development.

However, the accelerating rate of development of one-off commuter-driven housing in rural areas close to larger cities and towns and along transport corridors, such as the motorway network, is locking in long-term environmental impacts.

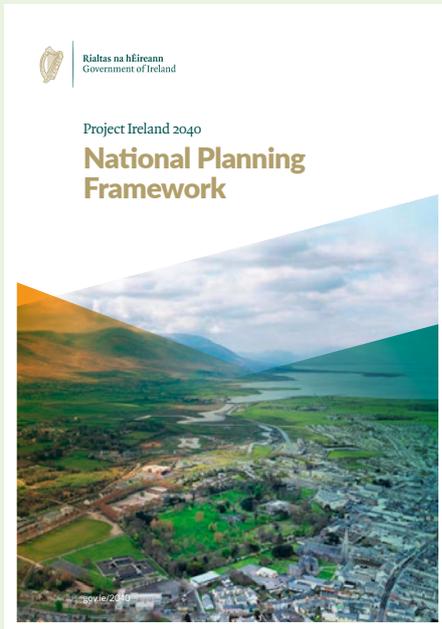
These impacts include climate impacts (from long-distance commuting in private vehicles), water quality impacts (because of poorly performing or maintained domestic wastewater treatment systems), the fragmentation of ecological linkages and habitats, and the fragmentation of agricultural land holdings. These result in a loss of food production and ecosystems, as well as limiting the opportunities for sensitive infill development and coordinated development of rural villages and small towns, many of which are in long-term decline.

At the same time, the key reasons why the housing needs of rural communities are not being met in smaller rural towns and villages include a lack of physical infrastructure, such as water service infrastructure, as well as affordable access to self-build options, such as low-cost local authority individual sites.



Topic Box 5.5 National Planning Framework

The National Planning Framework, published in 2018, is Ireland's top-level statutory land use plan (Government of Ireland, 2018).



It sets out a vision for how Ireland can sustainably accommodate an additional 1 million people by 2040 and grow our economy and society. It commits, where possible, to prioritising the development of brownfield and regeneration areas over greenfield development. It aims to focus growth primarily in our cities, while also supporting focused targeted growth in towns, villages and rural areas.

Regarding rural settlement in particular, the National Planning Framework (Policy Objective 18b) committed the government to developing 'a programme for new homes in small towns and villages with local authorities, public infrastructure agencies such as Irish Water and local communities to provide serviced sites with appropriate infrastructure to attract people to build their own homes and live in small towns and villages' (p. 162).

Currently, Policy Objective 18b is still to be implemented and needs to be allied to the careful management of rural areas under pressure of random and uncoordinated single-home development; its implementation will be essential to achieving the wider National Planning Framework policy objectives of compact growth and use of brownfield over greenfield development.

The Regional Assemblies will implement the National Planning Framework through their regional spatial and economic strategies, which in turn will be implemented through the local authority planning process. This will help ensure that sustainable development is promoted in local and regional authority land use planning.

The Office of the Planning Regulator, established in April 2019, is responsible for evaluating and assessing statutory plans made under the Planning and Development Act 2000, as amended. Its role includes reviewing development plans and local area plans for consistency with the National Planning Framework, regional spatial and economic strategies, ministerial guidelines and government policies, as well as obligations related to climate change mitigation and adaptation.

The National Planning Framework also recognises the importance of the maritime economy and seafood sector in sustaining our more remote rural coastal and island communities. Offshore, the National Marine Planning Framework, being prepared by the Department of Housing, Local Government and Heritage, will set out a vision of how Ireland will use, protect and enjoy our marine area. It is important that spatial planning, both onshore and offshore, is closely aligned and integrated to ensure that environmentally sustainable development is achieved.

Flood Risk Management

The use of nature-based and natural water retention measures should not be forgotten when considering solutions for flood protection and flood alleviation works.

Flood risk management, including integrated coastal zone management, helps protect our homes, businesses, lands and supporting infrastructure from flooding. Flood risk management guidelines were prepared in 2009.

These require planning authorities to carry out flood risk assessments to help ensure that land use (and associated land use zoning) is compatible with the risk of flooding identified.

In 2018, the Office of Public Works published 29 flood risk management plans and 40,000 flood maps for 300 communities as part of the first cycle of flood risk management planning required under the EU Floods Directive (2007/60/EC). These plans will help inform how and where our settlements develop into the future. Work is progressing on the second cycle of flood risk mapping. This will cover areas not previously assessed, including agricultural lands.

There are many environmental challenges when it comes to constructing flood alleviation works and relief schemes, especially where extensive engineering works are required. If not carefully planned, implemented and monitored, there is the potential for significant negative environmental



impacts on water quality and associated habitats and species. Nature-based and natural water retention measures should also be considered as solutions for flood protection and flood alleviation works. Example of these measures include restoring ecosystems such as wetlands

and reconnecting floodplains with water courses to better regulate the flow and transport of water. These types of solutions are encouraged in EU policies, as outlined by the European Environment Agency (EEA, 2019a).

Topic Box 5.6 Greener More Sustainable Cities and Urban Regeneration

Green infrastructure is based on the idea that protecting and enhancing nature and natural processes, which provide many benefits to society, needs to be integrated into spatial planning to underpin sustainable development. Green infrastructure consists of strategically planned and managed networks of natural and semi-natural areas. These areas provide a wide range of ecosystem services including biodiversity support, water purification, air quality, flood management, recreation and climate mitigation and adaptation (Figure 5.5). This network of green spaces (and blue spaces, for water linkages) helps to sustain (and can improve) our environment, our health and our quality of life. It also creates job opportunities and supports the green economy. Green infrastructure planning involves recognising the many benefits that green (and blue) spaces provide and protecting and managing these spaces within statutory land use plans.

Figure 5.5 Components of Green Infrastructure (Source: EC, 2013)



The European Commission (EC, 2011) identified that restoring at least 15 per cent of degraded ecosystems in the EU and expanding green infrastructure use will help overcome land fragmentation. Land fragmentation involves splitting up the landscape into smaller areas. This can impact on natural habitats and make it more difficult for animals to move safely in the modified landscape.

Ireland's National Planning Framework requires local authorities to incorporate planning for green infrastructure and ecosystem services into statutory land use plans. Similar commitments are also provided in regional spatial and economic strategies and at the county level, for example Fingal's Green Infrastructure Strategy.

Significant growth in green and blue schemes has occurred in Ireland since 2016. Recent examples of successful schemes include the Waterford Greenway and the Barrow Blueway. These schemes offer many environmental and health benefits, as well as providing opportunities for sustainable tourism and support to the local economy. If not carefully designed and developed and subjected to the proper environmental assessments, however, these types of schemes have the potential to impact on existing green infrastructure. For example, projects that aim to provide routes through Special Areas of Conservation or Special Protection Areas may risk undermining these designations.



Landscape

Ireland's National Landscape Strategy sets out the principles for protecting and enhancing the landscape while positively managing changes.

Our landscape has been shaped by long-running natural processes and human intervention throughout history. It forms an important part of our cultural and natural identity. It contributes to the wellbeing of our economy (e.g. the tourism industry), society and environment. How we value and protect our landscape plays an important role in where (and how) our settlements grow and where any supporting infrastructure should be placed.

The European Landscape Convention aims to balance spatial planning, development and landscape protection. In Ireland, this is being provided for through the Planning and Development Act Regulations 2000-2010 and Local Government Reform Act 2014. The Department of Agriculture, Food and the Marine has produced forestry-related landscape guidance since 2000. It also designates hedgerows, ditches and open drains as 'landscape features' to be protected under the Good Agricultural and Environmental Condition of cross-compliance. Archaeological sites and monuments are also recognised as important features to protect.

Ireland's National Landscape Strategy (DAHG, 2015b) sets out the principles for protecting and enhancing the landscape while positively managing changes. It recognises the need to establish a landscape policy framework approach to inform planning authorities' decision-making. It includes an action requiring public authorities to prepare 'State of the Landscape' reports, which would then be summarised by the Department of Culture, Heritage and the Gaeltacht. Although this was a positive commitment in 2015, to date it has not been implemented. The National Planning Framework similarly committed to preparing a national landscape character map as a specific objective; however, this has also not yet been implemented. The

absence of a national landscape character map makes it more difficult to plan for important strategic infrastructure, such as windfarms, for example.

The National Planning Framework also commits to developing guidance on local landscape character assessments (including historic landscape characterisation), to provide for a more consistent landscape character assessment approach across administrative boundaries.

The Marine Institute has recently developed a Seascape Character Assessment¹² for the first time. This will help define the key characteristics of our coastal seascapes, at a regional level and should help inform planning decisions on land and in the marine environment.

Regionally, the regional spatial and economic strategies will help coordinate local authority landscape character assessments. This should improve consistency between adjoining local authorities, in valuing, protecting and managing their shared landscape resources.

5. Research

We need to continue supporting ongoing collaborative research to address environmental knowledge gaps covering land use, soils and spatial planning.

Ongoing research will help inform national soil-related policies and interactions with wider environmental protection. The EPA research programme funds research to inform land and soil policy, implementation, enforcement and sustainable use. The range of projects funded includes desk and medium-scale studies, scholarships and fellowships. Some of these research projects are listed in Topic Box 5.7.

¹² <https://emff.marine.ie/blue-growth/project-13-definition-and-classification-ireland%E2%80%99s-seascapes>



Topic Box 5.7 Some Recent Developments in Mapping Technology

Significant improvements have been made in how geographical information systems and satellite imagery are used to map land cover. Continued research in this area will help improve our understanding of soils and land cover, as well as monitoring changes that occur.

One recent development arising from EPA-funded research was the launch of the Environmental Sensitivity Mapping Webtool in 2019. It helps planners highlight areas that are more environmentally sensitive, to inform better planning decisions and environmental assessments. It brings together over 100 datasets and allows users to create plan-specific environmental sensitivity maps. These maps can help identify suitable development locations, while also protecting the environment. It is available at www.enviromap.ie.

Some other relevant research in this area is shown below in Table 5.3.

Table 5.3 Some soils and landcover online resources

Soils map of Ireland ¹³ (Teagasc – EPA)	Soil information to inform land management activities
Irish wetlands mapping project ¹⁴	Information on the location and status of wetlands
Bird sensitivity mapping for wind energy developments ¹⁵ (Birdwatch Ireland)	Assists in locating wind energy developments, to minimise impacts on birds
Flood maps ¹⁶ (Office of Public Works)	Provides flood maps to inform land use planning
Catchments.ie ¹⁷ (EPA)	Information on and stories about our water catchments

Soils and Land Cover: EPA Research Programme 2014-2020

Since 2016, the EPA has funded 40 new research projects relevant to the Soils and Land Cover area; a commitment of €6.5 million. These projects were funded under the Sustainability (Natural Capital), Water and Climate Pillars of the EPA Research Programme 2014-2020.

During 2020 several new EPA research reports have been published that are relevant to the topics covered in this chapter. They include the two research reports mentioned in Table 5.4 below. All reports are available on the research pages of the EPA website.¹⁸

These EPA-funded projects include research on:

- habitat mapping, assessment and monitoring using high-resolution imagery
- Irish natural capital accounting
- peatlands and
- planning.

Table 5.4 Some recent EPA-funded research projects on soils, land cover and land use

- Ecohydrology, Greenhouse Gas Dynamics and Restoration Guidelines for Degraded Raised Bogs (Regan *et al.*, 2020)
- Evaluating the Suitability of the Land Parcel Identification System for Assessing Land Use and Land Use Change-Related Greenhouse Gas Emissions (Zimmerman *et al.*, 2020)
- TaLAM: Mapping land cover in lowlands and uplands with satellite imagery (Cawkwell *et al.*, 2018)
- SoilC – feasibility of grassland soil carbon survey (Kiely *et al.*, 2017)
- Mapping and monitoring land cover, use and change (Cawkwell *et al.*, 2017)
- 21st century deforestation in Ireland (Devaney *et al.*, 2017)
- Irish soil information system: soil property maps (Creamer *et al.*, 2016)
- Soil status and protection (Bampa *et al.*, 2016)

¹³ <http://gis.teagasc.ie/soils/>

¹⁴ <http://www.wetlandssurveyireland.com/wetlands/map-of-irish-wetlands--index.html>

¹⁵ <https://www.birdwatchireland.ie/OurWork/PolicyAdvocacy/BirdSensitivityMapping/tabid/1312/Default.aspx>

¹⁶ <http://www.floodinfo.ie/>

¹⁷ <https://www.catchments.ie/>

¹⁸ www.epa.ie/researchandeducation/research/researchpublications/researchreports/



The EU 2020 LANDMARK project¹⁹ considered local, regional and EU-scale aspects of soils and land cover. Pillar 1 (local) developed a Soil Navigator²⁰ as a decision support tool for use at local scales by farmers and advisors. It aims to assess and optimise soil functions in an integrated manner to inform long-term sustainability. Teagasc recommends that further research is carried out to refine this for use with Irish conditions and management regimes.

At the regional scale (Pillar 2), a monitoring scheme covering the many functions of soils, coupled with a set of indicators to describe soil functions, has been developed. This could support the development of a national-level monitoring scheme for soils in Ireland.

Finally, at the EU scale (Pillar 3), a set of policy options was proposed to optimise agronomic (using agricultural plants for food, fuel, fibre and land restoration) and associated environmental outcomes. Teagasc indicates that these policy options could be used and refined to inform national agricultural policy.

More information is available at <http://www.epa.ie/researchandeducation/research/>.

6. Conclusions

Soils and Land Resources

Our soils, land cover and landscape resources need to be protected, monitored and managed responsibly. This needs to happen in national policies right down to local management scale, covering cross-sector activities on farms, on forest plantations, on peatlands, and in urban and rural areas.

We must fully implement existing environmental policies, planning frameworks and strategies, as well as sectoral commitments, to protect, maintain and enhance our remaining biodiversity and ecosystem resources, including peatlands, forests and wetlands. In preparing sectoral plans and programmes, detailed land cover mapping information should, where available, be taken into account. This should be supported with continued environmental monitoring and reporting.

Land Cover Mapping

The national land cover mapping programme, once complete, will provide a detailed evidence base to allow better and more integrated decision-making across many sectors. We need to be able to monitor how well policies, plans and programmes are being implemented from an environmental standpoint. Developing and implementing a new national approach to land cover, land use and land management would allow us to coordinate how major environmental challenges, such as addressing climate change mitigation and the decline in nature, and improving water quality in our catchments, are being addressed across different sectors.

Protecting Peatlands

Our peatlands are a unique and important habitat, rich in historical, cultural and community significance. Although our peatlands have served our fuel and power needs, especially in the past, we need to continue the transition to using cleaner, more renewable sources of fuel.

Nationally, there needs to be a concerted effort to fully implement the commitments of the National Peatlands Strategy and the National Raised Bog SAC Management Plan 2017-2022 (DCHG, 2018). Rewetting degraded peatlands will help eliminate and reduce losses of carbon. Where peatland restoration is feasible, it will further improve the capacity of our peatlands to store CO₂. It will also help protect and, where possible, enhance important habitats and the many ecosystem services they provide us with.

Where peat extraction activities are still ongoing within national and European designated sites, these should continue to be regulated. We need to continue to progress options to rehabilitate and restore existing industrial cutaway and cutover bogs, with the overall aim of better protection and timely restoration of peatlands as carbon sinks.

¹⁹ <http://landmark2020.eu>

²⁰ www.soilnavigator.eu



Forestry

With regard to forestry, there needs to be a focus on increasing the level of forest cover, supporting further broadleaf planting and species diversification and maximising sustainable forest management practices (such as the right tree in the right place). We also need to better understand the barriers to uptake of forestry by landowners, to help increase the amount of planting of native woodlands, agroforestry and forestry for fibre.

Spatial Planning

We must ensure that our cities, towns, villages and rural areas are developed in an environmentally sustainable way. Active steps will be needed by many stakeholders, including government, local authorities, infrastructure bodies and local communities, to implement alternatives to urban sprawl and the suburbanisation of Ireland's countryside. These aims are well outlined in the National Planning Framework and include planned town and village development, measured controls on sporadic housing development in rural areas near cities, towns and major road corridors, implementing brownfield regeneration and delivering affordable town and village self-build housing options close to employment, services and amenities.

The importance of our green and blue spaces for our health and wellbeing, for providing quiet areas and for local biodiversity is now widely recognised. We should aim to protect existing natural green infrastructure and increase levels of green and blue infrastructure in towns and cities through county- and local-level land use planning.

In terms of wider planning and land management considerations, we should, where possible, aim to incorporate nature-based and natural water retention measures as solutions in flood risk management planning. For old industrial and waste areas, there is still a need to develop a national policy to remediate contaminated and degraded land and soil, as this is a gap at present.

Landscape

Regarding landscape protection, there has been little progress in achieving the aims of the National Landscape Strategy to date. We need to deliver on the commitments of the National Landscape Strategy and the National Planning Framework, as well as to prepare a national landscape character map. This will help us provide for planned economic and social development while also ensuring that we protect, enhance and manage changes in our landscapes in a coherent manner. Such strategies and frameworks will also help us understand and take account of the interactions between environmental and landscape sensitivities in our sectoral and land use planning activities.

Research

There is need to continue supporting collaborative research to address environmental knowledge gaps. Outputs of environmental research help inform policymaking to address the many environmental challenges facing us. Good examples of applied research include the Environmental Sensitivity Mapping Webtool, which is helping local authorities to prepare land use plans and related environmental assessments and the Soil Navigator, which helps farmers capture the trade-off and synergies between different soil functions.

Agriculture

With regard to agriculture, we need to continue improving our knowledge of soils and the functions and services they provide. This includes looking at how to maximise the potential for soils in Ireland to be carbon sinks. We must continue to carefully manage soil enrichment and land management activities, to avoid or minimise greenhouse gas emissions into the air or nutrient and sediment losses into our water catchments. The consequences of nutrient loss for Ireland's water quality are outlined in Chapters 7 and 8.

We should also continue to support high nature value farming and environmentally sustainable farming practices, for the many environmental benefits they provide.



Chapter Highlights for Land and Soil



Our soils and land need to become net sinks for capturing and storing carbon dioxide. The facilitation of further carbon storage will require widespread rehabilitation and protection of peatlands, increased levels of forestry and woodland, and changes to land management practices. Where land management is providing a store for carbon, this should be maintained or enhanced. Where land management is resulting in emissions of carbon dioxide, this source should be reduced or eliminated, and where land is degraded or has lost its ability to absorb or store carbon dioxide it should be restored. Nationally, there needs to be a concerted effort to fully implement the commitments of the strategies and plans to protect and restore peatlands.



A progressive approach to land cover, land use and land management is required to promote land practices that are sustainable and right for our environment and our people. Implementing such an approach will help coordinate, prioritise and measure Ireland's response to significant environmental issues such as climate change and the decline in nature across multiple sectors. An integrated national approach to land mapping will be needed to support this work.



We need to continue to improve our knowledge of soils and the functions and services they provide. Careful management of soil enrichment and land management activities will avoid or minimise GHG emissions into the air, as well as nutrient and sediment losses into water catchments. This needs to happen from the national policy level to the local management scale, covering cross-sectoral activities on farms, forest plantations and peatlands and within both urban and rural areas.



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