2 North West Region

2.1 Introduction

In this section we introduce the North West Region and describe the:

- Regional location in the national context;
- Projected population growth and economic development and how this is considered in our water resources planning approach;
- Natural water resources and the environmental status of our groundwater and surface water bodies; and
- Our water supply systems and the impacts of drought and climate change.

2.1.1 Regional Overview

Figure 2.1 shows the location of the North West Region for the purpose of the draft Regional Water Resource Plan (RWRP-NW). To deliver our RWRP-NW, we have subdivided the region into smaller management units to enable us to manage the process of identifying potential water supply solutions (Options) and the selection of our Preferred Approach to resolve our water supply and water quality deficits. These smaller units are referred to as Study Areas (SAs). Seven (7) SAs have been defined in the North West Region. The SA boundaries are based on Water Framework Directive (WFD) catchments and Water Resource Zones (WRZs), which represent an area where supply and demand are largely self-contained. This is further explained in Section 1.4.

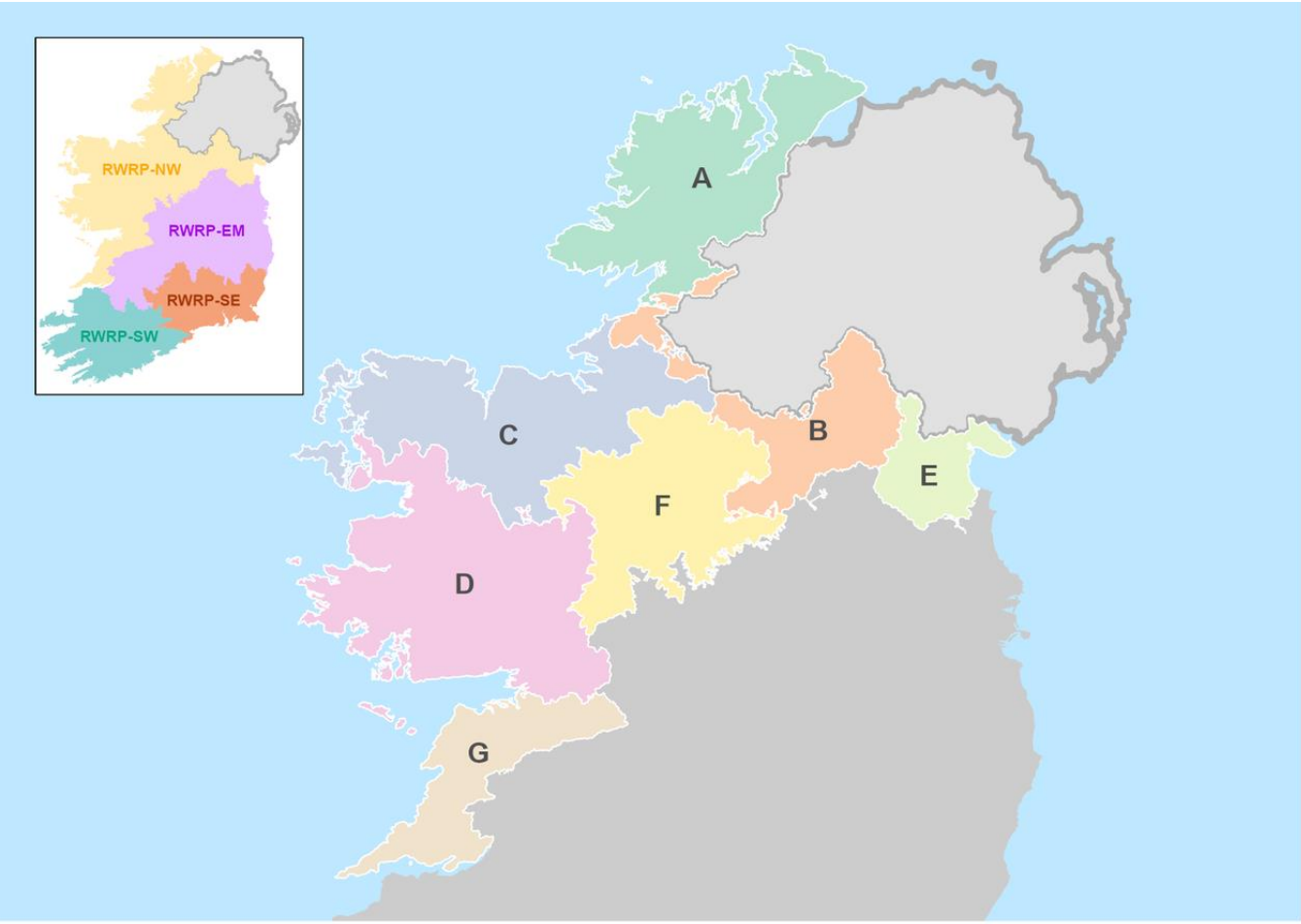


Figure 2.1 Location of the North West Region

The North West Region includes 13 counties: Galway City, Galway, Leitrim, Mayo, Roscommon, Sligo, Cavan, Donegal, Monaghan, Longford, Louth, Meath and Clare. It covers approximately 26,900 square kilometres (representing about 40% of the Republic of Ireland) and extends from the Shannon Estuary on the southern boundary of County Clare to County Donegal, which borders Northern Ireland. Galway City is located in the south west of the region lying on the River Corrib between Lough Corrib and Galway Bay and comprises 19% of the regional population. The area also includes eight (8) islands off the coast Ireland, namely Inishmore, Inishmean, Inishere, Inisboffin, Inishturk, Clare Island, Achill Island and Arranmore Island.

The predominant land use is agriculture, representing 57.4% of the total land area[1]. Natural habitats and forested areas comprise 31.7% and 9.5% of the land area, respectively. Urban areas cover just 1.2% of the region with industry and other minor land use categories making up the remaining 0.2%. The highest population density is in the west including Galway City and the surrounding area. Irish Water supplies around 369 million litres of water per day to a population of 732,700 people and 74,000 businesses in the North West Region. This represents 21% of our total supply nationally. It should be noted that in some rural areas there are small communities served by group and private schemes that do not receive a supply from Irish Water's networks.

2.1.2 Study Areas in the RWRP-NW

The seven (7) SAs making up the North West Region, and the cities, Key Towns and principal settlements (population greater than 10,000) located within them, are shown in Figure 2.2. Table 2.1 gives the area of each SA and lists the principal settlements located within them.

There are seven (7) Key Towns that are identified in the Northern and Western Region Regional Spatial and Economic Strategy (RSES) including Ballina, Castlebar, Cavan, Carrick-on-Shannon, Monaghan, Roscommon, and Tuam. These represent settlements that "will play a significant role in strengthening the urban structure of the Region…. based on their strategic location and influence". It is envisaged that local authorities will plan for significant growth in these towns. Castlebar is the largest of the Key Towns, with a population of approximately 12,100.

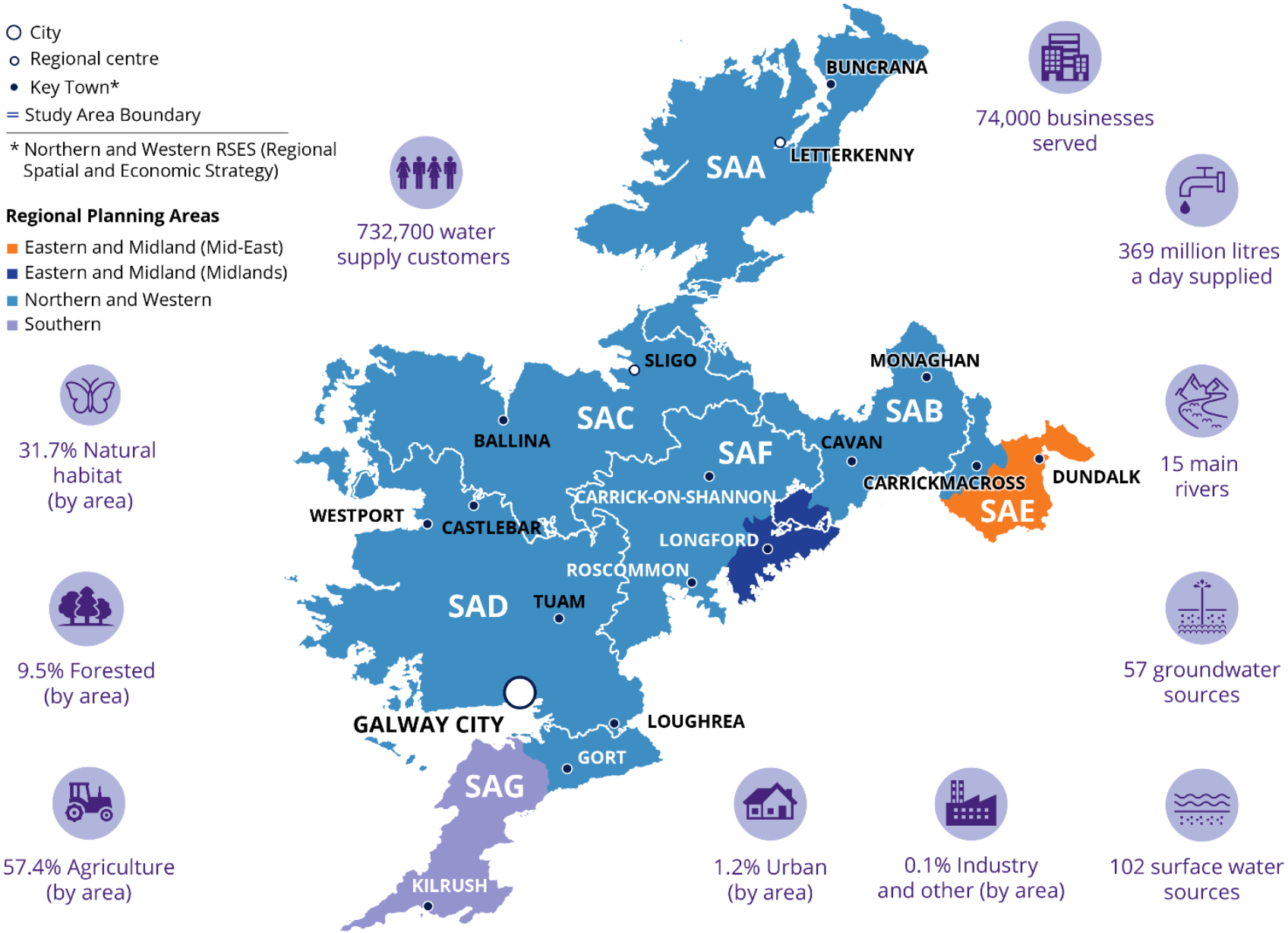


Figure 2.2 Study Areas of the North West Region and Key Regional Statistics

Table 2.1 Study Areas of the North West Region

Study Area	Description
SAA Donegal	SAA total area is approximately 4,630 km^2 and lies within the Donegal County. The principal settlement (with a population of over 10,000) within SAA is Letterkenny (CSO, 2016)[2].
SAB Cavan and Monaghan	SAB total area is approximately 2,790 km^2 and lies within the counties of Cavan, Monaghan, Leitrim, Longford, Donegal and Sligo. The principal settlement (with a population of over 10,000) within SAB is Cavan (CSO, 2016)[2].
SAC Mayo and Sligo	SAC total area is approximately 5,150 km^2 and lies within the counties of Mayo, Sligo, Leitrim, Cavan, and Roscommon. The principal settlements (with a population of over 10,000) within SAC are Sligo, Castlebar and Ballina (CSO, 2016)[2].
SAD Galway and Mayo	SAD total area is approximately 6,700 km^2 and lies within the counties of Galway, Mayo, Roscommon and Galway City. The principal settlement (with a population of over 10,000) within SAD are Galway City and suburbs, and Castlebar (CSO, 2016)[2].
SAE Louth	SAE total area is approximately 1,260 km^2 and lies within the counties of Louth, Monaghan, Meath and Cavan. The principal settlement (with a population of over 10,000) within SAE are Drogheda and Dundalk (CSO, 2016)[2].
SAF Roscommon and Leitrim	SAF total area is approximately 3,990 km^2 and lies within the counties of Roscommon, Leitrim, Longford, Galway, Sligo, Cavan, Mayo and Westmeath. The principal settlement (with a population of over 10,000) within SAF is Longford (CSO, 2016)[2].
SAG Clare	SAG total area is approximately 2,390 km^2 and lies within the counties of Clare and Galway. There are no principal settlements with a population of over 10,000 within SAG. The largest settlements (with population of over 2,000) within SAG are Gort and Kilrush (CSO, 2016)[2].

The population within the North West Region is served by 119 independent water supply systems defined by WRZs. Of the 119 WRZs, 10 WRZs are supplied water from Group Water Schemes (GWS) within the North West Region and four (4) WRZs are supplied via small imports from Northern Ireland Water. Thirty one percent (31%) of the regional population is in SAD (Galway and Mayo) which comprises Galway City, whilst a further 20% of the region's population is located in SAA (Donegal). Table 2.2 gives the population served by Irish Water and the number of WRZs in each Study Area.

Table 2.2 Study Area Population and Number of WRZs

SA No.	SA Name	Counties in SA	Total Population Served* (2019)	% of Regional Population	No. of WRZS
SAA	DONEGAL	Donegal	149,600	20	19
SAB	CAVAN & MONAGHAN	Cavan, Monaghan,Leitrim, Longford, Donegal and Sligo	58,270	8	22
SAC	MAYO & SLIGO	Mayo, Sligo, Leitrim, Cavan and Roscommon.	96,790	13	17
SAD	GALWAY & MAYO	Galway, Mayo, Roscommon and Galway City	228,610	31	25
SAE	LOUTH	Louth, Monaghan, Meath and Cavan	84,050	12	9
SAF	ROSCOMMON & LEITRIM	Roscommon, Leitrim, Longford, Galway, Sligo, Cavan, Mayo and Westmeath	85,570	12	15
SAG	CLARE	Clare and Galway	29,800	4	9
draft RWRP-NW Area Total			732,700	100	116**

* Population numbers are rounded to the nearest 10. The population for each WRZ includes the population presently served by Group Water Schemes.

** This number excludes three (3) of the four (4) WRZs that are supplied by small imports from Northern Ireland Water as we do not have detailed data for these WRZs.

2.2 Growth and Development

2.2.1 Current Population

The North West Region has a population of 732,700 (18% of the national population), with 139,300 people (26% of the regional population and 3% of Ireland's population) located within Galway City[2]. There are 10 settlements with a population of over 10,000 people. These are listed in Table 2.1 above. There are a further seven (7) settlements with a population of over 5,000[2] including Buncrana, Monaghan, Tuam, Westport, Loughrea, Carrickmacross and Roscommon. Fifty-four percent (54%) of the region's population live in settlements of less than 5,000[2]. Figure 2.3 shows the population density across the region, highlighting smaller population centres and illustrating how much of the region is sparsely populated, resulting in the need for numerous small independent water supply systems.

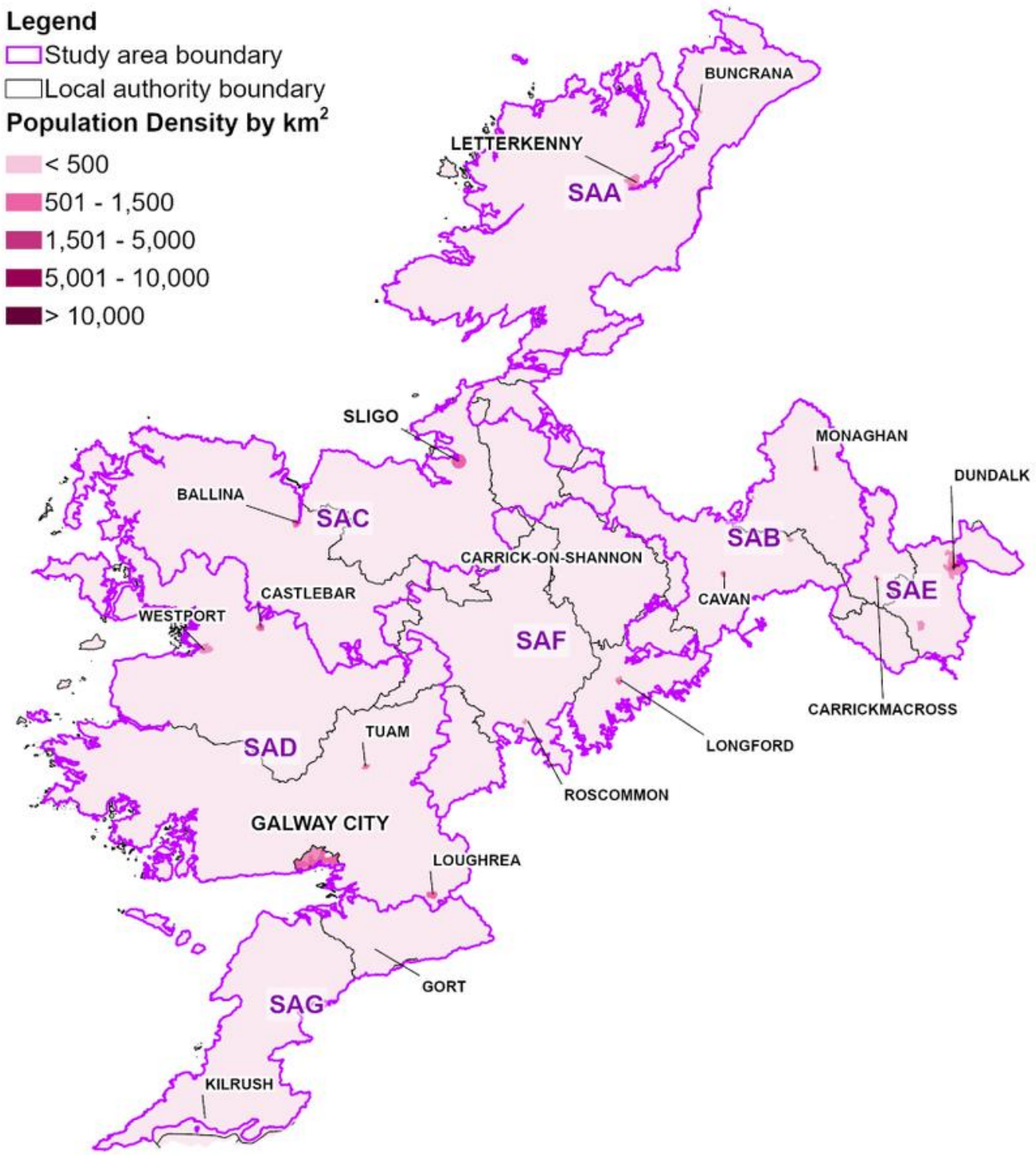


Figure 2.3 Population Density[2]

2.2.2 Growth and Economic Development Policies

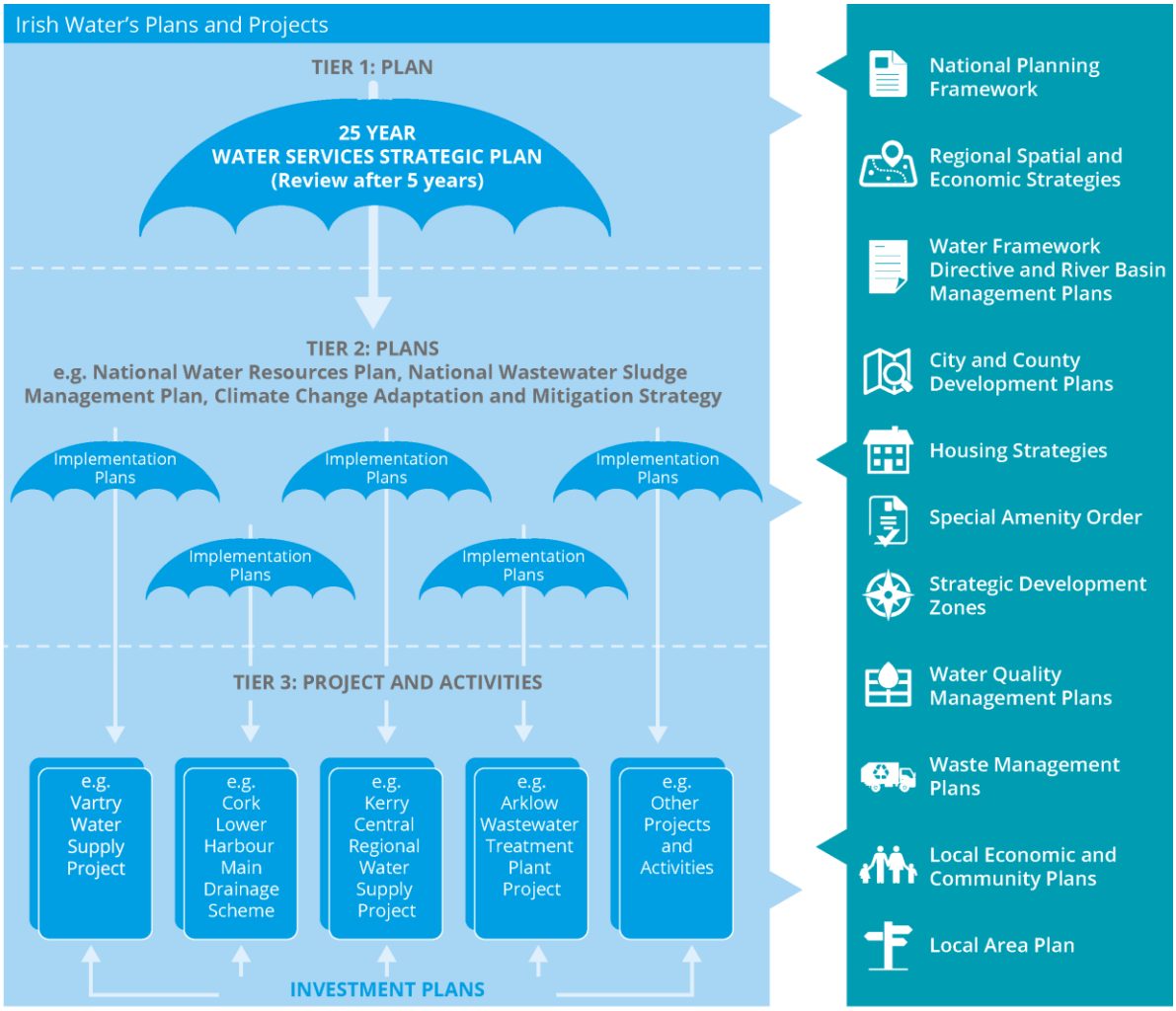
Irish Water's National Water Resources Plan (NWRP), which will comprise this draft RWRP-NW and the three (3) other regional water resource plans (Eastern and Midlands, South West and South East), is being developed to ensure water infrastructure can support the proposed growth policies at national, regional and county level. Supporting the National Policy Objectives (NPOs) and Regional Policy Objectives (RPOs) within the National Planning Framework (NPF)[3] and Regional Spatial and Economic Strategies (RSESs) is central to our NWRP.

The National Planning Framework (NPF) is the overarching policy setting out priorities for growth and development at national level over a 25-year period to 2040. A key objective is balancing development across three (3) Planning Regions, with 50% of future growth and development concentrated in the Eastern and Midland Planning Region and the other 50% directed towards the Northern and Western Region and the Southern Region.

The national objectives are then set out at regional level in the RSESs. There are three (3) regional assemblies – East/Midland Region, Southern Region, North West Region – which published RSESs for their respective regions in 2020. The RSES is a 12-year regional plan (2019-2031) which primarily aims to support the delivery of the programme for change set out in Project Ireland 2040, the National Planning Framework (NPF) and the National Development Plan 2018-27(NDP)[4].

At county level the regional policy is implemented through County/City Development Plans (CDPs), Local Area Plans (LAPs) and Metropolitan Strategic Plans (MASPs). The County Development Plan sets out the priorities within each local authority area for development over a 6-year timeframe.

The Office of the Planning Regulator (OPR) evaluates, assesses, and makes observations on the RSESs, CDPs and LAPs (including growth projections) to ensure they are in accordance with planning policy. The interaction between the planning system and Irish Water's plans and programmes is summarised in Figure 2.4 below.



It should be noted that the listing of the documents on the right of the graphic is not intended to show a hierarchy of plans or an alignment of the plans with the Irish Water Tier 1, Tier 2 and Tier 3 plans/ projects.

Figure 2.4 Interaction between the Planning System and Irish Water's Plans and Programs

Irish Water continually engages and interacts with the relevant public bodies in the planning process at all levels: national, regional and county level. Irish Water is committed to taking account of national, regional and local spatial planning policy when developing investment planning (including the NWRP process) within technical, environmental, and budgetary constraints (and taking into account our sustainability policy).

The National Planning Framework recognises that "investment in water services infrastructure is critical to the implementation of the National Development Plan". Irish Water's NWRP has been developed to ensure that water infrastructure can support the proposed growth policies at all three planning levels.

The draft RWRP-NW falls within the region of the Northern and Western Regional Assembly.

2.2.3 Population Forecasts in the RWRP-NW

Growth projections used within our draft RWRP-NW are based on best available data from the NPF and RSESs at the time of compiling the draft plan. The growth projections for the cities were taken from the NPF and RSESs, and projections for the Regional Growth Centres and Key Towns were taken from the RSESs. For all other areas, the growth projections were taken from the Draft NPF.

In addition, we recognise the ongoing work between the Regional Assemblies and the Local Authorities over the course of the development of the Local Authority County/City Development Plans and the MASPs. As these plans are finalised, Irish Water will incorporate the increasingly refined growth rates into our demand forecasts – see Section 2.2.3.1 below for further details. The demand forecasts are used in our Supply Demand Balance calculations to determine future water supply deficits in the region.

The projected population used in our demand forecasts for WRZs at our regional planning Study Area level is shown in Table 2.3.

Table 2.3 Study Area Population Growth (2019 to 2044)

SA No.	SA Name	Total Population* (Source: CSO, 2016[2] and IW population projections)		Change in Population
		2019	2044	%
SAA	DONEGAL	149,600	180,150	20
SAB	CAVAN AND MONDAGHAN	58,270	69,880	20
SAC	MAYO AND SLIGO	96,790	119,880	24
SAD	GALWAY AND MAYO	228,610	298,870	31
SAE	LOUTH	84,050	108,590	29
SAF	ROSMCOMMON AND LEITRIM	85,570	104,480	22
SAG	CLARE	29,800	35,740	20
	TOTAL	**732,700**	**917,580**	**25**

* Population values are rounded to the nearest 10

The overall regional population growth is 25% from 2019 to 2044. All SAs in the North West Region have a projected growth rate that exceeds the 12% national rate observed in the 10-year period from 2006 to 2016. The Galway and Mayo Study Area (SAD) has the highest projected growth rate at 31% between 2016 and 2044, which is driven by the Galway City forecast growth of 50-60%[3] by 2040.

The population growth at a WRZ level is presented in Figure 2.5. The figure shows the higher growth rate projections of Galway City and surrounds as well as the Regional Centre of Sligo. It should be noted that settlements and associated growth rates are not exactly aligned with the existing water supply asset base, as our water supplies can serve large areas covering urban and rural settlements through an interconnected asset base. Where this is the case, we have attributed the differing growth rates in proportion to the supply that is in the urban and rural settlements. This ensures that the overall growth is aligned with the NPF (and Draft LAPs, where applicable).

A summary of the population growth rates that we have assumed for the settlements in the draft RWRP-NW is presented in Section 3, which explains the demand forecast projections across the North West Region.

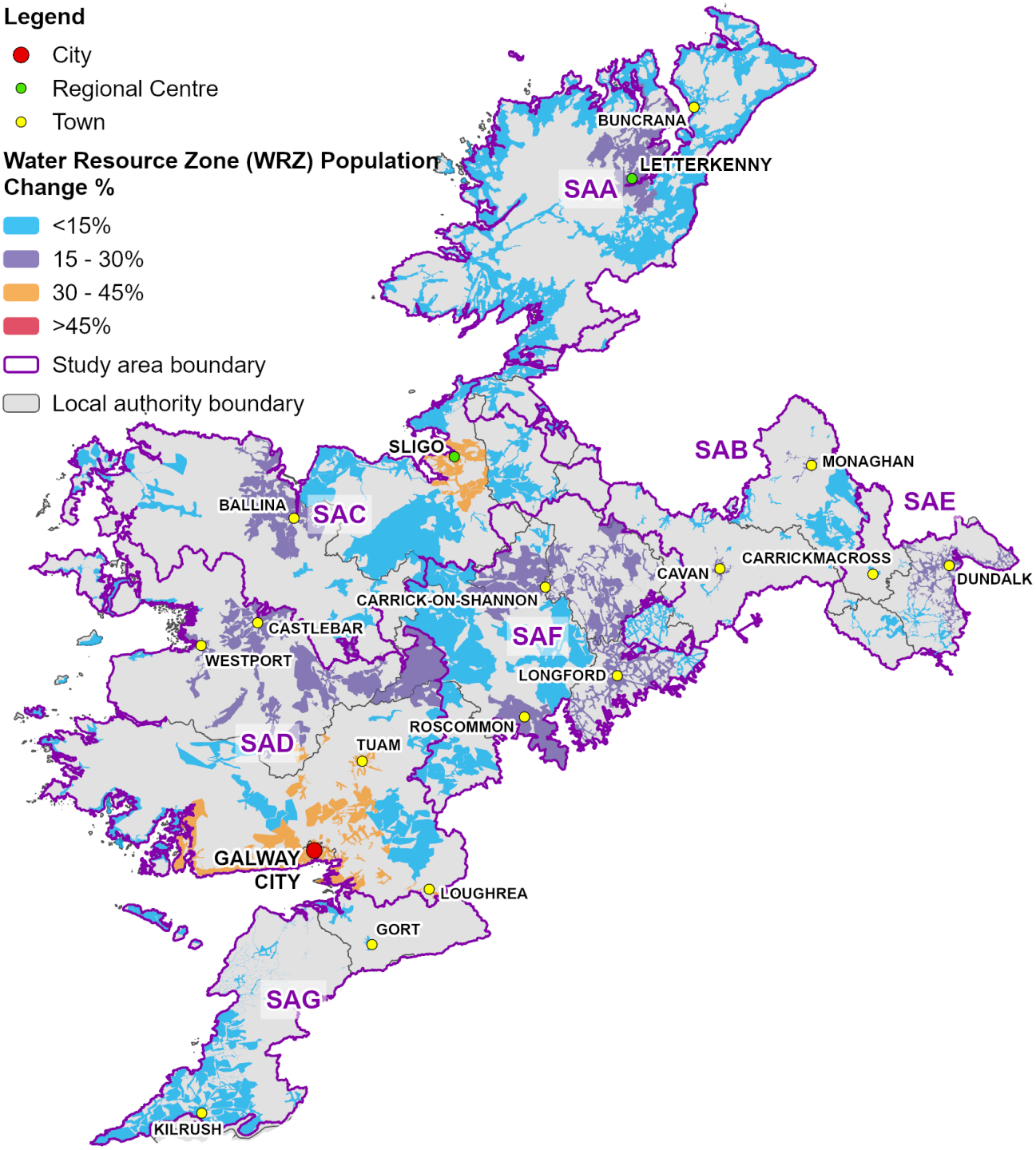


Figure 2.5 Percentage Change in Population (2019 to 2044) for WRZ's in the North West Region

2.2.3.1 Future Updates to Growth Projections

We recognise the ongoing work between the Regional Assemblies, the Office of the Planning Regulator and the local authorities over the course of the development of the Local Authority County/City Development Plans and the Galway City Metropolitan Area Strategic Plan (MASP). As these plans are finalised, Irish Water will incorporate the increasingly refined growth rates into our demand forecasts. In addition to the Framework Plan, Irish Water has developed a 10-year capacity register based on the Supply Demand Balance (SDB) to provide Local Authorities with an indication of settlements that have potential capacity constraints. These will be made available for use in Development Plans. This process will involve an ongoing feedback loop between the resources planning process and the forward planning processes in Irish Water, the Regional Assemblies and the Local Authorities. Irish Water will update the

SDB annually in line with the data received. This will allow Irish Water to respond to growth and development needs and prioritise water supply investment in collaboration with Local Authorities and with reference to the County/City Development Plans, LAPS and MASPs.

To account for uncertainty in our estimation of future growth, we have included a headroom allowance (safety margin) in our demand forecast. Given this allowance, we do not anticipate that an update to growth forecasts will significantly change the Plan outcomes. Updated data and information, including new census data, will be incorporated via the monitoring and feedback process outlined in Section 9.

The methods for forecasting water demand utilising the population projections are detailed in the NWRP Framework Plan Section 4. Projections of water demand and the resulting challenges for the North West Region are set out in Section 3 of this draft Plan.

2.2.3.2 Non-Domestic Growth

Within the RSES and the NPF there are also projections of non-domestic growth. The precise nature of the business activity created to drive non-domestic growth can have a significant impact on water demand as non-domestic water demand varies enormously from sector to sector and property to property. Therefore, an allowance has been made for non-domestic growth in towns and cities identified as strong growth areas in Project 2040[3]. For other areas it has been assumed that there will be no significant increase in non-domestic demand. Irish Water will facilitate growth in non-domestic water use via efficiency improvements and water conservation. This approach and the assumptions made are described in Section 4.3.2.3 of the Framework Plan. We will review policy and trends in relation to this over the coming years and refine our forecasts as per the monitoring and feedback process set out in Section 8.3.8 of the Framework Plan and Chapter 9 of this draft Plan.

2.2.4 Tourism and Recreation

Tourism has an important role in the region, particularly in rural locations, with the NPF[3] stating that tourism is a key aspect of rural job creation now and in the future. In 2019, over 11.3 million tourists visited Ireland, representing an increase of more than 100k compared with the previous year[5].

The core baseline area encompasses Ireland's Wild Atlantic Way on its eastern edge and extends into Ireland's Hidden Heartlands on its Western side, two of Fáilte Ireland's tourism programmes in the country. Ireland's Wild Atlantic Way is Ireland's first long-distance touring route and aims to achieve greater visibility for the west coast of Ireland[6]. Hidden Heartlands is located in the Mid-West, focussing on rural communities[7].

Key tourist attractions located within the region are described below[8]:

- The county of Galway City (SAD) is known as 'The City of the Tribes' and is a vibrant bohemian city located on the Wild Atlantic Way. The city is known for its historical medieval stone walls.
- The county of Galway (SAs D and G) is known for its coastlines, beaches and lofty mountain peaks including the wilds of Connemara, home to Kylemore Abbey.
- The county of Leitrim (SAs B, C and F) includes the towns Carrick-on-Shannon, Drumshanbo, Ballinamore, Manorhamilton and Dromahair. The county is home to Glencar waterfall, an inspiration to WB Yeats.
- The county of Mayo (SAs C, D and F) contains significant tourist attractions including the Museum of Ireland- Country Life, Céide Fields, Westport House, Foxford Woollen Mills, Michael Davitt Museum and the Jackie Clarke Collection[9].

- The county of Roscommon (SAs D and F) is known for its lakes, historic towns of Roscommon, Boyle and Castlerea). It is home to Lough Key Forest and Activity Park and Strokestown Park House and Garden.
- The county of Sligo (SAs A, C and F) is known for its scenery and remote islands. It is also the home county of W.B Yeats.
- The county of Cavan (SAs B, C E and F) is known as 'The Lake County'. It is home to Belturbet and Ballyconnell from which the River Erne and Shannon-Erne Canal can be explored.
- The county of Donegal (SAs A and B) is known as 'The County of the Gaels' and is home to the Derryveagh Mountains and Lough Eske. Malin Head is Ireland's most northerly point and is renowned for its landscape and beaches.
- The county of Monaghan (SAs B and E) is known for its rolling landscape and bountiful lakes. It is home to Glaslough, home to the Castle Leslie Estate, and Clones which hosts a number of festivals including the Flat Lake Festival.
- The county of Longford (SAs B and F) is known as 'Ancient Longford'. The town of Longford is full of history and has a thriving arts scene.
- The county of Louth (SAE) known as 'The Wee County' and is home to medieval Carlingford, Dundalk Bay, Cooley mountains and Clochafarmore's Standing Stone.
- The county of Meath (SAE) is known for its ancient history and busy towns.
- The county of Clare (SAG) is known for its coastline carved by the Atlantic, including the Cliffs of Moher. It is home to the holiday towns of Kilkee, Lahinch (home to Dough Castle) and Doolin (home to the longest free-hanging stalactite in the Northern Hemisphere).

Ireland's natural heritage is also recognised as an important tourism asset by the Department of Transport, Tourism and Sport[10]. Key natural heritage and outdoor recreation attractions within the region include:

- Study Area A: Glenveagh National Park, Lough Barra Bog Nature Reserve, Pettigo Plateau Nature Reserve, Sliabh Liag Cliffs, Inch Wildfowl Reserve and Silver Strand.
- Study Area B: Cavan Burren Park, Tullydermot Falls, Glangevlin, The Shannon Pot
- Study Area C: Ballygilgan Nature Reserve, Easkey Bog Nature Reserve, Knockmoyle Sheskin Nature Reserve, Céide Fields, Ballycroy National Park and Lough Cullin.
- Study Area D: Oldhead Wood Nature Reserve, Derryclare Nature Reserve, Leam West Bog Nature Reserve, Connemara National Park, Lough Corrib and Lough Mask.
- Study Area E: Lough An Leagh, Lough Muckno, Senator Bill Fox Memorial Park and Slieve Foy.
- Study Area F: Lough Allen, Lough Key, Termonbarry Harbour and Killykeen Forest Park.
- Study Area G: Cole Park Nature Reserve, Keelhilla (Slieve Carron) Nature Reserve, Ballyteigue Nature Reserve, The Burren National Park and Aillwee Cave.

Rivers, loughs and coastal areas across the region also make an important contribution to tourism and recreational opportunities and support important fisheries. For example, the River Shannon, which is the longest river in Ireland (and the British Isles) at approximately 360 km in length, is an important transportation route. The River Shannon is also connected to the River Erne via the Shannon-Erne Waterway. The River Erne is noted for fly fishing for trout and salmon[11]. The River Moy, which straddles counties Mayo and Sligo, is known as the premier salmon river in Ireland[12].

In planning our water resource infrastructure, we consider the increase in water demands resulting from the influx of tourists, particularly during summer months when local demand is elevated. In cases where

the holiday population is high relative to the resident population the demand peaks may be pronounced during hot, dry weather periods in the summer season. We have accounted for the impact of tourism in our water demand forecasts. This is further explained in Section 3.2.6

2.2.5 Impact of the Covid-19 Pandemic

We recognise that data relating to population forecasts, economic trends and tourism are based on information gathered before the Covid-19 pandemic. Therefore, trends and patterns may need to be revised as enough data and information is available to understand the long-term impact of the pandemic. Key considerations will include potential changes to demographics in relation to commercial and office settings, changes in hospitality and tourism impacts. Irish Water will incorporate any future changes as outlined in the monitoring and feedback process summarised in Chapter 8 of the Framework Plan. One of the benefits of a more interconnected water supply network will be the flexibility to adapt to changing growth patterns.

2.3 Natural Resources

A sustainable supply of clean water to support our growing communities depends on our understanding and protection of natural resources. At a fundamental level this includes the catchment that feeds surface water and groundwater bodies and the extent of ecosystem services that these waterbodies provide. Improving sustainability is at the heart of our plans and the NWRP assessment methodology incorporates Strategic Environmental Assessment (SEA) objectives into the decision-making process. This includes taking account of cumulative impacts within catchments. Examples of waterbodies that provide substantial environmental, social and cultural values for communities in the North West Region include Lough Veagh in Glenveagh National Park, and Lough Corrib and Lough Mask in County Galway and County Mayo. The River Shannon and its tributaries, along with the River Erne and Moy, are important for fishing and transportation.

Our freshwater systems support the provision of drinking water needs, livestock and firefighting as well as other uses including industry, irrigation, electricity generation, and recreation and amenities. In our planning, Irish Water recognises that in addition to anthropogenic uses, our freshwater resources also need to sustain habitats that rely on the quality, flows and volumes within these systems. We endeavour to protect aquatic environment/habitat by maintaining water quality, physical habitats, hydrological processes, flow regimes and broader biological diversity.

In the following sections we describe the features of our natural environment that impact water quality and describe the sensitivities of the riverine ecology to changes in the flow regime. This is an important consideration for understanding the impact of abstractions and hydromorphological modifications (such as large-scale damming and channelisation). We account for these impacts by limiting new abstractions to sustainable flow thresholds. This is discussed further is Section 2.3.7. We describe the environmental status of our surface water bodies and ground water systems in Section 2.3.5 and Section 2.3.6.

2.3.1 Geology

Understanding the geology of our catchments is vital to the provision of clean, secure and sustainable water supplies. Geology is responsible for shaping mountain ranges, defining river network systems and determining their character, i.e., slope and erosivity. The geology in the environment can impact the quality and quantity of water in the area through differences in drainage, chemical composition, filtration and resultant land use. The water supply can be heavily impacted by the type of aquifer in the area, as they impact the system’s ability to store and transmit groundwater. The resultant land use can have a detrimental impact on water quality.

The bedrock geological maps developed by the Geological Society of Ireland (GSI) are the foundation maps upon which groundwater protection and vulnerability maps have been constructed and upon which Water Framework Directive (WFD) groundwater bodies and monitoring programmes have been established by the Environment Protection Authority (EPA). In general, the topography and its associated geological deposits can be broadly split into topographic highs and lowland valleys. Considering the extent of glaciation during the last ice age the Irish landscape can be considered a glacial one. Bedrock outcrop often prevails in the mountainous areas, while the remainder of Ireland's bedrock is generally overlain by glacial material or glacially influenced materials (river alluvium, peat or coastal deposits).

The oldest geology of the North West Region, and indeed the country, comprise gneisses, schists (pelites and psammites), quartzites, and marbles formed during the Precambrian Period, 2,000 – 541 million years ago (mya). These represent 22% of the geology of the region, consisting of highly complex metamorphic rocks. Most of them originated as sedimentary rocks such as limestones (which became marbles), sandstones (which became quartzites or psammites) and mudstones (which became schists or pelites). Their main occurrence is in the Co. Donegal, northwest Co. Mayo and the Ox Mountains, and in the Maamturk Mountains in Connemara.

The Ordovician and Silurian Periods, when present day northwest and southeast Ireland lay along the margins of separate continental masses and divided roughly along the Shannon Estuary, represents a relatively minor proportion (13%) of the North West Regions' bedrock geology. During the closure of the Iapetus Ocean, the subduction of oceanic crust was responsible for the formation of a volcanic island arc. These volcanic rocks were erupted and intruded into the Silurian marine sedimentary sequences, which include greywackes, mudstones, lavas and tuffs. These can be found in southwest Co. Mayo and form a belt which runs from the Co. Down coast to Co. Longford, known as the Longford-Down inlier.

Granites and other intrusive igneous rocks were intruded in Connemara and Donegal during the Devonian Period (c. 419 - 370 mya). They are all complex bodies and range widely in composition. Abundant minor granitic dykes accompany all the granites. The various granites of Connemara are differentiated on the basis of their mineralogy and by changes in their colour and texture. Pale cream coarsely crystalline pegmatite veins, consisting mainly of quartz, are present. The Devonian Old Red Sandstones (ORS) only form a very minor proportion (2%) of the bedrock in the region, compared to the south, and can be found in north Roscommon and Mayo.

Most of the bedrock geology of the North West Region (48%) falls into the Lower Carboniferous period (350 mya), which consists of a mixture of sandstone, limestone and shale, and these represent the transition from terrestrial to marine depositional conditions. During the transgression of the warm, shallow sea limestone sediments ,derived from the breakdown and disintegration of calcareous shells of invertebrate animals, were deposited. They are present in the lower lying areas, notably in the Shannon Basin underlying much of east Galway, Mayo and Co. Roscommon and Leitrim. The Upper Carboniferous (325 mya) is represented by 6% of the North West Region, dominated by deep water shales in the lower Namurian sequence, while the upper portions are generally sandstones and siltstones. These occur mainly in West Clare with smaller occurrences in Leitrim.

2.3.2 Groundwater Aquifers

The geology of our catchments is vital to the quantity and quality of water which we can abstract. The quantity of water which can be abstracted from a groundwater source is impacted by the depth, porosity and connectivity of the target geological formation/layer. Geological horizons such as clay and igneous rocks have limited porosity and are therefore low yielding (poor aquifers) whilst geological formations such as chalk and limestone are associated with higher porosities and can yield substantial quantities of water (good aquifers). For water to move through an aquifer the internal voids and fractures must be connected. The porosity and degree of fracturing and interconnectivity therefore impacts not just the

available quantity of water but also the level of recharge of the groundwater body. This in turn impacts the potential sustainable abstraction rate.

About 12% of the water supply for the North West Region is abstracted from underground aquifers, either from boreholes, springs or infiltration galleries. Whilst only 12% of our water supply for the North West Region is sourced from groundwater supplies, 57 of our 159 supply sources are groundwater sources. Therefore, whilst our groundwater sources do not contribute as much to supply in volumetric terms, they still represent an important source of supply serving independent settlements within the region. The major aquifers in the North West Region are shown in Figure 2.6.

Geological Survey Ireland has classified and mapped nine (9) aquifer categories across the country. The broad criteria used to determine aquifer categories include hydrogeological data, the presence of large springs, geology and stream density. The categories describe both resource potential/value (Regionally important, Locally important, or Poor) and groundwater flow type (through fissures, karst conduits or intergranular porosity):

- Regionally important bedrock aquifers are defined as those that can service public water supplies or that have excellent yields (>400 cubic meters per day (m^3/day)). The aquifer area is >25 km^2 and flow is predominantly though fractures, fissures and joints.
- Locally important bedrock aquifers are defined as those that can service more local public water supplies/group schemes or that have good yields (100-400 m^3/day). Flow is predominantly though fractures, fissures and joints.
- Poor bedrock aquifers are defined as those that can service small abstractions (domestic supplies/small group schemes) or that have moderate-low yields (<100 m^3/day). Flow is predominantly though a limited and poorly-connected network of fractures, fissures and joints.

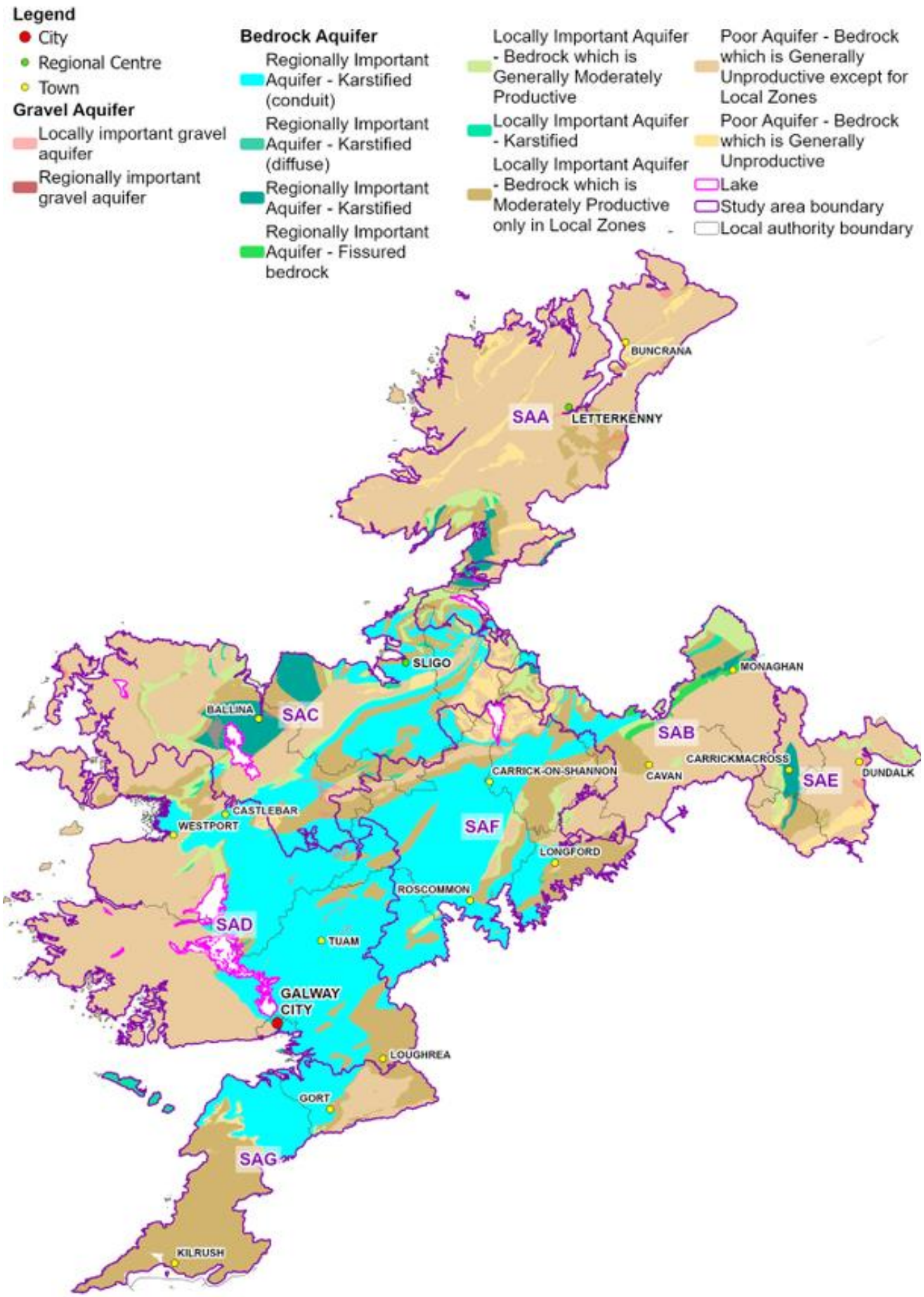


Figure 2.6 Spatial Extent of Major Aquifers in the North West Region

Additionally, GSI usefully grouped and summarised the aquifer categories into high-level groupings that succinctly describe the broad types:

- Sand/gravel;
- Karstic;
- Productive fissured bedrock; and
- Poorly productive bedrock.

Sand and gravel aquifers are classed as an aquifer if the deposit is highly permeable, more than 10 m thick and greater than one square kilometre in areal extent. The thickness is more often used than the more relevant saturated thickness as the data for this is often not available.

These general types of aquifers can be considered as groundwater systems that have similar properties with a good indication of resource, extent and risk. Table 1.2 in Appendix C of the Framework Plan describes the nine (9) aquifer categories in detail.

The predominant aquifer type of the North West Region, is made up of poorly productive bedrock (62%), followed by karstic aquifers (28%). The productivity of the Dinantian (Lower Carboniferous) aquifers depends on the nature and concentration of faults and fissures. Dinantian (early) Sandstones, Shales and Limestones Group comprise a mixture of siltstones, sandstones, mudstones, shales and limestones. Overall, the interbedding will tend to limit vertical permeabilities and groundwater flow systems will be localised. Permeability is generally low but may be higher in the sandstone and limestone beds, and substantially higher in certain areas, particularly in Co. Monaghan and Co. Cavan. Zones of higher permeability may be found in the above formations nearer faults and in the upper weathered fractured zone of the top 10-30 m. Groundwater flow in the lesser productive Dinantian Shales and Limestones circulates primarily though fissures as these rocks do not show significant intergranular permeability. These rocks occur primarily in the north and northwest of Ireland, in counties Monaghan, Cavan, Leitrim, Donegal and Sligo, and are predominantly interbedded shales and limestones, with little or no sandstone content. Development will usually be possible in local zones (i.e., along faults, fractures and zones of clean limestone). There are also large swathes of Dinantian (Lower Carboniferous) Impure Limestones which are interleaved with the Pure Bedded Limestones. The limestones are often characterised by the occurrence of chert and shale bands and are generally less productive than the Pure Bedded Limestones.

A number of large granite intrusions cover extensive areas, such as the Donegal Granite (949 km^2) and the Galway or Connemara Granite (701 km^2). Although fractured, these rocks generally have a low permeability and are poor aquifers. Lastly the Precambrian rocks consist mainly of gneisses, schists (pelites and psammites), quartzites, and marbles and can be found in Co. Donegal, northwest Co. Mayo and the Ox Mountains, and in the Maamturk Mountains in Connemara. The development potential of the Precambrian rocks is very limited. The marbles may contain some solutionally enhanced permeability zones which could provide a domestic or farm supply or small group water scheme.

The karst forms a key regionally important aquifer in some areas, particularly in the Burren, the Gort-Kinvara area, in Co. Roscommon, and the north-western Plateau (counties Sligo, Leitrim and Cavan). Limestone dissolution during karstification causes groundwater flow to concentrate along certain pathways/conduits, making it difficult to locate successful wells. Bare rock and thin subsoils are common across much of the area meaning groundwater is vulnerable to pollution, thus creating difficulties when it comes to water supply and pollution prevention. Although recharge is high due to high rainfall coupled with low evapotranspiration and shallow/bare rock, there is relatively low storage capacity among the limestones. Aquifer storage is low, and rapid flow-through means that the conduit karst aquifers are typified by erratic and unpredictable groundwater supplies, both from wells and springs. Large springs are characteristic of pure bedded limestones, especially in the West, and indicate a bulk permeability high enough to permit the throughput of substantial quantities of groundwater.

Groundwater flow in the productive fissured aquifers largely takes place along fractures and faults. Where extensive faulting occurs, such as in the Monaghan-Clones area, the aquifer permeability is likely to be increased. Additional, fracturing may also be associated with the faulting. Where clean limestones are present, dissolution may occur along faults, fractures and bedding planes, widening them and enhancing the permeability. Although lower permeability fine grained shale beds are interbedded in some areas, they can serve as supply routes for large amounts of water due to the interconnectedness caused by the faulting. This is evidenced by the high yields in some of the wells at Monaghan, with the entire scheme capable of supplying upwards of 2 million liters per day (Ml/day). Similarly, the Kingscourt Sandstone aquifer, mapped as a small band to the southwest of Carrickmacross in counties Cavan, Meath and Monaghan, are capable of supplying significant quantities of water. The Mullantra borehole of the Kingscourt PWS typically supplies 375 - 435 m^3/day (0.375 to 0.435 Ml/d).

The differing spatial extents and permeabilities of sand/gravel aquifers results in a variable development potential. They act as areas for groundwater filtration owing to the intergranular flow mechanics, which offers good protection against microbial contamination. There are a number of sand and gravel aquifers throughout the region, with the main ones occurring in Co. Mayo. The Moy Sand and Gravel groundwater body acts as a discharge zone for the Killaturly springs and the Charlestown spring. The gravel body, although classified by the GSI as a 'Locally Important Sand and Gravel aquifer', is significant, and provides water to several supply schemes in the region. The sand/gravel deposits, when overlying areas of bedrock aquifers, can improve the overall flow and storage to the aquifer and also protect against pollution. Conversely, groundwater from the bedrock can feed into the gravel under certain conditions. This can be seen at Killaturly groundwater scheme, where groundwater in the limestone discharges into the overlying sand and gravel body, under inferred upward hydraulic gradients.

2.3.3 Surface Water Systems

Relative to other European countries, Ireland has twice the EU average of lake coverage (12,000 lakes covering ~2% land area)[13]. In the North West Region there are 638 lakes covering approximately 3% of the region's land area (740 km^2). The six (6) largest lakes make up about 50% of the lake coverage in area - Lough Corrib (Upper and Lower), Lough Mask, Lough Conn, Lough Allen and Lough Erner (Upper). The larger known rivers within this region include the Shannon, Suck, Erne, Moy, the Clare-Corrib and the Inny, however, they represent only a fraction of the extensive 33,670 km network currently mapped by the EPA in the North West Region. Our surface water river systems are shown in Figure 2.7 and described below for each Study Area.

Study Area A (SAA) encompasses the Donagh Moville, Lough Swilly, Gweebarra Sheephaven, Foyle and Donegal Bay North catchments. It also includes seven (7) peninsulas; Doorin, Fanad, Horn Head, Inishowen, Isle of Doagh, Muckross Head and Rosguill, each of which are drained by a series of small rivers. The Study Area is split by the River Finn which flows west to east, confluencing with the River Mourne at Lifford to create the River Foyle. The River Foyle travels through Northern Ireland before entering Lough Foyle on the north east coast. The River Derg has its source in Lough Derg in the south of SAA. It flows into Northern Ireland joining the River Strule to form the River Mourne.

Study Area B (SAB) is split between the Erne catchment and the Lough Neagh & Lower Bann catchment. Lough Sillan is the source of the Annalee River which flows west through Lough Tacker before passing south of Cootehill, through a series of lakes, and confluencing with the River Erne. SAB is also home to the source of the River Shannon, the Shannon Pot. From here the River Shannon flows south into SAF towards Carrick-On-Shannon before continuing southwards to Athlone (SA5 in the Eastern and Midlands Region of the NWRP (RWRP-EM)) and Limerick (SA8 in the RWRP-EM). The Study Area is also the source of the River Finn in the Foyle catchment, which is known for salmon fishing.

Study Area C (SAC) is divided into three (3) catchments - the Blacksod Broadhaven catchment, the Moy and Killala Bay catchment and the Sligo Bay and Drowse catchment. The study area is home to neighbouring Lough Conn and Lough Cullin which feed into the River Moy. SAC is also home to Lough Gill which flows into river Garavogue which passes near Sligo.

Study Area D (SAD) encompasses the Corrib, Galway Bay North and Erriff Clew Bay catchments as well as sections of the Galway Bay South East, Moy and Kilala Bay and Upper Shannon catchment. It is home to Lough Mask and Lough Corrib as well as smaller Lough Carra. The River Clare flows east to west into Lough Corrib. The River Corrib flows south from Lough Corrib into Galway Bay.

Study Area E (SAE) sits in the Newry, Fane, Glyde and Dee catchment and is characterised by a network of small rivers. The Creggan River flows west to east into Castletown River in Dundalk. The River Dee and the River Glyde confluence in Annagassan in the south of the Study Area where they join the Irish Sea. The River Newry passes through the City of Newry before flowing into Carlingford Lough. The River Fane flows east towards Dundalk Bay with its source being Lough Ross in Northern Ireland.

Study Area F (SAF) consists of the Shannon River catchment, the longest river in Ireland. Lough Allen, Lough Derg and Lough Ree are the three major lakes situated on the River Shannon.

Study Area G (SAG) is located in the Lower Shannon, Galway Bay South East, Shannon Estuary North and Mal Bay catchment. It is characterised by a network of small rivers and streams with the largest being the River Fergus, Inagh and Kichrest.

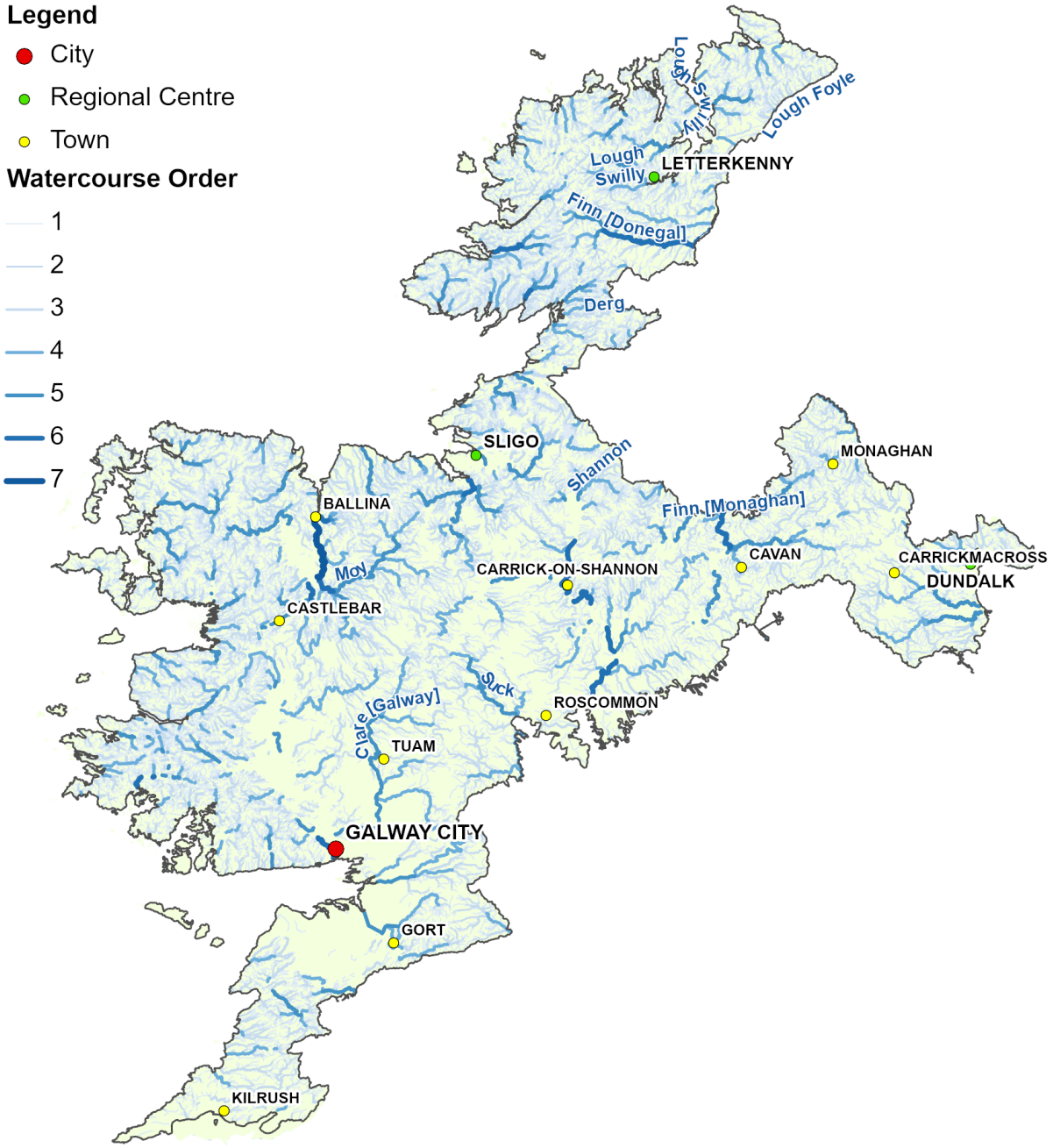


Figure 2.7 Rivers of the North West Region

2.3.3.1 River Typologies

The riverine ecology of many of our river systems is considered highly sensitive to changes in flow and water level. The parameters identified to reflect this sensitivity include geology, gradient and altitude. There are eight (8) typologies for water resources standards for rivers that are defined based on these parameters[14]. The river water bodies in the North West Region comprise five (5) of the eight (8) typologies, as shown in Figure 2.8. The dominant river typology is represented by D2 – Granites and other hard rocks; low-high altitude; and low-medium slope, ultra-oligo trophic with cobble boulder bedrock and/or pebble bed. This makes up 41% (503) of the main river water bodies in the region.

The most sensitive rivers are those within the C2 and D2 categories which are representative of headwaters, low nutrient, low pH and salmonid spawning and nursery areas. The salmonid spawning

and nursery areas are particularly sensitive to low flows and impounding structures. These categories combined make up 71% of the main river water bodies in the region.

The method by which waters of a similar ecological sensitivity are grouped into types for the Water Framework Directive, is referred to as a **typology**. For example, a river may be assigned to types based on altitude and alkalinity.

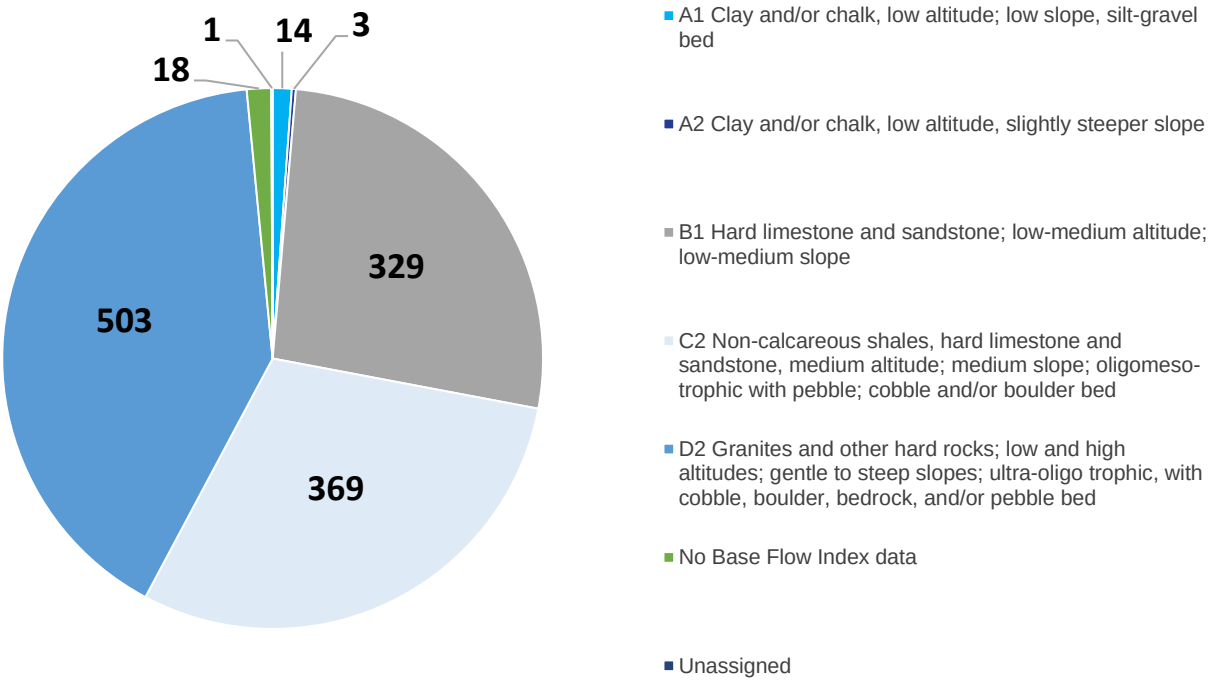


Figure 2.8 Main River Typologies in the North West Region

2.3.4 Groundwater – Surface Water Interaction

Surface water and groundwater interactions are important when considering the quantity of groundwater which can be abstracted, identifying options to support increased water demands and managing the water quality we supply. Interaction between surface water and groundwater can impact groundwater recharge rates, and therefore sustainable abstraction rates, as well as water quality through interactions with sources of pollution.

The degree of karstification is a large factor in controlling groundwater and surface water interaction. This is of importance in Groundwater Bodies (GWB) with protected ecosystems. In these karstified environments any surface water contaminants can be easily transported to groundwater and vice versa. Groundwater and surface water are more closely linked at certain karst features such as springs and swallow holes. Karst formations form regionally important aquifers in the North West Region particularly in the Burren, the Gort-Kinvara area, in Co. Roscommon, and the Northwestern Plateau (counties Sligo, Leitrim and Cavan), as discussed in Section 2.3.2. Bare rock and thin subsoils mean groundwater is vulnerable to pollution, thus presenting challenges for water supply and pollution prevention.

2.3.5 WFD 'Ecological Status' of Waterbodies

Our water planning approach, as set out in the Framework Plan, is developed to meet the environmental objectives of the European Union WFD (Directive 2000/60/EC) and the EPA's River Basin Management Plan (RBMP) (a requirement under the WFD). The WFD contains a standard European approach for managing waterbodies in our natural environment from abstraction to final discharge; while the RBMP outlines the WFD objectives for Ireland. It is underpinned by the following statement, "Water is not a commercial product like any other but, rather, a heritage which must be protected, defended and treated as such"[15]. The EPA coordinate WFD implementation in Ireland and carry out monitoring, assessment and setting of objectives for waterbody status nationally. Under the WFD, waterbodies are assigned an ecological status. The categories of ecological status are described in Box 2.1.

In accordance with the WFD, Irish Water must ensure that all waterbodies achieve 'Good' status by 2027. In addition, under the legislation, any modification to a WFD waterbody should not lead to deterioration in either the overall status or any of the quality elements

Irish Water considers the ecological status through the requirements for abstraction licences and discharge permits. The ecological status impacts drinking water quality and Irish Water work to support the ecological status of waterbodies through our catchment-based management programmes.

Box 2.1 – Water Framework Directive (WFD) River Basin Management Plan Ecological Status Categories

Surface water bodies are classified according to their **ecological status** which is assessed by the abundance of aquatic flora and fish fauna. The biology of a waterbody is supported by the chemistry (including general physio-chemical measurements and chemical pollutants), the hydrology (flow and water levels) and the morphology (physical structure). Hydromorphological quality is only used during the assessment of high ecological status waterbodies. The ecological status shows the influence of pressures (e.g., pollution and habitat degradation) and a good ecological status is defined as 'a slight variation from undisturbed conditions.'

The classification scheme for ecological status for surface water includes five categories: High, Good, Moderate, Poor and Bad. 'High status' means no or very low human pressure, 'Good status' means a 'slight' deviation from this condition, Moderate means a 'moderate' deviation whilst a Poor or Bad status recognises that the waterbody has been affected by an altered habitat and/or is polluted. The ecological status assigned for surface water bodies is determined by the status of the poorest quality element.

Overall status of groundwater bodies is assigned based on the combined chemical (the quality of groundwater) and quantitative element status. Groundwater chemical status is measured by concentrations of pollutants and changes in electrical conductivity in the groundwater body. Groundwater levels are used as one of the measures of quantitative status. Groundwater bodies are classified as either 'good' or 'poor' status.

2.3.5.1 Surface Water

The RBMP considers the actions Ireland will take to improve water quality and achieve "Good" ecological status in surface water bodies (rivers, lakes, estuaries and coastal waters) by 2027. In doing so it influences from where, in what quantities and under what conditions we can abstract water for public water supply. It also sets the legislative framework within which any new abstractions Irish Water develop must conform.

Across Ireland there has been a decline in the number of high-status surface water bodies and increase in the number of surface water bodies with poor ecological status over the last three WFD assessment cycles (2007 - 2009 relative to 2013 - 2018). Declines in ecological status between the last two assessment cycles primarily driven by changes in river water body status. The status of the North West region's surface water bodies, classified using data from 2013 - 2018, is depicted in Figure 2.9. Numerous rivers within the North West Region have reaches which are considered to be of high ecological status. Well known rivers with a high ecological status include the River Blackwater, Duff, Erne, Upper Shannon, Eske, Suck, Moy and Corrib . Study Area E (SAE) is the only study area within the North West Region which does not contain a high-status surface waterbody. Surface water bodies classified as bad status include Donegal Bay North (SAA), Donegal Bay South East (SAD) and Mal Bay (SAG).

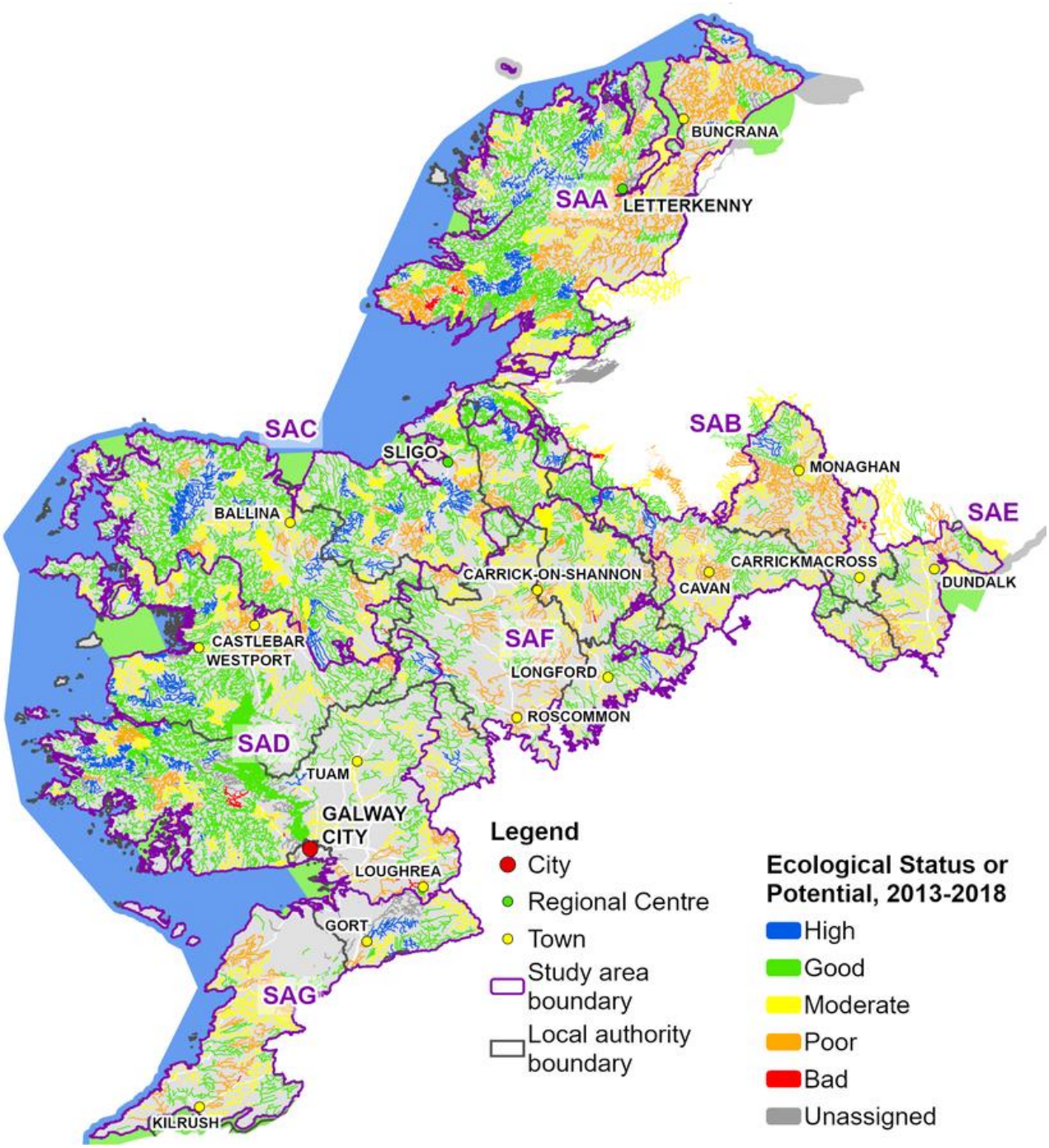


Figure 2.9 WFD 'Ecological Status' of Surface Water Bodies.

2.3.5.2 Groundwater

The bedrock geological maps developed by the Geological Survey Ireland (GSI) are the foundation maps upon which groundwater protection and vulnerability maps have been constructed and upon which Water Framework Directive (WFD) groundwater bodies and monitoring programmes have been established by the EPA.

The North West Region has a total of 216 groundwater bodies (GWBs). GWBs are classified by the EPA as either ‘good’ or ‘poor’ status depending on the outcome of five chemical tests and four quantitative tests. The failing of even one of these tests determines a ‘poor’ status for that waterbody. There are no GWBs in the North West Region that are currently at ‘poor’ Quantitative Status. Eight (8) GWBs are currently at ‘poor’ Chemical Status[16]. These include Tullynafrankagh Turlough GWB, Caherglassaun Turlough GWB, Belcoo Boho GWB, four (4) Waste Facilities GWBs, and one (1) Industrial Facility GWB.

The largest ‘poor’ status groundwater body is located across SAD and SAG and is associated with the Ground Water Dependent Terrestrial Environment (GWDTE) Caherglassaun Turlough. Tullynafrankagh Turlough, located in SAG, also has a ‘poor’ status groundwater status and is a GWDTE. There are four (4) further ‘poor’ status groundwater bodies related to waste facilities in SAA, SAB and SAD. The remaining ‘poor’ status groundwater body is located at Belcoo Boho (Figure 2.10). The remaining 208 GWBs in the region are currently at ‘good’ overall WFD status.

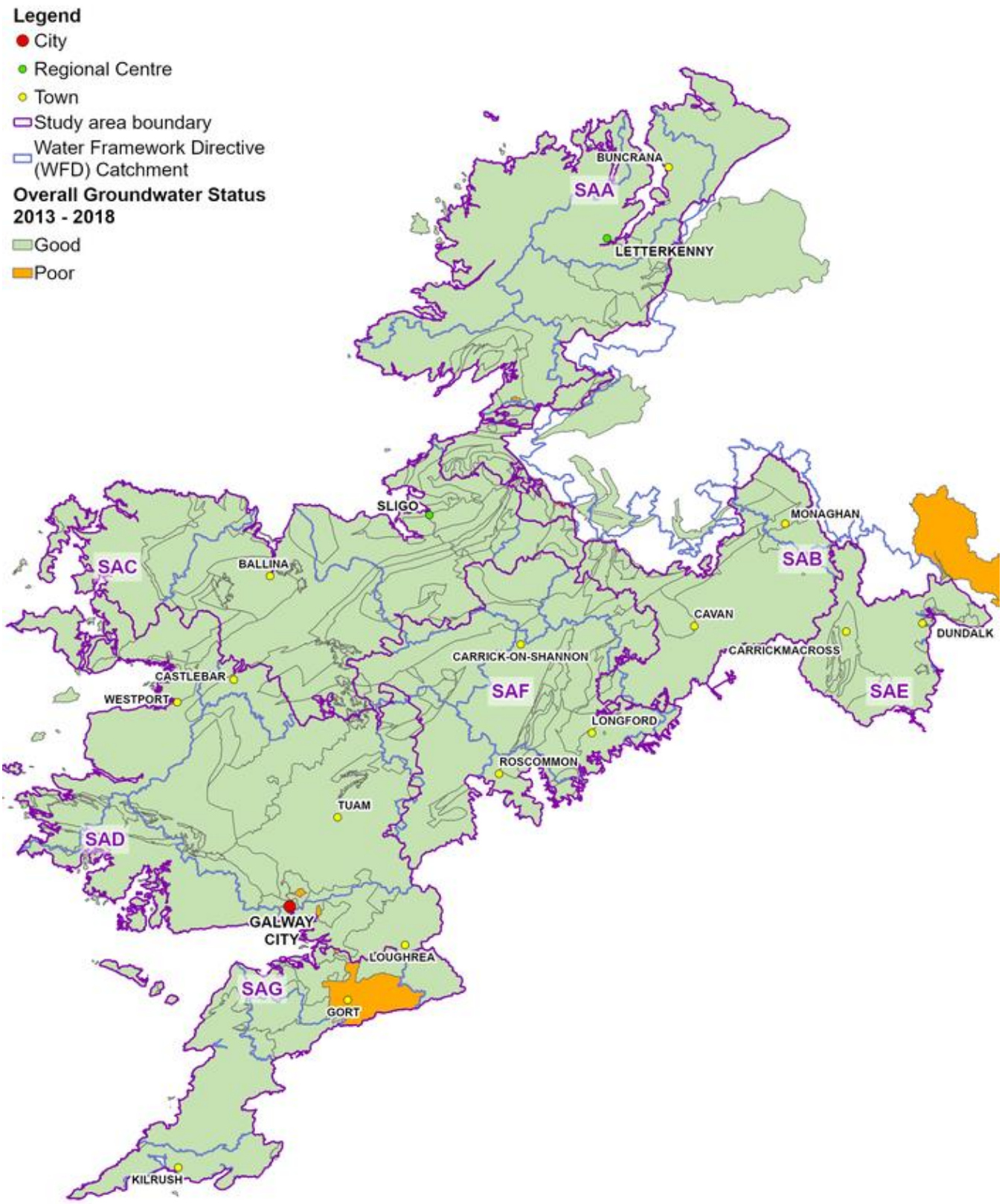


Figure 2.10 WFD Groundwater Body 'Ecological Status' (2013-2018)

Table 2.4 summarises the surface water and groundwater body classification for each Study Area. Across the region, 53% of surface water bodies (SWBs) are at 'High' or 'Good' status, while 14% SWBs are classified as below Moderate Status.

Fifty-five percent (55%) of the 1,252 river water bodies (RWBs) in the region are classified as 'High' or 'Good' status. Twenty-two percent (22%) of the RWBs are classified as 'Moderate condition' whilst 19% are classified as 'Poor' condition and 0.5% or five (5) are identified as 'Bad' Status. The remaining 3% are 'Unassigned'.

Table 2.4 Water Body WFD 'Ecological Status' for each Study Area [17-20]

Study Areas	No. of WFD Catchment areas	Number of Surface Water Bodies in the region			Number of Groundwater bodies in the region	Number of Waterbodies Rated Below Moderate (SW) or poor (GW)[16]	
		Rivers	Transitional and Coastal	Lakes		Surface Water	Groundwater
SAA	6	269	42	115	24	86	1
SAB	7	154	3	119	58	58	2
SAC	7	258	22	51	70	22	0
SAD	8	276	57	263	54	31	4
SAE	2	68	13	9	16	18	0
SAF	11	190	0	66	43	56	0
SAG	4	85	27	22	25	23	2
Regional Total	25	1252	164	634	216	289	8

*Some water bodies fall within more than one Study Area. For this reason, the sum of the number of water bodies in each Study Area will be greater than the regional total.

2.3.6 WFD 'Risk Status' of Water Bodies and Associated Pressures

2.3.6.1 Surface Water

Risk assessment data produced to support Cycle 3 of the RBMP identifies water bodies at risk of failing WFD objectives or at risk of deteriorating from their current status due to a number of pressures.

The 2013 – 2018 WFD Risk associated with river water bodies in the North West Region indicates that currently 35% (440 out of 1252) of river water bodies in the region are 'At Risk', 43% (537) are 'Not at Risk', and 22% (268) are 'Under Review'. The remaining seven (7) are not assigned a risk status[21]. Just over 15% (101 out of 638) of Lake Water Bodies (LWBs) are 'At Risk', 49% (314) are 'Not at Risk' and 35% (223) are 'Under Review'. This is represented in Figure 2.11.

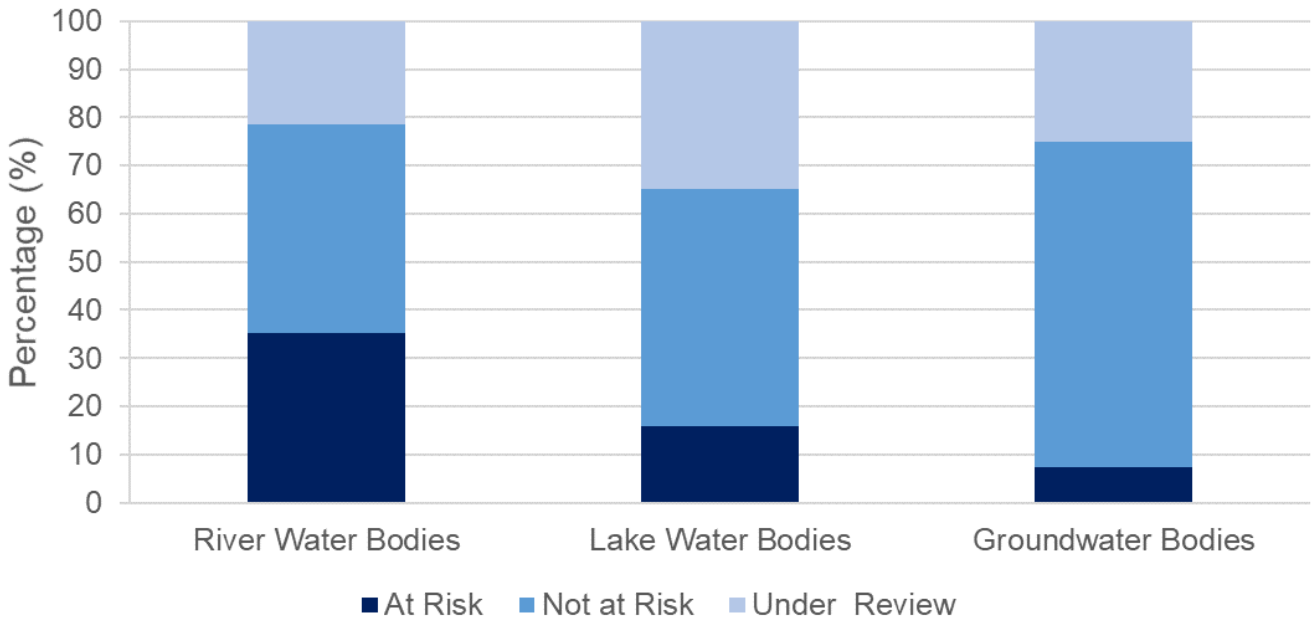


Figure 2.11 The 2013 – 2018 WFD Risk associated with River, Lake and Groundwater Bodies in the North West Region

Figure 2.12 presents the Surface Water Bodies (SWBs) 'At Risk' of not achieving the environmental objectives according to the pressures resulting from human activities. Surface Water Bodies that are 'At Risk', may be at risk due to one pressure or as a result of a combination of multiple pressures. For this reason, the sum of SWBs presented across the pressure categories exceeds the total number of SWBs reported as 'At Risk'. Of the SWBs 'At Risk' the predominant pressure associated with them is agriculture, followed by anthropogenic pressures, forestry, extractive industry, hydromorphology, domestic waste water, urban run-off, industry, abstractions, invasive species, aquaculture, water treatment and waste.

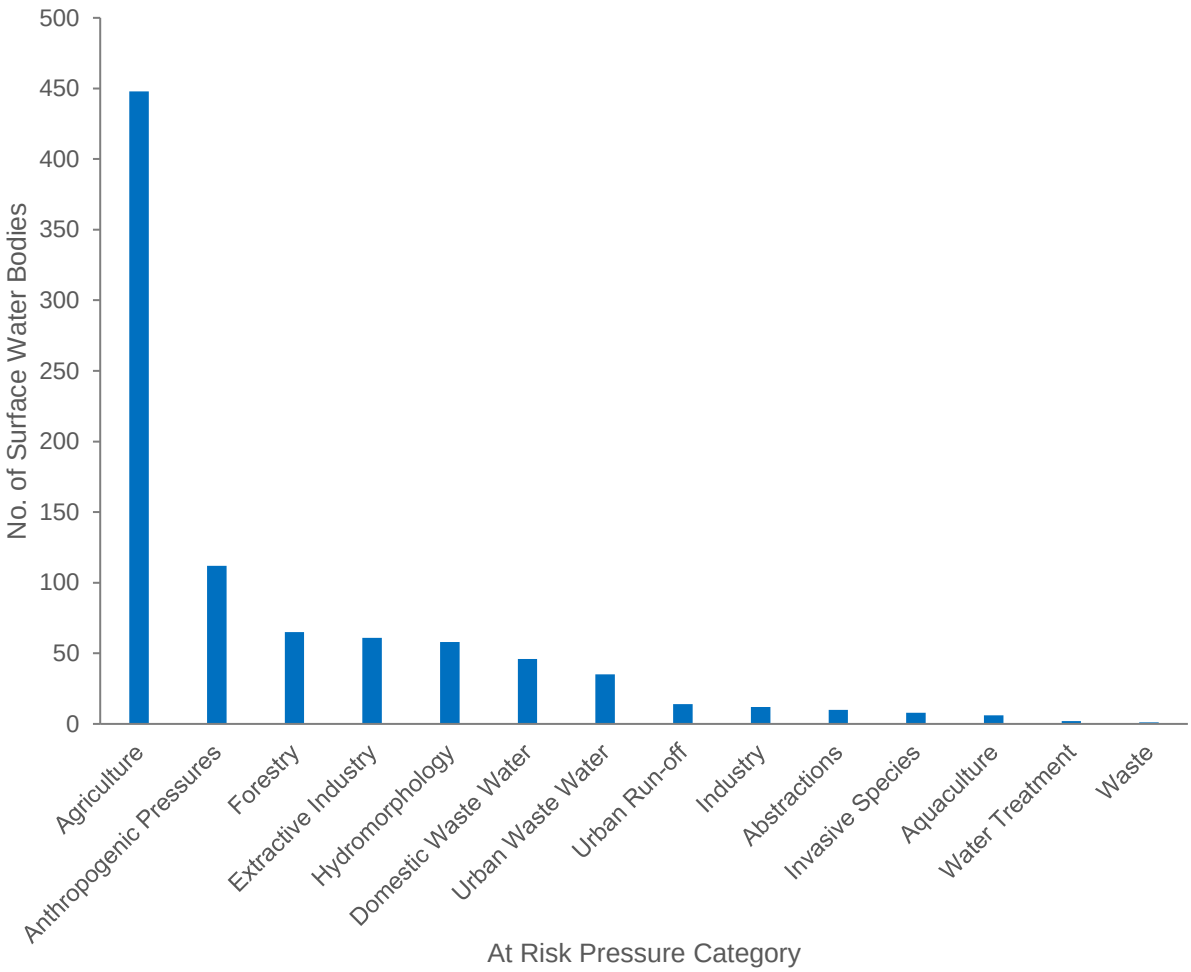


Figure 2.12 Number of Surface Water Bodies with Associated 'At Risk' Pressure Category[21]

2.3.6.2 Groundwater

The 2013 – 2018 WFD Risk associated with the Ground Water Bodies (GWB) in the South West Region indicates that currently 7% (16 out of 216) GWBs are 'At Risk', 68% (146) are 'Not at Risk' and 25% (54) GWBs are 'Under Review'. (Figure 2.11).

Of the GWBs 'At Risk' the predominant pressure associated with them is agriculture and waste facilities, followed by domestic waste water and forestry, and one anthropogenic pressure and industry (Figure 2.13).

The sustainable management of groundwater abstraction is challenging due to the large number of small abstractions in the region. Numerous smaller abstractions are necessary as the regions' hydrogeological conditions (as described in section 2.3.2) do not support the development of large abstractions. Irish Water are committed to active participation in collaborative multiagency working forums, to draw on the expertise of stakeholder agencies with subject experts, for optimum management of Ireland's water resources.

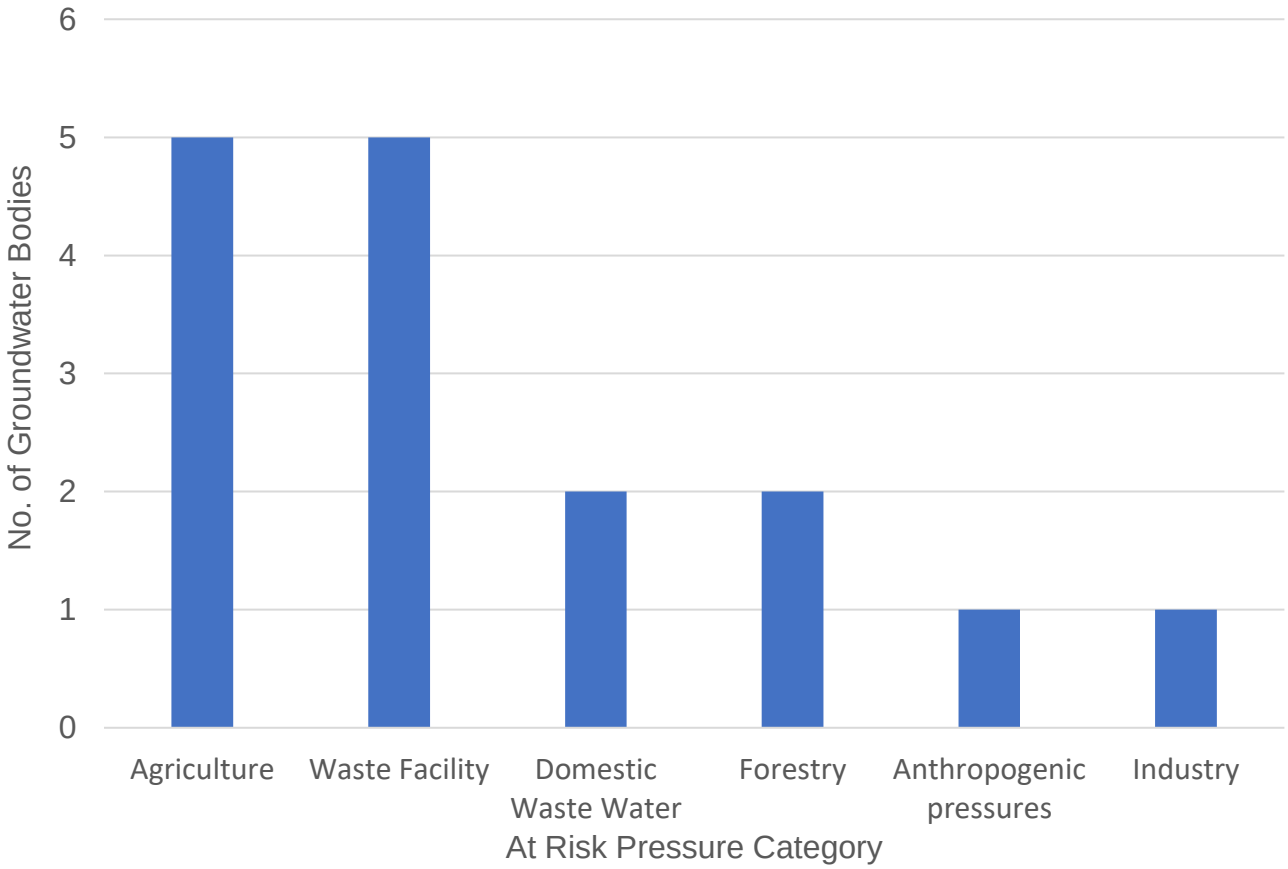


Figure 2.13 Number of Groundwater Bodies with Associated 'At Risk' Pressure Category[16]

2.3.7 Abstraction Pressures

In September 2022, the Government published the Water Environment (Abstractions and Associated Impoundments) Bill[22], which will align abstraction licencing with the requirements of the Water Framework Directive. As this legislation is still undergoing the legislative process, Irish Water does not have full visibility of the future regulatory regime. In addition, the exact level of abstraction at each source will depend on future licensing processes, with the EPA as the relevant adjudicator. In the interim, Irish Water are assessing existing abstractions to identify surface water sites that may exceed future abstraction thresholds. We have taken a precautionary approach based on our current understanding of how the pending abstraction legislation might be applied. This assessment suggests that certain schemes may be subject to reductions in abstraction under the new legislation.

In developing our Preferred Approach (solutions to address the current and future supply deficit), we have considered the potential impact of the pending Abstraction Legislation on our Supply Demand Balance and used this information to consider opportunities to improve environmental outcomes through our Plan solutions.

Irish Water has been an active participant in the characterisation process for the 3rd cycle River Basin Management Plan 2022-2027 and liaised closely with the EPA during the development of the Framework Plan. Therefore, although the proposed Abstractions Bill is still under development and there may be some uncertainty in our calculations of sustainable abstraction, the assessments used as part of the development of the Regional Plan have followed the same principles as those that will likely be used by the regulatory authorities (based on the legislation as currently envisaged) as outlined in Appendix G of the Framework Plan. The assessment is based on the technical guidance from the United Kingdom Technical Advisory Group (UKTAG) to identify sites potentially at risk from abstraction. (UKTAG

comprises the Environment Agency, Natural Resources Wales, Scottish Environmental Protection Agency and Northern Ireland Environment Agency). The application of this guidance is explained in Appendix C and Appendix G of the Framework Plan.

The UKTAG standards[23] for alteration to river flows (hydrological alteration), permit a degree of modification from natural conditions. The standards are defined as an allowable percentage variation from natural flows. For “Good” ecological status watercourses, the allowable percentage variation from natural flows depends on river typology, season and flow rate. More restrictive limits apply between April and October compared to the period between November and March. The standards for “High” ecological status water bodies are defined as a lower allowable percentage variation from natural flows compared to “Good” ecological status water bodies. The UKTAG allowable abstraction standards are detailed in Appendix C of the Framework Plan.

The standards are only a supporting element of the overall ecological status indicator, and the EPA will utilise its own assessment methodology, which will have the benefit of containing more detailed project information and analysis. The assessment of potential future abstractions is used in this Plan as a conservative guide/indicator of abstractions which might be at risk. As further data becomes available, and more specific Irish standards are developed, Irish Water will update the NWRP as appropriate using the monitoring and feedback process set out in Section 9 of this draft Plan.

The UKTAG method for determining the allowable abstraction for lakes requires detailed bathometry and water level data. As this data is not widely available in Ireland, the methodology set out in a 2009 report by the Dublin City Council[24] was used to estimate the potential ecological limit of abstraction at lakes. This method sets the threshold for abstraction from lake sources at 10% of the Q50 of the rivers flowing into the lake.

A summary map showing the degree of modification of natural flows which may be permitted during periods of low flows is shown in Figure 2.14 for the North West Region. The Ilen, Glore and Leannan river as well as the upper reaches of the Shannon have a high ecological status and hence the allowable abstraction is likely to be more restrictive. Currently no abstractions take place from these stretches of river.

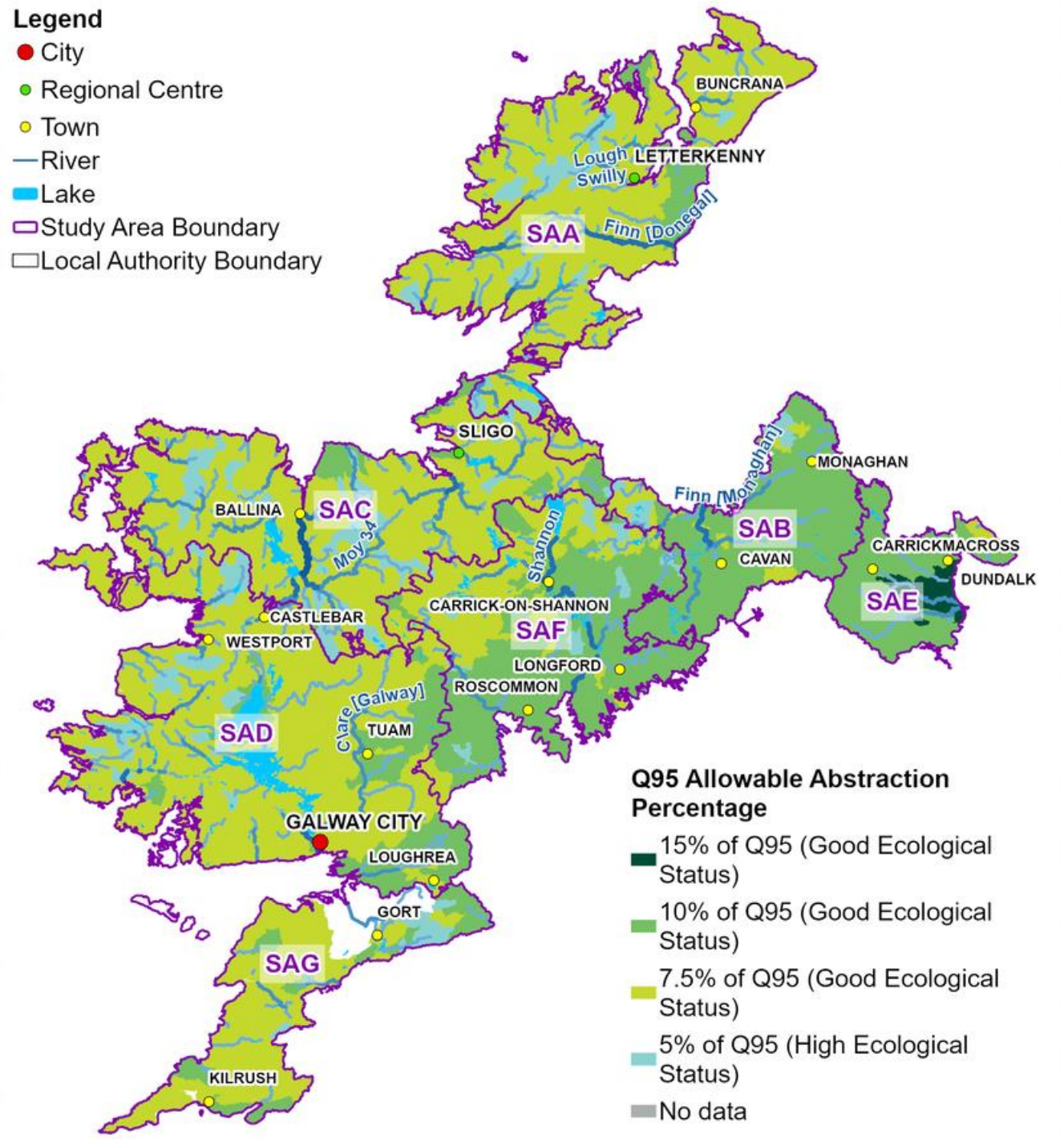


Figure 2.14 Percentage of natural flow at Q95 that can be abstracted to meet 'Good' Status

By applying the UKTAG allowable abstraction thresholds, Irish Water has determined there are 73 out of 102 surface water abstraction sites that may not meet sustainability guidelines during dry weather flows – 29 in SAA, nine (9) in SAB, eight (8) in SAC, 19 in SAD, four (4) in SAE, none in SAF and four (4) in SAG. These sites are represented in Figure 2.15 and are listed in the respective Study Area Technical Reports (Appendix 1 - 7). A small number of the abstractions are from surface water bodies with a Moderate WFD status, as shown in Figure 2.15. Further detailed site investigations will be required to confirm the impacts of existing abstractions.

The estimated volume of abstraction reductions which may be implemented in the future to meet allowable abstraction thresholds is presented in Section 3.5 of this draft Plan.

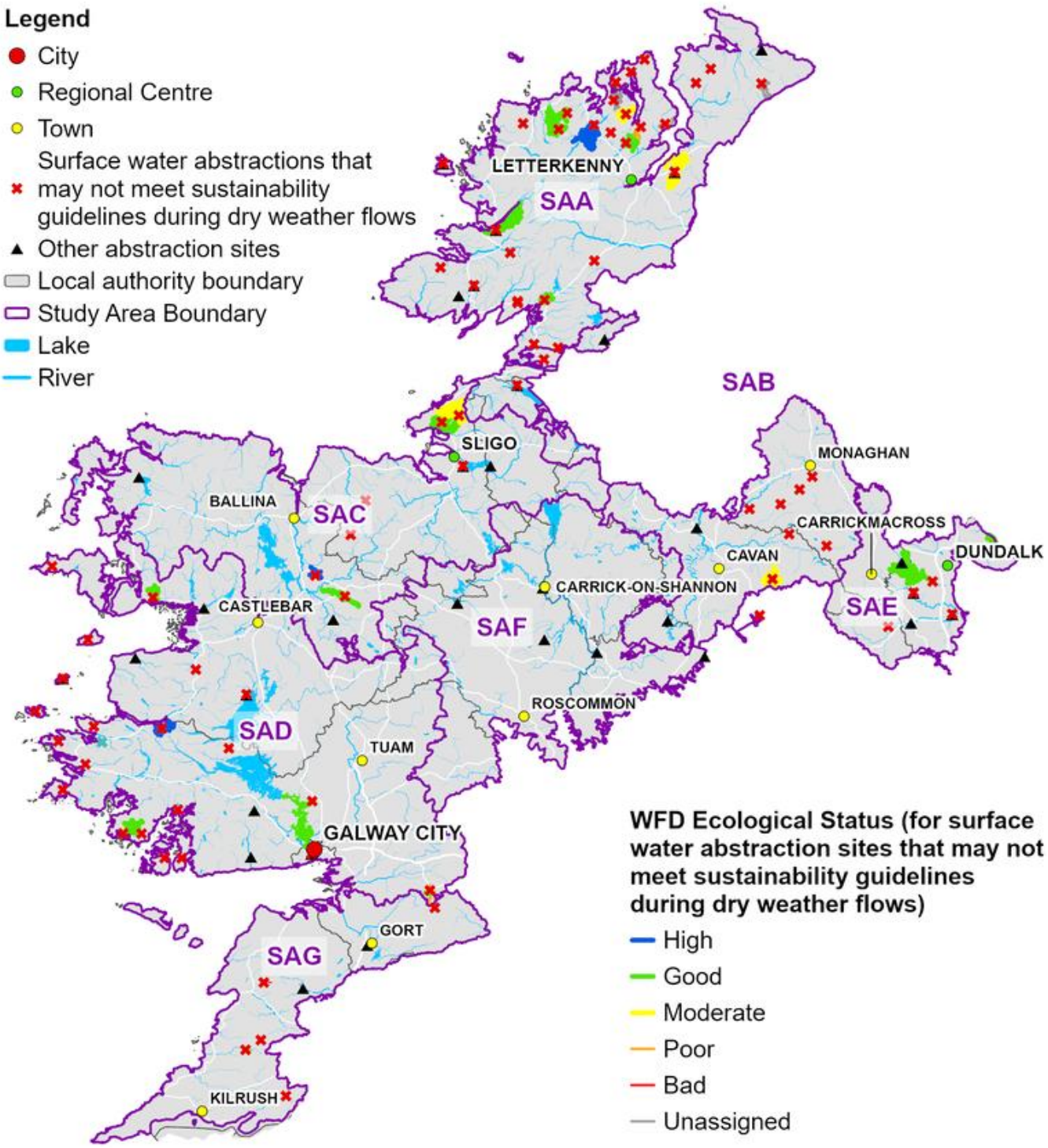


Figure 2.15 Surface Water Abstraction Sites that may not meet sustainability guidelines during dry weather flows

Groundwater abstractions will also need to conform to the proposed new abstraction licencing regime. These abstractions will be assessed in two ways:

- Impacts on the groundwater bodies from which they abstract; and
- Impact of the groundwater abstraction on the base flow in surface waterbodies.

On an interim basis, Irish Water has developed an initial assessment based on the best available information. Over the coming years, Irish Water will work with the environmental regulator (the EPA) and the Geological Survey of Ireland (GSI), to develop desktop and site investigation systems to better

understand the sustainability of our groundwater sources (informed by data gathered as part of GSI's ongoing Groundwater 3D project).

2.3.8 Designated Sites in the RWRP North West Region

Our habitats and species are protected under the Habitats Directive[25]. The habitats and species that are designated to afford protection are listed in the: Habitats Directive and the Birds Directive (2009/147/EC), Special Areas of Conservation (SACs) and Special Protection Areas (SPAs). There are 402 designated sites associated with the North West Region (Table 2.5 and Figure 2.16).

Water abstractions from both groundwater and surface water have been identified as being a potential threat to some habitats and species listed in the Annexes to the Habitats Directive. As discussed in Section 2.3.7, sustainable abstraction limits have been assessed for new water abstractions, which will ensure the protection of these Annexed species and habitats. A full list of water dependent species and their sensitivities to sedimentation and changes to flow regime is provided in Appendix C of the Natural Impact Statement (NIS) on the draft Framework Plan.

Many of the surface waters within the North West Region are within designated areas, including the large Moycullen Bogs National Heritage Area (NHA) (in SAD) which is the NHA of greatest coverage in the region. This is closely followed by Tullaghan Bay and Bog NHA (in SAC and SAD) and Barnesmore Bog NHA (in SAA). The largest SACs include Cloghernagore Bog and Glenveagh National Park SAC and Slieve Tooey/Tormore Island/Loughros Beg Bay SAC and Lough Swilly SAC all in SAA. The largest SPAs include the Slieve Aughty Mountains SPA in SAD and SAG, the River Shannon and River Fergus Estuaries SPA in SAG, and the Derryveagh and Glendowan Mountains SPA in SAA. These also represent the largest designated areas by coverage in the North West Region and are described in Box 2.2 below.

Table 2.5 Total Number of Designated Sites in the RWRP-NW*

Designated Sites	Number of Sites
Special Protection Areas (SPAs)	84
Special Areas of Conservation (SACs)	218
National Heritage Areas (NHA)	80
Ramsar Sites	17
National Parks	3

* Note, some SACs or SPAs may fall within more than one Study Area.

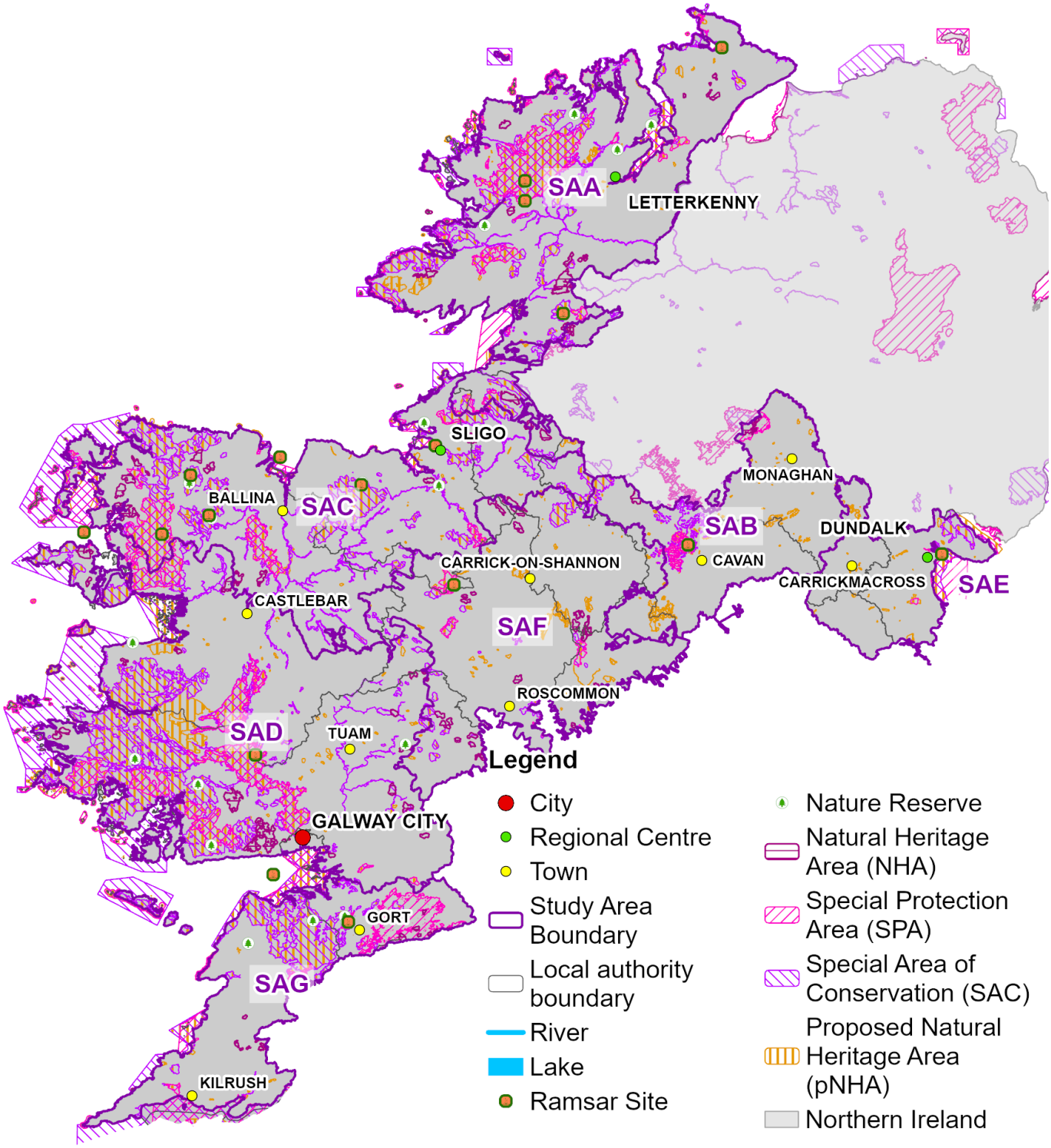


Figure 2.16 Designated Sites in the North West Region

Box 2.2 – Protected sites with the greatest coverage

Slieve Aughty Mountains SPA

A large area covering approximately 594 km^2 extending from south of Lough Rea, County Galway to Scariff in County Clare. The peaks are predominantly comprised of Old Red Sandstone, with the highest peak rising to 400 m. The site includes many small and medium sized lakes, and several important rivers. It also consists of a variety of upland habitats, though approximately half of this site is afforested. Almost one-third of the site is unplanted blanket bog and heath, with both wet and dry heath present. Well-developed blanket bog occurs at several locations. The remainder of the site is mostly rough grassland used for hill farming. The site is of ornithological significance, as it provides excellent nesting and foraging habitat for nationally important breeding populations of Hen Harrier and Merlin, both listed on Annex I of the E.U. Birds Directive. Some woodlands within the SPA are designated as Statutory Nature Reserves.

River Shannon and River Fergus Estuaries SPA

A large area covering approximately 320 km^2 spanning across counties Clare, Kerry, and Limerick. The estuaries form the largest estuarine complex in Ireland. The area is located in the Atlantic biogeographical region and protects 28 species of the Nature Directives. The SPA is under the E.U. Birds Directive, of special conservation interest for many bird species. The E.U. Birds Directive pays particular attention to wetlands and, as these form part of this SPA, the site and its associated waterbirds are of special conservation interest for Wetland & Waterbirds. The site is the most important coastal wetland site in the country and supports more than 50,000 wintering waterfowl, a concentration of international importance. It is also of special conservation interest for holding an assemblage of over 20,000 wintering waterbirds. The site provides both feeding and roosting areas for the wintering birds and habitat quality for most of the estuarine habitats is good. The site has vast expanses of intertidal flats. The intertidal flats are often fringed with salt marsh vegetation, areas which provide important high tide roost sites for the birds.

Derryveagh and Glendowan Mountains SPA

A large upland area of approximately 314 km^2 hectares in north west Donegal. Much of the site is over 300 m above sea level, rising to a peak of 678 m at Slieve Snaght. The solid geology is predominantly quartzite. The substrate over much of site is peat, with blanket bog and heath comprising the principal habitats. The site is a Special Protection Area (SPA) under the E.U. Birds Directive of special conservation interest. Glenveagh National Park is the central location for the Golden Eagle re-introduction programme, which commenced in 2000. The site is of high ornithological importance with nationally important breeding populations of five species that occur regularly are listed on Annex I of the E.U. Birds Directive, i.e., Red-throated Diver, Peregrine, Merlin, Golden Plover and Dunlin (subsp. schinzii). A large proportion of Lough Barra Bog, a Ramsar Convention site and a Statutory Nature Reserve, is within the Derryveagh and Glendowan Mountains SPA.

2.3.9 Opportunities for Protection, Restoration and Enhancement

Irish Water's long-term approach to protecting drinking water sources, and therefore our natural resources, will be the increasing implementation of catchment management for drinking water source protection. This will be achieved in partnership with key stakeholders. Our approach is in accordance with Article 7(3) of the Water Framework Directive and has the joint benefit of protecting our water habitats and managing the risk to our drinking water sources.

In 2019, the Irish Government declared a National Climate Change and Biodiversity Emergency to highlight the significant concerns around Ireland's biodiversity and recognizing the urgency to act on

these interconnected global crises. Irish Water recognizes the need to urgently increase and accelerate efforts to halt the decline of biodiversity. We are committed to ensuring that we build and manage our infrastructure responsibly so that our ecosystems are protected, and where possible enhanced.

Biodiversity protection is a key part of Irish Water's Biodiversity and Sustainability Policies. The overall aim of Irish Water's Biodiversity Policy is that in association with the provision of water and wastewater services, biodiversity and the natural environment are conserved, protected and where practical enhanced through our responsible stewardship, sustainable water services and strong partnerships. Irish Water launched its Biodiversity Action Plan (BAP)[26] in 2021 to deliver on this aim.

One of the key objectives of the BAP is the promotion of nature-based solutions (NBS) for water protection and wastewater treatment, which have considerable potential to deliver biodiversity. Nature-based solutions are multi-functional measures that aim to protect water resources and address water-related challenges by restoring or maintaining ecosystems, natural features and characteristics of waterbodies using natural means and processes[27]. The main functions are to improve water quality, reduce flood risk, and create habitats. Nature-based solutions have many additional benefits that include reduction in energy usage, carbon sequestration, and amenity use for local communities. They include a broad range of measures such as: wetlands, basins and ponds, reedbeds, buffer strips and hedges and forest riparian buffers.

Some examples of NBS being utilised by Irish Water in the North West Region include:

- Working in partnership with Local Authorities to progress an innovative wastewater project in Belturbet trialling an installation of reed beds as a way of sustainably managing water treatment sludge.
- Working in partnership with catchment stakeholders to support initiatives such as native tree planting and bog rehabilitation, which also help to protect and restore source waters.

Examples of our catchment management activities are described in Box 2.3.

Identifying opportunities for the incorporation of NBS and catchment management activities within our abstraction catchments will continue to be encouraged and promoted through the NWRP.

Box 2.3 – Source Protection and Catchment Management Activities

Irish Water is actively involved in pilot source protection projects in Ireland to trial catchment scale interventions to reduce the risk of pesticides causing exceedances in water supplies. The two key projects are described below:

A) Source to Tap Project is a cross-border partnership project that focuses on the River Erne and the River Derg catchments which cross the border between Ireland and Northern Ireland. Irish Water is a project partner on this project which is funded by INTERREG (European Regional Development Fund) with match-funding having been provided by the Department of Agriculture, Environment and Rural Affairs (DAERA) in Northern Ireland and the Department of Housing, Local Government and Heritage (DHPLG) in Ireland. The project began in 2017 and will continue until 2021. It aims to develop sustainable, catchment-scale solutions for the protection of rivers and lakes, which are the main sources of our shared drinking water. Source to Tap also delivers a learning and outreach programme targeted at informing and empowering the public about their role in protecting our clean and healthy freshwater environment. An Agricultural Land Incentive Scheme is being delivered focused on changing land management practices for the protection of our water.

B) Pilot Drinking Water Source Protection Project, as committed to under the River Basin Management Plan (RBMP). Irish Water is coordinating a pilot drinking water source protection project to "*trial innovative monitoring and management strategies aimed at reducing the risk of pesticide contamination of drinking waters*". Catchment management interventions to be undertaken as part of the project will involve a combination of behavioural-change initiatives and promotion of the sustainable use of pesticides. Scoping, consultation and planning of the project began in 2019 and is continuing. Our key stakeholders in catchment management include the National Pesticides and Drinking Water Action Group (NPDWAG), the National Water Forum (An Fórum Uisce), the Local Authority Water Programme (LAWPRO), Geological Survey Ireland (GSI), Department of Housing, Local Government and Heritage (DHLGH), Department of Agriculture, Food and the Marine, National Federation of Group Water Schemes, Inland Fisheries Ireland, the EPA Catchment Science Team and the National Parks and Wildlife Service (NPWS).

2.4 Water Supply

2.4.1 Rainfall

Rainfall is the key climatic variable that affects the availability of water resources. Understanding the variability across the North West Region and the impact that climate change may have on rainfall patterns is important to planning our water infrastructure.

The rainfall across Ireland is varied. Figure 2.17 shows that some of the highest areas of rainfall across Ireland occur in the North West Region. The west of the region, extending across the Maumturks up to Nephin Beg and further to the Blue Stack Mountains typically experiences an annual average rainfall of greater than 1,400 mm per year. In comparison, the east of the region across the Central Plain (dominated by the Shannon basin) is typically characterised by an annual average rainfall of 1,200 mm and less. The far east of the region around Ardee and Dundalk experience the driest conditions across both the region and Ireland with an average annual rainfall of less than 1000 mm

The comparison with population density (also shown in Figure 2.17) highlights that Galway, Ballina, Sligo and Letterkenny - areas which have the greatest population density - are situated in areas of lower rainfall, meaning water resources in these areas can become stressed.

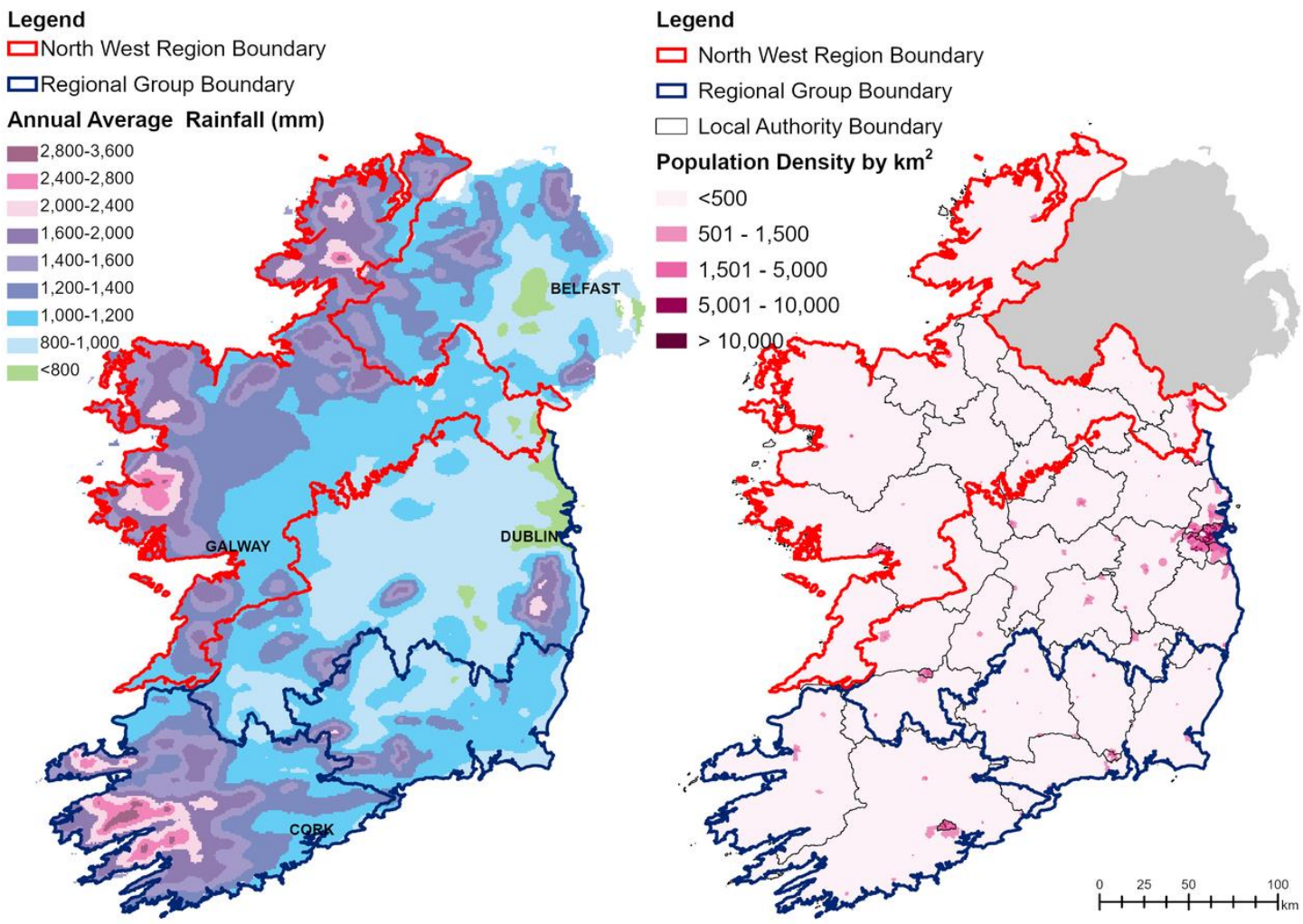


Figure 2.17 Rainfall across Ireland compared with Population Density[28]

Seasonal and annual variability of rainfall is an important consideration in water supply planning. The variability in time and magnitude will determine infrastructure requirements. For example, water reservoirs are required to store water captured during high flow periods, to supply customers during periods of low flow.

Across the North West Region, the variability in seasonal rainfall is higher in the west than the east (Figure 2.18). In the western part of the region (near Belmullet), monthly average rainfall across the year has a range of 77 mm, varying from 70 mm in May to 146 mm in October. The east of the region near Clones shows reduced seasonal variability, with a range of 41 mm between the minimum average monthly rainfall in April of 62 mm and the maximum average monthly rainfall in October of 103 mm. Climate change is likely to increase the within year variability, with wetter winters and drier springs and summers[29]. This is further discussed in Section 2.4.5.

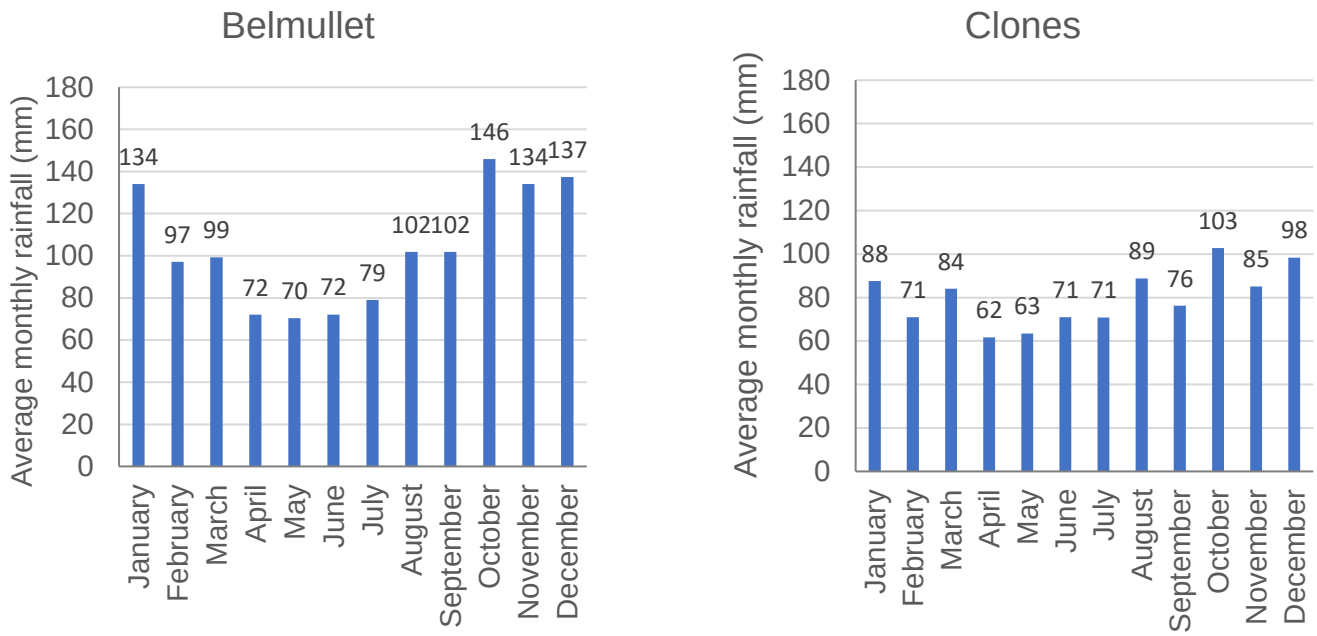


Figure 2.18 Monthly Rainfall Variability – 1981 to 2010[28]

2.4.2 Drought

Droughts occur when a period of lower-than-average rainfall causes a shortage of water. The shortage of water affects both the natural environment and sectors such as agriculture and water supply to our customers. The duration, timing and intensity of a drought can vary considerably, and these factors combine to affect different sectors in different ways. Although Ireland is considered to be a country with high rainfall, the country does experience drought events. Figure 2.19 shows there were 15 years of severe drought periods since records began in 1850 that would affect our key supplies.

The drought events experienced in 2018 and 2020, although severe, were short in duration and are therefore not registered when compared to historical droughts. Despite this, the late spring and early summer of 2018 saw some of the lowest rainfall totals on record leading to drought conditions. Whilst the drought event was not defined as ‘severe’ based on historical records (due to its short duration) it was still substantial enough to impact our water supply availability. Low rainfall levels resulted in low river flows and stress to water supplies. Customers experienced reductions in water pressure and some temporary loss of supplies, principally as a result of a lack of capacity in our existing infrastructure. Demand for water was also higher than normal during this period, driven by high temperatures. Several supplies in the North West Region were severely impacted (Table 2.6). Sandbagging of groundwater sources and some rivers was required to maintain groundwater levels. In-stream pumping and water tankering was used to maintain supplies to customers and night-time restrictions were implemented in some areas to reduce demand.

Table 2.6 Drought impact during the 2018 and/or 2020 dry period

Study Area	Drought impact
SAA	In 2018, lower water levels required in-stream pumping for water sources supplying Carrigart Downings and Lettermacaward.
SAB	Groundwater is sourced from shallow rainfall recharge-fed limestones in wet periods. For this reason, the available supplies at many raw water sources were impacted.
SAC	North Sligo, Kilkelly and Swinford required sandbagging to contain impoundment in 2018.
SAD	In-stream pumping and sandbagging were required in 2018 at raw water sources to maintain supplies to customers. This included Clifden WTP, Louisburg WTP, Mulranny WTP and Westport WTP; as well as the Bunowen River, which supplies Ahascragh. During the 2020 dry period, Inis Oirr WTP was tankered and night-time restrictions were in place for the areas served by the Inis Oirr WTP and Inishmean WTP. Night-time restrictions were also imposed in 2018 on the Aran Islands.
SAE	In 2018 raw water levels dropped significantly at Lough Muckno, requiring overpumping at headworks feeding River Fane for Cavanhill WTP and night-time restrictions for Collon WTP.
SAF	In 2020, night-time restrictions were imposed in Longford Springs and pumping from a nearby borehole was necessary to supplement supplies.
SAG	In 2018, raw water levels dropped significantly at the surface water abstraction at Gort WTP (where the river was sandbagged); and at the groundwater source at Carron WTP (Termon Spring). In these locations service interventions were required to maintain supplies to customers. Ballymacraven WTP and New Doolough WTP were also identified as at risk of potential drought. Surface water supplies to West Clare were impacted and required tankering to Moveen Reservoir.

As climate change continues, droughts are expected to become more frequent[29]. Combined with the requirements of the Water Framework Directive (WFD) to reduce unsustainable abstractions (Section 2.3.5), there is a clear identified need to invest in sustainable water supply solutions to secure reliable supplies across the region.

Valuable learning on strategic and tactical drought management was gained during the 2018 drought period, which helped to improve our response during drought conditions experienced in the Spring of 2020. Actions taken during the 2018 drought event and key lessons learnt are outlined in Box 2.4. Further information regarding our drought management approach is given in Appendix E of our Framework Plan.

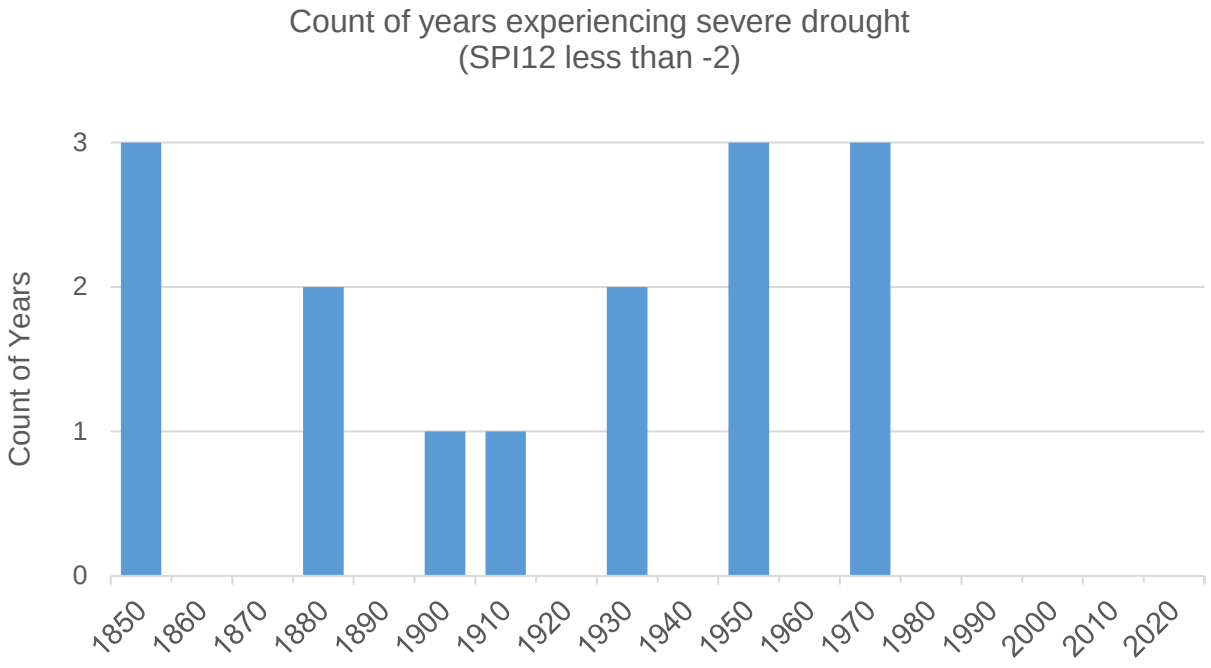


Figure 2.19 Number of Events of Severe Drought (The 12-month Standard Precipitation Index = -2)*

*The standardised Precipitation Index (SPI) is used to identify and classify meteorological drought, which is a period of abnormal rainfall deficit compared to long-term average conditions. An SPI that is less than or equal to -2.0 indicates extremely dry conditions.

Box 2.4 – 2018 Drought Experience

The late spring and early summer of 2018 saw some of the lowest rainfall totals on record, resulting in low river flows and stress to water supplies. Demand for water was also higher than normal during this period, driven by high temperatures.

In 2018, disruption to customers and environmental impacts were minimised as a result of emergency plans and activities carried out by Irish Water and Local Authority operational staff, including:

- Convening a crisis management team;
- Tracking drought indicators and planning responses and activities;
- Optimising existing supplies;
- Tankering water to maintain storage levels;
- Commissioning back-up supplies;
- Controlling pressures in networks to improve water availability;
- Night-time restrictions in critical areas to conserve supplies;
- Communication campaigns to promote water conservation;
- Introduction of the first ever National Water Conservation Order;
- Working with stakeholders including the Department of Housing, Local Government and Heritage (DHPLG), National Federation of Group Water Schemes (NFGWS), EPA, Electricity Supply Board (ESB), Inland Fisheries Ireland (IFI), National Park and Wildlife Service (NPWS), Met Éireann;
- Providing alternative water supplies to customers (Bowsers, stand-pipes and bottled water), attention to critical customers, healthcare customers and vulnerable customers; and
- Engagement of our Key Account Managers with large customers.

Unfortunately, customers experienced some impacts, including reductions in water pressure and some temporary loss of supplies, principally as a result of a lack of capacity in our existing infrastructure.

A key learning from this recent drought experience was that we need to undertake further research and investigation to increase our understanding of the hydrology and hydrogeology relating to some of our water sources. We also identified the following improvements to our operational management:

- Site specific level and flow monitoring
- Live operational data
- Controls within some areas of our distribution networks to allow us to manage supplies more effectively.

2.4.3 Flood Risk

Climate projections over the next century indicate an increased likelihood of river and coastal flooding[29,30], particularly in the north and west of the country (Section 2.4.5). Increased flooding can cause pressure on drains and sewers and can affect water quality.

The Floods Directive (2007/60/EC) required member states to develop Flood Risk Management Plans for areas of existing and future potentially significant flood risk. The Floods Directive was transposed into Irish law by the EU (Assessment and Management of Flood Risks) Regulations 2010 and sets out the responsibilities of the Office of Public Works (OPW). The OPW has been implementing the Directive mainly through the Catchment Flood Risk Assessment and Management (CFRAM) Programme, through which 29 draft Flood Risk Management Plans have been developed. Approximately 300 Areas for Further Assessment have been established along with a range of measures to reduce or manage the

flood risk within each catchment. CFRAM mapping for all Areas for Further Assessment is available to view on the CFRAM website[31].

Figure 2.20 presents areas with high and medium probability of pluvial, fluvial, coastal flooding as well as historical groundwater flooding. The figure shows there is low probability of groundwater flooding within the North West Region. Rivers considered to have high probability (10% Annual Exceedance Probability (AEP)) of fluvial flooding include the River Moy (SAC), the River Clare (SAD), the River Shannon (SAF) and Mulkear River (SAG).

As well as considering surface water flooding, there are ongoing efforts to better understand the role of karst groundwater systems in flooding within the Flood Risk topic[32].

Guidelines for Planning Authorities on flood risk management (November 2009)[33,34] highlight that flooding of the water supply network (this includes pumping stations; electricity substations and water treatment works) can result in a loss of supply over large areas and magnify the effects of flooding beyond the immediate community directly affected. Irish Water has considered the number of water treatment plants (WTPs) within areas of flood risk, where vulnerability to the effects of flooding need to be considered (Table 2.7). Four (4) of the 142 WTPs in the region have a 10% chance of flooding in any year. These include: Riverstown WTP in SAC, Loughrea WTP and Danganbeg WTP in SAD, and Ardee WTP in SAE. Ardee WTP is the largest of these, serving a population of 8,400.

The WTPs that are known to be at risk are under review and where needed, protection measures will be considered for sites at risk. All new water supply options will be reviewed in terms of their risk from flooding, and this will be taken into account in the detailed siting and design to ensure improved flood risk resilience for the supply network.

Table 2.7 Total Number of WTPs at Risk of Flooding

Type of Flooding	Number of Water Treatment Plants at Risk of Flooding	
	1 in 10-year Flood Risk (10% Annual Exceedance Probability)	1 in 100-year Flood Risk (1% Annual Exceedance Probability)
Fluvial Flooding[33]	4	7
Pluvial Flooding[33]	0	1
Coastal Flooding[33]	0	0
Groundwater Flooding[33,35]	0*	0**

*Classification for Groundwater flooding recorded in database as 'High Probability'

** Classification for Groundwater flooding recorded in database as 'Medium Probability'

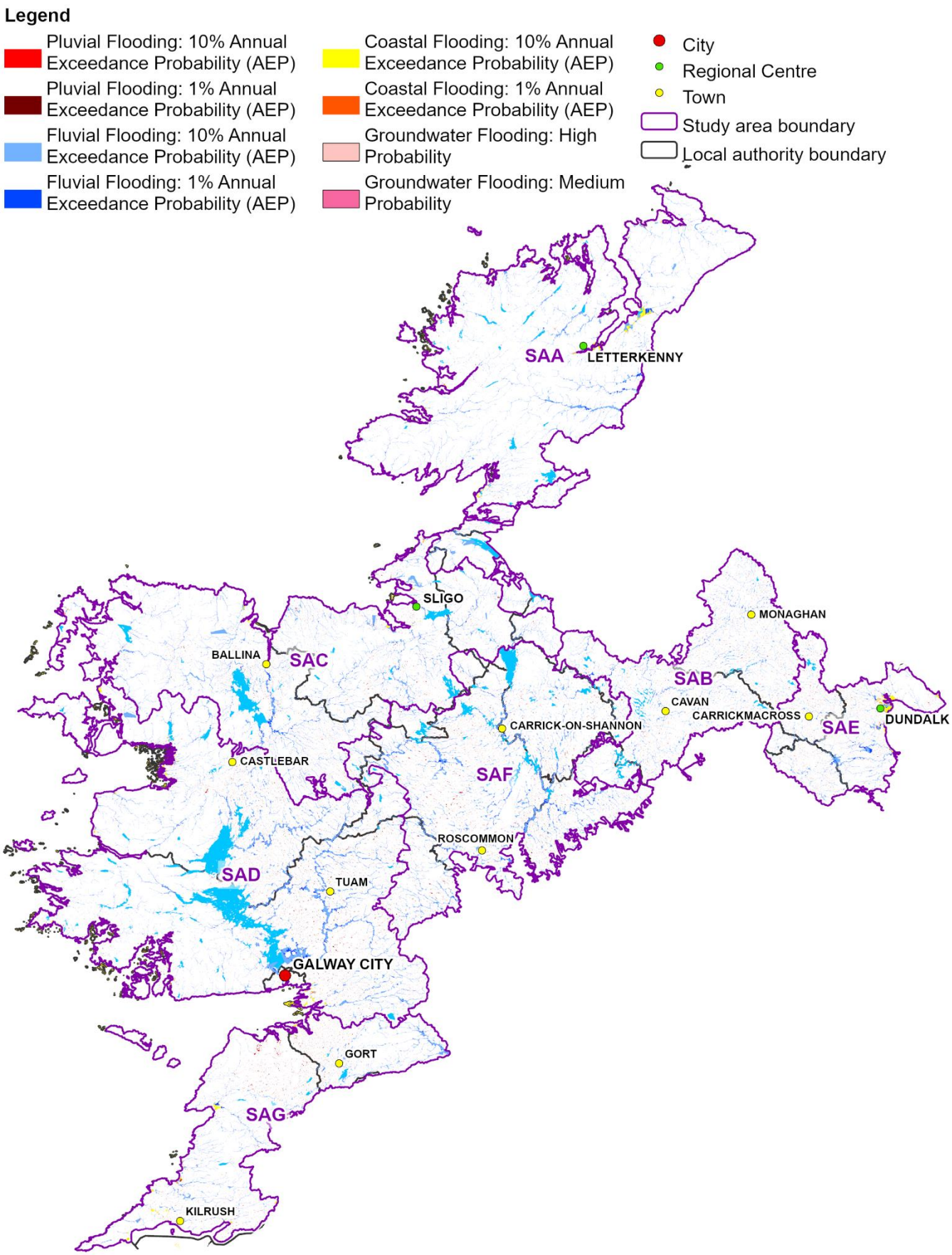


Figure 2.20 Surface Water and Groundwater Flooding

2.4.4 Water Supply Systems

The water supply systems across the North West Region draw from 159 sources (Table 2.8) and are treated in 142 Water Treatment Plants (WTPs). There are 102 surface water sources and 57 groundwater sources within the North West Region, with surface water sources supplying 88% of the total volume of water delivered to our customers either from rivers or lakes.

The highest volume surface water abstractions come from Lough Corrib and Lough Mask. The lakes are both located in SAD and supply Galway City and the Tuam Regional Water Supply Schemes and the Lough Mask Regional Water Supply Scheme, respectively. Abstraction from Lough Corrib accounts for 56% of the Water Available for Use (WAFU) for the Study Area in a normal year, while the abstraction Lough Mask accounts for another 23%. WAFU is further explained in Section 3.2.1 of this draft Plan. The River Fane is the largest river abstraction and accounts for 57% of the WAFU in SAE.

The highest volume groundwater abstraction is Ballinagard Spring, supplying Cavanhill in SAF, with an abstraction volume of approximately 42 million litres per day (Ml/d). This accounts for 8% of the WAFU in SAF and just 1% of the total regional WAFU. Groundwater supplies make up the dominant abstraction in SAE and SAF, which typically target the karst formations. These boreholes produce yields of around 1,000 m^3/d (or 1 Ml/d).

Table 2.8 Number of Water Sources in RWRP-NW

Study Area	No. of WRZS	No. of WTPS	Total Network Length* (km)	Water Sources		
				Total	Surface Water	Groundwater
SAA	19	29	4,010	35	31	4
SAB	22	17	1,205	21	12	9
SAC	17	19	3,120	21	14	7
SAD	25	33	3,565	34	26	8
SAE	9	16	1,035	19	8	11
SAF	15	18	3,340	18	5	13
SAG	9	10	1,455	11	6	5
TOTAL	**116****	**142**	**17,730**	**159**	**102**	**57**

* Network length values are rounded to the nearest 5km.

** This number excludes three (3) of the four (4) WRZs that are supplied by small imports from Northern Ireland Water as we do not have detailed data for these WRZs.

2.4.5 Climate Change

2.4.5.1 Potential Impact on Water Availability

Climate change will have significant effects on the availability of water at our sources in the future. Average annual temperatures for Ireland are expected to increase by 1.0 to 1.6 ºC by the middle of this century (2041 – 2060) compared with the reference period (1981 – 2000). Warming will be enhanced at the extremes, with summer daytime and winter night-time temperatures projected to increase by 1.0 to 2.4ºC[36]. The projected increase in temperature will affect the amount, timing and intensity of local precipitation. In Ireland, this is expected to result in wetter winters but also drier springs and summers. Climate change simulations for Ireland show the precipitation in the autumn and winter months could increase by between 5% to 35%, while summer precipitation could decrease by a range of 0% to 30%. Under the medium to high carbon emissions scenarios dry periods are projected to increase in frequency, duration and/or magnitude from between 12% to 40% for the spring and summer months[37].

The historical analysis of average rainfall data undertaken by Murphy (2020)[38] confirms a continued trend of drier summers and wetter winters. The recent report, 'The Status of Ireland's Climate 2020'[30], published by the Environmental Protection Agency, Met Éirean and the Marine Institute, also confirms that Ireland's climate is warmer and wetter than it used to be. The study shows that there has been a 6% rise in precipitation over the past 30 years when compared to the previous three decades. While this corresponds to an observed increase in flows across most of the country, the report states there is an increase in potential drought conditions. This is the case especially in the east of the country, broadening the difference in how climate change is affecting Ireland's rivers in the east compared to the west. For the North West region, drought conditions will likely be less severe than in the south. The increased threat of flooding across the region can also impact water availability if the drawdown of catchment reservoirs is required to increase flood capacity as this can lead to a reduction in available supplies for the following spring/summer.

The Climate Change Sectoral Adaptation Plan for Water Quality and Water Services Infrastructure[37], identifies the following key priority impacts of climate change for the water services infrastructure sector:

- Hot-weather related changes in demand.
- Increased drawdown in the autumn/winter for flood capacity, leading to resource issues in the following spring/summer.
- Reduced availability of water resources (surface and groundwater sources).

Irish Water considers these impacts in our approach to supply forecasts when assessing the Supply Demand Balance across our planning period. Our assessment of the impact of climate change on the water resources of the North West Region is discussed in further detail in Section 3 of this Plan.

2.4.5.2 Further Work

Whilst there is recent work on potential climate effects on rainfall, there is less work on the projected impacts of climate change to river flow regimes across Ireland. There is also no Ireland-wide guidance available at present outlining the effects of future climate change on flows. Recognising this, we commissioned the Climate Sensitive Catchments Project to improve our understanding of how river flows may change due to climate change and how best to prepare for a hotter climate. The research characterised five (5) catchment sensitivity types as described in Box 2.5. In the North West Region, many of the catchments are characterised as types (b), (c) and (e). Types (b) and (c) have lower natural water storage and see the greatest decreases in flow due to wetter winters and drier summers whilst type (e) lose more water due to evaporation. Type (c) catchments include the Moy and Kilala Bay and Corrib catchments as well as small areas of the Gweebarra Sheephavent catchment. Type (e) catchments include the Shannon and Erne catchments.

Box 2.5 - Climate Sensitive Catchments Project

Project Partner: Maynooth University Irish Climate Analysis and Research Units (ICARUS)

The Climate Sensitive Catchments research project improved our understanding of how river flows may change due to climate change and how best to prepare for a hotter climate. This research concluded in April 2019.

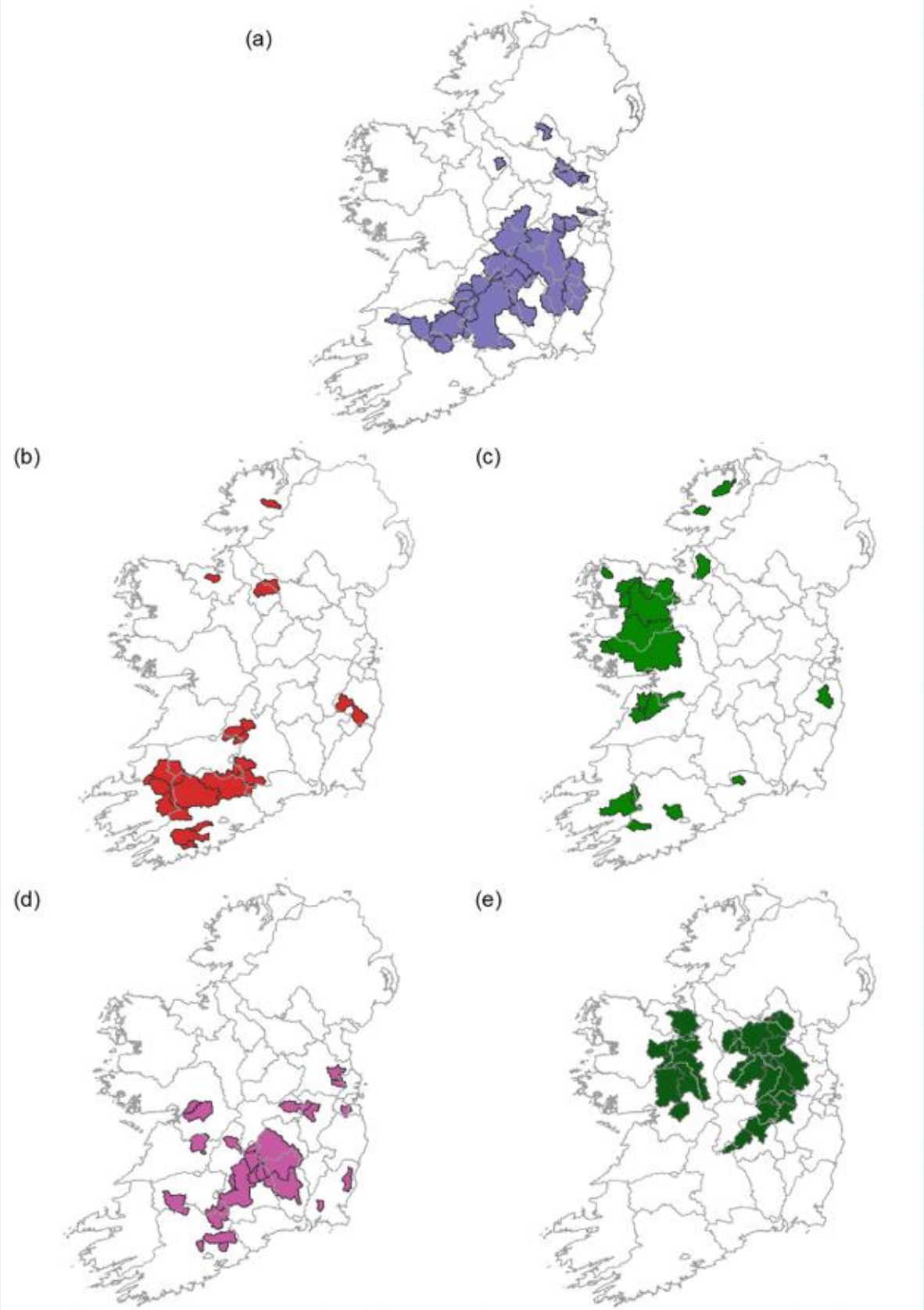
The traditional methodology to identify and assess catchments vulnerable to climate change takes a 'top down' approach, which applies information about large-scale climate change trends to small areas. This can result in inaccurate forecasting for catchments because it does not take area-specific information into consideration. This project applied a 'bottom up' methodology, which assessed how sensitive catchments are to climate change by building a catalogue of data specific to each catchment. This allowed us to identify the particular stressors and vulnerabilities in each area. By better assessing the sensitivity of catchments to climate change, we aim to increase the effectiveness of our national water management and to develop a more resilient water service.

The 206 river catchments included in this research were characterised into five (5) catchment sensitivity types (a) to (e) as illustrated below. The research concluded that catchment types (a) are the least sensitive to changes in seasonality of wetter winters and drier summers due to high groundwater storage in these catchments. Catchment types (b) and (c) have lower natural water storage and see the greatest decreases in flow due to wetter winters and drier summers. Catchment types (d) and (e) lose more water due to evaporation and are mostly drier catchments in the midlands and east. Catchment types (d) are most sensitive to changes in annual mean precipitation. When changes in seasonality and mean quantity are considered together, catchment type (d) is also the most sensitive and type (b) the least. Catchment type (e) experience less evaporative losses than (d) and while sensitive to changes in seasonality and mean quantity, are less sensitive to these changes than catchment type (d).

This research projected low flow allowances for each of the five (5) catchment sensitivity types. These low flow allowances provide resilience for lower river flows in the future due to climate change. The project concluded that in some instances an allowance for a 30% reduction in low flow would be insufficient to avoid future climate change impacts.

The findings of this research project will address the water quantity aspects of climate change, but because of changes either to temperature or flow regimes, changes in water quality will also have a bearing. In addition, climate change may result in land use changes which may compound the observed effects.

Box 2.5 continued- Climate Sensitive Catchments Project



2.4.5.3 Reducing Our Carbon Footprint

The impact of climate change will be felt by every individual, household, and community in Ireland and there is now a high level of awareness and understanding of this. There is therefore, an onus on us to mitigate the magnitude of long-term climate change by taking action to reduce Greenhouse Gas Emissions (GHG) emissions, and to increase the capacity of carbon sinks such as forests and wetlands. The European Green Deal frames Europe's response to these challenges. It is the new growth strategy that will lead the transformation in Europe to a climate-neutral, fair and prosperous society, with a modern, resource-efficient and competitive economy.

In line with EU ambition, Ireland commits to achieving a 51% reduction in Ireland's overall GHG emissions from 2021 to 2030, and to achieving net-zero emissions no later than 2050.

Section 15 of the Climate Action and Low Carbon Development Act 2015 (as amended in 2021)[39] sets a new "national climate objective" for Ireland, which provides that "The State shall, so as to reduce the extent of further global warming, pursue and achieve, by no later than the end of the year 2050, the transition to a climate resilient, biodiversity rich, environmentally sustainable and climate neutral economy". The amended Act requires public authorities, including Irish Water, so far as practicable, to perform their functions in a manner consistent with the furtherance of the national climate objective and the relevant national and sectoral plans and strategies to mitigate greenhouse gas emissions and adapt to the effects of climate change.

The Department of the Environment, Climate and Communications' Climate Action Plan (CAP)[40] published November 2021, replacing CAP 2019, commits to achieving a 51% reduction in overall greenhouse gas emissions by 2030 and reaching net zero carbon emissions by 2050. The aim is for more sustainable growth and to create a resilient, vibrant and sustainable country. The CAP defines a roadmap to this goal and initiates a set of policy actions to achieve this. A detailed sectoral roadmap has also been set out, which is designed to deliver a cumulative reduction in emissions, over the period 2021 to 2030. CAP 2021 updates existing targets with renewable energy to provide 80% of electricity by 2030 and setting targets for agriculture and forestry and improving land management to support carbon sequestration.

Irish Water is committed to improving energy efficiency and reducing carbon emissions. In 2020, we achieved a 32% improvement in our energy efficiency performance, saving an equivalent of 95,000 tonnes of carbon. We are on track to meet our target of 33% energy efficiency improvement, putting us in a strong position to meet our new target of 50% by 2030.

Irish Water is committed to reducing energy consumption through a range of energy initiatives, including asset replacement and the commencement of sustainable energy pilots at two wastewater treatment plants to install solar panels to generate renewable energy. We are also reviewing the potential to produce more renewable energy from on-site wind turbines.

Irish Water have made significant progress on the journey to become a low carbon, energy efficient, sustainable water utility. Our strategy and energy management programme take a business wide approach with 36 Energy Action Plans and 255 discrete energy projects, including energy efficient design, innovation, energy retrofits, renewable energy, lighting and heating, energy audits and planning, process optimisation, staff awareness and training. An example of this is the provision of 230 Solar Panels at the new WTP in Thurles, see Box 2.6.

We have also developed and published a Biodiversity Action Plan (BAP)[26] in 2020. It will help us to conserve, enhance and work with the natural environment. Our approach will protect and enhance biodiversity at our sites whilst also providing additional benefits such as carbon sequestration and drinking water source protection. We have implemented Biodiversity Management Plans and Enhancement Measures for 85 sites nationally.

Measures taken in 2020 to reduce our Carbon Footprint include;

- Decarbonising our energy consumption including installation of solar renewable energy sources.
- Implementing an energy governance model, using an asset management approach aligned with ISO 5000.
- Implementing energy efficiency projects across our operations including pumping, aeration, renewables, lighting and heating.
- Roll out the water conservation awareness campaign.
- Preparing a climate change mitigation and adaptation strategy.

The NWRP approach to assessing and selecting solutions to meet our existing and future water supply challenges, is aligned with national policy objectives. For example, Carbon Costs and Operational Costs (including energy costs) are included in the development of the overall Net Present Value (NPV) of all options. Therefore, it is a key consideration in the determination of the Preferred Approach.

Further to this, one of the six Approach Categories considered in the determination of the Preferred Approach is the Lowest Carbon Approach (Table 7.1, Section 7). The Lowest Carbon Approach is the Option or combination of Options with the lowest embodied and operational carbon cost.

At project development stage further considerations will be given to energy efficient design and the potential to reduce greenhouse gas emissions and improve energy efficiency of the project by the development of clean renewable energy on-site.

Box 2.6 - Thurles Renewable Energy Project

Irish Water, working in partnership with Tipperary County Council, has recently completed a solar energy project at the new water treatment plant in Thurles Co. Tipperary. This project involved the installation of 230 solar panels at the recently constructed water treatment plant, generating clean, renewable energy for the plant. This project will generate 83,264 kWh (kilowatt hours) electricity per year, improve energy efficiency at the plant and reduce carbon emissions.

This project will:

- Reduce the plant's carbon footprint, which will equate to a 40 tonnes reduction in carbon emissions.
- Generate 83,264 kWh (kilowatt hours) per year of electricity, which is equivalent to the electricity required to power 20 houses per year.
- The generation of clean renewable energy will lead to a 10% reduction in imported electricity at the site.
- Reduce greenhouse gas emissions and improve energy efficiency at the plant.

2.5 Summary

In this section we have outlined the following key characteristics of the draft RWRP-NW:

Population and Growth

- Irish Water supplies around 369 million litres of water per day to a population of 732,700 people (18% of the national population) and 74,000 businesses in the North West Region. Approximately 26% of the regional population is located within Galway City.
- The overall regional population growth is 25% from 2019 to 2044. All Study Areas in the North West region have a projected growth rate that exceeds the 12% national rate observed in the 10-year period from 2006 to 2016. The Galway and Mayo study Area (SAD) has the highest projected growth rate at 31%, which is driven by the Galway City forecast growth of 50-60%, by 2040.

Natural Resources and Environmental Pressures

- In the North West Region there are 638 lakes covering approximately 3% of the region's land area (740 square kilometres) with six (6) lakes making up about 50% of the area - Lough Corrib (Upper and Lower), Lough Mask, Lough Conn, Lough Allen and Lough Erner (Upper). The larger known rivers within this region include the Shannon, Suck, Erne, Moy, Clare-Corrib and the Inny; however, they represent only a fraction of the extensive 33,670 km network currently mapped by the EPA in the region.
- The riverine ecology of many of our river systems is considered highly sensitive to changes in flow and water level. The most sensitive rivers are those within the river typology categories that are representative of headwaters, low nutrient, low pH and salmonid spawning and nursery areas. The salmonid spawning and nursery areas are particularly sensitive to low flows and impounding structures. These categories combined make up 71% of the main river water bodies in the region.
- Across the region, 53% of surface water bodies (SWBs) are at 'High' or 'Good' status, while 289 SWBs are classified as below 'Moderate' status, representing about 14% of the total SWBs in the region.
- Eight (8) of the 216 groundwater bodies (GWBs) are currently at 'poor' Chemical Status. The remaining 208 GWBs are currently assessed at 'good' overall WFD status.
- The 2013 – 2018 WFD Cycle 3 assessed both GWBs and SWBs to determine which are currently considered to be at risk of failing WFD objectives or are at risk of deteriorating from their current status. Thirty-five percent (35%) of our river water bodies, just over 15% of our lake water bodies and 7% of our groundwater bodies are currently 'At Risk', with the predominant pressure being agriculture.
- In developing our Preferred Approach to securing future water supplies we have undertaken a desktop independent assessment to identify existing surface water sites where abstractions have the potential to exceed sustainable abstraction thresholds. We have identified 73 sites which we consider to be below target conditions. This was a conservative assessment based on plan level information. The EPA will be the authority to adjudicate with the benefit of more detailed project level information.
- There are 402 nationally and internationally designated sites listed in the North West Region. Protected sites with the greatest coverage in the region include the Slieve Aughty Mountains SPA, the River Shannon and River Fergus Estuaries SPA and the River Derryveagh and Glendowan Mountains SPA.

Water Resources and Existing Challenges

- Surface water abstractions make up 88% of the water delivered to customers in the North West region, with the remaining 12% being supplied from groundwater sources.
- Most of the region experiences average annual rainfall between 1,000 and 2,000 mm per year.
- The availability of water is anticipated to change over the 25-year planning period due to climate change with water availability increasing during autumn/winter and decreasing during the summer. Precipitation responsible for the recharge of our groundwater and surface water sources could increase by 5-35% during the autumn and winter months decrease by 0-30% during the summer.

Environmental and Climate Change Initiatives

- Irish Water is implementing Nature Based Solutions within the North West Region. This includes the installation of reed beds at Belturbet Waste Water Treatment Plant as a way of sustainably managing water treatment sludge. Identifying opportunities for the incorporation of NBS and catchment management activities within our abstraction catchments, will continue to be encouraged and promoted through the NWRP.
- Key Sustainability objectives planned for 2022 include:
    - Developing and implementing a sustainability strategy aligned with the Government Climate Action plan and UN Sustainable Development Goals.
    - Continuing the implementation of our sustainable energy strategy.
    - Implementing and communicating our climate change strategy.
    - Developing a carbon neutrality roadmap.
    - Continuing to decarbonise our energy consumption through energy efficiency improvement and renewable energy.
    - Improving energy efficiency by upgrading and replacing inefficient plant and processes.
    - Continuing to protect and enhance biodiversity on our assets.
    - Embedding energy efficiency design into our activities in collaboration with the Sustainable Energy Authority of Ireland (SEAI).
    - Implementation of a waste management strategy, with a particular focus on the circular economy.

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