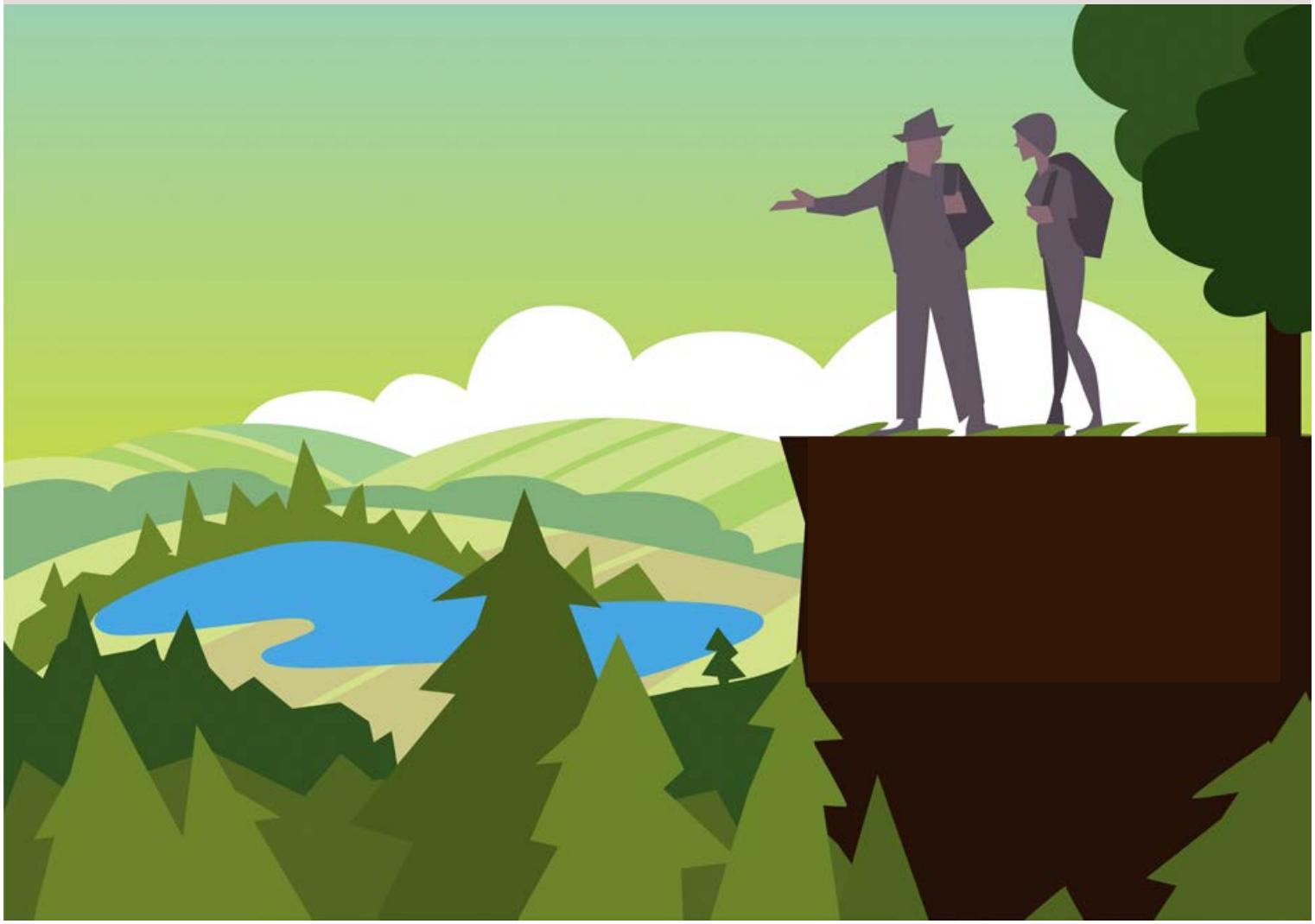
Our Environment, Our Health, Our Wellbeing:

Access to Blue/Green Spaces in Ireland



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epa Research

Climate - Water - Sustainability

Identifying pressures • Informing policy • Developing solutions

ENVIRONMENTAL PROTECTION AGENCY

The Environmental Protection Agency (EPA) is responsible for protecting and improving the environment as a valuable asset for the people of Ireland. We are committed to protecting people and the environment from the harmful effects of radiation and pollution.

The work of the EPA can be divided into three main areas:

Regulation: *We implement effective regulation and environmental compliance systems to deliver good environmental outcomes and target those who don't comply.*

Knowledge: *We provide high quality, targeted and timely environmental data, information and assessment to inform decision making at all levels.*

Advocacy: *We work with others to advocate for a clean, productive and well protected environment and for sustainable environmental behaviour.*

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We regulate the following activities so that they do not endanger human health or harm the environment:

- waste facilities *(e.g. landfills, incinerators, waste transfer stations)*;
- large scale industrial activities (*e.g. pharmaceutical, cement manufacturing, power plants)*;
- intensive agriculture *(e.g. pigs, poultry)*;
- the contained use and controlled release of Genetically Modified Organisms *(GMOs)*;
- sources of ionising radiation *(e.g. x-ray and radiotherapy equipment, industrial sources)*;
- large petrol storage facilities;
- waste water discharges;
- dumping at sea activities.

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- Overseeing local authorities' environmental protection responsibilities.
- Supervising the supply of drinking water by public water suppliers.
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- Enforcing Regulations such as Waste Electrical and Electronic Equipment (WEEE), Restriction of Hazardous Substances (RoHS) and substances that deplete the ozone layer.
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- Monitoring radiation levels, assessing exposure of people in Ireland to ionising radiation.
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- Generating greater environmental awareness and influencing positive behavioural change by supporting businesses, communities and householders to become more resource efficient.
- Promoting radon testing in homes and workplaces and encouraging remediation where necessary.

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- Office of Environmental Sustainability
- Office of Environmental Enforcement
- Office of Evidence and Assessment
- Office of Radiation Protection and Environmental Monitoring
- Office of Communications and Corporate Services

The EPA is assisted by an Advisory Committee of twelve members who meet regularly to discuss issues of concern and provide advice to the Board.

EPA RESEARCH PROGRAMME 2014–2020

Our Environment, Our Health, Our Wellbeing: Access to Blue/Green Spaces in Ireland

(2017-HW-MS-12)

A report commissioned by the Environmental Protection Agency Research Programme

by the SHEER Wellbeing Project Team

National University of Ireland, Galway

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This report is based on research carried out/data from 1 January 2018 to 31 May 2019. More recent data may have become available since the research was completed.

The EPA Research Programme addresses the need for research in Ireland to inform policymakers and other stakeholders on a range of questions in relation to environmental protection. These reports are intended as contributions to the necessary debate on the protection of the environment.

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Executive Summary

The study aimed to explore the key forces and patterns at work in relation to access to blue/green spaces in Ireland and possible impacts in national, regional and local contexts through data analytics, visualisation and mapping.

This project investigated the potential to document the connections between the environmental and socioeconomic determinants of health and wellbeing in Ireland by reviewing the various datasets available at national, regional and local levels, and mapping, analysing and synthesising these to identify both positive and negative associations and gaps in data. Hard and soft evidence sources for linking socioeconomic status and the health impacts of access to green/blue spaces were reviewed to identify potential relationships. Following the data audit and gap analysis, spatial differences in the thematic areas were explored. A systems dynamic map was produced, based on extensive stakeholder consultations, that models the key forces and patterns at work. This stakeholder systems map was complemented and further verified by a nationally representative survey that also aimed to address identified data gaps and test dynamic hypotheses in relation to blue/green spaces and health and wellbeing benefits. Recommendations towards healthier environmental ecosystems and towards future research and policies in Ireland at local, regional and national levels are made.

This project shows that there are connections between blue/green spaces and the socioeconomic determinants of health and wellbeing in Ireland. This study reviewed the various datasets available and identified potential relationships. However, although some relevant datasets are available at all levels, there is a clear need for more socioeconomic data at regional and local levels recognising that blue/green spaces are nested within adjacent and complementary systems, such as transport, food, air and water quality. It is blue/green spaces interconnected with other systems that generate spatial and environmental inequalities that are embedded within socioeconomic determinants of health and wellbeing in Ireland.

Recommendations

- Compliance with the Data Sharing and Governance Act 2019 and the national Open Data Strategy; a strategic collaborative effort across all sectors is needed to improve on the current fragmented, linear, case-by-case approach.
- Data at local authority level, electoral district level and small area level are required for spatial comparison of health status, risk and protective factors, and related inequalities as the foundation for equitable geographical and socioeconomic allocation of resources.
- Validated, standardised questions that comply with international standards on the usage of blue/green space need to be used to gather relevant data either in a dedicated European-wide survey (or in national household surveys) or in the national census of each country.
- A cross-sectoral framework for blue/green spaces is required that is linked with health, water and air quality, climate-proofing and housing; other related issues should be developed as part of the Health in All Policies approach promoted by the World Health Organization and aim to share best practice, develop new tools and raise the awareness of policymakers of the impact of poor design on health inequalities.

Conclusion

Proportionate universalism (the resourcing and delivering of universal services at a scale and intensity proportionate to the degree of need) ensures that services are available to all, not only the most advantaged, and are able to respond to the level of need. The findings of this study demonstrate to state agencies, regulators and policymakers that a sustainable blue/green strategy with healthy outcomes for individuals, groups and communities requires systemic change capable of accounting for both individual and macro factors over the lifecourse. Leverage points range from increasing access to and multiple usage of outdoors spaces to availability of data and information for planning and closing data

gaps. National protocols are needed for data sharing with a social inclusion focus. Although many of the data currently collected by various agencies for health, environmental or socioeconomic purposes are wholly satisfactory in their current form/level of granularity for the intended purpose, strategic trans- and interagency collaborations offer potential to provide richer evidence on the multiple links between environmental quality, health and wellbeing and socioeconomic status to transform and improve health for all.

1 Introduction

1.1 Background

At the inaugural Environmental Protection Agency (EPA)–Health Service Executive (HSE) joint conference on 30 November 2016 entitled "Our Environment, Our Health, Our Wellbeing", the challenge was set to promote a greater awareness of the impact of environmental quality on human health in Ireland. The fact that the environment and human health are inextricably linked is explicitly recognised in the Government's *Healthy Ireland* – a framework for improved health and wellbeing 2013–2025 (Department of Health, 2017), and in the *EPA Strategic Plan 2016–2020: Our Environment, Our Wellbeing* (EPA, 2016).

At present, various agencies across Ireland gather data for particular health, environmental or socioeconomic purposes, and this project investigated the potential to document the connections between the environmental and socioeconomic determinants of health and wellbeing in Ireland by reviewing the various datasets available. This included the mapping, analysing and synthesising of multi-agency data to identify both positive and negative associations between socioeconomic determinants of health and wellbeing and the environment, and identify gaps in available data.

This report reflects on how multiple environmental stressors combine to impact on human health and how the nature and scale of the impact are influenced by current trends in demography and urbanisation. The report also investigates the benefits provided by blue/green spaces, with a particular focus on accessibility and usage, and how these are influenced by socioeconomic determinants.

The Socioeconomic Health and Environment Research (SHEER Wellbeing) team's expertise is in systems and complexity science, big data analytics, Internet of things, biomonitoring, e-governance, collaborative local community-based participation, environment, public health and wellbeing research, and policy innovation. This project aims to answer the question "What is the environmental and health evidence regarding the role of socioeconomic status in determining exposure, susceptibility and vulnerability to access to blue/green spaces in Ireland?"

In 2017, the United Nations (UN) General Assembly and the Organisation for Economic Co-operation and Development (OECD) declared systems thinking to be key to dealing with the fundamental interconnectedness of complex, local-to-global economic, social and environmental issues (Operational Research Society, 2018). The *European Quality of Life Survey 2016* (Eurofound, 2017) has demonstrated a socioeconomic gradient in inequalities in access to green spaces. Inequality in relation to access to outdoor spaces is one type of spatial inequality. Spatial inequalities contribute to social inequalities, which themselves give rise to health inequalities. The mechanisms for the interactions between blue/green spaces and health and wellbeing inequalities are unclear; new approaches using qualitative and quantitative methods are needed.

1.2 Aims and Objectives

The aim of this study was to review, in collaboration with key environmental, health and socioeconomic stakeholders, the key forces and patterns at work in relation to access to blue/green spaces in Ireland and possible impacts in national, regional and local contexts through data analytics, visualisation and systems mapping. The specific objectives of this study were to:

1. review the national, regional and local evidence regarding the role of socioeconomic status in determining, and the health impacts of, access to blue/green spaces using hard and soft data;
2. conduct a national, regional and local data audit and gap analysis relating to blue/green spaces in Ireland;
3. explore, map and interpret spatial differences in Ireland;

4. map the dynamics in greater national, regional and local depth through data visualisation and community of practice/stakeholder modelling of the key forces and patterns at work;
5. make recommendations towards healthier environmental ecosystems and towards future research and policies in Ireland at local, regional and national levels.

2 Review of Benefits from Blue and Green Spaces on Health and Wellbeing

2.1 Introduction

The SHEER Wellbeing project explores the complex links between our environment, health and wellbeing and our socioeconomic status. The project emphasises how data from different domains are important to decision-making, policy development, community development and the quality of our lives. The project responds to the UN Sustainable Development Goals (SDGs) 3, 6, 10, 11, 13, 14, 15 and 17 and builds on emerging research in Ireland – Nature and Environment to Attain and Restore (NEAR) Health,[1] Green and Blue Infrastructure and Health (GBI Health),[2] Ecosystem Benefits of Green Space for Health (EcoHealth)[3] – to explore and improve our evolving understanding of the impacts that the environment ("blue/green spaces") can have on health and wellbeing. It is essential that Ireland assesses its current approach to sustainable environment and health management. The evidence underpinning the relationship between nature and human health is complex and comprises multi- and interdisciplinary research, which SHEER Wellbeing aims to examine. Prevention is the primary focus of, inter alia, the Irish National Obesity Policy and Action Plan (Department of Health, 2016), which recognises that preventing childhood overweight and obesity is central to sustainable reduction in adult obesity and related chronic disease. This must include addressing obesogenic environments and improving access to blue and green spaces (Lovell, 2016a).

2.2 Blue and Green Spaces

In relation to health and wellbeing research, natural environments tend to be broadly divided into blue and green spaces. *Blue space* may be described as a "threshold concept" (Meyer and Land, 2003) and is often subsumed under the umbrella concept of green space or green infrastructure, where the assumption is that these spaces will "improve environmental conditions and therefore citizens' health and quality of life" (EC, 2016). The European Environment Agency (EEA) provides a definition, indicators and glossary for urban green infrastructure but not for blue infrastructure. The EEA draws on the Water Framework Directive (WFD) (2000/60/EC; EC, 2000) to define a water body as "a clearly distinguishable part of surface water, such as a lake, a stream, river or a part a stream or river".

Definitions of blue space in the literature are limited. Studies that include a definition largely define blue space to include all visible outdoor surface waters (White *et al*., 2016; Grellier *et al*., 2017). Furthermore, Foley and Kisteman's (2015, p. 157) definition emphasises the health-enabling qualities, "where water is at the centre of a range of environments with identifiable potential for the promotion of human wellbeing". The definition used by the European Union (EU)-funded Horizon 2020 Blue Health[4] project includes man-made or urban "blue infrastructure". The project provides a detailed definition of blue space as "outdoor environments – either natural or manmade – that prominently feature water and are accessible to humans either proximally (being in, on or near water) or distally/virtually (being able to see, hear or otherwise sense water)" (Grellier *et al*., 2017). The inclusion of man-made water features highlights how many so-called natural water bodies have been modified and altered by human use and activities. The WFD outlines a definition for two types of altered water bodies: heavily modified water body (HMWB) and artificial water body (AWB). HMWBs are where the natural conditions of a water body have been substantially altered and can include reservoirs, canals and canalised rivers. The EEA (2015) provides the following definitions:

1 NEAR Health: http://whitakerinstitute.ie/project/near-health/ (accessed 6 December 2018).

2 GBI Health: https://gbihealthireland.com/ (accessed 6 December 2018).

3 EcoHealth: http://www.ecohealth.ie/ (accessed 6 December 2018).

4 Blue Health: https://bluehealth2020.eu/ (accessed 6 December 2018).

> HMWB are bodies of water which as a result of physical alterations by human activity, are substantially changed in character and cannot, therefore, meet good ecological status (GES). In this context physical alterations mean changes to e.g. the size, slope, discharge, form and shape of riverbed of a water body.

> AWBs are surface water bodies which have been created in a location where no water body existed before and which have not been created by the direct physical alteration, movement or realignment of an existing water body.

For the SHEER Wellbeing project blue space is defined as all visible, outdoor, natural or man-made surface waters with potential for the promotion of human health and wellbeing.

The definitions of *green space* (or greenspace) are varied, with different organisations, institutions and research groups using different interpretations. Definitions also overlap, with terms such as "public spaces", "urban spaces", "open spaces" and "green spaces" often used interchangeably within the literature, with many encompassing blue spaces. There is a lack of consensus as to what green space means. Taylor and Hochuli (2017), in their review of journal articles about green space, point out that there are generally two broad interpretations of green space used: (1) green space is synonymous with nature or (2) green space refers explicitly to urban vegetation. Of the 125 papers they reviewed, fewer than half defined green space and where definitions were provided these could be divided into six definition types: (1) acknowledged range, (2) definition by example, (3) ecosystem services, (4) green areas, (5) land use and (6) vegetated areas. They recommend that rather than suggest a single, prescriptive understanding of green space, researchers should construct a definition of green space for the context of their research that utilises both qualitative and quantitative aspects (Taylor and Hochuli, 2017). Nor does other academic literature clarify the terminology; for example, Gascon *et al*. (2015) define the term green space as referring to vegetation (trees, grass, forests, parks, etc.), whereas Kondo *et al*. (2018) used search terms including "green space", "urban nature", "urban garden", "nature area", "open space", "park" and "public land" in their literature search to investigate urban green space and its impacts on human health.

Outside the academic arena, the World Health Organization (WHO) (2016) publication *Urban Green Spaces and Health – A Review of Evidence*, focusing on urban areas, states that there is no universally accepted definition of urban green space regarding health and wellbeing impacts. Urban green spaces may include places with "natural surfaces" or "natural settings"; however, they may also include specific types of urban greenery, such as street trees, and may also include blue space that represents water elements ranging from ponds to coastal zones. The EEA has more than one green space definition; the *GEMET – Environmental Thesaurus* defines it as "a plot of vegetated land separating or surrounding areas of intensive residential or industrial use and devoted to recreation or park uses" (Eionet, 2018), with a similar definition of green urban area (GUA), adapted from the CORINE Land Cover classifications (Bossard *et al*., 2000; Kosztra *et al*., 2017), provided by the EEA glossary for urban green infrastructure (EEA, 2018):

> A patch of vegetated land within the urban fabric for predominantly recreational use. GUA can also refer to suburban natural areas that are managed as urban parks and may include assets of different scales from green roofs or pocket gardens to large urban parks.

The Copernicus *Urban Atlas*, a joint initiative of the European Commission (EC) Directorate-General (DG) for Regional and Urban Policy and the DG for Enterprise and Industry, with the support of the European Space Agency and the EEA, provides the following definition of green urban areas: "public green areas for predominantly recreational use such as gardens, zoos, parks, castle parks; suburban natural areas that have become and are managed as urban parks" (Copernicus, 2018). The EEA's *A Walk to the Park?* project (Poelman, 2016), authored by the same team as the *Cities in Europe – the new OECD-EC Definition* study (Dijkstra and Poelman, 2012), uses the same definition as the *Urban Atlas*, including forests with a minimum mappable area of 0.25 ha.

Based on the Natural England (NE) Accessible Natural Greenspace Standard (ANGSt), the NE (2010) *Nearby*

Nature guidance document defines "natural green spaces" as places where human control and activities are not intensive so that a feeling of naturalness is allowed to predominate. Natural and semi-natural green space exists as a distinct typology but also as discrete areas within the majority of other green space typologies. Greenspace Scotland takes a broader view and defines green spaces as:

> any vegetated land or water within an urban area; this includes: parks, gardens, playing fields, children's play areas, woods and other natural areas, grassed areas, cemeteries and allotments green corridors like paths, disused railway lines, rivers and canals derelict, vacant and contaminated land which has the potential to be transformed. (Greenspace Scotland, 2018).

In Ireland, the EPA, in its 2016 *Ireland's Environment – An Assessment*, states that green spaces include farmlands, parks and forests, whereas blue spaces include rivers, canals, lakes and coastlines (EPA, 2016).

Based on (1) the definitions and the recommendation from Taylor and Hochuli (2017) previously mentioned, (2) the need to separate blue and green space, (3) the definition used in the NEAR Health project and (4) the need to include both urban and rural areas, and given the focus of the study on health and wellbeing, the SHEER Wellbeing project has adopted the following definition of green space: all terrestrial outdoor, natural or semi-natural surfaces or settings or features with potential for the promotion of human health and wellbeing.

The NE 2010 *Nearby Nature* guidance document offers the following definition of accessible spaces: "Accessible spaces are places that are available for the general public to use free of charge and without time restrictions (although some sites may be closed to the public overnight and there may be fees for parking a vehicle)". These are places that are available to everyone, meaning that all reasonable efforts are made to fulfil the requirements under the UK Disability Discrimination Act (Government of the United Kingdom, 1995). Accessible spaces are also known to their target users, including potential users, living within the catchment of that space. SHEER Wellbeing is focused on accessible green and blue spaces, as defined previously, which excludes private spaces, such as gardens and those for which entrance fees need to be paid.

2.3 Blue Space and Human Health

There is increasing interdisciplinary interest in and recognition of the potential health benefits provided by the use of outdoor water environments, or blue space (Korpela *et al.*, 2010; Depledge *et al.*, 2013; Bell *et al*., 2015; Wheeler *et al.*, 2015; Domegan *et al*., 2016; Gascon *et al*., 2017; Grellier *et al.*, 2017; Levin and Poe, 2017). Although WHO and the UN recognise that water environments are essential to promote health (WHO, 2017), research on relationships between exposure and access to, and use of, blue spaces and health is less well established than that conducted on relationships between green spaces and health (Nieuwenhuijsen *et al*., 2014) and particularly little evidence exists regarding the effects of blue spaces other than coastlines (Britton *et al.*, 2018).

To date, literature on blue spaces and health has been primarily disease focused, dominated by environmental toxicology and microbiology (Depledge *et al.*, 2013). A number of emerging research initiatives offer an alternative perspective, recognising the interconnectedness of healthy blue spaces for human health and wellbeing (Seas and Oceans for Public Health in Europe – SOPHIE,[5] NEAR Health, Sea Change[6] and Blue Health). It is important to acknowledge the duality of blue spaces as a potential source of illness and good health; they can pose risks as well as potential benefits for health (Collins and Kearns, 2007; Pitt, 2018). While higher quality waters reduce potentially harmful contaminants and increase the time that recreationists will spend engaged in a water-based activity, polluted sites have a negative effect on perceived restorativeness and sense of wellbeing (Wyles *et al.*, 2016; Curtis and Hynes, 2017). The quality of surface waters is of huge relevance to recreational users, as in most water-based recreational

5 SOPHIE: https://sophie2020.eu (accessed 6 December 2018).

6 Sea Change: http://www.seachangeproject.eu/ (accessed 6 December 2018).

activities participants come into close contact with the water, which poses risks through exposure to pollution as well as physical risk, such as drowning and injury (IWS, 2018). At a worldwide scale, the contamination of coastal waters is a major public health issue and bathing in any contaminated waters has been shown to cause gastrointestinal illness, eye/ear/sinus infections and skin rashes (Henrickson *et al*., 2001; Shuval, 2003; Wade *et al*., 2003, 2010; Turbow, 2009). In Ireland, it is estimated that annually just under half of the adult population participates in some form of water-based leisure activity (Williams and Ryan, 2004). Higher water quality levels not only increase the time that recreational users spend engaged in their recreational activity (Curtis and Hynes, 2017) but also reduce their exposure to potentially harmful contaminants. Pro-environmental and community-based actions, such as organised beach clean-ups, can turn the negative impact of a poor-quality environment into the positive benefits of a potentially restorative environment, as well as a creating a strong sense of community through shared values and actions (Wyles *et al*., 2017).

As is the case for green space, evidence of direct causation is limited, but research findings highlight positive associations between various dimensions of human health and wellbeing and blue space. In particular, positive associations have been demonstrated between residential blue space and improved mental health outcomes (Gascon *et al*., 2017), reduced psychological distress (Nutsford *et al*., 2016), recreational use (Völker and Kistemann, 2011; Gascon *et al*., 2017; Britton *et al*., 2020), preference, affect and restorativeness (Völker and Kistemann, 2011; White *et al*., 2010), giving meaning to place (Yamashita, 2002) and greater social connectedness (Bell *et al.*, 2015). It is evident that blue space is an important leisure or activity space. However, study results are mixed and inconsistent, with limited findings for physical health. Studies have tended to focus primarily on residential experiences in industrialised/developed countries and often on those of student populations. Overall, there are potential health benefits of blue space, primarily mental health and the promotion of physical activity. However, better methodological approaches, sampling strategies and documented procedures, including process evaluations, are required to advance our knowledge on the topic (Gascon *et al*., 2017). A systematic review completed as part of the NEAR Health project examined “blue therapy”, or the benefits of health-based interventions in blue space, and suggests that blue space can have a direct benefit for health, especially mental health and psycho-social wellbeing (Britton *et al*., 2018). Although it is recognised that experiences of engaging with and immersion in water influence our sense of wellbeing and self-connection (Straughan, 2012; Throsby, 2013; Peters and Anderson, 2014; Brown and Humberstone, 2015; Foley, 2015; Brown and Peters, 2018; Strandvad, 2018), the concept has only recently emerged in the literature and, to date, studies have highlighted more knowledge gaps than understandings. These include (1) the need to consider and assess ease of access, or indeed barriers to access (Britton *et al*., 2018); (2) actual use and type of uses in, on and around blue spaces (Wyles *et al.*, 2016; White *et al.*, 2016); and (3) residential history, and variations in blue space over time (Gascon *et al*., 2017), especially given the high seasonal variability associated with use of blue space (Paloniemi *et al.*, 2018). There is growing recognition of the benefits of blue space for health and wellbeing. However, research on relationships between exposure and access to, and use of, blue spaces and health is less well established than that conducted on relationships between green spaces and health.

Specific interest in blue space has grown alongside recognition of the need for greater protection and adaptation in response to climate change (e.g. flood control and storm surge responses) (Karmanov and Hamel, 2008; Steinwader *et al*., 2008). Research in Finland emphasises “fair blue urbanism” and the need to consider the sociodemographics of those who access and use blue space (Assmuth *et al*., 2017). A study in the UK found that the health benefits of blue space increased in lower socioeconomic areas (Wheeler *et al.*, 2015). Unwanted trade-offs, such as the risk of increasing socioeconomic inequalities when developing blue space areas (e.g. high property value of waterfront areas), cannot be ignored (Paloniemi *et al.*, 2018; Pitt, 2018). The literature also highlights that proximity to blue space does not necessarily equate with access to or use of that space and there is a “need to combine factual and perceived accessibility” (Paloniemi *et al*., 2018, p. 366).

2.3.1 Blue space in Ireland

To date, studies of blue space in Ireland are very limited, with a few exceptions, such as therapeutic landscape geographer Ronan Foley's work (2011, 2015) on the health and wellbeing benefits of holy wells and open water swimming, and Dempsey *et al*. (2018), who found that coastal blue spaces are associated with positive mental health effects in older adults. In Ireland, there is great potential for the use of blue space for public health benefit, with an abundance of blue space resources. The country has over 70,000 km of river channels, 12,000 lakes, 850 km^2 of estuaries and 13,000 km^2 of coastal waters, and Ireland's marine environment is one of the largest in the EU (EPA, 2018). Studies in the UK have shown that perceived biodiversity of marine wildlife is positively associated with restorative potential (White *et al.*, 2017); this is a finding that has implications for Ireland, which is home to a rich diversity of marine life and some of the most important breeding grounds for seabirds in Europe. However, the health of Ireland's coastal and inland waterways has experienced a decline in recent years (EPA, 2018). With the recent establishment of Waterways Ireland, there is increasing interest in encouraging public access to and use of inland waterways, an ecosystem under threat from increasing degradation (EPA, 2018). It is notable that the quality of water in canals remains very high (EPA, 2019).

Risk-averse narratives and negative framings and representations of blue space settings, environments and uses dominate media and public discourse (Peters and Anderson, 2016; IWS, 2018). A culture of political lack of interest and under-appreciation of our aquatic and marine resources has persisted in Ireland since the founding of the nation state (de Courcy Ireland, 1981; Britton, 2012). As an *Irish Times* article reported, there is a "chronic under-appreciation for our coastline in this country" (Kelleher, 2017). However, the recent proliferation of blue space-related publications (e.g. peer-reviewed journal articles, autobiographies, memoirs, guides, blogs, press), in particular relating to and documenting experiences of the sea and the increasing uptake of "wild swimming", especially among women (Smolander *et al*., 2004; Throsby, 2013; Foley, 2015; Fitzmaurice, 2017; Heminsley, 2017; Landreth, 2017), suggests a potential cultural shift in how Irish people (as a society) engage with blue space. A 2017 online poll of 7147 people in Ireland showed that a majority stated they would swim in the sea that summer (*The Journal*, 2017). There is high recreational value and use associated with blue space (Curtis and Hynes, 2017), and the impact of recreational activity on health and wellbeing needs careful attention (Völker and Kistemann, 2011; Britton *et al.*, 2018). However, the non-monetary values of recreation activities based around blue space are often neglected (e.g. social, psychological and spiritual dimensions of health and wellbeing). Furthermore, the mechanisms for engagement – where, how and why people use blue space – are poorly understood.

Despite the recent proliferation of water sports and blue space interventions, not only in Ireland but indeed globally (Hynes *et al.*, 2018), water environments remain a paradox as places of loss as well as healing. For example, the number of drownings each year in Irish waters is almost on a par with the number of road deaths, yet relatively little is invested in public water safety education and awareness compared with road safety (IWS, 2018). Strong associations with death persist, with one-third to more than half of all drownings in Ireland being the result of suicide. Many of the drownings occur in relation to leisure activities (IWS, 2018). Another poorly considered factor or force within the literature and public and political discourses is the potential influence of Ireland's historical disconnect from the marine environment (Britton, 2012) and the recent (re)emergence of an aquatic leisure culture (Foley, 2015; Britton, 2019); these are further areas to be investigated in order to better understand potential barriers and bridges for engaging with blue space.

It is evident that there is much overlap between blue and green spaces; however, it is argued that blue spaces offer very different sensory experiences and are used in different ways, with different outcomes and benefits that are often overlooked and remain poorly understood (Haeffner *et al*., 2017). Considering how blue space is often subsumed under the umbrella concept of green space or green infrastructure (Haeffner *et al*., 2017), it is recommended that the potential interactions of exposure to both blue and green space are considered (Gascon *et al.*, 2017). The need for processes that facilitate the integration of diverse perspectives, values and needs at regional and local levels is also highlighted. Key areas for

future research include improving understanding of the mechanisms through which both green and, in particular, blue spaces can improve public health promotion.

2.4 Green Space and Human Health

The UN SDGs recognise the links between green space and human health and explicitly set out to "provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities" by 2030. This is based on the recognition that healthy green spaces promote human health and wellbeing, and, as part of a wider environmental context, have the potential to prevent "upstream" problems, which is more efficient than dealing with the "downstream" consequences of ill health and wellbeing.

This is supported by a growing body of evidence that demonstrates associations (not "causation") between exposure to green spaces and a variety of human health outcomes. Positive associations have been demonstrated between residential green spaces and lower all-cause mortality and a reduction in the risk of cardiovascular disease (Gascon *et al.*, 2016), improved mental health outcomes and increased feelings of relaxation and restoration (Hartig *et al*., 2014; van den Berg *et al*., 2015), and increased positive pregnancy and birth outcomes (James *et al*., 2016). Exposure to and use of green spaces is associated with higher rates of physical activity (Hartig *et al*., 2014; Lachowycz and Jones, 2014), which in turn has been shown to be linked to a range of health outcomes, including improved cardiovascular health, mental health and neurocognitive development (Owen *et al.*, 2010). The evaluation of green space effects further indicates positive associations with reduced risk of being overweight, reduced rates of obesity (Maas *et al*., 2008; Coombes, 2010; Lachowycz and Jones., 2011; Dadvand *et al*., 2014) and reduced rates of type 2 diabetes (Astell-Burt *et al.*, 2014; Bodicoat *et al*., 2014). Although associations between green spaces and cancer, musculoskeletal health and allergies are less clear (Lovell, 2016a,b), a causal relationship has been suggested between exposure to natural spaces, especially microbial diversity, and the maintenance of a healthy immune system and reduction in certain allergic and respiratory diseases such as asthma (Rook, 2013; Sandifer *et al.*, 2015). However, it needs to be considered that associations between human health and green spaces tend to vary with socioeconomic status, age, gender and ethnicity.

In an urban context, it has been demonstrated that green spaces can positively affect social and psychological wellbeing and reduce exposure to noise (WHO, 2010) as well as reduce air pollution and urban heat (Kuo *et al*., 2015). Furthermore, regular green space exposure in urban settings has been shown to have a positive association with attention, mood and physical activity, and negative associations with mortality, heart rate and violence (Kondo *et al*., 2018). Although urban green spaces can be associated with health hazards – e.g. increased exposure to allergenic pollen, infections transmitted by vectors such as ticks and risk of injuries – these can be minimised or eliminated through proper planning and maintenance (Lõhmus and Balbus, 2015).

Overall, the role that type and quality of green spaces, perceived attractiveness and accessibility, and level of biodiversity play in promoting human health is increasingly being considered. The perceived biodiversity of green spaces has been found to be associated with better human health (Lovell *et al.*, 2014). For example, people in the UK who live in areas with more grassland and broadleaf woodland have been found to be more likely to report better general health (Wheeler *et al.*, 2015), and improved access to woodland near deprived urban communities in Scotland was found to increase the use of green space and activity levels, contributing to improvements in perceived quality of life (Thompson *et al.*, 2013). Finally, green space can play an important role in promoting social interactions, in neighbourhood quality of life and in encouraging a sense of community (Kim and Kaplan, 2004; Douglas *et al.*, 2018) as well as in human health (Lengen and Kistemann, 2012). However, despite the evidence that green spaces provide vital health functions as well as environmental services, and facilitate activity and promote better health, availability of and access to green spaces tend to vary with socioeconomic status, age, gender and ethnicity, thus creating inequality (Marmot, 2013).

When it comes to the planning and design of green spaces and access to these spaces, positive impacts of green spaces on a respondent's health and wellbeing as a result of living in close proximity to

green spaces have been reported (Lange *et al*., 2008; Alcock *et al*., 2015; Finlay *et al*., 2015; Madureira *et al*., 2015; Triguero-Mas *et al*., 2015); however, there is no definitive guidance on recommended area and proximity. Measures of proximity vary greatly in research, often dependent on the study aims. Research from Norway found that recreational green areas further than 500 m from residents' homes were associated with a decrease in doctor visits by 56% (Koppen *et al*., 2014). Fuertes *et al*. (2014; Germany) looked at greenness in a 500 m radius around the home in terms of assessing links between greenness and allergies, whereas Cusack *et al*. (2017) looked at a 250 m radius in relation to greenness impacts on birth outcomes in Texas and James *et al*. (2016) determined that American women living in areas of high cumulative average greenness in the 250 m around their home had a 12% lower rate of all-cause non-accidental mortality.

The EEA recommends that people have access to green space within a 15-min walking distance (Stanners and Bourdeau, 1995), and ANGSt recommends that urban populations have an accessible green space no more than 300 m from their home (Barbosa *et al.*, 2007). The distance of 300 m to any green space over 5000 m^2 was used as an indicator by the EU, whereas the primary indicator recommended by WHO is an accessibility index – a green space (0.5 ha, or 1.0 ha) within 300 m. In terms of the amount of green space available, at least 9 m^2 per person of accessible open green space is recommended by WHO; however, this varies depending on the size of the city, number of inhabitants and where boundaries are drawn (Dzhambov and Dimitova, 2014).

2.4.1 Green space in Ireland

Research on environment and health-related topics in Ireland previously focused on improving environmental issues that might negatively impact human health, such as water or air pollution (e.g. Cormican *et al*., 2012). Recent years, however, have seen increased recognition of the need for interdisciplinary research on the benefits for human health and wellbeing from engagement with natural environments (Garavan *et al*., 2010). In 2011 a pilot project in County Donegal assessed benefits from nature in terms of mental wellbeing and physical activity (Stirrat *et al*., 2011). Although this project did not consider the use of specific green spaces, participants reported perceived improvements in wellbeing as a result of, *inter alia*, contact with nature (Stirrat *et al*., 2011). *Our Sustainable Future – A Framework for Sustainable Development for Ireland* recognised the role of green infrastructure and its importance for human health and wellbeing and includes commitments to implement green infrastructure through the Irish planning system (DECLG, 2012). In 2015, the Planning Policy Statement was published (DECLG, 2015), which set out 10 strategic principles to inform planning policy, including the recognition that biodiversity and landscape contribute to the quality of life of sustainable communities. The statement specifies as further principles the need to safeguard environmental quality, sustain communities and make walking and cycling more attractive, which can be achieved through the provision of green spaces and green infrastructure. The current *Project Ireland 2040 – National Planning Framework* (DHPLG, 2019) further builds on these principles, with a focus on ensuring "the creation of attractive, liveable, well designed, high quality urban places that are home to diverse and integrated communities that enjoy a high quality of life and well-being". The framework further recognises the need to promote healthy communities and the influence of place on people's quality of life. It notes the need to encourage increased walking and cycling accessibility to both existing and proposed developments; it also promotes the investment in activity-based tourism and recreation, which includes the creation and maintenance of greenways, and notes the need for integration of physical activity facilities for all age groups. Overall, the framework recommends that an integrated planning approach for green infrastructure and consideration of ecosystem services are incorporated in land use planning.

Based on the recognition that inter-, multi- and transdisciplinary research is needed in Ireland, the EPA, under its Research Programme 2014–2020, funded a project on the health and wellbeing benefits from biodiversity and green infrastructure in Ireland. This project by Carlin *et al*. (2016) was the first study in Ireland to connect perceptions and values of key decision-makers in Ireland regarding green spaces, nature and health. Furthermore, it identified access, lack of awareness and attitudinal blocks as barriers that prevent people from connecting and

engaging with nature (Carlin *et al*., 2016). Following the findings of this study, the EPA and HSE put out a joint funding call to support the implementation of the *EPA Strategic Plan 2016–2020 – Our Environment, Our Wellbeing* (EPA, 2016) and *Healthy Ireland*,[7] the national framework for action to improve the health and wellbeing of the people of Ireland, which resulted in two related research projects: NEAR Health and EcoHealth. The NEAR Health project connects people with health-enabling places and blue and green nature spaces. To do so it collaborates with communities to co-create and/or assess inclusive nature-based solutions that promote and restore health and wellbeing, helping people value and care for a healthy environment. The EcoHealth project provides an evidence base for understanding the health benefits from high-quality green space within an ecosystem approach framework. By addressing the concepts of healthy places, health-promoting environments and "green infrastructure", the project aims to inform policy and practice for enhancing ecosystem benefits for health across urban and rural space. Some of this research is still ongoing, but it shows that there is growing awareness that the benefits from green spaces are being recognised in Ireland.

2.5 Nature and Health in Ireland

In Ireland, there is a growing recognition of the importance of green spaces for health and wellbeing. The fact that the environment and human health are inextricably linked is recognised in *Healthy Ireland* and the EPA's Strategic Plan 2016–2020. The HSE's (2011) Health Promotion Strategic Framework recommended a salutogenic model to reorient health and other public services away from managing individual responses to disease and ill-health to *"*enable and empower communities and individuals to have greater influence over factors that affect their health". The connections between a high-quality environment, a healthy society and the economy are further emphasised by the *Healthy Ireland* Framework for action. The *Healthy Ireland* Outcomes Framework is being developed under Theme 6, Action 6.1, of *Healthy Ireland* (Department of Health, 2017) for the purpose of monitoring the achievement of the goals of *Healthy Ireland* related to health and wellbeing, associated lifestyle-related risks and the broader determinants of health. The proposed domains and related indicators of outcomes for the framework are social determinants of health (including socioeconomic factors, such as rate of consistent poverty and income inequality, and environmental factors, such as air and water quality), health status (including prevalence of lifestyle and behavioural risks, and uptake of preventive measures, such as screening and immunisation) and health outcomes (including morbidity, mortality and wellbeing factors). A strong information infrastructure to support, develop and maintain the high-quality data resources is central to the outcomes framework.

2.6 Summary

With UN SDGs and the Right to Health (International Covenant on Economic, Social and Cultural Rights – UN General Assembly, 1966; Universal Declaration of Human Rights – UN General Assembly, 1948) in mind, planners, policymakers, practitioners and researchers have a sustainability and equality duty of care to move away from a reductionist, top-down approach to blue/green spaces to a holistic, complex understanding of the interconnected context of blue/green spaces for health outcomes (UN General Assembly, 1948; UN General Assembly, 1966; UN General Assembly, 2015). There is an obligation to think beyond the discrete influence of particular contextual factors and to consider the connectedness of those factors. Access to blue/green spaces is a question of analysing interdependencies and patterns of system behaviours. Individuals have a right to collective thinking from policymakers, decision-makers, actors and stakeholders within the health and environmental systems. An example of this in blue/green spaces is the prioritisation of integrated health outcomes, where coordinated and strategic efforts are being imposed to transform existing health service structures and foster emergent interorganisational and cross-sector collaborations across the health and environmental systems. Having communities of people understand the blue/green space interdependencies affecting their health may ensure that they are vocal in communicating and questioning the role of these interdependencies in planning, housing, biodiversity, etc., as there is recognition that no one blue/green solution is necessarily the "right" solution. Instead,

7 *Healthy Ireland*: http://www.healthyireland.ie (accessed 6 December 2018).

the diversity and heterogeneity of blue/green spaces demands fairness and equality for the collective and individual good. Faced with a growing range of health and social problems, the challenge for practitioners, policymakers and decision-makers now lies in identifying sustainable opportunities to integrate nature and human health without causing further inequality.

3 Data Discovery and Analysis

3.1 Evidence Bases

The three evidence bases used in this project to assess wellbeing were socioeconomic, environment and health data. The term “socioeconomic” refers to the meeting point between economic and social factors affecting the lifestyle of an individual. Datasets of interest in this category are those that relate to the social and economic status of citizens by measuring income levels, deprivation, poverty and living standards. Others may focus on quality of life, cost of living or income disparity. Environmental data include blue and green space datasets and water quality datasets. The blue space datasets relate to water bodies (rivers, streams, canals, lakes and sea) and the green space datasets refer to green areas (e.g. parks, woodlands, forests and grasslands). There are a number of health portals providing useful health-related data; however, access to many of the datasets is restricted and they cannot be accessed by anyone outside the health service on account of data protection laws. Hospital in-patient data (HIPE) are provided openly in the form of PDF reports published by the HSE on a regular basis, but these data are of limited use, as they do not relate to any specific geographical area and can refer to individual patients who have multiple admissions. However, they can possibly be used for verification purposes. The Computerised Infectious Disease Reporting (CIDR) database is an important source of information to the health service compiled by the Health Protection Surveillance Centre (HPSC). Some of the data it provides are listed in the SHEER Wellbeing Data Discovery Report.

3.2 Data Search Keywords and Phrases

In the data search process for socioeconomic data, the following keywords and phrases were used: poverty index; income disparity; income index; deprivation index or report; living standard index; quality of life datasets or reports; socioeconomic index or datasets; employment datasets; cost of living datasets; wellbeing database or datasets; and air quality database or datasets.

The following search phrases were used to search for environmental datasets: blue and green space database or datasets; blue space data or reports; green space data or reports; parks and forests; environmental health datasets; wellbeing reports; child health reports; old people health; environment and mental health; quality of life reports; verocytotoxigenic *Escherichia coli* (VTEC) cases or report; and *E. coli* cases or reports.

To capture as many health data as possible, a wide range of keywords and phrases were used, and a wide range of themes relating to health were included. Many search words captured environmental data instead of health data because most health data are not open to search engines because of restrictions on sharing with unauthorised persons. The following search words and phrases were used: health data in Ireland; obesity data; health benefits of environment; *E. coli* cases and infections; *E. coli* outbreak report; *Cryptosporidium* cases and infections; *Cryptosporidium* outbreak report; The Irish Longitudinal Study on Ageing (TILDA); NEAR Health – blue and green spaces Ireland; health repositories and databases in Ireland; wellbeing index or reports; environment pollution; air quality index; heavy mental pollution; health impact of blue green spaces; and health benefits of green space in Ireland.

3.3 Metadata

The data discovery process compiled metadata for all datasets. The Open Data Technical Framework’s definition of metadata was used (Department of Public Expenditure and Reform, 2018). This states that, to help realise the benefits of open data (and big data), precise descriptors of datasets are needed to help in the identification, location and retrieval of online resources by data users. These descriptors are commonly known as “metadata”. Metadata are the summary information describing the data, including the availability, nature and constituents of the data. They provide context about the data that helps users understand their meaning, such as:

- What is the dataset called?
- What is the subject matter?

- Where can I locate the dataset?
- When was it produced and last updated?
- From what sources was the information compiled?
- Are there any restrictions on their use?

The metadata for all three dataset categories (socioeconomic, environmental and health) included source, accessibility, data collection methodology and compilation adopted by the data owner (researcher/ author) and the data format. It also described the scope or coverage (aggregation levels of data) and possible usability and download obligation where known.

3.3.1 Socioeconomic data

The majority of datasets in this category came from the Irish Social Science Data Archive (ISSDA) based at University College Dublin (UCD), the Central Statistics Office (CSO) and the CSO in collaboration with Ordnance Survey Ireland (OSi). A few of the datasets were collected from the Economic and Social Research Institute (ESRI), TILDA, Growing Up in Ireland (GUI) and the Department of Health.

The CSO datasets were the most accessible and most useful datasets in this category, being open data compiled mainly in tables populated with data from field surveys later processed into comma-separated values (CSV) format. However, they were not spatial datasets, and the dates of update were not available for some, although the majority had a date of first upload. Most CSO datasets cover national areas (NAs) which can be disaggregated into regional areas (RAs), county levels, electoral districts (EDs) or small areas (SAs). The usability level (1 = fully usable, 2 = fairly usable, 3 = to be decided, 4 = unlikely to be usable, 5 = unusable) of most of these datasets is estimated to be 2 (fairly usable) because they can be subjected to further computational, mathematic or statistical analysis. Some are rated 3 (to be decided) because more information is needed to decide whether or not they are relevant and can be manipulated mathematically. Categorising dataset “type” was carried out by assigning a description of the nature of the dataset. For example, socioeconomic data relate to both social and economic factors; socio-health describes social data relating to health issues and socio-safety describes social data relating to crime issues.

The data obtained from CSO/OSi sources are mainly socioeconomic datasets with CC-BY attribution (Open Data) presented in tabular and map compilations of file formats XLS, SHP, KML and JSON. Many cover the NA disaggregatable LAs, EDs or SAs and others cover RAs; a few cover just the SAs, Gaeltacht area and EDs. About half of the datasets from this CSO/Osi source have a usability rating of 1 (fully usable), whereas the remainder are considered to be 2 (fairly usable). The download obligation is considered applicable to about half of the data whereas the remaining half does not require a download obligation. The datasets from UCD/ISSDA are socioeconomic datasets relating to health and, as such, some are restricted in terms of accessibility. These datasets were obtained mostly from one-off studies. In some cases, such as for TILDA and GUI, these studies have been repeated in various waves, providing a longitudinal picture at the national level.

3.3.2 Environmental data

The majority of the environmental data discovered come from the Irish EPA. These files include data on drinking water quality for the various counties in Ireland. The format of the files is XLSX, XLS and CSV and that results in a usability rating estimation of 1 (fully usable), as they can be analysed further in a machine-readable format. They are open to the public and can be disaggregated to local authorities (LAs). However, there are some accompanying PDF reports on drinking water from the EPA that might provide ideas on decoding heading names on the XLSX files or point to other useful sources of raw data.

The aim of including these files is that they may provide a useful link to more raw datasets or to organisations/agencies that would be in a position to provide needed raw data. Most drinking water quality datasets do not contain latitude and longitude values; however, many bathing water bodies, e.g. lakes and rivers, contain geospatial values and can be mapped to locations. These reports include some health-related environmental data.

The data.gov.ie platform, via catchments.ie, provides datasets on bathing water compliance, transitional water quality, coastal water quality, lake and marine water quality, (Tellus) geochemistry – stream water, parks (e.g. parks in Galway city, other public and community parks, national parks and points of interest)

and bathing water locations around Ireland. These files are generally in XLSX format, covering in many cases the NA geographical location, with some reduced to LA level. Their usability is generally estimated to be 1 (fully usable) and 2 (fairly usable) whereas a few PDF reports are estimated to be 4 (unlikely to be usable), meaning that it could not be decided what level of usefulness they may offer. Most of the blue and green data obtained from these sources provide geospatial values, which means they have formats such as Geojson, shapefile, ArcGIS, ESRI or JSON. There are a few other environmental datasets from each of the following sources:

- Irish Water: providing data on water quality;
- EPAHydroNet: providing data on blue space;
- beaches.ie and Cleancoastassist.org: providing data on condition of beaches – quality and care on voluntary bases;
- catchments.ie: providing data on bathing waters and on rivers, lakes and coastal waters in general;
- gis.epa.ie: providing health-related data – environment and wellbeing in a geospatial format.

3.3.3 Health data

The majority of available health data are provided by the CSO and, because they are anonymised data, there is no restriction placed on accessibility. This includes self-reported health data obtained from the census, which are available at the SA level, the lowest level possible without breaching data protection protocols. There are files on self-reported longstanding illnesses and other files provide data on deaths occurring by gender, cause of death, age at death and year. The Irish Health Survey reports on longstanding health problems by overnight and day-patient admissions to hospital of persons aged 15 and over, compiled by region, per year. The files are recent data files, with the first upload time in 2016 through to 2018, covering the NAs. Another group of health-related files were obtained from the HPSC. Many of these are PDF reports on specific infectious diseases, for example the *Epidemiology of Verotoxigenic E. coli O157 in Ireland* publication from 1999 to 2016 (various files) (HPSC, no date). However, it is only a webpage (html) report that has been produced annually since 1999 covering the whole of Ireland (NA). The TILDA database is provided by Trinity College, Dublin. Typical examples of reports from this source include *Walking for 150 minutes per week associated with improved wellbeing in over-50s* and *Walking to wellbeing*. They are html presentation on webpages and are from one-off studies also covering the NA.

3.4 Specific Uses of Data

3.4.1 Socioeconomic data

The datasets were used to investigate the potential impact of the use of blue/green spaces on health outcomes. Factors such as income, deprivation, crime, safety and education may influence the access to and use of blue/green spaces.

3.4.2 Environmental data

Environmental data provide information on blue/green spaces and drinking and bathing water quality, including contaminants such as *E. coli*, VTEC, *Clostridium perfringens*, enterococci and coliform bacteria.

3.4.3 Health data

The health datasets contain information on the health status. The potential to investigate the impact of environmental and socioeconomic factors on health outcomes was examined.

3.5 Typical Data and Database Challenges

3.5.1 Lack of suitability of purpose

Many of the datasets examined were not suitable for the purposes of this project. For example, datasets on crime and safety did not cover the relevant geographical areas or the relevant years and hence could not be integrated with other datasets. Apart from CSO data, many of the datasets from other sources are presented as PDF files only, which are of low usability in terms of data. PDF files are not suitable for further statistical analysis. However, they could be used in the discovery of the raw data. Further challenges were presented by the lack of geo-locations using latitude and longitude values, which reduces the spatial accuracy.

3.5.2 Lack of access to health-related data for research purposes

Although health data are often available internally to the health services, it can be difficult to access them for research purposes. The health services generally do not have the resources for anonymisation of health data and cannot share many data because of patient confidentiality and privacy concerns.

3.5.3 Data privacy challenges

Data protection and privacy rules restrict the sharing of personal data. Data privacy measures have been strengthened by the introduction of the General Data Protection Regulation (GDPR). In particular, health-related data are considered to be in the special category of data that must be protected from falling into the hands of unauthorised users. Although legislation allows for properly anonymised and/or pseudonymised data, a reluctance to release health-related datasets to other users was observed. The GDPR provides irreversible pseudonymisation of data, which involves the removal of any personally identifiable elements (e.g. names, date of birth, address, DNA samples and results) from a dataset as a safeguard to achieve data minimisation for privacy purposes. It provides additional protection when determining the compatibility of a new purpose with the original purpose as a way to achieve the minimisation of health data for scientific research purposes. At present there is no standard agreed methodology of anonymisation and pseudonymisation of data to adequately protect data (Donohue, 2018; Lyons, 2018).

3.5.4 Data standards within the health service

Data sharing within the Irish health services can be problematic on account of limited resources, the lack of data standards that facilitate the interoperability of the various systems and the need for a governance framework that allows for the use of health data in line with best practice in data protection (Donohue, 2018).

3.5.5 Geographical data issues

Most drinking water quality datasets do not contain latitude and longitude values; however, all designated bathing water bodies do and they can be mapped. Although this category of data does not present accessibility challenges, owners request users to complete online application forms in order to be granted permission to download the required files. There are many files with dates of the initial file upload provided, as well as the date of update, but many data files are also from one-off studies. About half of the files cover LAs and some RAs, while others cover NAs in terms of geographical coverage. Immediate observations from the data discovery task reveal that there may be gaps in the data. For example, there may not be data for *E. coli* contamination for a given location and socioeconomic data for the same location and time period. Unlike the socioeconomic data category, which contains many health-related datasets and is hence restricted, environmental data are generally accessible by the public.

3.5.6 Access to low-level data

In some cases, it may be possible to gain access to the raw data used in these reports. For example, the GUI study or National Psychological Wellbeing and Distress Survey (NPWDS) and similar reports have their datasets held on the ISSDA website (http://www.ucd.ie/issda/data). Although a download service is not available online, it is available by formal application.

3.6 Data Process

The data process involves three frameworks to analyse, compare and contrast geographically aligned data.

3.6.1 Framework 1: discovery, capture and refinement of data

This is an iterative process involving multiple agencies and it is very much at the early stages of development in terms of clear linkages between socioeconomic, environmental and health data in Ireland. However, it should evolve over time as more granular data become available. Regularly collected data will lead to a much stronger longitudinal data flow. To facilitate the discovery, capture and refinement of data in the selected domains, realistic use cases were developed.

3.6.2 Framework 2: modelling and integration of data

This framework deals with complexity. It attempts to categorise all aspects of the potential data model under the following headings: availability, appropriateness, approachability and affordability. It is clear that there are significant gaps both in the process and in the available data and these are described in section 3.8.

3.6.3 Framework 3: data analysis

This framework provides the following 14 steps to analyse data using geographical references:

1. collection of the required data in tabular format and geographical format;
2. refining of the data, seeking to use the smallest geographical area possible while protecting anonymity;
3. creation of new data, looking for distances and coverage for geo-referenced data;
4. use of centroids where possible to reflect the midpoint of each geographical area;
5. identification of variables and developing a master file containing one row per area;
6. identification of the key variable to be explained by the other variables;
7. accounting for the use cases defined in framework 1, group variables for analysis;
8. initial calculation of the correlation between pairs of variables identified;
9. analysis of the results of the correlation, paying attention to the coefficients calculated by the model;
10. secondary analysis using regression analysis;
11. iterative regression analysis to isolate the variables of significance;
12. identification of the variables of significance;
13. reference of all variables not deemed to be of significance to gap analysis;
14. report on the outcome of the analysis.

3.7 Data Modelling

Because of the necessity of representing geographical objects and calculating different location-aware relationships and variables among them, a geographic information system (GIS) was used. This type of system is designed to capture, store, manipulate, analyse, manage and present all types of geographical data. These data are generally represented in one of two models: (1) a vector data model or (2) a raster data model.

The vector data model was deemed to be the most appropriate for use with the selected evidence bases. This model understands and represents the Earth's surface through discrete objects such as oceans, rivers, countries, buildings or streets, represented as lines, points and polygons. In this model, the boundaries for each feature are located over the Earth using a coordinate system, which uses variables to determine positions. Several coordinate systems exist as well as projection coordinate systems, which allow the two-dimensional representation of the Earth. Each feature contained in the vector model is mapped through a unique identifier recorded in an attributes table. This was combined with tabular data to analyse national, regional and local information using visualisation techniques.

The quality of data available in relation to health and the environment in Ireland is generally good. However, access to health data can be difficult because of data protection requirements and environmental data are often collected for specific purposes and/or not always granular enough for detailed local analysis (e.g. data are not provided at spatial geography that is linkable to other relevant datasets, i.e. census geographies) (MacCuirc, 2018). Public data in these areas are generally not well documented. The structures developed by the OSi and CSO in relation to SAs provide an excellent basis from which to work. It is recommended that public agencies in the areas of environment and health adopt these structures.

Ireland's Open Data Initiative has gone a long way in terms of opening up public data for use by all; however, some public agencies still have significant concerns in relation to data protection, in particular in relation to personal data. This restricts access and highlights the need to develop methodologies

for providing useful data in an aggregated way that complies fully with data protection rules.

In terms of providing reliable data for SAs, volume and consistency are crucial. Regarding volume, the Irish Census provides excellent data, as every household within each SA is surveyed. This is not easy to replicate for most health and environmental data. For example, to calculate the obesity level within a SA would be problematic, as a reasonable sample size would be required. Environmental data are somewhat easier, as regular sensor readings from sampling points already provide some useful information; however, it is likely that much more granular environmental data will emerge over the coming years as the Internet of Things continues to grow and citizen science and smart city and region initiatives continue to develop.

In Ireland, the Data Sharing and Governance Bill should provide a legislative basis for the sharing of public data at all levels. It is recommended that universal standards are developed to encourage the sharing of data between organisations and internally between departments. These standards should build upon and be consistent with existing national and international standards, legislation and directives, such as the INSPIRE Directive (2007/2/EC) and the Water Framework Directive (2000/60/EC). This requires certain technical considerations to be met but it also requires clarity in relation to what can be shared and who should have access to it.

3.8 Data Gap Analysis

The analysis of existing data allows for the identification of data gaps, i.e. to determine where data are not produced, available or analysed and identify processes by which this data gap can be addressed.

3.8.1 Consistent standards for compiling public data

Across the public service there appears to be a lack of consistency in terms of compiling public data. Ireland's Open Data Initiative tries to address this to some extent, as evidenced by the *Open Data Maturity in Europe – Report 2018*, which showed great progress in Ireland (Cecconi and Radu, 2018); however, in practice there appears to be some way to go in terms of developing standards for using data across the public service. For example, the frequency of updates for individual datasets appears to be an issue. For research purposes, a lack of longitudinal data prevents examination of cause and effect of individual initiatives (Lyons, 2018). Furthermore, there is a clear requirement for the sharing of base data in a machine-readable format for public projects.

The Irish Government's Open Data Initiative, led by the Department of Public Expenditure and Reform, has adopted the five-star data model proposed by the inventor of the World Wide Web, Sir Tim Berners-Lee (2012) (Table 3.1). This model could just as easily be adopted for other forms of public data.

3.8.2 Sharing data between agencies

A proper legislative basis for data sharing between agencies should allow it to take place in a safe and secure way.

3.8.3 Agreed geographical areas and regions across sectors

Regional data often differ in scope and geographical boundaries between agencies. In particular, health regions appear to be very different from all other types of region. A method of disaggregating data may provide a solution to this. The Health Atlas is a

Table 3.1. Description of the open data five-star model

Description of data availability and usability	Star rating
Data are available on the web – in any format but with open licence, e.g. image, PDF, scan	1 star
Data are structured, not a scanned image or PDF, e.g. Excel file	2 stars
Data are not a specific proprietary format, e.g. prepared as Csv rather than an Excel file	3 stars
The data use Uniform Resource Identifiers (URIs) as pointers to identify things and to enable users to point at things	4 stars
Link the data to other data to provide better context	5 stars

repository for some health data. The HSE is currently looking at ways in which it might be able to produce and release data for SAs that fully comply with data protection rules.

3.8.4 Integration and compilation of social data

The mixing of social data with public data could provide many benefits in terms of usage information for blue and green spaces. However, as a result of new GDPR regulations, many of the social media providers, such as Facebook and Instagram, have adopted a very cautious approach to the release of data for research purposes.

3.8.5 Granularity of data

Research into issues such as proximity to blue/green spaces requires hyperlocal data. To properly compare such data with health and environmental data, there is a clear need for access to equivalent data.

3.8.6 Calculating the centre of gravity of a small area

Small areas contain around 90 households. From a geographical point of view, this may mean that the centroid is not the same as the centre of population gravity. This may be possible to compile by using satellite data, aerial images and/or landcover maps.

3.8.7 Lack of standards in classifying specific blue/green spaces

Choosing which blue/green spaces are included in any study requires standards of classification, as different public, private and community-based agencies are responsible for providing public blue/green spaces. An example of the relative values of blue spaces emerged as a result of data analysis.

3.8.8 Local standards in classifying quality of specific blue/green spaces

Local standards are needed to accurately measure the quality of blue/green spaces. Ideally these would be internationally agreed. In terms of water quality and beaches, Ireland is already compliant with the EU Water Framework Directive (2000/60/EC) monitoring and the European Blue Flag and Green Coast standards are applied, which work very well.

3.8.9 Standards for the compilation of usage data

Standards are required to measure usage and benefits of blue/green spaces. This relates to social data, sensor data and survey data. This also applies to the association of facilities with specific blue/green spaces.

3.8.10 Lack of availability of localised water quality data

The relationship between water quality testing and water-related health issues, such as cryptosporidiosis and gastroenteritis, is clear. However, not all data are available in the public domain, e.g. although exceedance data are publicly available from the EPA, incidences of illness are not publicly available or easily available for research from the HSE.

3.8.11 Lack of accessibility to health-related data for research purposes

Although health data are often available to the health services in Ireland, it is very difficult to get access to them for research purposes. The health services are generally not given a budget for anonymisation of health data and cannot share them unless they are anonymised or pseudonymised, to comply with data protection protocols.

3.8.12 Data standards within the health service

Data sharing within the Irish health services is quite often problematic as a result of an absence of resources and data standards. Although these may exist at some levels, they are clearly not universal. There is perhaps a role for government policy in this regard.

3.8.13 Data access gaps

There are two main reasons why data may be unavailable. The most obvious one is that the data do not exist. The other one is that access to existing data is restricted, mainly for data protection reasons.

3.8.14 Availability

There is a gap in availability of data that can classify blue/green spaces in terms of quality and in terms of public awareness.

3.8.15 Appropriateness

There is a clear need to set up a system that will provide usage data for managed public blue/green spaces on an ongoing, longitudinal basis. These data do not currently exist. There is also a significant shortfall of reliable socioeconomic data at a granular level to improve understanding of facilities.

3.8.16 Approachability

The key data deficit relating to approachability is also usage data in terms of analysing which people use a specific public facility and how they get there.

3.8.17 Affordability

This mainly relates to sporting activities and could be included in the facilities data. The collection of such information may require a regular survey of organisations associated with blue/green spaces.

3.8.18 Data wrangling

Data wrangling is a new term used in data science to describe the process of getting different data sources into a format that can be used. The principal reasons observed for the reluctance to release data are data protection, commercial sensitivity, lack of resources to extract data in an agreed format and cautiousness. In many cases the way to deal with reluctance is to compromise in terms of what is being asked for or to work within the limitations that are imposed under the GDPR. For example, health data cannot be released with patients' names associated, but releasing the number of people diagnosed with lung cancer at a regional level should be possible.

The following sets out a proposed methodology for accessing health data:

1. Specify the data to be extracted.
2. Agree on the terms and conditions for release of the data.
3. Extract the required data in a format that complies with data protection rules.
4. Correlate the figures with other agencies.
5. Get approval for use of the data from those required to give it.
6. Agree on the release of the data.

3.9 Summary

This project assessed three Irish evidence bases: socioeconomic, environment and health data. Although the quality of available data in relation to health and the environment in Ireland is generally good, the project recognised issues, such as problematic access to health data and lack of granularity of environmental data, and identified clear data gaps. Aside from lacking data or level of detail, other common issues identified were a lack of suitability of purpose, lack of geographical data and data privacy rules restricting the sharing of personal data, in particular health data. The 2019 Data Sharing and Governance Act should provide solutions and a legislative basis for the sharing of public data at all levels, with universal standards to encourage the sharing of data between organisations and internally between government departments. The analysis of existing data allows for the identification of data gaps, to determine where data are not produced, available or analysed.

4 Access to Blue/Green Spaces and the Socioeconomic Determinants of Health and Wellbeing in Ireland[8]

4.1 Datasets Explored

More than 1000 datasets were searched and 261 were catalogued, and more than 100 maps were generated to examine relationships between access to blue/green spaces and health inequalities. All of these data are publicly available and compiled on an ongoing basis using consistent methodologies. This chapter first sets the context in terms of key definitions, data sources and health policy framework. Findings are then presented in terms of patterns between blue/green spaces, self-reported health and the Deprivation Index, nationally, regionally and locally.

4.2 Access to Blue/Green Spaces

For this project, "blue space" is defined as all visible, outdoor, natural or man-made surface waters with potential to improve human health and wellbeing. Examples of blue spaces include seas, coasts, rivers, lakes and ponds. "Green space" is defined as all terrestrial outdoor, natural or semi-natural surfaces or settings or features with potential to improve human health and wellbeing. Examples of green spaces include woods, meadows and parks.

The project used the CORINE (Co-ordinated Information on the Environment) Landcover Data[9] as a standard source of geo-spatial data for inland blue and green spaces across Europe and for mapping of the coastline OSi data were used (Figure 4.1). The Irish coastline is more than 3170 km long. There are over 70,000 km of rivers with 3192 river bodies (EPA, 2019). There are approximately 12,000 lakes, covering 1200 km^2. Transitional and coastal waters cover an area of over 14,000 km^2 (transitional 844 km^2 and coastal 13,325 km^2) (EPA, 2019). In Ireland, all land is currently either under private ownership (approx. 85%) or owned by the Irish Government or state agencies, and entry to land is at the discretion of the landowner. Therefore, this project focuses on CORINE landcover categories that are fully available to the public, i.e. <15% of urban green and amenity spaces (Figure 4.1), and excludes categories that are only partly available, e.g. wetlands and forests.

"Accessible spaces" implies their availability for the general public to use free of charge and without time restrictions (although some sites may be closed to the public overnight and there may be fees for parking a vehicle). Access to spaces also refers to the physical access to these spaces for public use, including the access to relevant equipment and clothing required for various uses, which may be limited by financial resources. A framework with operational measures that would enable further study of particular determinants of access to blue/green spaces across the lifecourse was developed (Appendix 1).

"Usage" refers to the repeated and multiple uses (including physical, recreational, conservation and cultural uses/purposes) of blue and green spaces, facilities and activities by individuals, groups and communities.

Three types of data were examined for this study: environmental, health and socioeconomic. The main data sources identified in this study were self-reported health statistics from the national census (CSO), the Pobal Deprivation Index, the CORINE Land Cover study carried out by the EPA on behalf of the EEA, and geo-data maps provided by OSi.

4.3 Findings

Figures 4.2, 4.3 and 4.4 show the distribution of urban green and sports spaces, self-reported health, and deprivation in three NUTS2 [Nomenclature of Territorial Units for Statistics as defined by Regulation (EC) No. 1059/2003] regions and counties, the local government administrative districts in Ireland and one city (Galway) (Figure 4.4).

Analysis of Ireland's three administrative regions provided a very clear picture of how environmental, health and socioeconomic data can align to demonstrate a regional disparity. The Pobal

8 Most of this chapter has been submitted in a report to the EEA (2020).

9 CORINE: http://www.epa.ie/soilandbiodiversity/soils/land/corine/ (accessed 6 December 2018).

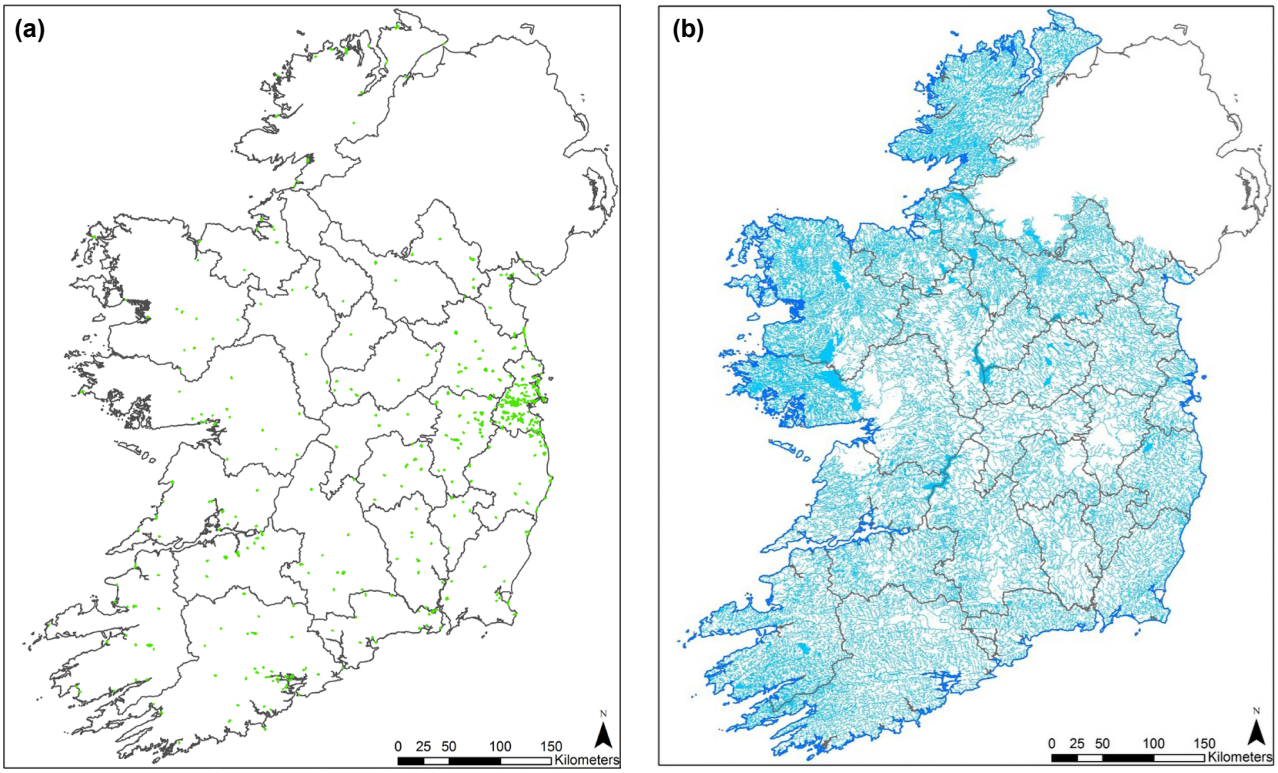

Figure 4.1. Access profile. (a) Green spaces (urban green and amenity spaces). (b) Blue spaces (coastline, rivers and lakes). Sources: CORINE (2012) and OSi (2017).

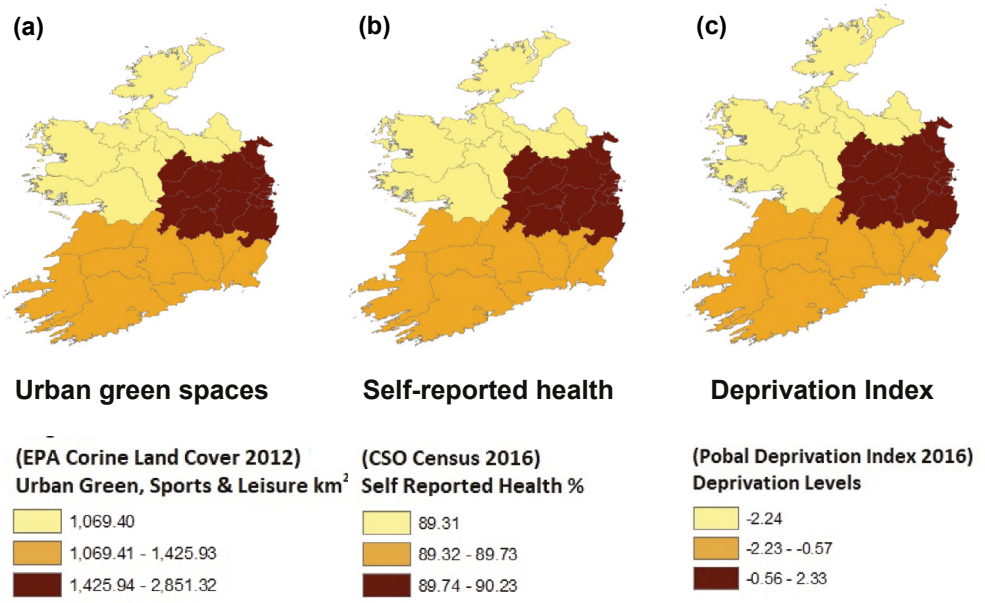

Figure 4.2. (a) Urban green spaces, (b) self-reported health and (c) Deprivation Index patterns by NUTS2 regions. Sources: EPA (2012), OpenStreetMap (2015), CSO (2017), Pobal (2016) and OSi (2017).

Deprivation Index for 2016 showed that the Northern and Western Regional Assembly (NWRA) was more deprived (–2.24) than either the Southern Regional Assembly (SRA) (–0.57) or the wealthiest (+2.33) Eastern and Midlands Regional Assembly (EMRA).

The self-reported health scores (CSO, 2017) for the regions mirrored these findings. The least healthy was the NWRA (89.31%); the SRA was healthier (89.73%) and the EMRA (90.23%) was the healthiest as well as the wealthiest. With regard to provision of blue/green

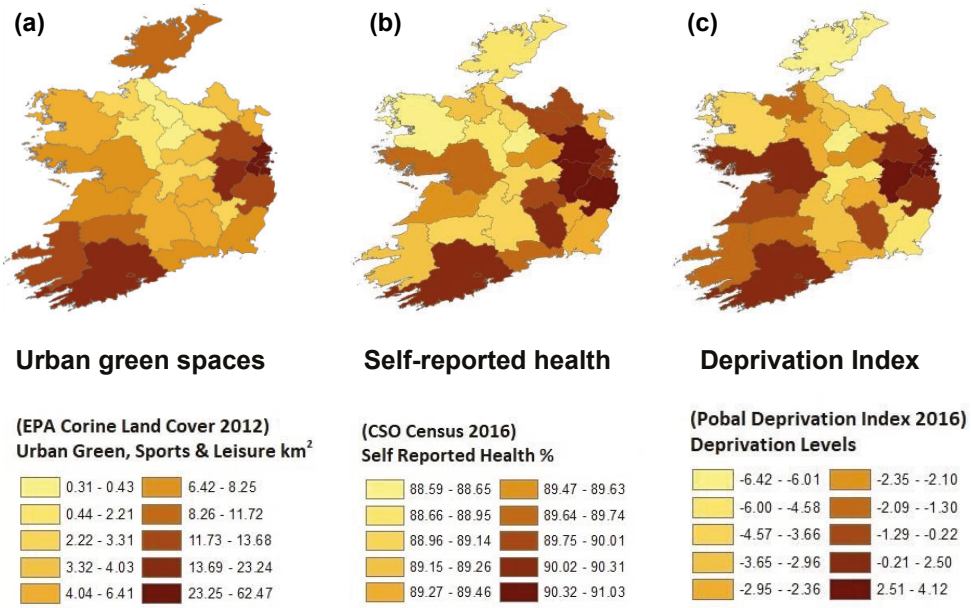

Figure 4.3. (a) Urban green spaces, (b) self-reported health and (c) Deprivation Index by county in Ireland. Sources: EPA (2012), OpenStreetMap (2015), CSO (2017), Pobal (2016) and OSi (2017).

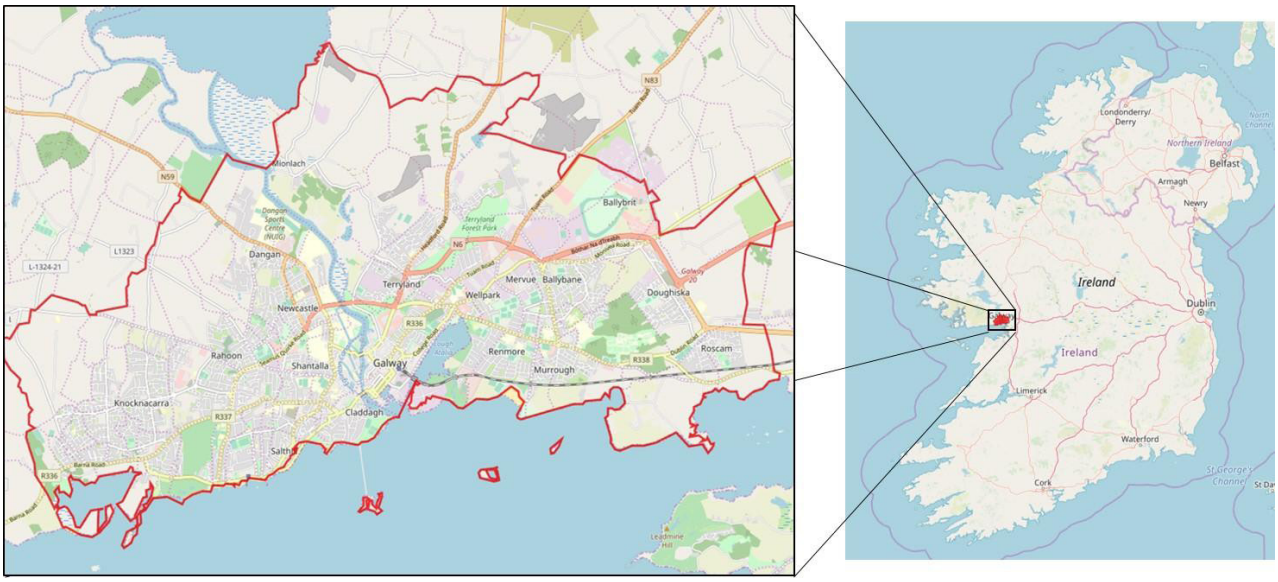

Figure 4.4. Location of Galway city on the west coast of Ireland showing Galway's position between Galway Bay to the south and Lough Corrib to the north. Source: OpenStreetMap.

spaces, the EMRA again showed better provision of facilities (2851 km²) than the SRA (1426 km²), with the NWRA again having the lowest urban green space area, at 1069 km². A similar pattern was observed for average age, population density, mains water connections, water quality and many other categories.

The findings suggest that there is a regional and urban/rural divide in Ireland in relation to blue/green spaces, health outcomes and their socioeconomic determinants. The EMRA (including Dublin city) has more blue/green spaces, higher rates of self-reported health and more relatively affluent areas than the other two regions. The SRA (including Cork city) is the middle-ranking region in all categories whereas the NWRA (including Galway city) is at the bottom end of the scale in all categories. The correlations for all classes of green- and blue-related land uses were calculated. The strongest correlation found at county level was 0.75 for sport and leisure space against the Deprivation Index.

Figure 4.5 shows the green space, self-reported health and Deprivation Index in Galway city. Galway city is an example of an urban area containing blue/green spaces. Although there is a very strong correlation between self-reported health and deprivation at all levels, it is not possible to accurately calculate the relationships to green spaces below county level without the availability of usage and usability figures.

Figure 4.6 shows the blue space area by ED in Galway city. It is not possible to accurately calculate the relationships to blue spaces below county level without the availability of usage and usability figures.

Usage figures for blue/green spaces are not yet readily available at regional and local levels. Surveys such as *Healthy Ireland*, GUI, TILDA and the Irish Sports Monitor provide some insight into specific types of usage. However, the lack of available data in this area is a major gap in terms of informing spatial planning and understanding for the allocation of resources to address inequalities. Of particular note, given the recent and growing interest in blue space activities for health and wellbeing in Ireland, and potential zoning of marine blue space under the forthcoming Marine Planning Framework for Ireland (DHPLG, 2018), is the need for usage data for blue space.

Another possible source of proxy usage data is the Irish Water Safety (IWS), which reports that the majority of accidental drownings occur in relation to leisure pursuits (IWS, 2015). There is a lack of

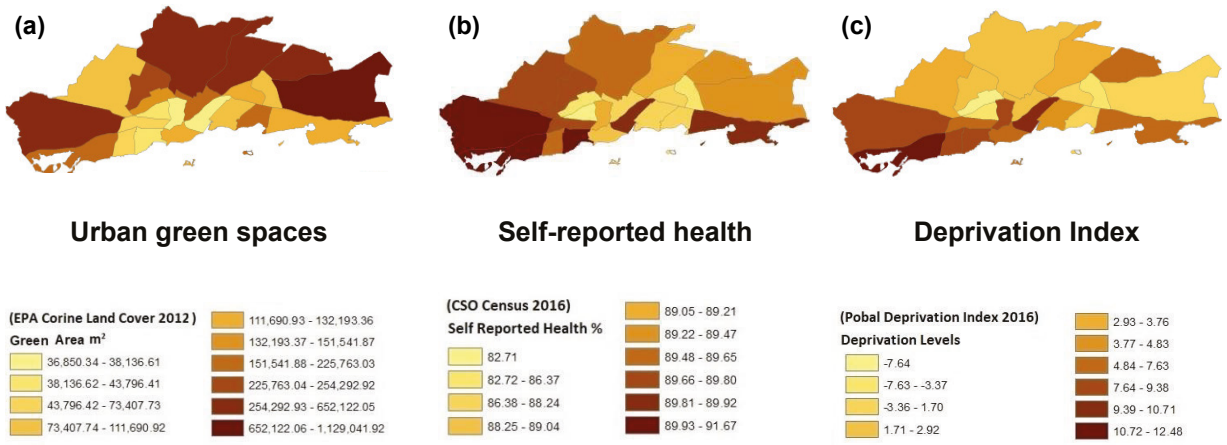

Figure 4.5. (a) Urban green spaces, (b) self-reported health and (c) Deprivation Index by electoral district in Galway city.[11] Sources: EPA (2012), OpenStreetMap (2015), CSO (2017), Pobal (2016) and OSi (2017).

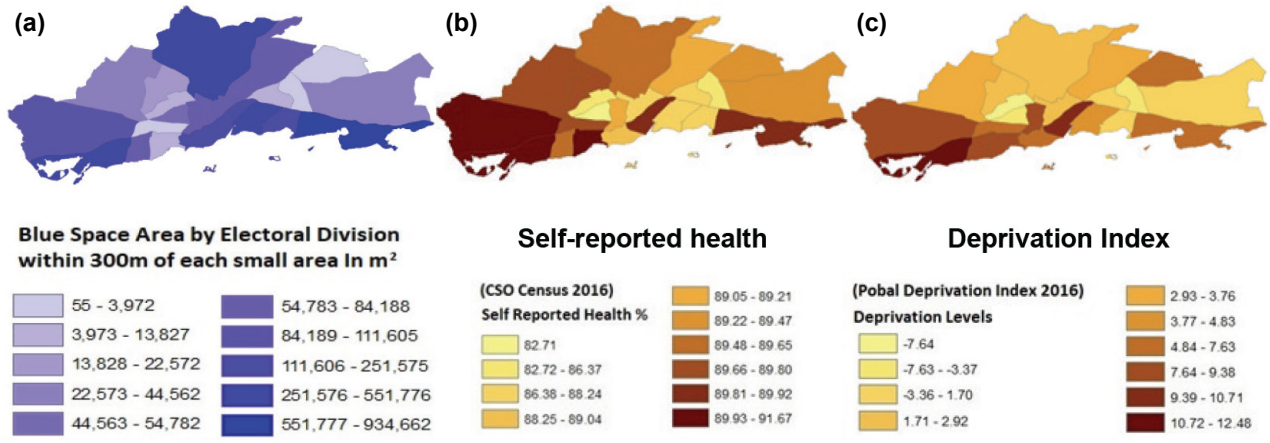

Figure 4.6. (a) Blue space area, (b) self-reported health and (c) Deprivation Index by electoral district in Galway city. Sources: EPA (2012), OpenStreetMap (2015), CSO (2017), Pobal (2016) and OSi (2017).

10 The EU and OECD definition of city: https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:City (accessed 6 December 2018).

uniformity on drowning incident reporting and the causes of a large proportion of incidents remain unknown. Rescue and accident prevention data on Irish beaches and waterways during the bathing season (June to September) highlight high usage of beaches and waterways in these areas, with 649 rescues, 29,682 incidents prevented and almost half a million accounts of advice given to the public in 2016 (IWS, 2016).

4.4 Discussion

4.4.1 Data issues and challenges

Data discovery was conducted based on the existing knowledge of the partners directly involved in the project, discussions with key stakeholders and desk research based on various keywords that were used to search for datasets based on the selected domains of blue/green spaces. Datasets were categorised under socioeconomic, environmental and health evidence bases, with some datasets relevant to multiple categories, such as environmental health and blue/green spaces or water quality. Environmental health datasets that aim to link health issues and environmental factors are relatively rare; only few, generally one-off, studies have been carried out in Ireland. This project identified websites that contain data relating to environmental health, and metadata for all the data discovered were extracted.

Environmental data are the most freely available, as they are subject to fewer data protection issues. Improvements in documentation and data dictionaries for environmental data are needed. Many health data are not freely available for research purposes; useful health data exist but they are difficult to access. There are clear data protection issues around health data, but these could be addressed by anonymisation techniques. There is also a requirement for wider availability of statistical health data at local and regional authority levels, as such data are not generally subject to data protection restrictions.

The Data Sharing and Governance Act 2019 (Number 5 of 2019) provides a legislative framework for the sharing of data between public bodies in Ireland. This includes publicly accessible written agreements between agencies. Commitment 6 of the Irish Open Government Partnership National Action Plan seeks to improve access to government services through technology. The Irish Government, through its Open Data strategy, is also committed to the following principles:

- encouraging the release of all appropriate high-value government data as open data by default;
- building a value-driven economy by making data publicly available and freely reusable, ensuring where possible a return on investment for the state;
- engaging with a broad community of stakeholders to promote and encourage use of open data.

The data required to answer specific research questions may not be available; either these data do not exist or access to data that do exist is restricted, usually for data protection reasons.

Lack of suitability for purpose

Many socioeconomic datasets were unsuitable. Apart from CSO data, many of the datasets from other sources are presented as PDF files, which are of low quality in terms of data and are not suitable for further computational or statistical analysis. Further problems relate to the presentation of data without reference to their geo-locations using latitude and longitude values, reducing the accuracy of using geographical locations.

Lack of accessibility to health-related data for research purposes

Although health data are often available internally to the health services in Ireland, it is very difficult to get access to them for research purposes. The health services are generally not given a budget for the anonymisation of health data and otherwise cannot release data in the context of data protection protocols.

Data privacy challenges

Data protection and privacy rules limit the sharing of personal data. Restrictions have become more stringent since the introduction of the GDPR. Despite the legal allowance provided to release properly anonymised and/or pseudonymised data, authorised bodies are reluctant to release health-related datasets to other users. The GDPR provides that there must be irreversible pseudonymisation of data, which involves the removal of any personally identifiable elements

(e.g. name, date of birth, address, DNA samples and results) from a dataset, which should provide an important safeguard to achieve data minimisation for privacy purposes. However, no standard acceptable methodology of anonymisation and pseudonymisation of data is available yet. Health officials are also reluctant to release health-related geographical data for fear of the identification of individual data subjects.

Data standards within the health service

Data sharing within the Irish health services is quite often problematic on account of an absence of resources and standards. Although these may exist at some levels, they are clearly not universal. There is a culture of caution relating to data protection and privacy that drives restrictive legislation, policy and practices, and limits the provision of open data, all of which in turn reinforces the culture of caution.

4.4.2 Usage data

Data relating to the multiple uses (including physical, recreational, conservation and cultural uses) of blue/green spaces, across the lifespan, in Ireland are piecemeal. There is also a lack of information on the types of blue/green spaces visited, frequency and duration of visits, and features and facilities available. Furthermore, there is a lack of information regarding the promotion of these spaces. There is no systematic process or reporting forum to capture, share and use this information. It is only with population-to-local level usage spatial data that the social and health inequalities that segments of society experience, and the social and community cohesion that other individuals and communities benefit from, can be understood and ultimately managed for in policies and practice.

Unlike in Ireland, the UK Monitoring Engagement with the Natural Environment (MENE) survey (carried out since 2009) includes questions on the volume of visits in the last week, type of place visited (specific and general information), mode of transport employed to reach the destination, activities undertaken, motivations for the visit, frequency of visit in the last 12 months, environmental attitudes and pro-environmental behaviours (NE, 2018).

With this information, park managers, planners, engineers, community groups and educators could help to deliver healthy sustainable communities and meet the requirements of *Healthy Ireland*, Ireland 2040 and other cross-sectoral plans. A previous study highlighted the need to better integrate policies and practices regarding health and nature (Carlin *et al*., 2016). This could be achieved if there was a cross-sectoral framework for blue/green spaces that linked with health, air quality, climate proofing, housing and other related issues.

4.4.3 Addressing inequalities in health and access to and use of blue/green spaces

Proportionate universalism (the resourcing and delivering of universal services at a scale and intensity proportionate to the degree of need) (Marmot *et al*., 2010) ensures that services are available to all, not only the most advantaged, and are able to respond to the level of need. The *Healthy Ireland* Outcomes Framework is being developed under Theme 6, Action 6.1, of *Healthy Ireland* for the purpose of monitoring the achievement of the goals of *Healthy Ireland* related to health and wellbeing, associated lifestyle-related risks and the broader determinants of health. The proposed domains and related indicators of outcomes for the framework are social determinants of health (including socioeconomic factors such as rate of consistent poverty and income inequality, and environmental factors such as air and water quality), health status (including prevalence of lifestyle and behavioural risks and uptake of preventative measures such as screening and immunisation) and health outcomes (including morbidity and mortality, and wellbeing factors). A strong information infrastructure to support, develop and maintain the high-quality data resources is central to this outcomes framework.

4.5 Summary

This project shows that there are connections between blue/green spaces and the socioeconomic determinants of health and wellbeing in Ireland. This project reviewed the various datasets available at national, regional and local levels, and identified potential relationships. However, although some relevant datasets are available at national, regional and local levels, there is a clear need for more socioeconomic data at regional and local levels recognising that blue/green spaces are nested

within adjacent and complementary systems, such as transport and food. It is blue/green spaces interconnected with other systems that generate spatial and environmental inequalities that are embedded within socioeconomic determinants of health and wellbeing in Ireland.

5 Blue/Green Spaces: System Dynamics

5.1 Introduction

This work focused on the complexity of mapping the key socioeconomic, environmental and health forces and patterns at work in relation to access to and use of blue/green spaces in Ireland. The aim was to map the overall system, i.e. the dynamics and complexities, in greater depth through data visualisation and modelling of the key forces and patterns currently at work.

A "system" is a set of elements, e.g. people, structures, organisational procedures, practices and roles, interconnected to produce its own pattern of behaviours and outcomes over time. Blue/green spaces for health and wellbeing outcomes are complex, emergent systems with a diversity of relationships, interactions and connections between individuals, groups, communities, facilities providers, governance and regulating stakeholders, e.g. LAs, the EPA, the HSE and the CSO.

5.2 Research Methodology

The SHEER Wellbeing case study is grounded in systems thinking and complexity science tailored to blue/green spaces in an Irish context. As a systems-based approach, the SHEER Wellbeing map highlights the socioeconomic dynamics that are foundational to a sustainable healthy environment, healthy population framework. The methodology adopts a group modelling, making extensive use of systemic stakeholder engagement to identify and map the feedback relationships between the socioeconomic, environmental, health and wellbeing system elements. It concentrates on the "complex social networks of individuals and groups linked through shared participation in the creation and delivery of the perceived quality of life" (Layton, 2015, pp. 303–305).

To create the systems map, this research employed a systems practice model (Ricigliano, 2012) integrated with stakeholder, organisational and behavioural science that "fills the gap between the promise of a systems approach for making social change and putting it into practice" (Omidyar Group, 2017, p. 2). Employing the adapted methodology set out by Omidyar Group (2017), an internal team generated the systems map together with key stakeholders and socioeconomic, environmental and health experts.

In stage 1, an extensive literature review that identified relevant forces that have been shown to influence people's use of blue/green spaces for their health and wellbeing was supplemented by the collection of primary data from key informant stakeholder interviews (KISIs) ($n = 27$), to identify and list their barriers and enablers to the access of blue/green spaces in Ireland. Primary data from NEAR Health stakeholder interviews complemented the SHEER Wellbeing KISIs. A total of 221 barriers and 118 enablers were identified. Stage 2 consisted of a multi-disciplinary team using paired comparison to generate barrier and enabler categories into 36 themes, 14 of which were positive (enabling). Causes and effects were analysed, and causal loops were created to build the overall systems map (Figure 5.1). Stage 3, an explanatory stage, analysed all the causes and effects and dynamic multi-causal relationships between all these perceived forces (barriers and enablers identified during stage 1). It also identified the central driving forces and entrenched patterns in the system. This resulted in the generation of a multi-causal blue/green spaces systems map, depicting the interactions between the socioeconomic, health, wellbeing and environmental elements that inhibit and/or enable access to blue/green spaces in Ireland (Figure 5.1).

Once the map was built, the narrative was refined and the map was reviewed with stakeholders and experts for feedback and verification, and relevant changes were made (Figure 5.1).

5.3 Findings

The resulting map (Figure 5.2) enables a visualisation of all the perceived dynamics currently at play in relation to the use of blue/green spaces for health and wellbeing in Ireland. It captures the interacting factors and incorporates diverse perspectives, experiences and structural issues. It captures the micro-individual variables, the macro organisational and structural elements together with their interactions. It identifies the complex, diverse dynamic interconnections between the forces. The map presents core forces

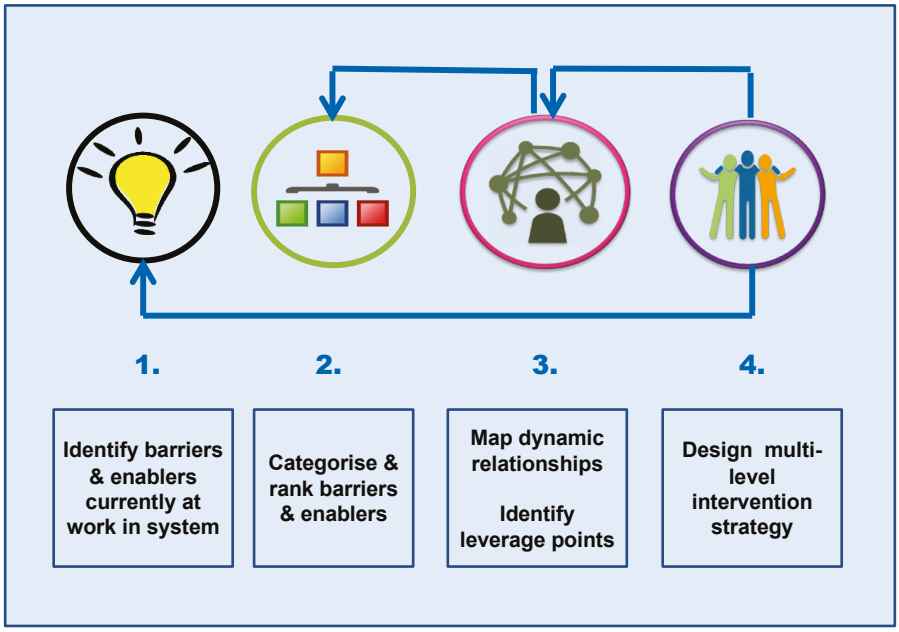

Figure 5.1. SHEER Wellbeing's social marketing systems framework.

that currently block (act as a barrier) or promote (act as enablers) health and wellbeing in the system. An example of an enabler is social and community cohesion, which, together with other enablers, forms a positive feedback or "virtuous" loop. Some of the barriers form negative feedback loops, for example risks and fears, which is an example of a "vicious loop".

The interconnected forces and factors identified in this systems map are:

- uses and values of blue/green spaces;
- social inequalities;
- social and community cohesion;
- risks and fears;
- participation and engagement;
- biodiversity quality and value;
- governance;
- data and knowledge systems;
- data stakeholder restrictions.

The map identifies "uses and values of outdoor spaces" as the core "deep structure" force that underpins the map. Then there are two dominant and interconnected themes. One theme relates to governance/big data and the second theme relates to social cohesion and stakeholder value.

- *Uses and values of outdoor spaces*. The number of outdoor spaces that are nearby and accessible, with appropriate and attractive facilities, for individuals, groups and communities across the lifecourse determines their uses, including physical, recreational, conservation and cultural uses. "Multiple uses" is about the variety of places, facilities and activities. "Multiple uses" is also about the repeated use of these places by individuals, groups and communities. When outdoor spaces are used by different individuals, groups and communities, benefits occur. These are health, social, community, cultural, environmental, economic and wellbeing benefits, which all impact on quality of life. When users and others (e.g. LAs, policymakers and health promoters) value and appreciate these quality-of-life benefits, outdoor spaces are invested in, increasing the number and quality of these spaces.
- *Time*. Perceived and actual lack of time limits the uses of outdoor spaces; the less we use an outdoor space, the less time we make for its use.
- *Environmental and weather conditions*. These are perceived as adversely limiting the uses of outdoor spaces. When different users are restricted in their use of outdoor spaces, user perceptions of environmental and weather constraints increase.
- *Social inequalities*. These strongly influence and determine access to and use of blue/green spaces. Social inequalities include disparities relating to health, socioeconomic status, employment, education, race, gender, housing

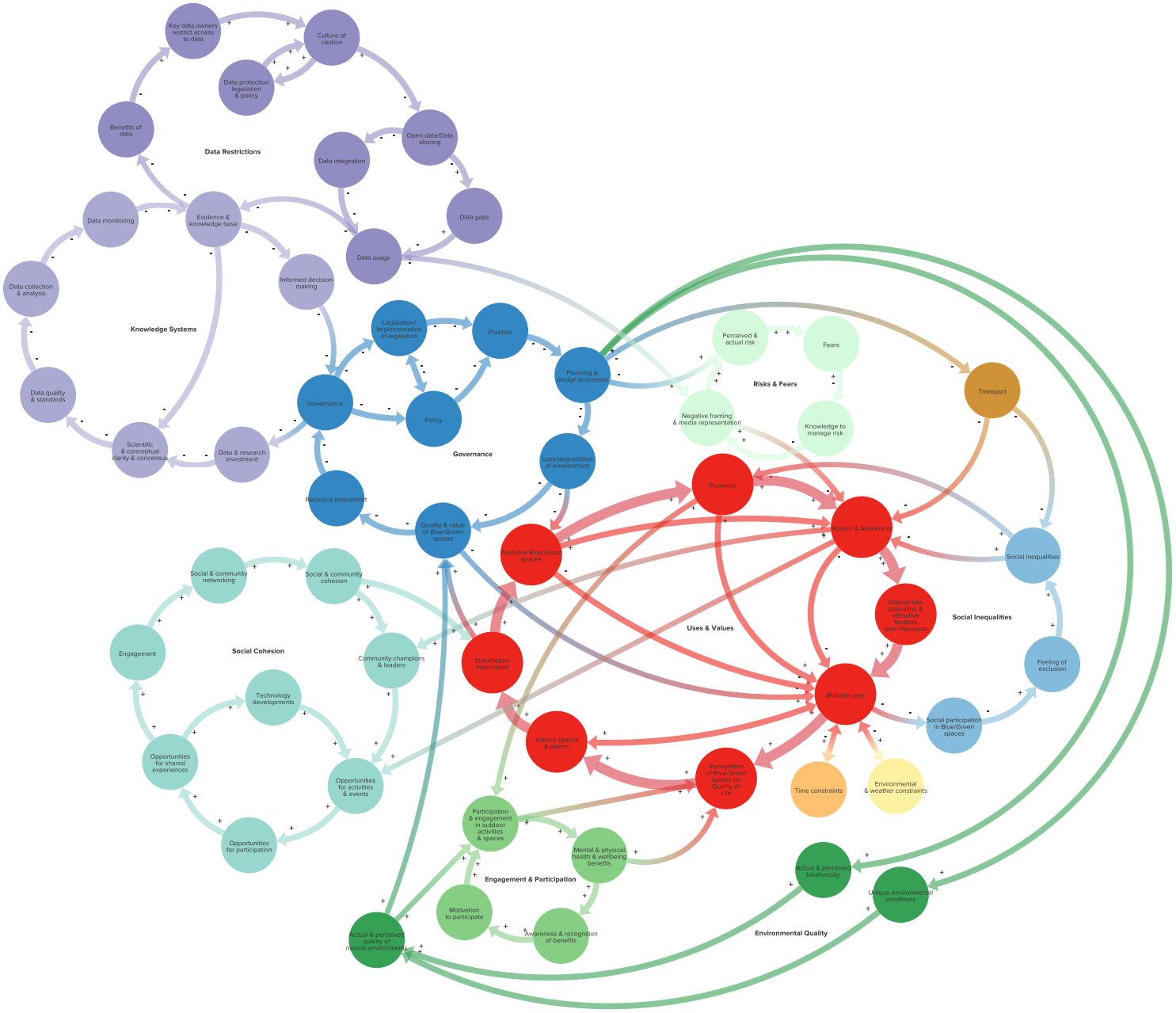

Figure 5.2. The forces and patterns currently at work in relation to the socioeconomic determinants, health and wellbeing outcomes and access to blue/ green spaces in Ireland.

quality, minority and relationship status, but they also relate to community wellbeing. At a population level, social inequalities are measured by the Pobal Deprivation Index. A higher deprivation index means greater social inequalities. Awareness of and access to outdoor spaces decreases with increasing social inequalities. Proximity to outdoor spaces decreases with increasing social inequalities. Awareness, access and proximity determine the uses of outdoor spaces, social participation in blue/green spaces, and feelings of exclusion, which reinforce social inequalities. The use of outdoor spaces is also determined by perceived and actual lack of time.

- *Social and community cohesion*. This benefits from blue/green spaces that are available and accessible. With increasing outdoor spaces that are available, accessible and appropriate, there are more community champions and leaders who help create opportunities for activities and events in these outdoor spaces. Opportunities for social and community participation and shared experiences are increased. Technology developments enhance opportunities for activities and events, opportunities for social and community participation and shared experiences. These promote engagement, social and community interactions, networking and social and community cohesion.
- *Risks and fears*. Negative framing and narratives, including news and media reports, myths, stories and cultural norms, influence how people and communities perceive risks associated with outdoor spaces. Perceived and actual risks create and enhance fears associated with outdoor spaces. A lack of knowledge on how to manage the perceived and actual risks and fears feeds negative narratives.
- *Participation and engagement*. Participation and engagement in outdoor activities and spaces deliver physical and mental health and wellbeing benefits. Awareness and recognition of these benefits motivates individuals, groups and communities to participate and engage in using outdoor spaces. Participation and engagement are also influenced by proximity.
- *Biodiversity and natural environments*. Biodiversity is about the abundance, variety and diversity of plants and animals in nature. Biodiversity (actual and perceived) shapes our perceptions of the quality of natural environments and participation and engagement in outdoor spaces. Ireland's unique environmental and cultural conditions (e.g. temperate climate, waves, dark skies) shape our perceptions of the quality of natural environments and participation and engagement in outdoor spaces. They also deliver cultural (including recreational) and economic benefits (e.g. the Wild Atlantic Way). Awareness and recognition of these multiple benefits add to how these spaces and places are valued by individuals, groups, communities and society. When the value of these spaces is recognised, individuals, groups, communities and society use them more. With increasing quality, the value and the number of blue and green spaces increases.
- *Governance*. This is about legislation, legislative implementation and policies. Poor policies and insufficient legislation and implementation lead to poor practices. This reinforces poor planning and design processes, including insufficient transport, and can increase perceived and actual risk in relation to outdoor environments. Poor planning and design increase environmental loss and degradation, limiting the amount and quality of, access to and usage of outdoor spaces. They also drive the lack of resources and investment in blue/green spaces, decreasing their value.
- *Transport*. Insufficient transport infrastructure reduces access to blue/green spaces for those who rely on public transport for access.
- *Data knowledge systems*. The lack of scientific and conceptual clarity and consensus around blue and green spaces hinders data quality, standards, collection and analysis, resulting in insufficient data monitoring of such spaces. This contributes to a weak evidence and knowledge base, leading to less informed and piecemeal decision-making and governance. This also contributes to a lack of data and research investment.
- *Data restrictions*. Some key data stakeholders, owners and providers restrict access to data because they have a culture of caution relating to data protection and privacy. This data restriction blocks data sharing and limits data integration. Gaps in data occur. Data usage is reduced, leading to less informed and piecemeal decision-making. There are few or no big data and few or no benefits from data to society, data stakeholders and governance decision-makers, because of

restricted access and lack of data integration between agencies. A culture of caution relating to data protection and privacy drives restrictive legislation, policy and practices, and limits the provision of open data, all of which in turn reinforces the culture of caution.

5.4 Limitations

This was an exploratory study using a systems methodology for a complex societal problem. Further construct and operational definitions of key blue/green variables, including data dictionaries and data monitoring, is required. Importantly, the power, tensions and conflicts between macro-, meso- and micro-stakeholders require further delineation. Lastly, this research did not focus on the implementation of the leverage points or their evaluation and monitoring, although many stakeholders made suggestions as to how to improve the dynamics in relation to the socioeconomic determinants, access to and multiple uses of blue/green spaces.

5.5 Summary

Various stakeholders, including citizens, in Ireland with knowledge of the complex socioeconomic determinants of health and wellbeing outcomes in relation to blue/green spaces collectively developed a systems dynamic model of the current situation. The involvement of various stakeholders in the system modelling process and the consensus-based elicitation of these stakeholders' knowledge, together with their co-operation and collaboration, lie at the core of the system methodology employed in this project (Andersen *et al*., 1997; Bérard, 2010).

The map demonstrates to stakeholders, decision-makers, and policy and programme managers that a sustainable blue/green strategy with healthy outcomes for individuals and communities requires a systemic perspective. This perspective needs to be capable of accounting for both individual and structural factors over the lifecourse. This includes access to and usage of outdoors spaces, data, data gaps, data sharing and data knowledge systems and social inclusions and exclusion.

6 National Survey of the Socioeconomic Determinants of Access to and Multiple Uses of Blue/Green Spaces in Ireland

6.1 Introduction

The relationship between blue/green spaces and human health is complex and, at present, data relating to access to and multiple uses of blue/green spaces in Ireland are piecemeal at best. This project reviewed the various datasets available at a variety of levels and identified potential relationships between nature and human health and wellbeing in Ireland. However, although the results of the data review and analysis show that there are connections between blue/green spaces and the socioeconomic determinants of health and wellbeing, the results also identified a definitive need for more data, in particular at regional and local levels. Specifically, usage figures for blue/green spaces are not yet readily available. Although surveys such as *Healthy Ireland*, Growing Up in Ireland and the Irish Sports Monitor provide some insight into specific types of usage, there is an overall lack of available data on usage of blue/green spaces in general and on an ongoing, longitudinal basis. This project recognised that at present there is also no systematic process or reporting forum to capture, share and use this information. Furthermore, it observed that there is also a significant shortfall of reliable socioeconomic data at a granular level to improve understanding of facilities. The lack of all of these datasets and processes presents a major information gap, in particular in terms of informing spatial planning and the allocation of resources to address existing inequalities. There is a need for population-to-local level usage spatial data that will allow the social and health inequalities that parts of Irish society experience, and the social and community cohesion that other individuals and communities benefit from, to be understood and ultimately managed.

While such data were recognised to be lacking in Ireland, the UK provides an example of how such gaps could be addressed. The NE MENE survey (carried out since 2009) addresses the data and reporting needs. The MENE survey includes questions on the frequency of outdoor visits in the previous week and over the last 12 months, the type of place visited, the mode of transport used to reach blue/green spaces, the activities undertaken in such spaces, the motivations for the visits, environmental attitudes and behaviours, and relevant socioeconomic data (NE, 2018). The results from the MENE survey then provide a basis for analyses of how different individuals and societal groups engage with blue/green spaces and allow for investigations into the links between nature and human health and wellbeing. The data are also used by NE to monitor changes in experiences of and attitudes towards blue/green spaces over time and to inform policy (NE, 2018). Recognising the possibilities that such a survey provides, a survey was performed as part of this project.

6.2 Methodology

The aim of the survey was to address the lack of data this project identified and investigate the link between nature, people, their health and wellbeing, and socioeconomic determinants. The survey was designed to help assess the connections people from different socioeconomic backgrounds in Ireland have with outdoor blue/green spaces and hence collected data on people's use of such spaces, with a particular focus on their local areas.

A nationally representative survey ($n = 1050$) was carried out in early 2019 to further investigate the socioeconomic relationship between nature and human health and wellbeing. A stratified sample of residents in Ireland was chosen as the sampling method. The stratum chosen is indicative of the age and gender and location of the Irish population based on the findings of the Irish Census 2016. Following approval from the National University of Ireland, Galway, Research Ethics Committee, an online questionnaire with validated, standardised questions based on surveys such as the Irish Census (CSO, 2017), MENE (NE, 2018) and *Healthy Ireland* (Department of Health, 2018) was conducted (see

Appendix 2 for questions). The questions covered socioeconomic status (i.e. income, education, employment), health (self-assessed health status, physical health – body mass index or BMI – and mental health – Energy and Vitality Index or EVI) and availability of, access to and uses of blue/green spaces. The survey further included a series of questions relating to blue/green outdoor spaces, respondents' perceptions of them, their use of such spaces, the perceived health and wellbeing benefits, and barriers to engagement such as socioeconomic factors; it further gathered relevant health and demographic data about each respondent. The survey considered outdoor spaces to include all blue spaces, such as seas, rivers and lakes, and all green spaces, such as woods, meadows and parks, as defined for the overall project, but excluded private gardens.

Using the obtained responses, structural equation modelling was used to test the internal logic and confirm, or not, the validity of the systems dynamic map and deep structure, specifically hypotheses relating to social inequalities and blue/green space access and usage in Ireland. The following hypotheses were tested:

- H1: Health is influenced by multiple use of blue/green spaces.
- H2: Socioeconomic determinants determine multiple use of blue/green spaces.
- H3: Access determines the multiple uses of blue/green spaces.
- H4: Socioeconomic determinants determine access to blue/green spaces.

6.3 Results

6.3.1 Respondent profile

A total of 1008 respondents completed the survey; they came from all counties of Ireland, with an almost even split of male (50.4%) and female (49.3%) participants and an average age of 45 years. Most respondents (66.5%) stated that they live in an urban environment in a town or city and 50% have children under 18 years of age living in their household. Although 39% of respondents stated they had a long-standing illness or health issue over the last 6 months, the majority of respondents (67%) ranked their health as good or better. The average BMI was 26.6.

6.3.2 Engagement with blue/green spaces

The survey findings show that 77% of the respondents spend leisure time outdoors at least once a week, if not more, with 16% using blue/green spaces on a daily basis. Parks in towns or cities were the most frequently used blue/green spaces (35.7%), followed by woodlands (22.4%) and beaches (20.1%). Walking was identified as the most frequently undertaken activity (67.1%) in blue/green spaces. Participants recognised the benefits from outdoor activities, with 90.6% agreeing that blue/green spaces benefited their mental health, making them feel calm and relaxed.

The majority of respondents stated that their local blue/green spaces were within easy walking distance (51%/73%) and easy to get into and around (63%/81%) (Figure 6.1).

With 53% of respondents travelling 5 km or less to get to the blue/green space they visit most, 65.3% of respondents stated that there was no lack of public spaces in their neighbourhood. Only 3.7% of respondents noted a lack of suitable blue/green spaces as a barrier to engagement with outdoor spaces. The main barriers identified by respondents were lack of time due to work (43.8%), bad weather (43.2%) and being busy at home (31.8%).

6.3.3 Structural equation modelling

With a goodness of fit (GFI) value of 0.851 and a model chi-squared value of 1225.401 (df = 131.00, $p = 0.000$), one of the models supported three of the four hypotheses (H1–H3). This indicates that health is influenced by multiple use, including both repeat use and diversity of use, of blue/green spaces (H1). Multiple use is determined by socioeconomic determinants (H2) and by access (H3). The final hypothesis (H4) was not supported by the model. The socioeconomic determinants included in this model are level of education, income and employment. Access variables included are the ease of access to local blue/green spaces, whereas multiple uses include the diversity of activities carried out together with reasons for visit. Health variables included in this model were taken from the EVI.

Another model, with a slightly lower GFI value of 0.847 and a model chi-squared value of 1348.321 (df = 148.00, $p = 0.000$), proved the same three

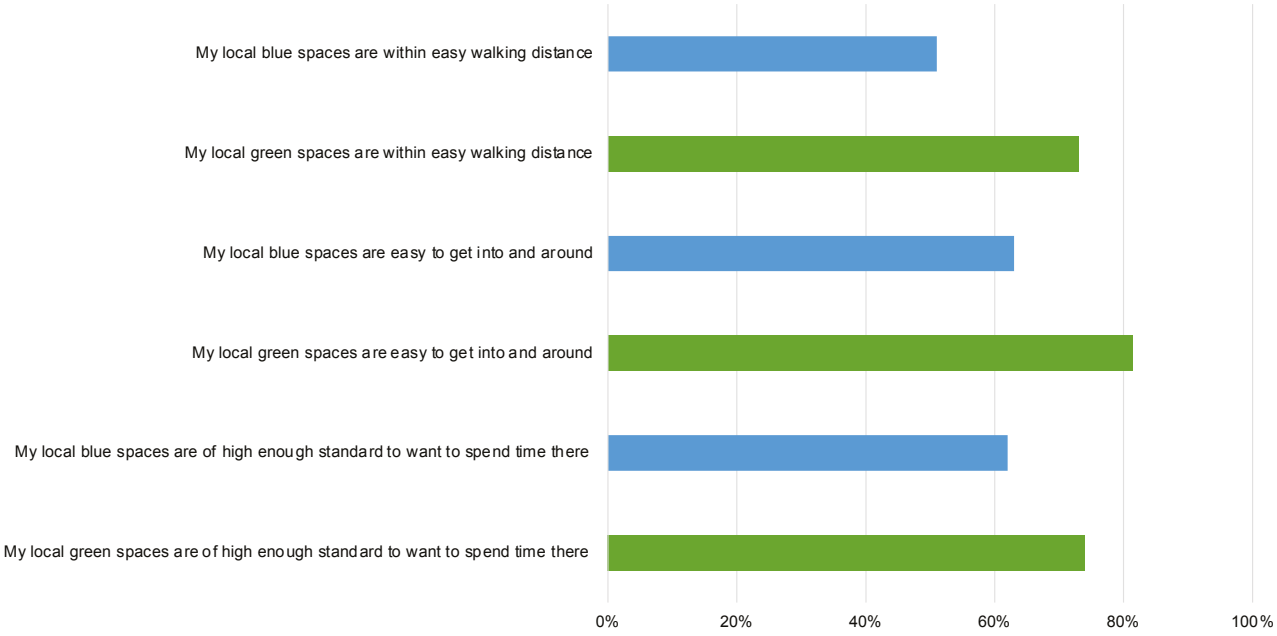

Figure 6.1. Access to blue/green spaces in Ireland based on the responses to a nationally representative survey (n = 1008).

hypotheses (H1–H3). The fourth hypothesis, setting out that socioeconomic determinants determine access to blue/green spaces, was again not supported. The variables included in the second model are the same as the first, with the only change being in the health variables, which also included self-reported health. A final model, with a GFI value of 0.924 and a model chi-squared value of 605.117 (df = 115.00, p = 0.000), included BMI as an additional health variable instead of self-reported health. This model again supported three of the four hypotheses (H1–H3), with the last hypothesis (H4) not supported.

6.4 Discussion

This project demonstrates that there are complex and constantly evolving relationships between blue/green spaces and the socioeconomic determinants of health and wellbeing in Ireland. However, it also identified a lack of data relating to access to and multiple uses of blue/green spaces in Ireland. To address this data gap, to complement the findings of the database analysis and to further investigate the forces identified in the systems map (Chapter 5), a nationally representative survey was carried out.

The results of the survey show that a high proportion of respondents are frequently visiting blue/green spaces in Ireland, with 77% of respondents spending time outdoors at least once a week. This is a higher proportion than the MENE survey shows for England, where 62% of respondents stated that they visited nature at least once a week in 2017/2018. Similar patterns can be observed in the countries in relation to the most frequently used blue/green spaces, which were parks in towns or cities. This reflects the profile of the respondents in Ireland, the majority of whom stated that they live in an urban environment in a town or city. The higher use of blue/green spaces in Ireland may be linked to the perceived proximity and availability of blue/green spaces in Ireland, as the majority of respondents stated that they have to travel only relatively short distances to get to the blue/green space that they visit most, and the majority of respondents stated that there is no lack of public spaces in their neighbourhood. Both proximity to and availability of blue/green spaces are recognised in the systems map as influencing multiple use of such spaces.

Respondents recognised the benefits from outdoor activities, in particular on their mental health, and these benefits were cited by many as reasons for engaging with blue/green spaces. However, there were several barriers to the use of blue/green spaces that respondents noted. In particular, lack of time was given as a main limitation to the use of outdoor spaces, as a result of either work or being busy at home, followed by bad weather, all of which again reflects the forces and patterns identified in the systems map.

The structural equation model supported three of the four hypotheses. This indicates that, in Ireland, health is influenced by multiple use, including both repeat use and diversity of use, of blue/green spaces (H1), i.e. the more blue/green spaces are used by different individuals, groups and communities, the better the health of these individuals, groups or communities. Multiple use is in turn determined by socioeconomic determinants (H2), so uses of blue/green spaces decrease with increasing levels of socioeconomic inequalities and by access to blue/green spaces (H3). These findings endorse the deep structure of the systems dynamic map. They further indicate that, at a national level, there are socioeconomic inequalities in relation to multiple use of blue/green spaces, which can influence health. Multiple use of outdoor spaces decreases with increasing socioeconomic inequalities, influencing health inequalities across Ireland. The analysis of the spatial distribution of blue/green spaces, focusing on urban green and amenity spaces, and the prevailing weather conditions in Ireland may influence the multiple uses of outdoor spaces, contributing to health inequalities.

The final hypothesis (H4) was that socioeconomic determinants determine access to blue/green spaces; however, this was not supported by the models. This indicates that, in Ireland, socioeconomic determinants do not define access to blue/green spaces. This seems to be endorsed by the majority of respondents stating that their local blue/green spaces were within easy walking distance and easy to get into and around. Only a few respondents noted a lack of suitable blue/green spaces as a barrier to engagement with outdoor spaces, and the majority of respondents stated that there was no lack of public spaces in their neighbourhood.

At present, there is a weak evidence and knowledge base in relation to blue/green spaces that does not facilitate informed and cohesive decision-making and governance. This study also demonstrates that a survey like this can gather relevant information that not only can close the existing data gap and provide practitioners, policymakers and decision-makers with valuable information that would allow them to understand how people use blue/green spaces and the benefits they obtain from this, but also inform planning and on-the-ground initiatives to better meet people's needs. With information like that provided by this survey, planners, engineers, community groups and educators could also deliver healthy sustainable communities and meet the requirements of *Healthy Ireland* and other cross-sectoral plans.

6.5 Summary

Based on the findings of this project, a survey was carried out to address the identified lack of data and investigate the links between blue/green spaces, people, their health and wellbeing, and socioeconomic determinants. The overall findings of this initial national survey indicate that, in Ireland, people's health and wellbeing are determined by multiple use of blue/green spaces, which in turn is determined by access to blue/green spaces and socioeconomic determinants. Therefore, socioeconomic inequalities have an impact on health. The distribution of blue/green spaces also contributes to spatial and environmental inequalities that are linked to socioeconomic determinants, multiple use and health in Ireland. The results of this study also further confirm the need for regional and more granular data, as, without these data, access and usage patterns could not have been investigated. Such information is extremely valuable, as it can inform planning and on-the-ground initiatives to better meet people's needs.

7 Conclusions and Recommendations

7.1 Conclusions

In addition to playing an important role in health and wellbeing (Lengen and Kistemann, 2012), blue/green outdoor spaces also promote social interactions and networking and encourage a sense of community (Kim and Kaplan, 2004; Douglas *et al*., 2018). In Ireland, the importance of high-quality blue/green spaces for human health and wellbeing is increasingly being acknowledged, with links between the quality of nature and human health increasingly recognised, for example in the Government's *Healthy Ireland* – a framework for improved health and wellbeing 2013–2025 (Department of Health, 2017) and in the *EPA Strategic Plan 2016–2020 – Our Environment, Our Wellbeing* (EPA, 2016). The *Health Promotion Strategic Framework* (HSE, 2011) aimed to implement a salutogenic model to reorient services to enable individuals and communities to have greater influence over factors that affect health and wellbeing, rather than managing individual responses to disease and ill health. The current *Healthy Ireland* framework further builds on this and aims to promote protective factors at every stage of life and address the wider social determinants of health, creating economic, social, cultural and physical environments that foster healthy living.

Although the connections between a high-quality environment, a healthy society and the economy are increasingly recognised, availability of and access to blue/green outdoor spaces have been shown to differ depending on, *inter alia*, socioeconomic status, age, gender and ethnicity, hence creating inequality (Marmot, 2013). In Ireland, a growing range of health and social problems pose challenges for practitioners, policymakers and decision-makers to identify sustainable opportunities to integrate access to and use of high-quality natural resources and human health without causing further inequality.

The evidence underpinning the relationship between socioeconomic determinants, blue/green spaces and human health is complex and requires multi- and interdisciplinary research and data sharing. This study aimed to explore the key forces and patterns at work in relation to access to blue/green spaces in Ireland and possible impacts in national, regional and local contexts through data analytics, visualisation and mapping.

7.1.1 Data analytics

The data audit and gap analysis shows that, although the quality of health and environmental data in Ireland is generally good, there are still issues, e.g. problematic access to health data, lack of granularity of environmental data and clear multi-agency data gaps. Further common issues identified were a lack of suitability of purpose, lack of geographical data and data privacy rules restricting the sharing of personal data, in particular in relation to health data. To facilitate collaboration across all relevant sectors, these will need to be overcome by setting universal standards and encouraging the sharing of data between departments and organisations.

7.1.2 Regional disparity

The findings suggest that there is a regional and urban/rural divide in Ireland in relation to blue/green spaces, health outcomes and their socioeconomic determinants. The EMRA (including Dublin city) has more blue/green spaces with facilities, higher rates of self-reported health and more relatively affluent areas than the other two regions. The SRA (including Cork city) is the middle-ranking region in all categories, while the NWRA (including Galway city) is at the bottom end of the scale in all categories.

7.1.3 Use of blue/green spaces

At present, there is a recognised lack of data on the use of blue/green spaces, which does not facilitate informed, cohesive planning and governance. The results from this survey support the patterns identified in the systems map that indicate health is influenced by multiple use of blue/green spaces. Multiple use, in turn, is influenced by socioeconomic determinants and by access. This study further indicates that a usage survey could allow relevant information to be gathered to close the current data gap, provide information

to practitioners, policymakers and decision-makers for them to understand how people use blue/green spaces and benefits provided, and inform planning to better meet individual, group and community needs.

7.1.4 Systemic change

It is vital to resource and deliver universal services in a manner that is proportionate to their degree of need instead of services being available only to the most advantaged. As this study, in particular the stakeholder systems map, shows, to achieve proportionate universalism and a sustainable blue/green strategy with healthy outcomes for individuals, groups and communities, systemic change is required. This could be achieved by facilitating targeted change such as increasing access to and multiple usage of blue/green spaces and informing the planning process through improved data gathering and sharing. Increased, strategic interagency collaboration across Ireland has the potential to transform and improve health and wellbeing for all.

7.2 Recommendations

This study indicates that regional disparities exist across Ireland in relation to socioeconomic determinants, health and access to blue/green spaces. Systemic change is required to address this disparity, leading to a change in the delivery of relevant services and the implementation of a sustainable blue/green strategy with healthy outcomes for all levels of stakeholders in Ireland. To achieve this change and increase access to and multiple usage of blue/green spaces, collaboration between relevant agencies and gathering and sharing of relevant data and information is required. Based on the analysis and results presented in this report, the following are the recommendations from this study.

7.2.1 Data sharing

- Compliance with the Data Sharing and Governance Bill 2018 and national Open Data Strategy: a strategic collaborative effort across all sectors is needed to improve on the current fragmented, linear, case-by-case approach.

7.2.2 Geocoding and geo-alignment of data

- Data at LA level, ED level and SA level are essential for spatial comparison of health status, risk and protective factors, and related inequalities as the foundation for equitable geographical and socioeconomic allocation of resources.

7.2.3 Blue/green space usage data

- Include validated, standardised questions that comply with international standards on usage of blue/green space either in a dedicated European-wide survey, in national household surveys, or the national census of each country.
- Develop a cross-sectoral framework for blue/green spaces that is linked with health, water and air quality, climate-proofing, housing and other related issues, as part of the Health in All Policies approach promoted by WHO (2012, 2014) and aim to share best practice, develop new tools and raise awareness to policymakers of the impact of poor design on health inequalities.

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Abbreviations

ANGSt	Accessible Natural Greenspace Standard
AWB	Artificial water body
BMI	Body mass index
CORINE	Co-ordinated Information on the Environment
CSO	Central Statistics Office
CSV	Comma-separated values
DG	Directorate-General
EC	European Commission
EcoHealth	Ecosystem Benefits of Green Space for Health
ED	Electoral district
EEA	European Environment Agency
EMRA	Eastern and Midlands Regional Assembly
EPA	Environmental Protection Agency
ESRI	Economic and Social Research Institute
EU	European Union
EVI	Energy and Vitality Index
GDPR	General Data Protection Regulation
GES	Good Ecological Standard
GFI	Goodness of fit
GUA	Green Urban Area
GUI	Growing Up in Ireland
HMWB	Heavily modified water body
HPSC	Health Protection Surveillance Centre
HSE	Health Service Executive
ISSDA	Irish Social Science Data Archive
IWS	Irish Water Safety
KISI	Key informant stakeholder interview
LA	Local authority
MENE	Monitor of Engagement with the Natural Environment
NA	National area
NE	Natural England
NEAR Health	Nature and Environment to Attain and Restore Health
NUTS	Nomenclature of Territorial Units for Statistics
NWRS	Northern and Western Regional Assembly
OECD	Organisation for Economic Co-operation and Development
OSi	Ordnance Survey Ireland
RA	Regional area
SA	Small area
SDG	Sustainable Development Goal
SHEER Wellbeing	Socioeconomic Health and Environment Research
SRA	Southern Regional Assembly
TILDA	The Irish Longitudinal Study on Ageing
UCD	University College Dublin
UN	United Nations

VTEC	Verocytotoxigenic *Escherichia coli*
WFD	Water Framework Directive
WHO	World Health Organization

Appendix 1 Conceptual Framework of Access to Green and Blue Spaces

The SHEER framework (Figure A1.1) attempts to portray the dynamic nature of the connection between green and blue spaces and health.

We examined the international literature for constructs and frameworks on access and use of green and blue spaces, and access and use of healthcare, to inform the development of a conceptual framework that identifies and integrates the broad dimensions and determinants of access to green and blue spaces in the context of improving health. This is situated in the multiple complex socioeconomic and environmental determinants of health that influence measurable health and wellbeing outcomes. We aimed for a framework with operational measures that would enable further study of particular determinants of access across the lifecourse.

"Access" has numerous definitions and meanings. The *Oxford English Dictionary* definitions include "the means or opportunity to approach or enter a place; the right or opportunity to use or benefit from something". We interpret it to mean people's ability to reach and appropriately use green and blue spaces for health; this involves personal capabilities, societal values, economic interests and political processes. The growing literature on access includes different emphases on characteristics of users and providers, characteristics of resources that influence use, aspects of supply and demand, notions of factors predisposing to use on one side and enabling or system factors on the other, and abilities of a population to seek and use services. Use has been described as realised access, determined by population characteristics and systems characteristics.

We conceptualise four broad dimensions that represent both nature and the supply side of blue/green spaces and related services, broadly grouped under the heading (external/infrastructure) architecture, which refers to both nature and the network of processes and organisations required to connect these dimensions. These dimensions reflect

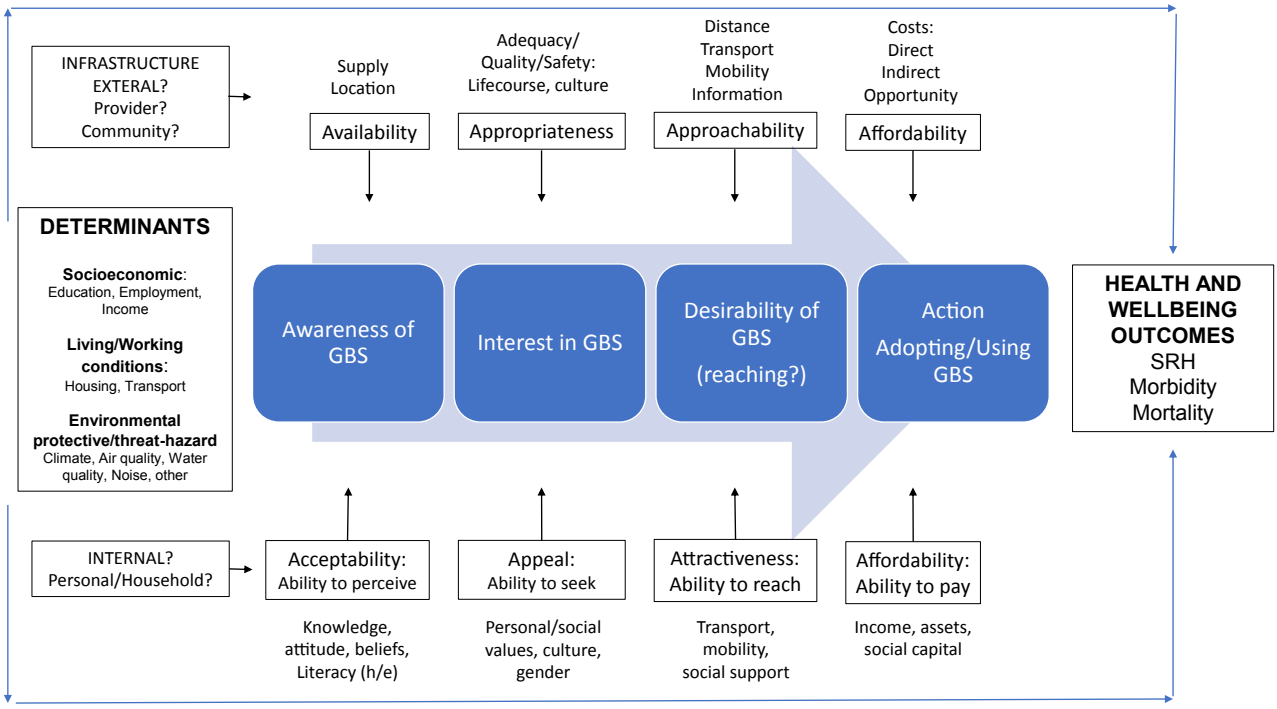

Figure A1.1. SHEER framework, including internal and external motivators that operate at the same time but not necessarily at the same scale. Modified from Levesque *et al*. (2013).

and are complemented by four broad abilities of people to use green and blue spaces at the personal or household level that ultimately lead to actions to use green and blue spaces with the aim of improving health and wellbeing, or adoption. Adoption also involves gaining acceptance of, and increasing demand for, use of green and blue spaces for health.

Availability refers to spaces and services that can be reached, in terms of physical location and time, and of the providers of related services. Ability to perceive (acceptability) is based on knowledge, attitudes, beliefs about health and the environment and both health literacy and environmental literacy, which are central to awareness of green and blue spaces.

Appropriateness refers to the fit between spaces and services and the public's needs or capacity to benefit. It includes elements of adequacy and quality. Ability to seek (appeal) overlaps with health and environmental literacy and includes personal and societal values, and includes cultural and gender aspects, which influence interest in using green and blue spaces. These generate interest in green and blue spaces. Opportunities to use only spaces or services of poor quality and lack of access to information and knowledge restrict this capability.

Approachability means that people can identify that spaces exist, can be reached and can have an impact on people. Ability to reach (attractiveness) links to personal mobility, availability of means of transport and knowledge. Restricted mobility or lack of means of transport restrict this capability.

Affordability means ensuring that spaces and services are not too costly for the people who will use them. Ability to pay (affordability) refers to the personal capacity to generate economic resources to pay for using green and blue spaces. Poverty and social isolation restrict this capability.

The dimensions described are interdependent; the relationship is not linear, as it is embedded in the overarching social and environmental determinants of health.

Appendix 2 Questions Asked in the Survey Referred to in This Report

What is your gender?

- Female
- Male
- Other

What is your age? (Please write your age as a number e.g. 43.)

In which county do you live?

Past 12 months

The following questions are about occasions in the last year (12 months) when you spent your time out of doors. Again, this may include time spent close to your home or workplace, further afield or while on holiday or having a short break in Ireland. However, this does not include: routine shopping trips or; places which you visit as part of work or; time spent in your own garden.

1. Thinking about the last 12 months, how often on average have you spent your leisure time out of doors, away from home?
   (1) More than once per day
   (2) Every day
   (3) Several times a week
   (4) Once a week
   (5) Once or twice a month
   (6) Once every 2–3 months
   (7) Once or twice
   (8) Never
2. How did you travel to the outdoor space you visited the most?
   (1) Car or van
   (2) Train (includes trams and underground)
   (3) Public bus or coach (scheduled service)
   (4) Coach trip/private coach
   (5) Motorcycle/scooter
   (6) Bicycle/mountain bike
   (7) On foot/walking
   (8) Wheelchair/mobility scooter
   (9) On horseback
   (10) Boat (sail or motor)
   (11) Taxi
   (12) Other (please specify)_____
   (13) I have not travelled to an outdoor space in the past 12 months
3. Approximately how far, in kilometres, did you travel to reach this space? By that we mean the one way distance from where you set off to the destination.
   (1) <1 km
   (2) 1–2 km
   (3) 3–5 km
   (4) 6–10 km
   (5) 11–20 km
   (6) 21–40 km
   (7) 41–60 km
   (8) 61–80 km
   (9) 81–100 km
   (10) >100 km

4. Which of the following list of types of place best describe where you spent your time during this visit?
   (1) Park in a town or city
   (2) Path, cycleway or bridleway
   (3) Woodland or forest
   (4) River, lake or canal
   (5) Another open space in a town or city
   (6) Country park
   (7) Another open space in the countryside
   (8) Playing field or other recreation area
   (9) Farmland
   (10) Village
   (11) A beach
   (12) Other coastline
   (13) Children's playground
   (14) Other places not in the list
   (15) Mountain, hill or moorland
   (16) Allotment or community garden
5. Which of the following, if any, best describe your reasons for this visit?
   (1) To spend time with family
   (2) To spend time with friends
   (3) To learn something about the outdoors
   (4) For fresh air or to enjoy pleasant weather
   (5) For health or exercise
   (6) For peace and quiet
   (7) To relax and unwind
   (8) To exercise your dog
   (9) To enjoy scenery
   (10) To enjoy wildlife
   (11) To entertain children
   (12) To challenge yourself or achieve something
   (13) To be somewhere you like
   (14) For other reasons _____
6. Which of these activities, if any, did you undertake?
   (1) Eating or drinking out
   (2) Fieldsports (for example, shooting and hunting)
   (3) Fishing
   (4) Horse riding
   (5) Informal games and sport (for example Frisbee or golf) _____
   (6) Off-road cycling or mountain biking
   (7) Off-road driving or motorcycling
   (8) Picnicking
   (9) Playing with children
   (10) Road cycling
   (11) Running
   (12) Appreciating scenery from your car (e.g. at a viewpoint)
   (13) Swimming outdoors
   (14) Team sport (for example football, hurling or rugby _____
   (15) Visits to a beach, sunbathing or paddling in the sea
   (16) Visiting an attraction
   (17) Walking, not with a dog (including short walks, rambling and hill walking)?
   (18) Walking, with a dog (including short walks, rambling and hill walking)?
   (19) Watersports
   (20) Wildlife watching
   (21) Any other outdoor activity (for example climbing) _____
7. And thinking of your visits to this place, how much do you agree or disagree with the following statements?

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
I enjoyed it					
It made me feel calm and relaxed					
It made me feel refreshed and revitalised					
I took time to appreciate my surroundings					
I felt close to nature					
I learned something new about the natural world					
I felt in tune with the world					
I felt able to connect with other people					

8. Why have you not spent more of your time out of doors in the last 12 months?

   (1) Too busy at work

   (2) Poor health

   (3) Too busy at home

   (4) Bad/poor weather

   (5) Old age

   (6) No particular reason

   (7) A physical disability

   (8) Not interested

   (9) Prefer to do other leisure activities

   (10) Have other caring responsibilities

   (11) No access to a car

   (12) Have young children

   (13) Don't like going on my own

   (14) Too expensive

   (15) This is not something for me/people like me

   (16) Lack of suitable places to go/suitable paths

   (17) Worried about safety/doesn't feel safe

   (18) Lack of public transport

   (19) Don't know where to go/lack of information

   (20) I don't feel welcome/feel out of place

   (21) Pregnant

   (22) Concerns about where allowed to go/ restrictions

   (23) Other _____

9. How much do you agree or disagree with the following statements relating to your nearest blue and green outdoor space areas?

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
My local blue spaces are within easy walking distance					
My local blue spaces are of a high enough standard to want to spend time there					
My local blue spaces are easy to get into and around					
My local green spaces are within easy walking distance					
My local green spaces are of a high enough standard to want to spend time there					
My local green spaces are easy to get into and around					

10. What is the distance to your nearest blue space?
11. What is the distance to your nearest green space?

Participant information

12. Which of the following best describes where you live?
    (1) In a city
    (2) In a town
    (3) In a village
    (4) Isolated location
    (5) Don't know
13. What is your nationality?
14. What is your ethnic or cultural background?
    (1) White – Irish
    (2) White – Irish Traveller
    (3) White – Any other White background
    (4) Black or Black Irish – African
    (5) Black or Black Irish – Any other Black background
    (6) Asian or Asian Irish – Chinese
    (7) Asian or Asian Irish – Any other Asian background
    (8) Other, including mixed background (specify)
15. How many children do you have living in your household?
16. What age is your youngest child ___
17. What is the highest level of education/training (full-time or part-time) which you have completed to date?
    (1) No formal education/training
    (2) Primary education (NFQ Levels 1 or 2, FETAC Level 1 or 2 Cert. or equivalent)
    (3) Lower Secondary (NFQ Level 3, Junior/Inter/Group Cert., FETAC Level 3 Cert., FÁS Introductory Skills, NCVA Foundation, Cert. or equivalent)
    (4) Upper Secondary (NFQ Levels 4 or 5, Leaving Cert. (including Applied and Vocational programmes) or equivalent)
    (5) Technical or Vocational (NFQ Levels 4 or 5, FETAC Level 4/5 Cert., NCVA Level 1/2, FÁS, Specific Skills, Teagasc Cert. in Agriculture, CERT Craft Cert. or equivalent)
    (6) Advanced Certificate/Completed (Apprenticeship, NFQ Level 6, FETAC Advanced Cert., NCVA Level 3, FÁS, National Craft Cert., Teagasc Farming Cert., CERT Professional Cookery Cert. or equivalent)
    (7) Higher Certificate (NFQ Level 6, NCEA/HETAC National Cert. or equivalent)
    (8) Ordinary Bachelor Degree or National Diploma (NFQ Level 7)
    (9) Honours Bachelor Degree/Professional qualification or both (NFQ Level 8)
    (10) Postgraduate Diploma or Degree (NFQ Level 9, Postgraduate Diploma, Masters Degree or equivalent)
    (11) Doctorate (PhD) or higher (NFQ Level 10)
18. What is your total household income per year (before tax)?
    (1) Under €40,000
    (2) €40,000–49,999
    (3) €50,000–59,999
    (4) €60,000–69,999
    (5) €70,000–99,999
    (6) €100,000–149,999
    (7) €150,000 plus
19. Do you own or have access to a car?
20. What is your height without shoes?
21. What is your weight without shoes?
22. How is your health in general?
    (1) Very good
    (2) Good
    (3) Fair

(4) Bad

(5) Very bad

(6) Don’t know

23. Do you have any long-standing illness or health problem, i.e. problems which have lasted or will last for at least 6 months or more?

    (1) Yes

    (2) No

    (3) Don’t know

AN GHNÍOMHAIREACHT UM CHAOMHNÚ COMHSHAOIL
Tá an Ghníomhaireacht um Chaomhnú Comhshaoil (GCC) freagrach as an gcomhshaol a chaomhnú agus a fheabhsú mar shócmhainn luachmhar do mhuintir na hÉireann. Táimid tiomanta do dhaoine agus don chomhshaol a chosaint ó éifeachtaí díobhálacha na radaíochta agus an truaillithe.

Is féidir obair na Gníomhaireachta a roinnt ina trí phríomhréimse:

Rialú: *Déanaimid córais éifeachtacha rialaithe agus comhlíonta comhshaoil a chur i bhfeidhm chun torthaí maithe comhshaoil a sholáthar agus chun díriú orthu siúd nach gcloíonn leis na córais sin.*

Eolas: *Soláthraímid sonraí, faisnéis agus measúnú comhshaoil atá ar ardchaighdeán, spriocdhírithe agus tráthúil chun bonn eolais a chur faoin gcinnteoireacht ar gach leibhéal.*

Tacaíocht: *Bímid ag saothrú i gcomhar le grúpaí eile chun tacú le comhshaol atá glan, táirgiúil agus cosanta go maith, agus le hiompar a chuirfidh le comhshaol inbhuanaithe.*

Ár bhFreagrachtaí

Ceadúnú
Déanaimid na gníomhaíochtaí seo a leanas a rialú ionas nach ndéanann siad dochar do shláinte an phobail ná don chomhshaol:
- saoráidí dramhaíola *(m.sh. láithreáin líonta talún, loisceoirí, stáisiúin aistrithe dramhaíola)*;
- gníomhaíochtaí tionsclaíocha ar scála mór *(m.sh. déantúsaíocht cógaisíochta, déantúsaíocht stroighne, stáisiúin chumhachta)*;
- an diantalmhaíocht *(m.sh. muca, éanlaith)*;
- úsáid shrianta agus scaoileadh rialaithe Orgánach Géinmhodhnaithe *(OGM)*;
- foinsí radaíochta ianúcháin *(m.sh. trealamh x-gha agus radaiteiripe, foinsí tionsclaíocha)*;
- áiseanna móra stórála peitril;
- scardadh dramhuisce;
- gníomhaíochtaí dumpála ar farraige.

Forfheidhmiú Náisiúnta i leith Cúrsaí Comhshaoil
- Clár náisiúnta iniúchtaí agus cigireachtaí a dhéanamh gach bliain ar shaoráidí a bhfuil ceadúnas ón nGníomhaireacht acu.
- Maoirseacht a dhéanamh ar fhreagrachtaí cosanta comhshaoil na n-údarás áitiúil.
- Caighdeán an uisce óil, arna sholáthar ag soláthraithe uisce phoiblí, a mhaoirsiú.
- Obair le húdaráis áitiúla agus le gníomhaireachtaí eile chun dul i ngleic le coireanna comhshaoil trí chomhordú a dhéanamh ar líonra forfheidhmiúcháin náisiúnta, trí dhíriú ar chiontóirí, agus trí mhaoirsiú a dhéanamh ar leasúchán.
- Cur i bhfeidhm rialachán ar nós na Rialachán um Dhramhthrealamh Leictreach agus Leictreonach (DTLL), um Shrian ar Shubstaintí Guaiseacha agus na Rialachán um rialú ar shubstaintí a ídíonn an ciseal ózóin.
- An dlí a chur orthu siúd a bhriseann dlí an chomhshaoil agus a dhéanann dochar don chomhshaol.

Bainistíocht Uisce
- Monatóireacht agus tuairisciú a dhéanamh ar cháilíocht aibhneacha, lochanna, uiscí idirchriosacha agus cósta na hÉireann, agus screamhuiscí; leibhéil uisce agus sruthanna aibhneacha a thomhas.
- Comhordú náisiúnta agus maoirsiú a dhéanamh ar an gCreat-Treoir Uisce.
- Monatóireacht agus tuairisciú a dhéanamh ar Cháilíocht an Uisce Snámha.

Monatóireacht, Anailís agus Tuairisciú ar an gComhshaol
- Monatóireacht a dhéanamh ar cháilíocht an aeir agus Treoir an AE maidir le hAer Glan don Eoraip (CAFÉ) a chur chun feidhme.
- Tuairisciú neamhspleách le cabhrú le cinnteoireacht an rialtais náisiúnta agus na n-údarás áitiúil *(m.sh. tuairisciú tréimhsiúil ar staid Chomhshaol na hÉireann agus Tuarascálacha ar Tháscairí)*.

Rialú Astaíochtaí na nGás Ceaptha Teasa in Éirinn
- Fardail agus réamh-mheastacháin na hÉireann maidir le gáis cheaptha teasa a ullmhú.
- An Treoir maidir le Trádáil Astaíochtaí a chur chun feidhme i gcomhair breis agus 100 de na táirgeoirí dé-ocsaíde carbóin is mó in Éirinn.

Taighde agus Forbairt Comhshaoil
- Taighde comhshaoil a chistiú chun brúnna a shainaithint, bonn eolais a chur faoi bheartais, agus réitigh a sholáthar i réimsí na haeráide, an uisce agus na hinbhuanaitheachta.

Measúnacht Straitéiseach Timpeallachta
- Measúnacht a dhéanamh ar thionchar pleananna agus clár beartaithe ar an gcomhshaol in Éirinn *(m.sh. mórphleananna forbartha)*.

Cosaint Raideolaíoch
- Monatóireacht a dhéanamh ar leibhéil radaíochta, measúnacht a dhéanamh ar nochtadh mhuintir na hÉireann don radaíocht ianúcháin.
- Cabhrú le pleananna náisiúnta a fhorbairt le haghaidh éigeandálaí ag eascairt as taismí núicléacha.
- Monatóireacht a dhéanamh ar fhorbairtí thar lear a bhaineann le saoráidí núicléacha agus leis an tsábháilteacht raideolaíochta.
- Sainseirbhísí cosanta ar an radaíocht a sholáthar, nó maoirsiú a dhéanamh ar sholáthar na seirbhísí sin.

Treoir, Faisnéis Inrochtana agus Oideachas
- Comhairle agus treoir a chur ar fáil d'earnáil na tionsclaíochta agus don phobal maidir le hábhair a bhaineann le caomhnú an chomhshaoil agus leis an gcosaint raideolaíoch.
- Faisnéis thráthúil ar an gcomhshaol ar a bhfuil fáil éasca a chur ar fáil chun rannpháirtíocht an phobail a spreagadh sa chinnteoireacht i ndáil leis an gcomhshaol *(m.sh. Timpeall an Tí, léarscáileanna radóin)*.
- Comhairle a chur ar fáil don Rialtas maidir le hábhair a bhaineann leis an tsábháilteacht raideolaíoch agus le cúrsaí práinnfhreagartha.
- Plean Náisiúnta Bainistíochta Dramhaíola Guaisí a fhorbairt chun dramhaíl ghuaiseach a chosc agus a bhainistiú.

Múscailt Feasachta agus Athrú Iompraíochta
- Feasacht chomhshaoil níos fearr a ghiniúint agus dul i bhfeidhm ar athrú iompraíochta dearfach trí thacú le gnóthais, le pobail agus le teaghlaigh a bheith níos éifeachtúla ar acmhainní.
- Tástáil le haghaidh radóin a chur chun cinn i dtithe agus in ionaid oibre, agus gníomhartha leasúcháin a spreagadh nuair is gá.

Bainistíocht agus struchtúr na Gníomhaireachta um Chaomhnú Comhshaoil
Tá an ghníomhaíocht á bainistiú ag Bord lánaimseartha, ar a bhfuil Ard-Stiúrthóir agus cúigear Stiúrthóirí. Déantar an obair ar fud cúig cinn d'Oifigí:
- An Oifig um Inmharthanacht Comhshaoil
- An Oifig Forfheidhmithe i leith cúrsaí Comhshaoil
- An Oifig um Fianaise is Measúnú
- Oifig um Chosaint Radaíochta agus Monatóireachta Comhshaoil
- An Oifig Cumarsáide agus Seirbhísí Corparáideacha

Tá Coiste Comhairleach ag an nGníomhaireacht le cabhrú léi. Tá dáréag comhaltaí air agus tagann siad le chéile go rialta le plé a dhéanamh ar ábhair imní agus le comhairle a chur ar an mBord.

Our Environment, Our Health, Our Wellbeing:

Access to Blue/Green Spaces in Ireland

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